Astronomy and Meteorology

Curriculum/Content Area: Science	**Course Length:** 1 Term
Course Title: Astronomy and Meteorology	**Date last reviewed:** October 2017
Prerequisites: 10-12 grades	**Board approval date:** December 2017
Primary Resource: TBD	

Desired Results

Course description and purpose: In this course students will learn the fundamental principles of astronomy and meteorology. The course will challenge students to read scientifically, think analytically, explore scientific theories and draw conclusions. Students will learn to think like both astronomers and meteorologists; developing critical thinking skills as they read, analyze, write about, and discuss current topics in relation to the core concepts. Astronomy concepts will include: the origin and history of the universe, the formation of the Earth and moon, the solar system and the sun. Meteorology concepts will include: atmospheric makeup, air quality, weather and weather formation, climate and the human dimensions related to weather and climate.

Enduring Understandings:	**Essential Questions**:
1. **Patterns:** Observed patterns in nature guide organization and classification and prompt questions about relationships and causes underlying them. 2. **Cause and Effect:** Events have causes, sometimes simple, sometimes multifaceted. Deciphering causal relationships, and the mechanisms by which they are mediated, is a major activity of science and engineering. 3. **Scale, Proportion, and Quantity:** In considering phenomena, it is critical to recognize what is relevant at different size, time, and energy scales, and to	1. What are some common patterns in nature and observed phenomena throughout the universe, including earth, and how do these drive the forces that shape and propel the known universe? (Patterns) 2. How can we find evidence using today's technology of the earliest origins of the Universe? (Cause and Effect) 3. How big is the Universe? (Scale) 4. How can we conceptualize time that goes back billions of years, into a scale we can understand? (Scale) 5. How can models help us understand complex phenomena from cosmic black holes

recognize proportional relationships between different quantities as scales change. 4. **Systems and System Models:** A system is an organized group of related objects or components; models can be used for understanding and predicting the behavior of systems. 5. **Energy and Matter:** Tracking energy and matter flows, into, out of, and within systems helps one understand their system's behavior. 6. **Structure and Function:** The way an object is shaped or structured determines many of its properties and functions. 7. **Stability and Change:** For both designed and natural systems, conditions that affect stability and factors that control rates of change are critical elements to consider and understand.	to hurricanes here on earth? (Systems and Models) 6. How does the origin of our own galaxy, solar system, inform our understanding of galaxies far away? (Systems and System Models) 7. How does understanding weather systems and the creation of weather models based on data collection help us predict future weather? (Systems and System Models) 8. How does structure of objects in the universe shape the function? (Structure and Function) 9. To what degree is change a normal and natural function of the universe and to what degree does derivation become a cause for concern or a disruption in relative predictability ? (Stability and Change)

Common Core Literacy

CCSS.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.

CCSS.ELA-LITERACY.RST.11-12.2: Determine the central ideas or conclusions of a text; summarize complex concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms.

CCSS.ELA-LITERACY.RST.11-12.3: Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text.

CCSS.ELA-LITERACY.RST.11-12.4: Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to *grades 11-12 texts and topics*.

CCSS.ELA-LITERACY.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.

Unit 1: The Universe and its Stars

Major Topics:
1. Origin of the Universe
2. Characteristics of Stars
3. Observing Space

Guiding Questions:
1. How does the Big Bang Theory explain the origins and expansion of the universe?
2. How can we use spectroscopy, the movement of stars and galaxies and the composition of matter in the universe to collect data as evidence to support the Big Bang?
3. How do we observe movement of stars and galaxies billions of light years away?
4. In what ways are stars continually changing?
5. What is modern science learning regarding exoplanets, black holes and other distant objects with the aid of new technologies?
6. How does size and composition influence a star's life cycle?
7. What questions still remain for modern astronomers (professional and amateur alike)?
8. What are recent discoveries and contributions to the growing field of astronomy?

Standards:

Cross Cutting Concepts
1. **Scale, Proportion, and Quantity -** The significance of a phenomenon is dependent on the scale, proportion, and quantity at which it occurs.
2. **Interdependence of Science, Engineering, and Technology -** Science and engineering complement each other in the cycle known as research and development (R&D). Many R&D projects may involve scientists, engineers, and others with wide ranges of expertise.
3. **Energy and Matter -** Energy cannot be created or destroyed–only moved between one place and another place, between objects and/or fields, or between systems. In nuclear processes, atoms are not conserved, but the total number of protons plus neutrons is conserved.

