Bristol Public Schools

Office of Teaching & Learning

Program	Bristol Prep Academy
Department Philosophy	Bristol Public Schools science programming provides students with knowledge of the science and engineering practices, crosscutting concepts, and core ideas of science and engineering to engage in public discussions on science related issues, to be critical consumers of scientific information related to their everyday lives, and continue to learn science throughout their lives. To ensure this level of scientific literacy, Bristol Public Schools anchor science units in phenomena, this practice promotes student ownership of learning and supports student application of science content as it pertains to the real world. In each science unit, students work to explain phenomena through the application of the three dimensions of the Next Generation Science Standards: (1) science and engineering practices, (2) disciplinary core ideas, and (3) cross cutting concepts. Bristol's use of phenom-based units and the three dimensions ensure that students connect with and build a deep conceptual understanding of science concepts. Throughout the kindergarten through grade 12 experience, this philosophy provides all Bristol students with the skills and concepts to be scientifically literate adults.
Department	Science
Course Description for Program of Studies	BPA has a compilation of 16 science courses anchored in real world contexts. Each hexmester course provides students with access to Next Generation Science Standards (NGSS) through 6 week mini courses that provide learning in a context, so students can see the relevance of science. Each course has a problem-based learning (PBL) approach and is fitted with performance tasks to see student application of the content in the real world content as posed by the PBL. The science content falls into 4 categories: 1-Consumer Chemistry, 2-Earth and Space Science, 3-Life Science, 4-Energy.
Grade Level	9-12
Pre-requisites	
Credit (if applicable)	0.2. per course

Table of Contents

P1-Consumer Chemistry 3: Textiles and Tye-Dye

P1-Earth and Space 1: A Year without Summer

P1-Earth and Space 2: Mined Over Matter

Earth and Space 3: Space Case

P1-Earth and Space 4: Meteorology

P1-Life Science 1: Food Fight

Life Science 2: Shots and Vaccines

P1-Life Science 3: Cancer

Life Science 4: Interpreting the Fossil Record (Tiktaalik)

P1-Energy 1: Electricity and Magnetism

Energy 2: Energy Consumption, Efficiency and Conservation

Energy 3: Biofuels

Energy 4: Alternative Energy Sources

Unit: name

P indicates standard will be a priority for the unit; S indicates a supporting standard

District Learning Expectations and Standards	Unit 1	Unit 2	Unit 3	Unit 4

Consumer Chemistry 1: Pharma's Market

Course Description: A six week investigation exploring the pharmaceutical industry in the United States. Topics explored will include the chemical, societal, and ethical aspects of the industry.

UNWRAPPED STANDARDS

Standard	Dimensions of the NGSS Standard		Big Ideas	Academic Vocabulary
operties of elements based on the HS-PS1-1 Use the periodic table as a model to predict the relative pre patterns of electrons in the outermost energy level of atoms.	**SEP**	**Developing and Using Models** ● Use a model to predict the relationships between systems or between components of a system.	● The periodic table is organized by atomic number. ● Every element has its own unique properties. ● The periodic table is arranged by groups and families.	● Mendeleev ● Group ● Family ● Periodic Law ● Atomic number ● Electron configuration ● Atomic arrangement ● Atomic theory
	DCI	**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. ● 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.		
	CCC	**Patterns** ● Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality explanations of phenomena.		
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.	**SEP**	**Constructing Explanations and Designing Solutions** ● Construct and revise an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) 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.	● The periodic table reflects repeating patterns. ● Not all chemical elements will react. ● Chemical reactions must be balanced.	● Metal ● Non metal ● Metalloid ● Noble gas ● Chemical reaction ● Valence electrons ● Law of Conservation of Mass
	DCI	**PS1.A: Structure and Properties of Matter** ● 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. **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.		

	CCC	**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.		
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.	**SEP**	**Planning and Carrying Out Investigations** ● 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.	● Synthetic drugs are similar in composition. ● Drugs need the approval of the FDA. ● Paid volunteers are test subjects for clinical trials. ● Once approved, a pharmaceutical may be removed from the market.	● Hydrogen bonding ● Dipole-dipole ● Dispersion forces ● Electrostatic forces ● Covalent ● Ionic ● pH ● Placebo effect
	DCI	**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. **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. (secondary)		
	CCC	**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.		

Consumer Chemistry 1: Pharma's Market
Course Details

Unit Phenomenon: Prescription Drugs
Storyline: Students will be introduced to the concept of "direct to consumer" advertising of pharmaceuticals. While learning key chemistry concepts related to molecular structures and chemical reactions.Students will examine current regulations and processes involved in the research, development, manufacture and distribution of pharmaceutical drugs in the US. Scientific, moral, and political questions will be considered.

Unit Essential Questions:
- What is the prevalence of prescription drug use in the United States?
- How is research on pharmaceutical composition conducted?
- What is the molecular structure of some common drugs?
- How are synthetic drugs created?
- Should Vioxx be kept off the market?
- Debate: Should prescription drugs be banned from TV?

Learning Sequence	**Objective(s):** The students will be able to:	Summative Assessment Strategy	Priority NGSS Dimensions	Common Learning Experiences
(1) What is the prevalence of prescription drug use in the United States?	• I can analyze statistical data on the prevalence of pharmaceutical use in the United States. • I can calculate a "pharma-factor" for my family. • I can identify salient issues surrounding pharmaceutical advertising.	☐ Selected Response x Constructed Response x Performance ☐ Observation	**SEP** | **DCI** | **CCC** • CCC:Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality explanations of phenomena. • DCI: Construct and revise an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) 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.	• Completion of We are Family p.270 ELA/Math Connection:
(2) How is research on pharmaceutical composition conducted?	• I can recognize the relationship between chemical formulas and everyday medicines.	☐ Selected Response x Constructed Response x Performance ☐ Observation	**SEP** | **DCI** | **CCC** • 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. • 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 t*he contact forces between material objects. (secondary)* • SEP: Construct and revise an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories,	• Completion of Drug Profile Sheet p. 273 • Introduction to MolView-Analysis of everyday chemicals • Locating Carbon on the periodic table and discussing it distinguishing features. ELA/Math Connection:

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<td>simulations, peer review) 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.</td>
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<td>(3)
What is the molecular structure of some common drugs?</td>
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I can create molecular models of some common drugs.
I can analyze the structure of molecules to identify similarities and differences.
I can describe the characteristics and chemical properties of carbon and explain why it is the backbone element for most drugs.
I can articulate drug action at target sites.

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<tr><td></td><td>Selected Response</td></tr>
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<tr><td></td><td>Observation</td></tr>
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SEP | DCI | CCC

CCC: 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.
DCI: 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.
SEP: Construct and revise an explanation based on valid and reliable evidence obtained from a variety of sources (including students’ own investigations, models, theories, simulations, peer review) 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.

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Construction of molecular models of a select group of common drug compounds.
Analyze drug structures on molView
Locating Carbon on the periodic table and discussing it distinguishing features.
Building simple organic compounds

ELA/Math Connection:
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<td>(4)
How are synthetic drugs created?</td>
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I can describe the 4 types of chemical reactions.
I can identify the key components of aspirin.
I can describe how aspirin is prepared.
I can identify the regulatory process surrounding the development and approval of pharmaceuticals.

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SEP | DCI | CCC

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.
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.
Construct and revise an explanation based on valid and reliable evidence obtained from a variety of sources (including students’ own investigations, models, theories, simulations, peer review) 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.

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Activity-Identifying and explaining the 4 reaction types: synthesis, decomposition, angle displacement, double displacement
Lesson 4, creating a synthetic drug. P.278 (focus on reaction type and carbone as the backbone element)
Review the chemical structure/ describe the chemical structure of the synthetic drug created.

ELA/Math Connection:
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Should Vioxx be kept off the market?</td>
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I can explain the chemical structure of vioxx.
I can articulate the scientific purpose and process involved in clinical trials.
I can articulate the consequences of removing a pharmaceutical from the market.
I can chemically compare vioxx to its replacement naproxen

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SEP | DCI | CCC

Construct and revise an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) 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.

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Case Study-Completion of Amanda's Absence p.285
Analyze the Vioxx molecule and market timeline.

ELA/Math Connection:
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<td>(6)
Debate: Should prescription drugs be banned from TV?</td>
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I can identify the scientific viewpoints of multiple stakeholders.
I can evaluate the use of evidence to advance claims and support decisions.

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<tr><td></td><td>Observation</td></tr>
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SEP | DCI | CCC

Construct and revise an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) 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.
Use a model to predict the relationships between systems or between components of a system.
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.

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Mock congressional subcommittee hearing. P 287.
ELA/Math Connection:
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RESOURCES

It's Debatable! Using Socioscientific Issues to Develop Scientific Literacy K-12 By: Dana L. Zeidler and Sami Kahn

Consumer Chemistry 2: Car Airbags

Course Description: A six week investigation into the concepts of the forces related to car crashes and the chemistry behind airbags.

UNWRAPPED STANDARDS

Standard	Dimensions of the NGSS Standard		Big Ideas	Academic Vocabulary
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.	**SEP**	**Constructing Explanations and Designing Solutions** ● Construct and revise an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) 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.	● Elements will react to fill energy levels. ● Not all elements will react. ● There is a specific order to how elements are arranged in the periodic table. ● Matter is neither created nor destroyed. ● The periodic table is an orderly arrangement.	● Valence ● Electron configuration ● Proton ● Neutron ● Electron ● Law of Conservation of Matter ● The Mole
	DCI	**PS1.A: Structure and Properties of Matter** ● 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. **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.		
	CCC	**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.		
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.	**SEP**	**Developing and Using Models** ● Develop a model based on evidence to illustrate the relationships between systems or between components of a system.	● Breaking bonds release energy. ● Making bonds requires energy. ● In reactions atoms are rearranged. ● Energy flows in and out of systems. ● Energy can be stored or released.	● Covalent ● Ionic ● Bond energy
	DCI	**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. **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.		
	CCC	**Energy and Matter** ● Changes of energy and matter in a system can be described in terms of energy and matter flows into, out of, and within that system.		
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.	**SEP**	**Constructing Explanations and Designing Solutions** ● Apply scientific principles and evidence to provide an explanation of phenomena and solve design problems, taking into account possible unanticipated effects.	● The rate of a chemical reaction can be changed. ● Atoms are in a constant state of motion.	● Endothermic ● Exothermic ● Kinetic energy ● Catalyst
	DCI	**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.		
	CCC	**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.		
HS-PS1-6 Refine the design of a chemical system by specifying a change in conditions that would produce increased amounts of products at equilibrium.*	**SEP**	**Constructing Explanations and Designing Solutions** ● Refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and trade off considerations.	● Some reactions are reversible. ● Chemical reactions are balanced.	● Law of Conservation of Mass ● The Mole ●
	DCI	**PS1.B: Chemical Reactions** ● In many situations, a dynamic and condition-dependent balance between a reaction and the reverse reaction determines the numbers of all types of molecules present. **ETS1.C: Optimizing the Design Solution** ● Criteria may need to be broken down into simpler ones that can be approached systematically, and decisions about the priority of certain criteria over others (trade-offs) may be needed. (secondary)		
	CCC	**Stability and Change** ● Much of science deals with constructing explanations of how things change and how they remain stable.		

HS-PS1-7 Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction.	**SEP**	**Using Mathematics and Computational Thinking** ● Use mathematical representations of phenomena to support claims.	● Given the reactants, one can predict the products. ● Energy is conserved. ● Matter is conserved. ● How does an airbag work?	● Chemical properties ● Metals. ● Nonmetals ● Metalloids ● Stability ● Closed system ● Gas laws
	DCI	**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.		
	CCC	**Energy and Matter** ● The total amount of energy and matter in closed systems is conserved.		

Consumer Chemistry 2: Car Airbags
Course Details

Unit Phenomenon:
Storyline: Students will investigate physical science concepts related to force and motion. They will then synthesize and apply their learning to address the questions of whether speed limits should be lowered to reduce traffic accidents.

Unit Essential Questions: What are the principles of chemistry that allows for a vehicle's airbags to deploy and protect humans?
- How can the number of atoms in a sample be counted?
- How is the number of atoms related to the mass?
- How can elements and compounds rearrange in a chemical reaction?
- What is evidence that a chemical reaction occurs?
- How can the rate of a chemical reaction be changed?
- How does the change in energy relate to chemical bonds?
- How can the volume of a gas produced in an airbag be determined based on a chemical reaction?

Learning Sequence	**Objective(s):** The students will be able to:	Summative Assessment Strategy	Priority NGSS Dimensions	Common Learning Experiences
(1) How can the number of atoms in a sample be counted? How is the number of atoms related to the mass?	• I can mathematically describe chemical formulas using the periodic table. • I can mathematically connect the number of atoms to the molar mass of the compound. • I can mathematically describe the chemical compounds found within an airbag. **Chemical Formulas and Compounds** • *Mass and mole, formula masses (simple)*	<table><tr><td></td><td>Selected response</td></tr><tr><td></td><td>Constructed response</td></tr><tr><td>x</td><td>Performance</td></tr><tr><td></td><td>Observation</td></tr></table>	**SEP** | **DCI** | **CCC** • *SEP:* Use mathematical representations of phenomena to support claims. **Providing background skill for:** • *DCI: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.* • *CCC: The total amount of energy and matter in closed systems is conserved.*	Common Assessment: • n/a Common experiences (lab/activity) • Introduction of the anchor phenomenon and solicitation of student initial ideas related to an Airbag Demo and QFT • How big is a mole? ELA/Math Connection: • n/a
(2) How can elements and compounds rearrange in a chemical reaction? What is evidence that a chemical reaction occurs?	• I can use mathematical representations to explain how atoms (mass) are conserved in a chemical reaction. • I can use patterns to identify and describe different reaction types. • I can use arguments from pattern evidence to identify the types of reactions in an airbag. **Chemical Equations and Reactions** • *Writing and balancing equations* • *Chemical reaction types (SR, DR, synthesis, decomp, combustion)*	<table><tr><td></td><td>Selected response</td></tr><tr><td>x</td><td>Constructed response</td></tr><tr><td>x</td><td>Performance</td></tr><tr><td></td><td>Observation</td></tr></table>	**SEP** | **DCI** | **CCC** • SEP: Use mathematical representations of phenomena to support claims. • DCI: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. • CCC: The total amount of energy and matter in closed systems is conserved. • SEP: Construct and revise an explanation based on valid and reliable evidence obtained from a variety of sources. • DCI: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	Common Assessment: • HS-PS1-7 (CREC Assessment) • CT NGSS IAB: HS-PS1-2 Common experiences: • *Provide examples and connections to everyday (statue of liberty, bunsen burners, etc)* • Types of Chemical Reactions Lab • Metallic Bullies Lab (optional) • CER-Concept of conservation to airbag development and deployment. • Common Unit Assessment (interim) ELA/Math Connection: • HS-PS1-7: HSN-Q.A.2 • HS-PS1-2:HSN-Q.A.1

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<td>patterns of this table reflect patterns of outer electron states.
● DCI: 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.
● CCC: 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.</td>
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How can the rate of a chemical reaction be changed?

