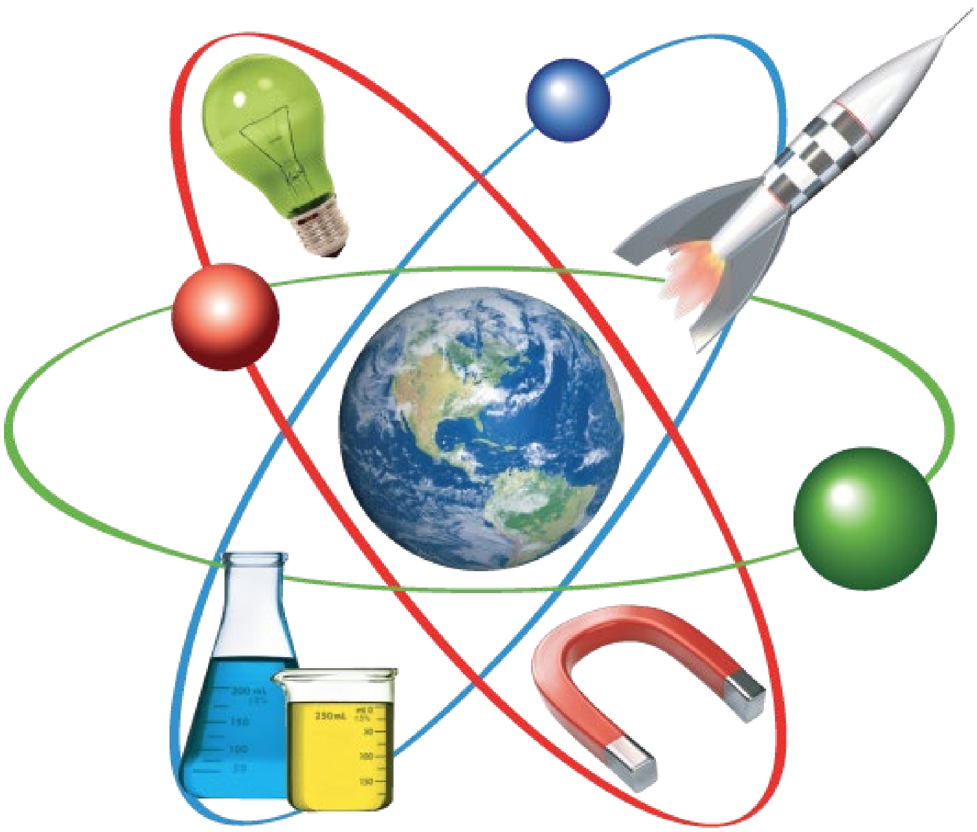
School District of Holmen
Science Curriculum



2016-2017

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Executive Summary

The Science Educators have worked to develop a curriculum that provides a framework for Science education and student learning in the School District of Holmen. This document is a road map for teachers, administrators, parents and students. It includes district and content specific information. It is a guide that focuses on student learning by defining a vision and curriculum aligned to the state standards and includes vocabulary and strategies essential for understanding. The result is a dynamic document that supports student achievement in the District.

The main part of the curriculum is divided by content area and grade level. The curriculum for each course outlines what the student should know or be able to do. It is student-focused, defining competencies, embedding standards, and outlining assessment expectations.

- Competencies are the broadest skills, knowledge or attitudes that tell students what primary intended outcomes they will learn. These competencies are developed from state standards, test objectives, textbooks, curriculum guides, and other professional sources. They are student centered, observable, and measurable.
- Assessment expectations establish the acceptable level of performance based on district criteria by grade level or discipline.

The former State Superintendent of Public Instruction, John Benson, stated that "fundamental to every child's success in school is a clear set of expectations for academic accomplishment. It should be no mystery to parents and community members what educators expect students to know and be able to do." If we are successful at defining curriculum, using a variety of instructional strategies, and evaluating students through on-going assessments, no children should be left behind and all students should succeed.

From Instructional Services

SCHOOL BOARD POLICY **FILE: 330**
School District of Holmen **SECTION: I**
Holmen, WI 54636 **INSTRUCTION**

CURRICULUM DEVELOPMENT AND ADOPTION

The Curriculum is the common body of knowledge that is the basis for the instructional program in the District. The School District of Holmen recognizes that written curriculum plans are an essential element in the education of all children. The School Board has a responsibility for maintaining a minimum program of instruction guaranteed by the state statutes and for initiating improvements beyond that minimum.

A written, sequential curriculum plan shall exist for the following:
- A sequential curriculum plan exists in each of the following areas: reading/language arts, mathematics, science, social studies, health, physical education, art, music, world language, guidance and counseling, career and technical education (agriculture, business education, marketing education, family and consumer education, and technology education), library media, computer literacy, and environmental education.
- The curriculum plan identifies how mandated statutes are addressed and included in the curriculum.
- The curriculum plan identifies how infused or integrated areas are addressed and included in the curriculum.
- The curriculum plan identifies course competencies, learning expectations, linked standards, and assessment methods/strategies. The course components are monitored continuously and revised as appropriate.

The professional staff, under the direction and supervision of the Superintendent of Schools and the Director of Curriculum and Instruction, shall be responsible for proposing, developing, implementing and evaluating PK-12 curriculum that reflects the best of current educational research and practice. The curriculum shall support the District's mission, goals and adopted academic standards and be in line with legal requirements. Communication and coordination among grade level and content area teachers shall be emphasized whenever curriculum is developed. Each content area shall follow an established curriculum revision cycle. Minor changes may be made as needed.

All content offerings and any additions or deletions to the curriculum shall be reviewed and approved by the Curriculum Council and the School Board before they are initiated or dropped from the existing program of instruction.

Legal Ref.: WI Statutes 118.01, 118.015, 118.015, 118.30, 120.12, 120.13, 121.02 (1)(k) and (l)
WI Admin. Code PI 8.01 (2) (k) and (l)
No Child Left Behind (NCLB) of 2001
Cross Ref.: Assessment of Student Achievement, 345
Equal Education and Employment Opportunities, 411
Grade Advancement Policy, 345.4
Grading Systems, 345.1
High School Graduation, 345.6
Reading Instruction, 341.1
Revised: October 10, 2012
Approved: March 29, 2005
November 26, 2012

District Vision Statement

Educating Every Student to Achieve Global Success

District Mission Statement

Educate and inspire students today and prepare them for tomorrow by:

Ensuring that all students learn at high levels.

Developing the following 21st Century Skills:

innovation, creativity, collaboration, communication, initiative, problem-solving, critical thinking, leadership, self-direction, responsibility, interpersonal skills, cross-cultural skills, and computer and media literacy.

Achieving a deeply held partnership with the entire community.

Operating and acting in a fiscally responsible manner while ensuring well-rounded educational experiences.

Strategic Objectives

Student Learning:

- Provide a rigorous, relevant curriculum and high quality instruction to prepare all students for the future.

Performance Excellence:

- Adopt and demonstrate a district-wide, research-based, systematic, and aligned approach to improvement.

Fiscal Sustainability:

- Provide and sustain the highest level of student learning in a fiscally responsible manner.

Workforce:

- Ensure a workforce environment conducive to high performance and is aligned with the vision and mission.

Customer/Stakeholder Focus:

- Engage customers (students and stakeholders) in the vision and mission by listening to their voice, building relationships with them, and valuing their input to identify opportunities for improvement.

Leadership:

- Engage and empower others throughout the school community so that the collaborative efforts of all support the shared vision and mission.

LEARNER GOALS

Philosophical Foundation:

The School District of Holmen is a system that empowers the community. This accomplished through continuous improvement, enhancement of self-worth and optimization of student performance. The focus for each student is on joy in learning, optimization of student performance and preparation of life skills.

Administrative Rule Provisions:

Therefore, in the School District of Holmen:

The Learner Will:

1. **Build a substantial knowledge base.**
   Students will build a solid knowledge base developed from challenging subject matter in computer/information, technology, environmental education, fine and performing arts, foreign language, health, language arts, mathematics, physical education, reading, science, social studies, and vocational education.
2. **Develop thinking and communication processes.**
   Students will develop a command of thinking processes (analysis, creative thinking, problem solving, decision making, visualizing, and concept development) that permit them to interpret and apply the knowledge base. Communication processes (listening, speaking, reading, writing, viewing, image making, and other symbolizing) enable them to communicate thoughts with others.
3. **Apply knowledge and processes.**
   Students will build upon knowledge and apply learning processes to create new ideas and understanding, enhance human relations, expand awareness, and enrich human experiences.
4. **Acquire the capacity and motivation for life-long learning.**
   Students will develop their natural curiosity to acquire habits of inquiry and a love for learning which will motivate them to continue learning throughout their lives.
5. **Develop physical and emotional wellness.**
   Students will acquire the attitudes, knowledge, and habits to grow physically and emotionally healthy, develop self-esteem and confidence, and exhibits a healthy life style.
6. **Develop character.**
   Students will exhibit personal characteristics, such as compassion, conviction, curiosity, ethics, integrity, motivation, and responsibility.
7. **Be a responsible citizen.**
   Students will possess and exercise the knowledge and processes necessary for full participation in the family, civic, economic, and cultural life of a complex interdependent, global society. Students will acquire an understanding of the basic workings of all levels of government, understanding the duties and responsibilities of citizenship. Students will make a commitment to the basic values of our government, including a reverence and respect for and the history of the American flag, the Declaration of Independence, the U.S. Constitution and the Constitution and Laws Wisconsin, and acquire a knowledge of state, national, and world history.
8. **Be prepared for productive work.**
   Students will acquire knowledge, capabilities, and attitudes necessary to make them contributing members of a dynamic national and world economy and prepare them for the transition from school to work.
9. **Respect culture diversity and pluralism.**
   Students will demonstrate the knowledge and attitudes necessary to understand and respect individual and multi-cultural diversity and to work cooperatively with all people.
10. **Develop aesthetic awareness.**
    Students will become aware of and be able to generate those forms of experience that have artistic and aesthetic meaning.

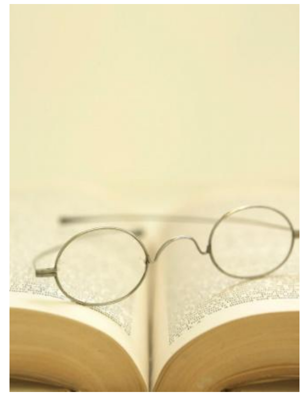
WISCONSIN TEACHER STANDARDS & LICENSURE
Wisconsin's 10 Standards for Teacher Development and Licensure

These standards become the basis of teacher licensing after August 31, 2004. The entire document, which includes knowledge, skills and dispositions under these standards, can be found on DPI's website -http://www.dpi.state.wi.us/dpi/dlsis/tel/pdf/10kdp.pdf

1. **Teachers know the subjects they are teaching.** The teacher understands the central concepts, tools of inquiry and structures of the disciplines she or he teaches and can create learning experiences that make these aspects of **subject matter** meaningful for pupils.
2. **Teachers know how children grow.** The teacher understands how children with **broad ranges of ability** learn and provides instruction that supports their intellectual, social and personal development.
3. **Teachers understand the children learn differently.** The teacher understands how pupils differ in their approaches to learning and the barriers that impede learning and **can adapt instruction to meet the diverse needs** of pupils, including those with disabilities and exceptionalities.
4. **Teachers know how to teach.** The teacher understands and **uses a variety of instructional strategies**, including the use of technology to encourage children's development of critical thinking, problem solving and performance skills.
5. **Teachers know how to manage a classroom.** The teacher uses an understanding of **individual and group motivation** and behavior to create a learning environment that encourages positive social interaction, active engagement in learning and self-motivation.
6. **Teachers communicate well.** The teacher uses effective **verbal and nonverbal communication** techniques as well as instructional media and technology to foster active inquiry, collaboration and supportive interaction in the classroom.
7. **Teachers are able to plan different kinds of lessons.** The teacher **organizes and plans systematic instruction** based upon knowledge of subject matter, pupils, and the community and curriculum goals.
8. **Teachers know how to test for student progress.** The teacher understands and **uses formal and informal assessment** strategies to evaluate and ensure the continuous intellectual, social and physical development of the pupil.
9. **Teachers are able to evaluate themselves.** The teacher is a **reflective practitioner** who continually evaluates the effects of his or her choices and actions on pupils, parents, professionals in the learning community and others and who actively seeks out opportunities to grow professionally.
10. **Teachers are connected with other teachers and the community.** The teacher **fosters relationships** with school colleagues, parents and agencies in the larger community to support pupil learning and well being and acts with integrity, fairness and in an ethical manner.

School District of Holmen
2016-17

SCHOOL BOARD OF EDUCATION MEMBERS



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Anita Jagodzinski– Vice President

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Gary Dunlap – Treasurer

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Jay Clark, Associate District Administrator

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Jill Mason, Director of Pupil Services

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Patrice Tronstad, Prairie View Elementary Principal

Brian Oberweiser, Sand Lake Elementary Principal

Bonnie Striegel, Viking Elementary Principal

Ryan Vogler, Middle School Principal

Keri Holter, Middle School Associate Principal

Bob Baer, High School Principal

Wayne Sackett, High School Associate Principal

Nick Weber, High School Associate Principal

Sue Eitland, EC/4K Associate Principal

Mark Englerth, Activities / Athletic Director

School District of Holmen
Board of Education Action Regarding State Standards

Action was taken by the School Board of Holmen School Board on Monday, May 18, 1998, to adopt the following:

Adoption of the Wisconsin State Standards *(CI98-017)*
The Holmen curriculum process includes the steps of aligning the curriculum to the Wisconsin State standards, the WSAS testing criteria, as well as what should be included locally. Therefore, the State Standards would be adopted by the District as part of a process to meet the students' needs.

BE IT RESOLVED *that the Board of Education approve the adoption of the Wisconsin State Standards which include CCSS for ELA, CCSS Math and Next Generation Science Standards as part of a process to meet the students' needs as recommended.*

School District of Holmen

Science K-12 Curriculum Department
Vision Statement

The goal of the K-12 science department is to develop citizens that have a strong foundation in science and have an understanding of the natural world.

Mission Statement

In order to achieve our vision, our Department will focus on:

- Implementing a self-study to identify strengths and weaknesses in existing curriculum
- Begin utilizing the Next Generation Science Standards as a guide for course mapping and curriculum development

School District of Holmen Grade K-5 Science Committee Members				
Grade Level	**Evergreen**	**Prairie View**	**Sand Lake**	**Viking**
K	Lisa Ottum	Brenda Witz	Teresa Ericksmoen	Caitlynn Hinytzke
1	Bobbie Nelson	Alyssa Haug	Robin George	Angela Franke
2	Melanie Carpenter	Melissa Wilbur	Tony Hart	Ben Everson
3	Janet Vike	Brian Sime	Jodi Hoscheit	Christina Klinge
4	Christy Wopat	Jeff Davis	Jamie Harlos	Sarah Meza
5	Kevin Bradley	Jen Aspenson	Phil Schollmeier	Sara Wengerter

School District of Holmen Grade 6-12 Science Committee Members			
Middle School		**High School**	
Co-Chair: Steve Mally		Co-Chair: Josh Kinsman	
Dianna Stratton	Stacy Howden	Anne Nyseth	Liz Rosendale
Cindy Baer	Eric Tande	Stephanie Teff	Bob Siewert
Scott Clifford	Jackson Baumgart	Greg Grokowsky	Matt Hanson
Anne Hagel		Michelle Wuensch	Jason Yusten
Kang Lor		Sam Frame	Jared Johnson

Administrator & Instructional Services Liaison:

Wendy Savaske, Instructional Services Director
Kari Huth, Instructional Services Coordinator

Middle School Timeline for Science Curriculum Writing

Date	Activity
4/13/16	Understanding UbD and looking at timeline 6-8
4/27/16	Middle School mission/vision Start work with UbD doc Translate course mapping into curriculum
5/11/16	Continued work on UbD
7/11/16	UbD doc work and course mapping
7/12/16	NGSS EST-6th Gr / UbD & Matrix development-8th Gr.
7/13/16	6th Gr-building units based on UbD / 8th Gr- Matrix development from UbD and assessments
7/14/16	6th Gr-building units based on UbD / 8th Gr- Matrix development from UbD and assessments
9/14/16	ER day 7th grade worked on UbD, 6th and 8th assessments development as it relates to new curriculum
10/12/16	ER day 7th grade worked on UbD, 6th and 8th assessments development as it relates to new curriculum
11/9/16	ER day 7th grade worked on UbD, 6th and 8th assessments development as it relates to new curriculum
12/14/16	ER day 7th grade worked on UbD, 6th and 8th assessments development as it relates to new curriculum
1/11/17	ER day 7th grade worked on UbD, 6th and 8th assessments development as it relates to new curriculum
1/23/17	PD day 7th grade finished up UbD of their curriculum.

High School Timeline for Science Curriculum Writing

Name(s)	When was Work Completed	Work Completed
May	All Department	Learned about UBD format and how to correctly input information into documents Some individuals created example UBD documents to share and discuss as a department so we are completing the documents with consistency
Anne Nyselth	3 days in June	Chemistry Writing
Michelle Wuensch	3 days in June	Chemistry
Greg Grokowsky	June 13th	Biology Writing
Matt Hanson	June 13th	Biology Writing
Jared Johnson	June 13th	Biology Writing
Stephanie Teff	June 13th	Biology Writing
Josh Kinsman	June 13th	Biology Writing
Josh Kinsman	June 22nd	ChemCom Writing
Jared Johnson	June 22nd	ChemCom Writing
Greg Grokowsky	June 27th	Biology Writing
Matt Hanson	June 27th	Biology Writing
Jared Johnson	June 27th	Biology Writing
Stephanie Teff	June 27th	Biology Writing
Josh Kinsman	June 27th	Biology Writing
Greg Grokowsky	June 28th	Biology Writing
Matt Hanson	June 28th	Biology Writing
Jared Johnson	June 28th	Biology Writing
Stephanie Teff	June 28th	Biology Writing
Josh Kinsman	June 28th	Biology Writing
Liz Rosendale	June 12,13,16,17	Physics
Anne Nyselth	3 days in July	Chemistry/Organic/AP
Michelle Wuensch	3 days in July	Microbiology/Genetics
Stephanie Teff	July (4 1/2 days)	Biology Writing
Josh Kinsman	3 days in July and August	Astronomy/Geology/ChemCom UBD writing
Jared Johnson	2 half days	ChemCom/Bio

Jason Yusten	August 8th and 9th	Physical World Writing
Liz Rosendale	August 8th and 9th	Physical World Writing
Jared Johnson	6 half days	Physical World/Env. Sci
Matt Hanson	July and August work	AP Bio/Biology
All	September	Department meeting evaluated progress of UBDs and organization of documents so they are easily identified by Kari or Wendy
Josh	October	Listing science vocabulary from each content area in glossary
All	Nov. 2nd	Developed HHS science description. Added document of Science Vocabulary used across the curriculum as provided by cambridge ACT prep. Updated timeline. Some individuals worked on completing UBD documents for classes.

Science Staff Recommendations
Overall Planning for Improvement

From the results of external evaluations, survey results, site visits, and advisory committee meeting the science staff has identified the following recommendations:

STRATEGIC OBJECTIVE 1 - STUDENT ACHIEVEMENT & LEARNING The School District of Holmen will provide a rigorous, relevant curriculum and high quality instruction to prepare all students for the future.	
Recommendations	6-8 Science Implement NGSS to guide our curriculum. 9-12 Science Integrate applicable NGSS standards while maintaining student choice and multiple pathways for post-secondary readiness.
Timeline for Implementation	6-8 Science 2016-17 partial implementation 2017-18 continued implementation 2018-19 full implementation and review 9-12 Science 2016-17 partial implementation 2017-18 continued implementation 2018-19 full implementation and review
Shared Involvement for Implementation	6-8 Science Grade level weekly PLC and 6-8 monthly PLC Curriculum writing 9-12 Science Weekly subject area PLC and monthly department PLC Curriculum writing
Action Taken To Date	6-8 Science Course mapping, gap analysis, external review, and sixth grade has looked at various units and has begun implementation. UbD’s are finished 6&8 9-12 Science Gap analysis. External review. We have also placed all courses within each of the NGSS strands within our venn diagram and will recommend students take courses in each of the three strands. NGSS@NSTA Hub lit review

STRATEGIC OBJECTIVE 2 - COMMUNICATION The School District of Holmen will communicate with students, parents, staff and community utilizing accurate, meaningful and timely methods.	
Recommendations	6-8 Science Utilizing the Google platform - including email, Infinite Campus, newsletters, report cards, parent teacher conferences, and telephone calls. 9-12 Science Communication with students and parents through science department website,emails, HHS course description guide, parent-teacher conferences, newsletters, and telephone calls. Also communicating within department using Google
Timeline for Implementation	6-8 Science Already implemented - will continue with current communication methods. 9-12 Science 2016-2017 - update science department website 2016-2017 - update course description guide 2015-2016 -communicate changes with staff and guidance
Shared Involvement for Implementation	6-8 Science Use of Google and PLC meetings 9-12 Assigning tasks at PLC meetings and communicating through Google
Action Taken To Date	6-8 Science Partial implementation - we are currently working on implementing the Google platform. 9-12 Communicating with staff through PLC meetings, email, and Google

STRATEGIC OBJECTIVE 3 – Fiscal Sustainability The School District of Holmen will provide and sustain the highest level of student learning in a fiscally responsible manner.	
Recommendations	6-8 Science Continue sharing of resources including texts and lab equipment, supplement new text with current, 6-8 professional development, and utilize online resources. 9-12 Science Continue sharing of equipment, chemicals, and ideas. Write grants to supplement the science department budget. Shop prices for large-ticket equipment. Continue to minimize chemical waste by sharing and careful lab planning.
Timeline for Implementation	6-8 Science Throughout curriculum implementation. 9-12 Science Throughout curriculum cycle and beyond.
Shared Involvement for implementation	6-8 Science Middle school science staff and building administrators. 9-12 Science HS science staff and building administrators.
Action Taken To Date	6-8 Science Struggling to begin implementation on current budget. 9-12 Science Continue to operate as before. We will need new textbooks soon, however. (new AP Chemistry for 2016-2017)

STRATEGIC OBJECTIVE 4: Improvement Capacity/Performance Excellence The School District of Holmen will have a district-wide, research-based, systematic and aligned approach to improvement.	
Recommendations	6-8 Science Utilizing common assessment data, SLO data, PLC, and Best Practices to drive instruction 9-12 Science Continue to research and develop instructional strategies and best practices to support student learning. Pursue more professional development focussed on science education
Timeline for Implementation	6-8 Science Ongoing 9-12 Science Ongoing
Shared Involvement for Implementation	6-8 Science Middle school science staff, Curriculum Director, and Building Administrators. 9-12 Science High School science staff, Cesa, Curriculum Director, Administrators
Action Taken To Date	6-8 Science Fully implemented 9-12 Science Sharing best practices among departments

Elementary School Curriculum

The Science Curriculum is…

The goal of science in the elementary years is to provide students with engaging experiences in which students collaborate, critically think, and problem solves about real world science inquiries. In order to do this, teachers will be guided by the Wisconsin Academic Science Standards. These science standards are rooted in the research-based Next Generation Science Standards.

1st Grade Science Curriculum Units:

Unit/NGSS Topic: LS/Plants and Animals	
Priority Standard(s) [Overarching]: 1-LS1-1: Use materials to design a solution to a human problem by mimicking how plants and/or animals use their external parts to help them survive, grow, and meet their needs. 1-LS3-1: Make observations to construct an evidence-based account that young plants and animals are like, but not exactly like, their parents.	**Supporting Standards:** 1-LS1-2: Read texts and use media to determine patterns in behavior of parents and offspring that help offspring survive.
Learning Targets: I can define the needs of animals, plants, and/or humans. I can identify a human problem. I can create a solution to a human problem. I can make observations of plants and animals using text, media, and environment. I can prove that parents and their young have similar characteristics. I can compare parents and their young. I can contrast parents and their young. I can use text and media to collect data. I can use text and media to record data. I can use data to find patterns in behavior of parents and young.	

Unit/NGSS Topic: ESS/Space Systems, Patterns and Cycles	
Priority Standard(s) [Overarching]: 1-ESS1-1. Use observations of the sun, moon, and stars to describe patterns that can be predicted.	**Supporting Standards:** 1-ESS1-2: Make observations at different times of year to relate the amount of daylight to the time of year.
Learning Targets: I can observe the sun, moon, and stars. I can recognize patterns in the sun, moon, and stars. I can use text and media to observe daylight at different times of the year.	

Unit/NGSS Topic: Waves: Light and Sound	
Priority Standard(s) [Overarching]: 1-PS4-1. Plan and conduct investigations to provide evidence that vibrating materials can make sound and that sound can make materials vibrate. 1-PS4-2. Make observations to construct an evidence-based account that objects can be seen only when illuminated.	**Supporting Standards:** 1-PS4-3. Plan and conduct an investigation to determine the effect of placing objects made with different materials in the path of a beam of light. 1-PS4-4. Use tools and materials to design and build a device that uses light or sound to solve the problem of communicating over a distance.
Learning Targets: I can understand what an experiment is. I can plan an experiment. I can perform an experiment. I can record data about my experiment. I can use tools to collect data. I can use tools to record data. I can draw conclusions about my experiment. I can provide evidence to support my ideas. I can display my data from my experiment. I can use text, media, and the environment to observe illuminated objects	

2nd Grade Science Curriculum Units:

Unit/NGSS Topic: Life Science: Interdependent Relationships in Ecosystems	
Priority Standard(s) [Overarching]: 2-LS2-1 Plan and conduct an investigation to determine if plants need sunlight and water to grow.	**Supporting Standards:** 2-LS-2-2 Develop a simple model that mimics the function of an animal in dispersing seeds or pollinating plants. 2-LS4-1 Make observations of plants and animals to compare the diversity of life in different habitats.
Learning Targets: I can understand what an investigation is I can outline/organize a science process/procedure I can perform a science process/procedure (measuring) I can use scientific tools to collect/record data I can draw conclusion from experimental/observational data I can justify a response when more than one answer is present I can collect and display data I can identify the cause and effect water and sunlight on plants. I can determine if plants need sun and water to grow. I can make a model of how animals help spread seeds and/or pollinate. I can observe how plants and animals compare in different habitats	

Unit/NGSS Topic: Physical Science - Matter	
Priority Standard(s) [Overarching]: 2-PS-1-1 Plan and conduct an investigation to describe and classify different kinds of materials by their observable properties. 2-PS1-4 Construct an argument that some changes caused by heating and cooling can be reversed and some cannot.	**Supporting Standards:** 2-PS1-2-Analyze data obtained from testing different materials to determine which materials have the properties that are best suited for an intended purpose. 2-PS1-3 Make observations to construct an evidence-based account of how an object made of a small set of pieces can be disassembled and made into a new object
Learning Targets: I can understand what an investigation is I can outline/organize a science process/procedure I can perform a science process/procedure (measuring) I can use scientific tools to collect/record data I can draw conclusions from experimental/observational data I can identify the cause and effect of a force on the motion of an object	

Unit/NGSS Topic: Earth Science - Processes that Shape the Earth	
Priority Standard(s) [Overarching]: 2-ESS1-1 Use information from several sources to provide evidence that Earth events can occur quickly or slowly. 2-ESS2-3 Obtain information to identify where water is found on Earth and that it can be solid or liquid.	**Supporting Standards:** 2-ESS2-1 Compare multiple solutions designed to slow or prevent wind or water from changing the shape of the land. 2-ESS2-2 Develop a model to represent the shapes and kinds of land and bodies of water in an area
Learning Targets: I can use a lot of resources to show the Earth can change quickly or slowly. I can design multiple solutions on how to prevent wind. I can design multiple solutions on how to prevent water erosion. I can communicate how erosion shapes the land. I can model different kinds of bodies of water in an area.	

3rd Grade Science Curriculum Units:

Unit/NGSS Topic: Ecosystems	
Priority Standard(s): LS4-3: Construct an argument with evidence that in a particular habitat some organisms can survive well, some survive less well, and some cannot survive at all.	**Supporting Standards:** LS2-1: Construct an argument that some animals form groups that help members survive LS 4-1: Analyze and interpret data from fossils to provide evidence of the organisms and the environments in which they lived long ago. LS 4-4: Make a claim about the merit of a solution to a problem caused when the environment changes and the types of plants and animals that live there may change.
Learning Targets: I can identify some animals that live in groups and give reasons why they do. I can explain how animal groups help its members survive. I can construct an argument that some animals form groups that help members survive. I can explain what fossils are and what they tell us about organisms and the environment in which they lived long ago. I can analyze and interpret data from fossils to provide evidence of the organisms and the environments in which they lived long ago. I can explain what a habitat is and describe specified/particular habitats. I can explain how adaptations of organisms living in a particular habitat help them to survive. I can construct an argument with evidence that in a particular habitat some organisms can survive well, some survive less well, and some cannot survive at all. I can identify ways the environment can change and can describe how changes in the environment can affect the types of plants and animals that live in it. I can identify solutions to a problem caused when the environment changes that affects the plants and animals that live there. I can make a claim about the merit of a solution to a problem caused when the environment changes and the types of plants and animals that live there may change.	

Unit/NGSS Topic: Forces and Interactions	
Priority Standard(s) [Overarching]: PS2-1: Plan and conduct an investigation to provide evidence of the effects of balanced and unbalanced forces on the motion of an object PS 2-3: Ask questions to determine cause and effect relationships of electric or magnetic interactions between two objects not in contact with each other	**Supporting Standards:** PS2-2: Make observations and/or measurements of an object's motion to provide evidence that a pattern can be used to predict future motion PS2-4: Define a simple design problem that can be solved by applying scientific ideas about magnets.
Learning Targets: I can explain what motion is. I can tell what a force is and can explain the difference between a balanced and an unbalanced force. I can describe the effects of balanced and unbalanced forces on the motion of an object. I can plan and conduct an investigation to provide evidence of the effects of balanced and unbalanced forces on the motion of an object. I can measure the effects of balanced and unbalanced forces on an object's motion. I can identify patterns in an object's motion based on the type of force that is acting on it. I can make observations and/or measurements of an object's motion to provide evidence that a pattern can be used to predict future motion. I can identify and describe the properties of magnets. I can explain what static electricity is. I can explain what electric and magnetic fields are. I can identify factors that affect the electric or magnetic interactions between two objects not in contact with each other. I can define a simple design problem that can be solved by applying scientific ideas about magnets.	

3rd Grade Science Curriculum Units Continued:

Unit/NGSS Topic: Life Cycles & Traits	
Priority Standard(s) [Overarching]: LS 4-2: Use evidence to construct an explanation for how the variations in characteristics among individuals of the same species may provide advantages in surviving, finding mates, and reproducing	**Supporting Standards:** LS 1-1: Develop models to describe that organisms have unique and diverse life cycles but all have in common birth, growth, reproduction, and death LS3-1: Analyze and interpret data to provide evidence that plants and animals have traits inherited from parents and that variation of these traits exists in a group of similar organisms LS 3-2: Use evidence to support the explanation that traits can be influenced by the environment
Learning Targets: I can explain what a life cycle is and what all life cycles have in common. I can develop models to describe that organisms have unique and diverse life cycles, but that all have in common birth, growth, reproduction, and death. I can explain what a trait is and can describe the difference between learned and inherited traits. I can analyze and interpret data to provide evidence that plants and animals have traits inherited from parents and that variation of these traits exists in a group of similar organisms. I can explain how traits can be influenced by the environment. I can use evidence to construct an explanation for how the variations in characteristics among individuals of the same species may provide advantages in surviving, finding mates, and reproducing. I can identify and describe how variations in characteristics (traits) among individuals of the same species may provide advantages in surviving, finding mates, and reproducing	

Unit/NGSS Topic: Weather and Climate	
Priority Standard(s) [Overarching]: ESS 2-2: Obtain and combine information to describe climates in different regions of the world	**Supporting Standards:** ESS2-1: Represent data in tables and graphical displays to describe typical weather conditions expected during a particular season ESS3-1: Make a claim about the merit of a design solution that reduces the impacts of a weather-related hazard
Learning Targets: I can identify what weather conditions are. I can identify and describe typical weather conditions expected during each of the four seasons. I can represent data in tables and graphical displays to describe typical weather conditions expected during a particular season. I can explain the difference between climate and weather. I can explain what a region is and identify different regions of the world. I can explain what a weather-related hazard is and describe the impacts of weather-related hazards. I can identify solutions that reduce the impacts of a weather-related hazard. I can compare design solutions that reduce the impacts of a weather-related hazard. I can make a claim about the merit of a design solution that reduces the impacts of a weather-related hazard.	

4th Grade Science Curriculum Units:

Unit/NGSS Topic: Structure and Function	
Priority Standard(s) [Overarching]: LS 1-1: Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction	**Supporting Standards:** PS 4-2: Develop a model to describe that light reflecting from objects and entering the eye allows objects to be seen LS 1-2: Use a model to describe that animals receive different types of information through their senses, process the information in their brain, and respond to the information in different ways
Learning Targets: I can identify and explain the parts of plant. I can construct an investigation that identifies the resources that plants need to live. I can conduct an investigation that identifies the resources that plants need to live. I can draw conclusions about the resources that plants need to live. I can explain animal adaptations. I can identify complex relationships between animals and other living things, and animals and non-living things, in their environment. I can apply my knowledge of the concepts of a healthy ecosystem in designing a model ecosystem that contains all elements of a healthy ecosystem.	

Unit/NGSS Topic: Energy	
Priority Standard(s) [Overarching]: PS 3-1: Use evidence to construct an explanation relating the speed of an object to the energy of that object.	**Supporting Standards:** ESS 3-1: Obtain and combine information to describe that energy and fuels are derived from natural resources and that their uses affect the environment PS 3-2: Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents PS 3-3: Ask questions and predict outcomes about the changes in energy that occur when objects collide PS 3-4: Apply scientific ideas to design, test, and refine a device that converts energy from one form to another
Learning Targets: I can identify and explain potential and kinetic energy. I can compare and contrast different energies. I can construct an investigation to explore what causes an object's motion to change. (includes speed (different heights of ramp) and collision (have an object on the bottom to collide with-higher ramp collides and makes that ball travel further bc it transfers more energy) I can conduct an investigation that shows the transfer of energy from one object to another. I can draw conclusions about different types of energy. I can conduct an investigation to explore how energy is stored and released.	

Unit/NGSS Topic: Waves	
Priority Standard(s) [Overarching]: PS 4-1: Develop a model of waves to describe patterns in terms of amplitude and wavelength and that waves can cause objects to move	**Supporting Standards:** PS 4-3: Generate and compare multiple solutions that use patterns to transfer information
Learning Targets: I can create a model that shows different intensities of energy within a wave. I can conclude what causes different levels of wave energy. I can develop situations where changing variables' effects on waves can be observed. I can recognize patterns and their causes. I can identify solutions that reduce the impacts of a weather-related hazard. I can compare design solutions that reduce the impacts of a weather-related hazard. I can make a claim about the merit of a design solution that reduces the impacts of a weather-related hazard.	

4th Grade Science Curriculum Continued:

<table>
<tr><td colspan="2">Unit/NGSS Topic: Processes that Shape the Earth</td></tr>
<tr><td>Priority Standard(s) [Overarching]:
ESS1-1: Identify evidence from patterns in rock formations and fossils in rock layers to support an explanation for changes in a landscape over time</td><td>Supporting Standards:
ESS 3-2: Generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans
ESS 2-1: Make observations and/or measurements to provide evidence of the effects of weather or the rate of erosion by water, ice, wind, or vegetation
ESS 2-2: Analyze and interpret data from maps to describe patterns of Earth's features</td></tr>
<tr><td colspan="2">Learning Targets:
I can analyze and interpret data to make sense of phenomena using logical reasoning.
I can show how wind, water, ice, and vegetation causes erosion(cause-effect).
I can analyze a piece of earth and find evidence to support an explanation.
I can prepare a test to prove certain hypotheses.</td></tr>
</table>

5th Grade Science Curriculum Units:

<table>
<tr><td colspan="2">Unit/NGSS Topic: Life Science (Matter and Energy in Organisms and Ecosystems)</td></tr>
<tr><td>Priority Standard(s) [Overarching]:

PS 3-1: Use models to describe that energy in animals' food (used for body repair, growth, motion, and to maintain body warmth) was once energy from the sun</td><td>Supporting Standards:

LS 1-1: Support an argument that plants get the materials they need for growth chiefly from air and water

LS 2-1: Develop a model to describe the movement of matter among plants, animals, decomposers, and the environment</td></tr>
<tr><td colspan="2">Learning Targets:
I can use models to show movement through the food chain.
I can describe how energy (from the sun) flows through a food chain.
I can support an argument that plants needs are met through Photosynthesis.
I can design a model representing photosynthesis and the flow of energy from the sun to plants/ animals.
I can analyze the producers, consumers and decomposers of the food chain.</td></tr>
</table>

<table>
<tr><td colspan="2">Unit/NGSS Topic: Space Systems</td></tr>
<tr><td>Priority Standard(s) [Overarching]:

ESS 1-2: Represent data in graphical displays to reveal patterns of daily changes in length and direction of shadows, day and night, and the seasonal appearance of some stars in the night sky</td><td>Supporting Standards:

ESS 1-1: Support an argument that differences in the apparent brightness of the sun compared to other stars is due to their relative distances from Earth

PS2-1: Support an Argument that the gravitational forces exerted by Earth on objects is directed down.</td></tr>
<tr><td colspan="2">Learning Targets:
I can represent the changes in shadows throughout a period of time to demonstrate the sun's movement throughout the day and year.
I can represent the visual changes of the lunar cycle.
I can demonstrate the Earth’s rotation affects the location of constellations within the night sky.
I can develop a logical argument to compare and contrast the brightness of the sun to other stars.
I can develop a logical argument to support how gravitational forces work on Earth.</td></tr>
</table>

<table>
<tr><td colspan="2">Unit/NGSS Topic: Structure</td></tr>
<tr><td>Priority Standard(s) [Overarching]:

PS1-1: Develop a model to describe that matter is made of particles too small to be seen.</td><td>Supporting Standards:

5-PS1-2: Measure and graph quantities to provide evidence that regardless of the type of change that occurs when heating, cooling, or mixing substances, the total weight of matter is conserved.

5-PS1-3: Make observations and measurements to identify materials based on their properties.

5-PS-4: Conduct an investigation to determine whether the mixing of two or more substances results in new substances.</td></tr>
<tr><td colspan="2">Learning Targets:
I can conduct an investigation to determine whether the mixing of two or more substances results in new substances.
I can make observations and measurements to identify materials based on their properties.
I can apply concepts of matter to construct an argument to prove matter is conserved.
I can develop a model to describe that matter is made of particles too small to be seen.</td></tr>
</table>

5th Grade Science Curriculum Units Continued:

Unit/NGSS Topic: Earth Systems	
Priority Standard(s) [Overarching]: 5-ESS3-1 Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment.	**Supporting Standards:** 5-ESS2-1: Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact. 5-ESS2-2: Describe and graph the amounts of saltwater and fresh water in various reservoirs to provide evidence about the distribution of water on Earth.
Learning Targets: I can create a model to describe how the geosphere, biosphere, hydrosphere and atmosphere interact. I can construct and interpret a graph to show the distribution of saltwater to freshwater on Earth. I can identify information on ways communities use science and protect resources in the environment. I can analyze communities use of Earth's resources.	

Middle School Curriculum

The Science Curriculum is…

The goal of the 6-8 science department is to develop citizens that have a strong foundation in science that can be applied to understanding and explaining the natural world. In order to achieve our vision, our department will implement the Next Generation Science Standards (NGSS) through a collaborative 6-8 spiraled curriculum with an emphasis on developing high school, college, and career readiness.

Holmen Middle School
Current Science Program Description & Course Offerings

Sixth Grade Science dives into earth science, chemistry, physical science, and life science. The earth science unit focuses on water by looking at the water cycle, groundwater, stream development, water erosion, and water as a natural resource. Chemistry builds the basics with states of matter, particle motion, and properties of substances. Physical science is all about waves - wave properties, sound waves, and light waves. Life science looks at the differences between the kingdoms, interactions between and within the kingdoms, and the dynamics of ecosystems.

Seventh Grade Science explores a variety of topics in the areas of Life, Earth, and Physical Science in addition to General Science skills and knowledge that exist throughout the year as outlined below.

General Science-

1. The Scientific Method
2. Scientific Measurement
3. Science Literacy

Life Science-

1. Body Organization and Homeostasis
2. Cells
    a) Structure and Function of Plant & Animal Cells
    b) Photosynthesis, Cellular Respiration, and Fermentation
    c) Cell Cycle (with an emphasis on Mitosis)
1. Human Body Systems
    a) Nervous
    b) Endocrine
    c) Skeletal
    d) Muscular
    e) Circulatory
    f) Respiratory
    g) Digestive

Earth Science-

1. Human Impacts on Earth Systems
2. Global Climate Change

Physical Science

1. Introduction to the Periodic Table of Elements
    a) History and Creation of the Periodic Table
    b) Organization and Information of Individual Elements
2. Structure of Atoms
    a) Protons, Neutrons, and Electrons
    b) Modeling Elements 1-20 on the Periodic Table
3. Basics of Chemical Reactions
    a) Physical and Chemical Change
    b) Reading and Writing Simple Reactions

c) Balancing Simple Reactions

4. Motion and Forces
    a) Speed, Velocity, and Acceleration
    b) Combining Forces, Friction, and Gravity
    c) Newton's Laws of Motion
5. Forces in Fluids
    a) Pressure
    b) Floating and Sinking (Buoyancy, Density, and Displacement)
    c) Pascal's Principle and Bernoulli's Principle
6. Work and Energy

<u>Eighth Grade Science</u>

Physical science:

History of the atomic model covering discoveries made and by whom that explains the current atom of the model.

The periodic table, how to read and interpret what it states for various elements

Chemical reactions and bonding, use of valence electrons, oxidations numbers to explain ionic and covalent bonds. Also demonstrate how to name and write chemical compounds/molecules as well as identify the types of chemical reactions and be able to balance those reactions.

Electricity: static electricity and current. Ohm's law and Faraday's law
Magnetism: domains and fields as well as forces and polarity. electromagnetism and direct application to the construction of an electric motor and electromagnet.

Life Science:

Infectious diseases and how the body's immune system functions

Genetics and traits, variation of gene that lead to an organism's physical characteristics. The role of probability when referring to possible outcomes for the offspring.

Earth Science:

Weather and climate/ how weather is predicted, high and low pressure
Plate tectonics and explaining how the earth's crust moves / Earth's layers/
Seafloor spreading
Star evolution and the sun's layers / solar system formation, relationships between planets
Constellations

<table>
<tr><th colspan="4">COURSE NAME: 6TH GRADE ENGINEERING AND DESIGN</th></tr>
<tr><td>Developers: Anne Hagel, Diana Stratton, & Stacy Pritchett</td><td>Development Date: 2016</td><td>Instructional Level: 6th grade</td><td>Unit: Scientific Method</td></tr>
</table>

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="4">ESTABLISHED GOALS (Which Content & CCSS from multiple strands (e.g. reading, writing, language, speaking, listening & content) can be integrated?)

MS-ETS1-1 Define the criteria and constraint of design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.

MS-ETS1-2. Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.

MS-ETS1-3. Analyze data from tests to determine similarities and differences among several design solutions to identify the best</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to independently use their learning to navigate through science labs and tasks in the future through the use of the Scientific Method.</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>UNDERSTANDINGS
Students will understand that…

The more precisely a design task’s criteria and constraints can be defined, the more likely it is that the designed solution will be successful. Specification of constraints includes consideration of scientific principles and other relevant knowledge that is likely to limit possible solutions. (MS-ETS1-1) (secondary to MS-PS3-3)

A solution needs to be tested, and then modified on the basis of the test results, in order to improve it. (MS-ETS1-4) (secondary to MS-PS1-6)

There are systematic processes for evaluating solutions with respect to how well they meet criteria and constraints of a problem. (MS-ETS1-2), (MS-ETS1-3) (secondary to MS-PS3-3) (secondary to MS-LS2-5)</td><td>ESSENTIAL QUESTIONS (What open-ended, age appropriate questions will prompt exploration and creative and critical thinking?)

How do you develop an effective, repeatable experiment?</td></tr>
</table>

characteristics of each that can be combined into a new solution to better meet the criteria for success. MS-ETS1-4. Develop a model to generate data for interactive testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.	Sometimes parts of different solutions can be combined to create a solution is better than any of its predecessors. (MS-ETS1-3) Models of all kinds are important for testing solutions. (MS-ETS1-4) Although one design may not perform the best across all tests, identifying the characteristics of the design that performed the best in each test can provide useful information for the redesign process—that is, some of the characteristics may be incorporated into the new design. (MS-ETS1-3) (secondary to MS-PS1-6) The iterative process of testing the most promising solutions and modifying what is proposed on the basis of the test results leads to greater refinement and ultimately to an optimal solution. (MS-ETS1-4) (secondary to MS-PS1-6)	
	Acquisition	
	Students will KNOW… (Including Tier II and Tier III vocabulary) Vocabulary: analyze, hypothesis, conclusion, problem Students will know how to design a successful experiment to answer a specific problem.	*Students will be skilled at (DO)…* I can design a successful experiment to answer a specific problem.

	Students will know how to evaluate procedures to determine an experiment's effectiveness. Students will know how to develop a model to test solutions. Students will know how to develop an experiment that can be modified to ensure that the experiment is repeatable by others with the same results.	I can evaluate procedures to determine an experiment's effectiveness. I can develop a model to test solutions. I can develop an experiment that can be modified to ensure that the experiment is repeatable by others with the same results.

Stage 2 - Evidence

How will you monitor and/or measure evidence of student learning? How will you communicate student learning? How do students provide feedback about their learning?

Evaluative Criteria	Assessment Evidence
Design Your Own Experiment Summative Assessment	PERFORMANCE TASK(S): <type here>
<type here>	OTHER EVIDENCE: <type here>

COURSE NAME: 6TH GRADE EARTH SCIENCE

Developers: Anne Hagel, Diana Stratton & Stacy Pritchett	Development Date: 2016	Instructional Level: 6th grade	Unit: Water

Stage 1 Desired Results

<table>
<tr><td rowspan="4">ESTABLISHED GOALS (Which Content & CCSS from multiple strands (e.g. reading, writing, language, speaking, listening & content) can be integrated?)

MS-ESS2-1. Develop a model to describe the cycling of Earth’s materials and the flow of energy that drives this process.

MS-ESS2-2. Construct an explanation based on evidence for how geoscience processes have changed Earth’s surface at varying time and spatial scales.

MS-ESS2-4. Develop a model to describe the cycling of water through Earth’s systems driven by energy</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to independently use their learning to apply how the water system works and how it affects Earth’s surface.</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>UNDERSTANDINGS
Students will understand that…

Water continually cycles among land, ocean, and atmosphere via transpiration, evaporation, condensation and crystallization, and precipitation, as well as downhill flows on land. (MS-ESS2-4)

Global movements of water and its changes in form are propelled by sunlight and gravity. (MS-ESS2-4)

Water’s movements—both on the land and underground—cause weathering and erosion, which change the land’s surface features and create underground formations. (MS-ESS2-2)

Humans depend on Earth’s land, ocean, atmosphere, and biosphere for many different resources. Minerals, fresh water, and biosphere resources are limited, and many are not renewable or replaceable over human lifetimes. These resources are distributed unevenly around the planet as a result of past geologic processes. (MS-ESS3-1)</td><td>ESSENTIAL QUESTIONS (What open-ended, age appropriate questions will prompt exploration and creative and critical thinking?)
What is the water cycle and how is it powered?

How do Earth’s surfaces affect what happens to water?

How does water affect Earth’s surfaces?

How does the distribution of natural resources affect their use?</td></tr>
</table>

<table>
<tr><td rowspan="2">from the sun and the force of gravity</td><td colspan="2">Acquisition</td></tr>
<tr><td>Students will KNOW… (Including Tier II and Tier III vocabulary)

Vocabulary: evaporation, water vapor, transpiration, condensation, precipitation, crystallization, V shaped stream, U shaped stream, meandering stream, slope, erosion, groundwater, aquifer, permeable, impermeable, water table, natural resource, water conservation

Students will know how to develop a model to describe the steps of the water cycle.

Students will know how to explain how the water cycle is powered.

Students will know how to construct an explanation about the cause and effect relationships of the water on and in the earth.

Students will know how to analyze the distribution and overuse of natural resources, such as water.</td><td>Students will be skilled at (DO)…

I can develop a model to describe the steps of the water cycle.

I can explain how the water cycle is powered.

I can construct an explanation about the cause and effect relationships of the water on and in the earth.

I can analyze the distribution and overuse of natural resources, such as water.</td></tr>
<tr><td colspan="3">Stage 2 - Evidence
How will you monitor and/or measure evidence of student learning? How will you communicate student learning? How do students provide feedback about their learning?</td></tr>
<tr><td>Evaluative Criteria</td><td colspan="2">Assessment Evidence</td></tr>
<tr><td>Water Unit Summative Assessment</td><td colspan="2">PERFORMANCE TASK(S):
<type here></td></tr>
<tr><td><type here></td><td colspan="2">OTHER EVIDENCE:</td></tr>
</table>

COURSE NAME: 6TH GRADE PHYSICAL SCIENCE

Developers: Anne Hagel, Diana Stratton & Stacy Pritchett	Development Date: 2016	Instructional Level: 6th grade	Unit: Chemistry

Stage 1 Desired Results

<table>
<tr><td rowspan="4">ESTABLISHED GOALS (Which Content & CCSS from multiple strands (e.g. reading, writing, language, speaking, listening & content) can be integrated?)

MS-PS1-1. Develop models to describe the atomic composition of simple molecules and extended structures.

MS-PS1-2. Analyze and interpret data on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred.

MS-PS1-3. Gather and make sense of information to describe that synthetic materials come from natural resources and impact society.</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to independently use their learning to: analyze the characteristics of a pure substance; develop models that display atom arrangement and energy in states of matter, and how states of matter are affected by energy, temperature, pressure, and volume.</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>UNDERSTANDINGS
Students will understand that…

Each pure substance has characteristic physical and chemical properties (for any bulk quantity under given conditions) that can be used to identify it. (MS-PS1-2), (MS-PS1-3)

Gases and liquids are made of molecules or inert atoms that are moving about relative to each other. (MS-PS1-4)

In a liquid, the molecules are constantly in contact with others; in a gas, they are widely spaced except when they happen to collide. In a solid, atoms are closely spaced and may vibrate in position but do not change relative locations. (MS-PS1-4)</td><td>ESSENTIAL QUESTIONS (What open-ended, age appropriate questions will prompt exploration and creative and critical thinking?)
What are the characteristics of a pure substance?

What are the characteristics of solids (regular and crystalline), liquids, and gasses?

How do energy, temperature, pressure, and volume affect the states of matter?</td></tr>
</table>

MS-PS1-4. Develop a model that predicts and describes changes in particle motion, temperature, and state of a pure substance when thermal energy is added or removed.	Solids may be formed from molecules, or they may be extended structures with repeating subunits (e.g., crystals). (MS-PS1-1) The changes of state that occur with variations in temperature or pressure can be described and predicted using these models of matter. (MS-PS1-4)	
	Acquisition	
	Students will KNOW… (Including Tier II and Tier III vocabulary) Vocabulary: physical characteristics, chemical characteristics, substance, atoms, crystalline solids, pressure, volume, states of matter Students will know how to analyze the physical and chemical characteristics of a pure substance. Students will know how to develop models that describe the arrangement and energy of the atoms in solids, liquids and gases. Students will know how to develop a model that represents the organized structure of crystalline solids. Students will know how to develop a model that describes how energy, temperature, pressure, and volume affect the states of matter.	*Students will be skilled at (DO)…* I can analyze the physical and chemical characteristics of a pure substance. I can develop models that describe the arrangement and energy of the atoms in solids, liquids and gases. I can develop a model that represents the organized structure of crystalline solids. I can develop a model that describes how energy, temperature, pressure, and volume affect the states of matter.

Stage 2 - Evidence ***How will you monitor and/or measure evidence of student learning? How will you communicate student learning? How do students provide feedback about their learning?***	
Evaluative Criteria	**Assessment Evidence**
Chemistry Unit Assessment	PERFORMANCE TASK(S): <type here>
<type here>	OTHER EVIDENCE: <type here>

COURSE NAME: 6TH GRADE PHYSICAL SCIENCE

Developers: Anne Hagel, Diana Stratton & Stacy Pritchett	Development Date: 2016	Instructional Level: 6th grade	Unit: Waves

Stage 1 Desired Results

ESTABLISHED GOALS *(Which Content & CCSS from multiple strands (e.g. reading, writing, language, speaking, listening & content) can be integrated?)*	***Transfer***	
	Students will be able to independently use their learning to: differentiate sound and light waves; analyze sound and light wave models; develop models to describe how frequency affects color, and how light interacts with materials; and develop an argument to the use of digital signals.	
	Meaning	
MS-PS4-1 Use mathematical representations to describe a simple model for waves that includes how the amplitude of a wave is related to the energy in a wave. MS-PS4-2 Develop and use a model to describe that waves are reflected, absorbed, or transmitted through various materials. MS-PS4-3 Integrate qualitative scientific and technical information to support the claim that digitized signals are a more reliable way to encode and transmit information than analog signals.	***UNDERSTANDINGS*** *Students will understand that…* A simple wave has a repeating pattern with a specific wavelength, frequency, and amplitude. (MS-PS4-1) A sound wave needs a medium through which it is transmitted. (MS-PS4-2) However, because light can travel through space, it cannot be a matter wave, like sound or water waves. (MS-PS4-2) When light shines on an object, it is reflected, absorbed, or transmitted through the object, depending on the object's material and the frequency (color) of the light. (MS-PS4-2)	ESSENTIAL QUESTIONS *(What open-ended, age appropriate questions will prompt exploration and creative and critical thinking?)* What can be observed from a wave model? How are sound and light waves different? How can the properties of light be demonstrated using a model? What are the benefits of digital signals?

	The path that light travels can be traced as straight lines, except at surfaces between different transparent materials (e.g., air and water, air and glass) where the light path bends. (MS-PS4-2) A wave model of light is useful for explaining brightness, color, and the frequency-dependent bending of light (refraction) at a surface between media. (MS-PS4-2) Digitized signals (sent as wave pulses) are a more reliable way to encode and transmit information. (MS-PS4-3)	
	Acquisition	
	Students will KNOW… (Including Tier II and Tier III vocabulary) Vocabulary: wavelength, frequency, amplitude, transparent, translucent, opaque, reflection, refraction, digital signals Students will know that a wave model can describe the wavelength, frequency, and amplitude of a wave. Students will know the difference between sound and light waves.	*Students will be skilled at (DO)…* I can analyze a model of a wave by describing the wavelength, frequency, and amplitude. I can differentiate sound and light waves. I can develop a model to describe how the frequency of light waves affect the color.

	Students will know how to develop a model that show how the frequency of light waves affect the color. Students will know how to develop a model to describe how light interacts with different materials. Students will know how to develop a model to describe the path of light as it travels through different states of matter. Students will know how to develop a model to describe the cause and effect relationship of light as it strikes an object. Students will know how to analyze models of light waves. Students will know how to develop an argument to support the benefits of digital signals.	I can develop a model to describe how light interacts with different materials. (T, T, O) I can develop a model to describe the path of light as it travels through different states of matter. (Refraction) I can develop a model to describe the cause and effect relationship of light as it strikes an object. (Reflection) I can analyze models of light waves. I can develop an argument to support the benefits of digital signals.

Stage 2 - Evidence

How will you monitor and/or measure evidence of student learning? How will you communicate student learning? How do students provide feedback about their learning?

Evaluative Criteria	**Assessment Evidence**
Waves - Part 1 Summative Assessment Wavves - Part 2 Summative Assessment	PERFORMANCE TASK(S): <type here>
<type here>	OTHER EVIDENCE: <type here>

COURSE NAME: 6TH GRADE LIFE SCIENCE

Developers: Anne Hagel, Diana Stratton & Stacy Pritchett	Development Date: 2016	Instructional Level: 6th grade	Unit: Living Things

Stage 1 Desired Results

<table>
<tr><td rowspan="3">ESTABLISHED GOALS (Which Content & CCSS from multiple strands (e.g. reading, writing, language, speaking, listening & content) can be integrated?)

MS-LS1-1. Conduct an investigation to provide evidence that living things are made of cells; either one cell or many different numbers and types of cells.

MS-LS2-1. Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem.

MS-LS3-2. Develop and use a model to describe why asexual reproduction results in offspring with identical genetic information and sexual reproduction results in offspring with genetic variation.</td><td colspan="2">Transfer
Students will be able to independently use their learning to prove whether something is living or nonliving, describe how limiting factors affect populations, and describe the genetic results of types of reproduction.</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>UNDERSTANDINGS
Students will understand that…

All living things are made up of cells, which is the smallest unit that can be said to be alive. An organism may consist of one single cell (unicellular) or many different numbers and types of cells (multicellular). (MS-LS1-1)

Organisms, and populations of organisms, are dependent on their environmental interactions both with other living things and with nonliving factors. (MS-LS2-1)

Organisms reproduce, either sexually or asexually and transfer their genetic information to their offspring. (secondary to MS-LS3-2)</td><td>ESSENTIAL QUESTIONS (What open-ended, age appropriate questions will prompt exploration and creative and critical thinking?)
What makes something living or nonliving?

How do limiting factors affect populations?

How do different types of reproduction affect genetic results?</td></tr>
</table>

	Acquisition	
	Students will KNOW… (Including Tier II and Tier III vocabulary) Vocabulary: sexual, asexual, limiting factors, organism, genetics Students will know how to conduct an investigation to give evidence that every living thing is made of one or many cells. Students will know how to analyze and interpret data to provide evidence for the effects of limiting factors on populations in an ecosystem. Students will know how to develop and use a model to describe the genetic results of asexual and sexual reproduction.	*Students will be skilled at (DO)…* I can conduct an investigation to give evidence that every living thing is made of one or many cells. I can analyze and interpret data to provide evidence for the effects of limiting factors on populations in an ecosystem. I can develop and use a model to describe the genetic results of asexual and sexual reproduction.

Stage 2 - Evidence

How will you monitor and/or measure evidence of student learning? How will you communicate student learning? How do students provide feedback about their learning?

Evaluative Criteria	Assessment Evidence
Living Things Summative Assessment	PERFORMANCE TASK(S): <type here>
<type here>	OTHER EVIDENCE: <type here>

COURSE NAME: 6TH GRADE LIFE SCIENCE

Developers: Anne Hagel, Diana Stratton & Stacy Pritchett	Development Date: 2016	Instructional Level: 6th grade	Unit: Plants & Animals

Stage 1 Desired Results

<table>
<tr><td rowspan="5">ESTABLISHED GOALS (Which Content & CCSS from multiple strands (e.g. reading, writing, language, speaking, listening & content) can be integrated?)

MS-LS1-4. Use argument based on empirical evidence and scientific reasoning to support an explanation for how characteristic animal behaviors and specialized plant structures affect the probability of successful reproduction of animals and plants respectively.

MS-LS1-6. Construct a scientific explanation based on evidence for the role of photosynthesis in the cycling of matter and flow of energy into and out of organisms.</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to independently use their learning to understand genetic factors essential to plant and animal reproduction and photosynthesis in plants.</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>UNDERSTANDINGS
Students will understand that…

Plants reproduce in a variety of ways, sometimes depending on animal behavior and specialized features for reproduction. (MS-LS1-4)

Plants, algae (including phytoplankton), and many microorganisms use the energy from light to make sugars (food) from carbon dioxide from the atmosphere and water through the process of photosynthesis, which also releases oxygen. These sugars can be used immediately or stored for growth or later use. (MS-LS1-6)

Animals engage in characteristic behaviors that increase the odds of reproduction. (MS-LS1-4)</td><td>ESSENTIAL QUESTIONS (What open-ended, age appropriate questions will prompt exploration and creative and critical thinking?)
How do plant characteristics affect the chances of successful reproduction?

How does energy flow through a plant?

How does animal behavior increase the odds of reproduction?</td></tr>
<tr><td colspan="2">Acquisition</td></tr>
</table>

	Students will KNOW… (Including Tier II and Tier III vocabulary) Vocabulary: photosynthesis, mating behavior, sporophyte, gametophyte, moss, gymnosperm, angiosperm, ovule, spore, fertilization, zygote, sperm cell, egg cell Students will know how to give evidence to support ways plant characteristics will affect the chances of successful reproduction. Students will know how to create a diagram showing the flow of energy in a plant. Students will know how to cite evidence proving animals engage in behavior that increases the odds of reproduction.	*Students will be skilled at (DO)…* I can give evidence to support ways plant characteristics will affect the chances of successful reproduction. I can create a diagram showing the flow of energy in a plant. I can cite evidence proving animals engage in behavior that increases the odds of reproduction.

Stage 2 - Evidence

How will you monitor and/or measure evidence of student learning? How will you communicate student learning? How do students provide feedback about their learning?