Scientific and Engineering Practices
1. **Developing and Using Models**
    - Modeling in 9–12 builds on K–8 experiences and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed world(s).
    - Develop a model based on evidence to illustrate the relationships between

systems or between components of a system.

2. **Constructing Explanations and Designing Solutions**
    - Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories.
    - Construct an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, 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.
    - Apply scientific reasoning to link evidence to the claims to assess the extent to which the reasoning and data support the explanation or conclusion.
3. **Obtaining, Evaluating, and Communicating Information**
    - Obtaining, evaluating, and communicating information in 9–12 builds on K–8 experiences and progresses to evaluating the validity and reliability of the claims, methods, and designs.
    - Communicate scientific ideas (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).

Disciplinary Core Ideas:

1. **ESS1.A: The Universe and Its Stars**
    a. The star called the sun is changing and will burn out over a lifespan of approximately 10 billion years.
    b. The study of stars' light spectra and brightness is used to identify compositional elements of stars, their movements, and their distances from Earth.
    c. The Big Bang theory is supported by observations of distant galaxies receding from our own, of the measured composition of stars and non-stellar gases, and of the maps of spectra of the primordial radiation (cosmic microwave background) that still fills the universe.
    d. Other than the hydrogen and helium formed at the time of the Big Bang, nuclear fusion within stars produces all atomic nuclei lighter than and including iron, and the process releases electromagnetic energy. Heavier elements are produced when certain massive stars achieve a supernova stage and explode.
2. **PS3.D: Energy in Chemical Processes and Everyday Life**
    a. Nuclear Fusion processes in the center of the sun release the energy that ultimately reaches Earth as radiation.
3. **PS4.B: Electromagnetic Radiation**
    a. Atoms of each element emit and absorb characteristic frequencies of light. These characteristics allow identification of the presence of an element, even in microscopic quantities.

Learning Targets:
1. I can, identify and describe the components that fuel the sun and stars 2. I can, using a model (the HR- Diagram), identify the relationships between mass and lifespan of star. 3. I can, define important concepts in astronomical calculations such as light year, absolute magnitude and apparent magnitude and star movement. 4. I can, construct an explanation of the Big Bang theory based on astronomical evidence of light spectra, motion of distant galaxies, and composition of matter in the universe. 5. I can, identify and explain evidence supporting the Big Bang Theory including red shift and existence of cosmic background radiation. 6. I can, identify the sources of evidence and technology used to establish evidence for the Big Bang Theory. 7. I can, use reasoning to connect evidence to explain the expansion of the universe. 8. I can, identify and communicate the relationships between the life cycle of the stars and compare elemental composition. 9. I can describe supernova explosions and the creation of elements. 10. I can describe electromagnetic emission and absorption spectra are used to determine a star's composition, motion and distance to Earth.

Assessment Evidence:	
Performance Assessment Options *May include, but are not limited to the following:* **HS-ESS1-1**.Develop a model based on evidence to illustrate the life span of the sun and the role of nuclear fusion in the sun's core to release energy in the form of radiation. [Clarification Statement: Emphasis is on the energy transfer mechanisms that allow energy from nuclear fusion in the sun's core to reach Earth. Examples of evidence for the model include observations of the masses and lifetimes of other stars, as well as the ways that the sun's radiation varies due to sudden solar flares ("space weather"), the 11-year sunspot cycle, and non-cyclic variations over centuries.] [*Assessment Boundary: Assessment does not include details of the atomic and sub-atomic processes involved with the sun's nuclear fusion.]* **HS-ESS1-2.** Construct an explanation of the Big Bang theory based on astronomical evidence of light spectra, motion of distant galaxies, and composition of matter in the universe. [Clarification Statement: Emphasis is on the astronomical evidence of the red shift of light from galaxies as an indication that the universe is currently expanding, the cosmic microwave background as the remnant radiation from the Big Bang, and the observed	**Other assessment options** *May include, but are not limited to the following:*

composition of ordinary matter of the universe, primarily found in stars and interstellar gases (from the spectra of electromagnetic radiation from stars), which matches that predicted by the Big Bang theory (3/4 hydrogen and 1/4 helium).] **HS-ESS1-3.** Communicate scientific ideas about the way stars, over their life cycle, produce elements. [Clarification Statement: Emphasis is on the way nucleosynthesis, and therefore the different elements created, varies as a function of the mass of a star and the stage of its lifetime.] [*Assessment Boundary: Details of the many different nucleosynthesis pathways for stars of differing masses are not assessed.*]	
Digital Tools & Supplementary Resources: *Tools and resources that can augment the learning experience for students*	