How does the change in energy relate to chemical bonds?</td>
<td>● I can design and conduct an investigation to collect evidence of how temperature, concentration and surface area impact the rate of a chemical reaction.
● I can develop a model to show how different factors impact the rate of reactions</td>
<td rowspan="2"><table><tr><td></td><td>Selected response</td></tr><tr><td>x</td><td>Constructed response</td></tr><tr><td>x</td><td>Performance</td></tr><tr><td></td><td>Observation</td></tr></table></td>
<td rowspan="2">SEP | DCI | CCC

● SEP: Develop a model based on evidence to illustrate the relationships between systems or between components of a system.
● SEP: Apply scientific principles and evidence to provide an explanation of phenomena and solve design problems, taking into account possible unanticipated effects.
● SEP: Create a computational model or simulation of a phenomenon, designed device, process, or system.
● DCI: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.
● DCI: 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 rearrangement 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.
● DCI: Energy is a quantitative property of a system that depends on the motion and interactions of matter and radiation within that system. There is a single quantity called energy 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.
● DCI: 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.
● DCI: Energy cannot be created or destroyed, but it can be transported from one place to another and transferred between systems.
● DCI: Mathematical expressions, which quantify</td>
<td>Common Assessment:
● HS-PS1-5(CREC Assessment)
● HS-PS1-4 (CREC Assessment)
● HS-PS3-1 (CREC Assessment)
Common Experiences (lab/activity)
● Magnesium and HCl Lab
● Defining reaction types and equations for the successful deployment of an airbag.
● Design/model an "airbag-like" system and describe principles of reaction rate and energy related to deployment.</td>
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<td>Reaction Rate
● Collision Theory
● Temperature,
● concentration
● surface area</td>
<td>ELA/Math Connection:
● HS-PS1-5: WHST.9-12.2; HSN-Q.A.1
● HS-PS1-4: MP.4
● HS-PS3-1: MP.2; HSN.Q.A.2</td>
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			how the stored energy in a system depends on its configuration 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. ● CCC: Changes of energy and matter in a system can be described in terms of energy and matter flows into, out of, and within that system. ● CCC: The availability of energy limits what can occur in any system. ● CCC: Models can be used to predict the behavior of a system, but these predictions have limited precision and reliability due to the assumptions and approximations inherent in models.	
(4) How much reactant is needed to maximize the product produced in a chemical reaction?	● I can use mathematical representation and modeling to show how mass is conserved in a chemical reaction. **Stoichiometry and Conservation of Mass** ● *Calculations (simple)*	<table><tr><td></td><td>Selected response</td></tr><tr><td>x</td><td>Constructed response</td></tr><tr><td>x</td><td>Performance</td></tr><tr><td></td><td>Observation</td></tr></table>	**SEP** **DCI** **CCC** ● SEP: Use mathematical representations of phenomena to support claims. ● DCI: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. ● CCC: The total amount of energy and matter in closed systems is conserved.	Common Assessment ● HS-PS1-7 Common Experiences (lab/activity): ● Conservation of Mass Assessment ● Design and Experiment: Efficiency of 3 airbags ● Molympics ELA/Math Connection: ● HS-PS1-7: HSN-Q.A.2
(5) How can the volume of a gas produced in an airbag be determined based on a chemical reaction?	● I can use a model to demonstrate how changing the amount of reactants will impact the volume of gas produced. **Gas Pressure and Volume** ● *Boyle's Law, Charles Law* ● *Ideal Gas Law (relative to airbag)*	<table><tr><td></td><td>Selected response</td></tr><tr><td>x</td><td>Constructed response</td></tr><tr><td>x</td><td>Performance</td></tr><tr><td></td><td>Observation</td></tr></table>	**SEP** **DCI** **CCC** ● Connects vertically to MS-PS1-4	Common Assessment: ● Boyle's and Charles Law Lab/Demo ● **Summative:** Engineering Design of an airbag and model--cdn.files.3rdl.com or Science Net links. ● reference ELA/Math Connection: ● n/a

ADDITIONAL CONSIDERATIONS

COMMON MISCONCEPTIONS	PRIOR KNOWLEDGE NEEDED TO MASTER STANDARDS FOR THIS UNIT	ADVANCED STANDARDS FOR STUDENTS WHO HAVE DEMONSTRATED PRIOR MASTERY	OPPORTUNITIES FOR STUDENT-DIRECTED LEARNING WITHIN THE UNIT
AAAS Misconceptions: ● Atoms, Molecules and States of Matter	HS-PS1-2: MS.PS1.A; MS.PS1.B		Engineering Design-Airbag All things being equal investigation.

● Energy: Forms, Transformation, Transfer, and Conservation ● Substances, Chemical Reactions, and Conservation of Matter	HS-PS1-4: MS.PS1.A ; MS.PS1.B ; MS.PS2.B ; MS.PS3.D ; MS.LS1.C HS-PS1-5: MS.PS1.A; MS.PS1.B; MS.PS2.B; MS.PS3.A; MS.PS3.B HS-PS1-6: MS.PS1.B HS-PS1-7: MS.PS1.A; MS.PS1.B; MS.LS1.C; MS.LS2.B; MS.ESS2.A HS-PS3-1: MS.PS3.A; MS.PS3.B; MS.ESS2.A		Airbag models

RESOURCES

Consumer Chemistry 3: Textiles and Tye-Dye

Course Description: A six week investigation into the chemistry of elements, compounds, and mixtures using tie-dying techniques as a practical application.

UNWRAPPED STANDARDS

Standard		Dimensions of the NGSS Standard	Big Ideas	Academic Vocabulary
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.	**SEP**	**Planning and Carrying Out Investigations** ● 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.	● Surface tension and viscosity provide measurable evidence of the strength of a substance's intermolecular forces. ● Matter can be classified as mixtures, compounds, or elements.	● Surface tension ● Viscosity ● Mixture ● Compound ● Element
	DCI	**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. **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. (secondary)		
	CCC	**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.		
HS-PS2-6 Communicate scientific and technical information about why the molecular-level structure is important in the functioning of designed materials.*	**SEP**	**Obtaining, Evaluating, and Communicating Information** ● Communicate scientific and technical information (e.g. about the process of development and the design and performance of a proposed process or system) in multiple formats (including orally, graphically, textually, and mathematically).	● Electrically conductive materials are often made of metal. ● Flexible materials are made up of long chained molecules. ● Pharmaceuticals are designed to interact with specific receptors.	● Polymers ● Attraction ● Repulsion ● Macroscopic properties ● Ionic compounds ● Covalent compounds
	DCI	**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.		
	CCC	**Structure and Function**		

		● Investigating or designing new systems or structures requires a detailed examination of the properties of different materials, the structures of different components, and connections of components to reveal its function and/or solve a problem.		
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.	**SEP**	**Using Mathematics and Computational Thinking** ● Create a computational model or simulation of a phenomenon, designed device, process, or system.	● Energy is neither created nor destroyed. ● Energy flows in a system. ● Energy equals force x distance. ● Energy is conserved in a system.	● Law of Conservation of Energy. ● Thermal energy ● Kinetic energy ● Endothermic ● Exothermic
	DCI	**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 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. **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. Energy cannot be created or destroyed, but it can be transported from one place to another and transferred between systems ● The availability of energy limits what can occur in any system.		
	CCC	**Systems and System Models** ● Models can be used to predict the behavior of a system, but these predictions have limited precision and reliability due to the assumptions and approximations inherent in models.		

● Consumer Chemistry 3: Textiles and Tye-Dye ● Course Details
● Unit Phenomenon: ● Storyline: Tye-dying is a commonly used technique that represents a chemical process that involves all aspects of the chemical nature of reactions.
● Unit Essential Questions: What principles of chemistry are used to dye fabric in the textile industry? ● What is an ionic compound or ionic dye? ● How do we name ionic compounds? ● Which stains are ionic? ● What are the properties of ionic compounds? ● What is a covalent compound? ● How do we name covalent compounds? ● Which stains are covalent? ● What are the properties of covalent compounds?

- Why do dyes stain fabrics differently?
- How does temperature impact staining?

Learning Sequence	Objective(s): The students will be able to:	Summative Assessment Strategy	Priority NGSS Dimensions	Common Learning Experiences
(1) What is an ionic compound or ionic dye? How do we name ionic compounds? Which stains are ionic? What are the properties of ionic compounds?	I can use patterns of the periodic table to identify elements that form ions and how to determine its charge. I can write formulas and names of ionic salts. Chemical Bonding/Forces Ionic Bonds Ionic Compounds (simple) Naming Properties of ionic compounds (covalent to be determined later)	Selected response Constructed response Performance Observation	SEP / DCI / CCC SEP:Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence. SEP: Communicate scientific and technical information in multiple formats. DCI: The structure and interactions of matter at the bulk scale are determined by electrical forces within and between atoms. DCI: 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. CCC: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. CCC:Investigating or designing new systems or structures requires a detailed examination of the properties of different materials, the structures of different components, and connections of components to reveal its function and/or solve a problem.	Common Assessments HS-PS1-3 (CREC Assessment) HS-PS2-6 (CREC Assessment) Common Experiences (lab/activity): Introduction of phenomenon-Staining differences on Flinn strips (modified AP lab) Chemical Bonding: Vibrant Colors QFT-Textile coloring differences Identify/name ionic compounds in inquiry activity. Predict ionic dyes. ELA/Math Connection: HS-PS1-3:HSN-Q.A.1 HS-PS2-6:WHST.11-12.2
(2) What is a covalent compound? How do we name covalent compounds? Which stains are covalent? What are the properties of covalent compounds?	I can use patterns of the periodic table to identify elements that form covalent compounds. I can write formulas and name of covalent compounds. I can conduct an investigation to identify unknowns as ionic or covalent compounds. I can communicate differences in properties between ionic and covalent compounds after identifying trends and patterns from investigations Chemical Bonding/Forces Covalent Nomenclature Lewis structures (simple)	Selected response Constructed response Performance Observation	SEP / DCI / CCC SEP:Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence. SEP: Communicate scientific and technical information in multiple formats. DCI: The structure and interactions of matter at the bulk scale are determined by electrical forces within and between atoms. DCI: 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. CCC: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	Common Assessments; HS-PS1-3 (CREC Assessment) HS-PS2-6 (CREC Assessment) Common Experiences (lab/activity) Students define properties of ionic and covalent compounds based on the results of investigations. Lab-Identify unknown as ionic or covalent CER-Identifying each of the textile staining ingredients as ionic or covalent ELA/Math Connection: HS-PS1-3:HSN-Q.A.1; HS-PS2-6:WHST.11-12.2; RST.11-12.1

<table>
<tr><td></td><td>● Bond polarity (no calculations)
● Properties of covalent compounds</td><td></td><td></td><td></td></tr>
<tr><td>● (3)
● Why do dyes stain fabrics differently?</td><td>● I can construct a scientific explanation for the solubility of different dyes based on chemical structure and intermolecular attractions.

● Chemical Bonding/Forces
● Intermolecular forces (dipole-dipole, H-bonds, London Dispersion Forces, ion-dipole)
● Intramolecular forces</td><td>●
<table><tr><td>●</td><td>● Selected response</td></tr><tr><td>●</td><td>● Constructed response</td></tr><tr><td>●</td><td>● Performance</td></tr><tr><td>●</td><td>● Observation</td></tr></table>●</td><td>● SEP | ● DCI | ● CCC

● SEP: Communicate scientific and technical information (e.g. about the process of development and the design and performance of a proposed process or system) in multiple formats (including orally, graphically, textually, and mathematically).
● DCI: The structure and interactions of matter at the bulk scale are determined by electrical forces within and between atoms.
● DCI: 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.
● CCC: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.
● CCC:Investigating or designing new systems or structures requires a detailed examination of the properties of different materials, the structures of different components, and connections of components to reveal its function and/or solve a problem.</td><td>● Common Assessments:
● HS-PS1-3 (CREC Assessment)
● HS-PS2-6 (CREC Assessment)
● Common Experiences (lab/activity):
● Develop a model to describe the differences in dye adherence for each of the fabric types.
●

● ELA/Math Connection:
● HS-PS1-3:HSN-Q.A.1;
● HS-PS2-6:WHST.11-12.2; RST.11-12.1
●</td></tr>
<tr><td>(4)
How does temperature impact staining?</td><td>● I can use a computational model (phase diagram) to explain how energy is conserved as the attraction and repulsion changes.
● I can construct an explanation about how the temperature of a solvent impacts the solubility of the dye.

● Heating and Cooling
● Intramolecular
● Intermolecular
● Heating and cooling curves
● Phase changes</td><td><table><tr><td></td><td>Selected response</td></tr><tr><td>x</td><td>Constructed response</td></tr><tr><td>x</td><td>Performance</td></tr><tr><td>x</td><td>Observation</td></tr></table></td><td>● SEP | ● DCI | ● CCC

● SEP:Create a computational model or simulation of a phenomenon, designed device, process, or system.
● SEP: Communicate scientific and technical information (e.g. about the process of development and the design and performance of a proposed process or system) in multiple formats (including orally, graphically, textually, and mathematically).
● DCI: 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.
● DCI: 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</td><td>● Common Assessments:
● HS-PS3-1 (CREC Assessment)
● HS-PS1-5 (CREC Assessment)
● HS-PS2-6 (CREC Assessment)
● Common Experiences (lab/activities)
● Lab-Phase change diagram-lauric acid
● Activity: Model the effects of temperature on fabric dyeing.
● Summative Assessment:
● Unit Test:TBD
● CER-Manufacturing Textiles Scenario

● ELA/Math Connection:
● HS-PS3-1:HSN.Q.A.1; HSN.Q.A.2
● HS-PS1-5: WHST.9-12.2; HSN-Q.A.1; MP.2
● HS-PS2-6: HSN.Q.A.1
●</td></tr>
</table>

			one object to another and between its various possible forms. ● CCC: 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. ● CCC: Models can be used to predict the behavior of a system, but these predictions have limited precision and reliability due to the assumptions and approximations inherent in models.	

ADDITIONAL CONSIDERATIONS

COMMON MISCONCEPTIONS	PRIOR KNOWLEDGE NEEDED TO MASTER STANDARDS FOR THIS UNIT	ADVANCED STANDARDS FOR STUDENTS WHO HAVE DEMONSTRATED PRIOR MASTERY	OPPORTUNITIES FOR STUDENT-DIRECTED LEARNING WITHIN THE UNIT
AAAS Misconceptions: Atoms, Molecules and States of Matter; Substances, Chemical Reactions, and Conservation of Matter	HS:PS1-3:MS.PS1.A ; MS.PS2.B HS-PS1-5:MS.PS1.A ; MS.PS1.B ; MS.PS2.B ; MS.PS3.A ; MS.PS3.B HS-PS2-6:MS.PS1.A ; MS.PS2.B HS-PS3-1: MS.PS3.A ; MS.PS3.B ;MS.ESS2.A		Inquiry Laboratory: Color Vibrancy Solar Dye Pots Tie-Dye (optional)

RESOURCES

Earth and Space 1: A Year without Summer

UNWRAPPED STANDARDS

Standard	Dimensions of the NGSS Standard		Big Ideas	Academic Vocabulary
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.	**SEP**	**Using Mathematics and Computational Thinking** ● Create a computational model or simulation of a phenomenon, designed device, process, or system.	● Energy from the sun is absorbed, scattered, or reflected back to space. ● Energy cannot be created or destroyed. ● Energy is conserved.	● Transparent ● Translucent ● Opaque ● Law of conservation of energy ● Radiation ● Conduction ● Convection
	DCI	**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. There is a single quantity called energy 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. **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. ● Energy cannot be created or destroyed, but it can be transported from one place to another and transferred between systems. ● 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. ● The availability of energy limits what can occur in any system.		
	CCC	**Systems and System Models** ● Models can be used to predict the behavior of a system, but these predictions have limited precision and reliability due to the assumptions		

		and approximations inherent in models. **Scientific Knowledge Assumes an Order and Consistency in Natural Systems** ● Science assumes the universe is a vast single system in which basic laws are consistent.		
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.*	**SEP**	**Constructing Explanations and Designing Solutions** ● Design, evaluate, and/or refine a solution to a complex real-world problem based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and trade off considerations.	● Energy is in many forms. ● Energy can be converted from one form to another. ● Energy is the ability to do work. ● Energy is both a particle and a wave. ● Energy flows in and out of systems.	● Closed system ● Photon ● Quanta ● Flow of matter
	DCI	**PS3.A: Definitions of Energy** ● At the macroscopic scale, energy manifests itself in multiple ways, such as in motion, sound, light, and thermal energy. **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. **ETS1.A: Defining and Delimiting an Engineering Problem** ● Criteria and constraints also include satisfying any requirements set by society, such as taking issues of risk mitigation into account, and they should be quantified to the extent possible and stated in such a way that one can tell if a given design meets them.		
	CCC	**Energy and Matter** ● Changes of energy and matter in a system can be described in terms of energy and matter flows into, out of, and within that system. **Influence of Science, Engineering and Technology on Society and the Natural World** ● Modern civilization depends on major technological systems. Engineers continuously modify these technological systems by applying scientific knowledge and engineering design practices to increase benefits while decreasing costs and risks.		
HS-ESS2-2. Analyze geoscience data to make the claim that one change to Earth's surface can create feedback that causes changes to other Earth systems.	**SEP**	**Analyzing and Interpreting Data** ● Analyze data using tools, technologies, and/or models (e.g., computational, mathematical) in order to make valid and reliable scientific claims	● Weather and climate differ ● The earth experiences seasonal changes. ● The amount of sunlight that	● Equinox ● Solstice ● Latitude ● Climate change

		or determine an optimal design solution.	reaches Earth varies. ● The earth is tilted on an axis	● Longitude ● Equator ●
	DCI	**ESS2.A: Earth Materials and Systems** ● Earth's systems, being dynamic and interacting, cause feedback effects that can increase or decrease the original changes. **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 reradiation into space.		
	CCC	**Stability and Change** ● Feedback (negative or positive) can stabilize or destabilize a system. **Influence of Engineering, Technology, and Science on Society and the Natural World** ● New technologies can have deep impacts on society and the environment, including some that were not anticipated. Analysis of costs and benefits is a critical aspect of decisions about technology.		
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.	**SEP**	**Developing and Using Models** ● Use a model to provide mechanistic accounts of phenomena. **Scientific Knowledge is Based on Empirical Evidence** ● Science arguments are strengthened by multiple lines of evidence supporting a single explanation.	● The Earth has undergone many climatic changes. ● The earth's tilt on its axis has varied. ● Natural events on earth can have an effect on climate. ● Human activity has an effect on climate. ● The shape of the Earth's orbit is not consistent. ● Climatic changes can occur within varying periods of time.	● Plate tectonics ● Rotation ● Revolution ● Greenhouse effect ● Greenhouse gases ● Milankovitch cycles ● Elliptical orbit ● Volcanic ash cloud ● Tectonic cycle ● Fossil fuels ● Nuclear winter ●
	DCI	**ESS1.B: Earth and the Solar System** ● Cyclical changes in the shape of Earth's orbit around the sun, together with changes in the tilt of the planet's axis of rotation, both occurring over hundreds of thousands of years, have altered the intensity and distribution of sunlight falling on the earth. These phenomena cause a cycle of ice ages and other gradual climate changes. **ESS2.A: Earth Materials and System** ● 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, 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. **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 reradiation into space.		
	CCC	**Cause and Effect** ● Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.		