Evaluative Criteria	**Assessment Evidence**
Plants and Animals Summative Assessment	PERFORMANCE TASK(S): <type here>
<type here>	OTHER EVIDENCE: <type here>

COURSE NAME: 6TH GRADE LIFE SCIENCE

Developers: Anne Hagel, Diana Stratton & Stacy Pritchett	Development Date: 2016	Instructional Level: 6th grade	Unit: Ecosystems & Adaptations

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="6">ESTABLISHED GOALS (Which Content & CCSS from multiple strands (e.g. reading, writing, language, speaking, listening & content) can be integrated?)

MS-LS4-6 Construct an explanation based on evidence that describes how genetic variations of traits in a population increase some individuals’ probability of surviving and reproducing in a specific environment.</td><th colspan="2">Transfer</th></tr>
<tr><td colspan="2">Students will be able to independently use their learning to analyze changes in species and evaluate data on how species have changed over time.</td></tr>
<tr><th colspan="2">Meaning</th></tr>
<tr><td>UNDERSTANDINGS
Students will understand that…

Adaptation by natural selection acting over generations is one important process by which species change over time in response to changes in environmental conditions. Traits that support successful survival and reproduction in the new environment become more common; those that do not become less common. Thus, the distribution of traits in a population changes. (MS-LS4-6)</td><td>ESSENTIAL QUESTIONS (What open-ended, age appropriate questions will prompt exploration and creative and critical thinking?)
What causes a species to change over time?

What can be inferred from mathematical data on how traits of a population changes over time?</td></tr>
<tr><th colspan="2">Acquisition</th></tr>
<tr><td>Students will KNOW… (Including Tier II and Tier III vocabulary)

Vocabulary: adaptations, biomes, ecosystems, natural selection, evolution, simulation, evaluate, infer, generations, mathematical representation, traits</td><td>Students will be skilled at (DO)…

I can analyze the changes and causes of those changes in a species over time.</td></tr>
</table>

<table>
<tr><td></td><td>Students will know how to analyze the changes and causes of those changes in a species over time.

Students will know how to evaluate mathematical representations and infer from that data how traits in a population change over time.</td><td>I can evaluate mathematical representations and infer from that data how traits in a population change over time.</td></tr>
<tr><td colspan="3">Stage 2 - Evidence
How will you monitor and/or measure evidence of student learning? How will you communicate student learning? How do students provide feedback about their learning?</td></tr>
<tr><td>Evaluative Criteria</td><td colspan="2">Assessment Evidence</td></tr>
<tr><td>Ecosystems and Adaptations Summative Assessment</td><td colspan="2">PERFORMANCE TASK(S):
<type here></td></tr>
<tr><td><type here></td><td colspan="2">OTHER EVIDENCE:
<type here></td></tr>
</table>

COURSE NAME: 6TH GRADE LIFE SCIENCE

Developers: Anne Hagel, Diana Stratton & Stacy Pritchett	Development Date: 2016	Instructional Level: 6th grade	Unit: Populations in Ecosystems

Stage 1 Desired Results

ESTABLISHED GOALS *(Which Content & CCSS from multiple strands (e.g. reading, writing, language, speaking, listening & content) can be integrated?)*	**Transfer**	
	Students will be able to independently use their learning to describe the effects of competition, biotic and abiotic factors, and carrying capacity on an ecosystem.	
	Meaning	
(MS-LS2-1) Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem. (MS-LS2-4) Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations.	***UNDERSTANDINGS*** *Students will understand that…* In any ecosystem, organisms and populations with similar requirements for food, water, oxygen, or other resources may compete with each other for limited resources, access to which consequently constrains their growth and reproduction. (MS-LS2-1) Ecosystems are dynamic in nature; their characteristics can vary over time. Disruptions to any physical (abiotic) or biological (biotic) component of an ecosystem can lead to shifts in all its populations. (MS-LS2-4) Growth of organisms and population increases are limited by access to resources. (MS-LS2-1)	ESSENTIAL QUESTIONS *(What open-ended, age appropriate questions will prompt exploration and creative and critical thinking?)* How do populations in ecosystems change over time? How does competition affect an ecosystem? What are the effects of biotic and abiotic factors on an ecosystem? How does carrying capacity of a population change over time?
	Acquisition	

	Students will KNOW… (Including Tier II and Tier III vocabulary) Vocabulary: population, competition, biotic, abiotic, carrying capacity, analyze, limiting factor The students will know how to describe the effects of competition on a population. The students will know how to argue and support the effect of biotic and abiotic factors on an ecosystem. The students will know how to analyze the carrying capacity of an ecosystem.	*Students will be skilled at (DO)…* I can describe the effects of competition on a population. I can argue and support the effect of biotic and abiotic factors on an ecosystem. I can analyze the carrying capacity of an ecosystem.

Stage 2 - Evidence

How will you monitor and/or measure evidence of student learning? How will you communicate student learning? How do students provide feedback about their learning?

Evaluative Criteria	**Assessment Evidence**
Populations in Ecosystems Summative Assessment	PERFORMANCE TASK(S): <type here>
<type here>	OTHER EVIDENCE: <type here>

COURSE NAME: 6TH GRADE LIFE SCIENCE

Developers: Anne Hagel, Diana Stratton & Stacy Pritchett	Development Date: 2016	Instructional Level: 6th grade	Unit: Interactions in Ecosystems

Stage 1 Desired Results

<table>
<tr><td rowspan="4">ESTABLISHED GOALS (Which Content & CCSS from multiple strands (e.g. reading, writing, language, speaking, listening & content) can be integrated?)

MS-LS2-2. Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems.

MS-LS2-3. Develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to independently use their learning to draw conclusions about populations and construct and label a model of a food web.</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>UNDERSTANDINGS
Students will understand that…

Similarly, predatory interactions may reduce the number of organisms or eliminate whole populations of organisms. Mutually beneficial interactions, in contrast, may become so interdependent that each organism requires the other for survival. Although the species involved in these competitive, predatory, and mutually beneficial interactions vary across ecosystems, the patterns of interactions of organisms with their environments, both living and nonliving, are shared. (MS-LS2-2)

Food webs are models that demonstrate how matter and energy is transferred between producers, consumers, and decomposers as the three groups interact within an ecosystem. Transfers of matter into and out of the physical environment occur at every level. Decomposers recycle nutrients from dead plant or animal matter back to the soil in</td><td>ESSENTIAL QUESTIONS (What open-ended, age appropriate questions will prompt exploration and creative and critical thinking?)
What are the patterns of interactions between organisms and their environment?

How do producers, consumers and decomposers function within a food web? (energy)</td></tr>
</table>

	terrestrial environments or to the water in aquatic environments. The atoms that make up the organisms in an ecosystem are cycled repeatedly between the living and nonliving parts of the ecosystem. (MS-LS2-3)	
	Acquisition	
	Students will KNOW… (Including Tier II and Tier III vocabulary) Vocabulary: symbiosis, mutualism, food web, predation, competition, commensalism, parasitism, niche, food chain, producer, consumer, decomposer, flow of energy The students will know how to draw conclusions about populations based on patterns of interactions between organisms and their environment. The students will know how to construct a model of a food web and identify producers, consumers and decomposers within it. (energy)	*Students will be skilled at (DO)…* I can draw conclusions about populations based on patterns of interactions between organisms and their environment. I can construct a model of a food web and identify producers, consumers and decomposers within it. (energy)

Stage 2 - Evidence

How will you monitor and/or measure evidence of student learning? How will you communicate student learning? How do students provide feedback about their learning?

Evaluative Criteria	**Assessment Evidence**
Interactions in Ecosystems Summative Assessment	PERFORMANCE TASK(S): <type here>
<type here>	OTHER EVIDENCE: <type here>

COURSE NAME: 6TH GRADE LIFE SCIENCE

Developers: Anne Hagel, Diana Stratton & Stacy Pritchett	Development Date: 2016	Instructional Level: 6th grade	Unit: Sustainable Ecosystems

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="6">ESTABLISHED GOALS (Which Content & CCSS from multiple strands (e.g. reading, writing, language, speaking, listening & content) can be integrated?)

MS-LS2-5. Evaluate competing design solutions for maintaining biodiversity and ecosystem services.</td><th colspan="2">Transfer</th></tr>
<tr><td colspan="2">Students will be able to independently use their learning to evaluate the changes in biodiversity and the impact of humans on the health of the environment</td></tr>
<tr><th colspan="2">Meaning</th></tr>
<tr><td>UNDERSTANDINGS
Students will understand that…

Changes in biodiversity can influence humans' resources, such as food, energy, and medicines, as well as ecosystem services that humans rely on—for example, water purification and recycling. (secondary to MS-LS2-5)

Biodiversity describes the variety of species found in Earth's terrestrial and oceanic ecosystems. The completeness or integrity of an ecosystem's biodiversity is often used as a measure of its health. (MS-LS2-5)</td><td>ESSENTIAL QUESTIONS (What open-ended, age appropriate questions will prompt exploration and creative and critical thinking?)
What is the human impact on ecosystems and how does that impact humans?

What are the characteristics of a healthy ecosystem?</td></tr>
<tr><th colspan="2">Acquisition</th></tr>
<tr><td>Students will KNOW… (Including Tier II and Tier III vocabulary)</td><td>Students will be skilled at (DO)…

I can evaluate the human impact on biomes and the impact of those</td></tr>
</table>

	Vocabulary: sustainability, human impact, nutrients, purification, recycling, reduce, reuse, biodiversity, invasive species, emissions, global warming The students will know how to evaluate the human impact on biomes and the impact of those changes on humans. (water purification, nutrient recycling, and prevention of soil erosion) The students will know how to evaluate the health of an ecosystem based on its completeness and use that information to predict how changes will affect the health of the ecosystem.	changes on humans. (water purification, nutrient recycling, and prevention of soil erosion) I can evaluate the health of an ecosystem based on its completeness and use that information to predict how changes will affect the health of the ecosystem.

Stage 2 - Evidence

How will you monitor and/or measure evidence of student learning? How will you communicate student learning? How do students provide feedback about their learning?

Evaluative Criteria	**Assessment Evidence**
Sustainability Summative Project	PERFORMANCE TASK(S): <type here>
<type here>	OTHER EVIDENCE: <type here>

COURSE NAME: 7TH GRADE LIFE SCIENCE

Developers: Clifford/Tande/Baumgart	Development Date: 4/26/16	Instructional Level: 7	Unit: Cell Structure and Function

Stage 1 Desired Results	
ESTABLISHED GOALS *(Which Content & CCSS from multiple strands (e.g. reading, writing, language, speaking, listening & content) can be integrated?)* **MS-LS1-1**. Conduct an investigation to provide evidence that living things are made of cells; either	***Transfer*** *Students will be able to independently use their learning to…* • Conclude that all living things are made up of cells, which is the smallest unit that can be said to be alive. (LS1-1) • Determine that organisms may consist of one single cell or many different numbers and types of cells. (LS1-1) • Model and describe the role of special structures responsible for particular functions within cells. (LS1-2) • Explain how the cell membrane controls the movement of molecules in and out to the cell. (LS1-2) ***Meaning***

one cell or many different numbers and types of cells. **MS-LS1-2**. Develop and use a model to describe the function of a cell as a whole and ways parts of cells contribute to the function.	***UNDERSTANDINGS*** *Students will understand that…* ***<u>Disciplinary Core Ideas:</u>*** **LS1.A: Structure and Function** All living things are made up of cells, which is the smallest unit that can be said to be alive. An organism may consist of one single cell (unicellular) or many different numbers and types of cells (multicellular). **LS1.A: Structure and Function** Within cells, special structures are responsible for particular functions, and the cell membrane forms the boundary that controls what enters and leaves the cell. ***<u>Science and Engineering Practices:</u>*** **Planning and Carrying Out Investigations** Conduct an investigation to produce data to serve as the basis for evidence that meet the goals of an investigation. **Developing and Using Models** Develop and use a model to describe phenomena.	ESSENTIAL QUESTIONS *(What open-ended, age appropriate questions will prompt exploration and creative and critical thinking?)* 1. How did the advancement of magnification tools lead to the discovery of cells and the creation of the Cell Theory? (LS1-1) 2. How are unicellular and multicellular organisms different? (LS1-1) 3. How do the roles of individual cell parts contribute to the overall functioning of a cell? (LS1-2) 4. How do cells control the movement of molecules in and out of the cell? (LS1-2) 5. Why are cells small? (LS1-2) 6. Why do scientists use models to study cells? (LS1-2)

	<u>Cross-Cutting Concepts:</u> **Scale, Proportion, and Quantity Phenomena** that can be observed at one scale may not be observable at another scale. **Structure and Function** Complex and microscopic structures and systems can be visualized, modeled, and used to describe how their function depends on the relationships among its parts, therefore complex natural structures/systems can be analyzed to determine how they function.	

<table>
<tr><th rowspan="2"></th><th colspan="2">Acquisition</th></tr>
<tr><td>Students will KNOW… (Including Tier II and Tier III vocabulary)

Students will…
• Conduct an investigation to provide evidence that living things are made of cells; either one cell or many different numbers and types of cells.
• Develop and use a model to describe the function of a cell as a whole and ways parts of cells contribute to the function.

Vocabulary:
• Cell
• Microscope
• Robert Hooke
• Anton van Leeuwenhoek
• Theodor Schwann
• Matthias Schleiden
• Rudolf Virchow
• Cell Theory
• Organelle
• Cell Wall
• Cell Membrane
• Nucleus
• Cytoplasm
• Mitochondria
• Endoplasmic Reticulum
• Ribosome
• Golgi Body
• Chloroplast</td><td>Students will be skilled at (DO)…

I can...
• Conduct an investigation to provide evidence that living things are made of cells; either one cell or many different numbers and types of cells.
• Develop and use a model to describe the function of a cell as a whole and ways parts of cells contribute to the function.</td></tr>
</table>

	• Vacuole • Lysosome • Prokaryotic Cell • Eukaryotic Cell • Chromosome • Selectively Permeable • Diffusion • Osmosis • Passive Transport • Active Transport	

Stage 2 - Evidence

How will you monitor and/or measure evidence of student learning? How will you communicate student learning? How do students provide feedback about their learning?

Evaluative Criteria	Assessment Evidence
<type here>	PERFORMANCE TASK(S): <type here>
<type here>	OTHER EVIDENCE: <type here>

COURSE NAME: 7TH GRADE LIFE SCIENCE

Developers: Clifford/Tande/Baumgart	Development Date: 4/26/16	Instructional Level: 7	Unit: Organization in Living Things

Stage 1 Desired Results

<table>
<tr><td rowspan="4">ESTABLISHED GOALS (Which Content & CCSS from multiple strands (e.g. reading, writing, language, speaking, listening & content) can be integrated?)

MS-LS1-3. Use argument supported by evidence for how the body is a system of interacting subsystems composed of groups of cells.</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…

• Describe the relationship between interacting subsystems in a multicellular organism, explaining that groups of cells work together to form tissues, organs, and organ systems to perform particular body functions. (MS-LS1-3)</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>UNDERSTANDINGS
Students will understand that…

<u>Disciplinary Core Ideas:</u>
LS1.A: Structure and Function
In multicellular organisms, the body is a system of multiple interacting subsystems. These subsystems are groups of cells that work together to form tissues and organs that are specialized for particular body functions.

<u>Science and Engineering Practices:</u>
Engaging in Argument from Evidence Use an oral and written argument supported by evidence to support or refute an explanation or a model for a phenomenon.

<u>Cross-Cutting Concepts:</u></td><td>ESSENTIAL QUESTIONS (What open-ended, age appropriate questions will prompt exploration and creative and critical thinking?)

1. What are the levels of organization in living things?
2. How do subsystems in a multicellular organisms work together for its survival?
3. What is the importance of homeostasis and how does it maintain balance in an organism?</td></tr>
</table>

	Systems and System Models Systems may interact with other systems; they may have sub-systems and be a part of larger complex systems. ***<u>Connections to Nature of Science:</u>*** **Science is a Human Endeavor** Scientists and engineers are guided by habits of mind such as intellectual honesty, tolerance of ambiguity, skepticism, and openness to new ideas.	
	Acquisition	

	Students will KNOW… (Including Tier II and Tier III vocabulary)
	
	Students will…
	• Use argument supported by evidence for how the body is a system of interacting subsystems composed of groups of cells.
	
	Vocabulary:
	• Cell
	• Tissue
	    ○ Epithelial Tissue
	    ○ Connective Tissue
	    ○ Muscle Tissue
	    ○ Nervous Tissue
	• Organ
	• Organ System
	• Homeostasis
	• Stress
		Students will be skilled at (DO)…
		
		I can...
		• Use argument supported by evidence for how the body is a system of interacting subsystems composed of groups of cells.

Stage 2 - Evidence *How will you monitor and/or measure evidence of student learning? How will you communicate student learning? How do students provide feedback about their learning?*	
Evaluative Criteria	**Assessment Evidence**
<type here>	PERFORMANCE TASK(S): <type here>
<type here>	OTHER EVIDENCE: <type here>

COURSE NAME: 7TH GRADE LIFE SCIENCE

Developers: Clifford/Tande/Baumgart	Development Date: 4/26/16	Instructional Level: 7	Unit: Obtaining and Releasing Energy in Organisms

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="4">ESTABLISHED GOALS
(Which Content & CCSS from multiple strands (e.g. reading, writing, language, speaking, listening & content) can be integrated?)

MS-LS1-6. Construct a scientific explanation based on evidence for the role of photosynthesis in the cycling of matter and flow of energy into and out of organisms.

MS-LS1-7. Develop a model to describe how food is rearranged through chemical reactions forming new molecules that support growth and/or release energy as this matter moves through an organism.</td><th colspan="2">Transfer</th></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…
• Describe how photosynthesis used by plants and many microorganisms to convert sunlight energy into chemical energy in the form of sugar molecules for immediate use or stored for later. (LS1-6)
• Identify the reactants and products of photosynthesis. (LS1-6)
• Examine and explain how food is broken down into simpler molecules to support growth or release of energy. (LS1-7)
• Identify the reactants and products of cellular respiration and fermentation. (LS1-7)</td></tr>
<tr><th colspan="2">Meaning</th></tr>
<tr><td>UNDERSTANDINGS
Students will understand that…

<u>Disciplinary Core Ideas:</u>
LS1.C: Organization for Matter and Energy Flow in Organisms
Plants, algae (including phytoplankton), and many microorganisms use the energy from light to make sugars (food) from carbon dioxide from the atmosphere and water through the process of photosynthesis, which also releases oxygen. These sugars can be used immediately or stored for growth or later use.
PS3.D: Energy in Chemical Processes and Everyday Life</td><td>ESSENTIAL QUESTIONS (What open-ended, age appropriate questions will prompt exploration and creative and critical thinking?)
1. How do different organisms obtain energy? (LS1-6, LS1-7)
2. How are photosynthesis, cellular respiration, and fermentation interrelated? (LS1-6, LS1-7)
3. How does human anatomy/physiology accomplish energy acquisition and release to support growth and repair? (LS1-7)</td></tr>
</table>

	The chemical reaction by which plants produce complex food molecules (sugars) requires an energy input (i.e., from sunlight) to occur. In this reaction, carbon dioxide and water combine to form carbon-based organic molecules and release oxygen. (secondary) **LS1.C: Organization for Matter and Energy Flow in Organisms** Within individual organisms, food moves through a series of chemical reactions in which it is broken down and rearranged to form new molecules, to support growth, or to release energy. **PS3.D: Energy in Chemical Processes and Everyday Life** Cellular respiration in plants and animals involve chemical reactions with oxygen that release stored energy. In these processes, complex molecules containing carbon react with oxygen to produce carbon dioxide and other materials. (secondary) ***<u>Science and Engineering Practices:</u>*** **Constructing Explanations and Designing Solutions** Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future.	4. How are photosynthesis and cellular respiration related to flow energy within organisms? (LS1-6, LS1-7) 5. What is the role of the cell and specific cell structures in obtaining and releasing energy? (LS1-7)

	Developing and Using Models Develop a model to describe unobservable mechanisms. ***<u>Connections to Nature of Science:</u>*** **Scientific Knowledge is Based on Empirical Evidence** Science knowledge is based upon logical connections between evidence and explanations. ***<u>Cross-Cutting Concepts:</u>*** **Energy and Matter** Within a natural system, the transfer of energy drives the motion and/or cycling of matter. **Energy and Matter** Matter is conserved because atoms are conserved in physical and chemical processes.	
	Acquisition	
	Students will KNOW… (Including Tier II and Tier III vocabulary) Students will… • Construct a scientific explanation based on evidence for the role of photosynthesis in the cycling of matter and flow of energy into and out of organisms. • Develop a model to describe how food is rearranged through chemical reactions forming new molecules that support	*Students will be skilled at (DO)…* I can… • Construct a scientific explanation based on evidence for the role of photosynthesis in the cycling of matter and flow of energy into and out of organisms. • Develop a model to describe how food is rearranged through chemical reactions

<table>
<tr><td></td><td>growth and/or release energy as this matter moves through an organism.

Vocabulary
Photosynthesis
Autotroph
Heterotroph
Chlorophyll
Glucose
Respiration
Fermentation
Alcoholic Fermentation
Lactic Acid Fermentation</td><td>forming new molecules that support growth and/or release energy as this matter moves through an organism.</td></tr>
<tr><td colspan="3">Stage 2 - Evidence
How will you monitor and/or measure evidence of student learning? How will you communicate student learning? How do students provide feedback about their learning?</td></tr>
<tr><td>Evaluative Criteria</td><td colspan="2">Assessment Evidence</td></tr>
<tr><td><type here></td><td colspan="2">PERFORMANCE TASK(S):
<type here></td></tr>
<tr><td><type here></td><td colspan="2">OTHER EVIDENCE:
<type here></td></tr>
</table>

COURSE NAME: 7TH GRADE LIFE SCIENCE

Developers: Clifford/Tande/Baumgart	Development Date: 4/26/16	Instructional Level: 7	Unit: Receiving and Responding to Information

Stage 1 Desired Results

<table>
<tr><td rowspan="4">ESTABLISHED GOALS (Which Content & CCSS from multiple strands (e.g. reading, writing, language, speaking, listening & content) can be integrated?)

MS-LS1-8. Gather and synthesize information that sensory receptors respond to stimuli by sending messages to the brain for immediate behavior or storage as memories.</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…
Describe the role sensory, inter-, and motor neurons play in receiving and responding to stimuli. (MS-LS1-8)
Explain how the central nervous system processes information, resulting in immediate behaviors and storage of memories. (MS-LS1-8)</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>UNDERSTANDINGS
Students will understand that…

<u>Disciplinary Core Ideas:</u>
LS1.D: Information Processing
Each sense receptor responds to different inputs (electromagnetic, mechanical, chemical), transmitting them as signals that travel along nerve cells to the brain. The signals are then processed in the brain, resulting in immediate behaviors or memories.

<u>Science and Engineering Practices:</u>
Obtaining, Evaluating, and Communicating Information
Gather, read, and synthesize information from multiple appropriate sources and assess the credibility, accuracy, and possible bias of each publication and methods used, and</td><td>ESSENTIAL QUESTIONS (What open-ended, age appropriate questions will prompt exploration and creative and critical thinking?)
How are the roles of sensor-, inter-, and motor neurons interrelated for organisms to receive and respond to stimuli?
How does the central nervous system process information, resulting in immediate behaviors and storage of memories?
What is the cause and effect relationship in an neural pathway (reaction and reflex)?</td></tr>
</table>

	describe how they are supported or not supported by evidence. ***<u>Cross-Cutting Concepts:</u>*** **Cause and Effect** Cause and effect relationships may be used to predict phenomena in natural systems.	4. What is the structure of a neuron and what kind of neurons are found in the body? 5. How do nerve impulses travel from one neuron to another? 6. What are the structures and functions of the central nervous system (CNS). 7. What are the structures and functions of the peripheral nervous system (PNS). 8. What are ways in which the nervous system can be injured, and how can we prevent that? 9. What are the different structures of our brain, and what functions do they carry out? 10. What are some specific characteristics of the teenage brain? 11. How does the endocrine system control body processes? 12. How does negative feedback control hormone levels?
	Acquisition	
	Students will KNOW… (Including Tier II and Tier III vocabulary)	*Students will be skilled at (DO)…* I can…

	Students will... • Gather and synthesize information that sensory receptors respond to stimuli by sending messages to the brain for immediate behavior or storage as memories. Vocabulary • Stimulus • Response • Neuron • Nerve Impulse • Dendrite • Axon • Nerve • Sensory Neuron • Interneuron • Motor Neuron • Synapse • Central Nervous System • Peripheral Nervous System • Somatic Nervous System • Autonomic Nervous System • Brain • Spinal Cord • Cerebrum • Cerebellum • Brain Stem • Frontal Lobe • Parietal Lobe • Occipital Lobe • Temporal Lobe	• Gather and synthesize information that sensory receptors respond to stimuli by sending messages to the brain for immediate behavior or storage as memories.

	• Cerebral Cortex • Motor Cortex • Sensory Cortex • Prefrontal Cortex • Auditory Cortex • Endocrine gland • Hormone • Target cell • Hypothalamus • Pituitary gland • Negative Feedback • Thyroid Gland • Parathyroid Gland • Thymus Gland • Pancreas • Adrenal Glands • Ovaries • Testes	

Stage 2 - Evidence

How will you monitor and/or measure evidence of student learning? How will you communicate student learning? How do students provide feedback about their learning?

Evaluative Criteria	Assessment Evidence
<type here>	PERFORMANCE TASK(S): <type here>
<type here>	OTHER EVIDENCE: <type here>

COURSE NAME: 7TH GRADE EARTH & SPACE SCIENCE

Developers: Clifford/Tande/Baumgart	*Development Date:*	*Instructional Level: 7*	*Unit: Earth and Human Activity*

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="4">ESTABLISHED GOALS
(Which Content & CCSS from multiple strands (e.g. reading, writing, language, speaking, listening & content) can be integrated?)

MS-ESS3-3. Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.

MS-ESS3-4. Construct an argument supported by evidence for how increases in human population and per capita consumption of natural resources impact Earth's systems.

MS-ESS3-5. Ask questions to clarify evidence of the factors that have caused the rise in</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…
Describe how human activities have significantly altered the biosphere, sometimes damaging or destroying natural habitats and causing the extinction of other species. (MS-ESS3-3)
Discuss how changes to Earth's environments can have different impacts (negative and positive) for different living things. (MS-ESS3-3)
Explain how as human consumption of natural resources increase, so do the negative impacts on Earth unless the activities and technologies involved are engineered otherwise. (MS-ESS3-3)(MS-ESS3-4)
Argue how human activities factor in the current rise in Earth's mean surface temperature (global warming). (MS-ESS3-5)</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>UNDERSTANDINGS
Students will understand that…

<u>Disciplinary Core Ideas:</u>
ESS3.C: Human Impacts on Earth Systems
Human activities have significantly altered the biosphere, sometimes damaging or destroying natural habitats and causing the extinction of other species. But changes to Earth's environments can have different impacts (negative and positive) for different living things.</td><td>ESSENTIAL QUESTIONS (What open-ended, age appropriate questions will prompt exploration and creative and critical thinking?)
How do human activities contribute to the changing planet terrestrial, aquatic, and atmospheric environments? (ESS3-3, ESS3-4
How can technology and engineering improve or sustain</td></tr>
</table>

global temperatures over the past century.	• Typically as human populations and per-capita consumption of natural resources increase, so do the negative impacts on Earth unless the activities and technologies involved are engineered otherwise. **ESS3.D: Global Climate Change** • Human activities, such as the release of greenhouse gases from burning fossil fuels, are major factors in the current rise in Earth's mean surface temperature (global warming). Reducing the level of climate change and reducing human vulnerability to whatever climate changes do occur depend on the understanding of climate science, engineering capabilities, and other kinds of knowledge, such as understanding of human behavior and on applying that knowledge wisely in decisions and activities. ***Science and Engineering Practices:*** **Constructing Explanations and Designing Solutions** • Apply scientific principles to design an object, tool, process or system. • Construct an oral and written argument supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem. • Ask questions to identify and clarify evidence of an argument.	natural resource management?

	Cross-Cutting Concepts: **Cause and Effect** • Relationships can be classified as causal or correlational, and correlation does not necessarily imply causation. • Cause and effect relationships may be used to predict phenomena in natural or designed systems. **Stability and Change** • Stability might be disturbed either by sudden events or gradual changes that accumulate over time. **Influence of Science, Engineering, and Technology on Society and the Natural World** • The uses of technologies and any limitations on their use are driven by individual or societal needs, desires, and values; by the findings of scientific research; and by differences in such factors as climate, natural resources, and economic conditions. Thus technology use varies from region to region and over time. • All human activity draws on natural resources and has both short and long-term consequences, positive as well as negative, for the health of people and the natural environment. **Science Addresses Questions About the Natural and Material World**	

	• Scientific knowledge can describe the consequences of actions but does not necessarily prescribe the decisions that society takes.	
	Acquisition	
	Students will KNOW… (Including Tier II and Tier III vocabulary) Students will… • Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment. • Construct an argument supported by evidence for how increases in human population and per capita consumption of natural resources impact Earth's systems. • Ask questions to clarify evidence of the factors that have caused the rise in global temperatures over the past century. Vocabulary • Ecosystem • Biosphere • Habitat • Extinction • Terrestrial • Aquatic • Atmosphere • Ozone • Renewable resources • Non-renewable resources	*Students will be skilled at (DO)…* <type here> I can… • Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment. • Construct an argument supported by evidence for how increases in human population and per capita consumption of natural resources impact Earth's systems. • Ask questions to clarify evidence of the factors that have caused the rise in global temperatures over the past century.

	• Climate • Pollution • Fossil Fuel • Greenhouse effect • Climate change • Global warming	

Stage 2 - Evidence

How will you monitor and/or measure evidence of student learning? How will you communicate student learning? How do students provide feedback about their learning?

Evaluative Criteria	**Assessment Evidence**
<type here>	PERFORMANCE TASK(S): <type here>
<type here>	OTHER EVIDENCE: <type here>

COURSE NAME: 7TH GRADE PHYSICAL SCIENCE

Developers: Clifford/Tande/Baumgart	Development Date:	Instructional Level: 7	Unit: Matter and its Interactions

Stage 1 Desired Results

<table>
<tr>
<td rowspan="3">ESTABLISHED GOALS (Which Content & CCSS from multiple strands (e.g. reading, writing, language, speaking, listening & content) can be integrated?)

MS-PS1-2. Analyze and interpret data on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred.

MS-PS1-3. Gather and make sense of information to describe that synthetic materials come from natural resources and impact society.

MS-PS1-5. Develop and use a model to describe how the total number of atoms does not change in a chemical reaction and thus mass is conserved.</td>
<td colspan="2">Transfer
Students will be able to independently use their learning to…
Identify physical and chemical properties of pure substances. (PS1-2, PS1-3)
Explain the relationship between reactants and products of a chemical reaction with respect to the conservation and rearrangement of atoms into new substances with new physical and chemical properties. (PS1-5)
Describe and test the endothermic or exothermic nature of a chemical reaction. (PS1-6)</td>
</tr>
<tr>
<td colspan="2">Meaning</td>
</tr>
<tr>
<td>UNDERSTANDINGS
Students will understand that…

<u>Disciplinary Core Ideas:</u>
PS1.A: Structure and Properties of Matter
Each pure substance has characteristic physical and chemical properties (for any bulk quantity under given conditions) that can be used to identify it.
PS1.B: Chemical Reactions
Substances react chemically in characteristic ways. In a chemical process, the atoms that make up the original substances are regrouped into different molecules, and these new substances have different properties from those of the reactants.</td>
<td>ESSENTIAL QUESTIONS (What open-ended, age appropriate questions will prompt exploration and creative and critical thinking?)

How can the physical and chemical properties be used to identify an unknown substance? (PS1-2, PS1-3))
What happens to individual atoms in a chemical reaction? (PS1-5)
What evidence supports that a chemical reaction has occurred? (PS1-5)</td>
</tr>
</table>

MS-PS1-6. Undertake a design project to construct, test, and modify a device that either releases or absorbs thermal energy by chemical processes.	***<u>Science and Engineering Practice:</u>*** • Analyze and interpret data to determine similarities and differences in findings. • Gather, read, and synthesize information from multiple appropriate sources and assess the credibility, accuracy, and possible bias of each publication and methods used, and describe how they are supported or now supported by evidence. • Develop a model to describe unobservable mechanisms • Undertake a design project, engaging in the design cycle, to construct and/or implement a solution that meets specific design criteria and constraints. ***<u>Crosscutting Concepts:</u>*** **Patterns** • Macroscopic patterns are related to the nature of microscopic and atomic level structure. **Structure and Function** • Structures can be designed to serve particular functions by taking into account properties of different materials, and how materials can be shaped and used. **Energy and Matter** • Matter is conserved because atoms are conserved in physical and chemical processes.	4. In what ways is energy involved in a chemical reaction? (PS1-6)

	• The transfer of energy can be tracked as energy flows through a designed or natural system.	
	Acquisition	
	Students will KNOW… (Including Tier II and Tier III vocabulary) Students will… • Analyze and interpret data on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred. • Gather and make sense of information to describe that synthetic materials come from natural resources and impact society. • Develop and use a model to describe how the total number of atoms does not change in a chemical reaction and thus mass is conserved. • Undertake a design project to construct, test, and modify a device that either releases or absorbs thermal energy by chemical processes. Vocabulary • Atom • Nucleus • Proton • Neutron	*Students will be skilled at (DO)…* I can… • Analyze and interpret data on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred. • Gather and make sense of information to describe that synthetic materials come from natural resources and impact society. • Develop and use a model to describe how the total number of atoms does not change in a chemical reaction and thus mass is conserved. • Undertake a design project to construct, test, and modify a device that either releases or absorbs thermal energy by chemical processes.

	• Electron • Positive charge • Negative charge • Matter • Element • Periodic Table • Atomic Number • Atomic Mass • Mass Number • Period • Group • Compound • Molecule • Chemical equation • Reactant • Product • Yields • Subscript • Coefficient • Open system • Closed system • Physical property • Chemical property • Physical change • Chemical change • Energy • Temperature • Thermal change • Endothermic change • Exothermic change • Conservation of Mass • Conservation of Energy	

Stage 2 - Evidence *How will you monitor and/or measure evidence of student learning? How will you communicate student learning? How do students provide feedback about their learning?*	
Evaluative Criteria	**Assessment Evidence**
<type here>	PERFORMANCE TASK(S): <type here>
<type here>	OTHER EVIDENCE: <type here>

COURSE NAME: 7TH GRADE PHYSICAL SCIENCE

Developers: Clifford/Tande/Baumgart	Development Date:	Instructional Level: 7	Unit: Motion and Stability: Forces and Interactions

Stage 1 Desired Results

<table>
<tr>
<td rowspan="4">ESTABLISHED GOALS (Which Content & CCSS from multiple strands (e.g. reading, writing, language, speaking, listening & content) can be integrated?)

MS-PS2-1. Apply Newton’s Third Law to design a solution to a problem involving the motion of two colliding objects.

MS-PS2-2. Plan an investigation to provide evidence that the change in an object’s motion depends on the sum of the forces on the object and the mass of the object.</td>
<td colspan="2">Transfer</td>
</tr>
<tr>
<td colspan="2">Students will be able to independently use their learning to…
• solve a problem involving a collision of two objects by designing a solution that includes components within the system involved in the collision, forces exerted within the collision, how Newton’s 3rd Law can be applied to design a solution, and technologies that will be used in the solution. (MS-PS2-1)
• identify the phenomenon under investigation, including the change in motion of an object providing evidence that the change in an object’s motion is due to balanced or unbalanced forces acting on the object, or the mass of the object. (MS-PS2-2)</td>
</tr>
<tr>
<td colspan="2">Meaning</td>
</tr>
<tr>
<td>UNDERSTANDINGS
Students will understand that…
<u>Disciplinary Core Ideas:</u>
• For any pair of interacting objects, the force exerted by the first object on the second object is equal in strength to the force that the second object exerts on the first, but in the opposite direction (Newton’s third law).
• The motion of an object is determined by the sum of the forces acting on it; if the total force on the object is not zero, its motion will change. The greater the mass of the object, the greater the force needed to achieve the same change in motion.</td>
<td>ESSENTIAL QUESTIONS (What open-ended, age appropriate questions will prompt exploration and creative and critical thinking?)

1. When is an object said to be in motion? (PS2-2)
2. How to forces interact to change an object’s motion? (PS2-1, PS2-2)
3. What characteristics of an object determine its tendency to change its current state of motion? (PS2-2)</td>
</tr>
</table>

	For any given object, a larger force causes a larger change in motion. • All positions of objects and the directions of forces and motions must be described in an arbitrarily chosen reference frame and arbitrarily chosen units of size. In order to share information with other people, these choices must also be shared. ***<u>Science and Engineering Practice:</u>*** • Apply scientific ideas or principles to design an object, tool, process or System. • Plan an investigation individually and collaboratively, and in the design: identify independent and dependent variables and controls, what tools are needed to do the gathering, how measurements will be recorded, and how many data are needed to support a claim. ***<u>Crosscutting Concepts:</u>*** **Systems and System Models** • Models can be used to represent systems and their interactions—such as inputs, processes and outputs—and energy and matter flows within systems. **Stability and Change** • Explanations of stability and change in natural or	

	designed systems can be constructed by examining the changes over time and forces at different scales.	
	Acquisition	
	Students will KNOW… (Including Tier II and Tier III vocabulary) **Students will…** • Apply Newton's Third Law to design a solution to a problem involving the motion of two colliding objects. • Plan an investigation to provide evidence that the change in an object's motion depends on the sum of the forces on the object and the mass of the object. **Vocabulary** • Motion • Reference point • Speed • Instantaneous speed • Velocity • Acceleration • Force • Newton • Net Force • Unbalanced forces • Balanced forces • Friction ○ Static friction	*Students will be skilled at (DO)…* **I can…** • Apply Newton's Third Law to design a solution to a problem involving the motion of two colliding objects. • Plan an investigation to provide evidence that the change in an object's motion depends on the sum of the forces on the object and the mass of the object.

	- Sliding friction - Rolling friction - Fluid friction - Gravity - Mass - Weight - Free Fall - Air resistance - Terminal velocity - Projectile - Newton's First Law - Inertia - Newton's Second Law - Newton's Third Law - Momentum - Law of Conservation of Momentum - Pressure - Pascal - Fluid - Barometer - Buoyant force - Archimedes' principle - Density - Pascal's principle - Hydraulic system - Bernoulli's principle - Lift	

Stage 2 - Evidence *How will you monitor and/or measure evidence of student learning? How will you communicate student learning? How do students provide feedback about their learning?*	
Evaluative Criteria	**Assessment Evidence**
<type here>	PERFORMANCE TASK(S): <type here>
<type here>	OTHER EVIDENCE: <type here>

<table>
<tr><td colspan="4">COURSE NAME: 7TH GRADE PHYSICAL SCIENCE</td></tr>
<tr><td>Developers:
Clifford/Tande/Baumgart</td><td>Development Date:</td><td>Instructional Level: 7</td><td>Unit: Energy</td></tr>
<tr><td colspan="4">Stage 1 Desired Results</td></tr>
<tr><td rowspan="3">ESTABLISHED GOALS (Which Content & CCSS from multiple strands (e.g. reading, writing, language, speaking, listening & content) can be integrated?)

MS-PS3-1. Construct and interpret graphical displays of data to describe the relationships of kinetic energy to the mass of an object and to the speed of an object.

MS-PS3-2. Develop a model to describe that when the arrangement of objects interacting at a distance changes, different amounts of potential energy are stored in the system.

MS-PS3-3. Apply scientific principles to design, construct, and test a device that either minimizes or maximizes thermal energy transfer.

MS-PS3-4. Plan an investigation to determine the relationships among the energy transferred, the type of matter, the mass, and the change in the</td><td colspan="3">Transfer
Students will be able to independently use their learning to…
Differentiate between kinetic and potential energy related to the mass, movement, and position of matter. (PS3-1)
Calculate the kinetic and potential energy of interacting objects. (PS3-2)
Describe thermal energy and minimizing/maximizing the transfer of thermal energy. (PS3-3)
Explain how the motion of particles of a substance changes as thermal energy is either added or taken away. (PS1-4)
Explain how energy is conserved between two interacting objects. (PS3-5)</td></tr>
<tr><td colspan="3">Meaning</td></tr>
<tr><td colspan="2">UNDERSTANDINGS
Students will understand that…

<u>Disciplinary Core Ideas:</u>
PS3.A: Definitions of Energy
Motion energy is properly called kinetic energy; it is proportional to the mass of the moving object and grows with the square of its speed.
A system of objects may also contain stored (potential) energy, depending on their relative positions.</td><td>ESSENTIAL QUESTIONS (What open-ended, age appropriate questions will prompt exploration and creative and critical thinking?)
When is work done on an object? (PS3-1)
How do you determine the work done on an object?
What is power? (PS3-1)
How are energy, work, and power related? (PS3-1)</td></tr>
</table>

average kinetic energy of the particles as measured by the temperature of the sample. **MS-PS1-4.** Develop a model that predicts and describes changes in particle motion, temperature, and state of a pure substance when thermal energy is added or removed. **MS-PS3-5.** Construct, use, and present arguments to support the claim that when the kinetic energy of an object changes, energy is transferred to or from the object.	• Temperature is a measure of the average kinetic energy of particles of matter. The relationship between the temperature and the total energy of a system depends on the types, states, and amounts of matter present. **PS3.C**: Relationship Between Energy and Forces • When two objects interact, each one exerts a force on the other that can cause energy to be transferred to or from the object. **PS3.B**: Conservation of Energy and Energy Transfer • Energy is spontaneously transferred out of hotter regions or objects and into colder ones **PS1.A:** Structures and Properties of Matter • Gases and liquids are made of molecules or inert atoms that are moving about relative to each other. • In a liquid, the molecules are constantly in contact with others; in a gas, they are widely spaced except when they happen to collide. In a solid, atoms are closely spaced and	5. What are the two basic kinds of energy? (PS3-1) 6. How can you determine an object's mechanical energy? (PS3-2) 7. What are some forms of energy associated with the particles that make up objects? (PS1-4) 8. How are different forms of energy related? (PS3-4) 9. What is a common energy transformation? (PS3-5) 10. What is the law of conservation of energy? (PS3-5) 11. What are the three common temperature scales? (PS3-4) 12. How is thermal energy related to temperature and heat? (PS3-4) 13. What does having a high specific heat mean? (PS3-4)

	may vibrate in position but do not change relative locations. • The changes of state that occur with variations in temperature or pressure can be described and predicted using these models of matter. ***Science and Engineering Practice:*** • Construct and interpret graphical displays of data to identify linear and nonlinear relationships. • Develop a model to describe unobservable mechanisms • Apply scientific ideas or principles to design, construct, and test a design of an object, tool, process or system. • Plan an investigation individually and collaboratively, and in the design: identify independent and dependent variables and controls, what tools are needed to do the gathering, how measurements will be recorded, and how many data are needed to support a claim. • Science knowledge is based upon logical and conceptual	

	connections between evidence and explanations • Construct, use, and present oral and written arguments supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon. • Science knowledge is based upon logical and conceptual connections between evidence and explanations • ***Crosscutting Concepts:*** • Proportional relationships (e.g. speed as the ratio of distance traveled to time taken) among different types of quantities provide information about the magnitude of properties and processes • Models can be used to represent systems and their interactions – such as inputs, processes, and outputs – and energy and matter flows within systems. • The transfer of energy can be tracked as energy flows through a designed or natural system.	

	• Proportional relationships (e.g. speed as the ratio of distance traveled to time taken) among different types of quantities provide information about the magnitude of properties and processes. • Energy may take different forms (e.g. energy in fields, thermal energy, energy of motion). •	
	Acquisition	
	Students will KNOW… (Including Tier II and Tier III vocabulary) **Students will…** • Construct and interpret graphical displays of data to describe the relationships of kinetic energy to the mass of an object and to the speed of an object. • Develop a model to describe that when the arrangement of objects interacting at a distance changes, different amounts of potential energy are stored in the system. • Apply scientific principles to design, construct, and test a	*Students will be skilled at (DO)…* **I can…** • Construct and interpret graphical displays of data to describe the relationships of kinetic energy to the mass of an object and to the speed of an object. • Develop a model to describe that when the arrangement of objects interacting at a distance changes, different amounts of potential energy are stored in the system. • Apply scientific principles to design, construct, and test a device that either minimizes

	device that either minimizes or maximizes thermal energy transfer. • Plan an investigation to determine the relationships among the energy transferred, the type of matter, the mass, and the change in the average kinetic energy of the particles as measured by the temperature of the sample. • Develop a model that predicts and describes changes in particle motion, temperature, and state of a pure substance when thermal energy is added or removed. • Construct, use, and present arguments to support the claim that when the kinetic energy of an object changes, energy is transferred to or from the object. Vocabulary: • Work • Joule • Power • Energy • Watt • Kinetic energy	or maximizes thermal energy transfer. • Plan an investigation to determine the relationships among the energy transferred, the type of matter, the mass, and the change in the average kinetic energy of the particles as measured by the temperature of the sample. • Develop a model that predicts and describes changes in particle motion, temperature, and state of a pure substance when thermal energy is added or removed. • Construct, use, and present arguments to support the claim that when the kinetic energy of an object changes, energy is transferred to or from the object.

	• Potential energy • Gravitational potential energy • Elastic potential energy • Mechanical energy • Thermal energy • Electrical energy • Chemical energy • Nuclear energy • Electromagnetic energy • Energy transformation • Law of Conservation of Energy	

Stage 2 - Evidence

How will you monitor and/or measure evidence of student learning? How will you communicate student learning? How do students provide feedback about their learning?

Evaluative Criteria	**Assessment Evidence**
<type here>	PERFORMANCE TASK(S): <type here>
<type here>	OTHER EVIDENCE: <type here>

COURSE NAME: 7TH GRADE ENGINEERING & TECHNOLOGY

Developers: Clifford/Tande/Baumgart	*Development Date: 4/27/16*	*Instructional Level: 7th*	*Unit: Embedded*

Stage 1 Desired Results

ESTABLISHED GOALS	***Transfer***
MS-ETS1-1. Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions. **MS-ETS1-2.** Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem. **MS-ETS1-3.** Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new	*Students will be able to independently use their learning to…* • The more precisely a design task's criteria and constraints can be defined, the more likely it is that the designed solution will be successful. Specification of constraints includes consideration of scientific principles and other relevant knowledge that is likely to limit possible solutions. (MS-ETS1-1) (secondary to MS-PS3-3) • A solution needs to be tested, and then modified on the basis of the test results, in order to improve it. (MS-ETS1-4) (secondary to MS-PS1-6) • There are systematic processes for evaluating solutions with respect to how well they meet criteria and constraints of a problem. MS-ETS1-2), (MS-ETS1-3) (secondary to MS-PS3-3) (secondary to MS-LS2-5) • Sometimes parts of different solutions can be combined to create a solution that is better than any of its predecessors. (MS-ETS1-3) • Models of all kinds are important for testing solutions. (MS-ETS1-4) • Although one design may not perform the best across all tests, identifying the characteristics of the design that performed the best in each test can provide useful information for the redesign process—that is, some of the characteristics may be incorporated into the new design. (MS-ETS1-3 (secondary to MS-PS1-6) • The iterative process of testing the most promising solutions and modifying what is proposed on the basis of the test results leads to greater refinement and ultimately to an optimal solution. (MS-ETS1-4) (secondary to MS-PS1-6)

<table>
<tr>
<td rowspan="3">solution to better meet the criteria for success.

MS-ETS1-4. Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.</td>
<td colspan="2"></td>
</tr>
<tr>
<td colspan="2">Meaning</td>
</tr>
<tr>
<td>UNDERSTANDINGS
• The more precisely a design task’s criteria and constraints can be defined, the more likely it is that the designed solution will be successful. Specification of constraints includes consideration of scientific principles and other relevant knowledge that are likely to limit possible solutions. (MS-ETS1-1)

ETS1.B: Developing Possible Solutions

• A solution needs to be tested, and then modified on the basis of the test results in order to improve it. (MS-ETS1-4)
• There are systematic processes for evaluating solutions with respect to how well they meet criteria and constraints of a problem. MS-ETS1-2), (MS-ETS1-3) (secondary to MS-PS3-3) (secondary to MS-LS2-5)
• Sometimes parts of different solutions can be combined to create a solution that is better than</td>
<td>ESSENTIAL QUESTIONS

1. Use background and prior knowledge of concepts and understand new scientific principles to design improved solutions for engineering problems.
2. Demonstrate understanding of a solution by retesting and modifying a model to make it better.
3. Explain how to evaluate solutions systematically with respect to how they meet criteria and constraints.
4. Why would you combine different outcomes?
5. What is the importance of different kinds of models when testing solutions?
6. Recognize and identify the characteristics from various designs that will, when incorporated into one design, perform the best across all tests.
7. Perform multiple tests and modify the procedure/model to</td>
</tr>
</table>

<table>
<tr>
<td rowspan="3"></td>
<td>any of its predecessors. (MS-ETS1-3)
• Models of all kinds are important for testing solutions. (MS-ETS1-4)

ETS1.C: Optimizing the Design Solution

• Although one design may not perform the best across all tests, identifying the characteristics of the design that performed the best in each test can provide useful information for the redesign process - that is, some of the characteristics may be incorporated into the new design. (MS-ETS1-3)
• The iterative process of testing the most promising solutions and modifying what is proposed on the basis of the test results leads to greater refinement and ultimately to an optimal solution. (MS-ETS1-4)</td>
<td>refine and achieve optimal solution.</td>
</tr>
<tr>
<td colspan="2">Acquisition</td>
</tr>
<tr>
<td>Students will…

• define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account</td>
<td>Students will be skilled at (DO)…

I can...
• define the criteria and constraints of a design problem with sufficient precision to ensure a</td>
</tr>
</table>

	relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions. • evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem. • analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success. • develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved. **Vocabulary** • Criteria • Constraints • Precision • Relevant • Principles • Impacts • Models • Economic	successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions. • evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem. • analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success. • develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.

	• Refutes • Convincing • Quantitative • Correlation • Causation • Statistical • Phenomenon • Interactive • Predecessors	

Stage 2 - Evidence

How will you monitor and/or measure evidence of student learning? How will you communicate student learning? How do students provide feedback about their learning?

Evaluative Criteria	Assessment Evidence
<type here>	PERFORMANCE TASK(S): <type here> If we already have an existing assessment link it here.
<type here>	OTHER EVIDENCE: <type here>

COURSE NAME: 8TH GRADE PHYSICAL SCIENCE

Developers: Kang Lor, Cindy Baer, Steve Mally	*Development Date: 4/27/16*	*Instructional Level: 8th*	*Units: Chemistry/Electricity/Magnetism*

Stage 1 Desired Results

<table>
<tr><td rowspan="4">ESTABLISHED GOALS
Chemistry:
Develop models to describe the atomic composition of simple molecules and extended structures. MS-PS1-1

Analyze and interpret data on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred. MS-PS1-2

Gather and make sense of information to describe that synthetic materials come from natural resources and impact society. MS-PS1-3

Develop and use a model to describe how the total number of atoms does not change in a chemical reaction and thus</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…
Understand that substances are made from different types of atoms, which combine with one another in various ways.
Know that substances react chemically in characteristic ways.
Realize that the mass of atoms do not change.
Recognize that some types of chemical reactions release energy, others store energy.
Understand the relationship between electric and magnetic (electromagnetic) forces.
Explain the relationships that exist between electric and magnetic force fields over distance.</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>UNDERSTANDINGS
Students will understand that…

<u>PS1.A: Structure and Properties of Matter</u>
<u>Substances are made from different types of atoms, which combine with one another in various ways. Atoms form molecules that range in size from two to thousands of atoms.</u> <u>(MS-PS1-1)</u></td><td>ESSENTIAL QUESTIONS

How can a model be used to explain how two elements differ and show the distances that exist between parts of the atom?

How can chemical and physical properties be used to identify an element?</td></tr>
</table>

mass is conserved. MS-PS1-5 Undertake a design project to construct, test, and modify a device that either releases or absorbs thermal energy by chemical processes. * MS-PS1-6 (*The performance expectations marked with an asterisk integrate traditional science content with engineering through a Practice or Disciplinary Core Idea.)	PS1.B: Chemical Reactions • Substances react chemically in characteristic ways. In a chemical process, the atoms that make up the original substances are regrouped into different molecules, and these new substances have different properties from those of the reactants. (MS-PS1-3) *(Note: This Disciplinary Core Idea is also addressed by MS-PS1-2.)* • The total number of each type of atom is conserved, and thus the mass does not change. (MS-PS1-5) • Some chemical reactions release energy, others store energy. (MS-PS1-6) **PS2.B: Types of Interactions** • Electric and magnetic (electromagnetic) forces can be attractive or repulsive, and their sizes depend on the magnitudes of the charges, currents, or magnetic strengths involved and on the distances between the interacting objects. (MS-PS2-3) • Forces that act at a distance (electric, magnetic, and gravitational) can be explained by fields that extend through space and can be mapped by their effect on a test object (a	When molecules combine, why do they have different structural designs and change properties? When atoms change state, does the thermal energy level change? How can a lab be designed to show endothermic and/or exothermic chemical reactions? How do electric and magnetic forces interact to allow a motor and/or generator to work?

	charged object, or a ball, respectively). (MS-PS2-5)	What is the relationship between electromagnetic forces and the interacting distances between them?
	Acquisition	
	Students will KNOW… (Including Tier II and Tier III vocabulary) Students will... -develop models to describe the atomic composition of simple molecules and extended structures. -analyze and interpret data on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred. -gather and make sense of information to describe that synthetic materials come from natural resources and impact society. -develop and use a model to describe how the total number of atoms does not change in a chemical reaction and thus mass is conserved. -undertake a design project to construct, test, and modify a device that either releases or absorbs thermal energy by chemical processes. -ask questions about data to determine the factors that affect the strength of electric and magnetic forces. -conduct an investigation and evaluate the experimental design to provide	*Students will be skilled at (DO)…* I can... -develop models to describe the atomic composition of simple molecules and extended structures. -analyze and interpret data on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred. -gather and make sense of information to describe that synthetic materials come from natural resources and impact society. -develop and use a model to describe how the total number of atoms does not change in a chemical reaction and thus mass is conserved. -undertake a design project to construct, test, and modify a device that either releases or absorbs thermal energy by chemical processes. -ask questions about data to determine the factors that affect the strength of electric and magnetic forces.

Electricity and Magnetism: Ask questions about data to determine the factors that affect the strength of electric and magnetic forces. MS-PS2-3 Conduct an investigation and evaluate the experimental design to provide evidence that fields exist between objects exerting forces on each other even though the objects are not in contact. MS-PS2-5	evidence that fields exist between objects exerting forces on each other even though the objects are not in contact. Vocabulary: Composition Molecules Chemical Reactions Endothermic Exothermic Substance Reactants Inert Collide Vibrate Variation Yields Interactions Output Input Variables Phenomena Thermal Proportional Interactions State of Matter Electromagnet Energy	-conduct an investigation and evaluate the experimental design to provide evidence that fields exist between objects exerting forces on each other even though the objects are not in contact.

Stage 2 - Evidence *How will you monitor and/or measure evidence of student learning? How will you communicate student learning? How do students provide feedback about their learning?*	
Evaluative Criteria	**Assessment Evidence**
<type here>	PERFORMANCE TASK(S): <type here> If we already have an existing assessment link it here.
<type here>	OTHER EVIDENCE: <type here>

COURSE NAME: 8TH GRADE LIFE SCIENCE

Developers: Kang Lor, Cindy Baer, Steve Mally	Development Date: 4/27/16	Instructional Level: 8th	Unit: Genetics Unit / Unity and Diversity Unit, Natural Selection Unit

Stage 1 Desired Results

ESTABLISHED GOALS	***Transfer***
Genetics: Develop and use a model to describe why asexual reproduction results in offspring with identical genetic information and sexual reproduction results in offspring with genetic variation. MS-LS3-2 Construct a scientific explanation based on evidence for how environmental and genetic factors influence the growth of organisms. MS-LS1-5 Develop and use a model to describe why structural changes to genes (mutations) located on chromosomes may affect proteins and may result in harmful, beneficial, or neutral effects to the structure and function of the organism. MS-LS3-1	*Students will be able to independently use their learning to…* • Understand that organisms reproduce, either sexually or asexually, and transfer their genetic information to their offspring. (secondary to MS-LS3-2) • **Explain how genetic factors as well as local conditions affect the growth of the adult plant. (MS-LS1-5)** • Demonstrate that genes are located in the chromosomes of cells, genes control the production of specific proteins, which in turn affects the traits of the individual, and changes can cause mutations. (MS-LS3-1) • Know that variations of inherited traits between parent and offspring arise from genetic differences that result from inherited traits. (MS-LS3-2) • Explain how in sexually reproducing organisms, each parent contributes half of the gene randomly to the offspring. • Realize that individuals have homozygous and/or heterozygous traits. (MS-LS3-2) • Summarize how variations from sexual reproduction genetic information can be altered because of mutations and mutations may be beneficial, harmful, and/or neutral to the organism. (MS-LS3-1) • **Understand fossil record and how to determine the existence, diversity, extinction, and change of many life forms throughout the history of life on Earth. (MS-LS4-1)** • **Analyze anatomical similarities and differences between various organisms living today and organisms in the fossil record to hypothesize the evolutionary history and the inference of lines of evolutionary descent. (MS-LS4-2)**

<table>
<tr>
<td rowspan="3">Biological Evolution:

Analyze and interpret data for patterns in the fossil record that document the existence, diversity, extinction, and change of life forms throughout the history of life on Earth under the assumption that natural laws operate today as in the past.MS-LS4-1

Apply scientific ideas to construct an explanation for the anatomical similarities and differences among modern organisms and between modern and fossil organisms to infer evolutionary relationships. MS-LS4-2

Analyze displays of pictorial data to compare patterns of similarities in the embryological development across multiple species to identify relationships not evident in the fully formed anatomy. MS-LS4-3

Construct an explanation based on evidence that describes how</td>
<td colspan="2">• Recognize the embryological development of different species that reveals similarities that show relationships not evident in the fully-formed anatomy. (MS-LS4-3)
• Explain how natural selection leads to the predominance of certain traits in a population, and the suppression of others. (MS-LS4-4)
• Show how in artificial selection, humans have the capacity to influence certain characteristics of organisms by selective breeding and how one can choose desired parental traits determined by genes, which are then passed onto offspring. (MS-LS4-5)</td>
</tr>
<tr>
<td colspan="2">Meaning</td>
</tr>
<tr>
<td>UNDERSTANDINGS
Students will understand that…

• Organisms reproduce, either sexually or asexually, and transfer their genetic information to their offspring. (secondary to MS-LS3-2)
• Genetic factors as well as local conditions affect the growth of the adult plant. (MS-LS1-5)
• Genes are located in the chromosomes of cells, with each chromosome pair containing two variants of each of many distinct genes. Each distinct gene chiefly controls the production of specific proteins, which in turn affects the traits of the individual. Changes (mutations) to genes can result in changes to proteins, which can affect the structures and functions of the organism and thereby change traits. (MS-LS3-1)</td>
<td>ESSENTIAL QUESTIONS

How do organisms transfer their genetic information to their offspring?

How does the environment combined with its DNA affect a plant's growth?

How do changes in proteins caused by mutation affect the structure and function of an organism?</td>
</tr>
</table>

genetic variations of traits in a population increase some individuals' probability of surviving and reproducing in a specific environment. MS-LS4-4 Gather and synthesize information about the technologies that have changed the way humans influence the inheritance of desired traits in organisms. MS-LS4-5	• Variations of inherited traits between parent and offspring arise from genetic differences that result from the subset of chromosomes (and therefore genes) inherited. (MS-LS3-2) • In sexually reproducing organisms, each parent contributes half of the genes acquired (at random) by the offspring. • Individuals have two of each chromosome and hence two alleles of each gene, one acquired from each parent. These versions may be identical or may differ from each other. (MS-LS3-2) • **The collection of fossils and their placement in chronological order (e.g., through the location of the sedimentary layers in which they are found or through radioactive dating) is known as the fossil record. It documents the existence, diversity, extinction, and change of many life forms throughout the history of life on Earth. (MS-LS4-1)** • **Anatomical similarities and differences between various organisms living today and between them and organisms in the fossil record, enable the deconstruction of evolutionary history and the inference of lines of evolutionary descent. (MS-LS4-2)**	Why are there differences between the traits of parents and offspring? How do genes combine in sexual reproduction to produce offspring? Explain how alleles of offsprings differ from their parents. What life form information can be gained through the fossil record?

	• **Comparison of the embryological development of different species also reveals similarities that show relationships not evident in the fully-formed anatomy. (MS-LS4-3)** • **Natural selection leads to the predominance of certain traits in a population, and the suppression of others. (MS-LS4-4)** • **In artificial selection, humans have the capacity to influence certain characteristics of organisms by selective breeding. One can choose desired parental traits determined by genes, which are then passed onto offspring. (MS-LS4-5)**	Why is it important to examine the evolutionary history of fossils and present day organisms to understand evolutionary descents? Do anatomical similarities of different species of embryos result in the same or different features in the adult forms? How does an organism's environment support or prevent an organism's trait from being expressed? How is artificial selection used to influence certain traits in organisms?