Unit 2: The Solar System
Major Topics: 1. Origin of the Solar System 2. Characteristics and Features of the Sun 3. The Planets 4. Asteroids, Comets, Meteors **Guiding Questions:** 1. How did the solar system form? 2. How are the observed phenomena and objects in our solar system traced back to the origins of the solar system? 3. How do the unique features and characteristics of our sun shape what occurs within our solar system? 4. How is the Earth able to support life and other planets are seemingly not? 5. How have recent discoveries contributed to our understanding of planets and objects in our solar system? 6. How do asteroids, comets and meteors differ? 7. How have Kepler's laws helped us predict motion, orbits and distance? 8. How has the science of astronomy evolved over the centuries?
Standards:
Cross Cutting Concepts 1. **Scale, Proportion, and Quantity -** The significance of a phenomenon is dependent on the scale, proportion, and quantity at which it occurs. 2. **Interdependence of Science, Engineering, and Technology -** Science and engineering complement each other in the cycle known as research and development

(R&D). Many R&D projects may involve scientists, engineers, and others with wide ranges of expertise.

Scientific and Engineering Practices

1. **Developing and Using Models**
   - Modeling in 9–12 builds on K–8 experiences and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed world(s).
   - Develop a model based on evidence to illustrate the relationships between systems or between components of a system.
2. **Using Mathematical and Computational Thinking**
   - Mathematical and computational thinking in 9–12 builds on K–8 experiences and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions.
   - Use mathematical or computational representations of phenomena to describe explanations.

Disciplinary Core Ideas

1. **ESS1.A: The Universe and Its Stars**
   a. The star called the sun is changing and will burn out over a lifespan of approximately 10 billion years.
   b. The study of stars' light spectra and brightness is used to identify compositional elements of stars, their movements, and their distances from Earth.
   c. The Big Bang theory is supported by observations of distant galaxies receding from our own, of the measured composition of stars and non-stellar gases, and of the maps of spectra of the primordial radiation (cosmic microwave background) that still fills the universe.
   d. Other than the hydrogen and helium formed at the time of the Big Bang, nuclear fusion within stars produces all atomic nuclei lighter than and including iron, and the process releases electromagnetic energy. Heavier elements are produced when certain massive stars achieve a supernova stage and explode.
2. **ESS1.B: Earth and the Solar System**
   a. Kepler's laws describe common features of the motions of orbiting objects, including their elliptical paths around the sun. Orbits may change due to the gravitational effects from, or collisions with, other objects in the solar system.
3. **PS3.D: Energy in Chemical Processes and Everyday Life**
   a. Nuclear Fusion processes in the center of the sun release the energy that ultimately reaches Earth as radiation.

Learning Targets:

1. I can, identify and describe the components and features of the sun (nuclear fusion, zones, atmosphere and solar activities)
2. I can, analyse the given mathematical representation of Kepler's second law of planetary motion to predict the relationship between the distance between an orbiting body and its star, and the object's orbital velocity.
3. I can differentiate between the different types and formation of objects in our solar system.
4. I can identify, describe and apply relevant components in Kepler's Laws of Planetary Motion.

Assessment Evidence:	
Performance Assessment Options *May include, but are not limited to the following:* **HS-ESS1-1.** Develop a model based on evidence to illustrate the life span of the sun and the role of nuclear fusion in the sun's core to release energy in the form of radiation. [Clarification Statement: Emphasis is on the energy transfer mechanisms that allow energy from nuclear fusion in the sun's core to reach Earth. Examples of evidence for the model include observations of the masses and lifetimes of other stars, as well as the ways that the sun's radiation varies due to sudden solar flares ("space weather"), the 11-year sunspot cycle, and non-cyclic variations over centuries.] [*Assessment Boundary: Assessment does not include details of the atomic and sub-atomic processes involved with the sun's nuclear fusion.]* **HS-ESS1-4.** Use mathematical or computational representations to predict the motion of orbiting objects in the solar system. [Clarification Statement: Emphasis is on Newtonian gravitational laws governing orbital motions, which apply to human-made satellites as well as planets and moons.] [*Assessment Boundary: Mathematical representations for the gravitational attraction of bodies and Kepler's Laws of orbital motions should not deal with more than two bodies, nor involve calculus.*]	**Other assessment options** *May include, but are not limited to the following:*
Digital Tools & Supplementary Resources: *Tools and resources that can augment the learning experience for students*	

Unit 3: Formation of Earth and Moon
Major Topics:

1. Evidence of Formation of the Earth and Moon
2. Features and Composition of Moon
3. Space technology and exploration

Guiding Questions:

1. How did the earth and moon form and how does their formation affect the influence they have on each other?
2. How does the moon affect life on earth?
3. What have we learned about the moon based on space exploration to the moon?
4. How can the composition of the moon inform us about its formation?
5. What is the history of space exploration and what is its future?