Earth and Space 1: A Year Without Summer

Unit Phenomenon:
Storyline: The summer of 1816 was not like any summer people could remember,snow fell in New England, cold rains fell throughout Europe, and worldwide, it was cold, stormy, and dark. The results of a four month volcanic explosion of Indonesia's Mount Tambora.

Unit Essential Questions:

<table>
<tr><th>Learning Sequence</th><th>Objective(s): The students will be able to:</th><th>Summative Assessment Strategy</th><th>Priority NGSS Dimensions</th><th>Common Learning Experiences</th></tr>
<tr><td rowspan="2">1
Sequence Plan

What would life be like without summer?</td><td>● I can develop and design an initial model
● I can develop questions and discuss phenomenon</td><td rowspan="2"><table><tr><td></td><td>Selected Response</td></tr><tr><td>x</td><td>Constructed Response</td></tr><tr><td>x</td><td>Performance</td></tr><tr><td></td><td>Observation</td></tr></table></td><td rowspan="2">SEP | DCI | CCC

SEP:
● Students will develop an initial model using evidence from the anchoring phenomenon to describe how the structure and interactions of systems on Earth.</td><td>Common Assessment:
● (performance expectations)
Common Experience (lab/activity)
● A Year Without Summer anchoring phenomenon video or article
● Model reasons for a year without summer</td></tr>
<tr><td>Sequence Topic
● Introduction of the anchor and building student curiosity</td><td>ELA/Math Connection:</td></tr>
<tr><td rowspan="2">2
Sequence Plan

What makes summer?

5E Lesson Plan Template</td><td>● I can explain the energy transfer from the Sun to Earth and the processes of energy that drive seasonal climates.
● I can identify seasonal patterns as related to the phenomenon of summer and a year without summer.
● I can use this information, discussion, and collaboration to explore the phenomenon and revise the initial model about the year without a summer.</td><td rowspan="2"><table><tr><td></td><td>Selected Response</td></tr><tr><td>x</td><td>Constructed Response</td></tr><tr><td>x</td><td>Performance</td></tr><tr><td></td><td>Observation</td></tr></table></td><td rowspan="2">SEP | DCI | CCC

SEP:
● Develop a model to represent relationships
● Communicate science ideas in varied forms
DCI:
● Energy exists in different forms (motion, sound, light, gravitational, magnetic, electrical, thermal)
● Solar energy drives climate (reflection, albedo, absorption, storage, redistribution, convection, conduction)
● Energy from the sun reaches Earth via radiation
● The Earth's orbit and tilt of axis impact energy flow and seasons
CCC:
● Change and rates of change can be quantified and modeled over time
● Feedback can impact system stability
● The significance of a phenomenon is dependent on the scale, proportion, and quantity</td><td>Common Assessment:
● (performance expectations)
Common Experience (lab/activity)
● Modeling Earth's Seasons Activity (Review of orbit, axis of rotation, reason for seasons)
● PHET Bending Light Simulation
● Interpreting H-R Diagram for Impacts on Climate</td></tr>
<tr><td>Sequence Topic
● Seasons (tilt of earth rotation/revolution)
● Energy capture in atmosphere
● Climate</td><td>ELA/Math Connection:</td></tr>
</table>

<table>
<tr>
<td rowspan="2">3
Sequence Plan

What is energy? What are the characteristics of energy?</td>
<td>● I can identify the properties of energy
● I can use this information, discussion, and collaboration to explore the phenomenon and revise the initial model about the year without a summer.</td>
<td rowspan="2"><table>
<tr><td></td><td>Selected Response</td></tr>
<tr><td>x</td><td>Constructed Response</td></tr>
<tr><td>x</td><td>Performance</td></tr>
<tr><td></td><td>Observation</td></tr>
</table></td>
<td rowspan="2">SEP | DCI | CCC

SEP:
● Plan an investigation
● Conduct an investigation
● Analyze data to make scientific claims
● Develop a model to represent relationships
● Communicate science ideas in varied forms
DCI:
● Energy is Conserved
● Energy is transferred
● Energy is not created or destroyed
● Energy is a quantitative property
● Some forms of energy are more or less useful
● Systems move to more stable states (uniform energy distribution….high to low)
CCC:
● Energy flows in, out, and within a system
● Empirical evidence is used to explain cause and effect and develop patterns
● Algebraic thinking is used to examine scientific data and predict the effect of a change in one variable on another</td>
<td>Common Assessment:
● (performance expectations)
Common Experience (lab/activity)
● Black/White Soda Can Lab (radiation)
● Analysis of Climate Data (from NOAA site)</td>
</tr>
<tr>
<td>Sequence Topic
● Energy defined
● Forms of energy
● Absorption
● Reflection</td>
<td>ELA/Math Connection:</td>
</tr>
<tr>
<td rowspan="2">4
Sequence Plan

What are the sources (and types) of energy? How is energy quantified and calculated?</td>
<td>● I can understand the different sources and types of energy
● I can make predictions and express or model energy mathematically
● I can use this information, discussion, and collaboration to explore the phenomenon and reveal the initial model about the year without a summer.</td>
<td rowspan="2"><table>
<tr><td></td><td>Selected Response</td></tr>
<tr><td>x</td><td>Constructed Response</td></tr>
<tr><td>x</td><td>Performance</td></tr>
<tr><td></td><td>Observation</td></tr>
</table></td>
<td rowspan="2">SEP | DCI | CCC

SEP:
● Develop a model to represent relationships
● Communicate science ideas in varied forms
● Use mathematics and computational thinking to develop a computational model
DCI:
● Energy exists in different forms (motion, sound, light, thermal, chemical, mechanical)
● Energy is a quantitative property
● Energy can be expressed mathematically and used to predict system behavior
● Energy can be stored - potential energy (calculated based on position)</td>
<td>Common Assessment:
● (performance expectations)
Common Experience (lab/activity)
● (link or description)</td>
</tr>
<tr>
<td>Sequence Topic
● Energy conversion
● Infrared
● UV
● Spectrum</td>
<td>ELA/Math Connection:</td>
</tr>
</table>

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<td>
● Kinetic energy can be calculated using speed and mass
● Energy depends on motion and interaction of matter in a system
● Energy depends on radiation in a system
● Calculate energy transfer
● Radioactive decay (nuclear fission) generates new forms of energy
● Linked to interior of Earth
● Nuclear fusion occurs in the Sun
CCC:
● Models will have boundaries with defined inputs and outputs to the system
● Change and rates of change can be quantified and modeled over time
● Algebraic thinking is used to examine scientific data and predict the effect of a change in one variable on another
</td>
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<tr>
<td>5
<u>Sequence Plan</u>

What are the results of energy in Earth's systems?</td>
<td>
● I can explain how energy moves in and the impacts of energy on Earth systems.
● I can use this information, discussion, and collaboration to explore the phenomenon and revise the initial model about the year without summer.

Sequence Topic
● Energy flow in systems
● Biotic influences
● Abiotic influences
</td>
<td>
<table>
<tr><td></td><td>Selected Response</td></tr>
<tr><td>x</td><td>Constructed Response</td></tr>
<tr><td>x</td><td>Performance</td></tr>
<tr><td></td><td>Observation</td></tr>
</table>
</td>
<td>
SEP | DCI | CCC

SEP:
● Develop a model to represent relationships
● Communicate science ideas in varied forms
DCI:
● Earth's systems change and interact causing feedback effects
● Water's unique properties shape Earth
● Energy flow impacts climate (volcanic eruptions, ocean circulation, solar output)
● Interactions of abiotic and biotic factors of Earth's systems cause climate changes
● Interactions between water (hydrologic) and rock cycle (Based on the framework progression, students should know the processes of the water and rock cycles.)
CCC:
● Energy drives the cycling of matter in a system
● Empirical evidence is used to explain cause and effect and develop patterns
</td>
<td>
Common Assessment:
● (performance expectations)
Common Experience (lab/activity)
● (link or description)
● NOW-- Venn diagram

ELA/Math Connection:
</td>
</tr>
<tr>
<td>6
<u>Sequence Plan</u>

How could we solve</td>
<td>
● I can use this information, discussion, and collaboration to explore the phenomenon and revise the initial model about the year without summer.
</td>
<td>
<table>
<tr><td></td><td>Selected Response</td></tr>
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<td>
SEP | DCI | CCC

SEP:
● Communicate science ideas in varied
</td>
<td>
Common Assessment:
● (performance expectations)
Common Experience (lab/activity)
● (link or description)
● Global warming lesson plan--NOW-PBS
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<tr>
<td rowspan="2">problems presented by “a year without summer”?

5E Lesson Plan Template</td>
<td>● I can use my model to make a prediction of the possibility of “another year without summer” and predict solutions to real-world problems caused by no summer</td>
<td rowspan="2"><table>
<tr><td>x</td><td>Constructed Response</td></tr>
<tr><td>x</td><td>Performance</td></tr>
<tr><td></td><td>Observation</td></tr>
</table></td>
<td rowspan="2">forms
● Evaluate evidence and determine the merits of arguments
● Design, evaluate, and or refine a solution to a problem and support with evidence
DCI:
● Design a solution to complex, real-world problems
● Break problems down into smaller, more manageable problems
● Solve problems through engineering
CCC:
● Models will have boundaries with defined inputs and outputs to the system
● Feedback can impact system stability
● Models can be used to predict the behavior of systems</td>
<td>● Students will select a topic from the suggested list.</td>
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<tr>
<td>Sequence Topic
● Economic impact of weather
● Solutions to dramatic weather changes</td>
<td>ELA/Math Connection:</td>
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Earth and Space 2: Mined Over Matter

UNWRAPPED STANDARDS

Standard		Dimensions of the NGSS Standard	Big Ideas	Academic Vocabulary
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.	SEP	**Engaging in Argument from Evidence** ● Evaluate evidence behind currently accepted explanations or solutions to determine the merits of arguments.	● The Earth's surface is like a cracked egg shell. ● Continents float on the mantle. ● There are 7 major crustal plates. ● There are 3 primary types of plate boundaries.	● Tectonics ● Continental drift ● Pangea ● Mantle ● Asthenosphere ● Magma ● Convection ● Subduction
	DCI	**ESS1.C: The History of Planet Earth** ● Continental rocks, which can be older than 4 billion years, are generally much older than the rocks of the ocean floor, which are less than 200 million years old. **ESS2.B: Plate Tectonics and Large-Scale System Interactions** ● Plate tectonics is the unifying theory that explains the past and current movements of the rocks at Earth's surface and provides a framework for understanding its geologic history. **PS1.C: Nuclear Processes** ● Spontaneous radioactive decays follow a characteristic exponential decay law. Nuclear lifetimes allow radiometric dating to be used to determine the ages of rocks and other materials.		
	CCC	**Patterns** ● Empirical evidence is needed to identify patterns.		
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.	SEP	**Constructing Explanations and Designing Solutions** ● Much of science deals with constructing explanations of how things change and how they remain stable.	● There are 17 elements that are classified as rare earth metals. ● Advances in technology have increased the demand for rare earth metals. ● China accounts for more than 90% of global rare earth minerals. ● Rare earth metals are spread evenly over the planet.	● Periodic table ● Economics ● Supply and demand ● Alloy ● Lanthanide series ● Environmental impact ● Best practice mining ● Recycling ● Leaching
	DCI	**ESS3.A: Natural Resources** ● Resource availability has guided the development of human society. **ESS3.B: Natural Hazards**		

		• Natural hazards and other geologic events have shaped the course of human history; [they] have significantly altered the sizes of human populations and have driven human migrations.	• Mining of rare earth metals has a significant impact on the environment.	
	CCC	**Cause and Effect** • Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.		
HS-ESS3-2 Evaluate competing design solutions for developing, managing, and utilizing energy and mineral resources based on cost-benefit ratios.*	**SEP**	**Engage in Argument from Evidence** • Evaluate competing design solutions to a real-world problem based on scientific ideas and principles, empirical evidence, and logical arguments regarding relevant factors (e.g. economic, societal, environmental, ethical considerations).	• As technology advances, demand for rare earth metals will increase. • Very limited recycling of these critical elements currently takes place. • Increased amounts of REE recycling is needed to ensure security of supply. • REEs are critical to modern life and society. • The vast majority of REEs are discarded into the trash after only one use. • Recycling could create greater environmental harm than mining.	• Cost benefit • Ethics • Environmental impact study • Recovery • Ore • Toxicity
	DCI	**ESS3.A: Natural Resources** • All forms of energy production and other resource extraction have associated economic, social, environmental, and geopolitical costs and risks as well as benefits. New technologies and social regulations can change the balance of these factors. **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)		
	CCC	• n**/a**		

Earth and Space 2: Mined Over Matter

Unit Phenomenon:
Storyline:
Students investigate the dynamic interplay between environmental, political, and economic factors involved in deciding whether the US should begin mining for rare earth elements (REEs) REEs are of tremendous interest to students as they are used in everyday technologies such as computers, cell phones, and televisions. Through hands-on activities students will explore the sources, uses and environmental threats of mining these materials, while examining the controversial question of whether the US should become self reliant in supplying REEs, regardless of the environmental consequences.