	Acquisition	
	Students will KNOW… ...construct a scientific explanation based on evidence for how environmental & genetic factors influence the growth of organisms. ...develop and use a model to describe why structural changes to genes (mutations) located on chromosomes may affect proteins and may result in harmful, beneficial, or neutral effects to the structure and function of the organism. ...develop and use a model to describe why asexual reproduction results in offspring with identical genetic information and sexual reproduction results in offspring with genetic variation. ...analyze and interpret data for patterns in the fossil record that document the existence, diversity, extinction, and change of life forms throughout the history of life on Earth under the assumption that natural laws operate today as in the past. ...apply scientific ideas to construct an explanation for the anatomical similarities and differences among modern organisms and between modern and fossil organisms to infer evolutionary relationships. ...analyze displays of pictorial data to compare patterns of similarities in the embryological development across	*Students will be skilled at (DO)…* I can... -construct a scientific explanation based on evidence for how environmental & genetic factors influence the growth of organisms. -develop and use a model to describe why structural changes to genes (mutations) located on chromosomes may affect proteins and may result in harmful, beneficial, or neutral effects to the structure and function of the organism. -develop and use a model to describe why asexual reproduction results in offspring with identical genetic information and sexual reproduction results in offspring with genetic variation. -analyze and interpret data for patterns in the fossil record that document the existence, diversity, extinction, and change of life forms throughout the history of life on Earth under the assumption that natural laws operate today as in the past. -apply scientific ideas to construct an explanation for the

	multiple species to identify relationships not evident in the fully formed anatomy. ...construct an explanation based on evidence that describes how genetic variations of traits in a population increase some individuals' probability of surviving and reproducing in a specific environment. ...gather and synthesize information about the technologies that have changed the way humans influence the inheritance of desired traits in organisms. Vocabulary: Chromosome Variations Inherited Genetic Environmental Homozygous Heterozygous Hybrid Purebred Mutations Existence Diversity Extinction Anatomical Descent Embryological Predominance Suppression	anatomical similarities and differences among modern organisms and between modern and fossil organisms to infer evolutionary relationships. -analyze displays of pictorial data to compare patterns of similarities in the embryological development across multiple species to identify relationships not evident in the fully formed anatomy. -construct an explanation based on evidence that describes how genetic variations of traits in a population increase some individuals' probability of surviving and reproducing in a specific environment. -gather and synthesize information about the technologies that have changed the way humans influence the inheritance of desired traits in organisms.

<table>
<tr><td></td><td>Selective Breeding
Proteins
Alleles
Punnett Square
Probability
Chronological
Sedimentary
Fossil Record
Deconstruction
Inference
Artificial Selection</td><td></td></tr>
<tr><td colspan="3">Stage 2 - Evidence
How will you monitor and/or measure evidence of student learning? How will you communicate student learning? How do students provide feedback about their learning?</td></tr>
<tr><td>Evaluative Criteria</td><td colspan="2">Assessment Evidence</td></tr>
<tr><td><type here></td><td colspan="2">PERFORMANCE TASK(S):
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<tr><td><type here></td><td colspan="2">OTHER EVIDENCE:
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COURSE NAME: 8TH GRADE PHYSICAL EARTH AND SPACE SCIENCE

Developers: Kang Lor, Cindy Baer, Steve Mally	Development Date: 4/27/16	Instructional Level: 8th	Unit: Earth Science Unit Space Science Unit

Stage 1 Desired Results	
ESTABLISHED GOALS Earth's place in the Universe Develop and use a model of the Earth-sun-moon system to describe the cyclic patterns of lunar phases, eclipses of the sun and moon, and seasons. ESS-MS1-1 Develop and use a model to describe the role of gravity in the motions within galaxies and the solar system. ESS-MS1-2 Analyze and interpret data to determine scale properties of objects in the solar system. ESS-MS1-3 Construct a scientific explanation based on evidence from rock strata for how the geologic time scale is used to	***Transfer*** *Students will be able to independently use their learning to…* • Use models to demonstrate patterns, observations, predictions of the apparent motion of the sun, the moon, and stars in the sky. (MS-ESS1-1) • Understand that Earth and its solar system are part of the Milky Way galaxy, which is one of many galaxies in the universe. (MS-ESS1-2) • Discern that the solar system consists of the sun and a collection of objects, including planets, their moons, and asteroids that are held in orbit around the sun by its gravitational pull on them. (MS-ESS1-2),(MS-ESS1-3) • Model and explain eclipses of the sun and the moon and how the Earth's spin axis is fixed in direction over the short-term but tilted relative to its orbit around the sun determines seasons. (MS-ESS1-1) • Demonstrate that the solar system appears to have formed from a disk of dust and gas, drawn together by gravity. (MS-ESS1-2) • **Know the geologic time scale interpreted from rock strata provides a relative way to organize Earth's history. (MS-ESS1-4)** • Defend how tectonic processes continually generate new ocean sea floor at ridges and destroy old sea floor at trenches. (HS.ESS1.C GBE) (secondary to MS-ESS2-3) • **Understand all Earth processes are the result of energy flowing and matter cycling within and among the planet's systems. This energy is derived from the sun and Earth's hot interior which produce chemical and physical changes on Earth's material and living organisms. (MS-ESS2-1)** • **Recognize the planet's systems interact over scales that range from microscopic to global in size, and they operate over fractions of a second**

organize Earth's 4.6-billion-year-old history. ESS-MS1-4 Earth's Systems Develop a model to describe the cycling of Earth's materials and the flow of energy that drives this process. MS-ESS2-1 Construct an explanation based on evidence for how geoscience processes have changed Earth's surface at varying time and spatial scales. MS-ESS2-2 Analyze and interpret data on the distribution of fossils and rocks, continental shapes, and seafloor structures to provide evidence of the past plate motions. MS-ESS2-3	**to billions of years which have shaped Earth's history and will determine its future. (MS-ESS2-2)** • Show how maps of ancient land and water patterns, based on investigations of rocks and fossils, make clear how Earth's plates have moved great distances, collided, and spread apart. (MS-ESS2-3) • Demonstrate the use of transpiration, evaporation, condensation and crystallization, and precipitation, as well as downhill flows on land in relation to how water continually cycles among land, ocean, and atmosphere. (MS-ESS2-4) • **Explain how global movements of water and its changes in form are propelled by sunlight and gravity. (MS-ESS2-4)** • **Understand variations in density due to variations in temperature and salinity drive a global pattern of interconnected ocean currents. (MS-ESS2-6)** • Know weather and climate are influenced by interactions involving sunlight, the ocean, the atmosphere, ice, landforms, and living things. These interactions vary with latitude, altitude, and local and regional geography, all of which can affect oceanic and atmospheric flow patterns. (MS-ESS2-6) • Understand that weather patterns are so complex and can only be predicted probabilistically. (MS-ESS2-5) • Justify how ocean exerts a major influence on weather and climate by absorbing energy from the sun, releasing it over time, and globally redistributing it through ocean currents. (MS-ESS2-6) • **Explain how mapping the history of natural hazards in a region, combined with an understanding of related geologic forces, can help forecast the locations and likelihoods of future events. (MS-ESS3-2)** ***Meaning***

Develop a model to describe the cycling of water through Earth's systems driven by energy from the sun and the force of gravity. MS-ESS2-4 Collect data to provide evidence for how the motions and complex interactions of air masses results in changes in weather conditions. MS-ESS2-5 Develop and use a model to describe how unequal heating and rotation of the Earth cause patterns of atmospheric and oceanic circulation that determine regional climates. MS-ESS2-6 Earth and Human Activity Analyze and interpret data on natural hazards to forecast future catastrophic events and inform the development of technologies to mitigate their effects. MS-ESS3-2	***UNDERSTANDINGS*** • Patterns of the apparent motion of the sun, the moon, and stars in the sky can be observed, described, predicted, and explained with models. (MS-ESS1-1) • Earth and its solar system are part of the Milky Way galaxy, which is one of many galaxies in the universe. (MS-ESS1-2) • The solar system consists of the sun and a collection of objects, including planets, their moons, and asteroids that are held in orbit around the sun by its gravitational pull on them. (MS-ESS1-2),(MS-ESS1-3) • This model of the solar system can explain eclipses of the sun and the moon. Earth's spin axis is fixed in direction over the short-term but tilted relative to its orbit around the sun. The seasons are a result of that tilt and are caused by the differential intensity of sunlight on different areas of Earth across the year. (MS-ESS1-1) • The solar system appears to have formed from a disk of dust and gas, drawn together by gravity. (MS-ESS1-2) • **The geologic time scale interpreted from rock strata provides a way to organize Earth's history. Analyses of rock strata and the fossil record provide only relative dates, not an absolute scale. (MS-ESS1-4)** • Tectonic processes continually generate new ocean sea floor at ridges and destroy old sea	ESSENTIAL QUESTIONS How can the future locations of earth, the moon, the sun, and stars in relationship to each other? Describe the location of the Milky Way galaxy within the universe? Explain how the objects in our solar system are held in orbit around the sun. Explain earth's seasons and eclipses of the sun and moon through the use of a solar system model.

	floor at trenches. (HS.ESS1.C GBE) (secondary to MS-ESS2-3) • **All Earth processes are the result of energy flowing and matter cycling within and among the planet's systems. This energy is derived from the sun and Earth's hot interior. The energy that flows and matter that cycles produce chemical and physical changes in Earth's materials and living organisms. (MS-ESS2-1)** • **The planet's systems interact over scales that range from microscopic to global in size, and they operate over fractions of a second to billions of years. These interactions have shaped Earth's history and will determine its future. (MS-ESS2-2)** • Maps of ancient land and water patterns, based on investigations of rocks and fossils, make clear how Earth's plates have moved great distances, collided, and spread apart. (MS-ESS2-3) • Water continually cycles among land, ocean, and atmosphere via transpiration, evaporation, condensation and crystallization, and precipitation, as well as downhill flows on land. (MS-ESS2-4) • **Global movements of water and its changes in form are propelled by sunlight and gravity. (MS-ESS2-4)** • **Variations in density due to variations in temperature and salinity drive a global**	How was the solar system formed? Why don't rock strata and rock records provide definite geologic time information? How is it possible that tectonic processes both form and destroy the seafloor/earth surface? How do convection cells/currents influence earth processes? Identify planetary systems which interacted through time to shape our present earth, and will change earth in the future.

	pattern of interconnected ocean currents. (MS-ESS2-6) • Weather and climate are influenced by interactions involving sunlight, the ocean, the atmosphere, ice, landforms, and living things. These interactions vary with latitude, altitude, and local and regional geography, all of which can affect oceanic and atmospheric flow patterns. (MS-ESS2-6) • Because these patterns are so complex, weather can only be predicted probabilistically. (MS-ESS2-5) • The ocean exerts a major influence on weather and climate by absorbing energy from the sun, releasing it over time, and globally redistributing it through ocean currents. (MS-ESS2-6) • **Mapping the history of natural hazards in a region, combined with an understanding of related geologic forces can help forecast the locations and likelihoods of future events. (MS-ESS3-2)**	How is rock and fossil information used to support the fact that Earth's plates have moved and interacted over time. How can the water cycle be used to show the phase changes of water as it interacts with various Earth environments? Describe the effect of sunlight and gravity on the movement of water. How do temperature and salinity influence ocean currents? How does weather and climate interactions based on latitude, altitude and local geography vary its influence on oceanic and atmospheric flow patterns?

		Why can't weather be predicted with certainty? In what ways do oceans influence weather and climate? How can knowledge of geologic forces combined with an understanding of local geology help forecast the likelihood of future events?

	Acquisition	
	Students will KNOW… ... develop and use a model of the Earth-sun-moon system to describe the cyclic patterns of lunar phases, eclipses of the sun and moon, and seasons. ... develop and use a model to describe the role of gravity in the motions within galaxies and the solar system. …. analyze and interpret data to determine scale properties of objects in the solar system. ...construct a scientific explanation based on evidence from rock strata for how the geologic time scale is used to organize Earth's 4.6-billion-year-old history. ...develop a model to describe the cycling of Earth's materials and the flow of energy that drives this process. ...construct an explanation based on evidence for how geoscience processes have changed Earth's surface at varying time and spatial scales. ... analyze and interpret data on the distribution of fossils and rocks, continental shapes, and seafloor structures to provide evidence of past plate motions. ... develop a model to describe the cycling of water through Earth's systems driven by energy from the sun and the force of gravity. ... collect data to provide evidence for how the motions and complex interactions of air masses result in changes in weather conditions.	*Students will be skilled at (DO)…* *I can*... -develop and use a model of the Earth-sun-moon system to describe the cyclic patterns of lunar phases, eclipses of the sun and moon, and seasons. -develop and use a model to describe the role of gravity in the motions within galaxies and the solar system. - analyze and interpret data to determine scale properties of objects in the solar system. - construct a scientific explanation based on evidence from rock strata for how the geologic time scale is used to organize Earth's 4.6-billion-year-old history. - develop a model to describe the cycling of Earth's materials and the flow of energy that drives this process. - construct an explanation based on evidence for how geoscience processes have changed Earth's surface at varying time and spatial scales.

	... develop and use a model to describe how unequal heating and rotation of the Earth cause patterns of atmospheric and oceanic circulation that determine regional climate. ...analyze & interpret data on natural hazards to forecast future catastrophic events & inform the development of technologies to mitigate their effect. Vocabulary: Cyclic Eclipse Apparent Discern Asteroids Meteoroids Meteor Meteorite Rotation Revolution Solstice Equinox Vernal Autumnal Tectonic Plates Trenches Ridges Derived Microscopic Geoscience Faults	- analyze and interpret data on the distribution of fossils and rocks, continental shapes, and seafloor structures to provide evidence of past plate motions. - develop a model to describe the cycling of water through Earth's systems driven by energy from the sun and the force of gravity. - collect data to provide evidence for how the motions and complex interactions of air masses result in changes in weather conditions. - develop and use a model to describe how unequal heating and rotation of the Earth cause patterns of atmospheric and oceanic circulation that determine regional climate. - analyze & interpret data on natural hazards to forecast future catastrophic events & inform the development of technologies to mitigate their effect.

	Boundaries Divergent Convergent Deconstructive Constructive Strike Slip Transform Fossil Transpiration Evaporation Condensation Crystallization Precipitation Propelled Climate Groundwater Latitude Altitude Strata Mitigate	

Stage 2 - Evidence

How will you monitor and/or measure evidence of student learning? How will you communicate student learning? How do students provide feedback about their learning?

Evaluative Criteria	**Assessment Evidence**
<type here>	PERFORMANCE TASK(S): <type here>
<type here>	OTHER EVIDENCE: <type here>

COURSE NAME: 8TH GRADE ENGINEERING & TECHNOLOGY

Developers: Kang Lor, Cindy Bear, Steve Mally	Development Date: 4/27/16	Instructional Level: 8th	Unit: Embedded

Stage 1 Desired Results

<table>
<tr><td rowspan="3">ESTABLISHED GOALS

Engineering Design

Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions. MS-ETS1-1

Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem. MS-ETS1-2

Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…
The more precisely a design task's criteria and constraints can be defined, the more likely it is that the designed solution will be successful. Specification of constraints includes consideration of scientific principles and other relevant knowledge that is likely to limit possible solutions. (MS-ETS1-1) (secondary to MS-PS3-3)
A solution needs to be tested, and then modified on the basis of the test results, in order to improve it. (MS-ETS1-4) (secondary to MS-PS1-6)
There are systematic processes for evaluating solutions with respect to how well they meet criteria and constraints of a problem. MS-ETS1-2), (MS-ETS1-3) (secondary to MS-PS3-3) (secondary to MS-LS2-5)
Sometimes parts of different solutions can be combined to create a solution that is better than any of its predecessors. (MS-ETS1-3)
Models of all kinds are important for testing solutions. (MS-ETS1-4)
Although one design may not perform the best across all tests, identifying the characteristics of the design that performed the best in each test can provide useful information for the redesign process—that is, some of the characteristics may be incorporated into the new design. (MS-ETS1-3 (secondary to MS-PS1-6)
The iterative process of testing the most promising solutions and modifying what is proposed on the basis of the test results leads to greater refinement and ultimately to an optimal solution. (MS-ETS1-4) (secondary to MS-PS1-6)</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td></td><td>UNDERSTANDINGS</td><td>ESSENTIAL QUESTIONS</td></tr>
</table>

better meet the criteria for success. MS-ETS1-3 Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved. MS-ETS1-4	• The more precisely a design task's criteria and constraints can be defined, the more likely it is that the designed solution will be successful. Specification of constraints includes consideration of scientific principles and other relevant knowledge that are likely to limit possible solutions. (MS-ETS1-1) ETS1.B: Developing Possible Solutions • A solution needs to be tested, and then modified on the basis of the test results in order to improve it. (MS-ETS1-4) • There are systematic processes for evaluating solutions with respect to how well they meet criteria and constraints of a problem. MS-ETS1-2), (MS-ETS1-3) (secondary to MS-PS3-3) (secondary to MS-LS2-5) • Sometimes parts of different solutions can be combined to create a solution that is better than any of its predecessors. (MS-ETS1-3) • Models of all kinds are important for testing solutions. (MS-ETS1-4)	Use background and prior knowledge of concepts and understand new scientific principles to design improved solutions for engineering problems. Demonstrate understanding of a solution by retesting and modifying a model to make it better. Explain how to evaluate solutions systematically with respect to how they meet criteria and constraints.

	ETS1.C: Optimizing the Design Solution • Although one design may not perform the best across all tests, identifying the characteristics of the design that performed the best in each test can provide useful information for the redesign process - that is, some of the characteristics may be incorporated into the new design. (MS-ETS1-3) • The iterative process of testing the most promising solutions and modifying what is proposed on the basis of the test results leads to greater refinement and ultimately to an optimal solution. (MS-ETS1-4)	Why would you combine different outcomes? What is the importance of different kinds of models when testing solutions? Recognize and identify the characteristics from various designs that will, when incorporated into one design, perform the best across all tests. Perform multiple tests and modify the procedure/model to refine and achieve optimal solution.
	Acquisition	
	Students will KNOW…	*Students will be skilled at (DO)…* I can...

	...define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions. ...evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem. ...analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success. ...develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved. *Vocabulary* Criteria Constraints Precision Relevant Principles Impacts Models Economic Refutes	- define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions. - evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem. - analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success. - develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.

	Convincing Quantitative Correlation Causation Statistical Phenomenon Interative Predecessors	

Stage 2 - Evidence

How will you monitor and/or measure evidence of student learning? How will you communicate student learning? How do students provide feedback about their learning?

Evaluative Criteria	**Assessment Evidence**
<type here>	PERFORMANCE TASK(S): <type here> If we already have an existing assessment link it here.
<type here>	OTHER EVIDENCE: <type here>

High School Curriculum

The Science Curriculum is …

It is the mission of our Science Department to teach students to evaluate and analyze information through experimentation and discussion. We will endeavor to instill in our students an interest in science and demonstrate a connection between class activities and real-world experiences. We will strive to share a sense of excitement for learning and encourage all of our students to be careful observers of their environment so that they will become responsible and productive citizens.

The Holmen High School science department offers a variety course options that correlate with NGSS standards in Life Sciences, Physical Sciences, Earth and Space Sciences, and Engineering practices. Students also have access to multiple AP science courses and electives to meet the needs of students of all levels. Students may choose from a variety of pathways to prepare them for future experiences.

Holmen High School
Current Science Program Description & Course Offerings

MISSION STATEMENT

It is the mission of our Science Department to teach students to evaluate and analyze information through experimentation and discussion. We will endeavor to instill in our students an interest in science and demonstrate a connection between class activities and real-world experiences. We will strive to share a sense of excitement for learning and encourage all of our students to be careful observers of their environment so that they will become responsible and productive citizens.

BROAD GOALS

Goal 1—Problem-solving

- *Students will have the capacity for scientific ways of thinking.*
- *Students will be able to use scientific knowledge and ways of thinking for individual and social purposes.*

Goal 2—Knowledge

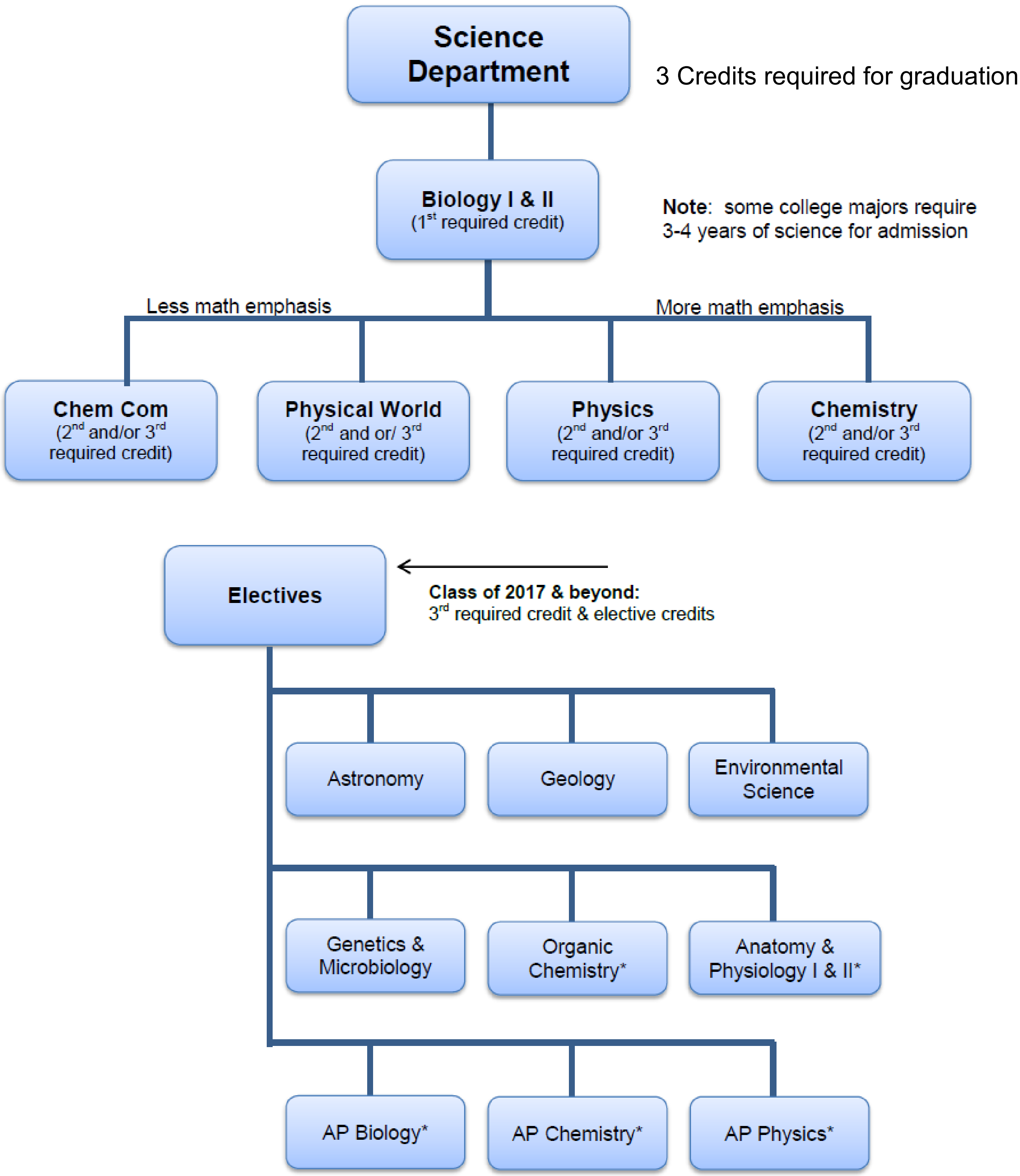
- *The students will understand concepts and principles of science.*

Goal 3—Appreciation

- *The students will understand the role science plays in their daily lives and the world around them.*
- *Students will appreciate the role science has played in the development of modern society.*

Goal 4—Wisdom - Critical Thinking

- *Students will understand the strengths and limitations of science and technology.*
- *Students will gain the scientific literacy necessary to make reasonable judgments regarding issues in science, technology, and society.*



**Class has additional prerequisite coursework*

Course Title	Description
*****ANATOMY AND PHYSIOLOGY (I) Credit: .5 Grade: 10-12 Pre: 2 Science credits***	***Anatomy and Physiology (I) will emphasize human biology in detail. The integumentary, skeletal, muscle, nervous, and endocrine units will follow a systems approach to human anatomy and physiology. In addition to studying the systems of the human body, units of study also include terminology, organization of the human body and tissue. Technology related to anatomy and physiology is also emphasized through personal study, computer programs and guest speakers. Students who have an interest in biology, nursing, medicine or any other health career are encouraged to enroll. NCAA approved.***
*****ANATOMY AND PHYSIOLOGY (II) Credit: .5 Grade: 10-12 Pre: Anatomy/Physiology (I)***	***Anatomy and Physiology (II) will emphasize human biology in detail. The circulatory, lymphatic, respiratory, digestive, urinary, and reproductive units will follow a systems approach to human anatomy and physiology. In addition to studying the systems of the human body, growth and development will also be a unit of study. Technology related to anatomy and physiology is also emphasized through personal study, computer programs, and guest speakers. Students who have an interest in biology, nursing, medicine, or any other health career are encouraged to enroll. NCAA approved.***
*****AP BIOLOGY Credit: 2.0 Grade: 10-12 Pre: Chemistry***	***AP Biology is designed to be the equivalent of a first-year college biology course for science majors. This class explores the major themes in biology, including biochemistry, cell biology, metabolism, heredity, molecular genetics, evolution, diversity of life, population biology, ecology, and comparative anatomy and physiology. We will be doing AP recommended labs, in addition to other labs and activities to supplement specific topics. This class will focus on preparation for the national AP Biology exam in May. Successful test results may be used for appropriate placement, college credit, or both. NCAA approved.***
*****AP CHEMISTRY Credit: 2.0 Grade: 11-12 Pre: Chemistry and Department recommendation***	***AP Chemistry is designed to be the equivalent of a general chemistry course offered at a university. Students who enroll are expected to prepare for the AP Chemistry exam in May. Successful test results may be used for appropriate placement, college credit, or both. Students will encounter a rigorous curriculum that emphasizes atomic theory, chemical bonding, nuclear chemistry, kinetics, and thermodynamics. About twenty lab experiences, some of which require milligram precision, spectrophotometers, and pH meters, will be completed. Students will be expected to maintain an organized lab notebook and test in May. NCAA approved.***
*****AP PHYSICS Credit: 2.0 Grade: 11-12 Pre: Physics and Department Recommendation***	***This course covers material included on the AP Physics 1 exam including mechanics, thermodynamics, waves, and optics. A background in trigonometry and algebra is essential for understanding concepts in this class. Laboratory experiments will be emphasized and students are expected to maintain a lab notebook for independent lab exercise. The curriculum for this course will cover all concepts essential for completing the AP Physics 1 exam in May. Students enrolling in this course are expected to complete the AP Physics 1 exam. NCAA approved.***
****ASTRONOMY Credit: .5 Grade: 10-12 Pre: Biology I, II***	***Students in this course will study the history of astronomy, methods of astronomy, stars and galaxies, cosmology, the sun-earth-moon system, the solar system, space exploration, and life in the universe. Astronomy is an observational science so emphasis is placed on developing strong observation skills. Students will also have the opportunity to participate in night sky observations and visits to a planetarium. NCAA approved.***

BIOLOGY I and II Credit: .5 per term Grade: 9 Required courses for graduation	***Biology is a one credit (two-term) class required for all 9th grade students. It is composed of two consecutive terms. Students will study cells and cell processes, biochemistry and energy transfer, Mendelian and molecular genetics, ecology, evolution, and the diversity of life. This course involves practical laboratory work including measurement, microscopy, experimental design, chemistry of life, genetics, and investigations in diversity. Successful completion of two terms of biology is required for graduation. This class provides the foundation for later coursework in the biological sciences field.***
CHEMISTRY Credit: 1.0 Grade: 10-12 Pre: Biology I & II, Algebra I (C or better)	***Chemistry introduces the student to the concept of matter and its properties and changes. This course is designed so that the student learns about the structure of matter, its properties and changes. Major units of study are matter, atomic structure, bonding, periodic properties, chemical reactions, solutions, acids and bases. This course involves both lecture and lab settings. It is recommended for students who are preparing for college, especially those students seeking training in any science-related career. A student is required to pass first term before taking second term. To receive any credit for Chemistry, a student must pass both terms in the same semester. NCAA approved.***
****CHEMISTRY IN THE COMMUNITY (ChemCom) Credit: 1.0 Grade: 10-12 Pre: Biology I, II***	***Chemistry in the Community is a chemistry course developed by the American Chemical Society. The course provides students with an idea of how chemical knowledge is incorporated into day-to-day decisions that govern our planet. ChemCom teaches many of the same chemical concepts as the traditional chemistry course, but the approach is less math-based. There is an emphasis on critical thinking and decision-making skills. The main topics are water, materials, petroleum, air, industry, atoms, and food. Most colleges accept ChemCom as a lab science credit. A student is required to pass the first term before he or she may take the second term. To receive any credit for ChemCom, a student must pass both terms in the same semester.***
****ENVIRONMENTAL SCIENCE Credit: .5 Grade: 10-12 Pre: 2 credits of Science***	***Environmental Science students will investigate the biological, chemical, geological, and physical aspects of their environment. The course is an elective for students who have completed both terms of Biology. Specific topics covered in the class include ecosystems, biodiversity, environmental attitudes, energy, pollution, and the impacts of these topics on public policymaking. Laboratory investigations will be emphasized and often include outdoor activities and periods of walking. This is a one-term, 0.5 credit class. NCAA approved.***
GENETICS AND MICROBIOLOGY Credit: .5 Grade: 10-12 Pre: 2 credits of Science	***Genetics and Microbiology is a one-term elective class focusing on advanced understanding and practical application of genetics and microbiology. This is a laboratory-centered course where students will investigate genetic crosses and microbial life. Laboratory work and research will be emphasized. Students who have an interest in pursuing biology-related fields are encouraged to enroll. NCAA approved.***
****GEOLOGY Credit: .5 Grade: 10-12 Pre: Biology I, II***	***Students in this course will study plate tectonics, volcanoes, earthquakes, mineral and rock identification, map interpretation, hydrogeology, glacial geology, Earth history (with emphasis on WI geology), and economic geology (oil and mineral resources). Field trips will be included when practical. Students interested in careers in Earth and environmental sciences are encouraged to enroll. NCAA approved.***
ORGANIC CHEMISTRY Credit: .5 Grade: 10-12 Pre: Chemistry	***Organic chemistry is designed to give an overview of the chemistry involved in life's processes. Topics will include organic molecules and reactions, cellular respiration, digestion, and nutrition. The course will involve both lecture and lab settings. NCAA approved.***
PHYSICAL WORLD Credit: 1.0 Grade: 10-12	***Students will be presented numerous topics including the natures of science, mechanics, properties of matter, heat, sound, light, electricity, magnetism, atomic and nuclear physics. These topics will not be explored in detail but in a general***

Pre: Biology I, II	*way. Students who do not intend to pursue a college degree should enroll in this class. Topics will include lab experiences and will not emphasize mathematical relationships to physics. Practical applications of physics will be encountered and emphasized. This is a one credit and one semester class. A student is required to pass the first term before he or she may take the second term. To receive any credit for Physical World, a student must pass both terms in the same semester. NCAA Approved.*
***PHYSICS* *Credit: 1.0* *Grade: 10-12* *Pre: Biology I, II, Algebra I, Geometry*	*Physics presents units about measurement, motion, Newton's Laws, vector resolution, gravity, the energy-work theorem, machines and sound. Students will learn theories in the lecture part of class and confirm these theories in the lab. Traditional and virtual laboratory experiences are required activities in this class. Students interested in science, or who want to prepare for a science career, are encouraged to enroll in Physics. A student is required to pass the first term before he or she may take the second term. To receive any credit for Physics, a student must pass both terms in the same semester. NCAA approved.*

***Denotes courses that are designated as lab sciences for meeting college entrance requirements.*

**Denotes courses that may be designated as lab sciences for meeting college entrance requirements. Please check with your Guidance Counselor.*

SCIENCE

**Indicates Prerequisite requirement*

GRADE 9

Course:	Course #:
Biology I	2219
Biology II	2220

GRADE 10

Course:	Course #:
*Chem Com	A: 2217 B: 2255
*Chemistry	A: 2218 B: 2256
*Physical World	A: 2213 B: 2258
*Physics	A: 2222 B: 2257
*Anatomy/Physiology I	2231
*Anatomy/Physiology II	2232
*Genetics/Microbiology	2233
*Environmental Science	2214
*Organic Chemistry	2216
*Geology	2226
*Astronomy	2228

GRADE 11

Course:	Course #:
*Chem Com	A: 2217 B: 2255
*Chemistry	A: 2218 B: 2256
*Physical World	A: 2213 B: 2258
*Physics	A: 2222 B: 2257
*Anatomy/Physiology I	2231
*Anatomy/Physiology II	2232
*Genetics/Microbiology	2233
*Environmental Science	2214
*Organic Chemistry	2216
*Geology	2226
*Astronomy	2228
*AP Biology	A: 2223 B: 2197 C: 2198 D: 2199
*AP Chemistry	A: 2221 B: 2225 C: 2227 D: 2229
*AP Physics	A: 2241 B: 2211 C: 2212 D: 2215

GRADE 12

Course:	Course #:
*Chem Com	A: 2217 B: 2255
*Chemistry	A: 2218 B: 2256
*Physical World	A: 2213 B: 2258
*Physics	A: 2222 B: 2257
*Anatomy/Physiology I	2231
*Anatomy/Physiology II	2232
*Genetics/Microbiology	2233
*Environmental Science	2214
*Organic Chemistry	2216
*Geology	2226
*Astronomy	2228
*AP Biology	A: 2223 B: 2197 C: 2198 D: 2199
*AP Chemistry	A: 2221 B: 2225 C: 2227 D: 2229
*AP Physics	A: 2241 B: 2211 C: 2212 D: 2215

COURSE NAME: BIOLOGY

Developers: Josh Kinsman	*Development Date:May2016*	*Instructional Level: 9*	*Unit: Chemistry of Life*

Stage 1 Desired Results

<table>
<tr><td rowspan="4">ESTABLISHED GOALS (Which Content & CCSS from multiple strands (e.g. reading, writing, language, speaking, listening & content) can be integrated?)

HS-LS1-6. Construct and revise an explanation based on evidence for how carbon, hydrogen, and oxygen from sugar molecules may combine with other elements to form amino acids and/or other large carbon-based molecules.

HS-PS1-1. Use the periodic table as a model to predict the relative properties of elements based on the patterns of electrons in the outermost energy level of atoms.</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…
• Critically analyze and compare contrasting viewpoints
• Evaluate evidence to support scientific positions
• Identify and understand patterns and causes
• Describe how science models, support Theories that explain natural phenomena</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>UNDERSTANDINGS
Students will understand that…

<u>PS1.A: Structure and Properties of Matter</u>
• Each atom has a charged substructure consisting of a nucleus, which is made of protons and neutrons, surrounded by electrons. (HS-PS1-1)

• The periodic table orders elements horizontally by the number of protons in the atom’s nucleus and places those with similar chemical properties in columns. The repeating patterns of this table reflect patterns of outer electron states. (HS-PS1-1)

• The structure and interactions of matter at the bulk scale are determined by electrical forces within and between atoms. (HS-PS1-3),(secondary to HS-PS2-6)</td><td>ESSENTIAL QUESTIONS (What open-ended, age appropriate questions will prompt exploration and creative and critical thinking?)

Why do atoms combine?

Why is water essential for living things?

Why are biological molecules made with carbon?

What if cells didn’t have enzymes?</td></tr>
</table>

	LS1.C: Organization for Matter and Energy Flow in Organisms • As matter and energy flow through different organizational levels of living systems, chemical elements are recombined in different ways to form different products. (HS-LS1-6),(HS-LS17)	
	Acquisition	
	Students will KNOW… (Including Tier II and Tier III vocabulary) Atomic structure The difference between atoms and ions How ionic bonds form How covalent bonds form The unique properties of water The difference between polar and nonpolar substances How polarity affects miscibility The pH scale What makes solutions acidic and/or basic What carbohydrates are How carbohydrates are used by the body What lipids are How lipids are used in the body What proteins are How proteins are used in the body What nucleic acids are and their purpose What enzymes are and their purpose How environmental conditions affect enzyme activity **Vocabulary Terms:** Atom, element, compound, ion, ionic bond, covalent bond, polar bond, nonpolar bond, molecule, hydrogen bond, cohesion,	*Students will be skilled at (DO)…* Identify polar and nonpolar substances based on lab tests Test solutions to determine pH level Test samples for specific carbohydrates Determine the effects of pH and temperature on enzyme activity in a lab

	adhesion, solution, solute, solvent, acid, base, pH Monomer, polymer, carbohydrates, monosaccharides, disaccharides, polysaccharides, lipids, fatty acids, amino acids, proteins, peptide bond, enzymes, catalyst, activation energy, substrate, active site, nucleic acids, nucleotides	

Stage 2 - Evidence

How will you monitor and/or measure evidence of student learning? How will you communicate student learning? How do students provide feedback about their learning?

Evaluative Criteria	**Assessment Evidence**
Answer keys	PERFORMANCE TASK(S):
<type here>	OTHER EVIDENCE: <type here>

<table>
<tr><td colspan="4">COURSE NAME: BIOLOGY</td></tr>
<tr><td>Developers: Biology Team</td><td>Development Date:May2016</td><td>Instructional Level: 9</td><td>Unit: Cells</td></tr>
</table>

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="4">HS-LS1-1. Construct an explanation based on evidence for how the structure of DNA determines the structure of
proteins which carry out the essential functions of life through systems of specialized cells
HS-LS1-2. Develop and use a model to illustrate the hierarchical organization of interacting systems that provide
specific functions within multicellular organisms.
HS-LS1-3. Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis.
HS-LS1-4. Use a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms.
HS-LS1-5. Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy.
HS-LS1-6. Construct and revise an explanation based on evidence for how carbon, hydrogen, and oxygen from sugar molecules may combine with other elements to form amino acids and/or other large carbon-based molecules.
HS-LS1-7. Use a model to illustrate that cellular respiration is a chemical process whereby the bonds of food molecules</td><th colspan="2">Transfer</th></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…
• Critically analyze and compare contrasting viewpoints
• Evaluate evidence to support scientific positions
• Model time and events to provide a scope and sequence for processes
• Identify and understand patterns and causes
• Describe how science models, support theories that explain natural phenomena</td></tr>
<tr><th colspan="2">Meaning</th></tr>
<tr><td>UNDERSTANDINGS
Students will understand that…
LS1.A: Structure and Function
 Systems of specialized cells within organisms help them
perform the essential functions of life. (HS-LS1-1)
 All cells contain genetic information in the form of DNA
molecules. Genes are regions in the DNA that contain the
instructions that code for the formation of proteins, which
carry out most of the work of cells. (HS-LS1-1) (Note:
This Disciplinary Core Idea is also addressed by HS-LS3-
1.)
 Multicellular organisms have a hierarchical structural</td><td>ESSENTIAL QUESTIONS (What open-ended, age appropriate questions will prompt exploration and creative and critical thinking?)
What is the role of the microscope in cell study?
What early discoveries and studies led to the development of cell theory?
How do cells fundamentally differ?
What structures are necessary for a cell to function properly?
How do cells maintain homeostasis?</td></tr>
</table>

and oxygen molecules are broken and the bonds in new compounds are formed resulting in a net transfer of energy.	organization, in which any one system is made up of numerous parts and is itself a component of the next level. (HS-LS1-2) Feedback mechanisms maintain a living system's internal conditions within certain limits and mediate behaviors, allowing it to remain alive and functional even as external conditions change within some range. Feedback mechanisms can encourage (through positive feedback) or discourage (negative feedback) what is going on inside the living system. (HS-LS1-3) **LS1.B: Growth and Development of Organisms** In multicellular organisms individual cells grow and then divide via a process called mitosis, thereby allowing the organism to grow. The organism begins as a single cell (fertilized egg) that divides successively to produce many cells, with each parent cell passing identical genetic material (two variants of each chromosome pair) to both daughter cells. Cellular division and differentiation	

	produce and maintain a complex organism, composed of systems of tissues and organs that work together to meet the needs of the whole organism. (HS-LS1-4) **LS1.C: Organization for Matter and Energy Flow in Organisms** The process of photosynthesis converts light energy to stored chemical energy by converting carbon dioxide plus water into sugars plus released oxygen. (HS-LS1-5) The sugar molecules thus formed contain carbon, hydrogen, and oxygen: their hydrocarbon backbones are used to make amino acids and other carbon-based molecules that can be assembled into larger molecules (such as proteins or DNA), used for example to form new cells. (HS-LS1-6) As matter and energy flow through different organizational levels of living systems, chemical elements are recombined in different ways to form different products. (HS-LS1-6),(HS-LS1-7) As a result of these chemical reactions, energy is	

	transferred from one system of interacting molecules to another. Cellular respiration is a chemical process in which the bonds of food molecules and oxygen molecules are broken and new compounds are formed that can transport energy to muscles. Cellular respiration also releases the energy needed to maintain body temperature despite ongoing energy transfer to the surrounding environment. (HS-LS1-7)	
	Acquisition	
	Students will KNOW… (Including Tier II and Tier III vocabulary) Vocabulary terms: cell theory, prokaryotic, eukaryotic, cell membrane, nucleus, nucleolus, nuclear membrane, mitochondria endoplasmic reticulum ribosomes, golgi bodies mitochondria, vacuoles lysosomes, chloroplasts cell wall ,cytoplasm, passive transport, active transport, diffusion, osmosis, isotonic, hypertonic, hypotonic,	*Students will be skilled at (DO)…* • Properly find microscopic structures using correct technique • Identify parts of a microscope • Draw and label parts of cell • Use evidence/logic to construct a conclusion • Identify 3 parts of cell theory & explain the development of the theory • Identify organelles in the cell • Identify important functions and structures of the cell membrane • Compare and contrast plant and animal cells • Compare and contrast prokaryotic and eukaryotic cells • Distinguish between passive and active transport

	endocytosis, phagocytosis, exocytosis	• Describe and explain the process of diffusion and osmosis • Explain what happens to an animal cell in a hypertonic, hypotonic, and isotonic solution. • Describe and explain the process of active transport • Describe and explain endocytosis and exocytosis

Stage 2 - Evidence

How will you monitor and/or measure evidence of student learning? How will you communicate student learning? How do students provide feedback about their learning?

Evaluative Criteria	**Assessment Evidence**
Answer keys	PERFORMANCE TASK(S): Quizzes Test Cloud drawings assignment
<type here>	OTHER EVIDENCE: <type here>

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<tr><td>Developers: Biology Team</td><td>Development Date:May2016</td><td>Instructional Level: 9</td><td>Unit: Cellular Life Processes</td></tr>
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 All cells contain genetic information in the form of DNA
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This Disciplinary Core Idea is also addressed by HS-LS3-
1.)
 Multicellular organisms have a hierarchical structural</td><td>ESSENTIAL QUESTIONS (What open-ended, age appropriate questions will prompt exploration and creative and critical thinking?)

How does the cell utilize energy for cell processes?

How do organisms obtain energy without the sun?

What is the role of photosynthesis in making energy available to plants and other organisms?

How does cellular respiration make energy available for cell processes?

How does the cell grow and regulate development?</td></tr>
</table>

energy.	organization, in which any one system is made up of numerous parts and is itself a component of the next level. (HS-LS1-2) Feedback mechanisms maintain a living system's internal conditions within certain limits and mediate behaviors, allowing it to remain alive and functional even as external conditions change within some range. Feedback mechanisms can encourage (through positive feedback) or discourage (negative feedback) what is going on inside the living system. (HS-LS1-3) **LS1.B: Growth and Development of Organisms** In multicellular organisms individual cells grow and then divide via a process called mitosis, thereby allowing the organism to grow. The organism begins as a single cell (fertilized egg) that divides successively to produce many cells, with each parent cell passing identical genetic material (two variants of each chromosome pair) to both daughter cells. Cellular division and differentiation	How is cell size limited? What internal and external factors regulate cell growth?

	produce and maintain a complex organism, composed of systems of tissues and organs that work together to meet the needs of the whole organism. (HS-LS1-4) **LS1.C: Organization for Matter and Energy Flow in Organisms** The process of photosynthesis converts light energy to stored chemical energy by converting carbon dioxide plus water into sugars plus released oxygen. (HS-LS1-5) The sugar molecules thus formed contain carbon, hydrogen, and oxygen: their hydrocarbon backbones are used to make amino acids and other carbon-based molecules that can be assembled into larger molecules (such as proteins or DNA), used for example to form new cells. (HS-LS1-6) As matter and energy flow through different organizational levels of living systems, chemical elements are recombined in different ways to form different products. (HS-LS1-6),(HS-LS1-7) As a result of these chemical reactions, energy is	

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	Acquisition	
	Students will KNOW… (Including Tier II and Tier III vocabulary) Vocabulary terms: Chemosynthesis, ATP, ADP, photosynthesis, chlorophyll, thylakoid, light dependent and light independent reactions, cell respiration, aerobic, glycolysis, anaerobic, Krebs cycle, cell cycle, mitosis, cytokinesis, chromosome, histone, chromatin, chromatid, centromere, telomere, prophase, metaphase, anaphase, telophase, growth factor, apoptosis, cancer, benign, malignant, metastasize, carcinogen	*Students will be skilled at (DO)…* • Explain the importance of energy in nature • Identify ATP as the main energy molecule for all living things. • Draw and Label the parts of ATP. • Describe how energy is released and stored in the ATP molecule. • List metabolic uses for ATP in the body. • Define photosynthesis • Write the formula for photosynthesis • Apply the reactants and products of the light dependent reaction to the photosynthetic formula. • Apply the reactants and products of light independent reaction to the photosynthetic formula.

		• Label the chloroplast with the locations of the light dependent and independent reactions. • Compare and contrast the reactions of PSII and PS I. • Identify reactants and products in PSII and PSI. • Identify reactants and products in cellular respiration • Describe the process of glycolysis • Identify the different shapes of DNA as it moves through the cell cycle. • Describe the cell cycle • Label the parts of a chromosome • Define Mitosis • Describe and explain the function of organelles involved in mitosis • Draw the different stages of mitosis • Contrast cytokinesis in plant and animal cells. • Relate concepts of mitosis to the development of a complex organism. • Relate uncontrolled cell division to cancer and tumor formation • Describe how to prevent Cancer • List different causes of cancer •

Stage 2 - Evidence ***How will you monitor and/or measure evidence of student learning? How will you communicate student learning? How do students provide feedback about their learning?***	
Evaluative Criteria	**Assessment Evidence**
Answer keys	PERFORMANCE TASK(S): Quizzes Test Cloud drawings assignment
<type here>	OTHER EVIDENCE: <type here>

COURSE NAME: BIOLOGY

Developers: Biology Team	Development Date: June2016	Instructional Level: 9	Unit: Genetics

Stage 1 Desired Results

HS-LS3-1. **Ask questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring.** **HS-LS3-2.** **Make and defend a claim based on evidence that inheritable genetic variations may result from: (1) new genetic combinations through meiosis, (2) viable errors occurring during replication, and/or(3) mutations caused by environmental factors.** **HS-LS3-3.** **Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population.**	***Transfer*** *Students will be able to independently use their learning to…* • **Examine scientific data and predict the effect of a change in one variable on another** • **Identify and understand patterns and causes** • **Ask questions and define problems** • **Engage in Argument from Evidence** ***Meaning*** UNDERSTANDINGS *Students will understand that…* **LS1.A: Structure and Function** All cells contain genetic information in the form of DNA molecules. Genes are regions in the DNA that contain the instructions that code for the formation of proteins. (secondary to HS-LS3-1) (Note: This Disciplinary Core Idea is also addressed by HS-LS1-1.) **LS3.A: Inheritance of Traits** Each chromosome consists of a single very long DNA molecule, and each gene on the chromosome is a particular segment of that DNA. The instructions for forming species' characteristics are carried in DNA. All cells in an organism have the same genetic content, but the genes used (expressed) by the cell may be regulated in different ways. Not all DNA	ESSENTIAL QUESTIONS *(What open-ended, age appropriate questions will prompt exploration and creative and critical thinking?)* **Why do people look different?** **How do genes influence the development of traits?** **What is the relationship between DNA and proteins?**

	codes for a protein; some segments of DNA are involved in regulatory or structural functions, and some have no as-yet known function. (HS-LS3-1) **LS3.B: Variation of Traits** In sexual reproduction, chromosomes can sometimes swap sections during the process of meiosis (cell division), thereby creating new genetic combinations and thus more genetic variation. Although DNA replication is tightly regulated and remarkably accurate, errors do occur and result in mutations, which are also a source of genetic variation. Environmental factors can also cause mutations in genes, and viable mutations are inherited. (HS-LS3-2) Environmental factors also affect expression of traits, and hence affect the probability of occurrences of traits in a population. Thus the variation and distribution of traits observed depends on both genetic and environmental factors. (HS-LS3-2),(HS-LS3-3)	
	Acquisition	
	Students will KNOW… (Including Tier II and Tier III vocabulary) • How body cells and sex cells differ in the number of chromosomes • How meiosis differs from mitosis • The patterns of inheritance that Mendel's data reveled	*Students will be skilled at (DO)…* • Complete a monohybrid cross • Analyze allele combinations • Examine patterns of inheritance an make predictions mathematically • Analyze pedigrees and make predictions

	- How there can be many versions of one gene. - The inheritance of traits follows the rules of probability - How heredity can be illustrated mathematically - The patterns of inheritance and predicted outcomes of different allele interactions including: sex-linked, incomplete dominance, codominance - How sexual reproduction creates unique gene combinations and increases diversity - How environmental factors affect expression of inheritance - How a pedigree is used - That karyotypes are used in mapping human chromosomes - The structure of DNA - The process of DNA replication - The role of enzymes in in DNA replication - The three kinds of RNA and their functions - How transcription and replication differ - That mRNA codons are a translated into amino acids - The process of protein synthesis - Mutations may or may not affect phenotype - Factors that cause mutations	

	Vocabulary Terms: somatic cell, gamete, germ cell, homologous chromosome, autosome, sex chromosome, sexual reproduction, fertilization, diploid, haploid, meiosis, sperm, egg, trait, genetics, purebred, cross, gene, allele, homozygous, heterozygous, genome, genotype, phenotype, dominant, recessive, Punnett square, monohybrid cross, dihybrid cross, probability, crossing over, centromere, sister chromatids, chromatin carrier, sex-linked gene, incomplete dominance, codominance, polygenic trait, pedigree, karyotype nucleotides, adenine, thymine, cytosine, guanine, double helix, base Pairing Rule, Replication, DNA Polymerase, Central Dogma, RNA, Transcription , RNA Polymerase, helicase, protein, mRNA (messenger), rRNA (ribosomal), tRNA (transfer) , Translation, Codon, Stop Codon, Start Codon, Anticodon, mutation, mutagens	

Stage 2 - Evidence

How will you monitor and/or measure evidence of student learning? How will you communicate student learning? How do students provide feedback about their learning?

Evaluative Criteria	Assessment Evidence
Answer keys	PERFORMANCE TASK(S): Quizzes Test Cloud drawings assignment
<type here>	OTHER EVIDENCE:type here>

COURSE NAME: BIOLOGY

Developers: Matt Hanson	Development Date:May2016	Instructional Level: 9	Unit: Evolution

Stage 1 Desired Results

<table>
<tr>
<td rowspan="4">HS-LS4-1. Communicate scientific information that common ancestry and biological evolution are supported by multiple
lines of empirical evidence.

HS-LS4-2. Construct an explanation based on evidence that the process of evolution primarily results from four factors: (1) the potential for a species to increase in number, (2) the heritable genetic variation of individuals in a species due
to mutation and sexual reproduction, (3) competition for limited resources, and (4) the proliferation of those organisms that are better able to survive and reproduce in the environment.

HS-LS4-3. Apply concepts of statistics and probability to support explanations that organisms with an advantageous heritable trait tends to increase in proportion to organisms lacking this trait.

HS-LS4-4. Construct an explanation based on evidence for how natural selection leads to adaptation of populations.
HS-LS4-5. Evaluate the evidence supporting claims that changes in environmental conditions may result in: (1) increases in</td>
<td colspan="2">Transfer</td>
</tr>
<tr>
<td colspan="2">Students will be able to independently use their learning to…
Critically analyze and compare contrasting viewpoints
Evaluate evidence to support scientific positions
Model time and events to provide a scope and sequence for processes
Identify and understand patterns and causes
Describe how science models, support Theories that explain natural phenomena</td>
</tr>
<tr>
<td colspan="2">Meaning</td>
</tr>
<tr>
<td>UNDERSTANDINGS
Students will understand that…

LS4.A: Evidence of Common Ancestry and Diversity
 Genetic information provides evidence of evolution. DNA
sequences vary among species, but there are many overlaps;
in fact, the ongoing branching that produces multiple lines of
descent can be inferred by comparing the DNA sequences of
different organisms. Such information is also derivable from the
similarities and differences in amino acid sequences and from
anatomical and embryological evidence. (HS-LS4-1)</td>
<td>ESSENTIAL QUESTIONS (What open-ended, age appropriate questions will prompt exploration and creative and critical thinking?)
How did the earth form and change over time?
How did life develop and change over the earth's history?
What is evolution, and what is the mechanism by which it occurs?
What are some supportive pieces of evidence for evolutionary processes?</td>
</tr>
</table>

the number of individuals of some species, (2) the emergence of new species over time, and (3) the extinction of other species. **HS-LS4-6. Create or revise a simulation to test a solution to mitigate adverse impacts of human activity on biodiversity.*** **HS-ESS1-6. Apply scientific reasoning and evidence from ancient Earth materials, meteorites, and other planetary surfaces to construct an account of Earth's formation and early history.**	**LS4.B: Natural Selection** Natural selection occurs only if there is both (1) variation in the genetic information between organisms in a population and (2) variation in the expression of that genetic information—that is, trait variation—that leads to differences in performance among individuals. (HS-LS4-2), (HS-LS4-3) The traits that positively affect survival are more likely to be reproduced, and thus are more common in the population. (HS-LS4-3) **LS4.C: Adaptation** Evolution is a consequence of the interaction of four factors: (1) the potential for a species to increase in number, (2) the genetic variation of individuals in a species due to mutation and sexual reproduction, (3) competition for an environment's limited supply of the resources that individuals need in order to survive and reproduce, and (4) the ensuing proliferation of those organisms that are better able to survive and reproduce in that environment. (HS-LS4-2) Natural selection leads to adaptation, that is, to a population	

	dominated by organisms that are anatomically, behaviorally, and physiologically well suited to survive and reproduce in a specific environment. That is, the differential survival and reproduction of organisms in a population that have an advantageous heritable trait leads to an increase in the proportion of individuals in future generations that have the trait and to a decrease in the proportion of individuals that do not. (HS-LS4-3), (HS-LS4-4) Adaptation also means that the distribution of traits in a population can change when conditions change. (HS-LS4-3) Changes in the physical environment, whether naturally occurring or human induced, have thus contributed to the expansion of some species, the emergence of new distinct species as populations diverge under different conditions, and the decline–and sometimes the extinction–of some species. (HS-LS4-5),(HS-LS4-6) Species become extinct because they can no longer survive and reproduce in their altered environment. If members cannot	

	adjust to change that is too fast or drastic, the opportunity for the species' evolution is lost. (HS-LS4-5) **LS4.D: Biodiversity and Humans** Humans depend on the living world for the resources and other benefits provided by biodiversity. But human activity is also having adverse impacts on biodiversity through overpopulation, overexploitation, habitat destruction, pollution, introduction of invasive species, and climate change. Thus sustaining biodiversity so that ecosystem functioning and productivity are maintained is essential to supporting and enhancing life on Earth. Sustaining biodiversity also aids humanity by preserving landscapes of recreational or inspirational value. (HS-LS4-6) (Note: This Disciplinary Core Idea is also addressed by HS-LS2-7.) **ETS1.B: Developing Possible Solutions** When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts. (secondary to HS-LS4-6)	

	Both physical models and computers can be used in various ways to aid in the engineering design process. Computers are useful for a variety of purposes, such as running simulations to test different ways of solving a problem or to see which one is most efficient or economical; and in making a persuasive presentation to a client about how a given	
	Acquisition	
	Students will KNOW… (Including Tier II and Tier III vocabulary) • The milestones associated with the history of the atom How the earth formed, and what were early environmental conditions and causes of changes. Major biological milestones in earth's history The history of evolution, and specific examples that helped shape current scientific understanding. Current examples of evidence that evolution is occurring How evolution affect individuals and populations	*Students will be skilled at (DO)…* • Create a biological and geological timeline to model change • Organize embryological states of development • Calculate ½ life of radiometric isotopes • Develop a hypothesis using evidence

	Vocabulary terms: • Evolution, Natural selection, adaptation, variation, heritability, resources, fitness, mutation, embryology, radiometric dating, relative dating, plate tectonics, biodiversity, selective pressure Era, Period, geologic time scale, index fossil, half-life, analogous structure, homologous structure, population species, artificial selection, vestigial structure, gene pool, allele frequency, molecular clock, cladogram, relative dating, radiometric dating, endosymbiosis, cyanobacteria, isotope, stabilizing selection, directional selection, disruptive selection, sexual selection, speciation, coevolution, convergent evolution, punctuated equilibrium, adaptive radiation Extinction	

Stage 2 - Evidence

How will you monitor and/or measure evidence of student learning? How will you communicate student learning? How do students provide feedback about their learning?

Evaluative Criteria	Assessment Evidence
Answer keys	PERFORMANCE TASK(S): Quizzes Test
<type here>	OTHER EVIDENCE: <type here>

COURSE NAME: BIOLOGY

Developers: Biology Team	Development Date:May2016	Instructional Level: 9	Unit: Classification & Microbes

Stage 1 Desired Results

<table>
<tr>
<td rowspan="3">
HS-LS2-6. Evaluate the claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, but changing conditions may result in a new ecosystem. [Clarification Statement: Examples of changes in ecosystem conditions could include modest biological or physical changes, such as moderate hunting or a seasonal flood; and extreme changes, such as volcanic eruption or sea level rise.]

HS-LS4-1. Communicate scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence.

HS-LS4-2. Construct an explanation based on evidence that the process of evolution primarily results from four factors: (1) the potential for a species to increase in number, (2) the heritable genetic variation of individuals in a species due to mutation and sexual reproduction, (3) competition for limited resources, and (4) the proliferation of those organisms that are better able to survive and reproduce in the environment.