Standards:

Cross Cutting Concepts

1. **Stability and Change -** Much of science deals with constructing explanations of how things change and how they remain stable.

Scientific and Engineering Practices

1. **Constructing Explanations and Designing Solutions**
    - Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories.
        - Apply scientific reasoning to link evidence to the claims to assess the extent to which the reasoning and data support the explanation or conclusion.

Disciplinary Core Ideas

1. **ESS1.C: The History of Planet Earth**
    a. 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.

Learning Targets:

1. I can construct an account of Earth's formation and early history
2. I can describe using evidence the formation, age and composition of the moon as determined by radiometric dating and examining surface features.
3. I can describe the influence and achievements of engineering, technology and science on space exploration

Assessment Evidence:	
Performance Assessment Options *May include, but are not limited to the following:* ● 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. [Clarification Statement: Emphasis is on using available evidence within the solar system to reconstruct the early history of Earth, which formed along with the rest of the solar system 4.6 billion years ago. Examples of evidence include the absolute ages of ancient materials (obtained by radiometric dating of meteorites, moon rocks, and Earth's oldest minerals), the sizes and compositions of solar system objects, and the impact cratering record of planetary surfaces.]	**Other assessment options** *May include, but are not limited to the following:*
Digital Tools & Supplementary Resources:	

Unit 4: Earth's Systems (Atmosphere and Hydrosphere)

Major Topics:
1. Properties of water and water cycle
2. How water in the atmosphere influences living and nonliving matter on earth
3. Earth's Atmosphere composition and circulation
4. Interaction between Earth's atmosphere and hydrosphere systems including the impact on humans and human's impact on the systems

Guiding Questions:
1. How do water's unique properties influence matter on earth?
2. How is the atmosphere layered and how do the layers of atmosphere affect the planet?
3. How does the earth's atmosphere and hydrosphere systems including the impact on humans and human's impact on the systems

Standards:

Cross Cutting Concepts
1. **Stability and Change -** Much of science deals with constructing explanations of how things change and how they remain stable. Feedback (negative or positive) can stabilize or destabilize a system.
2. **Energy and Matter -** The total amount of energy and matter in closed systems is conserved. Energy drives the cycling of matter within and between systems.

3. **Cause and Effect -** Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.
4. **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.

Scientific and Engineering Practices

1. **Analyzing and Interpreting Data**
    - Analyzing data in 9–12 builds on K–8 experiences and progresses to introducing more detailed statistical analysis, the comparison of data sets for consistency, and the use of models to generate and analyze data.
        - Analyze data using tools, technologies, and/or models (e.g., computational, mathematical) in order to make valid and reliable scientific claims or determine an optimal design solution.
2. **Planning and Carrying Out Investigations**
    - Planning and carrying out investigations in 9-12 builds on K-8 experiences and progresses to include investigations that provide evidence for and test conceptual, mathematical, physical, and empirical models.
        - Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g., number of trials, cost, risk, time), and refine the design accordingly.

Disciplinary Core Ideas

1. **ESS2.A: Earth Materials and Systems**
    a. Earth's systems, being dynamic and interacting, cause feedback effects that can increase or decrease the original changes.
    b. 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.
2. **ESS2.C: The Roles of Water in Earth's Surface Processes**
    a. 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, and lower the viscosities and melting points of rocks.
3. **ESS2.D: Weather and Climate**
    a. 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. b. Gradual atmospheric changes were due to plants and other organisms that captured carbon dioxide and released oxygen. c. Changes in the atmosphere due to human activity have increased carbon dioxide concentrations and thus affect climate.
Learning Targets:
1. I can describe using models the composition and circulation of Earth's atmosphere 2. I can identify the relationships between energy flow into and out of Earth's systems and its effect on those systems. 3. I can analyze data to describe the unintended consequences of human activity and selected technologies on Earth's systems 4. I can organize and analyze data to predict changes in hydrospheric and atmospheric systems in response to Earth's unique position and features. 5. I can develop an investigation to describe the movement and availability of water on Earth's surface. 6. I can describe the phenomenon under investigation to determine a connection between the properties of water and its effects on the hydrosphere and atmosphere.
Assessment Evidence:

Performance Assessment Options	Other assessment options
May include, but are not limited to the following: HS-ESS2-2. Analyze geoscience data to make the claim that one change to Earth's surface can create feedbacks that cause changes to other Earth systems. [Clarification Statement: Examples should include climate feedbacks, such as how an increase in greenhouse gases causes a rise in global temperatures that melts glacial ice, which reduces the amount of sunlight reflected from Earth's surface, increasing surface temperatures and further reducing the amount of ice. Examples could also be taken from other system interactions, such as how the loss of ground vegetation causes an increase in water runoff and soil erosion; how dammed rivers increase groundwater recharge, decrease sediment transport, and increase coastal erosion; or how the loss of wetlands causes a decrease in local humidity that further reduces the wetland extent.] 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. [Clarification Statement: Examples of the causes of climate change differ by timescale, over 1-10 years: large volcanic eruption, ocean circulation; 10-100s of years: changes in human activity, ocean circulation, solar output; 10-100s of	*May include, but are not limited to the following:*

thousands of years: changes to Earth's orbit and the orientation of its axis; and 10-100s of millions of years: long-term changes in atmospheric composition.] [*Assessment Boundary: Assessment of the results of changes in climate is limited to changes in surface temperatures, precipitation patterns, glacial ice volumes, sea levels, and biosphere distribution.*] HS-ESS2-5. Plan and conduct an investigation of the properties of water and its effects on Earth materials and surface processes. [Clarification Statement: Emphasis is on mechanical and chemical investigations with water and a variety of solid materials to provide the evidence for connections between the hydrologic cycle and system interactions commonly known as the rock cycle. Examples of mechanical investigations include stream transportation and deposition using a stream table, erosion using variations in soil moisture content, or frost wedging by the expansion of water as it freezes. Examples of chemical investigations include chemical weathering and recrystallization (by testing the solubility of different materials) or melt generation (by examining how water lowers the melting temperature of most solids).]	
Digital Tools & Supplementary Resources:	

Unit 5: Earth's Weather and Climate
Major Topics: 1. Weather 2. Climate **Guiding Questions:** 1. How are the weather dynamics on earth influence by the motion of the earth and water in the atmosphere? 2. What are the forces that drive weather? 3. How are weather predictions made using models? 4. How do collections of weather data help us understand climate? 5. What evidence exists of changes to climate? 6. How do climate and weather affect humans and vice versa?
Standards:
<u>Cross Cutting Concepts</u> 1. **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. Feedback (negative or positive) can stabilize or destabilize a system.

2. **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.
3. **Cause and Effect -** Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.

<u>Scientific and Engineering Practices:</u>

1. **Analyzing and Interpreting Data**
   a. Analyzing data in 9–12 builds on K–8 experiences and progresses to introducing more detailed statistical analysis, the comparison of data sets for consistency, and the use of models to generate and analyze data.
      i. Analyze data using computational models in order to make valid and reliable scientific claims.

<u>Disciplinary Core Ideas</u>

1. **ESS2.D: Weather and Climate**
   a. 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.
2. **ESS3.D: Global Climate Change**
   a. Though the magnitudes of human impacts are greater than they have ever been, so too are human abilities to model, predict, and manage current and future impacts.
   b. 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.

Learning Targets:

1. I can analyze data to observe and predict changes in climate over time on multiple scales (temperature, precipitation, ocean pH, chemical composition of atmosphere)

Assessment Evidence:

Performance Assessment Options *May include, but are not limited to the following:* HS-ESS3-5. Analyze geoscience data and the results from global climate models to make an evidence-based forecast of the current rate of global or regional climate change and associated future impacts to Earth systems. [Clarification	**Other assessment options** *May include, but are not limited to the following:*

Statement: Examples of evidence, for both data and climate model outputs, are for climate changes (such as precipitation and temperature) and their associated impacts (such as on sea level, glacial ice volumes, or atmosphere and ocean composition).] [*Assessment Boundary: Assessment is limited to one example of a climate change and its associated impacts.*] 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. [Clarification Statement: Examples of Earth systems to be considered are the hydrosphere, atmosphere, cryosphere, geosphere, and/or biosphere. An example of the far-reaching impacts from a human activity is how an increase in atmospheric carbon dioxide results in an increase in photosynthetic biomass on land and an increase in ocean acidification, with resulting impacts on sea organism health and marine populations.] [*Assessment Boundary: Assessment does not include running computational representations but is limited to using the published results of scientific computational models.*]	
Digital Tools & Supplementary Resources:	