Adapted from *It's Debatable: Mined Over Matter*

Learning Sequence	**Objective(s):** The students will be able to:	Summative Assessment Strategy	Priority NGSS Dimensions	Common Learning Experiences
(1) Should rare Earth elements be mined in the United States? What are rare earth elements? What is the connection between REEs and technology?	• I can access prior knowledge about elements, minerals, and mining and their connection to products used by society. • I can demonstrate an understanding of the connections between science, technology and society. • I can connect science content learned in the classroom with larger community and societal issues.	<table><tr><td></td><td>Selected Response</td></tr><tr><td>x</td><td>Constructed Response</td></tr><tr><td>x</td><td>Performance</td></tr><tr><td></td><td>Observation</td></tr></table>	**SEP** | **DCI** | **CCC** • SEP-Much of science deals with constructing explanations of how things change and how they remain stable. • DCI-Resource availability has guided the development of human society. • CCC-Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.	Figure 6.1 The 17 rare earth minerals and their uses. Figure 6.2 Mine production and reserves of REEs ELA/Math Connection:
(2) What is your personal mineral consumption (demand)?	• I can calculate the total amount of selected minerals consumed in a lifetime. • I can explain the concept of supply and demand and its role in mining for certain minerals. • I can predict the impact of a limited mineral supply on society	<table><tr><td></td><td>Selected Response</td></tr><tr><td>x</td><td>Constructed Response</td></tr><tr><td>x</td><td>Performance</td></tr><tr><td></td><td>Observation</td></tr></table>	**SEP** | **DCI** | **CCC** • SEP-Evaluate evidence behind currently accepted explanations or solutions to determine the merits of arguments. • DCI-All forms of energy production and other resource extraction have associated economic, social, environmental, and geopolitical costs and risks as well as benefits. New technologies and social regulations can change the balance of these factors • DCI-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)	Worksheets 1 and 2--p.233-234. ELA/Math Connection:
(3) Where are rare earth metals found? How has plate tectonics and	• I can model the layers of the earth (include common substances) • I can explain how plate tectonics have led to an unequal distribution of REEs. • I can analyze the relationship between	<table><tr><td></td><td>Selected Response</td></tr><tr><td>x</td><td>Constructed Response</td></tr></table>	**SEP** | **DCI** | **CCC** • DCI-Natural hazards and other geologic events have shaped the course of human history; [they] have significantly altered	"Mountain Maker, Earth Shaker" interactive. Analysis questions. P. 238

the rock cycle impacted the location of these REEs?	Earth's layers, plate tectonics and the rock cycle.	x Performance Observation	the sizes of human populations and have driven human migrations. ● DCI-Plate tectonics is the unifying theory that explains the past and current movements of the rocks at Earth's surface and provides a framework for understanding its geologic history. ● DCI-Spontaneous radioactive decays follow a characteristic exponential decay law. Nuclear lifetimes allow radiometric dating to be used to determine the ages of rocks and other materials.	ELA/Math Connection:
(4) What is the relationship between elements, rocks and minerals?	● I can compare and contrast rocks, minerals, and elements. ● I can Identify and classify different rocks and minerals.	Selected Response x Constructed Response x Performance Observation	**SEP** **DCI** **CCC** ● DCI-Natural hazards and other geologic events have shaped the course of human history; [they] have significantly altered the sizes of human populations and have driven human migrations.	Lesson 3-p.240 ELA/Math Connection:
(5) What are the environmental and economic impacts of mining?	● I can explain the effects mining can have on the ground water supply. ● I can identify the toxic chemicals that are used to separate minerals from ores. ● I can explain how mining can cause air pollution. ● I can predict the impact of toxins on biodiversity.	Selected Response x Constructed Response x Performance Observation	**SEP** **DCI** **CCC** ● CCC-Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. ● SEP-Evaluate competing design solutions to a real-world problem based on scientific ideas and principles, empirical evidence, and logical arguments regarding relevant factors (e.g. economic, societal, environmental, ethical considerations).	Cookie mining activity--Earth Science Week--earth science week.org ELA/Math Connection:
(6) Should REEs be mined in the United States?	● I can explain why 80% of the REEs used in the U. S. are imported from China. ● I can predict the political ramifications of our reliance on a foreign country for REEs. ● I can explain why REEs are readily mined in China but not in the United States.	Selected Response x Constructed Response x Performance Observation	**SEP** **DCI** **CCC** ● Evaluate competing design solutions to a real-world problem based on scientific ideas and principles, empirical evidence, and logical arguments regarding relevant factors (e.g. economic, societal, environmental, ethical considerations).	Lesson 5--Digging Deeper--p.249 The decision making process. Lesson 6-The decision-making Process-p.252 Debate-Should the United States Mine rare earth Metals? ELA/Math Connection:

Earth and Space 3: Space Case

Resource: NASA Mission to Mars, NASA's Journey to Mars
National Geographic Curriculum Guide

UNWRAPPED STANDARDS

Standard	Dimensions of the NGSS Standard		Concepts and Disciplinary-Specific Vocabulary	Academic Vocabulary
	SEP	**Title** Content		
	DCI	**Title** Content		
	CCC	**Title** Content		
	SEP	**Title** Content		
	DCI	**Title** Content		
	CCC	**Title** Content		
	SEP	**Title** Content		
	DCI	**Title** Content		
	CCC	**Title** Content		
	SEP	**Title** Content		
	DCI	**Title** Content		
	CCC	**Title** Content		

	SEP	**Title** Content		
	DCI	**Title** Content		
	CCC	**Title** Content		
	SEP	**Title** Content		
	DCI	**Title** Content		
	CCC	**Title** Content		
	SEP	**Title** Content		
	DCI	**Title** Content		
	CCC	**Title** Content		

Earth and Space 3: Space Case

Unit Phenomenon:
Storyline: Who owns space? Do humans have the right to colonize extraterrestrial environments? Is Mars a viable environment?

Unit Essential Questions:

- What are the hierarchical relationships between planets and other astronomical bodies relative to the universe, including distance, size, and composition?
- Is Mars Earth 2?
- How will extending human presence into and beyond the solar system affect society and culture on Earth?
- What legal, ethical, and other value systems should govern human settlement and other activities in space?
- Are space settlements colonies?
- Do humans have the right to utilize or colonize extraterrestrial environments?
- Do humans have the right to use extraterrestrial resources?
- Should there be limits to how much “damage” can be done to another planet?
- Will advanced space technology improve life on Earth?
- Who will govern a space colony?
- Will settlements be public or private property?
- Do Earth laws apply in space?
- How realistic is a manned trip to Mars?
- What are the requirements for humans to survive on Mars?
- Should we assume Mars is ours?

Learning Sequence	**Objective(s):** The students will be able to:	Summative Assessment Strategy	Priority NGSS Dimensions	Common Learning Experiences
1 What are the hierarchical relationships between planets and other astronomical bodies relative to the universe, including, distance, size, and composition? Is Mars Earth 2?	I can identify the planets in the solar system. I can distinguish between the inner and outer planets based on composition, size , and location. I can create a scale model based on planetary nass, size, or distance. I can identify the physical characteristics of Mars, including the location, climate, geographical features, atmosphere, and surface.	☐ Selected Response ☐ Constructed Response ☐ Performance ☐ Observation	**SEP** **DCI** **CCC**	ELA/Math Connection:
2 How will extending human presence into and beyond the solar system affect society and culture on Earth? What legal, ethical, and other value systems should govern human settlement and other activities in space? Are space settlements colonies?	I can summarize the Outer Space Treaty adopted by the United Nations on December 19, 1966. I can compare and contrast Earth Law with Space Law. I can hypothesize the political ramifications of a new “space race”	☐ Selected Response ☐ Constructed Response ☐ Performance ☐ Observation	**SEP** **DCI** **CCC**	ELA/Math Connection:
3 Do humans have the right to utilize or colonize extraterrestrial environments? Should there be limits to how much “damage”can be done to another planet?		☐ Selected Response ☐ Constructed Response ☐ Performance ☐ Observation	**SEP** **DCI** **CCC**	ELA/Math Connection:
4 Will advanced space technology improve life on	I can identify 5 specific advances that have come from space exploration technologies.	☐ Selected Response	**SEP** **DCI** **CCC**	

Earth?		☐ Constructed Response ☐ Performance ☐ Observation		ELA/Math Connection:
5 Who will govern a space colony? Will settlements be public or private property? Do Earth laws apply in space?		☐ Selected Response ☐ Constructed Response ☐ Performance ☐ Observation	**SEP** **DCI** **CCC**	ELA/Math Connection:
6 How realistic is a manned trip to Mars? What are the requirements for humans to survive on Mars?	I can discuss what information we learned about Mars from previous space missions. I can discuss the personality traits required of the first Martian explorers. I can identify and understand what a new Martian colony would need for human survival.	☐ Selected Response ☐ Constructed Response ☐ Performance ☐ Observation	**SEP** **DCI** **CCC**	ELA/Math Connection:
7 Should we assume Mars is ours?	I can discuss the ethical question, "Just because we have the technical capacity to do something, does it mean we should do it?"	☐ Selected Response ☐ Constructed Response ☐ Performance ☐ Observation	**SEP** **DCI** **CCC**	ELA/Math Connection:

ADDITIONAL CONSIDERATIONS

COMMON MISCONCEPTIONS	PRIOR KNOWLEDGE NEEDED TO MASTER STANDARDS FOR THIS UNIT	ADVANCED STANDARDS FOR STUDENTS WHO HAVE DEMONSTRATED PRIOR MASTERY	OPPORTUNITIES FOR STUDENT-DIRECTED LEARNING WITHIN THE UNIT

RESOURCES			

Earth and Space 4: Meteorology

UNWRAPPED STANDARDS

Standard	Dimensions of the NGSS Standard		Big Ideas	Academic Vocabulary
HS-ESS2-1. Develop a model to illustrate how Earth's internal and surface processes operate at different spatial and temporal scales.	**SEP**	**Developing and Using Models** ● Develop a model based on evidence to illustrate the relationships between systems or between components of a system.	● Feedback mechanisms create weather events. Some are severe, others are not. ● Earth has a variety of climates defined by average temperature, precipitation, humidity, air pressure, and wind that have changed over time in a particular location. ● Day-to-day weather reports are different from overall climatic conditions for a region. ● The earth is surrounded by a thin envelope of gases called the atmosphere. This atmosphere is divided into five layers, each with compositional and other qualities. ● There are patterns to our seasonal climates and weather that are somewhat predictable, caused by the sun, the tilt of our planet, our latitude, proximity to large bodies of water, etc. ● Weather is a result of complex interactions of Earth's atmosphere, land, and water, that are driven by energy from the sun, and can be predicted and described through complex models.	● Feedback ● Climate ● Weather ● Weather patterns ● Atmospheric layers ○ Exosphere ○ Ionosphere ○ Aurora ○ Thermosphere ○ Mesosphere ○ Stratosphere ○ Troposphere ● Atmospheric composition (elements) ● Major ocean currents ● Seasons ● Latitude ● Direct/indirect sunlight ● Annual precipitation ● Humidity ● Air pressure ● Wind ● Redistribution ● Density ● Diurnal cycle ● Biodiversity ● Climate zones ○ Rain forest ○ Grassland ○ Ice caps ○ Tundra ○ Boreal forest ○ etc
	DCI	**Stability and Change** ● Change and rates of change can be quantified and modeled over very short or very long periods of time. Some system changes are irreversible.		
	CCC	**Stability and Change** ● Change and rates of change can be quantified and modeled over very short or very long periods of time. Some system changes are irreversible.		
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.	**SEP**	**Developing and Using Models** ● Use a model to provide mechanistic accounts of phenomena.	● There are 3 methods of heat transfer that occur in our atmosphere, causing climate and weather patterns. ● There are different types of clouds and they often indicate types of weather. ● The Earth undergoes differential	● Electromagnetic radiation ● Conduction ● Convection ● Radiation ● Re-radiation ● Rotation ● Revolution ● Ocean currents
	DCI	**ESS1.B: Earth and the Solar System** ● Cyclical changes in the shape of Earth's orbit around the sun, together with changes in the tilt of the planet's axis of rotation, both occurring over		

		hundreds of thousands of years, have altered the intensity and distribution of sunlight falling on the earth. These phenomena cause a cycle of ice ages and other gradual climate changes. (secondary) **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, 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. **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.	(unequal) heating which causes aspects of weather. ● Climate across the globe drives biodiversity and what species of living things exist in certain areas.	● Temperature ● Thermometer ● Fahrenheit ● Celsius ● Tilt-Seasons ● Albedo ● Unequal heating ● Storage ● Ultraviolet light ● Infrared ● Water vapor ● Chlorofluorocarbons ● Greenhouse gases ● Absorption ● Reflection ● Positive & negative feedback loops ● Types of clouds ○ Cumulus ○ Stratus ○ Cirrus ● Pollutants (carbon monoxide, SOx, NOx, Ozone, CO2 etc.) ● Altitude ● Ice age ● Volcano ● Glacier
	CCC	**Cause and Effect** ● Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.		
HS-ESS2-5. Plan and conduct an investigation of the properties of water and its effects on Earth materials and surface processes.	**SEP**	**Planning and Carrying Out Investigations** ● 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.	● Although most of our weather occurs in the troposphere, it is important to know the surrounding layers of the atmosphere. ● The water cycle, driven by the sun's energy, is an important component of weather/climate	● Troposphere ● Stratosphere ● Mesosphere ● Thermosphere ● Exosphere ● Water Cycle ○ Evaporation ○ Condensation ○ Precipitation ○ Surface runoff ○ Water cycle ○ Dew point ○ Saturation ○ Cloud cover ○ Wind direction ○ Visibility ○ Humidity (relative, etc)
	DCI	**ESS2.C: The Roles of Water in Earth's Surface Processes** ● The abundance of liquid water on Earth's surface and its unique combination of physical and chemical properties are central to the planet's dynamics. These properties include water's exceptional capacity to absorb, store, and release large amounts of energy, transmit sunlight, expand upon freezing, dissolving and transport of materials.		
	CCC	**Structure and Function** ● The functions and properties of natural and designed objects and systems can be inferred from their		

		overall structure, the way their components are shaped and used, and the molecular substructures of its various materials.		
HS-ESS2-6. Develop a quantitative model to describe the cycling of carbon among the hydrosphere, atmosphere, geosphere, and biosphere.	**SEP**	**Developing and Using Models** ContentDevelop a model based on evidence to illustrate the relationships between systems or between components of a system.	• The carbon cycle has possibly shifted or been altered due to human activity. What effect will this have on our future climate?	• Carbon dioxide • Global warming • Ice age • Climate change • Greenhouse gases • Heat • Greenhouse effect • Thermohaline circulation • Feedback loops • Open vs. Closed system
	DCI	**ESS2.D: Weather and Climate** • Gradual atmospheric changes were due to plants and other organisms that captured carbon dioxide and released oxygen. Changes in the atmosphere due to human activity have increased carbon dioxide concentrations and thus affect climate.		
	CCC	**Structure and Function** • The functions and properties of natural and designed objects and systems can be inferred from their overall structure, the way their components are shaped and used, and the molecular substructures of its various materials.		
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.	**SEP**	**Using Mathematics and Computational Thinking** • Use a computational representation of phenomena or design solutions to describe and/or support claims and/or explanations.	• In what way do humans have an impact on our atmosphere? • What changes in atmosphere does the future hold? • What do these changes mean for life on Earth?	• Industrial Revolution • Carbon Footprint
		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 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. (secondary) **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.		
		Systems and System Models • When investigating or describing a system, the boundaries and initial conditions of the system need to be defined and their inputs and outputs analyzed and described using models.		

Earth and Space 4: Meteorology

Unit Phenomenon:
Storyline: Our lives are constantly influenced by weather. A greater understanding of the mechanisms behind its generation will allow students do deal with the changes in a safe manner.

Unit Essential Questions:

- What was Earth's early atmosphere like, compared to what it is today?
- What are some ways in which the four spheres of the Earth interact?
- What is the difference between weather and climate?
- What is the structure and composition of the atmosphere?
- How do the layers of the atmosphere impact weather/climate and life on Earth?
- How does the temperature and density of the atmosphere change with altitude?
- What are the sources, and impacts, of pollutants in our atmosphere?
- What variables impact Earth's surface temperature?
- How does a change in surface and atmospheric temperature impact climate?
- Do all environments respond to climate change in the same way?
- What are the different cloud types we can observe?
- How do clouds form?
- How do different cloud types indicate weather?
- What are some major ocean currents that drive climate?

Learning Sequence	Learning Target(s)	Summative Assessment Strategy	Priority NGSS Dimensions	Common Learning Experiences
1 Phenomenon-Historic Climate Data What is the difference between weather and climate? What are some ways in which the four "spheres" (hydrosphere, biosphere, atmosphere, and geosphere) interact? What was Earth's early atmosphere like compared to the atmosphere today?	• I can draw and identify layers of Earth's present atmosphere and describe the difference between each. • I can compare Earth's early atmosphere to its present atmosphere. • I can compare and contrast day-to-day weather to overall climate patterns. • I can identify and use weather tools, terms, and symbols to collect weather data. • I can collect daily and analyze weather data and compare it to climate trends. • I can explore how Earth's four spheres interact to create specific regional climate and weather conditions. **Sequence Topics** • Weather • Climate • Spheres of Earth • Earth's early atmosphere • Meteorological tools • Cloud types	x Selected Response x Constructed Response x Performance x Observation	**SEP** / **DCI** / **CCC** **Using Mathematics and Computational Thinking** • Use a computational representation of phenomena or design solutions to describe and/or support claims and/or explanations. **ESS2.D: Weather and Climate** • Gradual atmospheric changes were due to plants and other organisms that captured carbon dioxide and released oxygen. **ESS2.A: Earth Materials and Systems** • Earth's systems, being dynamic and interacting, cause feedback effects that can increase or decrease the original changes. **Stability and Change** • Change and rates of change can be quantified and modeled over very short or very long periods of time. Some system changes are irreversible.	• Daily use of weather tools and weather apps for a weather report and record keeping throughout the semester. • Compare-contrast to forecasts from various sources. Begin to investigate why the inaccuracies? • Climate records from regions around the world-Graphing data (annual rainfall, etc) • Climate zones around the world - maps, powerpoint, jigsaw activity Resources: • Meteorology Labs • NASA Meteorology Guide • Better Lesson Resources • Temperature readings (Fahrenheit and Celsius conversion review) • Weather Analysis Lab • Video-Wind Currents and Weather • Atmosphere stations lab

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Phenomenon-Atmospheric Pollution Levels During COVID-19 Global Shutdown

What is the structure and composition of the atmosphere?

How does the temperature and density of the atmosphere change with altitude?