HS-LS4-3. Apply concepts of statistics and probability to support explanations that organisms with an advantageous heritable trait tends to increase in proportion to organisms lacking this trait.
</td>
<td colspan="2">Transfer
Students will be able to independently use their learning to…

Critically analyze and compare contrasting viewpoints
Evaluate evidence to support scientific positions
Identify and understand patterns and causes
Describe how science models, support Theories that explain natural phenomena
Use empirical evidence to differentiate between cause and correlation

</td>
</tr>
<tr>
<td colspan="2">Meaning</td>
</tr>
<tr>
<td>UNDERSTANDINGS
Students will understand that…

LS4.A: Evidence of Common Ancestry and Diversity
Genetic information provides evidence of evolution. DNA sequences vary among species, but there are many overlaps; in fact, the ongoing branching that produces multiple lines of descent can be inferred by comparing the DNA sequences of different organisms. Such information is also derivable from the similarities and differences in amino acid sequences and from anatomical and embryological evidence. (HS-LS4-1)
</td>
<td>ESSENTIAL QUESTIONS
(What open-ended, age appropriate questions will prompt exploration and creative and critical thinking?)
What are some past and current ways of grouping living organisms?
How has our understanding of classification changed with new scientific knowledge?
How has life changed over the earth's history?
What characteristics help define major groupings of life?
In what ways do microbes impact multicellular life?
</td>
</tr>
</table>

HS-LS4-4. Construct an explanation based on evidence for how natural selection leads to adaptation of populations. **HS-LS4-5. Evaluate the evidence supporting claims that changes in environmental conditions may result in: (1) increases in the number of individuals of some species, (2) the emergence of new species over time, and (3) the extinction of other species.** **HS-LS4-6. Create or revise a simulation to test a solution to mitigate adverse impacts of human activity on biodiversity.* [Clarification Statement: Emphasis is on designing solutions for a proposed problem related to threatened or endangered species, or to genetic variation of organisms for multiple species.]**	**LS4.B: Natural Selection** Natural selection occurs only if there is both (1) variation in the genetic information between organisms in a population and (2) variation in the expression of that genetic information—that is, trait variation—that leads to differences in performance among individuals. (HS-LS4-2),(HS-LS4-3) The traits that positively affect survival are more likely to be reproduced, and thus are more common in the population. (HS-LS4-3) **LS4.C: Adaptation** Evolution is a consequence of the interaction of four factors: (1) the potential for a species to increase in number, (2) the genetic variation of individuals in a species due to mutation and sexual reproduction, (3) competition for an environment's limited supply of the resources that individuals need in order to survive and reproduce, and (4) the ensuing proliferation of those organisms that are better able to survive and reproduce in that environment. (HS-LS4-2) Natural selection leads to adaptation, that is, to a population	How can the process of natural selection be applied to antibiotic resistance?

	dominated by organisms that are anatomically, behaviorally, and physiologically well suited to survive and reproduce in a specific environment. That is, the differential survival and reproduction of organisms in a population that have an advantageous heritable trait leads to an increase in the proportion of individuals in future generations that have the trait and to a decrease in the proportion of individuals that do not. (HS-LS4-3),(HS-LS4-4) Adaptation also means that the distribution of traits in a population can change when conditions change. (HS-LS4-3) Changes in the physical environment, whether naturally occurring or human induced, have thus contributed to the expansion of some species, the emergence of new distinct species as populations diverge under different conditions, and the decline–and sometimes the extinction–of some species. (HS-LS4-5),(HS-LS4-6) Species become extinct because they can no longer survive and reproduce in their altered environment. If members cannot	

	adjust to change that is too fast or drastic, the opportunity for the species' evolution is lost. (HS-LS4-5) **LS4.D: Biodiversity and Humans** Humans depend on the living world for the resources and other benefits provided by biodiversity. But human activity is also having adverse impacts on biodiversity through overpopulation, overexploitation, habitat destruction, pollution, introduction of invasive species, and climate change. Thus sustaining biodiversity so that ecosystem functioning and productivity are maintained is essential to supporting and enhancing life on Earth. Sustaining biodiversity also aids humanity by preserving landscapes of recreational or inspirational value. (HS-LS4-6) (Note: This Disciplinary Core Idea is also addressed by HS-LS2-7.) **ETS1.B: Developing Possible Solutions** When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts. (secondary to HS-LS4-6) Both physical models and computers can be used in various	

	ways to aid in the engineering design process. Computers are useful for a variety of purposes, such as running simulations to test different ways of solving a problem or to see which one is most efficient or economical; and in making a persuasive presentation to a client about how a given	
	Acquisition	
	Students will KNOW… (Including Tier II and Tier III vocabulary) How and why organisms are classified by their evolutionary relationships Different models of classification used through history Characteristics and examples of major groupings of organisms Differences between and examples of bacteria, viral diseases Vocabulary terms: • Evolution, Natural selection, Adaptation, Variation, Heritability, Dichotomous key, Autotroph, Heterotroph, Prokaryotic, Binomial nomenclature, Eukaryotic, Domain, Kingdom, Phylum, Class, Order, Family, Genus, Species, Taxonomy, Phylogeny, Antibiotic resistance, Colonial, Multicellular, Strep, Staph, Cocci, Bacilli, Spriili, Capsid, Cell	*Students will be skilled at (DO)…* • Develop and use a dichotomous key to classify and identify organisms • Properly name organisms using Binomial Nomenclature system • Classify and identify bacteria based on defining characteristics • Analyze experimental data to show comprehension of antibiotic resistance via natural selection

	wall, Conjugation, Flagellum, Pili, Bioremediation, Endospore, Nitrogen fixation, Lytic cycle, Lysogenic cycle, Prophage, Vaccine, Epidemic, Retrovirus, Protist	

Stage 2 - Evidence

How will you monitor and/or measure evidence of student learning? How will you communicate student learning? How do students provide feedback about their learning?

Evaluative Criteria	**Assessment Evidence**
Answer keys	PERFORMANCE TASK(S): Quizzes Test
<type here>	OTHER EVIDENCE: <type here>

COURSE NAME: BIOLOGY

Developers: Bio Team	*Development Date: 2016*	*Instructional Level: 9th*	*Unit: Ecology*

Stage 1 Desired Results

<table>
<tr><td rowspan="3">ESTABLISHED GOALS (Which Content & CCSS from multiple strands (e.g. reading, writing, language, speaking, listening & content) can be integrated?)

. HS-LS2-1. Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales.
HS-LS2-2. Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales.
HS-LS2-3. Construct and revise an explanation based on evidence for the cycling of matter and flow of energy in aerobic and anaerobic conditions.
HS-LS2-4. Use mathematical representations to support claims for the cycling of matter and flow of energy among organisms in an ecosystem.
HS-LS2-5. Develop a model to illustrate the role of photosynthesis and cellular respiration in the cycling of carbon among the biosphere, atmosphere, hydrosphere, and geosphere.</td>
<td colspan="2">Transfer
Students will be able to independently use their learning to…
Critically analyze and compare contrasting viewpoints
Evaluate evidence to support scientific positions
Model time and events to provide a scope and sequence for processes
Identify and understand patterns and causes
Describe how science models, support Theories that explain natural phenomena</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>UNDERSTANDINGS
Students will understand that…
LS2.A: Interdependent Relationships in Ecosystems
Ecosystems have carrying capacities, which are limits to the numbers of organisms and populations they can support. These limits result from such factors as the availability of living and nonliving resources and from such challenges such as predation, competition, and disease. Organisms would have the capacity to produce populations of great size were it not for the fact that environments and resources are finite. This fundamental tension affects the abundance (number of individuals) of species in any given ecosystem. (HS-LS2-1),(HS-LS2-2)

LS2.B: Cycles of Matter and Energy Transfer in Ecosystems</td>
<td>ESSENTIAL QUESTIONS (What open-ended, age appropriate questions will prompt exploration and creative and critical thinking?)
Why is it important to use observations, experimentation, and modeling when conducting ecological research?

How do different symbiotic relationships affect ecosystems?

How does population density and dispersion affect populations and communities?

How and why do populations grow?

What is the role of energy in an ecosystem and how does it move?

How does matter cycle through environments and why is that important?</td></tr>
</table>

HS-LS2-6. Evaluate the claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, but changing conditions may result in a new ecosystem. HS-LS2-7. Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity HS-LS2-8. Evaluate the evidence for the role of group behavior on individual and species' chances to survive and reproduce. HS-LS4-5. Evaluate the evidence supporting claims that changes in environmental conditions may result in: (1) increases in the number of individuals of some species, (2) the emergence of new species over time, and (3) the extinction of other species. HS-ESS2-7. Construct an argument based on evidence about the simultaneous coevolution of Earth's systems and life on Earth. HS-ESS3-3. Create a computational simulation to illustrate the relationships among management of natural resources, the sustainability of human populations, and biodiversity.	Photosynthesis and cellular respiration (including anaerobic processes) provide most of the energy for life processes. (HS-LS2-3) Plants or algae form the lowest level of the food web. At each link upward in a food web, only a small fraction of the matter consumed at the lower level is transferred upward, to produce growth and release energy in cellular respiration at the higher level. Given this inefficiency, there are generally fewer organisms at higher levels of a food web. Some matter reacts to release energy for life functions, some matter is stored in newly made structures, and much is discarded. The chemical elements that make up the molecules of organisms pass through food webs and into and out of the atmosphere and soil, and they are combined and recombined in different ways. At each link in an ecosystem, matter and energy are conserved. (HS-LS2-4) Photosynthesis and cellular respiration are important components of the carbon cycle, in which carbon is exchanged among the biosphere, atmosphere, oceans, and geosphere through chemical, physical, geological, and biological processes. (HS-LS2-5) LS2.C: Ecosystem Dynamics, Functioning, and Resilience A complex set of interactions within an ecosystem can keep its numbers and	Why is ecological succession important? What are the goals of ecological conservation? What are the challenges with ecological conservation?

HS-ESS3-4. Evaluate or refine a technological solution that reduces impacts of human activities on natural systems. HS-LS4-6. Create or revise a simulation to test a solution to mitigate adverse impacts of human activity on biodiversity.	types of organisms relatively constant over long periods of time under stable conditions. If a modest biological or physical disturbance to an ecosystem occurs, it may return to its more or less original status (i.e., the ecosystem is resilient), as opposed to becoming a very different ecosystem. Extreme fluctuations in conditions or the size of any population, however, can challenge the functioning of ecosystems in terms of resources and habitat availability. (HS-LS2-2),(HS-LS2-6	
	Acquisition	
	Students will KNOW… (Including Tier II and Tier III vocabulary) • How understanding ecosystems is essential to studying them • How changing abiotic/biotic factors change ecosystems • How energy moves through ecosystems • The differences between a food chain and a food web • How nutrients cycle through an ecosystem • The difference between habitat and niche • Characteristics of different biomes • How traits, reproductive strategies, and environmental pressures impact the survival of populations • How populations grow • Effects of invasive species	*Students will be skilled at (DO)…* • Designing thoughtful ecological research • Using food chains, food webs, pyramids of energy, biomass, and numbers to demonstrate the flow of energy between trophic levels in an ecosystem • Identifying different community interactions and how they affect the ecosystem. • Simulating and graphing population growth and dispersion patterns • Explaining why ecosystems change or stay the same • Identifying stages of succession

	• How human activities effect on the environment • The future of ecology and conservation Vocabulary: Ecology, biotic/abiotic factor, species, population, community, ecosystem, biome, keystone species, biodiversity, trophic level, producer, autotroph, heterotroph, consumer, chemosynthesis, food chain, food web, carnivore, herbivore, omnivore, detritivore, decomposer, nutrient cycle mutualism, parasitism, commensalism ,symbiosis, niche, habitat, interspecific, intraspecific, carrying capacity, density independent, density dependent, succession, invasive species, habitat fragmentation, endangered species,	• Identifying and creating solutions to different issues regarding conservation and ecology

Stage 2 - Evidence

How will you monitor and/or measure evidence of student learning? How will you communicate student learning? How do students provide feedback about their learning?

Evaluative Criteria	**Assessment Evidence**
<type here>	PERFORMANCE TASK(S): <type here>
<type here>	OTHER EVIDENCE: <type here>

COURSE NAME: CHEMISTRY

Developers: Anne Nyseth	Development Date: 2016	Instructional Level: 10-12	Unit: Numbers and Measurement

Stage 1 Desired Results

ESTABLISHED GOALS *(Which Content & CCSS from multiple strands (e.g. reading, writing, language, speaking, listening & content) can be integrated?)*

HSN-Q.A.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.

HSN-Q.A.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.

HSA-CED.A.4 Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations.

Transfer

Students will be able to independently use their learning to…

- **Work safely and efficiently in the laboratory**
- **Use mathematics and computational thinking to apply problem solving strategies**
- **Develop and use models**
- **Plan and carry out investigations**
- **Ask questions and define problems**

Meaning

UNDERSTANDINGS
Students will understand that…

PS1.A: Structure and Properties of Matter

♣Attraction and repulsion between electric charges at the atomic scale explain the structure, properties, and transformations of matter, as well as the contact forces between material objects.

ESSENTIAL QUESTIONS *(What open-ended, age appropriate questions will prompt exploration and creative and critical thinking?)*

What is the importance of significant figures used in lab work and calculations?
How is the structure of matter related to density?
Describe in detail how to find the density of an irregular solid.

Acquisition

Students will KNOW… (Including Tier II and Tier III vocabulary)

- Appropriate safety rules and behaviors
- Emergency procedures
- The difference between accuracy and precision

Students will be skilled at (DO)…

- Determining the correct number of significant figures to use in calculations involving measurement
- Choosing correct equipment for lab procedures

	• Rules for using significant figures • How to convert between standard number form and scientific notation • The metric prefixes and their quantities • The meanings of vocabulary including: scientific notation, significant figures, accuracy, precision, meniscus, density	• Using lab equipment for its intended purpose • Using mathematical equations to solve for variables • Converting measurements within the metric system • Measuring and calculating density of liquids and solids

Stage 2 - Evidence

How will you monitor and/or measure evidence of student learning? How will you communicate student learning? How do students provide feedback about their learning?

Evaluative Criteria	Assessment Evidence
<type here>	PERFORMANCE TASK(S): <type here>
<type here>	OTHER EVIDENCE: <type here>

COURSE NAME: CHEMISTRY

Developers: Anne Nyseth	Development Date: 2016	Instructional Level: 10-12	Unit: Matter and Energy

Stage 1 Desired Results

<table>
<tr><td rowspan="4">ESTABLISHED GOALS (Which Content & CCSS from multiple strands (e.g. reading, writing, language, speaking, listening & content) can be integrated?)
HS-PS1-4. Develop a model to illustrate that the release or absorption of energy from a chemical reaction system depends upon the changes in total bond energy.

HS-PS3-1. Create a computational model to calculate the change in the energy of one component in a system when the change in energy of the other component(s) and energy flows in and out of the system are known.

HS-PS3-2. Develop and use models to illustrate that energy at the macroscopic scale can be accounted for as a combination of energy associated with the motions of particles (objects) and energy associated with the relative position of particles (objects).

HS-PS3-4. Plan and conduct an investigation to provide evidence that the transfer of thermal energy when two components of different temperature are combined within a closed system results in a more uniform energy distribution among the components in the system (second law of thermodynamics).</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…
Work safely and efficiently in the laboratory
Use mathematics and computational thinking to apply problem solving strategies
Develop and use models
Plan and carry out investigations
Ask questions and define problems
Obtain, evaluate, and communicate information</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>UNDERSTANDINGS
Students will understand that…
PS1.B: Chemical Reactions
♣The fact that atoms are conserved, together with knowledge of the chemical properties of the elements involved, can be used to describe and predict chemical reactions.
PS3.A: Definitions of Energy
♣ Energy is a quantitative property of a system that depends on the motion and interactions of matter and radiation within that system. That there is a single quantity called energy is due to the fact that a system's total energy is conserved, even as, within the system, energy is continually transferred from one object to another and between its various possible forms. (HSPS3-1),(HS-PS3-2)</td><td>ESSENTIAL QUESTIONS (What open-ended, age appropriate questions will prompt exploration and creative and critical thinking?)
How can scientists determine if a material is a mixture or a pure substance?

Describe heat flow in a closed system.</td></tr>
</table>

MP.4 Model with mathematics. **MP.2 Reason abstractly and quantitatively** **HSN-Q.A.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.** **HSN-Q.A.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.** **HSA.CED.A.4 Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations.** **WHST.9-12.2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.**	♣ At the macroscopic scale, energy manifests itself in multiple ways, such as in motion, sound, light, and thermal energy. (HSPS3-2) (HS-PS3-3) ♣ These relationships are better understood at the microscopic scale, at which all of the different manifestations of energy can be modeled as a combination of energy associated with the motion of particles and energy associated with the configuration (relative position of the particles). In some cases, the relative position energy can be thought of as stored in fields (which mediate interactions between particles). This last concept includes radiation, a phenomenon in which energy stored in fields moves across space. (HS-PS3-2) PS3.B: Conservation of Energy and Energy Transfer ♣ Conservation of energy means that the total change of energy in any system is always equal to the total energy transferred into or out of the system. (HS-PS3-1) ♣ Energy cannot be created or destroyed, but it can be transported from one place to another and transferred between systems. (HS-PS3-1), (HS-PS3-4) **PS3.D: Energy in Chemical Processes** ♣ Although energy cannot be destroyed, it can be converted to less useful forms—for example, to thermal energy in the surrounding environment.	
	Acquisition	

	Students will KNOW… (Including Tier II and Tier III vocabulary) • The difference between homogeneous and heterogeneous materials. • The difference between physical and chemical properties. • The difference between intensive and extensive physical properties. • The difference between physical and chemical changes. • The hints that a chemical reaction has occurred. • How to determine if a change is exothermic or endothermic. • The relationship between specific heat and conductivity. • The meanings of vocabulary including: matter, element, compound, substance, organic, inorganic, solution, mixture, heterogeneous, homogeneous, colloid, suspension, ductile, malleable, luster, intensive property, extensive property, precipitate, distillation, exothermic, endothermic, specific heat, Joules	*Students will be skilled at (DO)…* • Classifying examples of matter as homogeneous, heterogeneous, pure substances, elements, or compounds. • Describing matter using physical and/or chemical properties. • Observing and classifying changes in matter as chemical or physical. • Solving specific heat problems using the equation $q=mCp\Delta T$. • Solving heat problems involving more than one substance with the equation heat gain = heat loss ($mCp\Delta T = mCp\Delta T$).

Stage 2 - Evidence

How will you monitor and/or measure evidence of student learning? How will you communicate student learning? How do students provide feedback about their learning?

Evaluative Criteria	**Assessment Evidence**
<type here>	PERFORMANCE TASK(S): Lab- Calculating Specific Heat of a Metal
<type here>	OTHER EVIDENCE:

	<type here>

COURSE NAME: CHEMISTRY

Developers: Anne Nyseth	*Development Date:May2016*	*Instructional Level: 10-12*	*Unit: Atomic Structure*

Stage 1 Desired Results

HS-PS1-1. Use the periodic table as a model to predict the relative properties of elements based on the patterns of electrons in the outermost energy level of atoms.

HS-PS4-1. Use mathematical representations to support a claim regarding relationships among the frequency, wavelength,
and speed of waves traveling in various media

Transfer

Students will be able to independently use their learning to…

- **Use mathematics and computational thinking**
- **Develop and use models**
- **Plan and carry out investigations**
- **Understand patterns**
- **Describe how science models, laws, mechanisms, and theories explain natural phenomena**

Meaning

UNDERSTANDINGS	ESSENTIAL QUESTIONS *(What open-ended, age appropriate questions will prompt exploration and creative and critical thinking?)*
Students will understand that… PS1.A: Structure and Properties of Matter ♣ Each atom has a charged substructure consisting of a nucleus, which is made of protons and neutrons, surrounded by electrons. (HS-PS1-1) ♣ The periodic table orders elements horizontally by the number of protons in the atom's nucleus and places those with similar chemical properties in columns. The repeating patterns of this table reflect patterns of outer electron states. (HS-PS1-1) PS1.C: Nuclear Processes ♣ Nuclear processes, including fusion, fission, and radioactive decays of unstable nuclei, involve release or absorption of energy. The total number of neutrons plus	Use examples to describe the progress science has made in determining the structure of the atom. How can we use the periodic table to predict properties of elements? Why is atomic structure still considered to be a theory? Why is the Quantum Theory important to chemists?

<table>
<tr><td rowspan="3"></td><td>protons does not change in any nuclear process. (HSPS1-8)

PS4.A: Wave Properties
♣ The wave length and frequency of a wave are related to one another by the speed of travel of the wav e, which depends on the type of wave and the medium through which it is passing. (HS-PS4-1)
PS4.B: Electromagnetic Radiation
♣ When light or longer wavelength electromagnetic radiation is absorbed in matter, it is generally converted into thermal energy (heat). Shorter wavelength electromagnetic radiation (ultraviolet, X-rays, gamma rays) can ionize atoms and cause damage to living cells. (HS-PS4-4)</td><td></td></tr>
<tr><td colspan="2">Acquisition</td></tr>
<tr><td>Students will KNOW… (Including Tier II and Tier III vocabulary)
• The milestones associated with the history of the atom
• The meaning of each piece of information in each box on the periodic table
• Differences in types of radiation (alpha, beta, gamma)
• The meanings of vocabulary including: atom, proton, electron, neutron, isotope, electron cloud, nucleus, mass number, atomic number, radiation, frequency, wavelength, speed of light,</td><td>Students will be skilled at (DO)…
• Correctly calculating atomic mass using the periodic table
• Using the periodic table to determine the number of protons, neutrons, and electrons in a given isotope
• Predicting properties of elements using the periodic table
• Making a cloud drawing for individual atoms (atomic number 1-20)
• Using the periodic table to write electron configurations and orbital diagrams for all elements</td></tr>
</table>

	electron configuration, electron dot diagram, orbital filling diagram, cloud drawing, Quantum Theory, energy level, energy sublevel, orbital, electron “spin”, Pauli Exclusion Principle, hadron, lepton • The basic idea of research at CERN	• Drawing Lewis dot diagrams of individual atoms

Stage 2 - Evidence

How will you monitor and/or measure evidence of student learning? How will you communicate student learning? How do students provide feedback about their learning?

Evaluative Criteria	**Assessment Evidence**
Answer keys	PERFORMANCE TASK(S): Quizzes Test Cloud drawings assignment
<type here>	OTHER EVIDENCE: <type here>

COURSE NAME: CHEMISTRY

Developers: Anne Nyseth	Development Date: 2016	Instructional Level: 10-12	Unit: Formulas and Bonding

Stage 1 Desired Results

ESTABLISHED GOALS *(Which Content & CCSS from multiple strands (e.g. reading, writing, language, speaking, listening & content) can be integrated?)*	***Transfer***	
HS-PS1-1. Use the periodic table as a model to predict the relative properties of elements based on the patterns of electrons in the outermost energy level of atoms. **MP.4 Model with mathematics.** **MP.2 Reason abstractly and quantitatively** **HSN-Q.A.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.**	*Students will be able to independently use their learning to…* • **Work safely and efficiently in the laboratory** • **Use mathematics and computational thinking to apply problem solving strategies** • **Develop and use models** • **Plan and carry out investigations** • **Ask questions and define problems**	
	Meaning	
	UNDERSTANDINGS *Students will understand that…* **PS1.A: Structure and Properties of Matter** ♣ Each atom has a charged substructure consisting of a nucleus, which is made of protons and neutrons, surrounded by electrons. (HS-PS1-1) ♣ The periodic table orders elements horizontally by the number of protons in the atom's nucleus and places those with similar chemical properties in columns. The repeating patterns of this table reflect patterns of outer electron states. (HS-PS1-1),(HS-PS1-2) ♣ The structure and interactions of matter at the bulk scale are determined by electrical forces within and between atoms. (HS-PS1-3),(secondary to HS-PS2-6) ♣ A stable molecule has less energy than the same set of atoms separated; one	ESSENTIAL QUESTIONS *(What open-ended, age appropriate questions will prompt exploration and creative and critical thinking?)* Describe the relationship between bond type and properties of a substance.

	must provide at least this energy in order to take the molecule apart. ♣ Attraction and repulsion between electric charges at the atomic scale explain the structure, properties, and transformations of matter, as well as the contact forces between material objects.	
	Acquisition	
	Students will KNOW… (Including Tier II and Tier III vocabulary) • How to predict the chemical stability of an atom based on the octet rule • How to determine if an atom will share, gain, or lose electrons in a bond. • Factors that influence bond type • How to identify the type of bond between two elements based on electronegativity. • Differences and similarities among ionic, covalent, and metallic bonds • Differences among single, double, and triple bonds. • How hydrogen bonding is different than covalent bonding • How a coefficient affects the number of atoms in a formula. • The meanings of vocabulary including: ionic, covalent, bond, intermolecular, intramolecular, ion, anion, cation, polyatomic ion, electronegativity, polarity, structural formula, electrostatic	*Students will be skilled at (DO)…* • Drawing electron dot structures for elements, polyatomic ions, and simple molecules • Writing formulas for ionic compounds using oxidation numbers. • Write formulas for covalent molecules using prefixes. • Naming ionic compounds and covalent molecules. • Finding empirical formulas from molecular formulas. • Determining the number of atoms in a formula. • Calculating the formula mass of a compound, molecule, or hydrate

	force, coefficient, subscript, molecular formula, empirical formula	

Stage 2 - Evidence

How will you monitor and/or measure evidence of student learning? How will you communicate student learning? How do students provide feedback about their learning?

Evaluative Criteria	Assessment Evidence
<type here>	PERFORMANCE TASK(S): Lab- Building Molecules
<type here>	OTHER EVIDENCE: <type here>

COURSE NAME: CHEMISTRY

Developers: Anne Nyseth	Development Date: 2016	Instructional Level: 10-12	Unit: Formulas and the Mole

Stage 1 Desired Results

ESTABLISHED GOALS	Transfer	
ESTABLISHED GOALS *(Which Content & CCSS from multiple strands (e.g. reading, writing, language, speaking, listening & content) can be integrated?)* **MP.4 Model with mathematics.** **MP.2 Reason abstractly and quantitatively** **HSN-Q.A.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays** **HSN-Q.A.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.** HS-PS1-2. Construct and revise an explanation for the outcome of a simple chemical reaction based on the outermost electron states of atoms, trends in the periodic table, and knowledge of the patterns of chemical properties.	*Students will be able to independently use their learning to…* • **Work safely and efficiently in the laboratory** • **Use mathematics and computational thinking to apply problem solving strategies** • **Develop and use models** • **Plan and carry out investigations** • **Ask questions and define problems**	
	Meaning	
	UNDERSTANDINGS *Students will understand that…* **PS1.A: Structure and Properties of Matter** ♣ Each atom has a charged substructure consisting of a nucleus, which is made of protons and neutrons, surrounded by electrons. (HS-PS1-1) ♣ The periodic table orders elements horizontally by the number of protons in the atom's nucleus and places those with similar chemical properties in columns. The repeating patterns of this table reflect patterns of outer electron states. (HS-PS1-1),(HS-PS1-2)	ESSENTIAL QUESTIONS *(What open-ended, age appropriate questions will prompt exploration and creative and critical thinking?)* What is a mole and what is its importance in chemistry? In class, we often compare a "mole" to a "dozen". Explain.
	Acquisition	
	Students will KNOW… (Including Tier II and Tier III vocabulary) • Avogadro's number (the mole)	*Students will be skilled at (DO)…* • Writing formulas for ionic compounds and covalent molecules.

	• The relationship between moles of a substance and grams of that substance. • The meanings of vocabulary including: mole, Avogadro's Number, molar mass, factor-label method, empirical formula, percent composition by mass	• Naming ionic compounds and covalent molecules. • Using the factor-label (unit cancelling) method to solve problems using mole concepts. • Calculating the molar mass of a substance. • Converting grams to moles, number of particles to moles, and grams to number of particles. • Calculating percent composition by mass. • Calculating an empirical formula for a substance based on lab data.

Stage 2 - Evidence

How will you monitor and/or measure evidence of student learning? How will you communicate student learning? How do students provide feedback about their learning?

Evaluative Criteria	**Assessment Evidence**
<type here>	PERFORMANCE TASK(S): Lab- Percent Composition Lab- Empirical Formula
<type here>	OTHER EVIDENCE: <type here>

COURSE NAME: CHEMISTRY

Developers: Anne Nyseth	Development Date: 2016	Instructional Level: 10-12	Unit: Chemical Equations

Stage 1 Desired Results

ESTABLISHED GOALS *(Which Content & CCSS from multiple strands (e.g. reading, writing, language, speaking, listening & content) can be integrated?)*

HS-PS1-2. Construct and revise an explanation for the outcome of a simple chemical reaction based on the outermost electron states of atoms, trends in the periodic table, and knowledge of the patterns of chemical properties.

HS-PS1-5. Apply scientific principles and evidence to provide an explanation about the effects of changing the temperature or concentration of the reacting particles on the rate at which a reaction occurs.

HS-PS1-7. Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction.

HS-PS1-8. Develop models to illustrate the changes in the composition of the nucleus of the atom and the energy released during the processes of fission, fusion, and radioactive decay.

MP.4 Model with mathematics.

MP.2 Reason abstractly and quantitatively

Transfer

Students will be able to independently use their learning to…

- **Work safely and efficiently in the laboratory**
- **Use mathematics and computational thinking to apply problem solving strategies**
- **Develop and use models**
- **Plan and carry out investigations**
- **Ask questions and define problems**
- **Obtain, evaluate, and communicate information**

Meaning

UNDERSTANDINGS
Students will understand that…

PS1.B: Chemical Reactions

♣ Chemical processes, their rates, and whether or not energy is stored or released can be understood in terms of the collisions of molecules and the rearrangements of atoms into new molecules, with consequent changes in the sum of all bond energies in the set of molecules that are matched by changes in kinetic energy.

♣ The fact that atoms are conserved, together with knowledge of the chemical properties of the elements involved, can be used to describe and predict chemical reactions.

PS1.C: Nuclear Processes

♣ Nuclear processes, including fusion, fission, and radioactive decays of unstable nuclei, involve release or absorption of

ESSENTIAL QUESTIONS *(What open-ended, age appropriate questions will prompt exploration and creative and critical thinking?)*

Describe the Law of Conservation of Mass.

How is stoichiometry useful to chemists in industry?

<table>
<tr>
<td rowspan="3">HSN-Q.A.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays

HSN-Q.A.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.

RST.9-10.7 Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words</td>
<td>energy. The total number of neutrons plus protons does not change in any nuclear process.</td>
<td></td>
</tr>
<tr>
<td colspan="2">Acquisition</td>
</tr>
<tr>
<td>Students will KNOW… (Including Tier II and Tier III vocabulary)

• Avogadro’s number (the mole)
• The relationship between moles of a substance and grams of that substance.
• The parts of a chemical equation
• How to recognize five types of chemical reactions
• How the Law of Conservation of Mass applies to chemical reactions
• The meanings of vocabulary including: mole, Avogadro’s Number, molar mass, reactant, product, yield, coefficient, subscript, factor-label method, stoichiometry, nuclear decay, alpha, beta, gamma, positron,</td>
<td>Students will be skilled at (DO)…
• Writing formulas for ionic compounds and covalent molecules.
• Naming ionic compounds and covalent molecules.
• Calculating the molar mass of a substance.
• Converting grams to moles and moles to grams.
• Writing chemical equations from a descriptive sentence.
• Balancing chemical equations using coefficients.
• Using the factor-label (unit cancelling) method to solve problems using mole concepts including mass-mass relationships.
• Writing and balancing nuclear equations.</td>
</tr>
</table>

<table>
<tr>
<td colspan="2">Stage 2 - Evidence
How will you monitor and/or measure evidence of student learning? How will you communicate student learning? How do students provide feedback about their learning?</td>
</tr>
<tr>
<td>Evaluative Criteria</td>
<td>Assessment Evidence</td>
</tr>
<tr>
<td><type here></td>
<td>PERFORMANCE TASK(S):
Lab- Stoichiometry</td>
</tr>
<tr>
<td><type here></td>
<td>OTHER EVIDENCE:
<type here></td>
</tr>
</table>

COURSE NAME: CHEMISTRY IN THE COMMUNITY

Developers: Josh Kinsman	*Development Date: June 2016*	*Instructional Level: 10-12*	*Unit: Measurement and Lab Safety*

Stage 1 Desired Results

<table>
<tr><td rowspan="4">
Science and Engineering Practice 4: Analyzing and Interpreting Data

 Consider limitations of data analysis (e.g., measurement error, sample selection) when analyzing and interpreting data.

 Compare and contrast various types of data sets (e.g., self-generated, archival) to examine consistency of measurements and observations.

Science and Engineering Practice 5: Using Mathematics and Computational Thinking

 Apply ratios, rates, percentages, and unit conversions in the context of complicated measurement problems involving quantities with derived or compound units (such as mg/mL, kg/m3, acre-feet, etc.)
</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…
• Work safely in a lab setting
• Properly use lab equipment
• Use dimensional analysis to solve calculations
• Make accurate measurements using lab equipment
• Convert between standard and metric units
• Understand basic organization and structure of periodic table
• Understand the relationship between mass, volume, and density</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>UNDERSTANDINGS
Students will understand that…

Specific safety precautions must be used while working in a science lab.

Lab equipment can be used in appropriate ways to perform scientific studies and collect data.

Dimensional analysis can be used to solve calculations and determine appropriate units.

Accurate measurement is essential in collecting quantitative data in labs.

The metric system is the system of measurement in science</td>
<td>ESSENTIAL QUESTIONS (What open-ended, age appropriate questions will prompt exploration and creative and critical thinking?)

Why are accurate measurements important in science?

Why is safety important in a lab setting?

What are the relationship between mass, volume, and density?

How is the periodic table organized?</td></tr>
</table>

<table>
<tr><td rowspan="3"></td><td>Standard units can be converted to metric units using dimensional analysis techniques.

Mass, volume, and density are related mathematically.

The periodic table is organized based on trends of the elements and atomic structure.</td><td></td></tr>
<tr><td colspan="2">Acquisition</td></tr>
<tr><td>Students will KNOW… (Including Tier II and Tier III vocabulary)

Specific safety precautions must be used while working in a science lab.

Lab equipment can be used in appropriate ways to perform scientific studies and collect data.

Dimensional analysis can be used to solve calculations and determine appropriate units.

Accurate measurement is essential in collecting quantitative data in labs.

The metric system is the system of measurement in science</td><td>Students will be skilled at (DO)…

• Conducting safe laboratory practices

• Measuring distance, volume, mass, weight

• Calculating volume and density

• Converting units (metric to metric, English to English, and metric to English)</td></tr>
</table>

	Standard units can be converted to metric units using dimensional analysis techniques. Mass, volume, and density are related mathematically. The periodic table is organized based on trends of the elements and atomic structure. **Vocabulary Terms:** Density, volume, mass, weight, dimensional analysis	

Stage 2 - Evidence

How will you monitor and/or measure evidence of student learning? How will you communicate student learning? How do students provide feedback about their learning?

Evaluative Criteria	Assessment Evidence
Answer keys	PERFORMANCE TASK(S):
<type here>	OTHER EVIDENCE: <type here>

COURSE NAME: CHEMISTRY IN THE COMMUNITY

Developers: Josh Kinsman and Jared Johnson	Development Date: June 2016	Instructional Level: 10-12	Unit: Materials

Stage 1 Desired Results

ESTABLISHED GOALS *(Which Content & CCSS from multiple strands (e.g. reading, writing, language, speaking, listening & content) can be integrated?)*

HS-PS1-1. Use the periodic table as a model to predict the relative properties of elements based on the patterns of electrons in the outermost energy level of atoms.

HS-PS2-6. Communicate scientific and technical information about why the molecular-level structure is important in the functioning of designed materials*

Cross-Cutting Concepts - Patterns
 Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena

Science and Engineering Practices
 Developing and Using Models

Transfer

Students will be able to independently use their learning to…

- **Identify and understand patterns and causes**
- **Describe how science models support theories that explain natural phenomena**
- **Plan and conduct investigations**
- **Use mathematics and computational thinking**

Meaning

UNDERSTANDINGS
Students will understand that…

PS1.A: Structure and Properties of Matter

- Each atom has a charged substructure consisting of a nucleus, which is made of protons and neutrons, surrounded by electrons. (HS-PS1-1)
- The periodic table orders elements horizontally by the number of protons in the atom's nucleus and places those with similar chemical properties in columns. The repeating patterns of this table reflect patterns of outer electron states. (HS-PS1-1)
- The structure and interactions of matter at the bulk scale are determined by

ESSENTIAL QUESTIONS *(What open-ended, age appropriate questions will prompt exploration and creative and critical thinking?)*

What are the properties of matter?

How do we organize matter?

How can matter change?

How can The Law of Conservation of Mass be modeled?

	electrical forces within and between atoms. (HS-PS1-3),	
	Acquisition	
	Students will KNOW… (Including Tier II and Tier III vocabulary) • Atomic structure (charge, mass, and locations of subatomic particles). • The periodic table is organized based on specific trends and can be used to predict properties of elements • Matter can be made of elements, molecules, compounds, and mixtures • Substances have unique chemical and physical properties • Examples of chemical and physical properties • How to determine if substances go through physical and chemical changes • How and why ionic compounds form • Why we need to balance chemical equations • What percent composition represents • How moles are used to represent quantities in chemistry **Vocabulary:** Physical property, chemical property physical change, chemical change	*Students will be skilled at (DO)…* • Create a model of an atom • Determine the number of atoms in a compound • Test substances for chemical and physical properties • Determining the percent composition • Balancing chemical equations • Calculate molar mass of substances

	Matter, atom, element, compound, molecule, chemical bond, reactant, product, metals, nonmetals, metalloids, isotope, period, group/family, ion, mole, molar mass	
Stage 2 - Evidence ***How will you monitor and/or measure evidence of student learning? How will you communicate student learning? How do students provide feedback about their learning?***		
Evaluative Criteria	**Assessment Evidence**	
<type here>	PERFORMANCE TASK(S): <type here>	
<type here>	OTHER EVIDENCE: <type here>	

COURSE NAME: CHEMISTRY IN THE COMMUNITY

Developers: Josh Kinsman and Jared Johnson	Development Date: 2016	Instructional Level: 10-12	Unit: Atmosphere

Stage 1 Desired Results

ESTABLISHED GOALS *(Which Content & CCSS from multiple strands (e.g. reading, writing, language, speaking, listening & content) can be integrated?)*

HS-PS3-1. Create a computational model to calculate the change in the energy of one component in a system when the change in energy of the other component(s) and energy flows in and out of the system are known.

HS-PS3-4. Plan and conduct an investigation to provide evidence that the transfer of thermal energy when two components of different temperature are combined within a closed system results in a more uniform energy distribution among the components in the system (second law of thermodynamics).

HS-ESS2-6. Develop a quantitative model to describe the cycling of carbon among the hydrosphere, atmosphere, geosphere, and biosphere.

HS-ESS2-4. Use a model to describe how variations in the flow of energy into and out of Earth's systems result in changes in climate.

HS-ESS3-5. Analyze geoscience data and the results from global climate models to

Transfer

Students will be able to independently use their learning to…

- **Identify and understand patterns and causes**
- **Describe how science models support theories that explain natural phenomena**
- **Plan and conduct investigations**
- **Use mathematics and computational thinking**
- **Constructing Explanations and Designing Solutions**

Meaning

UNDERSTANDINGS
Students will understand that…

PS3.A: Definitions of Energy

 Energy is a quantitative property of a system that depends on the motion and interactions of matter and radiation within that system. That there is a single quantity called energy is due to the fact that a system's total energy is conserved, even as, within the system, energy is continually transferred from one object to another and between its various possible forms. (HSPS3-1),(HS-PS3-2)

 These relationships are better understood at the microscopic scale, at which all of the different manifestations of energy can be modeled as a combination of energy associated with the motion of

ESSENTIAL QUESTIONS *(What open-ended, age appropriate questions will prompt exploration and creative and critical thinking?)*

How are pressure, volume, and temperature related in the different gas laws?

Why does matter change phases?

What are the key elements of the kinetic molecular theory?

What are the major components of the Earth's atmosphere?

How does the Earth's atmosphere interact with solar radiation?

How is the electromagnetic spectrum organized?

make an evidence-based forecast of the current rate of global or regional climate change and associated future impacts to Earth systems. HS-ESS3-6. Use a computational representation to illustrate the relationships among Earth systems and how those relationships are being modified due to human activity.*	particles and energy associated with the configuration (relative position of the particles). In some cases the relative position energy can be thought of as stored in fields (which mediate interactions between particles). This last concept includes radiation, a phenomenon in which energy stored in fields moves across space. (HS-PS3-2) **PS4.B: Electromagnetic Radiation** Electromagnetic radiation (e.g., radio, microwaves, light) can be modeled as a wave of changing electric and magnetic fields or as particles called photons. The wave model is useful for explaining many features of electromagnetic radiation, and the particle model explains other features. (HS-PS4-3) When light or longer wavelength electromagnetic radiation is absorbed in matter, it is generally converted into thermal energy (heat). Shorter wavelength electromagnetic radiation (ultraviolet, X-rays, gamma rays) can ionize atoms and cause damage to living cells. (HS-PS4-4) **ESS2.A: Earth Materials and Systems** The geological record shows that changes to global and regional climate can be caused by interactions among changes in the sun's energy output or Earth's orbit, tectonic events, ocean circulation, volcanic activity, glaciers,	What are ways that primary and secondary pollutants are affecting the Earth's atmosphere? What types of personal and global strategies can help reduce air pollutants?

	vegetation, and human activities. These changes can occur on a variety of time scales from sudden (e.g., volcanic ash clouds) to intermediate (ice ages) to very long-term tectonic cycles. (HS-ESS2-4) ESS2.D: Weather and Climate The foundation for Earth's global climate systems is the electromagnetic radiation from the sun, as well as its reflection, absorption, storage, and redistribution among the atmosphere, ocean, and land systems, and this energy's re-radiation into space. (HS-ESS2-4), (secondary to HS - ESS2 - 2) Changes in the atmosphere due to human activity have increased carbon dioxide concentrations and thus affect climate. (HS-ESS2-4) ESS3.D: Global Climate Change Though the magnitudes of human impacts are greater than they have ever been, so too are human abilities to model, predict, and manage current and future impacts. (HS-ESS3-5) **ESS2.D: Weather and Climate** Current models predict that, although future regional climate changes will be complex and varied, average global temperatures will continue to rise. The outcomes predicted by global climate models strongly depend on the amounts	

<table>
<tr><td rowspan="3"></td><td>of human-generated greenhouse gases added to the atmosphere each year and by the ways in which these gases are absorbed by the ocean and biosphere.

ESS3.D: Global Climate Change
 Through computer simulations and other studies, important discoveries are still being made about how the ocean, the atmosphere, and the biosphere interact and are modified in response to human activities. (HS-ESS3-6)

ETS1.B. Developing Possible Solutions
 When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts.</td><td></td></tr>
<tr><td colspan="2">Acquisition</td></tr>
<tr><td>Students will KNOW… (Including Tier II and Tier III vocabulary)
How kinetic theory relates to the behavior and properties of gases
The structure and composition of earth's atmosphere
The relationship between pressure and altitude in the atmosphere
How changes in temperature, pressure, and volume affect gas behavior
How to use gas laws (Boyle's, Charles', Gay-Lussac's, and</td><td>Students will be skilled at (DO)…
Using gas laws to solve for an unknown value in an algebraic equation.
Calculating specific heat
Using models to navigate the carbon cycle
Determine pH of solutions using indicators
Evaluate/discuss solutions related to human-induced climate change</td></tr>
</table>

	Dalton’s Laws) to determine changes in gas behavior • How energy is transferred through electromagnetic radiation • How energy is absorbed or reflected by different materials. • How specific heat can be used to describe heat transfer • Carbon moves through the carbon cycle • Carbon dioxide is a product of combustion reactions • Carbon dioxide levels have increased due to human activity • Greenhouse gases cause atmospheric temperatures to increase • Human activity has the ability to affect earth’s systems • How acid rain is produced • The pH scale and differences between acids and bases • How buffers affect pH changes to solutions • Primary and secondary pollutants and examples of each	

Stage 2 – Evidence

How will you monitor and/or measure evidence of student learning? How will you communicate student learning? How do students provide feedback about their learning?

Evaluative Criteria	Assessment Evidence
<type here>	PERFORMANCE TASK(S): <type here>
<type here>	OTHER EVIDENCE: <type here>

COURSE NAME: CHEMISTRY IN THE COMMUNITY

Developers:	Development Date: 2016	Instructional Level: 10-12	Unit: Petroleum

Stage 1 Desired Results

ESTABLISHED GOALS *(Which Content & CCSS from multiple strands (e.g. reading, writing, language, speaking, listening & content) can be integrated?)*

HS-PS1-3. Plan and conduct an investigation to gather evidence to compare the structure of substances at the bulk scale to infer the strength of electrical forces between particles.

HS-PS1-4. Develop a model to illustrate that the release or absorption of energy from a chemical reaction system depends upon the changes in total bond energy.

HS-PS3-1. Create a computational model to calculate the change in the energy of one component in a system when the change in energy of the other component(s) and energy flows in and out of the system are known.

HS-PS3-4. Plan and conduct an investigation to provide evidence that the transfer of thermal energy when two components of different temperature are combined within a closed system results in a more uniform energy distribution among the components in the system (second law of thermodynamics).

HS-ESS2-6. Develop a quantitative model to describe the cycling of carbon among the hydrosphere, atmosphere, geosphere, and biosphere.

Transfer

Students will be able to independently use their learning to…

- **Identify and understand patterns and causes**
- **Describe how science models support theories that explain natural phenomena**
- **Plan and conduct investigations**
- **Use mathematics and computational thinking**

Meaning

UNDERSTANDINGS
Students will understand that…

PS1.A: Structure and Properties of Matter

- The structure and interactions of matter at the bulk scale are determined by electrical forces within and between atoms. (HS-PS1-3),

PS1.A: Structure and Properties of Matter

- A stable molecule has less energy than the same set of atoms separated; one must provide at least this energy in order to take the molecule apart. (HS-PS1-4)

PS3.A: Definitions of Energy

- Energy is a quantitative property of a system that depends on the motion

ESSENTIAL QUESTIONS *(What open-ended, age appropriate questions will prompt exploration and creative and critical thinking?)*

In what ways is crude oil used?

How are hydrocarbons organized?

In what types of ways can we model hydrocarbons?

What is the relationship between monomers and polymers?

What is happening in a covalent bond?

How do kinetic and potential energy work with the law of conservation of energy?

	and interactions of matter and radiation within that system. That there is a single quantity called energy is due to the fact that a system's total energy is conserved, even as, within the system, energy is continually transferred from one object to another and between its various possible forms. (HSPS3-1),(HS-PS3-2) At the macroscopic scale, energy manifests itself in multiple ways, such as in motion, sound, light, and thermal energy. (HSPS3-2) (HS-PS3-3) **PS3.B: Conservation of Energy and Energy Transfer** Conservation of energy means that the total change of energy in any system is always equal to the total energy transferred into or out of the system. (HS-PS3-1) Energy cannot be created or destroyed, but it can be transported from one place to another and transferred between systems. (HS-PS3-1),(HS-PS3-4) **PS3.D: Energy in Chemical Processes** Although energy cannot be destroyed, it can be converted to less useful forms	What is the difference between endothermic and exothermic reactions? How are burning fossil fuels, the carbon cycle, and global climate change related? What are some alternatives to petroleum?

	ESS2.D: Weather and Climate • Changes in the atmosphere due to human activity have increased carbon dioxide concentrations and thus affect climate. (HS-ESS2-6)	
	Acquisition	
	Students will KNOW… (Including Tier II and Tier III vocabulary) • What petroleum is and location of major petroleum reserves • How petroleum is refined into various products • Examples of common petroleum products • How carbon forms hydrocarbon molecules through covalent bonds • The structure and name of alkane molecules • How intermolecular forces affect boiling point and other properties of hydrocarbon molecules • The role of petroleum as an energy source • The law of conservation of energy and energy transfer • How energy is released through the combustion of hydrocarbons • How the combustion of hydrocarbon fuels increases levels of carbon dioxide in the atmosphere • The role of petroleum in the carbon cycle	*Students will be skilled at (DO)…* • Track their carbon footprint and compare to the national average. • Building models of hydrocarbons • Naming different hydrocarbons • Calculating amount of energy released through combustion. • Thinking critically and using scientific evidence when addressing issues such as global climate change. • Evaluating alternative energy sources

	• How petroleum products are used to create new materials • How polymers are made using builder molecules • Possible alternative fuels and energy strategies • The difference between endothermic and exothermic reactions **Vocabulary**: hydrocarbon, fossil fuel, distillation, fractional distillation, intermolecular forces, alkane, molecular formula, structural formula, condensed formula, polar molecule, structural isomer, monomer, polymer, valence electron, covalent bond, petrochemicals, alkenes, saturated hydro carbon, unsaturated hydrocarbon, dimer, potential energy, kinetic energy, chemical energy, exothermic, endothermic, carbon cycle, global warming, octane rating, isomerization, oxygenated fuels, renewable energy.	

Stage 2 - Evidence

How will you monitor and/or measure evidence of student learning? How will you communicate student learning? How do students provide feedback about their learning?

Evaluative Criteria	**Assessment Evidence**
<type here>	PERFORMANCE TASK(S): <type here>
<type here>	OTHER EVIDENCE: <type here>

COURSE NAME: CHEMISTRY IN THE COMMUNITY

Developers: Josh Kinsman and Jared Johnson	Development Date: 2016	Instructional Level: 10-12	Unit: Water

Stage 1 Desired Results

<table>
<tr><td rowspan="4">ESTABLISHED GOALS (Which Content & CCSS from multiple strands (e.g. reading, writing, language, speaking, listening & content) can be integrated?)

HS-PS1-1. Use the periodic table as a model to predict the relative properties of elements based on the patterns of electrons in the outermost energy level of atoms.

HS-PS1-2. Construct and revise an explanation for the outcome of a simple chemical reaction based on the outermost electron states of atoms, trends in the periodic table, and knowledge of the patterns of chemical properties.

HS-PS1-3. Plan and conduct an investigation to gather evidence to compare the structure of substances at the bulk scale to infer the strength of electrical forces between particles.

HS-PS1-5.Apply scientific principles and evidence to provide an explanation about the effects of changing the temperature or concentration of the reacting particles on the rate at which a reaction occurs.</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>UNDERSTANDINGS
Students will understand that…
PS1.A: Structure and Properties of Matter
Each atom has a charged substructure consisting of a nucleus, which is made of protons and neutrons, surrounded by electrons. (HS-PS1-1)
The periodic table orders elements horizontally by the number of protons in the atom's nucleus and places those with similar chemical properties in columns. The repeating patterns of this table reflect patterns of outer electron states. (HS-PS1-1),(HS-PS1-2)
The structure and interactions of matter at the bulk scale are determined by electrical forces within and between atoms. (HS-PS1-3),(secondary to HS-PS2-6)

PS1.A: Structure and Properties of Matter</td><td>ESSENTIAL QUESTIONS (What open-ended, age appropriate questions will prompt exploration and creative and critical thinking?)

Where does the world's water come from and how do we use it?

How do we classify matter?

What are the physical properties of water?

Why do some substances dissolve in water and others do not?

What contaminates water?</td></tr>
</table>

	Attraction and repulsion between electric charges at the atomic scale explain the structure, properties, and transformations of matter, as well as the contact forces between material objects. (secondary to HS-PS1-1),(secondary to HS-PS1-3 **Science and Engineering Practices** Developing and Using Models Modeling in 9–12 builds on K–8 and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed worlds. Develop a model based on evidence to illustrate the relationships between systems or between components of a system. (HS-PS1-4),(HS-PS1-8) Use a model to predict the relationships between systems or between components of a system. (HS-PS1-1) Planning and Carrying Out Investigations Planning and carrying out investigations in 9-12 builds on K-8 experiences and progresses to include investigations that provide evidence for and test conceptual, mathematical, physical, and empirical models. Plan and conduct an investigation individually and collaboratively to produce	

	data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g., number of trials, cost, risk, time), and refine the design accordingly. (HS-PS1-3	
	Acquisition	
	Students will KNOW… (Including Tier II and Tier III vocabulary) • The different ways water is used • Where the worlds water is stored • How aquifers work • How the water cycle works • Physical properties of water • How matter is classified • How to identify and name ionic compounds • How to determine the solubility of a substance • To determine the concentration of a solution. • How water can be contaminated • Vocabulary; direct usage, indirect usage, aquifer, Freshwater, hydrologic cycle, cohesive, atom, element, compound, molecule, chemical bond, diatomic molecule, mixture, heterogeneous, homogeneous, solution, saturated, unsaturated, super saturated, aqueous, ion, ionic compound, solubility, concentration,	*Students will be skilled at (DO)…* • Measure their daily water use • Identify heterogeneous mixture vs homogeneous • Name ionic compounds • Use model to depict matter • Use physical properties to filter water • Use graphs to determine the solubility of a substance • Use mathematical relationships to determine the concentration of different solutions • Test water for different contaminates

Stage 2 - Evidence ***How will you monitor and/or measure evidence of student learning? How will you communicate student learning? How do students provide feedback about their learning?***	
Evaluative Criteria	**Assessment Evidence**
<type here>	PERFORMANCE TASK(S): <type here>
<type here>	OTHER EVIDENCE: <type here>

COURSE NAME: CHEMISTRY IN THE COMMUNITY

Developers: Jared Johnson, Josh Kinsman	*Development Date: 2016*	*Instructional Level: 10-12*	*Unit: Food*

Stage 1 Desired Results

ESTABLISHED GOALS *(Which Content & CCSS from multiple strands (e.g. reading, writing, language, speaking, listening & content) can be integrated?)* HS-PS3-1. Create a computational model to calculate the change in the energy of one component in a system when the change in energy of the other component(s) and energy flows in and out of the system are known. HS-PS3-4. Plan and conduct an investigation to provide evidence that the transfer of thermal energy when two components of different temperature are combined within a closed system results in a more uniform energy distribution among the components in the system (second law of thermodynamics). HS-LS1-5. Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy. HS-LS1-6. Construct and revise an explanation based on evidence for how carbon, hydrogen, and oxygen from sugar molecules may combine with other elements to form amino acids and/or other large carbon-based molecules. HS-LS1-7. Use a model to illustrate that cellular respiration is a chemical process whereby the bonds of food molecules and	***Transfer*** *Students will be able to independently use their learning to…* • **Identify and understand patterns and causes** • **Describe how science models support theories that explain natural phenomena** • **Plan and conduct investigations** • **Use mathematics and computational thinking** ***Meaning*** UNDERSTANDINGS *Students will understand that…* **PS3.A: Definitions of Energy** Energy is a quantitative property of a system that depends on the motion and interactions of matter and radiation within that system. That there is a single quantity called energy is due to the fact that a system's total energy is conserved, even as, within the system, energy is continually transferred from one object to another and between its various possible forms. (HSPS3-1),(HS-PS3-2) At the macroscopic scale, energy manifests itself in multiple ways, such as in motion, sound, light, and thermal energy. (HSPS3-2) (HS-PS3-3)	ESSENTIAL QUESTIONS *(What open-ended, age appropriate questions will prompt exploration and creative and critical thinking?)* Is your diet healthy? How is food energy stored, transferred and released? What chemical roles do carbohydrates and fats play in human metabolism Why are protein molecules essential to living organisms? What roles do vitamins, minerals, and additives play in the human body?

oxygen molecules are broken and the bonds in new compounds are formed resulting in a net transfer of energy.	**PS3.B: Conservation of Energy and Energy Transfer** • Conservation of energy means that the total change of energy in any system is always equal to the total energy transferred into or out of the system. (HS-PS3-1) • Energy cannot be created or destroyed, but it can be transported from one place to another and transferred between systems. (HS-PS3-1),(HS-PS3-4) **PS3.D: Energy in Chemical Processes** • Although energy cannot be destroyed, it can be converted to less useful forms—for example, to thermal energy in the surrounding environment. (HS-PS3-3),(HS-PS3-4) **LS1.C: Organization for Matter and Energy Flow in Organisms** • The process of photosynthesis converts light energy to stored chemical energy by converting carbon dioxide plus water into sugars plus released oxygen. (HS-LS1-5) • The sugar molecules thus formed contain carbon, hydrogen, and oxygen: their hydrocarbon backbones are used to make amino acids and other carbon-based molecules that can be assembled into larger molecules (such as proteins	

	or DNA), used for example to form new cells. (HS-LS1-6) • As matter and energy flow through different organizational levels of living systems, chemical elements are recombined in different ways to form different products. (HS-LS1-6),(HS-LS17) • As a result of these chemical reactions, energy is transferred from one system of interacting molecules to another and release energy to the surrounding environment and to maintain body temperature. Cellular respiration is a chemical process whereby the bonds of food molecules and oxygen molecules are broken and new compounds are formed that can transport energy to muscles. (HS-LS1-7) **LS2.B: Cycles of Matter and Energy Transfer in Ecosystems** • Photosynthesis and cellular respiration (including anaerobic processes) provide most of the energy for life processes. (HSLS2-3) **PS3.D: Energy in Chemical Processes** • The main way that solar energy is captured and stored on Earth is through the complex chemical process known as photosynthesis.	

	Acquisition	
	Students will KNOW… (Including Tier II and Tier III vocabulary) • The food groups making up their diets. • How food energy can be traced back to the sun. • Photosynthesis converts light energy to chemical energy • Cell respiration converts food energy to ATP (cell energy) • Food energy contains stored chemical energy • What carbohydrate molecules are and their role in the body • What lipids (fats) are and their role in the body • What proteins are and their role in the body • Sources of carbohydrates, lipids, and protein in our diets • The purpose of enzymes • The conditions that can affect enzyme activity • The role of vitamins and minerals in our body • The purpose of additives in food • The role of the FDA in regulating food and drug policies **Vocabulary**: Photosynthesis, cellular respiration, ATP (adenosine triphosphate), joules,	*Students will be skilled at (DO)…* • Quantifying daily energy intake • Calculating energy use for various activities • Converting between joules, calories, and Calorie units • Using the specific heat equation and calorimetry to measure and calculate the amount of energy stored in food • Evaluating diet choices • Testing conditions that affect enzyme activity • Quantifying the amount of vitamin C in various beverages

	calories, Calories, specific heat, calorimetry, carbohydrate, monosaccharide, disaccharide, polysaccharide, lipid, triglyceride, fatty acids, saturated fats, unsaturated fats, hydrogenation, LDL, HDL, proteins, amino acids, peptide bonds, dipeptide, polypeptide, essential amino acids, non-essential amino acids, complete protein, enzyme, substrate, active site, optimal range, inhibitor, water-soluble vitamins, fat-soluble vitamins, macrominerals, microminerals (trace minerals), antioxidants, emulsifiers, preservatives, carcinogen, nitrites, FDA (Food & Drug Administration)	

Stage 2 - Evidence

How will you monitor and/or measure evidence of student learning? How will you communicate student learning? How do students provide feedback about their learning?

Evaluative Criteria	**Assessment Evidence**
<type here>	PERFORMANCE TASK(S): <type here>
<type here>	OTHER EVIDENCE: <type here>

COURSE NAME: CHEMISTRY IN THE COMMUNITY

Developers: Josh Kinsman and Jared Johnson	*Development Date: 2016*	*Instructional Level: 10-12*	*Nuclear interactions*

Stage 1 Desired Results

ESTABLISHED GOALS *(Which Content & CCSS from multiple strands (e.g. reading, writing, language, speaking, listening & content) can be integrated?)*

HS-PS1-7. Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction.
HS-PS1-8. Develop models to illustrate the changes in the composition of the nucleus of the atom and the energy released during the processes of fission, fusion, and radioactive decay.

HS-PS4-4. Evaluate the validity and reliability of claims in published materials of the effects that different frequencies of electromagnetic radiation have when absorbed by matter.

HS-PS1-7.Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction.

Transfer

Students will be able to independently use their learning to…

Meaning

UNDERSTANDINGS
Students will understand that…

PS1.C: Nuclear Processes
□Nuclear processes, including fusion, fission, and radioactive decays of unstable nuclei, involve release or absorption of energy. The total number of neutrons plus protons does not change in any nuclear process. (HS-PS1-8)

PS1.B: Chemical Reactions
□The fact that atoms are conserved, together with knowledge of the chemical properties of the elements involved, can be used to describe and predict chemical reactions. (HS-PS1-2), (HS-PS1-7)

PS4.B: Electromagnetic Radiation
□Electromagnetic radiation (e.g., radio, microwaves, light) can be modeled as a wave of changing electric and magnetic fields or as particles called photons. The wave model is useful for explaining many features of electromagnetic radiation, and

ESSENTIAL QUESTIONS *(What open-ended, age appropriate questions will prompt exploration and creative and critical thinking?)*

What discoveries let to a modern understanding of the composition of atoms?

Why does exposure to some types of radiation cause health problems?

How do the radioactive materials break down?

What are the pros and cons of using nuclear energy?

	the particle model explains other features. (HS-PS4-3) When light or longer wavelength electromagnetic radiation is absorbed in matter, it is generally converted into thermal energy (heat). Shorter wavelength electromagnetic radiation (ultraviolet, X-rays, gamma rays) can ionize atoms and cause damage to living cells. (HS-PS4-4) Using Mathematics and Computational Thinking Mathematical and computational thinking at the 9–12 level builds on K–8 and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions. Use mathematical representations of phenomena to support claims. (HS-PS1-7)	
	Acquisition	
	Students will KNOW… (Including Tier II and Tier III vocabulary) • The different forms of nuclear radiation • What is released during radioactive decay • How nuclear bombardment works • The process of nuclear half-life	*Students will be skilled at (DO)…* • Using a Geiger counter to detect radiation • Determining their own exposure to radiation • Using mathematical models to show radioactive decay/half-life/bombardment.

<table>
<tr><td></td><td>The dangers of radon
The different ways to detect radiation
The dangers of nuclear exposure
How elements can exist as isotopes/radioisotopes
How we obtain and use nuclear energy
How nuclear radiation can be used in medicine.
Vocabulary; non-ionizing, ionizing, radiation, radioactive, radioactive decay, alpha particle, beta particle, gamma ray, background radiation, rad/rem, isotope, radioisotope, half-life, fission, fusion, vitrification, high level waste, low lever waste</td><td>Think critically to examine the uses and storage of radioactive material.</td></tr>
<tr><td colspan="3">Stage 2 - Evidence
How will you monitor and/or measure evidence of student learning? How will you communicate student learning? How do students provide feedback about their learning?</td></tr>
<tr><td>Evaluative Criteria</td><td colspan="2">Assessment Evidence</td></tr>
<tr><td><type here></td><td colspan="2">PERFORMANCE TASK(S):
<type here></td></tr>
<tr><td><type here></td><td colspan="2">OTHER EVIDENCE:
<type here></td></tr>
</table>

COURSE NAME: PHYSICS

Developers: Liz Rosendale	Development Date: 2016	Instructional Level: 10-12	Unit: Numbers and Measurement

Stage 1 Desired Results

<table>
<tr><td rowspan="6">ESTABLISHED GOALS (Which Content & CCSS from multiple strands (e.g. reading, writing, language, speaking, listening & content) can be integrated?)
HSN-Q.A.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.

HSN-Q.A.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.