What are some sources and impacts of pollutants in the atmosphere?</td>
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I can explain the impact of solar radiation on each of the layers of the atmosphere.
I can identify the layers of the atmosphere and compare and contrast them in terms of temperature, densities, etc.
I can identify sources and impacts of atmospheric pollutants and explain their impact on climate conditions using historic climate data.
I can analyze pollutant and atmospheric data from COVID-19 and make a claim about the impact of pollutants on the atmosphere.

Sequence Topics:

Layers of the atmosphere
Composition of the atmosphere

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<tr><td>x</td><td>Observation</td></tr>
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SEP | DCI | CCC

Developing and Using Models

Develop a model based on evidence to illustrate the relationships between systems or between components of a system.

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.

Systems and System Models

When investigating or describing a system, the boundaries and initial conditions of the system need to be defined and their inputs and outputs analyzed and described using models.

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Lab activities:

Percent of oxygen in our air
Atmosphere structure and composition
Temperature and pressure lab

ELA/Math Connection:
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<td>3
Phenomenon-Albedo

What variables impact Earth’s surface temperature?

How does the heating of the layers of the atmosphere impact weather/climate and life on Earth?</td>
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I can explain the different methods of heating in the atmosphere.
I can investigate how the atmosphere heats up and cools off using models in the lab.
I can describe the connection between changes in atmospheric heat patterns and weather conditions.

Sequence Topics:

Conduction
Radiation
Convection
Seasonal changes
Direct/indirect sunlight
Unequal/differential heating
Albedo, feedback loops, and other factors

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SEP | DCI | CCC

Planning and Carrying Out Investigations

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.

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.

Cause and Effect

Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.

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<td>
Lab activities:

Radiation
Conduction
Convection

Heat Transfer Lab
Absorb/Emit Lab
Albedo activities/demo

ELA/Math Connection:
</td>
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<tr>
<td>4
Phenomenon-Seasons

What variables impact Earth’s surface 4 temperature?

How does a change</td>
<td>

I can investigate how direct and indirect sunlight impacts Earth’s surface temperature.
I can explain the connection between Earth’s surface temperature and meterologolcial conditions.
I can model how sunlight and the

</td>
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<table>
<tr><td>x</td><td>Selected Response</td></tr>
<tr><td>x</td><td>Constructed Response</td></tr>
<tr><td>x</td><td>Performance</td></tr>
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SEP | DCI | CCC

Planning and Carrying Out Investigations

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

</td>
<td>
Powerpoint notes
Lab activities:

Direct/indirect sunlight
Reasons for the Seasons
Review of basic geography (U.S. mostly) and general land forms

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</table>

in surface and atmospheric temperature impact climate?	seasons impact climate and corresponding weather conditions. **Sequence Topics:** Latitude Seasons Altitude Land vs. Water Albedo Coriolis Effect Ocean currents & wind direction Time of day Cities, etc.	☐ Observation	measurements and consider limitations on the precision of the data (e.g., number of trials, cost, risk, time), and refine the design accordingly. **ESS1.B: Earth and the Solar System** ● Cyclical changes in the shape of Earth's orbit around the sun, together with changes in the tilt of the planet's axis of rotation, both occurring over hundreds of thousands of years, have altered the intensity and distribution of sunlight falling on the earth. These phenomena cause a cycle of ice ages and other gradual climate changes. **ESS2.C: The Role of Water in Earth's Surface Processes** ● The abundance of liquid water on Earth's surface and its unique combination of physical and chemical properties are central to the planet's dynamics. These properties include water's exceptional capacity to absorb, store, and release large amounts of energy, transmit sunlight, expand upon freezing, dissolve and transport materials. **Stability and Change** ● Much of science deals with constructing explanations of how things change and how they remain stable.	ELA/Math Connection:
5 Phenomenon-Ocean's Role in Weather What are some major currents in the oceans that drive climate? How does a change in surface and atmospheric temperature impact ocean currents? How do changes in ocean currents impact weather and climate?	● I can examine Earth's major ocean currents. ● I can model the impact of changing surface and atmospheric temperatures on ocean currents. ● I can connect ocean currents to climate and meteorological changes. **Sequence Topics** World climate zones/biomes Greenhouse effect Climate change Oceanic currents, global circulation	x Selected Response x Constructed Response ☐ Performance x Observation	**SEP** / **DCI** / **CCC** **Using Mathematics and Computational Thinking** ● Use a computational representation of phenomena or design solutions to describe and/or support claims and/or explanations. **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 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. (secondary) **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. **Stability and Change** ● Much of science deals with constructing	● Graphics, discussion ● Webquest or other online research ● Video: What if Earth suddenly lost its atmosphere? ● Ocean currents activity and videos (Nike shoes, rubber ducks) ● Video: How do Ocean Currents Work? ELA/Math Connection:

<table>
<tr><td></td><td></td><td></td><td>explanations of how things change and how they remain stable.</td><td></td></tr>
<tr><td>6
Phenomenon-Clouds

What are the different cloud types we can observe?

How do clouds form?
How do different cloud types indicate weather?</td><td>● I can explain the connection between cloud types and altitudes, moisture content and weather conditions.
● I can examine the importance of the water cycle and its impact on weather/climate.
● I can analyze clouds and use meteorological symbols and tools to describe the weather.
● I can calculate and model specific and relative humidity on a weather map.

Sequence Topics
Water cycle
Cloud types
Relative Humidity</td><td>x Selected Response
x Constructed Response
x Performance
x Observation</td><td>SEP | DCI | CCC

Planning and Carrying Out Investigations
● 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.
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.
Cause and Effect
● Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effect</td><td>● Water cycle webquest
● Diagram of water cycle
● Types of precipitation
● Lab: cloud formation
● Identifying cloud types (height, structure) powerpoint, photos
● Lab: Wet vs. Dry bulb
● Calculating relative humidity

Resources:
● New York Science Teacher Files-Types of Clouds
● New York Science Teacher Files-Water Cycle</td></tr>
<tr><td>7
Phenomenon-Modeling weather

How do meteorologists represent patterns on weather maps?

How do we collect and track daily weather data?</td><td>● I can explain the function of each symbol used on a weather map.
● I can model a weather forecast using the appropriate symbols.

Sequence topics:
Weather symbols
Weather maps
reading/plotting weather maps</td><td>x Selected Response
x Constructed Response
x Performance
x Observation</td><td>SEP | DCI | CCC

Using Mathematics and Computational Thinking
● Use a computational representation of phenomena or design solutions to describe and/or support claims and/or explanations.
ESS2.D: Weather and Climate
● Gradual atmospheric changes were due to plants and other organisms that captured carbon dioxide and released oxygen.
ESS2.A: Earth Materials and Systems
● Earth’s systems, being dynamic and interacting, cause feedback effects that can increase or decrease the original changes.
Stability and Change
● Change and rates of change can be quantified and modeled over very short or very long periods of time. Some system changes are irreversible.</td><td>● Station Model Lab
● Daily weather log collecting data
● Writing a forecast
● Mapping, using symbols

Resource:
Meteorology Resources</td></tr>
</table>

Life Science 1: Food Fight

UNWRAPPED STANDARDS

Standard	Dimensions of the NGSS Standard		Big Ideas	Academic Vocabulary
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).	**SEP**	**Developing and Using Models** ● Develop and use a model based on evidence to illustrate the relationships between systems or between components of a system.	● Childhood obesity in the U.S. has increased over the last several decades. ● Many children lead sedentary lives. ● Fast food restaurants provide a "quick fix" meal solution. ● Some nations charge a "fat tax" for unhealthy foods. ● Eating healthy is expensive.	● Obese ● Sedentary ● Calorie ● Balanced diet
	DCI	**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. There is a single quantity called energy 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. ● At the macroscopic scale, energy manifests itself in multiple ways, such as in motion, sound, light, and thermal energy. ● 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.		
	CCC	**Energy and Matter** ● Energy cannot be created or destroyed; it only moves between one place and another place, between objects and/or fields, or between systems.		
HS-LS1-2. Develop and use a model to illustrate the hierarchical organization of interacting	**SEP**	**Developing and Using Models** ● Develop and use a model based on evidence to	● The digestion of food requires the coordination of several body	● Nutrition ● Photosynthesis

systems that provide specific functions within multicellular organisms. ● [Clarification Statement: Emphasis is on functions at the organism system level such as nutrient uptake, water delivery, and organism movement in response to neural stimuli. An example of an interacting system could be an artery depending on the proper function of elastic tissue and smooth muscle to regulate and deliver the proper amount of blood within the circulatory system.] ● [*Assessment Boundary: Assessment does not include interactions and functions at the molecular or chemical reaction level.*]		illustrate the relationships between systems or between components of a system.	systems. ● Energy flows in a system. ● Matter is conserved.	● Synthesis ● Decomposition ● Alimentary canal ● Digestive glands
	DCI	**LS1.A: Structure and Function** ● Multicellular organisms have a hierarchical structural organization, in which any one system is made up of numerous parts and is itself a component of the next level.		
	CCC	**Systems and System Models** ● Models (e.g., physical, mathematical, computer models) can be used to simulate systems and interactions—including energy, matter, and information flows—within and between systems at different scales.		
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. ● [Clarification Statement: Emphasis is on using evidence from models and simulations to support explanations.] ● *[Assessment Boundary: Assessment does not include the details of the specific chemical reactions or identification of macromolecules.]*	**SEP**	**Constructing Explanations and Designing Solutions** ● Construct and revise an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) 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.	● Carbon, hydrogen, and oxygen are building blocks in the cell. ● Elements can combine in several ways.	● Enzyme ● Dehydration ● Hydrolysis ● Organic ● Carbohydrate ● Hydrocarbon ● Monosaccharide ● Disaccharide ● Polysaccharide ● Amino acid ● DNA
	DCI	**LS1.C: Organization for Matter and Energy Flow in Organisms** ● 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. ● As matter and energy flow through different organizational levels of living systems, chemical elements are recombined in different ways to form different products.		
	CCC	**Energy and Matter** ● Changes of energy and matter in a system can be described in terms of energy and matter flows into, out of, and within that system.		

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. ● [Clarification Statement: Emphasis is on the conceptual understanding of the inputs and outputs of the process of cellular respiration.] ● *[Assessment Boundary: Assessment should not include identification of the steps or specific processes involved in cellular respiration.]*	**SEP**	**Developing and Using Models** ● Use a model based on evidence to illustrate the relationships between systems or between components of a system.	● Cellular respiration is a complex chemical process. ● Energy and matter continually flow through systems. ● Breaking chemical bonds releases energy. ● Energy is needed for growth and repair. ● Energy is conserved. ● Useful components of food are called nutrients. ● Daily Calorie needs vary from individual to individual. ● A balanced diet includes a variety and quantity of nutrients. ● Each nutrient has specific functions in the body. ● Not all food is digested.	● Homeostasis ● ATP ● Glycolysis ● Electron transport chain ● Kreb's cycle ● Aerobic ● Anaerobic ● Mitochondria ● Endothermic ● Protein ● Fat ● Sugar ● Starch ● Saturated ● Unsaturated ● Vitamins ● Minerals ● Roughage
	DCI	**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. ● 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.		
	CCC	**Energy and Matter** ● Energy cannot be created or destroyed; it only moves between one place and another place, between objects and/or fields, or between systems.		
HS-ETS1-1. Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.	**SEP**	**Asking Questions and Defining Problems** ● Analyze complex real-world problems by specifying criteria and constraints for successful solutions.	● Global food production is influenced by a variety of factors. ● Those with financial resources outbid the poor and increase hunger. ● Not all food produced goes directly to humans. ● Food additives have a wide variety of purposes and possible side effects. ● Reading food labels MAY provide some insight into what is consumed. ● We are influenced by food commercials. ● Global warming may impact food production.	● Arable ● GMO ● Food additive ● RDA ● Famine ● Biological control ● Pesticides
	DCI	**ETS1.A: Defining and Delimiting Engineering Problems** ● Criteria and constraints also include satisfying any requirements set by society, such as taking issues of risk mitigation into account, and they should be quantified to the extent possible and stated in such a way that one can tell if a given design meets them. ● Humanity faces major global challenges today, such as the need for supplies of clean water and food or for energy sources that minimize pollution, which can be addressed through engineering. These global challenges also may have manifestations in local communities.		
	CCC	**Influence of Science, Engineering, and Technology**		

		on Society and the Natural World ● New technologies can have deep impacts on society and the environment, including some that were not anticipated. Analysis of costs and benefits is a critical aspect of decisions about technology.		

Life Science 1: Food Fight

Unit Phenomenon:
Storyline: In an effort to encourage healthier eating habits some countries are considering adding a tax on unhealthy foods. In addition, foods additives as well as the introduction of GMOs have created much debate about the quality of the foods we consume. Students will analyze their eating habits and evaluate the safety and nutritional value of what they consume.

Unit Essential Questions:

Learning Sequence	**Objective(s):** The students will be able to:	Summative Assessment Strategy	Priority NGSS Dimensions	Common Learning Experiences
(1) What are the components of a high quality, healthy meal? How does your socioeconomic status impact your ability to access healthy food on a regular basis?	• I can share initial ideas about the relationship between socioeconomic and access to healthy food. • I can share my ideas about the components of a healthy meal. • I can ask questions to support a deeper understanding of the nutrients needed for a healthy body and how those nutrients are used.	☐ Selected Response ☒ Constructed Response ☒ Performance ☐ Observation	**SEP** / **DCI** / **CCC** • Construct and revise an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) 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.	It's debatable pp 56-58 ELA/Math Connection:
(2) How are foods categorized? (biomolecules) How does your body use each biomolecule? Which biomolecules are cheapest to purchase?	• I can identify the importance of each macromolecule (carbohydrates, proteins, fats). • I can compare and contrast nutritional values from food labels.	☐ Selected Response ☒ Constructed Response ☒ Performance ☐ Observation	**SEP** / **DCI** / **CCC** • 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. • As matter and energy flow through different organizational levels of living systems, chemical elements are recombined in different ways to form different products. • Energy cannot be created or destroyed; it only moves between one place and another place, between objects and/or fields, or between systems.	Biology U2, sequence 2: Brady's Diet It's Debatable Lessons 2 and 4(pp.60-63, 69-74) ELA/Math Connection:
(3) How do preservatives keep food fresh? How do preservatives impact the quality of food?	• I can make observations of factors that influence mold growth. • I can understand the fundamental differences between organic, preservatives, and all natural.	☐ Selected Response ☒ Constructed Response	**SEP** / **DCI** / **CCC** • The sugar molecules thus formed contain carbon, hydrogen, and oxygen: their hydrocarbon backbones are used to make	Food Preservation Investigation Analysis-Historical Approaches to food preservation

<table>
<tr>
<td>How do the costs of preservative rich foods compare to fresh foods?</td>
<td>

I can evaluate the use of food preservatives in food processing.
I can analyze the cost differences in fresh foods vs. processed foods.

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<tr><td></td><td>Observation</td></tr>
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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.

As matter and energy flow through different organizational levels of living systems, chemical elements are recombined in different ways to form different products.

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<td>ELA/Math Connection:</td>
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<td rowspan="2">(4)
How does the body get what it needs from food?</td>
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I can model the digestive system as different foods are introduced to the body. (focus on what happens with molecules understood by the body and those that are not such as preservatives.

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<tr><td></td><td>Selected Response</td></tr>
<tr><td>x</td><td>Constructed Response</td></tr>
<tr><td>x</td><td>Performance</td></tr>
<tr><td></td><td>Observation</td></tr>
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<td rowspan="2">
SEP | DCI | CCC

SEP-Develop and use a model based on evidence to illustrate the relationships between systems or between components of a system.
As matter and energy flow through different organizational levels of living systems, chemical elements are recombined in different ways to form different products.
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.
Multicellular organisms have a hierarchical structural organization, in which any one system is made up of numerous parts and is itself a component of the next level.
Energy cannot be created or destroyed; it only moves between one place and another place, between objects and/or fields, or between systems.

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<td>
Digestive system model comparison

Simple carbohydrates
Complex carbohydrates
Fats
Foods with combined preservatives

ELA/Math Connection:
</td>
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<tr>
<td>Sequence Topics</td>
</tr>
<tr>
<td>(5)
How can we test for unhealthy foods?

Are food labels a sufficient source of information to</td>
<td>

I can evaluate the nutritional value of a selected processed food and its healthy counterpart. (i.e potato chips vs popcorn)
I can distinguish the difference

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SEP | DCI | CCC

Construct and revise an explanation based on valid and reliable evidence obtained from a variety of sources

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<td>Cheeseburger on trial-Find the fat. Page 80</td>
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<td>understand the relative health of a food?</td>
<td>between high and low fat foods using a paper bag grease test.</td>
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<tr><td>x</td><td>Performance</td></tr>
<tr><td></td><td>Observation</td></tr>
</table>
</td>
<td>(including students’ own investigations, models, theories, simulations, peer review) 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.</td>
<td>ELA/Math Connection:</td>
</tr>
<tr>
<td>(6)
Debate:Should a law be passed requiring labels that identifies all GM foods in the U.S.?</td>
<td>

I can identify specific GMOs in food.
I can evaluate current government regulations.
I can compare and contrast laws in other countries.
I can make an argument for or against GMO food labels.