HSA-CED.A.4 Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations.</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…
• Work safely and efficiently in the laboratory
• Use mathematics and computational thinking to apply problem solving strategies
• Develop and use models
• Plan and carry out investigations</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>UNDERSTANDINGS
Students will understand that…
• The metric system is based on powers of ten
• Measurable quantities have units
• An amount of something does not change when it is converted, only the unit</td><td>ESSENTIAL QUESTIONS (What open-ended, age appropriate questions will prompt exploration and creative and critical thinking?)
What is the importance of significant figures used in lab work and calculations?
What is the difference between precision and accuracy?
What is the meaning of a unit with “per” (ei: miles per hour, meters per second, etc)?</td></tr>
<tr><td colspan="2">Acquisition</td></tr>
<tr><td>Students will KNOW… (Including Tier II and Tier III vocabulary)
• Appropriate safety rules and behaviors</td><td>Students will be skilled at (DO)…

• Determining the correct number of significant figures</td></tr>
</table>

	• Emergency procedures • The difference between accuracy and precision • Rules for using significant figures • How to convert between standard number form and scientific notation • The metric prefixes and their quantities • The meanings of vocabulary including: scientific notation, significant figures, accuracy, precision, meniscus, density, speed	to use in calculations involving measurement • Using dimensional analysis to convert quantities • Developing lab procedure to test a prediction • Using mathematical equations to solve for variables • Measuring and calculating density of liquids and solids

Stage 2 - Evidence

How will you monitor and/or measure evidence of student learning? How will you communicate student learning? How do students provide feedback about their learning?

Evaluative Criteria	Assessment Evidence
<type here>	PERFORMANCE TASK(S): Test Quiz
<type here>	OTHER EVIDENCE: Penny Drop lab Homework

COURSE NAME: PHYSICS

Developers: Liz Rosendale	*Development Date: 2016*	*Instructional Level: 10-12*	*Unit: Motion in One dimension*

ESTABLISHED GOALS	***Transfer***	
MP.4 Model with mathematics. **HSN-Q.A.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.** **HSA.CED.A.4 Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations.**	*Students will be able to independently use their learning to…* Calculate the average speed of a car if informed of distance covered and duration of travel.	
	Meaning	
	UNDERSTANDINGS *Students will understand that…* -Speed is a rate of change of position -Velocity is a rate of change of displacement -We can't determine instantaneous speed without precise (fraction of a second) instruments	ESSENTIAL QUESTIONS *(What open-ended, age appropriate questions will prompt exploration and creative and critical thinking?)* In your daily life, how is speed measured and calculated? How can we measure the speed of a cart in the lab?
	Acquisition	
	Students will KNOW… (Including Tier II and Tier III vocabulary) -The difference between scalar and vector quantities -The difference and similarities between average and instantaneous velocity -Velocity, Acceleration, position, time, slope, and speed	*Students will be skilled at (DO)…* -Analyzing ticker tape results to qualitatively and quantitatively determine average speed and acceleration -Graph motion in one direction as a relationship of displacement, velocity, or acceleration versus time

Stage 2 - Evidence *How will you monitor and/or measure evidence of student learning? How will you communicate student learning? How do students provide feedback about their learning?*	
Evaluative Criteria	**Assessment Evidence**
<type here>	PERFORMANCE TASK(S): Pre-lab: Determine the average speed of someone in the hallway. Defend your procedure and data.
<type here>	OTHER EVIDENCE: <type here>

COURSE NAME: PHYSICS

Developers: Liz Rosendale	Development Date:2016	Instructional Level: 10-12	Unit: Accelerated Motion (kinematics)

Stage 1 Desired Results

<table>
<tr><td rowspan="6">ESTABLISHED GOALS

HSN-Q.A.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Interpret basic graph to assign meaning to shape of trend (mathematical relationship of variables), slope, and intercepts
Construct and mathematically “unbiased” graph and recognize when a graph is presented in a biased way.</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>UNDERSTANDINGS
-Acceleration is a rate of change of velocity
-The slope of a position time graph dictates velocity
-The slope of a velocity time graph represents accelerations
-The area under a velocity time graph tells us displacement
-The area under an acceleration time graph tells us change in velocity</td><td>ESSENTIAL QUESTIONS
How can we measure acceleration of an object down a ramp or due to a force by a hanging object?
What factors determine the rate of acceleration of an object? (leading into next unit)</td></tr>
<tr><td colspan="2">Acquisition</td></tr>
<tr><td>Students will KNOW
The three kinematic equations and when to use them
How the three motion graphs are related
Velocity, Acceleration, position, time, slope, and speed</td><td>Students will be skilled at (DO)…
-Calculating displacement, velocity, acceleration, and the duration of an interaction
-Graphing displacement, velocity, and acceleration as a function of time
-Solve systems of equations</td></tr>
</table>

Stage 2 - Evidence *How will you monitor and/or measure evidence of student learning? How will you communicate student learning? How do students provide feedback about their learning?*	
Evaluative Criteria	**Assessment Evidence**
Answer keys	PERFORMANCE TASK(S): Quizzes Test
<type here>	OTHER EVIDENCE: White board sketches

COURSE NAME: PHYSICS

Developers: Liz Rosendale	Development Date: 2016	Instructional Level: 10-12	Unit: Newton's Laws (forces)

Stage 1 Desired Results

<table>
<tr><td rowspan="6">ESTABLISHED GOALS
HS-PS2-1. Analyze data to support the claim that Newton's second law of motion describes the mathematical relationship among the net force on a macroscopic object, its mass, and its acceleration.

HSN-Q.A.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.

HSN-Q.A.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.

HSA-CED.A.4 Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations.</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…
Identify force, mass, acceleration relationships in the real world.
Understand the concept of inertia</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>UNDERSTANDINGS
PS2.A: Forces and Motion
Newton's second law accurately predicts of macroscopic objects.
(HS-PS2-1)</td><td>ESSENTIAL QUESTIONS
-What factors determine the rate of acceleration of an object?
Why are heavy football players favored for the defensive line, while thin cheerleaders are preferred as "fliers"?
If all forces exist in pairs, why doesn't the ground accelerate towards us in the same way we accelerate towards the ground</td></tr>
<tr><td colspan="2">Acquisition</td></tr>
<tr><td>Students will KNOW
Objects at rest tend to remain at rest, and objects in motion tend to remain in motion unless acted upon by an unbalanced external force
The acceleration of an object is proportional to the force exerted upon it and inversely</td><td>Students will be skilled at (DO)…
Identifying Newton's three laws in work in any interaction between objects
Calculating the apparent weight of an object in an elevator when at rest, when traveling at a constant speed, or when accelerating.</td></tr>
</table>

	proportional to the mass of the object • For every force, there is an equal and opposite reactive force • The apparent weight of an object is the force a scale would apply to an object at any given time • Vocabulary including: Force, Acceleration, Newton, weight, and inertia	• Calculating the thrust needed to accelerate a mass upward at a given rate • Calculate the acceleration of a known mass, given a force • Diagram forces with vectors

Stage 2 - Evidence

How will you monitor and/or measure evidence of student learning? How will you communicate student learning? How do students provide feedback about their learning?

Evaluative Criteria	**Assessment Evidence**
<type here>	PERFORMANCE TASK(S): Test Quiz Homework
<type here>	OTHER EVIDENCE: <type here>

COURSE NAME: PHYSICS

Developers: Liz Rosendale	Development Date: 2016	Instructional Level: 10-12	Unit: Forces in Two Dimensions (Vectors) and Projectiles

Stage 1 Desired Results

<table>
<tr><td rowspan="6">ESTABLISHED GOALS (Which Content & CCSS from multiple strands (e.g. reading, writing, language, speaking, listening & content) can be integrated?)
HSN-Q.A.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.

HSN-Q.A.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.

HSA-CED.A.4 Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations.</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…
• Use trigonometric functions in right triangles
• Qualitatively determine the direction of motion of an object with several forces or velocities in different directions</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>UNDERSTANDINGS
• Vectors can be added using trigonometry
• Kinematic equations can be used to describe position, velocity, and acceleration of the horizontal and/or vertical motion of a projectile</td><td>ESSENTIAL QUESTIONS
Does the order of vector addition make a difference?
How can the range of a projectile be maximized?
How can the height of a projectile be maximized</td></tr>
<tr><td colspan="2">Acquisition</td></tr>
<tr><td>Students will KNOW
• Vectors have both magnitude and direction
• Direction is conventionally measured counterclockwise from the horizontal, positive x, or east direction
• Vocabulary includes: Sine, Cosine, Tangent, Resultant, Scalar, and Vector</td><td>Students will be skilled at (DO)…
• Calculating the sum of vectors
• Stating resultants with both direction and magnitude</td></tr>
</table>

Stage 2 - Evidence *How will you monitor and/or measure evidence of student learning? How will you communicate student learning? How do students provide feedback about their learning?*	
Evaluative Criteria	**Assessment Evidence**
<type here>	PERFORMANCE TASK(S): Tests Quizzes
<type here>	OTHER EVIDENCE: <type here>

COURSE NAME: PHYSICS

Developers: Liz Rosendale	Development Date: 2016	Instructional Level: 10-12	Unit: Conservation of Momentum

Stage 1 Desired Results

<table>
<tr><td rowspan="6">ESTABLISHED GOALS

HS-PS2-2. Use mathematical representations to support the claim that the total momentum of a system of objects is conserved when there is no net force on the system.

HS-PS2-3. Apply scientific and engineering ideas to design, evaluate, and refine a device that minimizes the force on a macroscopic object during a collision.*

HSA-CED.A.4 Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations.</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">• Predict the consequence of a collision between similar masses</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>UNDERSTANDINGS
• PS2.A: Forces and Motion
Momentum is defined for a particular frame of reference; it is
the mass times the velocity of the object. (HS-PS2-2)

If a system interacts with objects outside itself, the total momentum of the system can change; however, any such change is balanced by changes in the momentum of objects outside the system. (HS-PS2-2),(HS-PS2-3)</td><td>ESSENTIAL QUESTIONS
How is momentum similar or different from inertia?
Why is the way you catch an egg or water balloon important?
Why do we have airbags?
What happens when a rolling cart hits an identical cart at rest? (What if they are both traveling towards each other with a constant velocity? What if they stick together? What if they are at rest and an internal spring splits them apart?</td></tr>
<tr><td colspan="2">Acquisition</td></tr>
<tr><td>Students will KNOW… (Including Tier II and Tier III vocabulary)
• How each variable in the impulse momentum theorem is related
• Internal forces do not change the momentum of a system
• Vocabulary includes: momentum, impulse, and conservation</td><td>Students will be skilled at (DO)…
• Calculating the momentum for each part of a system before and after a collision
• Creating solutions to minimize or maximize force during an impact</td></tr>
</table>

Stage 2 – Evidence *How will you monitor and/or measure evidence of student learning? How will you communicate student learning? How do students provide feedback about their learning?*	
Evaluative Criteria	**Assessment Evidence**
<type here>	PERFORMANCE TASK(S): Create an egg drop structure Tests Quizzes
<type here>	OTHER EVIDENCE: <type here>

COURSE NAME: PHYSICS

Developers: Liz Rosendale	Development Date: 2016	Instructional Level: 10-12	Unit: Work and Simple Machines

Stage 1 Desired Results

<table>
<tr><td rowspan="6">ESTABLISHED GOALS
HSN-Q.A.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.

HSN-Q.A.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.

HSA-CED.A.4 Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations.</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…
Describe changes in energy within a more complex machine</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>UNDERSTANDINGS
Students will understand that…
• Simple machines do not reduce the work required to accomplish a task
• Combining simple machines reduces the overall efficiency of a machine</td><td>ESSENTIAL QUESTIONS (What open-ended, age appropriate questions will prompt exploration and creative and critical thinking?)
Do simple machines reduce the work required to accomplish a task? If not, what is their benefit?
Why is is harder to do work faster?
What is efficiency, and how can we measure it?</td></tr>
<tr><td colspan="2">Acquisition</td></tr>
<tr><td>Students will KNOW… (Including Tier II and Tier III vocabulary)
• Work=Force * Displacement (in the direction of the force)
• Power= Work/Time
• Efficiency is a ration of work output over work input
• Vocabulary includes: Work, efficiency, energy, mechanical advantage, compound machine,</td><td>Students will be skilled at (DO)…

• Testing simple and compound machines
• Measuring quantities necessary for calculating efficiency</td></tr>
</table>

	power, lever, pulley, wedge, screw, wheel and axle, and ramp.	
Stage 2 - Evidence ***How will you monitor and/or measure evidence of student learning? How will you communicate student learning? How do students provide feedback about their learning?***		
Evaluative Criteria	**Assessment Evidence**	
<type here>	PERFORMANCE TASK(S): <type here>	
<type here>	OTHER EVIDENCE: <type here>	

COURSE NAME: PHYSICS

Developers: Liz Rosendale	Development Date: 2016	Instructional Level: 10-12	Unit: Conservation of Energy

Stage 1 Desired Results

<table>
<tr><td rowspan="4">ESTABLISHED GOALS

HS-PS3-1. Create a computational model to calculate the change in the energy of one component in a system when the change in energy of the other component(s) and energy flows in and out of the system are known.
HS-PS3-2. Develop and use models to illustrate that energy at the macroscopic scale can be accounted for as a combination of energy associated with the motions of particles (objects) and energy associated with the relative position of particles (objects).
HS-PS3-3. Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy*

HSN-Q.A.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…
Describe changes in energy within a more complex machine</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>UNDERSTANDINGS
PS3.A: Definitions of Energy

Energy is a quantitative property of a system that depends on the motion and interactions of matter and radiation within that system. That there is a single quantity called energy is due to the fact that a system’s total energy is conserved, even as, within the system, energy is continually transferred from one object to another and between its various possible forms. (HS-
PS3-1),(HS-PS3-2)

At the macroscopic scale, energy manifests itself in multiple ways, such as in motion, sound, light, and thermal energy. (HS-PS3-2)
(HS-PS3-3)

These relationships are better understood at the microscopic scale, at which all of the different manifestations of energy can be modeled as a combination of energy associated with the</td><td>ESSENTIAL QUESTIONS
Do simple machines reduce the work required to accomplish a task? If not, what is their benefit?
Why is is harder to do work faster?
What is efficiency, and how can we measure it?</td></tr>
</table>

HSN-Q.A.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. **HSA-CED.A.4 Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations.**	**motion of particles and energy associated with the configuration (relative position of the particles). In some cases, the relative position energy can be thought of as stored in fields (which mediate interactions between particles). This last concept includes radiation, a phenomenon in which energy stored in fields moves across space. (HS-PS3-2)** **PS3.B: Conservation of Energy and Energy Transfer** **Conservation of energy means that the total change of energy in any system is always equal to the total energy transferred into or out of the system. (HS-PS3-1)** **Energy cannot be created or destroyed, but it can be transported from one place to another and transferred between systems. (HS-PS3-1),(HS-PS3-4)** **Mathematical expressions, which quantify how the stored energy in a system depends on its configuration (e.g. relative positions of charged particles, compression of a spring) and how kinetic energy depends on mass and speed, allow the concept of conservation of energy to be used to predict and describe system behavior. (HS-PS3-1)** **The availability of energy limits what can occur in any system. (HS-PS3-1)**	

<table>
<tr><td rowspan="3"></td><td>Uncontrolled systems always evolve toward more stable states—that is, toward more uniform energy distribution (e.g., water flows downhill, objects hotter than their surrounding environment cool down). (HS-PS3-4)
<u>When two objects interacting through a field change relative position, the energy stored in the field is changed. (HS-PS3-5)</u></td><td></td></tr>
<tr><td colspan="2">Acquisition</td></tr>
<tr><td>Students will KNOW
Work is the product of force and displacement (in the direction of the force)
Power is the quotient of work over time
Efficiency is a ration of work output over work input
Equations for various types of energy
Vocabulary includes: Work, efficiency, energy, Potential Energy, Kinetic Energy, power, conservation, thermal, and elastic</td><td>Students will be skilled at (DO)…
Creating a machine (Rube Golberg) that converts one type of energy into another type
Create a projectile launcher
Measure maximum height object reached, estimate greatest instantaneous velocity, and diagram energy and forces at important points of motion
Calculate PE, and KE</td></tr>
<tr><td colspan="3">Stage 2 - Evidence
How will you monitor and/or measure evidence of student learning? How will you communicate student learning? How do students provide feedback about their learning?</td></tr>
<tr><td>Evaluative Criteria</td><td colspan="2">Assessment Evidence</td></tr>
<tr><td>Rubric</td><td colspan="2">PERFORMANCE TASK(S):
Construct Rube Golberg device (illustrate use of three different types of energy (GPE, KE, Spring, Elastic, Thermal, etc)
Create a projectile launcher report</td></tr>
<tr><td><type here></td><td colspan="2">OTHER EVIDENCE: Tests, Quizzes</td></tr>
</table>

COURSE NAME: PHYSICS

Developers: Liz Rosendale	Development Date: 2016	Instructional Level: 10-12	Unit: Thermodynamics

Stage 1 Desired Results

<table>
<tr><td rowspan="6">ESTABLISHED GOALS
HS-PS3-1. Create a computational model to calculate the change in the energy of one component in a system when the change in energy of the other component(s) and energy flows in and out of the system are known.
HS-PS3-2. Develop and use models to illustrate that energy at the macroscopic scale can be accounted for as a combination of energy associated with the motions of particles (objects) and energy associated with the relative position of particles (objects).
HS-PS3-4. Plan and conduct an investigation to provide evidence that the transfer of thermal energy when two components of different temperature are combined within a closed system results in a more uniform energy distribution among the components in the system (second law of thermodynamics).</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…
• Describe factors of heat transfer in daily experiences.
• Explain the difference between heat, temperature, and energy to others.</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>UNDERSTANDINGS
Students will understand that…

PS3.D: Energy in Chemical Processes

Although energy cannot be destroyed, it can be converted to less useful forms—for example, to thermal energy in the surrounding environment. (HS-PS3-3),(HS-PS3-4)</td><td>ESSENTIAL QUESTIONS
What factors influence temperature changes in two materials in contact (initially of differing temperatures)?
What is the difference between temperature and heat?</td></tr>
<tr><td colspan="2">Acquisition</td></tr>
<tr><td>Students will KNOW…
• While energy cannot be lost or gained, it can be transferred
• Equations for heat lost
• Definitions for heat, temperature,kinetic energy, evaporation, condensation, freezing, melting, fusion, vaporization, and entropy</td><td>Students will be skilled at (DO)…
• Calculate heat transfer and temperature.
• Describe the relationship between friction, thermal energy, and work.</td></tr>
</table>

Stage 2 - Evidence ***How will you monitor and/or measure evidence of student learning? How will you communicate student learning? How do students provide feedback about their learning?***	
Evaluative Criteria	**Assessment Evidence**
<type here>	PERFORMANCE TASK(S): <type here>
<type here>	OTHER EVIDENCE: <type here>

COURSE NAME: PHYSICS

Developers: Liz Rosendale	*Development Date: 2016*	*Instructional Level: 10-12*	*Unit: Fluid Statics*

Stage 1 Desired Results

ESTABLISHED GOALS

HS-PS1-3. Plan and conduct an investigation to gather evidence to compare the structure of substances at the bulk scale to infer the strength of electrical forces between particles.

HSN-Q.A.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.

HSN-Q.A.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.

HSA-CED.A.4 Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations.

Transfer

Students will be able to independently use their learning to…

- **Describe what makes a boat float (even if it's material is denser than water)**

Meaning

UNDERSTANDINGS

-The weight of water an object displaces is equal to the buoyant force it experiences

- PS1.A: Structure and Properties of Matter. The structure and interactions of matter at the bulk scale are determined by electrical forces within and between atoms. (secondary to HS-PS2-6)
- PS2.B: Types of Interactions Attraction and repulsion between electric charges at the atomic scale explain the structure, properties, and transformations of matter, as well as the contact forces between material objects. (HS-PS2-6),(secondary to HS-PS1-1),(secondary to HS-PS1-3)

ESSENTIAL QUESTIONS

-What is required for an object to float?

-On a molecular level, what determines the number of drops of a liquid can fit on the head of a penny?

--When you blow across the top of a sheet of paper, which direction will the paper move and why?

Acquisition

Students will KNOW

- Bernoulli's Principle
- How to calculate density
- The definition of buoyant force
- Vocabulary includes: buoyancy, pressure, cohesion, adhesion, and evaporation

Students will be skilled at (DO)…

- Determining the correct number of significant figures to use in calculations involving measurement

		• Using dimensional analysis to convert quantities • Developing lab procedure • Using mathematical equations to solve for variables • Measuring and calculating density of liquids and solids

Stage 2 - Evidence ***How will you monitor and/or measure evidence of student learning? How will you communicate student learning? How do students provide feedback about their learning?***	
Evaluative Criteria	**Assessment Evidence**
<type here>	PERFORMANCE TASK(S): Create a boat that (within volume constraints) to float with as much additional mass as possible.
<type here>	OTHER EVIDENCE: <type here>

COURSE NAME: PHYSICS

Developers: Liz Rosendale	Development Date: 2016	Instructional Level: 10-12	Unit: Wave basics

Stage 1 Desired Results

ESTABLISHED GOALS	Transfer	
HS-PS4-1. Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, **HS-PS4-2. Evaluate questions about the advantages of using a digital transmission and storage of information. [Clarification** **HS-PS4-3. Evaluate the claims, evidence, and reasoning behind the idea that electromagnetic radiation can be described** **HS-PS4-4. Evaluate the validity and reliability of claims in published materials of the effects that different frequencies of electromagnetic radiation have when absorbed by matter.** **HS-PS4-5. Communicate technical information about how some technological devices use the principles of wave behavior and speed of waves traveling in various media. [Clarification Statement: Examples of data could include electromagnetic radiation traveling in a vacuum and glass, sound waves traveling through air and water, and seismic waves traveling through the Earth.] [Assessment Boundary: Assessment is limited to algebraic relationships and describing those relationships qualitatively.]**	*Students will be able to independently use their learning to…* • Describe waves behaviors in various real world situations using scientific vocabulary • Identify daily uses of electric and magnetic energy • The flow of electricity can induce magnetism and the change of magnetic fields can induce the flow of electricity. ***Meaning*** ***UNDERSTANDINGS*** *Students will understand that…* **PS3.D: Energy in Chemical Processes** **Solar cells are human-made devices that likewise capture the sun's energy and produce electrical energy. (secondary to HS-PS4-5)** **PS4.A: Wave Properties** **The wavelength and frequency of a wave are related to one another by the speed of travel of the wave, which depends on the type of wave and the medium through which it is passing. (HS-PS4-1)** **Information can be digitized (e.g., a picture stored as the values of an array of pixels); in this form, it can be stored reliably in computer memory and sent over long distances as a series of wave pulses. (HS-PS4-2),(HS-PS4-5)**	ESSENTIAL QUESTIONS To waves transfer particles? -Why does the sound quality change as a train passes you? - What are the differences between electromagnetic and mechanical waves? What do they have in common? -How are electricity, magnetism, and gravity similar and different? -What is light?

Statement: Examples of advantages could include that digital information is stable because it can be stored reliably in computer memory, transferred easily, and copied and shared rapidly. Disadvantages could include issues of easy deletion, security, and theft.] **either by a wave model or a particle model, and that for some situations one model is more useful than the other. Clarification Statement: Emphasis is on how the experimental evidence supports the claim and how a theory is generally modified in light of new evidence. Examples of a phenomenon could include resonance, interference, diffraction, and photoelectric effect.] [Assessment Boundary: Assessment does not include using quantum theory.]** **electromagnetic radiation has when absorbed by matter. [Clarification Statement: Emphasis is on the idea that photons associated with different frequencies of light have different energies, and the damage to living tissue from electromagnetic radiation depends on the energy of the radiation. Examples of published materials could include trade books, magazines, web resources, videos, and other passages that may reflect bias.] [Assessment Boundary: Assessment is limited to qualitative descriptions.] and wave interactions with matter to transmit and capture information and energy.* [Clarification Statement: Examples could include solar cells capturing light and converting it to electricity; medical imaging; and communications technology.] [Assessment Boundary: Assessments are limited to qualitative information. Assessments do not include band theory.]**	**[From the 3–5 grade band endpoints] Waves can add or cancel one another as they cross, depending on their relative phase (i.e., relative position of peaks and troughs of the waves), but they emerge unaffected by each other. (Boundary: The discussion at this grade level is qualitative only; it can be based on the fact that two different sounds can pass a location in different directions without getting mixed up.) (HS-PS4-3)** **PS4.B: Electromagnetic Radiation** **Electromagnetic radiation (e.g., radio, microwaves, light) can be modeled as a wave of changing electric and magnetic fields or as particles called photons. The wave model is useful for explaining many features of electromagnetic radiation, and the particle model explains other features. (HS-PS4-3)** **When light or longer wavelength electromagnetic radiation is absorbed in matter, it is generally converted into thermal energy (heat). Shorter wavelength electromagnetic radiation (ultraviolet, X-rays, gamma rays) can ionize atoms and cause damage to living cells. (HS-PS4-4)** **Photoelectric materials emit electrons when they absorb light of a high-enough frequency. (HS-PS4-5)**	

<table>
<tr><td></td><td>PS4.C: Information Technologies and Instrumentation
Multiple technologies based on the understanding of waves and their interactions with matter are part of everyday experiences in the modern world (e.g., medical imaging, communications, scanners) and in scientific research. They are essential tools for producing, transmitting, and capturing signals and for storing and interpreting the information contained in them. (HS-PS4-5)</td><td></td></tr>
<tr><td></td><td colspan="2">Acquisition</td></tr>
<tr><td></td><td>Students will KNOW
• Definitions for Doppler effect, frequency, period, wavelength, velocity, amplitude, reflection, refraction, diffraction, and interference</td><td>Students will be skilled at (DO)…
-using echo information to determine distance from a barrier
-Illustrate wave behaviors in a ripple tank and on paper
-Describe possibilities when waves collide
-Use ray tracing diagrams to predict the location of an image for a mirror or lens</td></tr>
<tr><td colspan="3">Stage 2 - Evidence
How will you monitor and/or measure evidence of student learning? How will you communicate student learning? How do students provide feedback about their learning?</td></tr>
<tr><td>Evaluative Criteria</td><td colspan="2">Assessment Evidence</td></tr>
<tr><td><type here></td><td colspan="2">PERFORMANCE TASK(S):
<type here></td></tr>
<tr><td><type here></td><td colspan="2">OTHER EVIDENCE: <type here></td></tr>
</table>

COURSE NAME: PHYSICS

Developers: Liz Rosendale	Development Date: 2016	Instructional Level: 10-12	Unit: Electricity

Stage 1 Desired Results

<table>
<tr><td rowspan="4">ESTABLISHED GOALS

HS-PS3-5. Develop and use a model of two objects interacting through electric or magnetic fields to illustrate the forces between objects and the changes in energy of the objects due to the interaction.

HS-PS2-5. Plan and conduct an investigation to provide evidence that an electric current can produce a magnetic field and that a changing magnetic field can produce an electric current.

HS-PS2-6. Communicate scientific and technical information about why the molecular-level structure is important in the functioning of designed materials.*

HS-PS2-4. Use mathematical representations of Newton's Law of Gravitation and Coulomb's Law to describe and predict the gravitational and electrostatic forces between objects.

PS1.A: Structure and Properties of Matter. Each atom has a charged substructure consisting of a nucleus, which is made of</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>UNDERSTANDINGS
Students will understand that…
TPS1.A: Structure and Properties of Matter
The structure and interactions of matter at the bulk scale are determined by electrical forces (secondary to HS-PS2-6)

PS2.B: Types of Interactions
Newton's law of universal gravitation and Coulomb's law provide the mathematical models to describe and predict the effects of gravitational and electrostatic forces between distant objects. (HS-PS2-4)

Forces at a distance are explained by fields (gravitational,electric, and magnetic) permeating space that can transfer energy through space. Magnets or electric currents cause magnetic fields;</td><td>ESSENTIAL QUESTIONS
-What moves when electricity is flowing?
-What determines the rate of flow of electricity?
-What factors influence the brightness of bulbs in a circuit?</td></tr>
</table>

protons and neutrons, surrounded by electrons. (HS-PS1-1) The periodic table orders elements horizontally by the number of protons in the atom's nucleus and places those with similar chemical properties in columns. The repeating patterns of this table reflect patterns of outer electron states. (HS-PS1-1),(HS-PS1-2) The structure and interactions of matter at the bulk scale are determined by electrical forces within and between atoms. (HS-PS1-3),(secondary to HS-PS2-6) A stable molecule has less energy than the same set of atoms separated; one must provide at least this energy in order to take the molecule apart. (HS-PS1-4)	**electric charges or changing magnetic fields cause electric fields. (HS-PS2-4),(HS-PS2-5)** **Attraction and repulsion between electric charges at the atomic scale explain the structure, properties, and transformations of matter, as well as the contact forces between material objects. (HS-PS2-6),(secondary to HS-PS1-1),(secondary to HS-PS1-3)** **PS3.A: Definitions of Energy** **"Electrical energy" may mean energy stored in a battery or energy transmitted by electric currents. (secondary to HS-PS2-5)** ♣ Each atom has a charged substructure consisting of a nucleus, which is made of protons and neutrons, surrounded by electrons. (HS-PS1-1) ♣ The periodic table orders elements horizontally by the number of protons in the atom's nucleus and places those with similar chemical properties in columns. The repeating patterns of this table reflect patterns of outer electron states. (HS-PS1-1)	
	Acquisition	
	Students will KNOW… (Including Tier II and Tier III vocabulary) • Coulomb's Law • Ohm's Law • The connection between electricity and magnetism • Vocabulary includes: voltage, current, resistance, Ohm, potential, circuit, battery, electron	*Students will be skilled at (DO)…* • Using Ohm's Law to determine voltage, current, or resistance within a circuit. • Describing the differences between

		a circuit with resistors in parallel and resistors in series.

Stage 2 - Evidence

How will you monitor and/or measure evidence of student learning? How will you communicate student learning? How do students provide feedback about their learning?

Evaluative Criteria	Assessment Evidence
<type here>	PERFORMANCE TASK(S): <type here>
<type here>	OTHER EVIDENCE: <type here>

COURSE NAME: PHYSICS

Developers: Liz Rosendale	Development Date: 2016	Instructional Level: 10-12	Unit: Circular Motion and Gravity

Stage 1 Desired Results

<table>
<tr><td rowspan="6">ESTABLISHED GOALS (Which Content & CCSS from multiple strands (e.g. reading, writing, language, speaking, listening & content) can be integrated?)
HS-PS2-4. Use mathematical representations of Newton’s Law of Gravitation and Coulomb’s Law to describe and predict the gravitational and electrostatic forces between objects.
HS-PS3-1. Create a computational model to calculate the change in the energy of one component in a system when the change in energy of the other component(s) and energy flows in and out of the system are known.
HS-PS3-2. Develop and use models to illustrate that energy at the macroscopic scale can be accounted for as a combination of energy associated with the motions of particles (objects) and energy associated with the relative position of particles (objects).

HSN-Q.A.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.

HSN-Q.A.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>UNDERSTANDINGS
Students will understand that…
• PS2.B: Types of Interactions
Newton’s law of universal gravitation and Coulomb’s law provide the mathematical models to describe and predict the effects of gravitational and electrostatic forces between distant objects. (HS-PS2-4)

Forces at a distance are explained by fields (gravitational,electric, and magnetic) permeating space that can transferenergy through space. Magnets or electric currents cause magnetic fields; electric charges or changing magnetic fields cause electric fields. (HS-PS2-4),(HS-PS2-5)

•
• Measurable quantities have units
• An amount of something does not change when it is converted, only the unit</td><td>ESSENTIAL QUESTIONS
-What is gravity? What causes gravity to exist?</td></tr>
<tr><td colspan="2">Acquisition</td></tr>
<tr><td>Students will KNOW… (Including Tier II and Tier III vocabulary)</td><td>Students will be skilled at (DO)…</td></tr>
</table>

HSA-CED.A.4 Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations.	•	•

Evaluative Criteria	Assessment Evidence
<type here>	PERFORMANCE TASK(S): <type here>
<type here>	OTHER EVIDENCE: <type here>

COURSE NAME: PHYSICAL WORLD

Developers: Jason Yusten, Jared Johnson, Liz Rosendale	*Development Date: 2016*	*Instructional Level: 10-12*	*Unit: Introduction (Metrics and scientific method)*

ESTABLISHED GOALS *(Which Content & CCSS from multiple strands (e.g. reading, writing, language, speaking, listening & content) can be integrated?)*	***Transfer***	
HSN-Q.A.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays. **HSN-Q.A.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.** **HSA-CED.A.4 Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations.**	*Students will be able to independently use their learning to…* **Work safely and efficiently in the laboratory** • **Use mathematics and computational thinking to apply problem solving strategies** • **Develop and use models** • **Plan and carry out investigations**	
	Meaning	
	UNDERSTANDINGS *Students will understand that…* • **The metric system is based on powers of ten** • **Measurable quantities have units** • **An amount of something does not change when it is converted, only the unit**	ESSENTIAL QUESTIONS *(What open-ended, age appropriate questions will prompt exploration and creative and critical thinking?)* What is the importance of significant figures used in lab work and calculations? What is the difference between precision and accuracy? What is the meaning of a unit with "per" (ei: miles per hour, meters per second, etc)?
	Acquisition	
	Students will KNOW… (Including Tier II and Tier III vocabulary)	*Students will be skilled at (DO)…*

	• Appropriate safety rules and behaviors • Emergency procedures • The difference between accuracy and precision • Rules for using significant figures • How to convert between standard number form and scientific notation • The metric prefixes and their quantities • The meanings of vocabulary including: scientific notation, significant figures, accuracy, precision, meniscus, density, speed	• Determining the correct number of significant figures to use in calculations involving measurement • Using dimensional analysis to convert quantities • Developing lab procedure • Using mathematical equations to solve for variables • Measuring and calculating density of liquids and solids

Stage 2 - Evidence

How will you monitor and/or measure evidence of student learning? How will you communicate student learning? How do students provide feedback about their learning?

Evaluative Criteria	**Assessment Evidence**
<type here>	PERFORMANCE TASK(S): <type here>
<type here>	OTHER EVIDENCE: <type here>

COURSE NAME: PHYSICAL WORLD

Developers: Jason Yusten, Jared Johnson, Liz Rosendale	Development Date: 2016	Instructional Level: 10-12	Unit: Motion in One and two dimensions

Stage 1 Desired Results

<table>
<tr><td rowspan="6">ESTABLISHED GOALS (Which Content & CCSS from multiple strands (e.g. reading, writing, language, speaking, listening & content) can be integrated?)

MP.4 Model with mathematics.

HSN-Q.A.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.

HSA.CED.A.4 Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations.</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…
Calculate the average speed of a car if informed of distance covered and duration of travel.
Identify the difference between constant velocity, positive and negative acceleration.</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>UNDERSTANDINGS
Students will understand that…
• -Speed is a rate of change of position
• -Velocity is a rate of change of displacement
• -We can’t determine instantaneous speed without precise (fraction of a second) instruments
• Vectors can be added using trigonometry
• Kinematic equations can be used to describe position, velocity, and acceleration of the horizontal and/or vertical motion of a projectile</td><td>ESSENTIAL QUESTIONS (What open-ended, age appropriate questions will prompt exploration and creative and critical thinking?)
In your daily life, how is speed measured and calculated?
How can we measure the speed of a cart in lab or a person in motion
How can the range of a projectile be maximized?
How can the height of a projectile be maximized</td></tr>
<tr><td colspan="2">Acquisition</td></tr>
<tr><td>Students will KNOW… (Including Tier II and Tier III vocabulary)
• -The difference between scalar and vector quantities</td><td>Students will be skilled at (DO)…
• -Analyzing motion in the real world to qualitatively and</td></tr>
</table>

	• -The difference and similarities between average and instantaneous velocity • Vectors have both magnitude and direction	quantitatively determine average speed • -Graph motion in one direction as a relationship of displacement and velocity • Calculating the sum of vectors • Stating resultants with both direction and magnitude

Stage 2 - Evidence

How will you monitor and/or measure evidence of student learning? How will you communicate student learning? How do students provide feedback about their learning?

Evaluative Criteria	Assessment Evidence
<type here>	PERFORMANCE TASK(S): <type here>
<type here>	OTHER EVIDENCE: <type here>

COURSE NAME: PHYSICAL WORLD

Developers: Jason Yusten, Jared Johnson, Liz Rosendale	Development Date: 2016	Instructional Level: 10-12	Unit: Forces

Stage 1 Desired Results

<table>
<tr>
<td rowspan="6">ESTABLISHED GOALS (Which Content & CCSS from multiple strands (e.g. reading, writing, language, speaking, listening & content) can be integrated?)

HS-PS2-1. Analyze data to support the claim that Newton’s second law of motion describes the mathematical relationship amongthe net force on a macroscopic object, its mass, and its acceleration.

HS-PS2-3. Apply scientific and engineering ideas to design, evaluate, and refine a device that minimizes the force on a macroscopic object during a collision.*</td>
<th colspan="2">Transfer</th>
</tr>
<tr>
<td colspan="2">Students will be able to independently use their learning to…
-Recognize and apply Newton’s Forces in everyday settings</td>
</tr>
<tr>
<th colspan="2">Meaning</th>
</tr>
<tr>
<td>UNDERSTANDINGS
Students will understand that…
• Forces cause accelerations
• Forces act on on all objects
• For every force, there is an equal and opposite reactive force</td>
<td>ESSENTIAL QUESTIONS (What open-ended, age appropriate questions will prompt exploration and creative and critical thinking?)
-If a force is being applied to an object will have to move? Will it have to accelerate?
-How does the mass of an object relate to its acceleration?</td>
</tr>
<tr>
<th colspan="2">Acquisition</th>
</tr>
<tr>
<td>Students will KNOW…
(Including Tier II and Tier III vocabulary)
• A force is a push or pull
• Inertia is a property of matter.
• The more mass an object has, the more inertia it has.</td>
<td>Students will be skilled at (DO)…
• Drawing balanced and unbalanced forces acting on an object using free body diagrams
• Predicting the acceleration of an object based on mass and the sum of applied forces.</td>
</tr>
</table>

Stage 2 - Evidence *How will you monitor and/or measure evidence of student learning? How will you communicate student learning? How do students provide feedback about their learning?*	
Evaluative Criteria	**Assessment Evidence**
<type here>	PERFORMANCE TASK(S): <type here>
<type here>	OTHER EVIDENCE: <type here>

COURSE NAME: PHYSICAL WORLD

Developers: Jason Yusten, Jared Johnson, Liz Rosendale	Development Date: 2016	Instructional Level: 10-12	Unit: Energy and Momentum

Stage 1 Desired Results

<table>
<tr><td rowspan="4">ESTABLISHED GOALS (Which Content & CCSS from multiple strands (e.g. reading, writing, language, speaking, listening & content) can be integrated?)

HS-PS2-3. Apply scientific and engineering ideas to design, evaluate, and refine a device that minimizes the force on a macroscopic object during a collision.*

HSA-CED.A.4 Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations.
HS-PS3-2. Develop and use models to illustrate that energy at the macroscopic scale can be accounted for as a combination of energy associated with the motions of particles (objects) and energy associated with the relative position of particles (objects).
HS-PS3-3. Design, build, and refine a device that works within given constraints to convert one form</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…
Predict the consequence of a collision between similar and differing masses
Describe energy transitions between potential and kinetic energy</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>UNDERSTANDINGS
Students will understand that…
PS2.A: Forces and Motion
Momentum is defined for a particular frame of reference; it is
the mass times the velocity of the object. (HS-PS2-2) If a system interacts with objects outside itself, the total momentum of the system can change; however, any such change is balanced by changes in the momentum of objects outside the system. (HS-PS2-2),(HS-PS2-3)

PS3.A: Definitions of Energy

Energy is a quantitative property of a system that depends on the motion and interactions of matter [. . .]

At the macroscopic scale, energy manifests itself in multiple ways, such as in motion,</td><td>ESSENTIAL QUESTIONS (What open-ended, age appropriate questions will prompt exploration and creative and critical thinking?)
How is momentum similar or different from inertia?
Why is the way you catch an egg or water balloon important?
Why do we have airbags?
What happens when a rolling cart hits an identical cart at rest? (What if they are both traveling towards each other with a constant velocity? What if they stick together? What if they are at rest and an internal spring splits them apart?</td></tr>
</table>

<table>
<tr><td rowspan="3">of energy into another form of energy.*
HSN-Q.A.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.

HSN-Q.A.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.

HSA-CED.A.4 Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations.</td><td>sound, light, and thermal energy. (HS-PS3-2) (HS-PS3-3)

PS3.B: Conservation of Energy and Energy Transfer

Conservation of energy means that the total change of energy in any system is always equal to the total energy transferred into or out of the system. (HS-PS3-1)

Energy cannot be created or destroyed, but it can be transported from one place to another and transferred between systems. (HS-PS3-1),(HS-PS3-4)</td><td></td></tr>
<tr><td colspan="2">Acquisition</td></tr>
<tr><td>Students will KNOW… (Including Tier II and Tier III vocabulary)
Definitions of impulse, momentum, and conservation
How each variable in the impulse momentum theorem is related</td><td>Students will be skilled at (DO)…
Calculating the momentum for each part of a system before and after a collision
Creating solutions to minimize or maximize force during an impact
Calculate potential and kinetic energy</td></tr>
<tr><td colspan="3">Stage 2 - Evidence
How will you monitor and/or measure evidence of student learning? How will you communicate student learning? How do students provide feedback about their learning?</td></tr>
<tr><td>Evaluative Criteria</td><td colspan="2">Assessment Evidence</td></tr>
<tr><td><type here></td><td colspan="2">PERFORMANCE TASK(S):
<type here></td></tr>
<tr><td><type here></td><td colspan="2">OTHER EVIDENCE:
<type here></td></tr>
</table>

COURSE NAME: PHYSICAL WORLD

Developers: Jason Yusten, Jared Johnson, Liz Rosendale	Development Date: 2016	Instructional Level: 10-12	Unit: Circular Motion

Stage 1 Desired Results

ESTABLISHED GOALS *(Which Content & CCSS from multiple strands (e.g. reading, writing, language, speaking, listening & content) can be integrated?)*	***Transfer***	
HS-PS2-4. Use mathematical representations of Newton's Law of Gravitation and Coulomb's Law to describe and predict the gravitational and electrostatic forces between objects.	*Students will be able to independently use their learning to…*	
	Meaning	
	UNDERSTANDINGS *Students will understand that…* • Newton's law of universal gravitation and Coulomb's law provide the mathematical models to describe and predict the effects of gravitational and electrostatic forces between distant objects. (HS-PS2-4) • Forces at a distance are explained by fields (gravitational, electric, and magnetic) permeating space that can transfer energy through space. Magnets or electric currents cause magnetic fields; electric charges or changing magnetic fields cause electric fields. (HS-PS2-4),(HS-PS2-5) •	ESSENTIAL QUESTIONS *(What open-ended, age appropriate questions will prompt exploration and creative and critical thinking?)* How are the directions of force and acceleration related in circular motion? How is the distance between two objects related to the force between them? How is artificial gravity created? How does the motion of one celestial object influence another?
	Acquisition	
	Students will KNOW… (Including Tier II and Tier III vocabulary) • Know the difference between centripetal and centrifugal	*Students will be skilled at (DO)…* • Applying the equation of the Newton's Law of Universal Gravitation

	• Vocabulary includes: toppling, revolution, rotation, rotational speed, tangential speed, center of gravity, center of mass, rotational inertia, rotational velocity, torque, lever, inverse square law, Newton's Law of Universal Gravitation	• Predicting whether an object will topple or not • Predict patterns of celestial movement • Predict tidal patterns

Stage 2 - Evidence

How will you monitor and/or measure evidence of student learning? How will you communicate student learning? How do students provide feedback about their learning?

Evaluative Criteria	Assessment Evidence
<type here>	PERFORMANCE TASK(S): <type here>
<type here>	OTHER EVIDENCE: <type here>

COURSE NAME: PHYSICAL WORLD

Developers: Jason Yusten, Jared Johnson, Liz Rosendale	Development Date: 2016	Instructional Level: 10-12	Unit:Molecular Theory and Thermodynamics

Stage 1 Desired Results

<table>
<tr><td rowspan="4">ESTABLISHED GOALS (Which Content & CCSS from multiple strands (e.g. reading, writing, language, speaking, listening & content) can be integrated?)
HS-PS3-4. Plan and conduct an investigation to provide evidence that the transfer of thermal energy when two components of different temperature are combined within a closed system results in a more uniform energy distribution among the components in the system (second law of thermodynamics).
HS-PS1-1. Use the periodic table as a model to predict the relative properties of elements based on the patterns of electrons in the outermost energy level of atoms.
HS-PS1-5. Apply scientific principles and evidence to provide an explanation about the effects of changing the

temperature or concentration of the reacting particles on the rate at which a reaction occurs.</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…
- Understand that the relationship between mass, specific heat, and initial temperature of materials determine the temperature at thermodynamic equilibrium.
-The structure of the atom determines the properties of the material
-The phase of matter is dependent upon the motion of particles.</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>UNDERSTANDINGS
Students will understand that…
• PS1.A: Structure and Properties of Matter. The structure and interactions of matter at the bulk scale are determined by electrical forces within and between atoms. (secondary to HS-PS2-6)
• PS2.B: Types of Interactions Attraction and repulsion between electric charges at the atomic scale explain the structure, properties, and transformations of matter, as well as the contact forces between material objects. (HS-PS2-6),(secondary to HS-PS1-1),(secondary to HS-PS1-3)
•</td><td>ESSENTIAL QUESTIONS (What open-ended, age appropriate questions will prompt exploration and creative and critical thinking?)
- If we combine equal masses of the same material at two different temperatures, will the final temperature be halfway in between? If not, what factors will influence the temperature.
- What structural factors influence the properties of a material?

-How are heat, temperature, and energy related? How are they different?</td></tr>
</table>

<table>
<tr><td rowspan="3"></td><td></td><td>-When you blow across the top of a sheet of paper, which direction will the paper move and why?
-How is wind formed?
-Which will cool faster, pie in a refrigerator or on a table? Why?</td></tr>
<tr><td colspan="2">Acquisition</td></tr>
<tr><td>Students will KNOW… (Including Tier II and Tier III vocabulary)
• Energy associated with the structure, phase, and temperature of a substance
• Vocabulary including: Specific Heat, density, elasticity, specific gravity, pressure, buoyancy, water displacement, Archimedes principle, Pascal’s principle, Boyle’s Law, conduction, convection, and radiation, boiling, evaporation, sublimation, deposition</td><td>Students will be skilled at (DO)…
• Calculate pressure given a force and an area
• Determine the factors involved in keeping boats floating
• Calculate heat transfer between materials using the specific heat equation
• Calculate final pressure based on initial pressure and initial and final volume.
• Identify the mode of heat transfer in various situations</td></tr>
<tr><td colspan="3">Stage 2 - Evidence
How will you monitor and/or measure evidence of student learning? How will you communicate student learning? How do students provide feedback about their learning?</td></tr>
<tr><td>Evaluative Criteria</td><td colspan="2">Assessment Evidence</td></tr>
<tr><td><type here></td><td colspan="2">PERFORMANCE TASK(S):
<type here></td></tr>
<tr><td><type here></td><td colspan="2">OTHER EVIDENCE: <type here></td></tr>
</table>

COURSE NAME: PHYSICAL WORLD

Developers: Jason Yusten, Jared Johnson, Liz Rosendale	Development Date: 2016	Instructional Level: 10-12	Unit: Waves (Sound, Light, Electricity, and Magnetism)

Stage 1 Desired Results

<table>
<tr><td rowspan="4">ESTABLISHED GOALS (Which Content & CCSS from multiple strands (e.g. reading, writing, language, speaking, listening & content) can be integrated?)
HS-PS4-1. Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling in various media.
HS-PS4-3. Evaluate the claims, evidence, and reasoning behind the idea that electromagnetic radiation can be described either by a wave model or a particle model, and that for some situations one model is more useful than the other.
HS-PS4-5. Communicate technical information about how some technological devices use the principles of wave behavior and wave interactions with matter to transmit and capture information and energy.*</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…
• Describe waves behaviors in various real world situations using scientific vocabulary
• Electric and magnetic energy is used to power many devices in our daily lives
• The flow of electricity can induce magnetism and the change of magnetic fields can induce the flow of electricity</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>UNDERSTANDINGS
Students will understand that…
• PS4.A: Wave Properties
The wavelength and frequency of a wave are related to one another by the speed of travel of the wave, which
depends on the type of wave and the medium through which it is passing. (HS-PS4-1)
Information can be digitized (e.g., a picture stored as the values of an array of pixels); in this form, it can be stored reliably in computer memory and sent over long distances as a series of wave pulses. (HS-PS4-2),(HS-
PS4-5) Waves can add or cancel one another as they cross, depending on their relative phase (i.e., relative position of peaks and troughs of the waves), but they emerge unaffected by each other. (Boundary: The discussion at this grade level is qualitative only; it can be based on the fact that two different sounds can</td><td>ESSENTIAL QUESTIONS (What open-ended, age appropriate questions will prompt exploration and creative and critical thinking?)

-Why does the sound quality change as a train passes you?
- What are the differences between electromagnetic and mechanical waves? What do they have in common?
-How are electricity, magnetism, and gravity similar and different?
-What is light?</td></tr>
</table>

	pass a location in different directions without getting mixed up.) (HS-PS4-3) PS4.B: Electromagnetic Radiation Electromagnetic radiation (e.g., radio, microwaves, light) can be modeled as a wave of changing electric and magnetic fields or as particles called photons. The wave model is useful for explaining many features of electromagnetic radiation, and the particle model explains other features. (HS-PS4-3) When light or longer wavelength electromagnetic radiation is absorbed in matter, it is generally converted into thermal energy (heat). Shorter wavelength electromagnetic radiation (ultraviolet, X-rays, gamma rays) can ionize atoms and cause damage to living cells. (HS-PS4-4) Photoelectric materials emit electrons when they absorb light of a high-enough frequency. (HS-PS4-5)	
	Acquisition	
	Students will KNOW… (Including Tier II and Tier III vocabulary) • Vocabulary including: Doppler Effect, frequency, amplitude, wavelength, node, antinode, crest, trough, Constructive and destructive interference, sonic boom, and bow waves, longitudinal and transverse waves, pitch, volume, rarefaction, compression, reflection, absorption, transmission,	*Students will be skilled at (DO)…* • Calculate the speed of a wave based on frequency and wavelength • Label the parts of a wave • Draw rays of light as they interact with a transparent, opaque, or translucent object. • Construct simple circuits and qualitatively

		describe benefits and drawbacks of parallel and series circuits

Stage 2 - Evidence

How will you monitor and/or measure evidence of student learning? How will you communicate student learning? How do students provide feedback about their learning?

Evaluative Criteria	Assessment Evidence
<type here>	PERFORMANCE TASK(S): -Project related to wiring house or similar real life task
<type here>	OTHER EVIDENCE: <type here>

COURSE NAME: ASTRONOMY

Developers: Josh Kinsman	*Development Date: 2016*	*Instructional Level: 10-12*	*Unit: Intro to Astronomy*

Stage 1 Desired Results

ESTABLISHED GOALS *(Which Content & CCSS from multiple strands (e.g. reading, writing, language, speaking, listening & content) can be integrated?)*	***Learning Targets***
Engaging in Argument from Evidence Engaging in argument from evidence in 9–12 builds on K–8 experiences and progresses to using appropriate and sufficient evidence and scientific reasoning to defend and critique claims and explanations about natural and designed worlds. Arguments may also come from current scientific or historical episodes in science. Evaluate the claims, evidence, and reasoning behind currently accepted explanations or solutions to determine the merits of arguments. (HS-PS4-3)	Identify advances in astronomy made by civilizations or famous astronomers Describe the celestial sphere and identify lines of right ascension, declination, the ecliptic, the north celestial pole, and south celestial pole. Describe the motions of the night sky and the causes of this apparent motion Identify the seasons in the northern hemisphere based on the position of the earth Explain the winter and summer solstices, and autumnal and vernal equinoxes Use the coordinate system to identify objects on star charts (right ascension and declination) Describe altitude and azimuth in the horizon system Define circumpolar stars Identify your latitude based on the altitude of the North Star Identify common constellations in the winter night sky

Stage 2 - Evidence

How will you monitor and/or measure evidence of student learning? How will you communicate student learning? How do students provide feedback about their learning?

PERFORMANCE TASK(S):

COURSE NAME: ANATOMY/PHYSIOLOGY I

Developers: Greg Grokowsky	Development Date: 2016	Instructional Level: 10-12	Unit: Introduction to Structure and Function

Stage 1 Desired Results

ESTABLISHED GOALS *(Which Content & CCSS from multiple strands (e.g. reading, writing, language, speaking, listening & content) can be integrated?)*	***Learning Targets***
HS-LS1-2. **Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms** **HS-LS1-3.** **Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis.**	*Define the study of anatomy and physiology *List and discuss levels of organization *Demonstrate and define correct anatomical position *List and define the principle planes of dissection and body part relationships *List and define the major cavities of the body and subdivisions *Discuss and contrast axial and appendicular portions of the body *Explain and give examples of homeostasis *Explain and define the 11 systems of the human body

Stage 2 - Evidence

How will you monitor and/or measure evidence of student learning? How will you communicate student learning? How do students provide feedback about their learning?

PERFORMANCE TASK(S):
Daily performance quizzes
Chapter exam

COURSE NAME: ANATOMY/PHYSIOLOGY I

Developers: Greg Grokowsky	Development Date: 2016	Instructional Level: 10-12	Unit: Tissues

Stage 1 Desired Results

ESTABLISHED GOALS *(Which Content & CCSS from multiple strands (e.g. reading, writing, language, speaking, listening & content) can be integrated?)*	***Learning Targets***
HS-LS1-2. **Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms** **HS-LS1-3.** **Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis.**	*Differentiate the four types of tissues in the human body *Utilize technology to view tissues

Stage 2 - Evidence

How will you monitor and/or measure evidence of student learning? How will you communicate student learning? How do students provide feedback about their learning?

PERFORMANCE TASK(S):
Correctly use microscope
Correctly use NYU Tissue Internet Page
Identification Exam

COURSE NAME: ANATOMY/PHYSIOLOGY I

Developers: Greg Grokowsky	*Development Date: 2016*	*Instructional Level: 10-12*	*Unit: Integumentary System*

Stage 1 Desired Results

ESTABLISHED GOALS *(Which Content & CCSS from multiple strands (e.g. reading, writing, language, speaking, listening & content) can be integrated?)*	***Learning Targets***
HS-LS1-2. **Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms** **HS-LS1-3.** **Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis.**	*List and describe the primary functions of the integument *Classify, compare and give examples of each type of membrane in the human body *Describe the structure and function of the epidermis and dermis *List and describe accessory organs of the skin *List and describe major skin disorders *Classify and describe burns

Stage 2 - Evidence

How will you monitor and/or measure evidence of student learning? How will you communicate student learning? How do students provide feedback about their learning?

PERFORMANCE TASK(S):
Daily performance quizzes/assignments
Integument ID quiz
Chapter exam

COURSE NAME: ANATOMY/PHYSIOLOGY I

Developers: Greg Grokowsky	*Development Date: 2016*	*Instructional Level: 10-12*	*Unit: Skeletal System*

Stage 1 Desired Results

ESTABLISHED GOALS *(Which Content & CCSS from multiple strands (e.g. reading, writing, language, speaking, listening & content) can be integrated?)*	***Learning Targets***
HS-LS1-2. **Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms** **HS-LS1-3.** **Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis.**	*List and discuss functions of the skeleton *Identify major anatomical structures of long bone *Discuss microscopic structure of bone *Explain how bone forms, grows and are remodeled *Identify the two subdivisions of the skeleton *Compare and contrast the types of joints in the body *Name and describe major bone disorders

Stage 2 - Evidence

How will you monitor and/or measure evidence of student learning? How will you communicate student learning? How do students provide feedback about their learning?

PERFORMANCE TASK(S):
Daily performance quizzes/assignments
Bone ID quiz
Chapter exam

COURSE NAME: ANATOMY/PHYSIOLOGY I

Developers: Greg Grokowsky	Development Date: 2016	Instructional Level: 10-12	Unit: Muscle System

Stage 1 Desired Results

ESTABLISHED GOALS *(Which Content & CCSS from multiple strands (e.g. reading, writing, language, speaking, listening & content) can be integrated?)*	***Learning Targets***
HS-LS1-2. **Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms** **HS-LS1-3.** **Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis.**	*List, locate and compare structure and function of the three major types of muscle tissue *Discuss the microscopic structure of skeletal muscle sarcomere and motor unit *Discuss muscle stimulation and types of contractions *Name and identify major muscles of the human body *List and explain types of muscle movement *Name and describe muscle disorders *Properly dissect muscles on a rat

Stage 2 - Evidence

How will you monitor and/or measure evidence of student learning? How will you communicate student learning? How do students provide feedback about their learning?

PERFORMANCE TASK(S):
Daily performance quizzes/assignments
Rat Dissection ID quiz
Chapter exam

COURSE NAME: ANATOMY/PHYSIOLOGY I

Developers: Greg Grokowsky	*Development Date: 2016*	*Instructional Level: 10-12*	*Unit: Nervous System*

Stage 1 Desired Results

ESTABLISHED GOALS *(Which Content & CCSS from multiple strands (e.g. reading, writing, language, speaking, listening & content) can be integrated?)*	***Learning Targets***
HS-LS1-2. **Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms** **HS-LS1-3.** **Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis.**	*List organs and divisions of the nervous systems and their functions *Identify major cell types in the nervous system and discuss function *Define and demonstrate reflex arcs *Explain the propagation of a nervous impulse in an axon and synapse *Identify the anatomical components of the brain and spinal cord and describe their function *Identify and discuss the importance of protective coverings and fluid spaces of the brain and spinal cord *Compare and contrast spinal and cranial nerves *Discuss the function of the autonomic nervous system *Describe major nervous system disorders

Stage 2 - Evidence

How will you monitor and/or measure evidence of student learning? How will you communicate student learning? How do students provide feedback about their learning?

PERFORMANCE TASK(S):
Daily performance quizzes/assignments
Brain structure ID Quiz
Chapter exam

COURSE NAME: ANATOMY/PHYSIOLOGY I

Developers: Greg Grokowsky	*Development Date: 2016*	*Instructional Level: 10-12*	*Unit: Endocrine System*

Stage 1 Desired Results

ESTABLISHED GOALS *(Which Content & CCSS from multiple strands (e.g. reading, writing, language, speaking, listening & content) can be integrated?)*	***Learning Targets***
HS-LS1-2. **Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms** **HS-LS1-3.** **Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis.**	*Distinguish between exocrine and endocrine glands *Identify and locate the primary endocrine glands *Describe the action of steroid and non-steroid action *Describe the role of positive and negative feedback loops in the endocrine system

Stage 2 - Evidence

How will you monitor and/or measure evidence of student learning? How will you communicate student learning? How do students provide feedback about their learning?

PERFORMANCE TASK(S):
Daily performance quizzes
Chapter exam

COURSE NAME: ANATOMY/PHYSIOLOGY I

Developers: Greg Grokowsky	Development Date: 2016	Instructional Level: 10-12	Unit: The Senses

Stage 1 Desired Results

ESTABLISHED GOALS *(Which Content & CCSS from multiple strands (e.g. reading, writing, language, speaking, listening & content) can be integrated?)*	***Learning Targets***
HS-LS1-2. **Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms** **HS-LS1-3.** **Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis.**	*Classify sense organs as special of general and how they differ *Discuss how a stimulus is converted into a sensation *Discuss general sense organs and their function *Discuss the structure of the eye and the functions *Name and describe the major visual disorders *Discuss the anatomy of the ear and its sensory function in hearing and equilibrium *Name and describe the major forms of hearing impairment *Discuss chemical receptors and their functions

Stage 2 - Evidence

How will you monitor and/or measure evidence of student learning? How will you communicate student learning? How do students provide feedback about their learning?

PERFORMANCE TASK(S):
Daily performance quizzes
Dissection
Chapter exam

COURSE NAME: ANATOMY/PHYSIOLOGY II

Developers: Greg Grokowsky	*Development Date: 2016*	*Instructional Level: 10-12*	*Unit: Cardiovascular*

Stage 1 Desired Results

ESTABLISHED GOALS *(Which Content & CCSS from multiple strands (e.g. reading, writing, language, speaking, listening & content) can be integrated?)*	***Learning Targets***
HS-LS1-2. **Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms** **HS-LS1-3.** **Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis.**	*Describe the functions of blood *Describe the characteristics of blood plasma *List the formed elements and identify the functions of each *Discuss major blood disorders and their characteristics *Describe the steps of blood clotting *Describe ABO and Rh blood typing *Discuss the location, size, and position of the heart *Discuss and explain the important structures of the heart including chambers, valves and vessels *Describe the major valve disorders of the heart *Trace the proper path of blood from entrance to exit *Describe coronary circulation and myocardial infarction *List the anatomical components of the electrical path of the heart and discuss the ECG *Describe the major types of cardiac dysrhythmia *Describe possible causes of heart failure *Describe the structure and function of each of the major blood vessels: artery, vain and capillary *List and describe the major disorders of blood vessels and how they develop *Trace the path of blood through systemic, pulmonary, portal and fetal circulation *Identify and discuss factors that influence blood pressure. *Define and discuss major pulse points in the body *Explain circulatory shock

Stage 2 - Evidence

How will you monitor and/or measure evidence of student learning? How will you communicate student learning? How do students provide feedback about their learning?

PERFORMANCE TASK(S):
Daily performance quizzes/assignments
Heart, Vessel and blood cell ID quizzes

Dissection Chapter exam

COURSE NAME: ANATOMY/PHYSIOLOGY II

Developers: Greg Grokowsky	*Development Date: 2016*	*Instructional Level: 10-12*	*Unit: Lymphatic*

Stage 1 Desired Results

ESTABLISHED GOALS *(Which Content & CCSS from multiple strands (e.g. reading, writing, language, speaking, listening & content) can be integrated?)*	***Learning Targets***
HS-LS1-2. **Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms** **HS-LS1-3.** **Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis.**	*Describe the general functions and main structures of the lymphatic system *Compare/describe non-specific and specific immunity *Compare/describe inherited and acquired/active and passive immunity. *Name the major disorders associated with the lymphatic system *Discuss the major types of immune system molecules and indicate how antibodies and complement proteins function *Compare and contrast the development and function of B and T cells *Compare and contrast humoral and cell-mediated immunity *Describe the mechanisms of allergy, autoimmunity and isoimmunity *List and describe major types of immune deficiencies

Stage 2 - Evidence

How will you monitor and/or measure evidence of student learning? How will you communicate student learning? How do students provide feedback about their learning?

PERFORMANCE TASK(S):
Daily performance quizzes/assignments
Chapter exam

COURSE NAME: ANATOMY/PHYSIOLOGY II

Developers: Greg Grokowsky	Development Date: 2016	Instructional Level: 10-12	Unit: Respiratory

Stage 1 Desired Results

ESTABLISHED GOALS *(Which Content & CCSS from multiple strands (e.g. reading, writing, language, speaking, listening & content) can be integrated?)*	***Learning Targets***
HS-LS1-2. **Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms** **HS-LS1-3.** **Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis.**	*Discuss the general function of the respiratory system *List the major organs of the respiratory system and describe the function of each *Compare and contrast the mechanisms responsible for gas exchange that occur in internal and external respiration *List and explain the volumes of air exchanged during pulmonary ventilation *Identify and discuss the mechanisms that regulate respiration *Identify and describe the major disorders of the upper and lower respiratory tracts

Stage 2 - Evidence

How will you monitor and/or measure evidence of student learning? How will you communicate student learning? How do students provide feedback about their learning?

PERFORMANCE TASK(S):
Daily performance quizzes/assignments
Chapter exam

COURSE NAME: ANATOMY/PHYSIOLOGY II

Developers: Greg Grokowsky	*Development Date: 2016*	*Instructional Level: 10-12*	*Unit: Digestive*

Stage 1 Desired Results

ESTABLISHED GOALS *(Which Content & CCSS from multiple strands (e.g. reading, writing, language, speaking, listening & content) can be integrated?)*	***Learning Targets***
HS-LS1-2. **Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms** **HS-LS1-3.** **Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis.**	*List in sequence each of the component parts or segments of the alimentary canal from mouth to anus *Identify the name and function of the accessory organs in the digestive system *Compare and contrast the structural similarities and differences on the alimentary canal *List and describe the major disorders of the digestive system *Discuss the basics of protein, fat and carbohydrate digestion and the end products of each. *Define and contrast mechanical a chemical digestion

Stage 2 - Evidence

How will you monitor and/or measure evidence of student learning? How will you communicate student learning? How do students provide feedback about their learning?

PERFORMANCE TASK(S):
Daily performance quizzes
Dissection
Chapter exam

COURSE NAME: ANATOMY/PHYSIOLOGY II

Developers: Greg Grokowsky	Development Date: 2016	Instructional Level: 10-12	Unit: Urinary

Stage 1 Desired Results

ESTABLISHED GOALS *(Which Content & CCSS from multiple strands (e.g. reading, writing, language, speaking, listening & content) can be integrated?)*	***Learning Targets***
HS-LS1-2. **Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms** **HS-LS1-3.** **Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis.**	*Identify the major organs of the urinary system and give the generalized function of each *Name the parts of a nephron and describe their roles in urine formation *Explain the importance of filtration, reabsorption and secretion *Discuss the mechanisms that control urine volume *Explain how the kidneys help to maintain homeostasis *List and explain major renal and urinary disorders

Stage 2 - Evidence

How will you monitor and/or measure evidence of student learning? How will you communicate student learning? How do students provide feedback about their learning?

PERFORMANCE TASK(S):
Daily performance quizzes
Chapter exam

COURSE NAME: ANATOMY/PHYSIOLOGY II

Developers: Greg Grokowsky	*Development Date: 2016*	*Instructional Level: 10-12*	*Unit: Reproductive*

Stage 1 Desired Results

ESTABLISHED GOALS *(Which Content & CCSS from multiple strands (e.g. reading, writing, language, speaking, listening & content) can be integrated?)*	***Learning Targets***
HS-LS1-2. **Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms** **HS-LS1-3.** **Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis.**	*List the essential and accessory organs of the male and female reproductive system *Describe the gross and microscopic structure of the gonads in both sexes and how sperm and eggs develop *Discuss the primary functions of sex hormones and what is responsible for secretion *List the major disorders of the male and female reproductive systems *List the phases of the menstrual cycle

Stage 2 - Evidence

How will you monitor and/or measure evidence of student learning? How will you communicate student learning? How do students provide feedback about their learning?

PERFORMANCE TASK(S):
Daily performance quizzes
Chapter exam

COURSE NAME: ENVIRONMENTAL SCIENCE

Developers: Jared Johnson	Development Date: 2016	Instructional Level: 10-12	Unit: Fundamentals of Earth Science

Stage 1 Desired Results

ESTABLISHED GOALS *(Which Content & CCSS from multiple strands (e.g. reading, writing, language, speaking, listening & content) can be integrated?)*	***Learning Targets***
HS-ESS2-1. Develop a model to illustrate how Earth's internal and surface processes operate at different spatial and temporal scales to form continental and ocean-floor features. HS-ESS2-3. Develop a model based on evidence of Earth's interior to describe the cycling of matter by thermal convection. HS-ESS2-2. Analyze geoscience data to make the claim that one change to Earth's surface can create feedbacks that cause changes to other Earth systems. HS-ESS2-5. Plan and conduct an investigation of the properties of water and its effects on Earth materials and surface processes. HS-ESS2-6. Develop a quantitative model to describe the cycling of carbon among the hydrosphere, atmosphere, geosphere, and biosphere.	Students will understand…. -Major geological ideas and how they impact our planet -The structure and function of our atmosphere -How water exists and is used on Earth -The importance and dynamics of rocks and soils

Stage 2 - Evidence

How will you monitor and/or measure evidence of student learning? How will you communicate student learning? How do students provide feedback about their learning?

PERFORMANCE TASK(S):

COURSE NAME: ENVIRONMENTAL SCIENCE

Developers: Jared Johnson	*Development Date: 2016*	*Instructional Level: 10-12*	*Unit: Earths Living World*

Stage 1 Desired Results

ESTABLISHED GOALS *(Which Content & CCSS from multiple strands (e.g. reading, writing, language, speaking, listening & content) can be integrated?)*	***Learning Targets***
HS-LS2-2. Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales. HS-LS2-8. Evaluate the evidence for the role of group behavior on individual and species' chances to survive and reproduce.	Students will understand… -how energy flows through ecosystems -the principles of population ecology -how ecosystems change -characteristics of human population dynamics -effects of population size and growth -earth's biogeochemical cycles

Stage 2 - Evidence

How will you monitor and/or measure evidence of student learning? How will you communicate student learning? How do students provide feedback about their learning?

PERFORMANCE TASK(S):

COURSE NAME: ENVIRONMENTAL SCIENCE

Developers: Jared Johnson	*Development Date: 2016*	*Instructional Level: 10-12*	*Unit: Land and Water Use*

Stage 1 Desired Results

ESTABLISHED GOALS *(Which Content & CCSS from multiple strands (e.g. reading, writing, language, speaking, listening & content) can be integrated?)*	***Learning Targets***
HS-ESS3-1. Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity. HS-ESS3-2. Evaluate competing design solutions for developing, managing, and utilizing energy and mineral resources based on cost-benefit ratios. * HS-ESS3-3. Create a computational simulation to illustrate the relationships among management of natural resources, the sustainability of human populations, and biodiversity.	Students will understand… -The effects of agriculture in a growing world -How resources affect land use and land management. - How to manage lands in a sustainable way

Stage 2 - Evidence

How will you monitor and/or measure evidence of student learning? How will you communicate student learning? How do students provide feedback about their learning?

PERFORMANCE TASK(S):

COURSE NAME: ENVIRONMENTAL SCIENCE

Developers: Jared Johnson	*Development Date: 2016*	*Instructional Level: 10-12*	*Unit: Energy Resources and Energy Consumption*

Stage 1 Desired Results	
ESTABLISHED GOALS *(Which Content & CCSS from multiple strands (e.g. reading, writing, language, speaking, listening & content) can be integrated?)* HS-PS3-1. Create a computational model to calculate the change in the energy of one component in a system when the change in energy of the other component(s) and energy flows in and out of the system are known. HS-PS3-2. Develop and use models to illustrate that energy at the macroscopic scale can be accounted for as a combination of energy associated with the motions of particles (objects) and energy associated with the relative position of particles (objects).	***Learning Targets*** Students will understand…. -characteristics of our energy sources (fossil, nuclear, and renewable) and how we obtain them -forms of energy and consumption and their consequences -possible future energy sources.

Stage 2 - Evidence
How will you monitor and/or measure evidence of student learning? How will you communicate student learning? How do students provide feedback about their learning?
PERFORMANCE TASK(S):

COURSE NAME: ENVIRONMENTAL SCIENCE

Developers: Jared Johnson	*Development Date: 2016*	*Instructional Level: 10-12*	*Unit: Pollution*

Stage 1 Desired Results	
ESTABLISHED GOALS *(Which Content & CCSS from multiple strands (e.g. reading, writing, language, speaking, listening & content) can be integrated?)* HS-LS2-5. Develop a model to illustrate the role of photosynthesis and cellular respiration in the cycling of carbon among the biosphere, atmosphere, hydrosphere, and geosphere.	***Learning Targets*** Students will understand….. -the different types and causes of pollution -effects of pollution in the atmosphere, water, and soil -how do deal with pollution in an environmentally conscience way

Stage 2 - Evidence
How will you monitor and/or measure evidence of student learning? How will you communicate student learning? How do students provide feedback about their learning?
PERFORMANCE TASK(S):

COURSE NAME: ENVIRONMENTAL SCIENCE

Developers: Jared Johnson	*Development Date: 2016*	*Instructional Level: 10-12*	*Unit: Changing the earth*

Stage 1 Desired Results

ESTABLISHED GOALS *(Which Content & CCSS from multiple strands (e.g. reading, writing, language, speaking, listening & content) can be integrated?)*	***Learning Targets***
HS-LS2-5. Develop a model to illustrate the role of photosynthesis and cellular respiration in the cycling of carbon among the biosphere, atmosphere, hydrosphere, and geosphere. HS-LS2-6. Evaluate the claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, but changing conditions may result in a new ecosystem. HS-LS4-6. Create or revise a simulation to test a solution to mitigate adverse impacts of human activity on biodiversity.* HS-ESS2-2. Analyze geoscience data to make the claim that one change to Earth's surface can create feedbacks that cause changes to other Earth systems. HS-ESS3-4. Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.* HS-ESS3-5. Analyze geoscience data and the results from global climate models to make an evidence-based forecast of the current rate of global or regional climate change and associated future impacts to Earth systems. HS-ESS3-6. Use a computational representation to illustrate the relationships among Earth systems and how those relationships are being modified due to human activity.	Students will understand….. -the status of our atmosphere -the dynamics of global climate change -the loss our earth's biodiversity -what we are doing to minimize our impacts of our planet.

Stage 2 - Evidence *How will you monitor and/or measure evidence of student learning? How will you communicate student learning? How do students provide feedback about their learning?*
PERFORMANCE TASK(S):

COURSE NAME: GEOLOGY

Developers: Josh Kinsman	Development Date: 2016	Instructional Level: 10-12	Unit: Earth History and Time Earth History

Stage 1 Desired Results

ESTABLISHED GOALS *(Which Content & CCSS from multiple strands (e.g. reading, writing, language, speaking, listening & content) can be integrated?)*	***Learning Targets***
HS-ESS1-5. Evaluate evidence of the past and current movements of continental and oceanic crust and the theory of plate tectonics to explain the ages of crustal rocks. HS-ESS1-6. Apply scientific reasoning and evidence from ancient Earth materials, meteorites, and other planetary surfaces to construct an account of Earth's formation and early history. HS-ESS2-7. Construct an argument based on evidence about the simultaneous coevolution of Earth systems and life on Earth.	Describe the basic conditions on early Earth. Describe major biological and geological events in each of the four eras (Precambrian, Paleozoic, Mesozoic, and Cenozoic). Explain how the land area we call "Wisconsin" has changed over geologic time. Identify some major events in Wisconsin's geologic history. Understand the geologic time scale and how it is organized. (Eons, Eras, Periods, Epochs). Describe the difference between relative dating and absolute dating. Use relative dating techniques to identify the relative age of rock layers or fossils. Identify different types of absolute dating. Explain how radiometric dating is used to date rocks or fossils. Calculate half-life problems.

Stage 2 - Evidence

How will you monitor and/or measure evidence of student learning? How will you communicate student learning? How do students provide feedback about their learning?

PERFORMANCE TASK(S):

COURSE NAME: GEOLOGY

Developers: Josh Kinsman	Development Date: 2016	Instructional Level: 10-12	Unit: Plate-tectonics Earth History

Stage 1 Desired Results

ESTABLISHED GOALS *(Which Content & CCSS from multiple strands (e.g. reading, writing, language, speaking, listening & content) can be integrated?)*	***Learning Targets***
HS-ESS1-5. Evaluate evidence of the past and current movements of continental and oceanic crust and the theory of plate tectonics to explain the ages of crustal rocks. HS-ESS2-1. Develop a model to illustrate how Earth's internal and surface processes operate at different spatial and temporal scales to form continental and ocean-floor features. HS-ESS2-3. Develop a model based on evidence of Earth's interior to describe the cycling of matter by thermal convection.	Identify the major layers making up Earth and the properties/composition of each layer. Explain the driving force that causes plates to move. Compare and contrast oceanic crust and continental crust. Provide evidence used to support the theory of continental drift. Explain the process of sea-floor spreading and the effects on tectonic plates. Describe the process of subduction and predict when it will occur. Draw models to demonstrate different types of plate boundaries (divergent, transform, and convergent). Explain the key features present in different boundary types.

Stage 2 - Evidence

How will you monitor and/or measure evidence of student learning? How will you communicate student learning? How do students provide feedback about their learning?

PERFORMANCE TASK(S):

COURSE NAME: GEOLOGY

Developers: Josh Kinsman	Development Date: 2016	Instructional Level: 10-12	Unit: Igneous Processes

Stage 1 Desired Results

ESTABLISHED GOALS *(Which Content & CCSS from multiple strands (e.g. reading, writing, language, speaking, listening & content) can be integrated?)*	***Learning Targets***
HS-ESS2-1. Develop a model to illustrate how Earth's internal and surface processes operate at different spatial and temporal scales to form continental and ocean-floor features. HS-ESS2-3. Develop a model based on evidence of Earth's interior to describe the cycling of matter by thermal convection. HS-ESS3-1. Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity.	Describe how the temperature of Earth's interior changes as depth changes Explain the trends described by Bowen's Reaction Series Use Bowen's Reaction Series to determine which minerals will melt or crystallize first/last Identify common rock forming minerals using properties such as hardness, color, habit, streak, etc. Describe where magma comes from Identify 3 ways to melt rock and use a P/T graph to explain each method Explain how fractional crystallization can change the composition of magma Describe differences between mafic, felsic, and intermediate rock types. Describe what type of plate boundaries (or tectonic environments) associated with mafic, intermediate, or felsic rock types. Compare and contrast intrusive vs extrusive rock types Identify common intrusive and extrusive igneous rocks Identify or label different types of intrusive bodies (batholith, dike, sill, etc.)

	Explain how the silica content of lava/magma can affect the type of volcanism that occurs Identify the types of environments would produce explosive and non-explosive volcanism Compare and contrast the different types of volcanoes Identify types of volcanic landforms using images or maps Explain how scientists predict volcanic eruptions Describe various hazards associated with volcanic activity and how they form (pyroclastic debris, gases, lahars, etc.)

Stage 2 - Evidence

How will you monitor and/or measure evidence of student learning? How will you communicate student learning? How do students provide feedback about their learning?

PERFORMANCE TASK(S):

COURSE NAME: GEOLOGY

Developers: Josh Kinsman	Development Date: 2016	Instructional Level: 10-12	Unit: Sedimentary Processes

Stage 1 Desired Results

ESTABLISHED GOALS *(Which Content & CCSS from multiple strands (e.g. reading, writing, language, speaking, listening & content) can be integrated?)*	***Learning Targets***
HS-ESS2-1. Develop a model to illustrate how Earth's internal and surface processes operate at different spatial and temporal scales to form continental and ocean-floor features. HS-ESS2-5. Plan and conduct an investigation of the properties of water and its effects on Earth materials and surface processes.	Describe the differences between physical and chemical weathering Evaluate how climate would affect physical and chemical weathering processes Explain examples of physical weathering Describe the difference between weathering and erosion Explain examples of chemical weathering Explain the basic process of soil formation and the role of weathering in the process (Where does soil come from?) Classify soil based on composition and texture using a key/chart provided Identify the different soil horizons (A, B, C horizons) Describe three different methods of transporting sediments Describe how sediments can change during transportation Compare and contrast depositional environments (where sediment is deposited - Terrestrial vs Marine environments). Use the following terms (**Weathering, Erosion, Transportation, Deposition, Stratification/Layering, Compaction/cementation, Lithification)** to describe the sequence leading to formation of sandstone.

	Compare and contrast *clastic* and *chemical* sedimentary rocks Use features to describe a rock's depositional environment (example: cross-bedding) Identify sedimentary rocks from our lab using keys Infer past environments based on sedimentary rock characteristics Describe the sedimentary rocks one could find in LaCrosse County Answer questions regarding silica sand mining Identify basic fossil types and explain the role of fossils in identifying rock units Describe why you would find fossils in sedimentary rock but not igneous rock

Stage 2 - Evidence

How will you monitor and/or measure evidence of student learning? How will you communicate student learning? How do students provide feedback about their learning?

PERFORMANCE TASK(S):

COURSE NAME: GEOLOGY

Developers: Josh Kinsman	Development Date: 2016	Instructional Level: 10-12	Unit: Metamorphic Processes, Structure, and Earthquakes

Stage 1 Desired Results

ESTABLISHED GOALS *(Which Content & CCSS from multiple strands (e.g. reading, writing, language, speaking, listening & content) can be integrated?)*	***Learning Targets***
HS-ESS2-1. Develop a model to illustrate how Earth's internal and surface processes operate at different spatial and temporal scales to form continental and ocean-floor features. HS-ESS3-1. Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity.	Describe what metamorphism is and how it fits into the rock cycle. Describe the types of changes caused by metamorphism. Explain the causes for metamorphism (heat, pressure) and how heat and pressure could be increased in different tectonic environments. Identify common metamorphic rocks Describe the process of going from a parent rock (like granite) →clay → shale → various metamorphic rock types. Compare and contrast metamorphic textures (foliation vs granular) and how they represent different parent rocks. Describe different types of stress that rocks can go under. Identify the 3 main types of faults and the types of boundaries associated with them. Describe the different situations in which folding and faulting would occur. Compare and contrast anticlines and synclines. Use a geologic map to identify rock types and geologic structures (anticlines, synclines, faults). Describe why and where most earthquakes occur.

	Identify types of hazards associated with earthquakes. Describe the types of waves used to detect and measure earthquakes. Compare and contrast the 3 types of waves (p, s, surface). Explain how to determine the epicenter of an earthquake. Interpret the speed and magnitude of an earthquake wave using seismographic data.
Stage 2 - Evidence ***How will you monitor and/or measure evidence of student learning? How will you communicate student learning? How do students provide feedback about their learning?***	
PERFORMANCE TASK(S):	

COURSE NAME: GEOLOGY

Developers: Josh Kinsman	Development Date: 2016	Instructional Level: 10-12	Unit: Hydrogeology and Water Resources

Stage 1 Desired Results

ESTABLISHED GOALS *(Which Content & CCSS from multiple strands (e.g. reading, writing, language, speaking, listening & content) can be integrated?)*	***Learning Targets***
HS-ESS3-1. Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity. HS-ESS2-5. Plan and conduct an investigation of the properties of water and its effects on Earth materials and surface processes.	Use the following terms to describe where water exists above and underground: groundwater, surface water, saturated zone, unsaturated zone, water table Describe how porosity and permeability affect groundwater storage and movement Explain what an aquifer is Use topographic maps to predict surface water flows Use well data and water table elevations to draw lines of equipotential Use well data and water table elevations to predict direction of groundwater flow Explain how groundwater contamination occurs and describe the difference between point and nonpoint pollution sources

Stage 2 - Evidence

How will you monitor and/or measure evidence of student learning? How will you communicate student learning? How do students provide feedback about their learning?

PERFORMANCE TASK(S):

COURSE NAME: ORGANIC CHEMISTRY

Developers: Anne Nyseth	*Development Date: 2016*	*Instructional Level: 10-12*	*Unit: Inorganic Chemistry Review*

Stage 1 Desired Results

ESTABLISHED GOALS *(Which Content & CCSS from multiple strands (e.g. reading, writing, language, speaking, listening & content) can be integrated?)*	***Learning Targets***
HS-PS1-1. Use the periodic table as a model to predict the relative properties of elements based on the patterns of electrons in the outermost energy level of atoms. **HS-PS1-2. Construct and revise an explanation for the outcome of a simple chemical reaction based on the outermost electron states of atoms, trends in the periodic table, and knowledge of the patterns of chemical properties.**	Demonstrate safe practices and techniques in lab settings. Utilize an MSDS. Renew knowledge of inorganic chemistry concepts including atomic structure, chemical compounds, chemical reactions (including redox), and descriptive chemistry vocabulary. Distinguish between inorganic and organic compounds based on solubility.

Stage 2 - Evidence

How will you monitor and/or measure evidence of student learning? How will you communicate student learning? How do students provide feedback about their learning?

PERFORMANCE TASK(S):
Element Research
Lab- Solubility
Quiz- Safety and Inorganic Chemistry Review

COURSE NAME: ORGANIC CHEMISTRY

Developers: Anne Nyseth	*Development Date: 2016*	*Instructional Level: 10-12*	*Unit: Hydrocarbons*

Stage 1 Desired Results

ESTABLISHED GOALS *(Which Content & CCSS from multiple strands (e.g. reading, writing, language, speaking, listening & content) can be integrated?)*	***Learning Targets***
	Demonstrate safe practices and techniques in lab settings. Characterize inorganic and organic substances. Identify, draw and name alkanes, alkenes, alkynes, and aromatic molecules. Consider how molecular structure impacts molecular properties. Build organic molecules with model kits. Draw, name, and build isomers (including structural and geometric isomers).

Stage 2 - Evidence

How will you monitor and/or measure evidence of student learning? How will you communicate student learning? How do students provide feedback about their learning?

PERFORMANCE TASK(S):
Lab- Building Molecules
Quiz- Alkanes
Quiz- Alkenes
Quiz- Alkynes
Quiz- Aromatic Molecules
Test- Structure of Hydrocarbons

COURSE NAME: ORGANIC CHEMISTRY

Developers: Anne Nyseth	*Development Date: 2016*	*Instructional Level: 10-12*	*Unit: Organic Oxygen, Sulfur, Nitrogen Molecules and Organic Reactions*

Stage 1 Desired Results

ESTABLISHED GOALS *(Which Content & CCSS from multiple strands (e.g. reading, writing, language, speaking, listening & content) can be integrated?)*	***Learning Targets***
HS-PS1-2. Construct and revise an explanation for the outcome of a simple chemical reaction based on the outermost electron states of atoms, trends in the periodic table, and knowledge of the patterns of chemical properties. **WHST.9-12.7 Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation. (HS-LS2-7),(HS-LS4-6)**	Demonstrate safe practices and techniques in lab settings. Identify, draw, and name organic molecules containing oxygen, nitrogen, or sulfur. Draw and name isomers. Write and draw structures for six types of organic reactions. Predict products for six types of organic reactions. Evaluate sources of information for objectivity.

Stage 2 - Evidence

How will you monitor and/or measure evidence of student learning? How will you communicate student learning? How do students provide feedback about their learning?

PERFORMANCE TASK(S):
Lab- Formation of Esters
Quiz- Organic O, N, S Molecules
Quiz- Organic Reactions
Organic Molecule Research
Test- Organic Molecules and Reactions

COURSE NAME: ORGANIC CHEMISTRY

Developers: Anne Nyseth	Development Date: 2016	Instructional Level: 10-12	Unit: Macronutrients

Stage 1 Desired Results

ESTABLISHED GOALS *(Which Content & CCSS from multiple strands (e.g. reading, writing, language, speaking, listening & content) can be integrated?)*	***Learning Targets***
HS-LS1-6. Construct and revise an explanation based on evidence for how carbon, hydrogen, and oxygen from sugar molecules may combine with other elements to form amino acids and/or other large carbon-based molecules. **WHST.9-12.2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes. (HS-LS2-1),(HS-LS2-2)** **SL.11-12.5 Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest. (HS-PS1-4)**	Demonstrate safe practices and techniques in lab settings. Differentiate among structures of carbohydrates, proteins, and lipids. Distinguish among the digestive processes and functions of carbohydrates, proteins, and lipids. Compare and contrast the lock-and-key and induced fit models of enzyme function. Use chemical indicators to test for the presence of starch, monosaccharides, proteins, and lipids. Test for and classify types of carbohydrates and molecular conversions. Test for saturated and unsaturated fats. Examine and experiment with the process of protein denaturation.

Stage 2 - Evidence

How will you monitor and/or measure evidence of student learning? How will you communicate student learning? How do students provide feedback about their learning?

PERFORMANCE TASK(S):
Lab- Chemical Indicators
Lab- Carbohydrate Conversions
Lab- Properties of Proteins
Lab- Properties of Lipids
Lab- Enzyme Function
Test- Macronutrients

COURSE NAME: ORGANIC CHEMISTRY

Developers: Anne Nyseth	Development Date: 2016	Instructional Level: 10-12	Unit: Cellular Respiration

Stage 1 Desired Results

ESTABLISHED GOALS *(Which Content & CCSS from multiple strands (e.g. reading, writing, language, speaking, listening & content) can be integrated?)*	***Learning Targets***
HS-LS1-6. Construct and revise an explanation based on evidence for how carbon, hydrogen, and oxygen from sugar molecules may combine with other elements to form amino acids and/or other large carbon-based molecules. **HS-LS1-7. Use a model to illustrate that cellular respiration is a chemical process whereby the bonds of food molecules and oxygen molecules are broken and the bonds in new compounds are formed resulting in a net transfer of energy.** **HS-LS2-3. Construct and revise an explanation based on evidence for the cycling of matter and flow of energy in aerobic and anaerobic conditions.**	Demonstrate safe practices and techniques in lab settings. Review eukaryotic cell structure. Use key terms to describe the processes of glycolysis, pyruvate conversions, the citric acid cycle, electron transport chain, beta-oxidation of lipids, and protein catabolism. Calculate the number of ATP molecules produced through the metabolism of one glucose molecule.

Stage 2 - Evidence

How will you monitor and/or measure evidence of student learning? How will you communicate student learning? How do students provide feedback about their learning?

PERFORMANCE TASK(S):
Lab- Fermentation and Cell Respiration
Quiz- Citric Acid Cycle Process
Test- Nutrient Metabolism

AP® Biology

Advanced Placement Biology is a year-long laboratory course scheduled daily for 90 minutes throughout the school year. The AP Biology curriculum is designed to be the equivalent of a college-level, introductory biology course taken by biology majors during their first year. Students can earn college credit for taking AP courses by “passing” the AP exam that this class culminates with in the spring. Though many of the topics are consistent with Biology I classes, this course differs significantly in the depth of topics covered, the laboratory work, and the independent time required to succeed on the AP exam.

AP courses follow a curriculum that is determined by the College Board in working with subject area college professors. This course emphasizes eight major themes in biology, as suggested by the AP Biology course description. The major themes that are interwoven throughout the course and include: science as a process, evolution, energy transfer, relationship of structure and function, regulation, interdependence in nature, continuity and change, and technology and society. These themes are found in the course immersed within the topics of study. Units will include chemistry of life, cells and cell processes, heredity, molecular genetics, evolution, diversity of organisms, and ecology.

The amount of time and emphasis on topics in AP Biology is broken down as follows: Molecules and Cells 25%, Heredity and Evolution 25%, Organisms and Populations 50%. In this course, all of the text units on Molecules, Cells, Heredity, and Evolution will be covered in class. About half of the Organisms and Populations chapters will be covered in class and the remaining text will be assigned as self-study units.

Course goals

This class will:

1. Assist students in understanding content and honing analytical skills through classroom instruction and laboratory activities.
2. Develop inquiry and critical thinking skills through supplemental readings and inquiry-based labs
3. Help students grasp and apply the concept that “nothing in Biology makes sense except in the light of Evolution”
4. Prepare students for the AP exam through multiple choice tests and essay writing activities
5. Finally, I hope to ignite a passion and intrigue in biology that will carry through in student’s lives after the class. I want students to view the world through a lens of biological awe and reverence for the interwoven fabric of life.

Philosophy

Teaching AP Biology perhaps takes a different perspective than in introductory classes. Whereas younger students require more direct instruction, students pursuing AP Biology require guidance, prompting and mentoring to foster their inquisitive nature and help them grapple content. I feel it is imperative to provide an environment where students can develop their ability to communicate their ideas through self-designed experiments, oral questioning, and essay writing. Enthusiasm for both the content and the learning journey that we take through the year is necessary to temper the rigor that this course demands. I want to help students grasp their own place in the world through the study of biology. As humans, our own place and role in the world is precariously undecided. Understanding the intricate threads that tie all levels of life together is paramount to our own existence.

Grading and Assessment

This class will have a variety of assessments to determine a student's grade. Included will be quizzes, unit content tests, topic essays, projects, laboratory work, along with some traditional class work and homework.

Multiple Choice Exams, Quizzes 50%
Labwork, Essays 30%
Homework & Classwork 20%

Like college classes, students will be expected to spend time daily studying AP Biology even though there may not be "assignments" that are due. Preparation for lecture by background reading is essential for your understanding. Pre-lab work is vital for student success in the complex labs done in AP biology. Supplemental readings are often at a level that requires more attention than standard texts.

Quizzes & Tests

There will be periodic quizzes in this course, focusing on the previous lectures and key concepts of readings. There will be tests every unit that will be composed of released AP multiple choice questions, questions from AP central, textbook authored questions, and teacher authored questions. Each unit will also have several essay questions, often from previous AP exams, which will be scored using the same criteria as on the actual national exam. Instruction will be given on preparing for these essays and we will focus on developing writing skills for this aspect of the exam. Multiple choice exam taking and essay writing are both crucial skills that this class will focus on to prepare for the AP Biology National exam in May.

Classroom Learning Strategies

Readings

AP Biology relies heavily upon autonomous study, usually reinforced through in-class activities. The textbook used in this class is Campbell and Reese's *Biology*, 8th Edition. Students will be required to not only read the corresponding sections of the text but they will also be assigned selected readings from scientific journals, lay periodicals, or other books as they relate to the topic. Critical analysis and discussion of these articles will add to student understanding of content. Students may be required to answer specific questions about points in the article, or they may be asked to write a modified abstract summarizing key points. Students will also present and discuss current science articles that relates to each unit of study.

Lecture

Lecture is an important way for students to get exposure to some of the finer points of each unit. Examples will be provided and explanations given to help students grasp critical concepts. Use of graphics & video, board illustrations, student drawings, classroom demonstrations, and question-answer sessions all are crucial parts of the learning process in AP Biology. Accompanying lecture may be pen & paper activities that help reinforce concepts. Not all topics will be covered in lecture, students must be responsible for corresponding text chapters.

Laboratories

The College Board recommends 12 AP laboratories to be covered in AP biology. Our lab schedule will cover all of these labs, usually with additional labs related to the topics. Lab content is an important part of the AP national exam, and it is common to find essay questions referencing labs. Students will use the AP Biology Lab Manual for Students to direct inquiry. Lab reports will be required for the designated AP labs, and data analysis is an important part of this course. For most units of study, we will supplement additional laboratory activities to further enrich the lab experience and relate textbook concepts. Many lab activities require pre-lab setup & prep, and often the lab itself takes two days for completion. Laboratories in AP Biology are data-driven, where the quantitative analysis of data is paramount to understanding the concepts. These labs are more complex that those found in Biology I classes, and require close attention to detail and record keeping. Laboratories will occupy around 30% of classroom time, occupying 2 days per week regularly. Some of the non-AP labs will be based on student inquiry, where individuals will be involved in the laboratory design and synthesis of information based on data. In addition to providing laboratory experience and reinforcing lecture concepts, student-driven research will be an important part of this course.

" I believe in scientific inquiry for its own sake. I think the history of science gives ample examples that pure investigation has enormous benefit…I can't tell you what this might be good for, but learning about nature is important. And lovely things turn up." James Van Allen (1914-2006) University of Iowa Professor Emeritus and discoverer of the Van Allen Radiation Belts

Breakdown of Activities & Key Concepts by Unit

Unit	Laboratory Activities	Key Concepts
Nature of Science	• Designing an Experiment lab, student designed • Termite investigation lab, student designed	• Grasping content versus the big picture. • Promoting understanding through inquiry-based activities/ • Probing the limits of scientific inquiry, what does science do? • Understanding science, technology, and the impact of and to society.
Chemistry of Life	• Molecular Model Building lab • Biochemical Testing lab • Introduction to Spectrophotometry lab • AP Lab 2: Enzyme Catalysis Lab • Succinic Dehydrogenase lab	• Structure and nature of atoms. • Classification and characteristics of macromolecules. • Enzymes & biological control. • Water & its role in life.
Cell Biology	• Microscopy & Cell Organelles lab • AP Lab 1 Osmosis • Spectroscopic analysis of cell division lab	• Review cell structure and function of organelles • Investigate cell membranes and intra & intercellular transport • Study of the evolution of pro & eukaryotic life • Compare and contrast cell types • Moving from unicellular to multicellular life

Cell Processes	• AP Lab 3: Mitosis & Meiosis • AP Lab 5: Respiration • Fermentation labs: Cheese, Kraut & Rootbeer	• Review cell cycle & the relationship of genetics to apoptosis & division • Detailed biochemistry of cellular respiration • Cellular communication as a means of metabolic control, uni & multicellular level • Evolution of biochemical pathways
Heredity	• AP Lab 7: Genetics of Organisms • Wisconsin FastPlants lab • M&M Chi Square lab	• Historical perspective of Mendelian genetics • Recognizing the mechanism of evolutionary trends through genetics
Molecular Genetics	• DNA Model Building lab • DNA Extraction lab • T&T Protein synthesis lab • DNA Gel Electrophoresis intro lab • Plasmid Tranfer P-Glo lab • AP Lab 6: Molecular Biology	• Historical perspective of chemicals & heredity • Biographic accounts of Watson & Crick, Franklin • Detail the processes of replication, transcription & translation • Cellular control & gene regulation at the molecular level • Application of molecular technology today • Genethics, what can we do vs. what should we do?
Evolutionary Biology	• Production of Coacervates lab • Natural Selection lab • Gene Frequency lab	• Chemical origin of life • Darwin in historical perspective

	• Building cladograms lab • Evolution of Beans lab • Hardy-Weinberg Goldfish lab	• Natural selection as a process • Speciation & isolation • Population biology intro • Evidence for evolution • Using case studies (Grant's finch work) to show measureable changes • Biology can be explained only via evolution, recapping previous topics under the guise of evolution
Diversity of Life	• AP Lab 8: Population Genetics & Evolution	• Domains and Phylogenic Trees • Evolution & leading to diversity of life
Invertebrate Biology	• AP Lab 11: Animal Behavior, pillbug lab • Redworm behavior lab	• Dicotomous keying of pondwater organisms • Comparison & contrast of diversity & evolution of invertebrates
Vertebrate Biology	• AP Lab 10: Physiology of the Circulatory System • Cow heart dissection lab • Animal Diversity lab	• Comparative anatomy & physiology of major classes of vertebrates • Comparison of evolutionary adaptations by organisms for their environment.
Plant Biology	• Fruit & flowers lab • AP Lab 4 Chlorophyll extraction & Photosynthesis • AP Lab 9 Transpiration	• Examining angiosperm anatomy & phisiology • Evolutionary adaptations of plants

		• Biochemical diversity of photosynthesis C3/C4/CAM • Evolution of various types of photosynthetic pathways
Ecology	• AP Lab 12: Dissolved Oxygen & Primary Productivity	• Exploring various terrestrial and aquatic biomes and their inhabitants • Examining changes in ecosystems, and the impact on organsisms • Investigating human environmental impact • Identifying the social impact of biological phenomena, disease, UV, temp, population changes • Trophic structure and productivity • Population biology and ecological impact to changes

AP Biology Readings

History and Nature of Science
Text: Chapter 1

Chemistry of Life
Chemistry & Biochemistry
Text: Chapters 2,3,4,5
The Essential Trace Elements, Mertz, Watler*, Science* vol 213, 1981 pgs 1332-1338
Carbohydrates, Sharon, Nathan, *Scientific American*
Proteins, Doolittle, Russell, F. *Scientific American*
The Protein Folding Problem, Richards, Frederic, M. *Scientific American*
Generic introduction to Carbohydrates and Lipids author unknown

The Origin of Life
Text: Chapters 25
Tracing Living Signs of Ancient Life Forms author unknown
The Origins of Life- A Status Report, Joyce, G.F., Orgel, L.E. *The American Biology Teacher*, Jan, 98
End of the Proterozoic Eon, Knoll, Andrew H. *Scientific American*, Oct 1991,
RNA Evolution and the origins of Life, Joyce, G.F. *Nature* vol 338 217-224
Orgel, L.E. The Origin of Life on Earth, *Scientific American,* vol 271(4) 52-1
Molecular Replication, Orgel, L.E *Nature,* vol 358 203-209
Directed Molecular Evolution. Joyce, G.F. *Scientific American*, vol 267 90-97

Cell Biology
Text: Chapters 6,7,
The Prion Diseases, *Scientific American*, Jan 1995, vol 272 pgs 48-57
The Insulin Factory. Orci, L., Vassalli, J., and a. Perrelet. *Scientific American* vol259:85-94
How animal cells move. Bretscher, M. (Dec. 1987) *Scientific American*. 257:72-90

Cell Processes
Text: Chapters 8,9,10,11,12, 13
Molecular Structure of Nucleic Acids, Watson, J, and Crick, F. *Nature*, April 25, 1953
The Discovery of the Double Helix was a Matter of Selecting the Right Problem & Sticking to it. Crick, F.
What controls the cell cycle. Murray, A, and M. Kirschner. (Mar. 1991). *Scientific American*. 264:56-63
Genetic recombination. Stahl, F. (Feb 1987) *Scientific American* 256: 90-101

Heredity
Text: Chapters 12,13,14,15
Blood, Genes, and Malaria, Diamond, Jared, *Natural History*, 2/89

Molecular Genetics
Text: Chapters 16,17,18, 20
Whose Genome is it, Anyway? Lowenstein, Jerold M. *Discover*
Mining Treasures from "Junk DNA" *Science* Vol 263 pg608 Feb 1994
The Ancestry of the Giant Panda, O'Brien, Stephen J.
The New Genetic Medicines, Cohen, J.S. and Hogan, M.E.
Our Chimp Cousins Get That Much Closer, Gibbons, Ann, *Science*, vol 250, pg 376

Evolutionary Biology
Text: Chapters 21, 22, 23, 24, 25, 26
Selections from **The Beak of the Finch,** Jonathan Weiner

Invertebrates:
Text: Chapters 27, 28, 32, 33

Plant Life:
Text: Chapters 10, 29, 30, 31, 35, 36, 39

Vertebrate Structure and Function
Text: Chapters 34, 40, 42,43,44,45, 48, 49,

Ecology:
Text: Chapters 51, 52,53,54,55

Learning Objectives AP Biology

LO 1.1 The student is able to convert a data set from a table of numbers that reflect a change in the genetic makeup of a population over time and to apply mathematical methods and conceptual understandings to investigate the cause(s) and effect(s) of this change. [See SP 1.5, 2.2]

LO 1.2 The student is able to evaluate evidence provided by data to qualitatively and quantitatively investigate the role of natural selection in evolution. [See SP 2.2, 5.3]

LO 1.3 The student is able to apply mathematical methods to data from a real or simulated population

LO 1.4 The student is able to evaluate data-based evidence that describes evolutionary changes in the genetic makeup of a population over time. [See SP 5.3]

LO 1.5 The student is able to connect evolutionary changes in a population over time to a change in the environment.[See SP 7.1]

LO 1.6 The student is able to use data from mathematical models based on the Hardy-Weinberg equilibrium to analyze genetic drift and effects of selection in the evolution of specific populations. [See SP 1.4, 2.1]

LO 1.7 The student is able to justify data from mathematical models based on the Hardy-Weinberg equilibrium to analyze genetic drift and the effects of selection in the evolution of specific populations. [See SP 2.1]

LO 1.8 The student is able to make predictions about the effects of genetic drift, migration and artificial selection on the genetic makeup of a population.

LO 1.9 The student is able to evaluate evidence provided by data from many scientific disciplines that support biological evolution. [See SP 5.3]

LO 1.10 The student is able to refine evidence based on data from many scientific disciplines that support biological evolution. [See SP 5.2]

LO 1.11 The student is able to design a plan to answer scientific questions regarding how organisms have changed over time using information from morphology, biochemistry and geology. [See SP 4.2]

LO 1.12 The student is able to connect scientific evidence from many scientific disciplines to support the modern concept of evolution. [See SP 7.1]

LO 1.13 The student is able to construct and/or justify mathematical models, diagrams or simulations that represent processes of biological evolution.

LO 1.14 The student is able to pose scientific questions that correctly identify essential properties of shared, core life processes that provide insights into the history of life on Earth. [See SP 3.1]

LO 1.15 The student is able to describe specific examples of conserved core biological processes and features shared by all domains or within one domain of life, and how these shared, conserved core processes and features support the concept of common ancestry for all organisms. [See SP 7.2]

LO 1.16 The student is able to justify the scientific claim that organisms share many conserved core processes and features that evolved and are widely distributed among organisms today. [See SP 6.1]

LO 1.17 The student is able to pose scientific questions about a group of organisms whose relatedness is described by a phylogenetic tree or cladogram in order to (1) identify shared characteristics, (2) make inferences about the evolutionary history of the group, and (3) identify character data that could extend or improve the phylogenetic tree. [See SP 3.1]

LO 1.18 The student is able to evaluate evidence provided by a data set in conjunction with a phylogenetic tree or a simple cladogram to determine evolutionary history and speciation. [See SP 5.3]

LO 1.19 The student is able create a phylogenetic tree or simple cladogram that correctly represents evolutionary history and speciation from a provided data set.

LO 1.20 The student is able to analyze data related to questions of speciation and extinction throughout the Earth's history. [See SP 5.1]

LO 1.21 The student is able to design a plan for collecting data to investigate the scientific claim that speciation and extinction have occurred throughout the Earth's history. [See SP 4.2]

LO 1.22 The student is able to use data from a real or simulated population(s), based on graphs or models of types of selection, to predict what will happen to the population in the future. [See SP 6.4

] LO 1.23 The student is able to justify the selection of data that address questions related to reproductive isolation and speciation. [See SP 4.1]

LO 1.24 The student is able to describe speciation in an isolated population and connect it to change in gene frequency, change in environment, natural selection and/or genetic drift. [See SP 7.2]

LO 1.25 The student is able to describe a model that represents evolution within a population. [See SP 1.2]

LO 1.26 The student is able to evaluate given data sets that illustrate evolution as an ongoing process. [See SP 5.3]

LO 1.27 The student is able to describe a scientific hypothesis about the origin of life on Earth. [See SP 1.2]

LO 1.28 The student is able to evaluate scientific questions based on hypotheses about the origin of life on Earth. [See SP 3.3]

LO 1.29 The student is able to describe the reasons for revisions of scientific hypotheses of the origin of life on Earth. [See SP 6.3]

LO 1.30 The student is able to evaluate scientific hypotheses about the origin of life on Earth. [See SP 6.5]

LO 1.31 The student is able to evaluate the accuracy and legitimacy of data to answer scientific questions about the origin of life on Earth. [See SP 4.4]

LO 1.32 The student is able to justify the selection of geological, physical, and chemical data that reveal early Earth conditions. [See SP 4.1]

LO 2.1 The student is able to explain how biological systems use free energy based on empirical data that all organisms require constant energy input to maintain organization, to grow and to reproduce. [See SP 6.2]

LO 2.2 The student is able to justify a scientific claim that free energy is required for living systems to maintain organization, to grow or to reproduce, but that multiple strategies exist in different living systems. [See SP 6.1]

LO 2.3 The student is able to predict how changes in free energy availability affect organisms, populations and ecosystems. [See SP 6.4]

LO 2.4 The student is able to use representations to pose scientific questions about what mechanisms and structural features allow organisms to capture, store and use free energy. [See SP 1.4, 3.1]

LO 2.5 The student is able to construct explanations of the mechanisms and structural features of cells that allow organisms to capture, store or use free energy.

LO 2.6 The student is able to use calculated surface area-to-volume ratios to predict which cell(s) might eliminate wastes or procure nutrients faster by diffusion.

LO 2.7 Students will be able to explain how cell size and shape affect the overall rate of nutrient intake and the rate of waste elimination. [See SP 6.2]

LO 2.8 The student is able to justify the selection of data regarding the types of molecules that an animal, plant or bacterium will take up as necessary building blocks and excrete as waste products. [See SP 4.1]

LO 2.9 The student is able to represent graphically or model quantitatively the exchange of molecules between an organism and its environment, and the subsequent use of these molecules to build new molecules that facilitate dynamic homeostasis, growth and reproduction. [See SP 1.1, 1.4]

LO 2.10 The student is able to use representations and models to pose scientific questions about the properties of cell membranes and selective permeability based on molecular structure. [See SP 1.4, 3.1]

LO 2.11 The student is able to construct models that connect the movement of molecules across membranes with membrane structure and function.

LO 2.12 The student is able to use representations and models to analyze situations or solve problems qualitatively and quantitatively to investigate whether dynamic homeostasis is maintained by the active movement of molecules across membranes. [See SP 1.4]

LO 2.13 The student is able to explain how internal membranes and organelles contribute to cell functions. [See SP 6.2]

LO 2.14 The student is able to use representations and models to describe differences in prokaryotic and eukaryotic cells. [See SP 1.4]

LO 2.15 The student can justify a claim made about the effect(s) on a biological system at the molecular, physiological or organismal level when given a scenario in which one or more components within a negative regulatory system is altered. [See SP 6.1]

LO 2.16 The student is able to connect how organisms use negative feedback to maintain their internal environments. [See SP 7.2]

LO 2.17 The student is able to evaluate data that show the effect(s) of changes in concentrations of key molecules on negative feedback mechanisms. [See SP 5.3]

LO 2.18 The student can make predictions about how organisms use negative feedback mechanisms to maintain their internal environments.

LO 2.19 The student is able to make predictions about how positive feedback mechanisms amplify activities and processes in organisms based on scientific theories and models. [See SP 6.4]

LO 2.20 The student is able to justify that positive feedback mechanisms amplify responses in organisms. [See SP 6.1]

LO 2.21 The student is able to justify the selection of the kind of data needed to answer scientific questions about the relevant mechanism that organisms use to respond to changes in their external environment. [See SP 4.1]

LO 2.22 The student is able to refine scientific models and questions about the effect of complex biotic and abiotic interactions on all biological systems, from cells and organisms to populations, communities and ecosystems. [See SP 1.3, 3.2]

LO 2.23 The student is able to design a plan for collecting data to show that all biological systems (cells, organisms, populations, communities and ecosystems) are affected by complex biotic and abiotic interactions. [See SP 4.2, 7.2]

LO 2.24 The student is able to analyze data to identify possible patterns and relationships between a biotic or abiotic factor and a biological system (cells, organisms, populations, communities or ecosystems). [See SP 5.1]

LO 2.25 The student can construct explanations based on scientific evidence that homeostatic mechanisms reflect continuity due to common ancestry and/or divergence due to adaptation in different environments. [See SP 6.2]

LO 2.26 The student is able to analyze data to identify phylogenetic patterns or relationships, showing that homeostatic mechanisms reflect both continuity due to common ancestry and change due to evolution in different environments. [See SP 5.1]

LO 2.27 The student is able to connect differences in the environment with the evolution of homeostatic mechanisms. [See SP 7.1]

LO 2.28 The student is able to use representations or models to analyze quantitatively and qualitatively the effects of disruptions to dynamic homeostasis in biological systems. [See SP 1.4]

LO 2.29 The student can create representations and models to describe immune responses. [See SP 1.1, 1.2]

LO 2.30 The student can create representations or models to describe nonspecific immune defenses in plants and animals.[See SP 1.1, 1.2]

LO 2.31 The student can connect concepts in and across domains to show that timing and coordination of specific events are necessary for normal development in an organism and that these events are regulated by multiple mechanisms. [See SP 7.2]

LO 2.32 The student is able to use a graph or diagram to analyze situations or solve problems (quantitatively or qualitatively) that involve timing and coordination of events necessary for normal development in an organism.

LO 2.33 The student is able to justify scientific claims with scientific evidence to show that timing and coordination of several events are necessary for normal development in an organism and that these events are regulated by multiple mechanisms. [See SP 6.1]

LO 2.34 The student is able to describe the role of programmed cell death in development and differentiation, the reuse of molecules, and the maintenance of dynamic homeostasis. [See SP 7.1]

LO 2.35 The student is able to design a plan for collecting data to support the scientific claim that the timing and coordination of physiological events involve regulation. [See SP 4.2]

LO 2.36 The student is able to justify scientific claims with evidence to show how timing and coordination of physiological events involve regulation. [See SP 6.1]

LO 2.37 The student is able to connect concepts that describe mechanisms that regulate the timing and coordination of physiological events. [See SP 7.2]

LO 2.38 The student is able to analyze data to support the claim that responses to information and communication of information affect natural selection. [See SP 5.1]

LO 2.39 The student is able to justify scientific claims, using evidence, to describe how timing and coordination of behavioral events in organisms are regulated by several mechanisms.

LO 2.40 The student is able to connect concepts in and across domain(s) to predict how environmental factors affect responses to information and change behavior.

LO 3.1 The student is able to construct scientific explanations that use the structures and mechanisms of DNA and RNA to support the claim that DNA and, in some cases, that RNA are the primary sources of heritable information. [See SP 6.5]

LO 3.2 The student is able to justify the selection of data from historical investigations that support the claim that DNA is the source of heritable information. [See SP 4.1]

LO 3.3 The student is able to describe representations and models that illustrate how genetic information is copied for transmission between generations. [See SP 1.2]

LO 3.4 The student is able to describe representations and models illustrating how genetic information is translated into polypeptides. [See SP 1.2]

LO 3.5 The student can justify the claim that humans can manipulate heritable information by identifying at least two commonly used technologies. [See SP 6.4]

LO 3.6 The student can predict how a change in a specific DNA or RNA sequence can result in changes in gene expression. [See SP 6.4]

LO 3.7 The student can make predictions about natural phenomena occurring during the cell cycle. [See SP 6.4]

LO 3.8 The student can describe the events that occur in the cell cycle. [See SP 1.2]

LO 3.9 The student is able to construct an explanation, using visual representations or narratives, as to how DNA in chromosomes is transmitted to the next generation via mitosis, or meiosis followed by fertilization. [See SP 6.2]

LO 3.10 The student is able to represent the connection between meiosis and increased genetic diversity necessary for evolution. [See SP 7.1]

LO 3.11 The student is able to evaluate evidence provided by data sets to support the claim that heritable information is passed from one generation to another generation through mitosis, or meiosis followed by fertilization. [See SP 5.3]

LO 3.12 The student is able to construct a representation that connects the process of meiosis to the passage of traits from parent to offspring. [See SP 1.1, 7.2]

LO 3.13 The student is able to pose questions about ethical, social or medical issues surrounding human genetic disorders. [See SP 3.1]

LO 3.14 The student is able to apply mathematical routines to determine Mendelian patterns of inheritance provided by data sets. [See SP 2.2]

LO 3.15 The student is able to explain deviations from Mendel's model of the inheritance of traits. [See SP 6.5]

LO 3.16 The student is able to explain how the inheritance patterns of many traits cannot be accounted for by Mendelian genetics. [See SP 6.3]

LO 3.17 The student is able to describe representations of an appropriate example of inheritance patterns that cannot be explained by Mendel's model of the inheritance of traits. [See SP 1.2]

LO 3.18 The student is able to describe the connection between the regulation of gene expression and observed differences between different kinds of organisms. [See SP 7.1]

LO 3.19 The student is able to describe the connection between the regulation of gene expression and observed differences between individuals in a population. [See SP 7.1]

LO 3.20 The student is able to explain how the regulation of gene expression is essential for the processes and structures that support efficient cell function. [See SP 6.2]

LO 3.21 The student can use representations to describe how gene regulation influences cell products and function. [See SP 1.4]

LO 3.22 The student is able to explain how signal pathways mediate gene expression, including how this process can affect protein production. [See SP 6.2]

LO 3.23 The student can use representations to describe mechanisms of the regulation of gene expression. [See SP 1.4]

LO 3.24 The student is able to predict how a change in genotype, when expressed as a phenotype, provides a variation that can be subject to natural selection. [See SP 6.4, 7.2]

LO 3.25 The student can create a visual representation to illustrate how changes in a DNA nucleotide sequence can result in a change in the polypeptide produced. [See SP 1.1]

LO 3.26 The student is able to explain the connection between genetic variations in organisms and phenotypic variations in populations. [See SP 7.2]

LO 3.27 The student is able to compare and contrast processes by which genetic variation is produced and maintained in organisms from multiple domains. [See SP 7.2]

LO 3.28 The student is able to construct an explanation of the multiple processes that increase variation within a population. [See SP 6.2]

LO 3.29 The student is able to construct an explanation of how viruses introduce genetic variation in host organisms. [See SP 6.2]

LO 3.30 The student is able to use representations and appropriate models to describe how viral replication introduces genetic variation in the viral population.

LO 3.31 The student is able to describe basic chemical processes for cell communication shared across evolutionary lines of descent. [See SP 7.2]

LO 3.32 The student is able to generate scientific questions involving cell communication as it relates to the process of evolution. [See SP 3.1]

LO 3.33 The student is able to use representation(s) and appropriate models to describe features of a cell signaling pathway. [See SP 1.4]

LO 3.34 The student is able to construct explanations of cell communication through cell-to-cell direct contact or through chemical signaling. [See SP 6.2]

LO 3.35 The student is able to create representation(s) that depict how cell-to-cell communication occurs by direct contact or from a distance through chemical signaling. [See SP 1.1]

LO 3.36 The student is able to describe a model that expresses the key elements of signal transduction pathways by which a signal is converted to a cellular response.

LO 3.37 The student is able to justify claims based on scientific evidence that changes in signal transduction pathways can alter cellular response. [See SP 6.1]

LO 3.38 The student is able to describe a model that expresses key elements to show how change in signal transduction can alter cellular response. [See SP 1.5]

LO 3.39 The student is able to construct an explanation of how certain drugs affect signal reception and, consequently, signal transduction pathways. [See SP 6.2]

LO 3.40 The student is able to analyze data that indicate how organisms exchange information in response to internal changes and external cues, and which can change behavior. [See SP 5.1]

LO 3.41 The student is able to create a representation that describes how organisms exchange information in response to internal changes and external cues, and which can result in changes in behavior. [See SP 1.1]

LO 3.42 The student is able to describe how organisms exchange information in response to internal changes or environmental cues. [See SP 7.1

LO 3.43 The student is able to construct an explanation, based on scientific theories and models, about how nervous systems detect external and internal signals, transmit and integrate information, and produce responses. [See SP 6.2, 7.1]

LO 3.44 The student is able to describe how nervous systems detect external and internal signals. [See SP 1.2]

LO 3.45 The student is able to describe how nervous systems transmit information. [See SP 1.2]

LO 3.46 The student is able to describe how the vertebrate brain integrates information to produce a response. [See SP 1.2]

LO 3.47 The student is able to create a visual representation of complex nervous systems to describe/explain how these systems detect external and internal signals, transmit and integrate information, and produce responses. [See SP 1.1]

LO 3.48 The student is able to create a visual representation to describe how nervous systems detect external and internal signals. [See SP 1.1]

LO 3.49 The student is able to create a visual representation to describe how nervous systems transmit information. [See SP 1.1

LO 3.50 The student is able to create a visual representation to describe how the vertebrate brain integrates information to produce a response. [See SP 1.1]

LO 4.1 The student is able to explain the connection between the sequence and the subcomponents of a biological polymer and its properties. [See SP 7.1]

LO 4.2 The student is able to refine representations and models to explain how the subcomponents of a biological polymer and their sequence determine the properties of that polymer. [See SP 1.3]

LO 4.3 The student is able to use models to predict and justify that changes in the subcomponents of a biological polymer affect the functionality of the molecule.

LO 4.4 The student is able to make a prediction about the interactions of subcellular organelles. [See SP 6.4]

LO 4.5 The student is able to construct explanations based on scientific evidence as to how interactions of subcellular structures provide essential functions. [See SP 6.2]

LO 4.6 The student is able to use representations and models to analyze situations qualitatively to describe how interactions of subcellular structures, which possess specialized functions, provide essential functions. [

LO 4.7 The student is able to refine representations to illustrate how interactions between external stimuli and gene expression result in specialization of cells, tissues and organs. [See SP 1.3]

LO 4.8 The student is able to evaluate scientific questions concerning organisms that exhibit complex properties due to the interaction of their constituent parts. [See SP 3.3]

LO 4.9 The student is able to predict the effects of a change in a component(s) of a biological system on the functionality of an organism(s). [See SP 6.4]

LO 4.10 The student is able to refine representations and models to illustrate biocomplexity due to interactions of the constituent parts.[See SP 1.3]

LO 4.11 The student is able to justify the selection of the kind of data needed to answer scientific questions about the interaction of populations within communities. [See SP 1.4, 4.1]

LO 4.12 The student is able to apply mathematical routines to quantities that describe communities composed of populations of organisms that interact in complex ways. [See SP 2.2]

LO 4.13 The student is able to predict the effects of a change in the community's populations on the community. [See SP 6.4

LO 4.14 The student is able to apply mathematical routines to quantities that describe interactions among living systems and their environment, which result in the movement of matter and energy. [See SP 2.2]

LO 4.15 The student is able to use visual representations to analyze situations or solve problems qualitatively to illustrate how interactions among living systems and with their environment result in the movement of matter and energy. [See SP 1.4]

LO 4.16 The student is able to predict the effects of a change of matter or energy availability on communities.[See SP 6.4]

LO 4.17 The student is able to analyze data to identify how molecular interactions affect structure and function. [See SP 5.1]

LO 4.18 The student is able to use representations and models to analyze how cooperative interactions within organisms promote efficiency in the use of energy and matter. [See SP 1.4]

LO 4.19 The student is able to use data analysis to refine observations and measurements regarding the effect of population interactions on patterns of species distribution and abundance. [See SP 5.2]

LO 4.20 The student is able to explain how the distribution of ecosystems changes over time by identifying large-scale events that have resulted in these changes in the past. [See SP 6.3]

LO 4.21 The student is able to predict consequences of human actions on both local and global ecosystems. [See SP 6.4]

LO 4.22 The student is able to construct explanations based on evidence of how variation in molecular units provides cells with a wider range of functions.

LO 4.23 The student is able to construct explanations of the influence of environmental factors on the phenotype of an organism. [See SP 6.2]

LO 4.24 The student is able to predict the effects of a change in an environmental factor on the genotypic expression of the phenotype. [See SP 6.4]

LO 4.25 The student is able to use evidence to justify a claim that a variety of phenotypic responses to a single environmental factor can result from different genotypes within the population. [See SP 6.1]

LO 4.26 The student is able to use theories and models to make scientific claims and/or predictions about the effects of variation within populations on survival and fitness. [See SP 6.4]

LO 4.27 The student is able to make scientific claims and predictions about how species diversity within an ecosystem influences ecosystem stability.