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<table>
<tr><td></td><td>Selected Response</td></tr>
<tr><td>x</td><td>Constructed Response</td></tr>
<tr><td>x</td><td>Performance</td></tr>
<tr><td></td><td>Observation</td></tr>
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<tr><th>SEP</th><th>DCI</th><th>CCC</th></tr>
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Analyze complex real-world problems by specifying criteria and constraints for successful solutions.
Humanity faces major global challenges today, such as the need for supplies of clean water and food or for energy sources that minimize pollution, which can be addressed through engineering. These global challenges also may have manifestations in local communities.

</td>
<td>Learning lab-USGBC Debate guidelines
GMO
CER-Food Labes

ELA/Math Connection:</td>
</tr>
</table>

Life Science 2: Shots and Vaccines

Link to CREC Unit (click here)
Link to Bristol Adapted Unit (click here)

UNWRAPPED STANDARDS

Standard	Dimensions of the NGSS Standard		Big Ideas	Academic Vocabulary
	SEP	**Title** Content		
	DCI	**Title** Content		
	CCC	**Title** Content		
	SEP	**Title** Content		
	DCI	**Title** Content		
	CCC	**Title** Content		
	SEP	**Title** Content		
	DCI	**Title** Content		
	CCC	**Title** Content		
	SEP	**Title** Content		
	DCI	**Title** Content		
	CCC	**Title** Content		
	SEP	**Title**		

		Content		
	DCI	**Title** Content		
	CCC	**Title** Content		
	SEP	**Title** Content		
	DCI	**Title** Content		
	CCC	**Title** Content		
	SEP	**Title** Content		
	DCI	**Title** Content		
	CCC	**Title** Content		

Life Science 2: Shots and Vaccines

Unit Phenomenon:
Storyline: Students will gain an understanding of the human immune system by studying the interactions between immunity and vaccinations, relationships between certain viruses and cancer, and the mechanisms of allergic reactions. In addition,students will discuss the personal,societal,and economic impacts of scientific innovations.

Unit Essential Questions:

- What is the function of the immune system?
- What are the effects of being born without an immune system?
- How does skin function as a defense against disease?
- Should Gardasil vaccinations be mandatory?
- Should any vaccination be mandatory?
- What is the relationship between vaccination and immunity?
- What is the difference between specific and nonspecific responses?
- Does immunity last for a person's lifetime?
- What happens during an immune response?
- What are autoimmune diseases?
- What are the various ways the body can develop immunity?
- What are the functions of B cells and T cells in an immune response?
- Why are some people born immune to certain diseases?
- Should there be a law requiring the mandatory vaccination against certain diseases?
- What lessons were learned from the 1918 influenza pandemic?

- What lessons were learned from the COVID-19 pandemic?

Learning Sequence	**Objective(s):** The students will be able to:	Summative Assessment Strategy	Priority NGSS Dimensions	Common Learning Experiences
(1) What is the function of the immune system? What are the effects of being born without an immune system? How does skin function as a defense against disease?	• I can identify the various ways the body prevents disease. • I can explain the immune response. • I can identify 5 natural barriers that provide disease protection.	[ ] Selected Response [x] Constructed Response [x] Performance [ ] Observation	**SEP** **DCI** **CCC**	"Understanding the Immune System" pamphlet published by NIH. Youtube video David Vetter. Bozeman Science-The immune System ELA/Math Connection:
(2) Should Gardasil vaccinations be mandatory? Should any vaccinations be mandatory?	• I can discuss the moral,ethical,scientific, and societal implications of requiring vaccinations. • I can explain the specific function of the Gardasil vaccination. • I can assess the validity of scientific research.	[ ] Selected Response [x] Constructed Response [x] Performance [ ] Observation	**SEP** **DCI** **CCC**	Position statement sheet--p198 (*It's Debatable)* Andrew Wakefield 1997 study. ELA/Math Connection:
(3) What is the relationship between vaccination and immunity? What is the difference between specific and nonspecific responses? Does immunity last for a person's lifetime?	• I can explain how vaccines provide immunity. • I can explain the antigen-antibody reaction.	[ ] Selected Response [x] xConstructed Response [x] Performance [ ] Observation	**SEP** **DCI** **CCC**	Concept map tracing various methods the body develops immunity to specific diseases. Edward Jenner's role, ethical ramifacations. Bozeman Science video-Vaccines and Herd Immunity. ELA/Math Connection:
(4) What happens during an immune response? What are autoimmune diseases?	• I can explain how certain biological responses can have both positive and negative effects. • I can describe the actions of B cells and T cells in an immune response.	[ ] Selected Response [x] Constructed Response [x] Performance [ ] Observation	**SEP** **DCI** **CCC**	Research and identify 5 specific immune disorders. B cell, T cell functions. ELA/Math Connection:

(5) What are the various ways a body can develop immunity? Why are some people born immune to certain diseases?	• I can distinguish among active, passive, natural, and acquired immunity.	[ ] Selected Response [x] Constructed Response [x] Performance [ ] Observation	**SEP**	**DCI**	**CCC**	Immunity concept map. ELA/Math Connection:
(6) Should there be laws requiring the mandatory vaccination against specific diseases? What lessons were learned from the 1918 influenza pandemic? What lessons were learned from the COVID-19 pandemic?	• I can rethink an original position based on additional information and research.	[ ] Selected Response [x] Constructed Response [x] Performance [ ] Observation	**SEP**	**DCI**	**CCC**	Lesson 5 Rethinking positions and relating the Gardasil debate to the nature of science. ELA/Math Connection:

ADDITIONAL CONSIDERATIONS

COMMON MISCONCEPTIONS	PRIOR KNOWLEDGE NEEDED TO MASTER STANDARDS FOR THIS UNIT	ADVANCED STANDARDS FOR STUDENTS WHO HAVE DEMONSTRATED PRIOR MASTERY	OPPORTUNITIES FOR STUDENT-DIRECTED LEARNING WITHIN THE UNIT

RESOURCES

Life Science 3: Cancer

UNWRAPPED STANDARDS

Standard	Dimensions of the NGSS Standard		Big Ideas	Academic Vocabulary
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. ● *[Assessment Boundary: Assessment does not include identification of specific cell or tissue types, whole body systems, specific protein structures and functions, or the biochemistry of protein synthesis.]*	**SEP**	**Constructing Explanations and Designing Solutions** ● Construct an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) 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.	● DNA contains the genetic code for synthesizing proteins. ● DNA is a nucleic acid. ● DNA consists of nucleotides. ● DNA is found in the chromosomes. ● The genetic code is unique to each individual. ● Genes are segments of DNA. ● Proteins are a chain of amino acids. ● DNA is a double helix.	● Transcription ● Translation ● Ribosome ● Nucleus ● Nucleotide ● Purine ● Pyrimidine ● Deoxyribose sugar ● Phosphate group ● Chromosome ● Histones ● Protein ● Amino acid ● Double helix
	DCI	**LS1.A: Structure and Function** ● Systems of specialized cells within organisms help them perform the essential functions of life. ● 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.		
	CCC	**Structure and Function** ● Investigating or designing new systems or structures requires a detailed examination of the properties of different materials, the structures of different components, and connections of components to reveal its function and/or solve a problem.		
HS-LS3-1. Ask questions to clarify relationships about the role of DNA and chromosomes in	**SEP**	**Asking Questions and Defining Problems** ● Ask questions that arise from examining models	● The DNA code consists of 4 nitrogen bases. ● DNA translates and transcribes	● Gene ● Chromosome ● m-RNA

coding the instructions for characteristic traits passed from parents to offspring. ● *[Assessment Boundary: Assessment does not include the phases of meiosis or the biochemical mechanism of specific steps in the process.]*		or a theory to clarify relationships.	the genetic code to RNA. ● All somatic cells contain the same number of chromosomes. ● Traits are passed from parent to offspring. ● The sequence of the bases varies from individual to individual. ●	● t-RNA
	DCI	**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. **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 codes for a protein; some segments of DNA are involved in regulatory or structural functions, and some have no as-yet known function.		
	CCC	**Cause and Effect** ● Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.		
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. ● [Clarification Statement: Emphasis is on using data to support arguments for the way variation occurs.] ● *[Assessment Boundary: Assessment does not include the phases of meiosis or the biochemical mechanism of specific steps in the process.]*	**SEP**	**Engaging in Argument from Evidence** ● Make and defend a claim based on evidence about the natural world that reflects scientific knowledge and student-generated evidence.	● Meiosis is a process of cell division that forms the gametes. ● Meiosis can result in genetic variation. ● Each gamete usually contains half the chromosome number. ● Mutations are errors in the genetic code. ● Genetic factors can cause mutations. ● Environmental factors can cause mutations ● Mutations are inherited.	● Meiosis ● Diploid ● Haploid ● Replication ● Mutagen ●
	DCI	**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. ● 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.		
	CCC	**Cause and Effect**		

		• Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.		
HS-LS1-4. Use a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms. • *[Assessment Boundary: Assessment does not include specific gene control mechanisms or rote memorization of the steps of mitosis.]*	**SEP**	**Developing and Using Models** • Develop and use a model based on evidence to illustrate the relationships between systems or between components of a system.	• Mitosis is a process where a single cell divides into two identical cells. • Cell size is limited. • All cells contain the same genetic material. • Cells will undergo differentiation. • Similar cells form tissues. • Mitosis is essential for growth and repair. • Mitosis is regulated. • Uncontrolled mitosis will result in abnormal cell production. • Cancer is a group of diseases involving abnormal cell growth.	• Fertilization • Daughter cell • Surface area • Volume • Tissue • Organ • System • Specialization • Differentiation • Benign • Malignant • Metastasis •
	DCI	**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.		
	CCC	**Systems and System Models** • Models (e.g., physical, mathematical, computer models) can be used to simulate systems and interactions—including energy, matter, and information flows—within and between systems at different scales.		
HS-LS3-3.Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population. • [Clarification Statement: Emphasis is on the use of mathematics to describe the probability of traits as it relates to genetic and environmental factors in the expression of traits.] • *[Assessment Boundary: Assessment does not include Hardy-Weinberg calculations.]*	**SEP**	**Analyzing and Interpreting Data** • Apply concepts of statistics and probability (including determining function fits to data, slope, intercept, and correlation coefficient for linear fits) to scientific and engineering questions and problems, using digital tools when feasible.	• -Each individual carries mutations. • -Not all mutations are lethal. • -Mutation brings about genetic diversity. •	• Adaptation • Diversity • Mendel • Punnett square • Inheritance •
	DCI	**LS3.B: Variation of Traits** • 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.		
	CCC	**Scale, Proportion, and Quantity** • Algebraic thinking is used to examine scientific		

		data and predict the effect of a change in one variable on another (e.g., linear growth vs. exponential growth). **Science is a Human Endeavor** ● Technological advances have influenced the progress of science and science has influenced advances in technology. ● Science and engineering are influenced by society and society is influenced by science and engineering.		

Life Science 3: Cancer

Unit Phenomenon:
Storyline: Students will apply their knowledge about cellular structure, function, and cell growth to increase their understanding about the development of cancer at the cellular level. Students will also identify common misconceptions of the disease and explore scientific research seeking a cure.

Essential Questions:
- What causes cancer?
- What causes a cell to become specialized?
- How do cancer cells compare to normal, specialized cells?
- How does DNA make protein?
- What is the role of DNA and chromosomes in the spread of cancer?
- Why do cells divide?
- How does the cell cycle in a cancer cell compare to a healthy cell?
- What is the role of chromosomes in genetic variation?
- What role does genetic variation play in the development of cancer?
- How are traits inherited?

Learning Sequence	**Objective(s):** The students will be able to:	Summative Assessment Strategy	Priority NGSS Dimensions	Common Learning Experiences
1 What causes cancer?	• I can make an initial evidence-based claim about the cause of cancer. • I can generate questions to drive learning about the cause(s) of cancer and how living things survive cancer. **Introduction to Anchor Phenomenon** • Introductions of the anchor phenomenon and collection of questions to drive instruction.	☐ Selected Response ☒ Constructed Response ☒ Performance ☐ Observation	**SEP** / **DCI** / **CCC** • SEP: Make and defend a claim based on evidence about the natural world that reflects scientific knowledge, and student-generated evidence. ⍟Ask questions that arise from examining models or a theory to clarify relationships. • DCI: (LS3.B) 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. ⍟(LS3.B) Environmental factors also affect expression of traits, and hence affect the probability of occurrence of traits in a population. Thus the variation and distribution of traits observed depends on both genetic and*	Assessment(s): • Initial claim and questions (process, not content) • Summary Table (link) Experience (lab/activity): • Cancer Survey and/or survivor stories • Cancer Driving Questions Board ELA/Math Connection: • n/a

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<td>environmental factors.
● CCC: Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.</td>
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What causes a cell to become specialized?

How do cancer cells compare to normal, specialized cells?</td>
<td>● I can develop a model to connect the structure of DNA to its function and identify its limitations.
● I can construct an explanation for how the function and structure of DNA results in the specialization of cells.
● I can develop a comparison model that identifies similarities and differences between normal, specialized cells and cancer cells.</td>
<td rowspan="2"><table><tr><td></td><td>Selected Response</td></tr><tr><td>x</td><td>Constructed Response</td></tr><tr><td>x</td><td>Performance</td></tr><tr><td></td><td>Observation</td></tr></table></td>
<td rowspan="2">SEP | DCI | CCC
● SEP: Construct an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) 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. ⍟Use a model based on evidence to illustrate the relationships between systems or between components of a system.
● DCI: (LS1.A) Systems of specialized cells within organisms help them perform the essential functions of life. ⍟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.
● CCC: Investigating or designing new systems or structures requires a detailed examination of the properties of different materials, the structures of different components, and connections of components to reveal its function and/or solve a problem.</td>
<td>Assessment(s):
● CREC Assessments: HS-LS1-1
● Summary Table (link)
● Comparison model
Experience (lab/activity):
● Specialized Cell Exploration Activity or Lab
● DNA model creation</td>
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<td>Specialized Cells
● Chromatin
● Chromosome
● DNA
● Genes
● Genetic Information
● Genetic variation
● Nucleolus
● Nucleus
● Protein
● RNA
● Specialized Cells</td>
<td>ELA/Math Connection:
ELA/Literacy
● RST.11-12.1 Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account.
● WHST.9-12.2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.
● WHST.9-12.9 Draw evidence from informational texts to support analysis, reflection, and research.</td>
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How does DNA make protein?

What is the role of DNA and chromosomes in the spread of cancer?</td>
<td>● I can construct an explanation for the role of DNA in developing proteins that carry out the work of the cell.
● I can create a comparative model representing the role of DNA in the production of proteins in a normal versus cancerous cell.
● I can use a model/simulation to develop an explanation of how DNA provides instructions for an organism's traits.</td>
<td rowspan="2"><table><tr><td></td><td>Selected Response</td></tr><tr><td>x</td><td>Constructed Response</td></tr><tr><td>x</td><td>Performance</td></tr><tr><td></td><td>Observation</td></tr></table></td>
<td rowspan="2">SEP | DCI | CCC
● SEP: Construct an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) 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. ⍟Ask questions that arise from examining models or a theory to clarify relationships.</td>
<td>Assessment(s):
● CREC Assessment: HS-LS3-1
● Summary Table (link)
Experience (lab/activity):
● DNA and protein synthesis modeling activity</td>
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<td>Protein Synthesis</td>
<td>ELA/Math Connection:</td>
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Adenine
Base Pairing Rules
Complementary strand
Cytosine
Deoxyribose
DNA sequence
Double Helix
Gene expression
Genotype
Guanine
Heredity
Nitrogenous Base
Phenotype
Phosphate
Thymine

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DCI: (LS1.A) Systems of specialized cells within organisms help them perform the essential functions of life. ⍟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. ⍟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 codes for a protein; some segments of DNA are involved in regulatory or structural functions, and some have no as-yet known function.
CCC:Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. ⍟Investigating or designing new systems or structures requires a detailed examination of the properties of different materials, the structures of different components, and connections of components to reveal its function and/or solve a problem.

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ELA/Literacy

RST.11-12.1 Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. (HS-LS3-1)
RST.11-12.9 Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible. (HS-LS3-1)

ELA/Math Connection:
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<td>4
Sequence Plan

Why do cells divide?