Science Practices for AP Biology

Science Practice 1: The student can use representations and models to communicate scientific phenomena and solve scientific problems. Visual representations and models are indispensable tools for learning and exploring scientific concepts and ideas. The student is able to create representations and models using verbal or written explanations that describe biological processes. The student also can use representations and models to illustrate biological processes and concepts; communicate information; make predictions; and describe systems to promote and document understanding. Illustrative examples of representations and models are diagrams describing the relationship between photosynthesis and cellular respiration; the structure and functional relationships of membranes; and diagrams that illustrate chromosome movement in mitosis and meiosis. Using model kits, the student can build three-dimensional representations of organic functional groups, carbohydrates, lipids, proteins and nucleic acids. The student is able to demonstrate how chemical structures, such as the Watson and Crick model for DNA, link structure to function at the molecular level and can relate key elements of a process or structure across multiple representations, such as a schematic two-dimensional diagram and a space-filling model of DNA. The student can refine and/or revise visual representations of biological processes, including energy flow through ecosystems; immunological processes; movement of molecules in and out of cells; and graphs or other visual data representations of experimental results. The student can use/apply representations and models to make predictions and address scientific questions as well as interpret and create graphs drawn from experimental data.

1.1 The student can create representations and models of natural or man-made phenomena and systems in the domain.

1.2 The student can describe representations and models of natural or man-made phenomena and systems in the domain.

1.3 The student can refine representations and models of natural or man-made phenomena and systems in the domain.

1.4 The student can use representations and models to analyze situations or solve problems qualitatively and quantitatively.

1.5 The student can reexpress key elements of natural phenomena across multiple representations in the domain.

Science Practice 2: The student can use mathematics appropriately. The student can routinely use mathematics to solve problems, analyze experimental data, describe natural phenomena, make predictions, and describe processes symbolically. The student also can justify the selection of a particular mathematical routine and apply the routine to describe natural phenomena. The student is able to estimate the answers to quantitative questions using simplifying assumptions and to use this information to help describe and understand natural phenomena. Examples of the use of mathematics in biology include, but are not limited to, the use of Chi-square in analyzing observed versus predicted inherited patterns; determination of mean and median; use of the HardyWeinberg equation to predict changes in gene frequencies in a population; measurements of concentration gradients and osmotic potential; and determination of the rates of chemical reactions, processes and solute concentrations. The student is able to measure and collect experimental data with respect to volume, size, mass, temperature, pH, etc. In addition, the student can estimate energy procurement and utilization in biological systems, including ecosystems.

2.1 The student can justify the selection of a mathematical routine to solve problems.

2.2 The student can apply mathematical routines to quantities that describe natural phenomena.

2.3 The student can estimate numerically quantities that describe natural phenomena.

Science Practice 3: The student can engage in scientific questioning to extend thinking or to guide investigations within the context of the AP course. As scientists and students, how do we know what we know? Facts, concepts and theories fill biology textbooks, but how did scientists discover facts, concepts and theories that make up modern science, such as that cells produce carbon dioxide as a by-product of respiration or that the details for copying the two strands of DNA differ during replication? What historical experiments provided evidence that DNA, not protein, was the hereditary material for living organisms? What scientific evidence supports evolution by natural selection, and how is this different than alternative ideas with respect to evolution and origin of life? To provide deeper understanding of the concepts, the student must be able to answer, “How do we know what we know?” with, “This is why we know what we know.” The student is able to pose, refine and evaluate scientific questions about natural phenomena and investigate answers through experimentation, research, and information gathering and discussion. For example, if the student poses the question: “What happens to photosynthesis at very high, nonbiological temperatures?” he or she can address this question in a variety of means: literature searches, fact finding and/or designing an experiment to investigate the effect of temperature on chloroplast function, including collecting data, making predictions, drawing conclusions and refining the original question or approaches. The student is able to formulate good scientific questions — ones that are amenable to experimental approaches and addressable through evidence — and can distinguish them from other questions that are ethical, social or teleological in nature. The student can pose and rationally discuss questions that address ethical and civic issues that surround the development and application of scientific knowledge, and controversial issues such as stem cells, cloning, genetically modified organisms, and who should decide what types of biological research are acceptable and which are not.

3.1 The student can pose scientific questions.

3.2 The student can refine scientific questions.

3.3 The student can evaluate scientific questions.

Science Practice 4: The student can plan and implement data collection strategies appropriate to a particular scientific question. Experimentation and the collection and analysis of scientific evidence are at the heart of biology. Data can be collected from many different sources: experimental investigation, scientific observation, the findings of others, historic reconstruction and archival records. After the student poses a question about biology, he or she is able to investigate and arrive at answers through experimentation and reasoning. In this coupled process, the student can justify the selection of the kind of data needed to answer a question. For example, if the question is about how temperature affects enzymatic activity, the student should be able to collect data about temperature while controlling other variables, such as pH and solute concentration. To test a hypothesis about an observation, the student is able to design an experiment; identify needed controls; identify needed supplies and equipment from a given list of resources; develop or follow an experimental protocol to collect data; analyze data and draw conclusions from the results; and describe the limitations of the experiment and conclusions. In addition, the student can draw conclusions from experimental results of other scientists, e.g., the historical experiments of Fredrick Griffith, Calvin and Krebs, Hershey and Chase, and Watson and Crick.

4.1 The student can justify the selection of the kind of data needed to answer a particular scientific question.

4.2 The student can design a plan for collecting data to answer a particular scientific question.

4.3 The student can collect data to answer a particular scientific question.

4.4 The student can evaluate sources of data to answer a particular scientific question.

Science Practice 5: The student can perform data analysis and evaluation of evidence. The student can analyze data collected from an experimental procedure or from a given source to determine whether the data support or does not support a conclusion or hypothesis. For example, if the student conducts an experiment to determine if light intensity affects the rate of photosynthesis, he or she can construct a graph based on the collected data and use the graph to formulate statements, conclusions, and possibly a hypothesis. Alternatively, the student can draw conclusions from a provided data set. For example, given a graph depicting the percent change in the mass of potato cores after exposure to different concentrations of sucrose, the student is able to estimate the concentration of sucrose within the potato core. The student also is able to assess the validity of experimental evidence. Using the same example, if given hypothetical data showing that potato cores increase in mass when placed in solutions with lower water potential (a hypertonic solution), the student is able to explain why the data (evidence) are likely invalid: Since potatoes contain sucrose, they should increase in mass only when placed in solutions with higher water potential (hypotonic). After identifying possible sources of error in an experimental procedure or data set, the student can then revise the protocol to obtain more valid results. When presented with a range of data, the student is able to identify outliers and propose an explanation for them as well as a rationale for how they should be dealt with.

5.1 The student can analyze data to identify patterns or relationships.

5.2 The student can refine observations and measurements based on data analysis.

5.3 The student can evaluate the evidence provided by data sets in relation to a particular scientific question.

Science Practice 6: The student can work with scientific explanations and theories. The student can work with scientific descriptions, explanations and theories that describe biological phenomena and processes. In efforts to answer, “How do we know what we know?” the student can call upon current knowledge and historical experiments, and draw inferences from his or her explorations to justify claims with evidence. For example, the student is able to cite evidence drawn from the different scientific disciplines that supports natural selection and evolution, such as the geological record, antibiotic-resistance in bacteria, herbicide resistance in plants or how a population bottleneck changes HardyWeinberg Equilibrium. The student can articulate through narrative or annotated visual representation how scientific explanations are refined or revised with the acquisition of new information based on experimentation; for example, the student can describe/explain how advances in molecular genetics made possible a deeper understanding of how genes are carried in DNA and of how genes are expressed to determine phenotypes. The student understands that new scientific discoveries often depend on advances in technology; for example, only when microscopy was sufficiently advanced could the linkage between chromosomes and the transmission of genetic traits be clearly established. Likewise, the ability to sequence whole genomes allows comparisons between the entire genetic information in different species, and technology is revealing the existence of many previously unknown genes and evolutionary relationships. In addition, the student can use existing knowledge and models to make predictions. For example, when provided a sequence of DNA containing a designated mutational change, the student can predict the effect of the mutation on the encoded polypeptide and propose a possible resulting phenotype. The student also can evaluate the merits of alternative scientific explanations or conclusions.

6.1 The student can justify claims with evidence.

6.2 The student can construct explanations of phenomena based on evidence produced through scientific practices.

6.3 The student can articulate the reasons that scientific explanations and theories are refined or replaced.

6.4 The student can make claims and predictions about natural phenomena based on scientific theories and models.

6.5 The student can evaluate alternative scientific explanations. Science Practice 7: The student is able to connect and relate knowledge across various scales, concepts and representations in and across domains.

Science Practice 7: The student is able to describe through narrative and/or annotated visual representation how biological processes are connected across various scales such as time, size and complexity. For example, DNA sequences, metabolic processes and morphological structures that arise through evolution connect the organisms that compose the tree of life, and the student should be able to use various types of phylogenetic trees/cladograms to show connections and ancestry, and to describe how natural selection explains biodiversity. Examples of other connections are photosynthesis at the cellular level and environmental carbon cycling; biomass generation and climate change; molecular and macroevolution; the relation of genotype to phenotype and natural selection; cell signaling pathways and embryonic development; bioenergetics and microbial ecology; and competition and cooperation from molecules to populations. The student is able to describe how enduring understandings are connected to other enduring understandings, to a big idea, and how the big ideas in biology connect to one another and to other disciplines. The student draws on information from other sciences to explain biological processes; examples include how the conservation of energy affects biological systems; why lipids are nonpolar and insoluble in water; why water exhibits cohesion and adhesion, and why molecules spontaneously move from high concentration to areas of lower concentration, but not vice versa.

7.1 The student can connect phenomena and models across spatial and temporal scales.

7.2 The student can connect concepts in and across domain(s) to generalize or extrapolate in and/or across enduring understandings and/or big ideas.

AP Chemistry Syllabus: 2013-2014

Curricular Requirements

- **CR 1** Students and teachers use a recently published (within the last 10 years) college level chemistry textbook.

- **CR 2** The course is structured around the enduring understandings within the big ideas as described in the AP Chemistry curriculum framework.

- **CR 3** Students are provided with opportunities to meet the learning objectives within each of the big ideas as described in the AP Chemistry curriculum framework. These opportunities must occur in addition to those within laboratory investigations.

- **CR 4** The course provides students with the opportunity to connect their knowledge of chemistry and science to major societal or technological components (e.g., concerns, technological advances, innovations) to help them become scientifically literate citizens.

- **CR 5** Students are provided the opportunity to engage in investigative laboratory work integrated throughout the course for a minimum of 25 percent of instructional time, which must include a minimum of 16 hands-on laboratory experiments while using basic laboratory equipment to support the learning objectives listed within the AP Chemistry curriculum framework.

- **CR 6** The laboratory investigations used throughout the course allow students to apply the seven science practices defined in the AP Chemistry curriculum framework. At minimum, six of the required 16 labs are conducted in a guided-inquiry format. **In this document, inquiry labs will be marked by an asterisk (*).**

- **CR 7** The course provides opportunities for students to develop, record, and maintain evidence of their verbal, written, and graphic communication skills through laboratory reports, summaries of literature or scientific investigations, and oral, written, and graphic presentations.

Course Description

This AP Chemistry course is designed to be the equivalent of the general chemistry course usually taken during the first year of college. For most students, the course enables them to undertake, as a freshman, second year work in the chemistry sequence at their institution or to register in courses in other fields where general chemistry is a prerequisite. This course is structured around the six big ideas articulated in the AP Chemistry curriculum framework provided by the College Board. **[CR2]** A special emphasis will be placed on the seven science practices, which capture important aspects of the work that scientists engage in, with learning objectives that combine content with inquiry and reasoning skills. AP Chemistry is open to all students that have completed a year of chemistry who wish to take part in a rigorous and academically challenging course.

Textbooks and Lab Books

The College Board. AP Chemistry Guided Inquiry Experiments: Applying the Science Practices. 2013.

Brown, Theodore, et. al. Chemistry: The Central Science, Thirteenth Edition. New Jersey: Pearson 2015.

[CR1]

Hall, James. Experimental Chemistry, Sixth Edition. Boston: Houghton Mifflin Company, 2003.

Required Materials

Graphing calculator, notebook for laboratory experiments, blue or black pen

Labs

The labs completed require following or developing processes and procedures, taking observations, and data manipulation. See lab list provided for lab details. Students communicate and collaborate in lab groups; however, each student writes a laboratory report in a lab notebook for every lab they perform. A minimum of 25% of student contact time will be spent doing hands-on laboratory activities. **[CR5]**

The 10 Parts of a Laboratory Report [CR7]

A specific format will be given to the student for each lab. Students must follow that format and label all sections very clearly. AP Chemistry lab reports are much longer and more in depth than the ones completed in the first year chemistry course. Therefore, it is important that students don't procrastinate when doing pre-lab and post-lab work. Late labs will not be accepted. Labs not completed in class must be done at lunch or before/after school by appointment.

Pre-Lab Work Pre-lab work is to be completed and turned in on the day the lab is performed.

1. **Title** The title should be descriptive. For example, "pH Titration Lab" is a descriptive title and "Experiment 5" is not a descriptive title.
2. **Date** This is the date the student performed the experiment.
3. **Purpose** A purpose is a statement summarizing the "point" of the lab.
4. **Procedure Outline** Students need to write an outline of the procedure. They should use bulleted statements or outline format to make it easy to read. If a student is doing a guided inquiry lab, they may be required to write a full procedure that they develop.
5. **Pre-Lab Questions** Students will be given some questions to answer before the lab is done. They will need to either rewrite the question or incorporate the question in the answer. The idea here is that when someone (like a college professor) looks at a student's lab notebook, they should be able to tell what the question was by merely looking at their lab report. It is important to produce a good record of lab work.
6. **Data Tables** Students will need to create any data tables or charts necessary for data collection in the lab.

During the Lab

7. **Data** Students need to record all their data directly in their lab notebook. They are NOT to be recording data on their separate lab sheet. They need to label all data clearly and always include proper units of measurement. Students should underline, use capital letters, or use any device they choose to help organize this section well. They should space things out neatly and clearly.

Post-Lab Work

8. **Calculations and Graphs** Students should show how calculations are carried out. Graphs need to be titled, axes need to be labeled, and units need to be shown on the axis. To receive credit for any graphs, they must be at least ½ page in size.

9. **Conclusions** This will vary from lab to lab. Students will usually be given direction as to what to write, but it is expected that all conclusions will be well thought out and well written.

10. **Post Lab Error Analysis Questions** Follow the same procedure as for Pre-Lab Questions.

Advanced Placement Chemistry — The Laboratory Notebook A record of lab work is an important document, which will show the quality of the lab work that students have performed.

AP Chemistry Unit Overview [CR3]

The Curriculum Framework Alignment refers to the Big Ideas
listed below: Big Idea 1: Structure of Matter
Big Idea 2: Properties of matter- characteristics, states, and forces
of attraction Big Idea 3: Chemical reactions
Big Idea 4: Rates of chemical
reactions Big Idea 5:
Thermodynamics
Big Idea 6: Equilibrium

Unit 1: Chemistry
Fundamentals Class
Periods (90 minutes): 6
Homework Sets
Assigned: 4 Number of
Quizzes: 4

Number of Exams:
1 Labs and
Activities:

Density Determinations- Determine the densities of regular and irregular solids, pure liquids, and solutions. [SP2, SP4]

Topic of Study	Curriculum Framework Alignment
Rules of mathematic operations	
Dimensional analysis in solving problems	
Classifications of matter	1.A.1, 2.A.3
Three states of matter	1.A.1, 2.A.1, 2.A.2

Unit 2: Atoms, Molecules, and
Ions Class Periods (90
minutes): 4 Homework Sets
Assigned: 3 Number of
Quizzes: 3

Number of Exams: 0

Labs and Activities:

Stoichiometric Determination of a Formula- Students study the reaction between magnesium metal and molecular oxygen. [SP2, SP4, SP5]

Percent of Copper in a Penny- Determine the percent of copper in a post 1982 penny.

[CR3] Pea Shooter- Students try our version of Rutherford and Bohr’s gold foil experiment. [SP1]

Topic of Study	Curriculum Framework Alignment
Atomic theory	1.A.1, 1.D.1
Structure of the atom	1.B.1, 1.D.1
Atomic number, mass number, isotopes	1.D.2
The periodic table	1.C.1
Molecules and ions	1.A.1, 1.B.1
Chemical formulas	1.A.1, 2.C.2
Naming compounds	

Unit 3: Reactions and Equations Class Periods (90 minutes): 11 Homework Sets Assigned: 8 Number of Quizzes: 6

Number of Exams: 1 Labs and Activities:

*Changes- Students gather evidence and determine whether or not a chemical change has occurred. [SP3, SP4, SP5, SP6]

Stoichiometry and Limiting Reactant- Students study the reactions between HCl and H_2SO_4 and NaOH. [SP2, SP3, SP4, SP5]

Determination of Iron by Redox Titration- An oxidation-reduction reaction is used in the titration analysis of an iron compound. [SP2, SP3, SP4, SP5]

[CR3c] Students write chemical equations based on demonstrations of chemical reactions.

[CR3c] Students write redox half-reactions for a set of chemical equations.

Topic of Study	Curriculum Framework Alignment
Atomic mass	1.A.3
Avogadro’s number and molar mass	1.A.3

Molecular mass	1.A.3
Mass spectrometer	1.D.2
Percent composition	1.A.1, 1.A.2, 1.A.3
Empirical formula determination	1.A.1, 1.A.2, 1.A.3, 1.E.2
Chemical reactions and equations	1.A.1, 1.E.1, 1.E.2, 3.A.1, 3.C.1
Amounts of reactants and products	1.A.1, 1.A.3, 1.E.1, 1.E.2, 3.A.1, 3.A.2
Limiting reagents	1.A.3, 1.E.1, 1.E.2, 3.A.1, 3.A.2
Reaction yield	1.A.1, 1.A.3, 1.E.1, 1.E.2, 3.A.1, 3.A.2
Properties of aqueous solutions	2.A.1, 2.A.3, 2.B.2, 2.D.1, 3.A.1, 6.A.1
Precipitation reactions	1.A.1, 3.A.1, 3.C.1
Redox reactions	1.E.1, 3.A.1, 3.B.1, 3.B.3
Redox titrations	1.A.2, 1.E.2, 3.A.2, 3.B.3

Unit 4: Electrochemistry

Class Periods (90 minutes): 7 Homework Sets Assigned: 3

Number of Quizzes: 3

Number of Exams: 1

Labs and Activities:

*Electrochemistry I: Chemical Cells- Students will construct and study a variety of chemical batteries. [SP1, SP3, SP6]

Topic of Study	Curriculum Framework Alignment
Redox reactions	3.B.3
Galvanic cells	3.B.3, 3.C.3
Standard reduction potential	3.B.3, 3.C.3
Batteries	3.B.3, 3.C.3

Unit 5: Gases

Class Periods (90 minutes): 8 Homework

Sets Assigned: 7

Number of Quizzes: 4

Number of Exams: 1

Labs and Activities:

Graham's Law- Students find the speed of diffusion in centimeters per second by measuring how long it takes a gas to pass through a tube of known length. [SP2, SP3, SP4, SP5, SP6]

Gas Properties (PhET simulation)- Students use a computer simulation to discover how the properties of a gas relate to each other. [SP1, SP3]

*Determination of "R" for PV=nRT- A sample of hydrogen gas is trapped in a eudiometer. Students use available equipment to determine "R". [SP2, SP3, SP4, SP5]

Topic of Study	**Curriculum Framework Alignment**
Pressure of a gas	2.A.2
Gas laws	1.E.1, 2.A.2
Ideal gas equation	2.A.2
Gas stoichiometry	1.E.2, 2.A.2, 3.A.2
Dalton's law of partial pressures	2.A.2
Kinetic molecular theory of gases	2.A.2, 5.A.1
Deviation from ideal gas behavior	2.A.2

Unit 6: Thermochemistry

Class Periods (90

minutes): 7 Homework

Sets Assigned: 5

Number of Quizzes: 4

Number of Exams: 1

Labs and Activities:

Calorimetry- A calorimeter is used to measure the quantity of heat that flows in several physical and chemical processes. [SP2, SP4, SP5]

Hess's Law- Students study the effects of Hess's Law. [SP2, SP5, SP6]

*Designing a Hand Warmer- Investigate energy changes in the formation of solutions and apply the results to design a hand warmer that is reliable, safe, and inexpensive.

[SP2, SP3, SP4, SP5, SP6]

[CR3c] Students observe a chemical reaction and draw an energy diagram to illustrate what is occurring on a particulate level.

[CR3e] Students calculate the efficiency of a variety of fuels when given formulas and heats of combustion.

Topic of Study	**Curriculum Framework Alignment**
Types of energy	5.B.2, 5.C.1, 5.D.1
Energy changes in chemical reactions	3.C.2, 5.B.1, 5.B.2, 5.B.3, 5.C.2, 5.D.2
Intro to thermodynamics	3.C.2, 5.A.2, 5.B.1, 5.B.2, 5.B.3
Enthalpy of chemical reactions	1.E.2, 3.C.2, 5.B.1, 5.B.2, 5.B.3
Calorimetry	3.C.2, 5.A.2, 5.B.1, 5.B.2, 5.B.3, 5.B.4
Standard enthalpy of formation	3.C.2, 5.C.2
Heat of solution	3.C.2, 5.B.1, 5.B.2, 5.B.3, 5.C.2, 5.D.2

Unit 7: The Electronic Structure of Atoms

Class Periods (90 minutes): 8

Homework Sets

Assigned: 6 Number

of Quizzes: 3 Number

of Exams: 1

Labs and Activities:

Teacher demonstration of spectral lines [SP1, SP6]

Classes of Chemical Reactions- Students examine examples of acid-base, complexation, and oxidation-reduction reactions. {SP3, SP4, SP5]

Topic of Study	**Curriculum Framework Alignment**
Quantum theory	1.C.2, 1.D.1, 1.D.3
Bohr's theory of the H atom	1.C.2, 1.D.3
Quantum numbers	1.B.2, 1.C.2

Atomic orbitals	1.B.2
Electron configurations	1.B.2
The building-up principle	1.B.2, 1.C.1

Unit 8: Periodic Table

Trends Class Periods

(90 minutes): 5

Homework Sets

Assigned: 3 Number of

Quizzes: 2 Number of

Exams: 1

Labs and Activities:

*Atomic Radii- Students use paper and pencil to approximate the radius of an atom. [SP1, SP2]

Topic of Study	**Curriculum Framework Alignment**
Development of the periodic table	
Classification of elements	1.C.1
Periodic variation in physical properties	1.C.1
Ionization energy	1.C.1, 1.D.1
Electron affinity	1.C.1, 1.D.1
Variation of chemical properties in representative elements	1.C.1

Unit 9: Chemical Bonding

Class Periods (90

minutes): 15 Homework

Sets Assigned: 10

Number of Quizzes: 10

Number of Exams: 2

Labs and Activities:

Gravimetric Determination of Chloride Ion- Students analyze an unknown

compound for chloride by precipitation and massing of the chloride. [SP2, SP4, SP5]

*Using ball-and-stick models to teach VSEPR- Students arrange pipe cleaners and Styrofoam balls to approximate electron clouds. [SP1, SP6]

[CR3b] Given combinations of atoms, students used the periodic table to predict the by type between or among the atoms.

Topic of Study	Curriculum Framework Alignment
Lewis dot symbols	1.C.1, 2.C.1, 2.C.2
Ionic bonds	2.C.1, 2.C.2
Lattice energy of ionic compounds	1.B.1, 2.C.2, 2.D.1
Covalent bonds	2.C.1, 2.D.1, 2.D.4
Electronegativity	1.C.1, 2.C.1
Writing Lewis structures	2.C.1, 2.C.4
Formal charge and Lewis structures	
Resonance	2.C.4
Bond enthalpy	3.C.2, 5.C.1, 5.C.2
Molecular geometry	2.C.4
Dipole moments	2.C.1, 2.C.4
Valence bond theory	2.C.4
Hybridization of atomic orbitals	2.C.4

Unit 10: Intermolecular Forces in Liquids and Solids Class Periods (90 minutes): 8

Homework Sets

Assigned: 5 Number of Quizzes: 4 Number of Exams: 1

Labs and Activities:

Change in Heat for the Vaporization of Water- Students measure the vapor pressure of water at different temperatures to determine change in heat. [SP2, SP4, SP5, SP6] **[CR3d]** Students watch a computer simulation and provide explanations for effective and ineffective collisions that lead to chemical bonding and reactions. **[CR3b]** Students are given two similar structures of compounds and write an explanation for the differences in properties using chemistry terms and ideas.

Topic of Study	Curriculum Framework Alignment
Kinetic molecular theory of liquids and solids	2.A.1
Intermolecular forces	2.B.1, 2.B.2, 2.B.3, 5.D.1
X-ray diffraction by crystals	
Types of crystals	2.C.2, 2.C.3, 2.D.1, 2.D.2, 2.D.3, 2.D.4
Phase changes	2.A.1, 2.A.2, 5.A.1, 5.B.3, 5.D.1, 5.D.2, 6.A.1

Unit 11: Properties of Solutions Class Periods (90 minutes): 7 Homework Sets Assigned: 5

Number of Quizzes: 3 Number of Exams: 1 Labs and Activities:

Gravimetric Determination of Sulfate Ion- Students analyze an unknown compound for sulfate by precipitation and massing of the sulfate. [SP2, SP4, SP5]

Solution Preparation- students make solutions of specifies concentrations gravimetrically and by dilution. Solution concentration will be checked for accuracy using a spectrophotometer. [SP2, SP4, SP5]

Topic of Study	Curriculum Framework Alignment
Types of solutions	2.A.3
Solution process	2.A.3, 2.B.3, 5.E.1
Concentration units	2.A.3
Temperature and solubility	
Pressure and gas solubility	
Colligative properties of electrolyte and nonelectrolyte solutions	2.A.3

Unit 12: Kinetics

Class Periods (90 minutes): 11 Homework Sets Assigned: 8

Number of Quizzes: 6

Number of Exams: 1

Labs and Activities:

Iodine Clock Lab- Students investigate the kinetics of an iodine clock reaction. [SP2, SP3, SP4, SP5, SP6]

*Kinetics of Crystal Violet Fading- Students measure the color intensity (absorbance) of a crystal violet solution versus time to determine the rate law. [SP2, SP3, SP4, SP5, SP6]

*Water Flow- Students use a buret and tap water to determine rate law. [SP1, SP2, SP3, SP4, SP5, SP6]

Topic of Study	Curriculum Framework Alignment
Rate of reaction	4.A.1, 4.A.3
Rate law	4.A.1, 4.A.2, 4.A.3
Reactant concentration and time	4.A.1, 4.A.2, 4.A.3

Activation energy, temperature and rate constants	4.A.1, 4.B.1, 4.B.2, 4.B.3
Reaction mechanisms	4.B.3, 4.C.1, 4.C.2, 4.C.3
Catalysis	4.B.3, 4.D.1, 4.D.2

Unit 13: Chemical Equilibrium

Class Periods (90 minutes): 10 Homework Sets Assigned: 7 Number of Quizzes: 6

Number of Exams:

1 Labs and Activities:

K_C for the solubility of NaCl- Students determine the K_C for NaCl. [SP2, SP3, SP4, SP5, SP6]

*Equilibrium: Can we make the colors of the rainbow? (Ward's Science) [SP2, SP3, SP4, SP5, SP6] **[CR3f]** Students use data to calculate concentration of either reactants or products and use the answers to calculate an equilibrium constant.

[CR3d] Students are given a set of data of concentration versus time, calculate the reaction order and rate constants (with correct units) and present the solution to the class or small group.

Topic of Study	**Curriculum Framework Alignment**
Equilibrium and equilibrium constant	6.A.1, 6.A.2, 6.A.3, 6.A.4
Equilibrium expressions	6.A.1, 6.A.2, 6.A.3, 6.A.4
Kinetics and equilibrium	6.A.3
Equilibrium constant	6.A.1, 6.A.2, 6.A.3, 6.A.4
Factors affecting equilibrium	6.A.2, 6.A.3, 6.B.1, 6.B.2

Unit 14: Acids and Bases

Class Periods (90

minutes): 17 Homework

Sets Assigned: 9

Number of Quizzes: 5

Number of Exams:

2 Labs and

Activities:

*Salts and pH- predicting and determining the pH of salt solutions [SP3, SP4, SP5]

Strong Acid-Strong Base Titration [SP2, SP3,
SP4, SP5, SP6] Weak Acid-Strong Base
Titration [SP2, SP3, SP4, SP5, SP6] Strong
Acid-Weak Base Titration [SP2, SP3, SP4, SP5,
SP6]

[CR3f] As a written assignment, students identify the components of a buffer solution, identify the species present, and qualitatively predict and explain changes in concentration of those species with addition of acid or base.

Topic of Study	**Curriculum Framework Alignment**
Bronsted acids and bases	6.C.1
Acid-base properties of water	6.C.1, 6.C.2
pH	6.C.1, 6.C.2
Strength of acids and bases	6.C.1, 6.C.2
Weak acids	6.C.1, 6.C.2
Weak bases	6.C.1, 6.C.2
Ionization constants of acids and their conjugate bases	6.C.1, 6.C.2, 6.A.4
Diprotic and polyprotic acids	6.C.1, 6.C.2, 6.A.4
Molecular strength of acids	6.C.1
Acid-base properties of salts	6.C.1, 6.C.2

Acid-base properties of oxides and hydroxides	6.C.1, 6.C.2
Homogeneous versus heterogeneous solution equilibria	6.C.1, 6.C.3
Common ion effect	6.B.1, 6.B.2, 6.B.4
Buffer solution	6.C.1, 6.C.2
Acid-base titration	1.E.2, 3.A.2, 3.B.2, 6.C.1
Acid-base indicators	6.C.1, 3.B.2
Solubility equilibria	6.C.3
Fractional precipitation	6.B.1, 6.B.2, 6.C.3
Common ion effect and solubility	6.B.1, 6.B.2, 6.C.3

Unit 15: Entropy, Free Energy, and Equilibrium Class Periods (90 minutes): 7

Homework Sets Assigned: 5 Number of Quizzes: 3 Number of Exams: 1

Labs and Activities:

Electrolysis of Potassium Iodide Solution- working with half-reactions [SP3]

Solubility and Determination of ΔH, ΔS, and ΔG of Calcium Hydroxide- Students collect and analyze date to determine ΔH, ΔS, and ΔG of calcium hydroxide. [SP2, SP3, SP4, SP5, SP6]

Students solve problems where they qualitatively and quantitatively predict the signs and values of ΔH^{o}, ΔS^{o}, and ΔG^{o}.

Topic of Study	Curriculum Framework Alignment
Three laws of thermodynamics	5.B.2
Spontaneous processes	5.E.2, 5.E.5
Entropy	5.E.1
Second law of thermodynamics	5.E.1, 5.E.2
Gibbs free energy	5.E.2, 5.E.3, 5.E.4, 5.E.5

Free energy and chemical equilibrium	6.D.1
Electrolysis	3.B.3, 3.C.3, 5.E.4

Unit 16: Miscellaneous

Class Periods (90 minutes): 3 Homework Sets Assigned: 2

Number of Quizzes: 1

Number of Exams: 0

Labs and Activities:

Demonstration of alpha, beta, and gamma radiation [SP3]

[CR4] Students write a report or make a presentation on an aspect of the chemistry of Earth’s atmosphere (e.g., smog, acid rain, greenhouse effect) based on the concepts from the chapter on Chemistry in the Atmosphere.

Topic of Study	Curriculum Framework Alignment
Natural radioactivity	4.A.3
Nuclear equations	
Organic chemistry basics	

AP Chemistry Learning Objectives

BIG IDEA 1

LO 1.1 The student can justify the observation that the ratio of the masses of the constituent elements in any pure sample of that compound is always identical on the basis of the atomic molecular theory.

LO 1.2 The student is able to select and apply mathematical routines to mass data to identify or infer the composition of pure substances and/or mixtures.

LO 1.3 The student is able to select and apply mathematical relationships to mass data in order to justify a claim regarding the identity and/or estimated purity of a substance.

LO 1.4 The student is able to connect the number of particles, moles, mass, and volume of substances to one another, both qualitatively and quantitatively.

LO 1.5 The student is able to explain the distribution of electrons in an atom or ion based upon data.

LO 1.6 The student is able to analyze data relating to electron energies for patterns and relationships.

LO 1.7 The student is able to describe the electronic structure of the atom, using PES data, ionization energy data, and/or Coulomb's Law to construct explanations of how the energies of electrons within shells in atoms vary.

LO 1.8 The student is able to explain the distribution of electrons using Coulomb's Law to analyze measured energies.

LO 1.9 The student is able to predict and/or justify trends in atomic properties based on location on the periodic table and/or the shell model.

LO 1.10 Students can justify with evidence the arrangement of the periodic table and can apply periodic properties to chemical reactivity.

LO 1.11 The student can analyze data, based on periodicity and the properties of binary compounds, to identify patterns and generate hypotheses related to the molecular design of compounds for which data are not supplied.

LO 1.12 The student is able to explain why a given set of data suggests, or does not suggest, the need to refine the atomic model from a classical shell model with the quantum mechanical model.

LO 1.13 Given information about a particular model of the atom, the student is able to determine if the model is consistent with specified evidence.

LO 1.14 The student is able to use data from mass spectrometry to identify the elements and the masses of individual atoms of a specific element.

LO 1.15 The student can justify the selection of a particular type of spectroscopy to measure properties associated with vibrational or electronic motions of molecules.

LO 1.16 The student can design and/or interpret the results of an experiment regarding the absorption of light to determine the concentration of an absorbing species in a solution.

LO 1.17 The student is able to express the law of conservation of mass quantitatively and qualitatively using symbolic representations and particulate drawings.

LO 1.18 The student is able to apply conservation of atoms to the rearrangement of atoms in various processes.

LO 1.19 The student can design, and/or interpret data from, an experiment that uses gravimetric analysis to determine the concentration of an analyte in a solution.

LO 1.20 The student can design, and/or interpret data from, an experiment that uses titration to determine the concentration of an analyte in a solution.

BIG IDEA 2

LO 2.1 Students can predict properties of substances based on their chemical formulas, and provide explanations of their properties based on particle views.

LO 2.2 The student is able to explain the relative strengths of acids and bases based on molecular structure, interparticle forces, and solution equilibrium.

LO 2.3 The student is able to use aspects of particulate models (i.e., particle spacing, motion, and forces of attraction) to reason about observed differences between solid and liquid phases and among solid and liquid materials.

LO 2.4 The student is able to use KMT and concepts of intermolecular forces to make predictions about the macroscopic properties of gases, including both ideal and nonideal behaviors.

LO 2.5 The student is able to refine multiple representations of a sample of matter in the gas phase to accurately represent the effect of changes in macroscopic properties on the sample.

LO 2.6 The student can apply mathematical relationships or estimation to determine macroscopic variables for ideal gases.

LO 2.7 The student is able to explain how solutes can be separated by chromatography based on intermolecular interactions.

LO 2.8 The student can draw and/or interpret representations of solutions that show the interactions between the solute and solvent.

LO 2.9 The student is able to create or interpret representations that link the concept of molarity with particle views of solutions.

LO 2.10 The student can design and/or interpret the results of a separation experiment (filtration, paper chromatography, column chromatography, or distillation) in terms of the relative strength of interactions among and between the components.

LO 2.11 The student is able to explain the trends in properties and/or predict properties of samples consisting of particles with no permanent dipole on the basis of London dispersion forces.

LO 2.12 The student can qualitatively analyze data regarding real gases to identify deviations from ideal behavior and relate these to molecular interactions.

LO 2.13 The student is able to describe the relationships between the structural features of polar molecules and the forces of attraction between the particles.

LO 2.14 The student is able to apply Coulomb's Law qualitatively (including using representations) to describe the interactions of ions, and the attractions between ions and solvents to explain the factors that contribute to the solubility of ionic compounds.

LO 2.15 The student is able to explain observations regarding the solubility of ionic solids and molecules in water and other solvents on the basis of particle views that include intermolecular interactions and entropic effects.

LO 2.16 The student is able to explain the properties (phase, vapor pressure, viscosity, etc.) of small and large molecular compounds in terms of the strengths and types of intermolecular forces.

LO 2.17 The student can predict the type of bonding present between two atoms in a binary compound based on position in the periodic table and the electronegativity of the elements.

LO 2.18 The student is able to rank and justify the ranking of bond polarity on the basis of the locations of the bonded atoms in the periodic table.

LO 2.19 The student can create visual representations of ionic substances that connect the microscopic structure to macroscopic properties, and/or use representations to connect the microscopic structure to macroscopic properties (e.g., boiling point, solubility, hardness, brittleness, low volatility, lack of malleability, ductility, or conductivity).

LO 2.20 The student is able to explain how a bonding model involving delocalized electrons is consistent with macroscopic properties of metals (e.g., conductivity, malleability, ductility, and low volatility) and the shell model of the atom.

LO 2.21 The student is able to use Lewis diagrams and VSEPR to predict the geometry of molecules, identify hybridization, and make predictions about polarity.

LO 2.22 The student is able to design or evaluate a plan to collect and/or interpret data needed to deduce the type of bonding in a sample of a solid.

LO 2.23 The student can create a representation of an ionic solid that shows essential characteristics of the structure and interactions present in the substance.

LO 2.24 The student is able to explain a representation that connects properties of an ionic solid to its structural attributes and to the interactions present at the atomic level.

LO 2.25 The student is able to compare the properties of metal alloys with their constituent elements to determine if an alloy has formed, identify the type of alloy formed, and explain the differences in properties using particulate level reasoning.

LO 2.26 Students can use the electron sea model of metallic bonding to predict or make claims about the macroscopic properties of metals or alloys.

LO 2.27 The student can create a representation of a metallic solid that shows essential characteristics of the structure and interactions present in the substance.

LO 2.28 The student is able to explain a representation that connects properties of a metallic solid to its structural attributes and to the interactions present at the atomic level.

LO 2.29 The student can create a representation of a covalent solid that shows essential characteristics of the structure and interactions present in the substance.

LO 2.30 The student is able to explain a representation that connects properties of a covalent solid to its structural attributes and to the interactions present at the atomic level.

LO 2.31 The student can create a representation of a molecular solid that shows essential characteristics of the structure and interactions present in the substance.

LO 2.32 The student is able to explain a representation that connects properties of a molecular solid to its structural attributes and to the interactions present at the atomic level.

BIG IDEA 3

LO 3.1 Students can translate among macroscopic observations of change, chemical equations, and particle views.

LO 3.2 The student can translate an observed chemical change into a balanced chemical equation and justify the choice of equation type (molecular, ionic, or net ionic) in terms of utility for the given circumstances.

LO 3.3 The student is able to use stoichiometric calculations to predict the results of performing a reaction in the laboratory and/or to analyze deviations from the expected results.

LO 3.4 The student is able to relate quantities (measured mass of substances, volumes of solutions, or volumes and pressures of gases) to identify stoichiometric relationships for a reaction, including situations involving limiting reactants and situations in which the reaction has not gone to completion.

LO 3.5 The student is able to design a plan in order to collect data on the synthesis or decomposition of a compound to confirm the conservation of matter and the law of definite proportions.

LO 3.6 The student is able to use data from synthesis or decomposition of a compound to confirm the conservation of matter and the law of definite proportions.

LO 3.7 The student is able to identify compounds as Bronsted-Lowry acids, bases, and/or conjugate acid-base pairs, using proton-transfer reactions to justify the identification.

LO 3.8 The student is able to identify redox reactions and justify the identification in terms of electron transfer.

LO 3.9 The student is able to design and/or interpret the results of an experiment involving a redox titration.

LO 3.10 The student is able to evaluate the classification of a process as a physical change, chemical change, or ambiguous change based on both macroscopic observations and the distinction between rearrangement of covalent interactions and noncovalent interactions.

LO 3.11 The student is able to interpret observations regarding macroscopic energy changes associated with a reaction or process to generate a relevant symbolic and/or graphical representation of the energy changes.

LO 3.12 The student can make qualitative or quantitative predictions about galvanic or electrolytic reactions based on half-cell reactions and potentials and/or Faraday's laws.

LO 3.13 The student can analyze data regarding galvanic or electrolytic cells to identify properties of the underlying redox reactions.

BIG IDEA 4

LO 4.1 The student is able to design and/or interpret the results of an experiment regarding the factors (i.e., temperature, concentration, surface area) that may influence the rate of a reaction.

LO 4.2 The student is able to analyze concentration vs. time data to determine the rate law for a zeroth-, first-, or second-order reaction.

LO 4.3 The student is able to connect the half-life of a reaction to the rate constant of a first-order reaction and justify the use of this relation in terms of the reaction being a first-order reaction.

LO 4.4 The student is able to connect the rate law for an elementary reaction to the frequency and success of molecular collisions, including connecting the frequency and success to the order and rate constant, respectively.

LO 4.5 The student is able to explain the difference between collisions that convert reactants to products and those that do not in terms of energy distributions and molecular orientation.

LO 4.6 The student is able to use representations of the energy profile for an elementary reaction (from the reactants, through the transition state, to the products) to make qualitative predictions regarding the relative temperature dependence of the reaction rate.

LO 4.7 The student is able to evaluate alternative explanations, as expressed by reaction mechanisms, to determine which are consistent with data regarding the overall rate of a reaction, and data that can be used to infer the presence of a reaction intermediate.

LO 4.8 The student can translate among reaction energy profile representations, particulate representations, and symbolic representations (chemical equations) of a chemical reaction occurring in the presence and absence of a catalyst.

LO 4.9 The student is able to explain changes in reaction rates arising from the use of acid-base catalysts, surface catalysts, or enzyme catalysts, including selecting appropriate mechanisms with or without the catalyst present.

BIG IDEA 5

LO 5.1 The student is able to create or use graphical representations in order to connect the dependence of potential energy to the distance between atoms and factors, such as bond order (for covalent interactions) and polarity (for intermolecular interactions), which influence the interaction strength.

LO 5.2 The student is able to relate temperature to the motions of particles, either via particulate representations, such as drawings of particles with arrows indicating velocities, and/or via representations of average kinetic energy and distribution of kinetic energies of the particles, such as plots of the Maxwell-Boltzmann distribution.

LO 5.3 The student can generate explanations or make predictions about the transfer of thermal energy between systems based on this transfer being due to a kinetic energy transfer between systems arising from molecular collisions.

LO 5.4 The student is able to use conservation of energy to relate the magnitudes of the energy changes occurring in two or more interacting systems, including identification of the systems, the type (heat versus work), or the direction of energy flow.

LO 5.5 The student is able to use conservation of energy to relate the magnitudes of the energy changes when two nonreacting substances are mixed or brought into contact with one another.

LO 5.6 The student is able to use calculations or estimations to relate energy changes associated with heating/cooling a substance to the heat capacity, relate energy changes associated with a phase transition to the enthalpy of fusion/vaporization, relate energy changes associated with a chemical reaction to the enthalpy of the reaction, and relate energy changes to $P\Delta V$ work.

LO 5.7 The student is able to design and/or interpret the results of an experiment in which calorimetry is used to determine the change in enthalpy of a chemical process (heating/cooling, phase transition, or chemical reaction) at constant pressure.

LO 5.8 The student is able to draw qualitative and quantitative connections between the reaction enthalpy and the energies involved in the breaking and formation of chemical bonds.

LO 5.9 The student is able to make claims and/or predictions regarding relative magnitudes of the forces acting within collections of interacting molecules based on the distribution of electrons within the molecules and the types of intermolecular forces through which the molecules interact.

LO 5.10 The student can support the claim about whether a process is a chemical or physical change (or may be classified as both) based on whether the process involves changes in intramolecular versus intermolecular interactions.

LO 5.11 The student is able to identify the noncovalent interactions within and between large molecules, and/or connect the shape and function of the large molecule to the presence and magnitude of these interactions.

LO 5.12 The student is able to use representations and models to predict the sign and relative magnitude of the entropy change associated with chemical or physical processes.

LO 5.13 The student is able to predict whether or not a physical or chemical process is thermodynamically favored by determination of (either quantitatively or qualitatively) the signs of both $\Delta H°$ and $\Delta S°$, and calculation or estimation of $\Delta G°$ when needed.

LO 5.14 The student is able to determine whether a chemical or physical process is thermodynamically favorable by calculating the change in standard Gibbs free energy.

LO 5.15 The student is able to explain how the application of external energy sources or the coupling of favorable with unfavorable reactions can be used to cause processes that are not thermodynamically favorable to become favorable.

LO 5.16 The student can use LeChatelier's principle to make qualitative predictions for systems in which coupled reactions that share a common intermediate drive formation of a product.

LO 5.17 The student can make quantitative predictions for systems involving coupled reactions that share a common intermediate, based on the equilibrium constant for the combined reaction.

LO 5.18 The student can explain why a thermodynamically favored chemical reaction may not produce large amounts of product (based on consideration of both initial conditions and kinetic effects), or why a thermodynamically unfavored chemical reaction can produce large amounts of product for certain sets of initial conditions.

BIG IDEA 6

LO 6.1 The student is able to, given a set of experimental observations regarding physical, chemical, biological, or environmental processes that are reversible, construct an explanation that connects the observations to the reversibility of the underlying chemical reactions or processes.

LO 6.2 The student can, given a manipulation of a chemical reaction or set of reactions (e.g., reversal of reaction or addition of two reactions), determine the effects of that manipulation on Q or K.

LO 6.3 The student can connect kinetics to equilibrium by using reasoning about equilibrium, such as LeChatelier's principle, to infer the relative rates of the forward and reverse reactions.

LO 6.4 The student can, given a set of initial conditions (concentrations or partial pressures) and the equilibrium constant, K, use the tendency of Q to approach K to predict and justify the prediction as to whether the reaction will proceed toward products or reactants as equilibrium is approached.

LO 6.5 The student can, given data (tabular, graphical, etc.) from which the state of a system at equilibrium can be obtained, calculate the equilibrium constant, *K*.

LO 6.6 The student can, given a set of initial conditions (concentrations or partial pressures) and the equilibrium constant, *K*, use stoichiometric relationships and the law of mass action (*Q* equals *K* at equilibrium) to determine qualitatively and/or quantitatively the conditions at equilibrium for a system involving a single reversible reaction.

LO 6.7 The student is able, for a reversible reaction that has a large or small *K*, to determine which chemical species will have very large versus very small concentrations at equilibrium.

LO 6.8 The student is able to use LeChatelier's principle to predict the direction of the shift resulting from various possible stresses on a system at chemical equilibrium.

LO 6.9 The student is able to use LeChatelier's principle to design a set of conditions that will optimize a desired outcome, such as product yield.

LO 6.10 The student is able to connect LeChatelier's principle to the comparison of *Q* to *K* by explaining the effects of the stress on *Q* and *K*.

LO 6.11 The student can generate or use a particulate representation of an acid (strong or weak or polyprotic) and a strong base to explain the species that will have large versus small concentrations at equilibrium.

LO 6.12 The student can reason about the distinction between strong and weak acid solutions with similar values of pH, including the percent ionization of the acids, the concentrations needed to achieve the same pH, and the amount of base needed to reach the equivalence point in a titration.

LO 6.13 The student can interpret titration data for monoprotic or polyprotic acids involving titration of a weak or strong acid by a strong base (or a weak or strong base by a strong acid) to determine the concentration of the titrant and the pK_a for a weak acid, or the pK_b for a weak base.

LO 6.14 The student can, based on the dependence of K_w on temperature, reason that neutrality requires $[H^+] = [OH^-]$ as opposed to requiring pH = 7, including especially the applications to biological systems.

LO 6.15 The student can identify a given solution as containing a mixture of strong acids and/or bases and calculate or estimate the pH (and concentrations of all chemical species) in the resulting solution.

LO 6.16 The student can identify a given solution as being the solution of a monoprotic weak acid or base (including salts in which one ion is a weak acid or base), calculate the pH and concentration of all species in the solution, and/or infer the relative strengths of the weak acids or bases from given equilibrium concentrations.

LO 6.17 The student can, given an arbitrary mixture of weak and strong acids and bases (including polyprotic systems), determine which species will react strongly with one another (i.e., with $K > 1$) and what species will be present in large concentrations at equilibrium.

LO 6.18 The student can design a buffer solution with a target pH and buffer capacity by selecting an appropriate conjugate acid-base pair and estimating the concentrations needed to achieve the desired capacity.

LO 6.19 The student can relate the predominant form of a chemical species involving a labile proton (i.e., protonated/deprotonated form of a weak acid) to the pH of a solution and the pK_a associated with the labile proton.

LO 6.20 The student can identify a solution as being a buffer solution and explain the buffer mechanism in terms of the reactions that would occur on addition of acid or base.

LO 6.21 The student can predict the solubility of a salt, or rank the solubility of salts, given the relevant K_{sp} values.

LO 6.22 The student can interpret data regarding solubility of salts to determine, or rank, the relevant K_{sp} values.

LO 6.23 The student can interpret data regarding the relative solubility of salts in terms of factors (common ions, pH) that influence the solubility.

LO 6.24 The student can analyze the enthalpic and entropic changes associated with the dissolution of a salt, using particulate level interactions and representations.

LO 6.25 The student is able to express the equilibrium constant in terms of $\Delta G°$ and RT and use this relationship to estimate the magnitude of K and, consequently, the thermodynamic favorability of the process.

AP Physics Syllubus

Curricular Requirements Page(s)
CR1 Students and teachers have access to college-level resources including college-level textbooks and reference materials in print or electronic format.

CR2a The course design provides opportunities for students to develop understanding of the foundational principles of kinematics in the context of the big ideas that organize the curriculum framework.

CR2b The course design provides opportunities for students to develop understanding of the foundational principles of dynamics in the context of the big ideas that organize the curriculum framework.

CR2c The course design provides opportunities for students to develop understanding of the foundational principles of gravitation and circular motion in the context of the big ideas that organize the curriculum framework.

CR2d The course design provides opportunities for students to develop understanding of the foundational principles of simple harmonic motion in the context of the big ideas that organize the curriculum framework.

CR2e The course design provides opportunities for students to develop understanding of the foundational principles of linear momentum in the context of the big ideas that organize the curriculum framework.

CR2f The course design provides opportunities for students to develop understanding of the foundational principle of energy in the context of the big ideas that organize the curriculum framework.

CR2g The course design provides opportunities for students to develop understanding of the foundational
principles of rotational motion in the context of the big ideas that organize the curriculum framework.

CR2h The course design provides opportunities for students to develop understanding of the foundational principles of electrostatics in the context of the big ideas that organize the curriculum framework.

CR2i The course design provides opportunities for students to develop understanding of the foundational principles of electric circuits in the context of the big ideas that organize the curriculum framework.

CR2j The course design provides opportunities for students to develop understanding of the foundational principles of mechanical waves in the context of the big ideas that organize the curriculum framework.

CR3 Students have opportunities to apply AP Physics 1 learning objectives connecting across enduring understandings as described in the curriculum framework. These opportunities must occur in addition to those within laboratory investigations.

CR4 The course provides students with opportunities to apply their knowledge of physics principles to real world questions or scenarios (including societal issues or technological innovations) to help them become scientifically literate citizens.

CR5 Students are provided with the opportunity to spend a minimum of 25 percent of instructional time engaging in hands-on laboratory work with an emphasis on inquiry-based investigations.

CR6a The laboratory work used throughout the course includes investigations that support the foundational

CR6b The laboratory work used throughout the course includes guided-inquiry laboratory investigations allowing students to apply all seven science practices.

CR7 The course provides opportunities for students to develop their communication skills by recording evidence of their research of literature or scientific investigations through verbal, written, and graphic presentations.

CR8 The course provides opportunities for students to develop written and oral scientific argumentation skills.

RESOURCES
TEXTBOOK
Etkina, Eugenia, Michael Gentile, and Alan Van Heuvelen. College Physics. San Francisco,
CA: Pearson, 2014. [CR1]

INSTRUCTIONAL STRATEGIES
The AP Physics 1 course is conducted using inquiry-based instructional strategies that focus on experimentation to develop students' conceptual understanding of physics principles. The students begin studying a topic by making observations and discovering patterns of natural phenomena. The next steps involve developing, testing, and applying models. Throughout the course, the students construct and use multiple representations of physical processes, solve multi-step problems, design investigations, and reflect on knowledge construction through self-assessment rubrics.
In most labs, the students use probeware technology in data acquisition. In the classroom, they use graphing calculators and digital devices for interactive simulations, Physlet-based exercises, collaborative activities, and formative assessments.

COURSE SYLLABUS

UNIT 1. KINEMATICS [CR2a]
• Kinematics in one-dimension: constant velocity and uniform accelerated motion
• Vectors: vector components and resultant
• Kinematics in two-dimensions: projectile motion
Big Idea 3
Learning Objectives: 3.A.1.1, 3.A.1.2, 3.A.1.3

UNIT 2. DYNAMICS [CR2b]
• Forces, types, and representation (FBD)
• Newton's First Law
• Newton's Third Law
• Newton's Second Law
• Applications of Newton's Second Law
• Friction
• Interacting objects: ropes and pulleys
Big Ideas 1, 2, 3, 4
Learning Objectives: 1.C.1.1, 1.C.1.3, 2.B.1.1, 3.A.2.1, 3.A.3.1, 3.A.3.2, 3.A.3.3, 3.A.4.1,
3.A.4.2, 3.A.4.3, 3.B.1.1, 3.B.1.2, 3.B.1.3, 3.B.2.1, 3.C.4.1, 3.C.4.2, 4.A.1.1, 4.A.2.1, 4.A.2.2, 4.A.2.3, 4.A.3.1, 4.A.3.2

UNIT 3. CIRCULAR MOTION AND GRAVITATION [CR2c]
• Uniform circular motion
• Dynamics of uniform circular motion
• Universal Law of Gravitation
Big Ideas 1, 2, 3, 4
Learning Objectives: 1.C.3.1, 2.B.1.1, 2.B.2.1, 2.B.2.2, 3.A.3.1, 3.A.3.3, 3.B.1.2, 3.B.1.3, 3.B.2.1, 3.C.1.1, 3.C.1.2, 3.C.2.1, 3.C.2.2, 3.G.1.1, 4.A.2.2

UNIT 4. ENERGY [CR2f]
• Work
• Power
• Kinetic energy
• Potential energy: gravitational and elastic
• Conservation of energy
Big Ideas 3, 4, 5
Learning Objectives: 3.E.1.1, 3.E.1.2, 3.E.1.3, 3.E.1.4, 4.C.1.1, 4.C.1.2, 4.C.2.1, 4.C.2.2,
5.A.2.1, 5.B.1.1, 5.B.1.2, 5.B.2.1, 5.B.3.1, 5.B.3.2, 5.B.3.3, 5.B.4.1, 5.B.4.2, 5.B.5.1, 5.B.5.2, 5.B.5.3, 5.B.5.4, 5.B.5.5, 5.D.1.1, 5.D.1.2, 5.D.1.3, 5.D.1.4, 5.D.1.5, 5.D.2.1, 5.D.2.3

UNIT 5. MOMENTUM [CR2e]

- Impulse
- Momentum
- Conservation of momentum
- Elastic and inelastic collisions

Big Ideas 3, 4, 5
Learning Objectives: 3.D.1.1, 3.D.2.1, 3.D.2.2, 3.D.2.3, 3.D.2.4, 4.B.1.1, 4.B.1.2, 4.B.2.1, 4.B.2.2, 5.A.2.1, 5.D.1.1, 5.D.1.2, 5.D.1.3, 5.D.1.4, 5.D.1.5, 5.D.2.1, 5.D.2.2, 5.D.2.3, 5.D.2.4 , 5.D.2.5, 5.D.3.1

UNIT 6. SIMPLE HARMONIC MOTION [CR2d]
- Linear restoring forces and simple harmonic motion
- Simple harmonic motion graphs
- Simple pendulum
- Mass-spring systems

Big Ideas 3, 5
Learning Objectives: 3.B.3.1, 3.B.3.2, 3.B.3.3, 3.B.3.4, 5.B.2.1, 5.B.3.1, 5.B.3.2, 5.B.3.3, 5.B.4.1, 5.B.4.2

UNIT 7. ROTATIONAL MOTION [CR2g]
- Torque
- Center of mass
- Rotational kinematics
- Rotational dynamics and rotational inertia
- Rotational energy
- Angular momentum
- Conservation of angular momentum

Big Ideas 3, 4, 5
Learning Objectives: 3.F.1.1, 3.F.1.2, 3.F.1.3, 3.F.1.4, 3.F.1.5, 3.F.2.1, 3.F.2.2, 3.F.3.1, 3.F.3.2, 3.F.3.3, 4.A.1.1, 4.D.1.1, 4.D.1.2, 4.D.2.1, 4.D.2.2, 4.D.3.1, 4.D.3.2, 5.E.1.1, 5.E.1.2, 5.E.2.1

UNIT 8. MECHANICAL WAVES [CR2j]
- Traveling waves
- Wave characteristics
- Sound
- Superposition
- Standing waves on a string
- Standing sound waves

Big Idea 6
Learning Objectives: 6.A.1.1, 6.A.1.2, 6.A.1.3, 6.A.2.1, 6.A.3.1, 6.A.4.1, 6.B.1.1, 6.B.2.1, 6.B.4.1, 6.B.5.1, 6.D.1.1, 6.D.1.2, 6.D.1.3, 6.D.2.1, 6.D.3.1, 6.D.3.2, 6.D.3.3, 6.D.3.4, 6.D.4.1, 6.D.4.2, 6.D.5.1

UNIT 9. ELECTROSTATICS [CR2h]
- Electric charge and conservation of charge
- Electric force: Coulomb’s Law

Big Ideas 1, 3, 5
Learning Objectives: 1.B.1.1, 1.B.1.2, 1.B.2.1, 1.B.3.1, 3.C.2.1, 3.C.2.2, 5.A.2.1

UNIT 10. DC CIRCUITS [CR2i]
• Electric resistance
• Ohm's Law
• DC circuits
• Series and parallel connections
• Kirchhoff's Laws
Big Ideas 1, 5
Learning Objectives: 1.B.1.1, 1.B.1.2, 1.E.2.1, 5.B.9.1, 5.B.9.2, 5.B.9.3, 5.C.3.1, 5.C.3.2,

LABORATORY INVESTIGATIONS AND THE SCIENCE PRACTICES
The AP Physics 1 course devotes over 25% of the time to hands-on laboratory investigations. [CR5] The laboratory component of the course allows the students to demonstrate the seven science practices through a variety of investigations in all of the foundational principles.

The students use guided–inquiry (GI) or open–inquiry (OI) in the design of their laboratory investigations. Some labs focus on investigating a physical phenomenon without having expectations of its outcomes. In other experiments, the student has an expectation of its outcome based on concepts constructed from prior experiences. In application experiments, the students use acquired physics principles to address practical
problems. Students also investigate topic-related questions that are formulated through student designed/selected procedures.

All investigations are reported in a laboratory journal. Students are expected to record their observations, data, and data analyses. Data analyses include identification of the sources and effects of experimental uncertainty, calculations, results and conclusions, and suggestions for further refinement of the experiment as appropriate. [CR7]

UNIT 1. KINEMATICS [CR6a]
LAB INVESTIGATION OBJECTIVE(S)
(Investigation identifier: Guided–Inquiry: GI Open–Inquiry: OI)
1. Meeting Point: To predict where two battery-powered cars will collide if they are released from opposite ends of the lab table at different times.
Science Practices 1.1, 1.2, 1.4, 2.1, 2.2, 3.1, 4.1, 4.2, 4.3, 5.1, 5.2, 5.3, 6.1, 6.2, 6.4, 7.2

2. Match the Graph (GI) [CR6b]
To determine the proper placement of an air track, a glider, and a
motion detector to produce a motion that matches a set of given
graphs: position, velocity, and acceleration versus time.
Science Practices 1.2, 1.5, 2.1, 2.2, 3.1, 4.1, 4.2, 4.3, 5.1, 5.3, 6.1, 6.4, 7.2

3. Free-Fall Investigation
To determine and compare the acceleration of two objects dropped simultaneously.
Science Practices 1.4, 2.1, 2.2, 3.1, 4.1, 4.2, 4.3, 5.1, 5.3, 6.1, 6.4, 7.2

4. Vector Addition (GI) [CR6b]
To determine the value of a resultant of several vectors, and then compare that value to the values obtained through graphical and analytical methods.
Science Practices 1.1, 1.2, 1.4, 2.1, 2.2, 3.1, 4.1, 4.2, 4.3, 5.3, 6.1, 6.4, 7.2

5. Shoot the Target (GI) [CR6b]
To determine the initial velocity of a projectile, the angle at which the maximum range can be attained, and predict where the projectile will land.
Science Practices 1.4, 1.5, 2.1, 2.2, 3.1, 4.1, 4.2, 4.3, 5.3, 6.1, 6.4, 7.2

6. Chase Scenario (GI) [CR6b]
Lab Practicum: Students use a battery cart and a fan cart to recreatea chase scenario (police-thief) to predict the position where the ‘thief’ will be caught and the final speeds of both cars.
Science Practices 1.1, 1.2, 1.4, 1.5, 2.1, 2.2, 3.1, 3.2, 3.3, 4.1, 4.2, 4.3, 5.1, 5.2, 5.3, 6.1, 6.2, 6.4, 7.2

UNIT 2.DYNAMICS [CR6a]
7. Inertial and Gravitational Mass (GI) [CR6b]
To determine the difference (if any) between inertial mass and gravitational mass.
Science Practices 1.4, 2.1, 2.2, 3.1, 4.1, 4.2, 4.3, 5.3, 6.1, 6.4, 7.2

8. Forces Inventory (GI) [CR6b]
Qualitative and quantitative investigation on a variety of interactions between objects.
Science Practices 1,1, 1.4, 1.5, 2.1, 2.2, 3.3, 4.1, 4.2, 4.3, 5.1, 6.1, 6.2, 6.4, 7.2

9. Static Equilibrium Challenge
To determine the mass of a hanging object in a setup with three strings at various angles.
Science Practices 1.1, 1.4, 2.1, 2.2, 3.1, 4.1, 4.2, 4.3, 5.1, 5.3, 6.1, 6.4, 7.2
10. Newton’s Second Law (OI) [CR6b]
To determine the variation of the acceleration of a dynamics cart in two scenarios: (1) the total mass of the system is kept constant while the net force varies, and (2) the net force is kept constant while the total mass of the system varies.
Science Practices 1.1, 1.4, 1.5, 2.1, 2.2, 3.1, 3.2, 3.3, 4.1, 4.2, 4.3, 5.1, 5.2, 5.3, 6.1, 6.2, 6.4, 7.2

11. Coefficient of Friction (GI) [CR6b]
To determine the maximum coefficient of static friction between a shoe and a wooden plank.
Science Practices 1.1, 1.4, 1.5, 2.1, 2.2, 3.1, 4.1, 4.2, 4.3, 5.3, 6.1, 6.4, 7.2

12. Atwood's Machine (GI) [CR6b]
To determine the acceleration of a hanging mass and the tension in the string.
Science Practices 1.1, 1.4, 1.5, 2.1, 2.2, 3.1, 4.1, 4.2, 4.3, 5.3, 6.1, 6.4, 7.2

UNIT 3.
CIRCULAR MOTIONAND GRAVITATION [CR6a]
13. Flying Toy (GI) [CR6b]
To determine the tension in the string and the centripetal acceleration of the flying toy.
Science Practices 1.1, 1.2, 1.4, 1.5, 2.1, 2.2, 3.1, 4.1, 4.2, 4.3, 5.3, 6.1, 6.4, 7.2

UNIT 4. ENERGY[CR6a]
14. Roller Coaster Investigation (GI) [CR6b]
To design a simple roller coaster using provided materials to test whether the total energy of the system is conserved if there are no external forces exerted on it by other objects.
Science Practices 1.1, 1.2, 1.3, 1.4, 1.5, 2.1, 2.2, 3.1, 4.1, 4.2, 4.3, 5.3, 6.1, 6.2, 6.4, 7.2

15. Work Done in Stretching a Spring (GI) [CR6b]
To determine the work done on the spring from force-versus-distance graph of the collected data.
Science Practices 1.1, 1.2, 1.3, 1.4, 1.5, 2.1, 2.2, 3.1, 4.1, 4.2, 4.3, 5.3, 6.1, 6.4, 7.2

16. Energy and Non-Conservative Forces (GI) [CR6b]
To determine the energy dissipated by friction of a system consisting of a modified Atwood's machine.
Science Practices 1.1, 1.2, 1.3, 1.4, 1.5, 2.1, 2.2, 3.1, 4.1, 4.2, 4.3, 5.3, 6.1, 6.4, 6.5, 7.2

UNIT 5.MOMENTUM[CR6a]
17. Bumper Design (GI) [CR6b]
To design a paper bumper that will soften the impact of the collision between a cart and a fixed block of wood. Their designs are evaluated by the shape of an acceleration-versus-time graph of the collision.
Science Practices 1.4, 2.1, 2.2, 3.1, 3.2, 4.1, 4.2, 4.3, 5.1, 5.2, 5.3, 6.1, 6.2, 6.4, 7.2

18. Impulse and Change in Momentum (GI) [CR6b]
To measure the change in momentum of a dynamics cart and compare it to the impulse received.
Science Practices 1.1, 1.2, 1.3, 1.4, 1.5, 2.1, 2.2, 3.1, 4.1, 4.2, 4.3, 5.1, 5.3, 6.1, 6.4, 7.2

19. Elastic and Inelastic Collisions (OI) [CR6b]
To investigate conservation of momentum and conservation of energy using a ballistic pendulum to determine the type of collision.
Science Practices 1.1, 1.2, 1.3, 1.4, 1.5, 2.1, 2.2, 3.1, 4.1, 4.2, 4.3, 5.1, 5.2, 5.3, 6.1, 6.2, 6.4, 7.2

20. Forensic Investigation (OI) [CR6b]
Lab Practicum: Apply principles of conservation of energy, conservation of momentum, the work-energy theorem, and a linear model of friction to find the coefficient of kinetic friction.
Science Practices 1.1, 1.2, 1.4, 1.5, 2.1, 2.2, 3.1, 3.2, 3.3, 4.1, 4.2, 4.3, 5.1, 5.2, 5.3, 6.1, 6.2, 6.4, 7.2

UNIT 6. SIMPLE HARMONIC MOTION [CR6a]
21. Finding the Spring Constant (GI) [CR6b]
To design two independent experiments to determine the spring constants of various springs of equal length.
Science Practices 1.1, 1.4, 2.1, 2.2, 3.1, 4.1, 4.2, 4.3, 5.3, 6.1, 6.4, 7.2

22. Graphs of an Oscillating System (GI) [CR6b]
To analyze graphs of position, velocity, and acceleration versus time for an oscillating system to determine how velocity and acceleration vary at the equilibrium position and at the endpoints.
Science Practices 1.1, 1.2, 1.4, 1.5, 2.1, 2.2, 3.1, 4.1, 4.2, 4.3, 5.1, 5.3, 6.1, 6.4, 7.2

23. Simple Pendulum Investigation (GI) [CR6b]
To investigate the factors that affect the period of a simple pendulum and test whether the period is proportional to the pendulum's length, the square of its length, or the square root of its length.
Science Practices 1.2, 1.4, 2.1, 2.2, 2.3, 3.1, 3.2, 3.3, 4.1, 4.2, 4.3, 5.1, 5.3, 6.1, 6.4, 7.2

UNIT 7. ROTATIONAL MOTION [CR6a]
24. Torque and the Human Arm (OI) [CR6b]
To design and build an apparatus that replicates the forearm and biceps muscle system to determine the biceps tension when holding an object in a lifted position.
Science Practices 1.1, 1.2, 1.4, 1.5, 2.1, 2.2, 3.1, 4.1, 4.2, 4.3, 5.1, 5.2, 5.3, 6.1, 6.2, 6.4, 7.1, 7.2

25. Rotational Inertia (GI) [CR6b]
To determine the rotational inertia of a cylinder from the slope of a graph of an applied torque versus angular acceleration.
Science Practices 1.1, 1.2, 1.4, 1.5, 2.1, 2.2, 3.1, 4.1, 4.2, 4.3, 5.1, 5.3, 6.1, 6.4, 7.2

26. Conservation of Angular Momentum (GI) [CR6b]
To investigate how the angular momentum of a rotating system responds to changes in the rotational inertia.
Science Practices 1.1, 1.2, 1.4, 1.5, 2.1, 2.2, 3.1, 4.1, 4.2, 4.3, 5.1, 5.3, 6.1, 6.4, 7.2

UNIT 8.MECHANICAL WAVES [CR6a]
27. Mechanical Waves (GI) [CR6b]
To model the two types of mechanical waves with a spring toy to test whether or not these characteristics affect the speed of a pulse: frequency, wavelength, and amplitude.

Science Practices 1.2, 2.1, 2.2, 3.1, 4.1, 4.2, 4.3, 5.1, 5.3, 6.1, 6.2, 6.4, 7.2

28. Speed of Sound (GI) [CR6b]
Design two different procedures to determine the speed of sound in air.
Science Practices 1.1, 1.2, 1.4, 1.5, 2.1, 2.2, 3.1, 4.1, 4.2, 4.3, 5.3, 6.1, 6.4, 7.2

29. Wave Boundary Behavior (GI) [CR6b]
To compare what happens to the phase of a transverse wave on a spring toy when a pulse is reflected from a boundary and when it is reflected and transmitted from various boundaries (spring to string).
Science Practices 1.4, 3.1, 4.1, 4.2, 4.3, 5.1, 6.1, 6.4, 7.2

30. Standing Waves (GI) [CR6b]
Given a specified tension, students predict the length of the string necessary to generate the first two harmonics of a standing wave on the string. Then they perform the experiment and compare the outcome with their prediction.
Science Practices 1.1, 1.2, 1.4, 1.5, 2.1, 2.2, 3.1, 4.1, 4.2, 4.3, 5.1, 5.3, 6.1, 6.4, 7.2

UNIT 9. ELECTROSTATICS [CR6a]
31. Static Electricity Interactions (GI) [CR6b]
Students use sticky tape and a variety of objects to make qualitative observations of the interactions when objects are charged, discharged, and recharged.
Science Practices 1.2, 3.1, 4.1, 4.2, 5.1, 6.2, 7.2

32. Coulomb's Law (GI) [CR6b]
To estimate the charge on two identical, equally charged spherical pith balls of known mass.
Science Practices 1.1, 1.2, 1.4, 1.5, 2.1, 2.2, 3.1, 4.1, 4.2, 4.3, 5.1, 5.3, 6.1, 6.4, 7.2

UNIT 10. DC CIRCUITS [CR6a]
33. Brightness Investigation (GI) [CR6b]
To make predictions about the brightness of light bulbs in a variety of series and parallel circuits when some of the bulbs are removed.
Science Practices 1.2, 3.1, 4.1, 4.2, 4.3, 5.3, 6.1, 6.4, 7.2
34. Voltage and Current (GI) [CR6b]
To determine the relationship between the current through a resistor and the voltage across the resistor.
Science Practices 1.1, 1.2, 1.4, 1.5, 2.1, 2.2, 3.1, 4.1, 4.2, 4.3, 5.1, 5.3, 6.1, 6.4, 7.2

35. Resistance and Resistivity (GI) [CR6b]
To investigate the effects of cross-sectional area and length on the flow of current through a roll of Play-Doh.
Science Practices 1.4, 2.1, 2.2, 3.1, 4.1, 4.2, 4.3, 5.1,5.3, 6.1, 6.4, 7.2

36. Series and Parallel Circuits (GI) [CR6b]

To investigate the behavior of resistors in series, parallel, and series-parallel circuits. The lab should include measurements of voltage and current.
Science Practices 1.1, 1.2, 1.4, 1.5, 2.1, 2.2, 3.1, 4.1, 4.2, 4.3, 5.1, 5.2, 5.3, 6.1, 6.4, 7.2

INSTRUCTIONAL ACTIVITIES
Throughout the course, the students engage in a variety of activities designed to build the students' reasoning skills and deepen their conceptual understanding of physics principles. Students conduct activities and projects that enable them to connect the concepts learned in class to real world applications. Examples of activities are described below.

1. PROJECT DESIGN [CR3]
Students engage in hands-on activities outside of the laboratory experience that support the connection to more than one Learning Objective.

ACTIVITY: Roller Coaster Investigation
DESCRIPTION:Working in groups of three, students design a simple roller coaster using provided materials (a track with a vertical loop and toy cars) to test whether the total energy of a car-Earth system is conserved if there are no external forces exerted on it by other objects. Students include multiple representations of energy to provide evidence for their claims. Students use a bar chart, the mathematical expression of conservation of energy represented by the graph, and the corresponding calculations to evaluate whether the outcome of the experiment supports the idea of energy conservation. This activity is designed to allow students to apply the following Learning

Objectives: 5.B.3.1, 5.B.3.2, 5.B.3.3, 5.B.4.2, 4.C.1.1, 4.C.1.2

2. REAL WORLD APPLICATION
ACTIVITY: Torque and the Human Arm [CR4]
DESCRIPTION: This activity provides an opportunity for students to make an interdisciplinary
connection to biological systems by investigating the structure and function of a major muscle (biceps) in the human body. Students design and build an apparatus that replicates the forearm and biceps muscle system. The objective is to determine the biceps tension when holding an object in a lifted position. Students may use the Internet to research the structure of the biceps muscle. They can use readily available materials in the classroom, such as a meter stick, a ring stand, weight hangers, an assortment of blocks, and a spring scale. In their lab journal, students are required to document the different stages of their design. Required elements include design sketches, force diagrams, mathematical representations of translational and rotational equilibrium, and numerical calculations.
Learning Objective 3.F.1.1, 3.F.1.2, 3.F.1.3, 3.F.1.4, 3.F.1.5

3. SCIENTIFIC ARGUMENTATION
In the course, students become familiar with the three components of scientific argumentation. The first element is the claim, which is the response to a prediction.

A claim provides an explanation for why or how something happens in a laboratory investigation. The second component is the evidence, which supports the claim and consists of the analysis of the data collected during the investigation. The third component consists of questioning, in which students examine and defend one another's
claims. Students receive explicit instruction in posing meaningful questions that include questions of clarification, questions that probe assumptions, and questions that probe implications and consequences. As a result of the scientific argumentation process, students are able to revise their claims and make revisions as appropriate [CR8].

ACTIVITY 1: Formative Assessment: Changing Representations in Energy
DESCRIPTION: Students work in pairs to create exercises that involve translation from one representation to another. Some possible translations are:
• from a bar chart to a mathematical representation
• from a physical situation diagram to a bar chart
• from a given equation to a bar chart
Each pair of students exchanges their exercises with another pair. After the students work through the exercises they received, the pairs meet and offer constructive criticism (peer critique) on each other's solutions.
Learning Objective 5.B.4.1, 5.B.4.2

ACTIVITY 2. Laboratory Investigation: Speed of Sound
DESCRIPTION: Working in small groups, students design two different procedures to determine
the speed of sound in air. They brainstorm their approaches and write them on the whiteboard. Each of the teams presents their ideas to the class. They receive feedback from their peers and then conduct their experiments. They record the revised procedures in their lab journals. During the post-lab discussion, the students discuss their results (evidence) by examining and defending one another's claims. Then as a class we reach consensus about the estimated value for the speed of sound.
Learning Objective 6.A.2.1, 6.A.4.1, 6.B.4.1

LEARNING OBJECTIVES AP PHYSICS 1

KINEMATICS

3.A.1.1 : The student is able to express the motion of an object using narrative, mathematical, and graphical representations. **[SP 1.5, 2.1, 2.2]**
3.A.1.2 : The student is able to design an experimental investigation of the motion of an object. **[SP 4.2] 3.A.1.3:** The student is able to analyze experimental data describing the motion of an object and is able to express the results of the analysis using narrative, mathematical, and graphical representations. **[SP 5.1]**

DYNAMICS

1.C.1.1: The student is able to design an experiment for collecting data to determine the relationship between the net force exerted on an object, its inertial mass, and its acceleration. **[SP 4.2]**
1.C.3.1: The student is able to design a plan for collecting data to measure gravitational mass and to measure inertial mass, and to distinguish between the two experiments. **[SP 4.2]**
2.B.1.1: The student is able to apply $\vec{F} = m\vec{g}$ to calculate the gravitational force on an object with mass *m* in a gravitational field of strength *g* in the context of the effects of a net force on objects and systems. **[SP 2.2, 7.2] 3.A.2.1:** The student is able to represent forces in diagrams or mathematically using appropriately labeled vectors with magnitude, direction, and units during the analysis of a situation. **[SP 1.1]**
3.A.3.1 : The student is able to analyze a scenario and make claims (develop arguments, justify assertions) about the forces exerted on an object by other objects for different types of forces or components of forces. **[SP 6.4, 7.2]**
3.A.3.2 : The student is able to challenge a claim that an object can exert a force on itself. **[SP 6.1] 3.A.3.3:** The student is able to describe a force as an interaction between two objects and identify both objects for any force. **[SP 1.4]**
3.A.4.1 : The student is able to construct explanations of physical situations involving the interaction of bodies using Newton's third law and the representation of action--- reaction pairs of forces. **[SP 1.4, 6.2]**
3.A.4.2 : The student is able to use Newton's third law to make claims and predictions about the action--- reaction pairs of forces when two objects interact. **[SP 6.4, 7.2]**
3.A.4.3 : The student is able to analyze situations involving interactions among several objects by using free--- body diagrams that include the application of Newton's third law to identify forces. **[SP 1.4]**
3.B.1.1 : The student is able to predict the motion of an object subject to forces exerted by several objects using an application of Newton's second law in a variety of physical situations with acceleration in one dimension. **[SP 6.4, 7.2]**
3.B.1.2 : The student is able to design a plan to collect and analyze data for motion (static, constant, or accelerating) from force measurements and carry out an analysis to determine the relationship between the net force and the vector sum of the individual forces. **[SP 4.2, 5.1]**

3.B.1.3 : The student is able to reexpress a free---body diagram representation into a mathematical representation and solve the mathematical representation for the acceleration of the object. **[SP 1.5, 2.2] 3.B.2.1:** The student is able to create and use free---body diagrams to analyze physical situations to solve problems with motion qualitatively and quantitatively. **[SP 1.1, 1.4, 2.2]**
3.C.4.1 : The student is able to make claims about various contact forces between objects based on the microscopic cause of those forces. **[SP 6.1]**
3.C.4.2 : The student is able to explain contact forces (tension, friction, normal, buoyant, spring) as arising from interatomic electric forces and that they therefore have certain directions. **[SP 6.2]**
4.A.2.1 : The student is able to make predictions about the motion of a system based on the fact that acceleration is equal to the change in velocity per unit time, and velocity is equal to the change in position per unit time. **[SP 6.4]**
4.A.2.2 : The student is able to evaluate using given data whether all the forces on a system or whether all the parts of a system have been identified. **[SP 5.3]**
4.A.2.3 : The student is able to create mathematical models and analyze graphical relationships for acceleration, velocity, and position of the center of mass of a system and use them to calculate properties of the motion of the center of mass of a system. **[SP 1.4, 2.2]**
4.A.3.1 **:** The student is able to apply Newton's second law to systems to calculate the change in the center---of--- mass velocity when an external force is exerted on the system. **[SP 2.2]**
4.A.3.2 **:** The student is able to use visual or mathematical representations of the forces between objects in a system to predict whether or not there will be a change in the center---of---mass velocity of that system. **[SP 1.4]**

CIRCULAR MOTION AND GRAVITATION
1.C.1.1: The student is able to design an experiment for collecting data to determine the relationship between the net force exerted on an object, its inertial mass, and its acceleration. **[SP 4.2]**
1.C.3.1: The student is able to design a plan for collecting data to measure gravitational mass and to measure inertial mass, and to distinguish between the two experiments. **[SP 4.2]**
2.B.1.1: The student is able to apply $\vec{F}=m\vec{g}$ to calculate the gravitational force on an object with mass m in a gravitational field of strength g in the context of the effects of a net force on objects and systems. **[SP 2.2, 7.2] 2.B.2.1:** The student is able to apply g = G ! to calculate the gravitational field due to an object with mass *M*, !! where the field is a vector directed toward the center of the object of mass *M*. **[SP 2.2]**
2.B.2.2: The student is able to approximate a numerical value of the gravitational field (*g*) near the surface of an object from its radius and mass relative to those of the Earth or other reference objects. **[SP 2.2]**
3.A.2.1: The student is able to represent forces in diagrams or mathematically using appropriately labeled vectors with magnitude, direction, and units during the analysis of a situation. **[SP 1.1]**

3.A.3.1 : The student is able to analyze a scenario and make claims (develop arguments, justify assertions) about the forces exerted on an object by other objects for different types of forces or components of forces. **[SP 6.4, 7.2]**
3.A.3.2 : The student is able to challenge a claim that an object can exert a force on itself. **[SP 6.1] 3.A.3.3:** The student is able to describe a force as an interaction between two objects and identify both objects for any force. **[SP 1.4]**
3.A.4.1 **:** The student is able to construct explanations of physical situations involving the interaction of bodies using Newton's third law and the representation of action---reaction pairs of forces. **[SP 1.4, 6.2]**
3.A.4.2 **:** The student is able to use Newton's third law to make claims and predictions about the action--- reaction pairs of forces when two objects interact. **[SP 6.4, 7.2]**
3.A.4.3 **:** The student is able to analyze situations involving interactions among several objects by using free--- body diagrams that include the application of Newton's third law to identify forces. **[SP 1.4]**
3.B.1.3: The student is able to reexpress a free---body diagram representation into a mathematical representation and solve the mathematical representation for the acceleration of the object. **[SP 1.5, 2.2] 3.B.2.1:** The student is able to create and use free---body diagrams to analyze physical situations to solve problems with motion qualitatively and quantitatively. **[SP 1.1, 1.4, 2.2]**
3.C.1.1 : The student is able to use Newton's law of gravitation to calculate the gravitational force the two objects exert on each other and use that force in contexts other than orbital motion. **[SP 2.2]**
3.C.1.2 : The student is able to use Newton's law of gravitation to calculate the gravitational force between two objects and use that force in contexts involving orbital motion **[SP 2.2]**
3.C.2.2: The student is able to connect the concepts of gravitational force and electric force to compare similarities and differences between the forces. **[SP 7.2]**
3.C.4.1 : The student is able to make claims about various contact forces between objects based on the microscopic cause of those forces. **[SP 6.1]**
3.C.4.2 : The student is able to explain contact forces (tension, friction, normal, buoyant, spring) as arising from interatomic electric forces and that they therefore have certain directions. **[SP 6.2]**
3.G.1.1: The student is able to articulate situations when the gravitational force is the dominant force and when the electromagnetic, weak, and strong forces can be ignored. **[SP 7.1]**
4.A.2.2: The student is able to evaluate using given data whether all the forces on a system or whether all the parts of a system have been identified. **[SP 5.3]**

ENERGY
3.E.1.1 : The student is able to make predictions about the changes in kinetic energy of an object based on considerations of the direction of the net force on the object as the object moves. **[SP 6.4, 7.2]**
3.E.1.2 : The student is able to use net force and velocity vectors to determine qualitatively whether kinetic energy of an object would increase, decrease, or

remain unchanged. **[SP 1.4]**
3.E.1.3 : The student is able to use force and velocity vectors to determine qualitatively or quantitatively the net force exerted on an object and qualitatively whether kinetic energy of that object would increase, decrease, or remain unchanged. **[SP 1.4, 2.2]**
3.E.1.4 : The student is able to apply mathematical routines to determine the change in kinetic energy of an object given the forces on the object and the displacement of the object. **[SP 2.2]**
4.C.1.1 : The student is able to calculate the total energy of a system and justify the mathematical routines used in the calculation of component types of energy within the system whose sum is the total energy. **[SP 1.4, 2.1, 2.2]**
4.C.1.2 : The student is able to predict changes in the total energy of a system due to changes in position and speed of objects or frictional interactions within the system. **[SP 6.4]**
4.C.2.1 : The student is able to make predictions about the changes in the mechanical energy of a system when a component of an external force acts parallel or antiparallel to the direction of the displacement of the center of mass. **[SP 6.4]**
4.C.2.2 : The student is able to apply the concepts of Conservation of Energy and the Work---Energy theorem to determine qualitatively and/or quantitatively that work done on a two---object system in linear motion will change the kinetic energy of the center of mass of the system, the potential energy of the systems, and/or the internal energy of the system. **[SP 1.4, 2.2, 7.2]**
5.A.2.1: The student is able to define open and closed systems for everyday situations and apply conservation concepts for energy, charge, and linear momentum to those situations. **[SP 6.4, 7.2]**
5.B.1.1 : The student is able to set up a representation or model showing that a single object can only have kinetic energy and use information about that object to calculate its kinetic energy. **[SP 1.4, 2.2]**
5.B.1.2 : The student is able to translate between a representation of a single object, which can only have kinetic energy, and a system that includes the object, which may have both kinetic and potential energies**. [SP 1.5]**
5.B.2.1: The student is able to calculate the expected behavior of a system using the object model (i.e., by ignoring changes in internal structure) to analyze a situation. Then, when the model fails, the student can justify the use of conservation of energy principles to calculate the change in internal energy due to changes in internal structure because the object is actually a system. **[SP 1.4, 2.1]**
5.B.3.1 : The student is able to describe and make qualitative and/or quantitative predictions about everyday examples of systems with internal potential energy. **[SP 2.2, 6.4, 7.2]**
5.B.3.2 : The student is able to make quantitative calculations of the internal potential energy of a system from a description or diagram of that system. **[SP 1.4, 2.2]**
5.B.3.3 : The student is able to apply mathematical reasoning to create a description of the internal potential energy of a system from a description or diagram of the objects and interactions in that system. **[SP 1.4, 2.2] 5.B.4.1:** The student is able to describe and make predictions about the internal energy of systems. **[SP 6.4, 7.2]**

5.B.4.2: The student is able to calculate changes in kinetic energy and potential energy of a system, using information from representations of that system. **[SP 1.4, 2.1, 2.2]**
5.B.5.1 : The student is able to design an experiment and analyze data to examine how a force exerted on an object or system does work on the object or system as it moves through a distance. **[SP 4.2, 5.1]**
5.B.5.2 : The student is able to design an experiment and analyze graphical data in which interpretations of the area under a force---distance curve are needed to determine the work done on or by the object or system. **[SP 4.2, 5.1]**
5.B.5.3 : The student is able to predict and calculate from graphical data the energy transfer to or work done on an object or system from information about a force exerted on the object or system through a distance. **[SP 1.4, 2.2, 6.4]**
5.B.5.4 : The student is able to make claims about the interaction between a system and its environment in which the environment exerts a force on the system, thus doing work on the system and changing the energy of the system (kinetic energy plus potential energy). **[SP 6.4, 7.2]**
5.B.5.5 : The student is able to predict and calculate the energy transfer to (i.e., the work done on) an object or system from information about a force exerted on the object or system through a distance. **[SP 2.2, 6.4] 5.D.1.1:** The student is able to make qualitative predictions about natural phenomena based on conservation of linear momentum and restoration of kinetic energy in elastic collisions. **[SP 6.4, 7.2]**
5.D.1.2 : The student is able to apply the principles of conservation of momentum and restoration of kinetic energy to reconcile a situation that appears to be isolated and elastic, but in which data indicate that linear momentum and kinetic energy are not the same after the interaction, by refining a scientific question to identify interactions that have not been considered. Students will be expected to solve qualitatively and/or quantitatively for one---dimensional situations and only qualitatively in two---dimensional situations. **[SP 2.2, 3.2, 5.1, 5.3]**
5.D.1.3 : The student is able to apply mathematical routines appropriately to problems involving elastic collisions in one dimension and justify the selection of those mathematical routines based on conservation of momentum and restoration of kinetic energy. **[SP 2.1, 2.2]**
5.D.1.4 : The student is able to design an experimental test of an application of the principle of the conservation of linear momentum, predict an outcome of the experiment using the principle, analyze data generated by that experiment whose uncertainties are expressed numerically, and evaluate the match between the prediction and the outcome. **[SP 4.2, 5.1, 5.3, 6.4]**
5.D.1.5 : The student is able to classify a given collision situation as elastic or inelastic, justify the selection of conservation of linear momentum and restoration of kinetic energy as the appropriate principles for analyzing an elastic collision, solve for missing variables, and calculate their values. **[SP 2.1, 2.2]**
5.D.2.1: The student is able to qualitatively predict, in terms of linear momentum and kinetic energy, how the outcome of a collision between two objects changes depending on whether the collision is elastic or inelastic. **[SP 6.4, 7.2]**
5.D.2.3: The student is able to apply the conservation of linear momentum to a

closed system of objects involved in an inelastic collision to predict the change in kinetic energy. **[SP 6.4, 7.2]**

MOMENTUM

3.D.1.1: The student is able to justify the selection of data needed to determine the relationship between the direction of the force acting on an object and the change in momentum caused by that force. **[SP 4.1] 3.D.2.1:** The student is able to justify the selection of routines for the calculation of the relationships between changes in momentum of an object, average force, impulse, and time of interaction. **[SP 2.1]**

3.D.2.2 : The student is able to predict the change in momentum of an object from the average force exerted on the object and the interval of time during which the force is exerted. **[SP 6.4]**

3.D.2.3 : The student is able to analyze data to characterize the change in momentum of an object from the average force exerted on the object and the interval of time during which the force is exerted. **[SP 5.1]**

3.D.2.4 : The student is able to design a plan for collecting data to investigate the relationship between changes in momentum and the average force exerted on an object over time. **[SP 4.2]**

4.B.1.1 **:** The student is able to calculate the change in linear momentum of a two---object system with constant mass in linear motion from a representation of the system (data, graphs, etc.). **[SP 1.4, 2.2]**

4.B.1.2 **:** The student is able to analyze data to find the change in linear momentum for a constant---mass system using the product of the mass and the change in velocity of the center of mass. **[SP 5.1]**

4.B.2.1 : The student is able to apply mathematical routines to calculate the change in momentum of a system by analyzing the average force exerted over a certain time on the system. **[SP 2.2]**

4.B.2.2 : The student is able to perform analysis on data presented as a force---time graph and predict the change in momentum of a system. **[SP 5.1]**

5.A.2.1: The student is able to define open and closed systems for everyday situations and apply conservation concepts for energy, charge, and linear momentum to those situations. **[SP 6.4, 7.2]**

5.D.1.1 : The student is able to make qualitative predictions about natural phenomena based on conservation of linear momentum and restoration of kinetic energy in elastic collisions. **[SP 6.4, 7.2]**

5.D.1.2 : The student is able to apply the principles of conservation of momentum and restoration of kinetic energy to reconcile a situation that appears to be isolated and elastic, but in which data indicate that linear momentum and kinetic energy are not the same after the interaction, by refining a scientific question to identify interactions that have not been considered. Students will be expected to solve qualitatively and/or quantitatively for one---dimensional situations and only qualitatively in two---dimensional situations. **[SP 2.2, 3.2, 5.1, 5.3]**

5.D.1.3 : The student is able to apply mathematical routines appropriately to problems involving elastic collisions in one dimension and justify the selection of those mathematical routines based on conservation of momentum and restoration of kinetic energy. **[SP 2.1, 2.2]**

5.D.1.4 : The student is able to design an experimental test of an application of the principle of the conservation of linear momentum, predict an outcome of the experiment using the principle, analyze data generated by that experiment whose uncertainties are expressed numerically, and evaluate the match between the prediction and the outcome. **[SP 4.2, 5.1, 5.3, 6.4]**

5.D.1.5 : The student is able to classify a given collision situation as elastic or inelastic, justify the selection of conservation of linear momentum and restoration of kinetic energy as the appropriate principles for analyzing an elastic collision, solve for missing variables, and calculate their values. **[SP 2.1, 2.2]**

5.D.2.1 The student is able to qualitatively predict, in terms of linear momentum and kinetic energy, how the outcome of a collision between two objects changes depending on whether the collision is elastic or inelastic. **[SP 6.4, 7.2]**

5.D.2.2 : The student is able to plan data collection strategies to test the law of conservation of momentum in a two---object collision that is elastic or inelastic and analyze the resulting data graphically. **[SP 4.1, 4.2, 5.1] 5.D.2.3:** The student is able to apply the conservation of linear momentum to a closed system of objects involved in an inelastic collision to predict the change in kinetic energy. **[SP 6.4, 7.2]**

5.D.2.4 : The student is able to analyze data that verify conservation of momentum in collisions with and without an external friction force. **[SP 4.1, 4.2, 4.4, 5.1, 5.3]**

5.D.2.5 : The student is able to classify a given collision situation as elastic or inelastic, justify the selection of conservation of linear momentum as the appropriate solution method for an inelastic collision, recognize that there is a common final velocity for the colliding objects in the totally inelastic case, solve for missing variables, and calculate their values**. [SP 2.1, 2.2]**

5.D.3.1: The student is able to predict the velocity of the center of mass of a system when there is no interaction outside of the system but there is an interaction within the system (i.e., the student simply recognizes that interactions within a system do not affect the center of mass motion of the system and is able to determine that there is no external force). **[SP 6.4]**

SIMPLE HARMONIC MOTION

3.B.3.1 : The student is able to predict which properties determine the motion of a simple harmonic oscillator and what the dependence of the motion is on those properties. **[SP 6.4, 7.2]**

3.B.3.2 : The student is able to design a plan and collect data in order to ascertain the characteristics of the motion of a system undergoing oscillatory motion caused by a restoring force. **[SP 4.2]**

3.B.3.3 : The student can analyze data to identify qualitative or quantitative relationships between given values and variables (i.e., force, displacement, acceleration, velocity, period of motion, frequency, spring constant, string length, mass) associated with objects in oscillatory motion to use that data to determine the value of an unknown. **[SP 2.2, 5.1]**

3.B.3.4 : The student is able to construct a qualitative and/or a quantitative explanation

of oscillatory behavior given evidence of a restoring force. **[SP 2.2, 6.2]**
5.B.2.1: The student is able to calculate the expected behavior of a system using the object model (i.e., by ignoring changes in internal structure) to analyze a situation. Then, when the model fails, the student can justify the use of conservation of energy principles to calculate the change in internal energy due to changes in internal structure because the object is actually a system. **[SP 1.4, 2.1]**
5.B.3.1 : The student is able to describe and make qualitative and/or quantitative predictions about everyday examples of systems with internal potential energy. **[SP 2.2, 6.4, 7.2]**
5.B.3.2 : The student is able to make quantitative calculations of the internal potential energy of a system from a description or diagram of that system. **[SP 1.4, 2.2]**
5.B.3.3 : The student is able to apply mathematical reasoning to create a description of the internal potential energy of a system from a description or diagram of the objects and interactions in that system. **[SP 1.4, 2.2] 5.B.4.1:** The student is able to describe and make predictions about the internal energy of systems. **[SP 6.4, 7.2]**
5.B.4.2: The student is able to calculate changes in kinetic energy and potential energy of a system, using information from representations of that system. **[SP 1.4, 2.1, 2.2]**

TORQUE AND ROTATIONAL MOTION
3.F.1.1: The student is able to use representations of the relationship between force and torque. **[SP 1.4] 3.F.1.2:** The student is able to compare the torques on an object caused by various forces. **[SP 1.4] 3.F.1.3:** The student is able to estimate the torque on an object caused by various forces in comparison to other situations. **[SP 2.3]**
3.F.1.4 : The student is able to design an experiment and analyze data testing a question about torques in a balanced rigid system. **[SP 4.1, 4.2, 5.1]**
3.F.1.5 : The student is able to calculate torques on a two---dimensional system in static equilibrium, by examining a representation or model (such as a diagram or physical construction). **[SP 1.4, 2.2]**
3.F.2.1 : The student is able to make predictions about the change in the angular velocity about an axis for an object when forces exerted on the object cause a torque about that axis. **[SP 6.4]**:
3.F.2.2 : The student is able to plan data collection and analysis strategies designed to test the relationship between a torque exerted on an object and the change in angular velocity of that object about an axis. **[SP 4.1, 4.2, 5.1]**
3.F.3.1 : The student is able to predict the behavior of rotational collision situations by the same processes that are used to analyze linear collision situations using an analogy between impulse and change of linear momentum and angular impulse and change of angular momentum. **[SP 6.4, 7.2]**
3.F.3.2 : In an unfamiliar context or using representations beyond equations, the student is able to justify the selection of a mathematical routine to solve for the change in angular momentum of an object caused by torques exerted on the object. **[SP 2.1]**
3.F.3.3 : The student is able to plan data collection and analysis strategies designed

to test the relationship between torques exerted on an object and the change in angular momentum of that object. **[SP 4.1, 4.2, 5.1, 5.3]**

4.A.1.1 The student is able to use representations of the center of mass of an isolated two---object system to analyze the motion of the system qualitatively and semiquantitatively. **[SP 1.2, 1.4, 2.3, 6.4]**

4.D.1.1 The student is able to describe a representation and use it to analyze a situation in which several forces exerted on a rotating system of rigidly connected objects change the angular velocity and angular momentum of the system. **[SP 1.2, 1.4]**

4.D.1.2 : The student is able to plan data collection strategies designed to establish that torque, angular velocity, angular acceleration, and angular momentum can be predicted accurately when the variables are treated as being clockwise or counterclockwise with respect to a well---defined axis of rotation, and refine the research question based on the examination of data. [**SP 3.2, 4.1, 4.2, 5.1, 5.3]**

4.D.2.1: The student is able to describe a model of a rotational system and use that model to analyze a situation in which angular momentum changes due to interaction with other objects or systems. **[SP 1.2, 1.4] 4.D.2.2:** The student is able to plan a data collection and analysis strategy to determine the change in angular momentum of a system and relate it to interactions with other objects and systems. **[SP 4.2]**

4.D.3.1 : The student is able to use appropriate mathematical routines to calculate values for initial or final angular momentum, or change in angular momentum of a system, or average torque or time during which the torque is exerted in analyzing a situation involving torque and angular momentum. **[SP 2.2]**

4.D.3.2 : The student is able to plan a data collection strategy designed to test the relationship between the change in angular momentum of a system and the product of the average torque applied to the system and the time interval during which the torque is exerted. **[SP 4.1, 4.2]**

5.E.1.1 : The student is able to make qualitative predictions about the angular momentum of a system for a situation in which there is no net external torque. **[SP 6.4, 7.2]**

5.E.1.2 : The student is able to make calculations of quantities related to the angular momentum of a system when the net external torque on the system is zero. **[SP 2.1, 2.2]**

5.E.2.1: The student is able to describe or calculate the angular momentum and rotational inertia of a system in terms of the locations and velocities of objects that make up the system. Students are expected to do qualitative reasoning with compound objects. Students are expected to do calculations with a fixed set of extended objects and point masses. **[SP 2.2]**

ELECTRIC CHARGE AND ELECTRIC FORCE

1.B.1.1 : The student is able to make claims about natural phenomena based on conservation of electric charge. **[SP 6.4]**

1.B.1.2 : The student is able to make predictions, using the conservation of electric charge, about the sign and relative quantity of net charge of objects or systems after various charging processes, including conservation of charge in simple circuits. **[SP**

6.4, 7.2]
1.B.2.1 The student is able to construct an explanation of the two---charge model of electric charge based on evidence produced through scientific practices. **[SP 6.2]**:
1.B.3.1: The student is able to challenge the claim that an electric charge smaller than the elementary charge has been isolated. **[SP 1.5, 6.1, 7.2]**
3.C.2.1 The student is able to use Coulomb's law qualitatively and quantitatively to make predictions about the interaction between two electric point charges. **[SP 2.2, 6.4]**
3.C.2.2 : The student is able to connect the concepts of gravitational force and electric force to compare similarities and differences between the forces. **[See SP 7.2]**
5.A.2.1: The student is able to define open and closed systems for everyday situations and apply conservation concepts for energy, charge, and linear momentum to those situations. **[SP 6.4, 7.2]**

DC CIRCUITS

1.B.1.1 : The student is able to make claims about natural phenomena based on conservation of electric charge. **[SP 6.4]**
1.B.1.2 : The student is able to make predictions, using the conservation of electric charge, about the sign and relative quantity of net charge of objects or systems after various charging processes, including conservation of charge in simple circuits. **[SP 6.4, 7.2]**
1.E.2.1 The student is able to choose and justify the selection of data needed to determine resistivity for a given material. **[SP 4.1]**
5.B.9.1 : The student is able to construct or interpret a graph of the energy changes within an electrical circuit with only a single battery and resistors in series and/or in, at most, one parallel branch as an application of the conservation of energy (Kirchhoff's loop rule). **[SP 1.1, 1.4]**
5.B.9.2 : The student is able to apply conservation of energy concepts to the design of an experiment that will demonstrate the validity of Kirchhoff's loop rule ($\sum\Delta V=0$) in a circuit with only a battery and resistors either in series or in, at most, one pair of parallel branches. **[SP 4.2, 6.4, 7.2]**
5.B.9.3 : The student is able to apply conservation of energy (Kirchhoff's loop rule) in calculations involving the total electric potential difference for complete circuit loops with only a single battery and resistors in series and/or in, at most, one parallel branch. **[SP 2.2, 6.4, 7.2]**
5.C.3.1 The student is able to apply conservation of electric charge (Kirchhoff's junction rule) to the comparison of electric current in various segments of an electrical circuit with a single battery and resistors in series and in, at most, one parallel branch and predict how those values would change if configurations of the circuit are changed. **[SP 6.4, 7.2]**:
5.C.3.2 The student is able to design an investigation of an electrical circuit with one or more resistors in which evidence of conservation of electric charge can be collected and analyzed. **[SP 4.1, 4.2, 5.1]** **5.C.3.3:** The student is able to use a description or schematic diagram of an electrical circuit to calculate unknown

values of current in various segments or branches of the circuit. **[SP 1.4, 2.2]**

MECHANICAL WAVES AND SOUND

6.A.1.1: The student is able to use a visual representation to construct an explanation of the distinction between transverse and longitudinal waves by focusing on the vibration that generates the wave. **[SP 6.2] 6.A.1.2:** The student is able to describe representations of transverse and longitudinal waves. **[SP 1.2] 6.A.2.1:** The student is able to describe sound in terms of transfer of energy and momentum in a medium and relate the concepts to everyday examples. **[SP 6.4, 7.2]**:

6.A.3.1: The student is able to use graphical representation of a periodic mechanical wave to determine the amplitude of the wave. **[SP 1.4]**

6.A.4.1: The student is able to explain and/or predict qualitatively how the energy carried by a sound wave relates to the amplitude of the wave, and/or apply this concept to a real---world example. **[SP 6.4]**

6.B.1.1: The student is able to use a graphical representation of a periodic mechanical wave (position versus time) to determine the period and frequency of the wave and describe how a change in the frequency would modify features of the representation. **[SP 1.4, 2.2]**

6.B.2.1: The student is able to use a visual representation of a periodic mechanical wave to determine wavelength of the wave. **[SP 1.4]**

6.B.4.1: The student is able to design an experiment to determine the relationship between periodic wave speed, wavelength, and frequency and relate these concepts to everyday examples. **[SP 4.2, 5.1, 7.2]**

6.B.5.1: The student is able to create or use a wave front diagram to demonstrate or interpret qualitatively the observed frequency of a wave, dependent upon relative motions of source and observer. **[SP 1.4]**

6.D.1.1 : The student is able to use representations of individual pulses and construct representations to model the interaction of two wave pulses to analyze the superposition of two pulses. **[SP 1.1, 1.4]**

6.D.1.2 : The student is able to design a suitable experiment and analyze data illustrating the superposition of mechanical waves (only for wave pulses or standing waves). **[SP 4.2, 5.1]**

6.D.1.3 : The student is able to design a plan for collecting data to quantify the amplitude variations when two or more traveling waves or wave pulses interact in a given medium. **[SP 4.2]**

6.D.2.1: The student is able to analyze data or observations or evaluate evidence of the interaction of two or more traveling waves in one or two dimensions (i.e., circular wave fronts) to evaluate the variations in resultant amplitudes. **[SP 5.1]**

6.D.3.1 : The student is able to refine a scientific question related to standing waves and design a detailed plan for the experiment that can be conducted to examine the phenomenon qualitatively or quantitatively. **[SP 2.1, 3.2, 4.2]**

6.D.3.2 : The student is able to predict properties of standing waves that result from the addition of incident and reflected waves that are confined to a region and have nodes and antinodes. **[SP 6.4]**

6.D.3.3 : The student is able to plan data collection strategies, predict the outcome based on the relationship under test, perform data analysis, evaluate evidence compared to the prediction, explain any discrepancy and, if necessary, revise the relationship among variables responsible for establishing standing waves on a string or in a column of air. **[SP 3.2, 4.1, 5.1, 5.2, 5.3]**

6.D.3.4 : The student is able to describe representations and models of situations in which standing waves result from the addition of incident and reflected waves confined to a region. **[SP 1.2]**

6.D.4.1 : The student is able to challenge with evidence the claim that the wavelengths of standing waves are determined by the frequency of the source regardless of the size of the region. **[SP 1.5, 6.1]**

6.D.4.2 The student is able to calculate wavelengths and frequencies (if given wave speed) of standing waves based on boundary conditions and length of region within which the wave is confined, and calculate numerical values of wavelengths and frequencies. Examples should include musical instruments. **[SP 2.2]**

6.D.5.1: The student is able to use a visual representation to explain how waves of slightly different frequency give rise to the phenomenon of beats. **[SP 1.2]**

Instructional Strategies and Assessment Information

Curriculum and assessment are connected by the teaching and learning that takes place day to day and year to year. The improvement of social studies achievement for all students requires effective teaching in all classrooms. Effective teaching means that students use a variety of processes to deepen their understanding, engage in thoughtful conversations and reflection, and connect previous learning and strategies to new knowledge. These processes on the following pages will be used in classrooms across the District

Vocabulary Instruction

A SIX-STEP PROCESS FOR TEACHING ACADEMIC VOCABULARY

1. Provide a description, explanation or example of the new term.
2. Ask students to restate the description, explanation, or example in their own words.
3. Ask students to construct a picture, symbol, or graphic representing the term or phrase.
4. Engage students periodically in activities that help them add to their knowledge of the terms in their notebooks.
5. Periodically ask students to discuss the terms with one another.
6. Involve students periodically in games that allow them to play with terms.

Source: *Building Academic Vocabulary, Marzano and Pickering, ASCD, 2005.*

School District of Holmen

Science Curriculum

Appendices
2016-17

Appendix A

Next Generation Science Standards

http://www.nextgenscience.org/

Appendix B

Bloom's Taxonomy

COGNITIVE DOMAIN VERBS					
Knowledge	**Comprehension**	**Application**	**Analysis**	**Synthesis**	**Evaluation**
Cite	Add	Acquire	Analyze	Abstract	Appraise
Count	Approximate	Adapt	Audit	Animate	Assess
Define	Articulate	Allocate	Blueprint	Arrange	Compare
Describe	Associate	Alphabetize	Breadboard	Assemble	Conclude
Draw	Characterize	Apply	Break down	Budget	Contrast
Enumerate	Clarify	Ascertain	Characterize	Categorize	Counsel
Identify	Classify	Assign	Classify	Code	Criticize
Index	Compare	Attain	Compare	Combine	Critique
Indicate	Compute	Avoid	Confirm	Compile	Defend
Label	Contrast	Back up	Contrast	Compose	Determine
List	Convert	Calculate	Correlate	Construct	Discriminate
Match	Defend	Capture	Detect	Cope	Estimate
Meet	Describe	Change	Diagnose	Correspond	Evaluate
Name	Detail	Classify	Diagram	Create	Explain
Outline	Differentiate	Complete	Differentiate	Cultivate	Grade
Point	Discuss	Compute	Discriminate	Debug	Hire
Quote	Distinguish	Construct	Dissect	Depict	Interpret
Read	Elaborate	Customize	Distinguish	Design	Judge
Recall	Estimate	Demonstrate	Document	Develop	Justify
Recite	Example	Depreciate	Ensure	Devise	Measure
Recognize	Explain	Derive	Examine	Dictate	Predict
Record	Express	Determine	Explain	Enhance	Prescribe
Repeat	Extend	Diminish	Explore	Explain	Rank
Reproduce	Extrapolate	Discover	Figure out	Facilitate	Rate
Review	Factor	Draw	File	Format	Recommend
Select	Generalize	Employ	Group	Formulate	Release
State	Give	Examine	Identify	Generalize	Select
Study	Infer	Exercise	Illustrate	Generate	Summarize
Tabulate	Interact	Explore	Infer	Handle	Support
Trace	Interpolate	Expose	Interrupt	Import	Test
Write	Interpret	Express	Inventory	Improve	Validate
	Observe	Factor	Investigate	Incorporate	Verify
	Paraphrase	Figure	Lay out	Integrate	
	Picture graphically	Graph	Manage	Interface	
	Predict	Handle	Maximize	Join	
	Review	Illustrate	Minimize	Lecture	
	Rewrite	Interconvert	Optimize	Model	
	Subtract	Investigate	Order	Modify	
	Summarize	Manipulate	Outline	Network	
	Translate	Modify	Point out	Organize	
	Visualize	Operate	Prioritize	Outline	
		Personalize	Proofread	Overhaul	
		Plot	Query	Plan	
		Practice	Relate	Portray	
		Predict	Select	Prepare	
		Prepare	Separate	Prescribe	
		Price	Size up	Produce	
		Process	Subdivide	Program	
		Produce	Summarize	Rearrange	
		Project	Train	Reconstruct	
		Protect	Transform	Reference	
		Provide		Relate	
		Relate		Reorganize	
		Round off		Revise	
		Sequence		Rewrite	
		Show		Specify	
		Simulate		Summarize	
		Sketch		Write	
		Solve			
		Subscribe			
		Tabulate			
		Transcribe			
		Translate			
		Use			

Appendix B (continued)

School District of Holmen
Bloom's Taxonomy

Affective Domain Verbs				
Receiving	**Responding**	**Valuing**	**Organization**	**Internalization**
Ask Choose Follow Give Hold Select Show interest	Accept responsibility Answer Assist Be willing to comply Conform Enjoy Greet Help Obey Perform Practice Present Report Select Tell	Associate with Assume responsibility Believe in Be convinced Complete Describe Differentiate Have faith in Initiate Invite Join Justify Participate Propose Select Share Subscribe to Work	Adhere to Alter Arrange Classify Combine Defend Establish Form judgments Identify with Integrate Organize Weigh alternatives	Act Change behavior Develop code of behavior Develop philosophy Influence Judge problems / issues Listen Propose Qualify Question Serve Show mature attitude Solve Verify

Psychomotor Domain Verbs			
Activate	Correct	Loosen	Transfer
Adjust	Create	Make	Troubleshoot
Align	Demonstrate	Manipulate	Tune
Apply	Design	Mend	Turn on/off
Arrange	Dismantle	Mix	Type
Assemble	Drill	Nail	Saw
Balance	Fasten	Operate	Sharpen
Break down	Fix	Paint	Set
Build	Follow	Press	Sew
Calibrate	Grind	Produce	Sketch
Change	Grip	Pull	Start
Clean	Hammer	Push	Stir
Close	Heat	Remove	Use
Combine	Hook	Repair	Weigh
Compose	Identify	Replace	Wrap
Connect	Load	Rotate	
Construct	Locate	Sand	

Appendix C

Glossary of Terms

alternative assessment – Assessments that ask students to construct, perform, or demonstrate their learning in manner that allows for a full understanding of their learning to be measured. Also termed performance assessment.

authentic assessment – Assessment that takes place in a real-life context or one that approximates how the skill or knowledge would be used in the "real world".

benchmark or target – Assessments administered throughout the school year to give teachers formative feedback on how their students are performing. A benchmark is the target at any particular time.

common assessment – An assessment given by two or more instructors with the intention of collaboratively examining the results for instructional planning for individual students and curriculum instruction, and/or assessment modifications.

content standards – Those standards that describe the information or skills children should learn that are specific to a particular discipline or content area.

course standards – Statements that define what students at a specific school level or in a specific course should achieve by the time they leave that particular level of school.

exit standards - The academic standards that students should achieve by the time they graduate from high school; these standards set the tone and give focus for what students should learn at the underlying grade levels.

formative assessment – This is an assessment **for** learning and is a check of understanding and application so that, if need be, adjustments can be made to the teaching and learning activities. These are often frequent and ongoing assessments. The results are used to gain an understanding of what students know and do not know to make responsive changes in teaching and learning. Benchmarks are clearly defined in order to provide interventions/enrichments.

lesson standards – Statements that define goals for instruction and students' learning over the course of a lesson.

performance – Observable affective or psychomotor behaviors demonstrated by students.

performance indicators – The part of the content standard that defines the skill or performance desired for students to demonstrate.

performance standards- The measure of how well students know and are able to work with (apply) the desired content standards. The standards describe what students must do, and how well they must do this, in order to show they have achieved the content standard.

performance task – used interchangeably with alternative assessment task and performance assessment task; those specific assessment tasks that require students to apply or do something with their learning in order to show their progress toward meeting desired standards.

portfolio – A collection of a student's work over time that demonstrates his or her progress toward the attainment of specific learning standards.

program standards – Broad statements that delineate the overall K-12 goals for a specific subject area for students in a particular state or district.

progress monitoring – A quick, frequent & consistent measure used to assess student progress and to evaluate the effectiveness of interventions. Instruction and intervention decisions are made based on these results.

Response to Intervention (RtI) - RtI is an individualized, comprehensive assessment and intervention process, utilizing a problem-solving framework to identify and address student academic difficulties using effective, efficient, research-based instruction

running record - observation notes made by the teacher about a student's oral reading ability. By looking at the running record, the teacher can analyze the type of reading and instruction that is best suited for the student.

rubric – A scale of criteria that explains in detail the possible levels of performance for an alternative assessment task.

Screening – A quick (to be defined) universal assessment given at the beginning of new learning; used to identify students who may be "potentially at risk."

standards – Statements that delineate what students should know and be able to do by the time they graduate from K-12 education.

S.M.A.R.T. goals – Originally coined by Peter Drucker in 1954, this acronym is used to help educators write quality goals. Specific or Strategic, Measurable, Attainable, Results-focused, Time-bound. An example: By the end of this year, at least 90% of students will meet the grade-level benchmark for running records.

summative assessment – This is an assessment **of** learning and is intended to measure end-of-unit or end-of-course knowledge and understanding; usually require students to demonstrate proficiency of all the essential knowledge and skills.

Appendix D

School District of Holmen
Statutes and Policies Addressing Student Needs

American Indian Studies Program

§115.28(17)(d), Wis Stats. AMERICAN INDIAN LANGUAGE AND CULTURE EDUCATION.
(d) Develop a curriculum for grades 4 to 12 on the Chippewa Indians' treaty-based, off-reservation rights to hunt, fish and gather.

§121.02, Wis Stats. School district standards. (1) Except as provided in §118.40 (2r)(d), each school board shall: (L) 4. Beginning September 1, 1991, as part of the social studies curriculum, include instruction in the history, culture and tribal sovereignty of the federally recognized American Indian tribes and bands located **in this state** at least twice in the elementary grades and at least once in the high school grades.

2005 ASSEMBLY BILL 314 - AN ACT ***to amend*** 118.01 (2) (c) 6. of the statutes; **relating to:** directing school boards to provide instruction about the recent history of the Hmong people.

Current law requires each school board to provide an instructional program designed to give pupils knowledge of state, nation, and world history. This bill directs school boards to include the role of the Hmong in fighting for the United States in the Vietnam War, the persecution of the Hmong by the Laotian government after the Vietnam War, and the reasons for the emigration of many Hmong to the United States.

The people of the state of Wisconsin, represented in senate and assembly, do enact as follows:
SECTION 1. 118.01 (2) (c) 6. of the statutes is amended to read: 118.01 **(2)** (c) 6. Knowledge of state, national, and world history, including the role of the Hmong in fighting for the United States in the Vietnam War, the persecution of the Hmong by the Laotian government after the Vietnam War, and the reasons for the emigration of many Hmong to the United States.

CHILDREN AT RISK <u>Standard n</u> (statute under WI Statute 118.153)

<u>Definition</u>: Pupils in grades 5-12 who are at risk of not graduating from high school because they are dropouts, or they can be defined in two or more of the following areas: one or more years behind their age group in the number of high school credits attained; two or more years behind their age group in basic skill levels; habitual truants (as defined in s.118.16(1)(a); parents; adjudicated delinquents; 8th grade students whose scores in each subject area on the WKCE was below the basic level and who failed to be promoted to the ninth grade.

***<u>Children at risk, Standard n</u>* – *<u>Interventions for Struggling Learners</u>* - The School District of Holmen uses a variety of interventions to meet the needs of struggling learners. MAP and common assessment data is used to determine which students would benefit from extra support (reading, writing, Pathways, and Auto Skills). This data is used to differentiate instruction through flex grouping, small groups and working 1-on-1 with students. Team taught classes are used to differentiate instruction. Some teachers adjust the pace of their instruction or use supplemental materials to enhance their instruction.**

ENGLISH LANGUAGE LEARNERS (ELL), (PI 13 and WI Statute 115.95)

PI 13 states that a district establishes identification, assessment, classification, and reporting requirements if pupil population includes one or more LEP pupils. This subchapter also establishes criteria and procedures to be used by a school district in determining whether to administer a test under s. 118.30 or 121.02 (1) (r), Stats., to an LEP pupil. Further, according to State Statute 115.96, a district must "provide equal educational opportunities by ensuring that necessary programs are available for limited-English proficient pupils while allowing each school district maximum flexibility in establishing programs suited to its particular needs."

ELL staff will help support and provide guidance to teachers when working with LEP pupils. Teachers should look for ways to enrich, add to, and accelerate ELLs' language development with the curriculum and learning activities. A variety of student-centered methodologies such as small group learning or thematic instruction can enhance the context for learning.

English Language Learners (ELL) **– Teachers and staff in the School District of Holmen offer a variety of services to meet the needs of English Language Learners in the classroom. In the upper-most grades, the district offers a wide variety of courses meant to meet students where they are individually. The instruction can be tailored to be accessible to the learner at almost any level, and the learners who need the most support are often placed in the smallest groups or team taught classes so as to receive more explicit instruction. Additionally, a variety of concrete and experiential learning techniques are used district-wide to support language arts. Other strategies include the deliberate use of common vocabulary and explicit instruction of those terms, real-life connections, and for the neediest students, some forms of assistive technology are used to scaffold the students learning based on the level of proficiency. Finally, the district ESL staff continues to work to educate all staff on the specific needs of the English Language Learner. ESL staff continues to work toward incorporating the WIDA Standards for English Language Development into the Social Studies curriculum that every student receives.**

TALENTED AND GIFTED (TAG) Standard t (statute under WI Statute 118.53)

Talented and gifted students are those individuals at an elementary or secondary level who, because of outstanding abilities, are capable of high performance. Students who are capable of high performance include those with demonstrated achievement and/or potential in any of the following areas, singly or in combination: (1) general intellectual ability, (2) specific academic aptitude, (3) creative or productive thinking, (4) leadership ability, (5) visual arts, (6) performing arts, (7) psychomotor ability, (8) talent associated with the student's cultural heritage, (9) psycho-social ability.

It is understood that task commitment on the part of the student is an integral ingredient in the delivery of services. TAG staff will help provide support and guidance to teachers when working with TAG students. A variety of methodologies such as small group learning, acceleration and differentiation can enhance the context of learning.

Talented and Gifted, Standard t **– Talented and Gifted (TAG) students are served by the regular education teachers and in conjunction with the Talented and Gifted teachers of the District. These students are identified based on a combination of standardized tests and nominations. TAG programming aligns with the Wisconsin Pyramid Model of delivery. Services include but are not limited to: Differentiation, flexible grouping, compacting, and advanced placement courses. In addition, there are a number of events that create and promote mathematics sponsored by the district and the Mississippi Valley Gifted and Talented Network. The academic performance of the program is assessed by identified student performance on standardized tests.**

INFUSED CURRICULAR AREAS

COMPUTER LITERACY and TECHNOLOGY

Students in the School District of Holmen use technology as a tool and have many opportunities to develop technology literacy. Students develop the ability to find generate, evaluate and apply information through the use of technology and prepare for life-long learning while developing 21st Century skills.

On May 27, 2009, the School Board approved a District Combined Information and Technology Plan. ***The vision is "Embracing 21st Century Learning for All."***

Definitions:

Digital Literacy is the ability to responsibly use appropriate technology to communicate, solve problems, and access, manage, integrate, evaluate and create information to improve learning in all subject areas and to acquire lifelong knowledge and skills in the 21st century.

21st Century Skills: 21st Century Skills represent the perspective required in light of historical events, globalization, and the idiosyncrasies of the Digital Age (digital age literacy, inventive thinking, effective communication and high productivity).

Computer literacy and technology **- Teachers use a variety of technology applications and tools to research, report, compile, and inquire about. Multiple forms of assistive technology also support the special needs learner.**

DIVERSITY

The vision of diversity in the School District of Holmen is to provide a nurturing environment in which each individual has the opportunity to reach his/her full human potential. This will be supported through strategic planning and building goals; curriculum planning and implementation, staff development, and resource selection and allocation. The plan will be monitored through data collection and analysis.

Diversity **– By including language arts content from a variety of cultures and personal experiences, teachers enhance the learning experience for all students. Recognizing the diversity within a classroom enriches the learning for all.**

EDUCATION FOR EMPLOYMENT (formerly SCHOOL TO WORK) – PI 26.01

Education for employment is one of Wisconsin's 20 school district standards. It is often referred to as Standard (m) and its purpose is to ensure that all students, regardless of career objective are given the skills, attitudes, and knowledge needed for future employment. It begins as early as kindergarten and is infused throughout the K-12 curriculum.

In Wisconsin education for employment initiatives are led by a series of mandates, dating back to September 1988:
WI Educational Standard, Education for Employment, WI Statute 121.02(1)(m)
WI Educational Standard, Curriculum WI Statute. 121.02(1)(k)
WI Educational Standard, Developmental Guidance Services, WI Statute 121.02 (1)(e)

"The purpose of education for employment programs is to prepare elementary and secondary pupils for future employment; to ensure technological literacy; to promote lifelong learning; to promote good citizenship; to promote cooperation among business, industry, labor, postsecondary schools, and public schools; and to establish in a role for public schools in the economic development of Wisconsin."

Education for Employment (E4E) **– *Social Studies* activities that include experiences built on real information and data help students to make connections and apply learning in a contextual environment. E4E involves the business community in educational issues and enriches the school curriculum. It promotes increased student achievement by expanding educational experiences.**

Appendix E

School District of Holmen
Resources and References