How does the cell cycle in a cancer cell compare to a healthy cell?

5E Sequence Planning Template</td>
<td>

I can create a model to describe the role of mitosis in the creation of differentiated cell types in multicellular organisms.
I can explain how a series of well controlled occurrences results in two identical cells by modeling the steps of mitosis.
I can evaluate the process of cell division by comparing/contrasting normal cell division and cancer cell division
I can statistically analyze data to identify relationships between different rates of cell cycle phases

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<table>
<tr><td></td><td>Selected Response</td></tr>
<tr><td>x</td><td>Constructed Response</td></tr>
<tr><td>x</td><td>Performance</td></tr>
<tr><td></td><td>Observation</td></tr>
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<tr><th>SEP</th><th>DCI</th><th>CCC</th></tr>
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SEP: Use a model based on evidence to illustrate the relationships between systems or between components of a system.
DCI: (LS1.B:) 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

</td>
<td>
Assessment(s):

CREC Assessment: HS-LS1-4
Summary Table (link)

Experience (lab/activity):

Mitosis Lab Activity or Agar Cube Diffusion
Comparison between cancerous and normal cell division

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<td>Cell Growth & Division
● Acquired trait
● Adaptation
● Beneficial change
● Body cells
● Detrimental change
● Differentiation
● Fertilization
● Interphase
● Mitosis</td>
<td></td>
<td>produce and maintain a complex organism, composed of systems of tissues and organs that work together to meet the needs of the whole organism.
● CCC: Models (e.g., physical, mathematical, computer models) can be used to simulate systems and interactions—including energy, matter, and information flows—within and between systems at different scales.</td>
<td>ELA/Math Connection:
Mathematics
● MP.4 Model with mathematics.
● HSF-BF.A.1 Write a function that describes a relationship between two quantities.</td>
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Sequence Plan

What is the role of chromosomes in genetic variation?

What role does genetic variation play in the development of cancer?

5E Sequence Planning Template</td>
<td>● I can identify scientific evidence that validates the claim: Sexual reproduction, which combines DNA in chromosomes, is a source of genetic variation.
● I can evaluate and critique evidence of meiosis as a form of cell division.
● I can make a claim that mutations are a source of genetic variation and that viable mutations are inherited
● I can analyze evidence of trait occurrences to identify patterns; differentiate between causes and correlations related to identified patterns.</td>
<td rowspan="2"><table><tr><td></td><td>Selected Response</td></tr><tr><td>x</td><td>Constructed Response</td></tr><tr><td>x</td><td>Performance</td></tr><tr><td></td><td>Observation</td></tr></table></td>
<td>SEP | DCI | CCC
● SEP: Make and defend a claim based on evidence about the natural world that reflects scientific knowledge, and student-generated evidence.
● DCI: (LS3.B) 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. ✪ (LS3.B) Environmental factors also affect expression of traits, and hence affect the probability of occurrence of traits in a population. Thus the variation and distribution of traits observed depends on both genetic and environmental factors.
● CCC: Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.</td>
<td>Assessment(s):
● CREC Assessment: HS-LS3-2
● CT NGSS IAB: HS-LS3-2
● Summary Table (link)
Experience (lab/activity):
● Meiosis lab, activity, or demonstration of phases and crossing-over
● DNA replication and mutation activity or research</td>
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<td>Sexual Reproduction (Meiosis)
● Allele
● Crossing Over
● Daughter cell
● Diploid
● DNA replication
● Gametes
● Genetic Variation
● Gregor Mendel
● Haploid
● Meiosis / Cell division
● Mutations
● Parent cell</td>
<td>ELA/Math Connection:
ELA/Literacy
● RST.11-12.1 Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account.
● WHST.9-12.1 Write arguments focused on discipline-specific content.

Mathematics
● MP.2 Reason abstractly and quantitatively.</td>
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Sequence Plan

How are traits inherited?

How does genetic testing</td>
<td>● I can use statistical analysis through punnett squares plots to predict patterns of inheritance traits.
● I can organize and interpret data to determine the effects of dominant and recessive alleles.</td>
<td><table><tr><td></td><td>Selected Response</td></tr></table></td>
<td>SEP | DCI | CCC
● SEP: Make and defend a claim based on evidence about the natural world that reflects scientific knowledge, and student-generated evidence. ✪Apply</td>
<td>Assessment(s):
● CREC Assessment HS-LS3-3, HS-LS3-2
● Summary Table (link)
● CER: Should everyone have a genetic testing for cancer?</td>
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provide a patient with probability of cancer? 5E Sequence Planning Template	• I can examine data to ask testable questions about the differences between dominant and recessive traits. **Genetics** • Distribution of traits • Expression of traits • Gene therapy • Genetic Factor • Genetic modification • GMO • Variation	x Constructed Response x Performance Observation	concepts of statistics and probability (including determining function fits to data, slope, intercept, and correlation coefficient for linear fits) to scientific and engineering questions and problems, using digital tools when feasible. ⍟Ask questions that arise from examining models or a theory to clarify relationships. • DCI: (LS3.B) 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. ⍟(LS1.A:) 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. ⍟ (LS3.B) 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. • CCC: Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. ⍟Algebraic thinking is used to examine scientific data and predict the effect of a change in one variable on another (e.g., linear growth vs. exponential growth).	Experience (lab/activity): • Punnett Square practice activity or Inherited Traits Lab • Karyotyping or Pedigree practice ELA/Math Connection: **ELA/Literacy** • RST.11-12.1 Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. (HS-LS3-1) • RST.11-12.9 Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible. (HS-LS3-1)
7 Sequence Plan What is the role of environment in genetic	• I can use evidence to make a claim about the effects of mutations in DNA. • I can evaluate the claims for the frequency of a trait caused by a mutation in a population.	Selected Response x Constructed Response	**SEP** | **DCI** | **CCC** • SEP: Make and defend a claim based on evidence about the natural world that reflects scientific knowledge, and	Assessment(s): • CREC Assessment: *HS-LS3-2, HS-LS3-3* • CER: mutations, genetic variation and inheritance

variation? How do certain environmental factors increase the risk of cancer? 5E Sequence Planning Template	• I can use evidence and scientific reasoning to defend a claim that mutations can create variation in proteins. • I can propose a solution and test it with a computer simulation. • I can make and defend a claim about the relationship between mutations, genetic variation and inheritance. • I can use reasoning to model/connect evidence that environmental factors can cause mutations and affect genetic traits. **Environmental Mutations** •	x Performance Observation	student-generated evidence. ⍟ Apply concepts of statistics and probability to scientific and engineering questions and problems, using digital tools when feasible. ⍟Use mathematical models and/or computer simulations to predict the effects of a design solution on systems and/or the interactions between systems. • DCI: (LS3.B) 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. ⍟(LS3.B) 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. ⍟(ETS1.B) 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 design will meet his or her needs. • CCC: Models (e.g., physical, mathematical, computer models) can be used to simulate systems and interactions—including energy, matter, and information flows—within and between systems at different scales.	• 9/11 Survivors and Cancer: Model how environmental effects cause cancer in 9/11 survivors. • Unit Summative Assessment: (link) Experience (lab/activity): • Investigation into chromosomal abnormalities or inherited disease and familial transmission or “One Wrong Letter” Tay-sachs investigation • Discussion or activity explaining how mutations may lead to evolution or Sickle Cell Computer Animation ELA/Math Connection: **ELA/Literacy** • RST.11-12.1 Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. • WHST.9-12.1 Write arguments focused on discipline-specific content. • WHST.9-12.9 Draw evidence from informational texts to support analysis, reflection, and research. **Mathematics** • MP.2 Reason abstractly and quantitatively. • MP.4 Model with mathematics.

Life Science 4: Interpreting the Fossil Record (Tiktaalik)

UNWRAPPED STANDARDS

Standard	Dimensions of the NGSS Standard		Concepts and Disciplinary-Specific Vocabulary	Academic Vocabulary
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.	**SEP**	**Constructing Explanations and Designing Solutions** ● Apply scientific reasoning to link evidence to the claims to assess the extent to which the reasoning and data support the explanation or conclusion.	●	●
	DCI	ESS1.C: The History of Planet Earth ● Although active geologic processes, such as plate tectonics and erosion, have destroyed or altered most of the very early rock record on Earth, other objects in the solar system, such as lunar rocks, asteroids, and meteorites, have changed little over billions of years. Studying these objects can provide information about Earth's formation and early history. PS1.C: Nuclear Processes ● Spontaneous radioactive decays follow a characteristic exponential decay law. Nuclear lifetimes allow radiometric dating to be used to determine the ages of rocks and other materials. (secondary)		
	CCC	**Stability and Change** ● Much of science deals with constructing explanations of how things change and how they remain stable.		
HS-LS4-1. Communicate scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence.	**SEP**	**Obtaining, Evaluating and Communicating Information** ● Communicate scientific information (e.g., about phenomena and/or the process of development and the design and performance of a proposed process or system) in multiple formats (including orally, graphically, textually, and mathematically).		
	DCI	**LS4.A: Evidence of Common Ancestry and Diversity** ● Genetic information, like the fossil record, 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.		
	CCC	**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.		
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. [	**SEP**	**Constructing Explanations and Designing Solutions** ● Construct an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) 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.	●	●
	DCI	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. 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.		
	CCC	**Cause and Effect** ● Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.		
HS-LS4-3. Apply concepts of statistics and probability to support explanations that organisms with an advantageous heritable trait tend to increase in proportion to organisms lacking this trait.	**SEP**	**Analyzing and Interpreting Data** ● Apply concepts of statistics and probability (including determining function fits to data, slope, intercept, and correlation coefficient for linear fits) to scientific and engineering questions and problems, using digital tools when feasible.	●	●
	DCI	**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. ● The traits that positively affect survival are more likely to be reproduced, and thus are more common in the population. **LS4.C: Adaptation** ● 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. ● Adaptation also means that the distribution of traits in a population can change when conditions change.		
	CCC	**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.		
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.	**SEP**	**Engaging in Argument from Evidence** ● Evaluate the evidence behind currently accepted explanations or solutions to determine the merits of arguments.	●	●
	DCI	**LS4.C: Adaptation** ● 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. ● 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.		
	CCC	**Cause and Effect** ● Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.		

Life Science: Interpreting the Fossil Record (Tiktaalik)

Unit Phenomenon: https://cptv.pbslearningmedia.org/resource/evol07.sci.life.evo.lptiktaalik/tiktaalik-evolution-of-a-fishapod/ tiktaalik
Storyline:
https://tiktaalik.uchicago.edu/resources.html
https://www.biointeractive.org/classroom-resources/your-inner-fish

Unit Essential Questions:

Learning Sequence	**Objective(s):** The students will be able to:	Summative Assessment Strategy	Priority NGSS Dimensions	Common Learning Experiences
(1) How do fossils help us understand life over time?	• I can make observations to identify similarities and differences of known and unknown fossils in an attempt to classify an unknown organism. Students will look at an image of a tiktaalik fossil (presented to students as an unknown) and a variety of known fossils. Students will make observations of the unknown and known samples to identify similarities and differences in an attempt to classify the mystery fossil. After students , in their collaborative groups come up with some of their ideas about what this organism is, what the students need to know more about inorder to get a better understanding of the fossil/organism (questions).	☐ Selected Response ☐ Constructed Response ☐ Performance ☐ Observation	**SEP** / **DCI** / **CCC** •	ELA/Math Connection:
(2) What are fossils? What parts of an organism fossilizes? Do all organisms fossilize?	• I can identify patterns in fossil remains to construct an explanation of what parts of an organism fossilize. • Need more HS content here Use real fossils and ask kids to make notice about what the fossils have in common and the types of tissues they represent. Types of fossils-imprints, mineralized structures, etc.	☐ Selected Response ☐ Constructed Response ☐ Performance ☐ Observation	**SEP** / **DCI** / **CCC** •	ELA/Math Connection:
(3) How can we determine the age of a fossil? What is the fossil record?	• I can analyze the patterns of fossils to determine the relative age. Rock strata and sedimentary rock. Radioactive dating and relative dating (layers) Bring the mystery fossil back into the discussion, provide some of the data to help students identify the relative age of the fossil. (this should prompt students to realize that they need to understand the complete fossil record/geologic time to make an estimation about the age of the mystery fossil)	☐ Selected Response ☐ Constructed Response ☐ Performance ☐ Observation	**SEP** / **DCI** / **CCC** •	ELA/Math Connection:

(4) How does the fossil record help us figure out geologic time?	• I can interpret data from the fossil record to construct an explanation of how life has changed over time. • I can use the data as evidence to place the mystery fossil on the time scale. • I can use the geologic time scale to predict the events that caused changes in life over geologic time. Students analyze the time scale and make note of changes in organisms . Using that evidence, students will place the mystery fossil in the time period they believe it belongs. Note changes in living things on the timeline. Bring in the structural comparisons of limbs (homologous and analogous structures.		Selected Response Constructed Response Performance Observation	**SEP**	**DCI**	**CCC**	ELA/Math Connection:
				•			
(5) What factors can and cannot be understood through the fossil record? What data, besides the fossil record can be used to understand evolutionary trends?	• I can interpret the fossil record to explain evolutionary trends. • I can define which factors of evolution can and cannot be understood through the fossil record. • I can evaluate the evidence in the fossil record to make a claim about the conditions that led to a change in a species (adaptation/extinction).		Selected Response Constructed Response Performance Observation	**SEP**	**DCI**	**CCC**	ELA/Math Connection:
				•			

ADDITIONAL CONSIDERATIONS

COMMON MISCONCEPTIONS	PRIOR KNOWLEDGE NEEDED TO MASTER STANDARDS FOR THIS UNIT	ADVANCED STANDARDS FOR STUDENTS WHO HAVE DEMONSTRATED PRIOR MASTERY	OPPORTUNITIES FOR STUDENT-DIRECTED LEARNING WITHIN THE UNIT

RESOURCES

Energy 1: Electricity and Magnetism

UNWRAPPED STANDARDS

Standard		Dimensions of the NGSS Standard	Concepts and Disciplinary-Specific Vocabulary	Academic Vocabulary
HS-PS2-5. Plan and conduct an investigation to provide evidence that an electric current can produce a magnetic field and that changing magnetic fields can produce an electric current.	**SEP**	**Planning and carrying Out Investigations** ● 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.	● Electric ● Electric Current ● Electric Energy ● Magnetic field ● Magnetism ● Wire ● Conductor ● Generator ● Insulator ● Electric field ● Magnetic field ● battery	● Data ● Investigation ● Empirical evidence ●
	DCI	**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; electric charges or changing magnetic fields cause electric fields. **PS3.A: Definitions of Energy** ● "Electrical energy" may mean energy stored in a battery or energy transmitted by electric currents. (secondary)		
	CCC	**Cause and Effect** ● Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.		
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.	**SEP**	**Using Mathematical and Computational Thinking** ● Use mathematical representations of phenomena to describe explanations.	● Magnetic field ● Electric field ● Electricity ● Electric Current	● Phenomena ●
	DCI	**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.~~ ● 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.		
	CCC	**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.		
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 motion of particles (objects) and energy associated with the relative positions of particles (objects).	**SEP**	**Developing and Using Models** ● Develop and use a model based on evidence to illustrate the relationships between systems or between components of a system.	● Ohm's Law ● Resistance ● Voltage ● Current ● Electric power ● Electrical energy	●
	DCI	**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 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. ● At the macroscopic scale, energy manifests itself in multiple ways, such as in motion, sound, light, and thermal energy. ● 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.		
	CCC	**Energy and Matter** ● Energy cannot be created or destroyed—only moves between one place and another place, between objects and/or fields, or between systems.		
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.	**SEP**	**Constructing Explanations and Designing Solutions** ● Design, evaluate, and/or refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence,	● Magnet turbine ● Transformer ● Transmission lines ● Conservation	●

		prioritized criteria, and trade off considerations.	• Efficiency • Grid • Power • Alternating Current • Direct Current • Sector	
	DCI	**PS3.A: Definitions of Energy** • At the macroscopic scale, energy manifests itself in multiple ways, such as in motion, sound, light, and thermal energy. **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. **ETS1.A: Defining and Delimiting an Engineering Problem** • Criteria and constraints also include satisfying any requirements set by society, such as taking issues of risk mitigation into account, and they should be quantified to the extent possible and stated in such a way that one can tell if a given design meets them. (secondary)		
	CCC	**Energy and Matter** • Changes of energy and matter in a system can be described in terms of energy and matter flows into, out of, and within that system.		
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. [	**SEP**	**Using Mathematics and Computational Thinking** • Create a computational model or simulation of a phenomenon, designed device, process, or system.	• Efficiency • Conservation	•
	DCI	**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. There is a single quantity called energy 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. **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. • Energy cannot be created or destroyed, but it can be transported from one place to another and transferred between systems. • 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. • The availability of energy limits what can occur in any system.		

	CCC	**System and System Models** ● Models can be used to predict the behavior of a system, but these predictions have limited precision and reliability due to the assumptions and approximations inherent in models.		

Energy 1: Electricity and Magnetism

Unit Phenomenon: Let there be light.
Storyline: The development of the light bulb has been considered to be the greatest scientific achievement since the discovery of fire. What is electricity, where does it come from, and how has it changed society?

- Unit Essential Questions:
- What is the history of electricity?
- How did the development of Alternating Current (AC) support electrical infrastructure?
- What was the role of the light bulb in building an electrical infrastructure?
- What is the connection between magnetism and electricity?
- How is electricity generated?
- How is electricity used to light a lightbulb?
- How is electricity measured and described in a circuit?
- What is the relationship between Ohm's and the lightbulb filament?
- How does electricity move through the power grid?
- What sectors use the most electrical energy?
- How does the current electrical usage align to the historical driver for developing an electrical society?
- How does improving the efficiency of light bulbs impact electricity consumption?

Learning Sequence	**Objective(s):** The students will be able to:	**Summative Assessment Strategy**	**Priority NGSS Dimensions**	**Common Learning Experiences**
(1) What is the history of electricity? How did the development of Alternating Current (AC) support electrical infrastructure? What was the role of the light bulb in building an electrical infrastructure?	● I can create a timeline to describe the history of electricity and the light bulb. ● I can describe the role of key scientists in the creation of usable electric current and light bulbs. ● I can differentiate between alternating and direct current and explain the role of each in the history of electricity. ● I can analyze the historical timelines of electricity and light bulbs to identify which (light bulb or electricity) had the greatest impact on the development of electrical societies.	☐ Selected Response ☒ Constructed Response ☐ Performance ☐ Observation	**SEP** / **DCI** / **CCC** **PS2.B: Types of Interactions** ● 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. **PS3.A: Definitions of Energy** ● "Electrical energy" may mean energy stored in a battery or energy transmitted by electric currents. (secondary) **Cause and Effect** ● Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.	Timeline-HIstory of Electricity and Use (NEED p62-63) CER-Pivotal moment in history of electricity ELA/Math Connection:
(2) What is the connection between magnetism and	● I can investigate the generation of an electrical current using a magnet. ● I can model how an electric current is generated in a generator.	☐ Selected Response	**SEP** / **DCI** / **CCC** **Planning and carrying Out Investigations** ● Plan and conduct an investigation individually	Electricity Investigation (Copper Wire and Nail) Constructed Explanatory Model-Creating an Electric Current

<table>
<tr>
<td>electricity?

How is electricity generated?

How is electricity used to light a lightbulb?</td>
<td>● I can model how an electrical current is used to light an edison style light bulb.</td>
<td>
<table>
<tr><td>x</td><td>Constructed Response</td></tr>
<tr><td>x</td><td>Performance</td></tr>
<tr><td></td><td>Observation</td></tr>
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</td>
<td>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.
Cause and Effect
● Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.</td>
<td>ELA/Math Connection:</td>
</tr>
<tr>
<td>(3)
How is electricity measured and described in a circuit?

What is the relationship between Ohm’s and the lightbulb filament?</td>
<td>● I can investigate and define the parts and types of circuit.
● I can explain the relationship between voltage, current and resistance using Ohm’s law.
● I can model how an electrical circuit is used to light a light bulb.
● I can use Ohm’s law to calculate resistance.
● I can describe the relationship between Ohm’s law and lighting an Edison style light bulb.</td>
<td>
<table>
<tr><td></td><td>Selected Response</td></tr>
<tr><td>x</td><td>Constructed Response</td></tr>
<tr><td>x</td><td>Performance</td></tr>
<tr><td></td><td>Observation</td></tr>
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<tr><th>SEP</th><th>DCI</th><th>CCC</th></tr>
</table>
Using Mathematical and Computational Thinking
● Use mathematical representations of phenomena to describe explanations.
Developing and Using Models
● Develop and use a model based on evidence to illustrate the relationships between systems or between components of a system.
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.
● At the macroscopic scale, energy manifests itself in multiple ways, such as in motion, sound, light, and thermal energy.
● 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.
Patterns
● Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in</td>
<td>Explanatory Model: Complete circuit-Lighting a lightbulb

Calculations using Ohm's

Circuit building investigation

ELA/Math Connection:</td>
</tr>
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<table>
<tr><td></td><td></td><td></td><td>explanations of phenomena.</td><td></td></tr>
<tr><td>(4)
How does electricity move through the power grid?

What sectors use the most electrical energy?

How does the current electrical usage align to the historical driver for developing an electrical society?</td><td>● I can investigate the parts of the electrical grid/infrastructure.
● I can define which sectors use the greatest amounts of electrical energy, presently and historically.
● I can visually represent the amount of electrical energy used for lighting in both residential and commercial use.</td><td><table><tr><td></td><td>Selected Response</td></tr><tr><td>x</td><td>Constructed Response</td></tr><tr><td>x</td><td>Performance</td></tr><tr><td></td><td>Observation</td></tr></table></td><td>SEP | DCI | CCC

System and System Models
● Models can be used to predict the behavior of a system, but these predictions have limited precision and reliability due to the assumptions and approximations inherent in models.</td><td>Research-history of electrical grid (westinghouse vs Edison)

ELA/Math Connection:</td></tr>
<tr><td>(5)
How does improving the efficiency of light bulbs impact electricity consumption?</td><td>● I can describe how the light bulb design impacts the amount of electricity consumption.
● I can investigate and compare incandescent efficiency to that of a fluorescent or LED bulb.
● I can explain how Ohm’s Law can be used to define the relative efficiency of a lightbulb.</td><td><table><tr><td></td><td>Selected Response</td></tr><tr><td>x</td><td>Constructed Response</td></tr><tr><td>x</td><td>Performance</td></tr><tr><td></td><td>Observation</td></tr></table></td><td>SEP | DCI | CCC

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.
● Energy cannot be created or destroyed, but it can be transported from one place to another and transferred between systems.
● 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.
● The availability of energy limits what can occur in any system.</td><td>Investigation-electrical efficiency
Electrical efficiency calculations

ELA/Math Connection:</td></tr>
</table>

RESOURCES

[The NEED Project]
Circuit building kits
Kil-a-watt meters

Energy 2: Energy Consumption, Efficiency and Conservation				
UNWRAPPED STANDARDS				
Standard	**Dimensions of the NGSS Standard**		**Concepts and Disciplinary-Specific Vocabulary**	**Academic Vocabulary**
	SEP	**Title** ● Content	●	●
	DCI	**Title** ● Content		
	CCC	**Title** ● Content		
	SEP	**Title** ● Content	●	●
	DCI	**Title** ● Content		
	CCC	**Title** ● Content		
	SEP	**Title** ● Content	●	●
	DCI	**Title** ● Content		
	CCC	**Title** ● Content		
	SEP	**Title** ● Content	●	●
	DCI	**Title** ● Content		
	CCC	**Title** ● Content		
	SEP	**Title** ● Content	●	●
		Title		

		• Content		
		Title • Content		

Energy 2: Energy Consumption, Efficiency and Conservation

Link to CREC Unit (click here)
Link to Bristol Adapted Unit (click here)

Unit Phenomenon:
Storyline:

Unit Essential Questions:

Learning Sequence	**Objective(s):** The students will be able to:	Summative Assessment Strategy	Priority NGSS Dimensions	Common Learning Experiences
(#) Insert Link to Lesson Plan	•	☐ Selected Response ☐ Constructed Response ☐ Performance ☐ Observation	**SEP** **DCI** **CCC** •	ELA/Math Connection:
(#) Insert Link to Lesson Plan	•	☐ Selected Response ☐ Constructed Response ☐ Performance ☐ Observation	**SEP** **DCI** **CCC** •	ELA/Math Connection:
(#) Insert Link to Lesson Plan	•	☐ Selected Response ☐ Constructed Response ☐ Performance	**SEP** **DCI** **CCC** •	ELA/Math Connection:

		Observation		
(#) Insert Link to Lesson Plan	•	Selected Response Constructed Response Performance Observation	**SEP** | **DCI** | **CCC** •	 ELA/Math Connection:
(#) Insert Link to Lesson Plan	•	Selected Response Constructed Response Performance Observation	**SEP** | **DCI** | **CCC** •	 ELA/Math Connection:
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(#) Insert Link to Lesson Plan	•	Selected Response Constructed Response Performance Observation	**SEP** | **DCI** | **CCC** •	 ELA/Math Connection:

ADDITIONAL CONSIDERATIONS			
COMMON MISCONCEPTIONS	**PRIOR KNOWLEDGE NEEDED TO MASTER STANDARDS FOR THIS UNIT**	**ADVANCED STANDARDS FOR STUDENTS WHO HAVE DEMONSTRATED PRIOR MASTERY**	**OPPORTUNITIES FOR STUDENT-DIRECTED LEARNING WITHIN THE UNIT**
RESOURCES			

Energy 3: Biofuels

UNWRAPPED STANDARDS

Standard	Dimensions of the NGSS Standard		Concepts and Disciplinary-Specific Vocabulary	Academic Vocabulary
	SEP	**Title** ● Content	●	●
	DCI	**Title** ● Content		
	CCC	**Title** ● Content		
	SEP	**Title** ● Content	●	●
	DCI	**Title** ● Content		
	CCC	**Title** ● Content		

	SEP	**Title** ● Content	●	●
	DCI	**Title** ● Content		
	CCC	**Title** ● Content		
	SEP	**Title** ● Content	●	●
	DCI	**Title** ● Content		
	CCC	**Title** ● Content		
	SEP	**Title** ● Content	●	●
		Title ● Content		
		Title ● Content		

Energy 3:Biofuels

Link to CREC Unit (click here)
Link to Bristol Adapted Unit (click here)

Unit Phenomenon:
Storyline:

Unit Essential Questions:

Learning Sequence	**Objective(s):** The students will be able to:	**Summative Assessment Strategy**	**Priority NGSS Dimensions**	**Common Learning Experiences**
(#) Insert Link to Lesson Plan	●	☐ Selected Response ☐ Constructed Response ☐ Performance	**SEP** / **DCI** / **CCC** ●	ELA/Math Connection:

		Observation		
(#) Insert Link to Lesson Plan	•	Selected Response Constructed Response Performance Observation	**SEP** **DCI** **CCC** •	 ELA/Math Connection:
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Insert Link to Lesson Plan		☐ Selected Response ☐ Constructed Response ☐ Performance ☐ Observation	•	ELA/Math Connection:
(#) Insert Link to Lesson Plan	•	☐ Selected Response ☐ Constructed Response ☐ Performance ☐ Observation	**SEP** / **DCI** / **CCC** •	ELA/Math Connection:

ADDITIONAL CONSIDERATIONS

COMMON MISCONCEPTIONS	PRIOR KNOWLEDGE NEEDED TO MASTER STANDARDS FOR THIS UNIT	ADVANCED STANDARDS FOR STUDENTS WHO HAVE DEMONSTRATED PRIOR MASTERY	OPPORTUNITIES FOR STUDENT-DIRECTED LEARNING WITHIN THE UNIT

RESOURCES

Energy 4: Alternative Energy Sources

UNWRAPPED STANDARDS				
Standard	**Dimensions of the NGSS Standard**		**Concepts and Disciplinary-Specific Vocabulary**	**Academic Vocabulary**
	SEP	**Title** ● Content	●	●
	DCI	**Title** ● Content		
	CCC	**Title** ● Content		
	SEP	**Title** ● Content	●	●
	DCI	**Title** ● Content		
	CCC	**Title** ● Content		
	SEP	**Title** ● Content	●	●
	DCI	**Title** ● Content		
	CCC	**Title** ● Content		
	SEP	**Title** ● Content	●	●
	DCI	**Title** ● Content		
	CCC	**Title** ● Content		
	SEP	**Title** ● Content	●	●
		Title ● Content		
		Title ● Content		

Energy 4: Alternative Energy

Link to CREC Unit (click here)
Link to Bristol Adapted Unit (click here)

Unit Phenomenon:
Storyline:

Unit Essential Questions:

Learning Sequence	**Objective(s):** The students will be able to:	Summative Assessment Strategy	Priority NGSS Dimensions	Common Learning Experiences
(#) Insert Link to Lesson Plan	•	☐ Selected Response ☐ Constructed Response ☐ Performance ☐ Observation	**SEP** **DCI** **CCC** •	ELA/Math Connection:
(#) Insert Link to Lesson Plan	•	☐ Selected Response ☐ Constructed Response ☐ Performance ☐ Observation	**SEP** **DCI** **CCC** •	ELA/Math Connection:
(#) Insert Link to Lesson Plan	•	☐ Selected Response ☐ Constructed Response ☐ Performance ☐ Observation	**SEP** **DCI** **CCC** •	ELA/Math Connection:
(#) Insert Link to Lesson Plan	•	☐ Selected Response	**SEP** **DCI** **CCC** •	

		☐ Constructed Response ☐ Performance ☐ Observation		ELA/Math Connection:
(#) Insert Link to Lesson Plan	•	☐ Selected Response ☐ Constructed Response ☐ Performance ☐ Observation	**SEP** / **DCI** / **CCC** •	ELA/Math Connection:
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(#) Insert Link to Lesson Plan	•	☐ Selected Response ☐ Constructed Response ☐ Performance ☐ Observation	**SEP** / **DCI** / **CCC** •	ELA/Math Connection:

ADDITIONAL CONSIDERATIONS

COMMON MISCONCEPTIONS	PRIOR KNOWLEDGE NEEDED TO MASTER STANDARDS FOR THIS UNIT	ADVANCED STANDARDS FOR STUDENTS WHO HAVE DEMONSTRATED PRIOR MASTERY	OPPORTUNITIES FOR STUDENT-DIRECTED LEARNING WITHIN THE UNIT

RESOURCES			

Unit: name				
UNWRAPPED STANDARDS				
Standard	**Dimensions of the NGSS Standard**		**Concepts and Disciplinary-Specific Vocabulary**	**Academic Vocabulary**
	SEP	**Title** ● Content	●	●
	DCI	**Title** ● Content		
	CCC	**Title** ● Content		
	SEP	**Title** ● Content	●	●
	DCI	**Title** ● Content		
	CCC	**Title** ● Content		
	SEP	**Title** ● Content	●	●
	DCI	**Title** ● Content		
	CCC	**Title** ● Content		
	SEP	**Title** ● Content	●	●
	DCI	**Title** ● Content		
	CCC	**Title** ● Content		
	SEP	**Title** ● Content	●	●

		Title • Content		
		Title • Content		

Unit: Name

Link to CREC Unit (click here)
Link to Bristol Adapted Unit (click here)

Unit Phenomenon:
Storyline:

Unit Essential Questions:

Learning Sequence	**Objective(s):** The students will be able to:	Summative Assessment Strategy	Priority NGSS Dimensions	Common Learning Experiences
(#) Insert Link to Lesson Plan	•	☐ Selected Response ☐ Constructed Response ☐ Performance ☐ Observation	**SEP** **DCI** **CCC** •	ELA/Math Connection:
(#) Insert Link to Lesson Plan	•	☐ Selected Response ☐ Constructed Response ☐ Performance ☐ Observation	**SEP** **DCI** **CCC** •	ELA/Math Connection:
(#) Insert Link to Lesson Plan	•	☐ Selected Response ☐ Constructed Response ☐ Performance	**SEP** **DCI** **CCC** •	ELA/Math Connection:

		Observation		
(#) Insert Link to Lesson Plan	•	Selected Response Constructed Response Performance Observation	**SEP** **DCI** **CCC** •	ELA/Math Connection:
(#) Insert Link to Lesson Plan	•	Selected Response Constructed Response Performance Observation	**SEP** **DCI** **CCC** •	ELA/Math Connection:
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(#) Insert Link to Lesson Plan	•	Selected Response Constructed Response Performance Observation	**SEP** **DCI** **CCC** •	ELA/Math Connection:

ADDITIONAL CONSIDERATIONS			
COMMON MISCONCEPTIONS	**PRIOR KNOWLEDGE NEEDED TO MASTER STANDARDS FOR THIS UNIT**	**ADVANCED STANDARDS FOR STUDENTS WHO HAVE DEMONSTRATED PRIOR MASTERY**	**OPPORTUNITIES FOR STUDENT-DIRECTED LEARNING WITHIN THE UNIT**
RESOURCES			