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| Earth Science Curriculum Overview | 2022-2023 |
| <http://science.dmschools.org> <http://grading.dmschools.org>  |  |



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| **Evidence shows the student ...** | **Topic Score** |
| Demonstrates proficiency (AT) in all learning targets and success at Level 4 | 4.0 |
| Demonstrates proficiency (AT) in all learning targets with partial success at Level 4 | 3.5 |
| Demonstrates proficiency (AT) in **all** learning targets  | 3.0 |
| Demonstrates proficiency (AT) in **at least half** of the learning targets | 2.5 |
| Demonstrates some success criteria (PT) toward **all** learning targets | 2.0 |
| Demonstrates some success criteria (PT) towards **some** of the learning targets | 1.5 |
| Does not yet meet minimum criteria for the targets.  | 1.0 |
| Produces no evidence appropriate to the learning targets at any level  | 0 |

**Standards-Referenced Grading Basics**

**Our purpose in collecting a body of evidence is to:**

* Allow teachers to determine a defensible and credible topic score based on a representation of student learning over time.

**Start at Level 3 when determining a topic → score.**

* Clearly communicate where a student’s learning is based on a topic scale to inform instructional decisions and push student growth.
* Show student learning of targets through multiple and varying points of data
* Provide opportunities for feedback between student and teacher.

**Scoring**

A collaborative scoring process is encouraged to align expectations of the scale to artifacts collected. Routine use of a collaborative planning and scoring protocol results in calibration and a collective understanding of evidence of mastery. Enough evidence should be collected to accurately represent a progression of student learning as measured by the topic scale. Teachers look at all available evidence to determine a topic score. All topic scores should be defensible and credible through a body of evidence.

**Guiding Practices of Standards-Referenced Grading**

1. A consistent 4-point grading scale will be used.
2. Student achievement and behavior will be reported separately.
3. Scores will be based on a body of evidence.
4. Achievement will be organized by learning topic and converted to a grade at semester’s end.
5. Students will have multiple opportunities to demonstrate proficiency.
6. Accommodations and modifications will be provided for exceptional learners.

**\*\*\*Only scores of 4, 3.5, 3, 2.5, 2, 1.5, 1, and 0 can be entered as Topic Scores**.

**Multiple Opportunities**

Philosophically, there are two forms of multiple opportunities, both of which require backwards design and intentional planning. One form is opportunities planned by the teacher throughout the unit of study and/or throughout the semester. The other form is reassessment of learning which happens after completing assessment of learning at the end of a unit or chunk of learning.

Students will be allowed multiple opportunities to demonstrate proficiency. Teachers need reliable pieces of evidence to be confident students have a good grasp of the learning topics before deciding a final topic score. To make standards-referenced grading work, the idea of “multiple opportunities” is emphasized. If after these opportunities students still have not mastered Level 3, they may then be afforded the chance to reassess.

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| ***Unit*** | ***Content Topics*** | ***Connected NGSS Performance Expectations*** | ***Rough Schedule*** |
| *History of Earth* | *Age of Earth* | [HS-ESS1-6](http://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/HS-ESS1-6%20Evidence%20Statements%20June%202015%20asterisks.pdf)[HS-ESS2-5](http://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/HS-ESS2-5%20Evidence%20Statements%20June%202015%20asterisks.pdf) | 3 weeks |
| *History of Earth* |  | 4 weeks |
| *Astronomy* | Origin of the Universe |  | 3 weeks |
| Fusion in the Stars |  | 4 weeks |
| *Orbital Motion* | [HS-ESS1-4](http://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/HS-ESS1-4%20Evidence%20Statements%20June%202015%20asterisks.pdf) | 4 weeks |
| **End of Semester 1** |
| *Dynamic Earth* | Plate Tectonics | HS-ESS1-5HS-ESS2-1HS-ESS2-3 | 5 weeks |
| Natural Resources | [HS-ESS3-1](http://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/HS-ESS3-1%20Evidence%20Statements%20June%202015%20asterisks.pdf) [HS-ESS3-2](http://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/HS-ESS3-2%20Evidence%20Statements%20June%202015%20asterisks.pdf) | 4 weeks |
| *Climate* | Carbon Cycle | HS-ESS2-6 | 3 weeks |
| Climate | HS-ESS2-2 HS-ESS2-4 | 3 weeks |
| Climate Change | HS-ESS3-5HS-ESS3-4 | 3 weeks |

**High School Earth and Space Sciences Standards Overview**

These performance expectations blend the core ideas with scientific and engineering practices and crosscutting concepts to support students in developing useable knowledge to explain ideas across the science disciplines. While the performance expectations shown in high school earth and space science couple particular practices with specific disciplinary core ideas, instructional decisions should include use of many practices that lead to the performance expectations.

The performance expectations in ESS1: Earth’s Place in the Universe, help students formulate an answer to the question: “What is the universe, and what is Earth’s place in it?” The ESS1 Disciplinary Core Idea from the NRC Framework is broken down into three sub-ideas: the universe and its stars, Earth and the solar system and the history of planet Earth. Students examine the processes governing the formation, evolution, and workings of the solar system and universe. Some concepts studied are fundamental to science, such as understanding how the matter of our world formed during the Big Bang and within the cores of stars. Others concepts are practical, such as understanding how short-term changes in the behavior of our sun directly affect humans. Engineering and technology play a large role here in obtaining and analyzing the data that support the theories of the formation of the solar system and universe. The crosscutting concepts of patterns, scale, proportion, and quantity, energy and matter, and stability and change are called out as organizing concepts for these disciplinary core ideas. In the ESS1 performance expectations, students are expected to demonstrate proficiency in developing and using models, using mathematical and computational thinking, constructing explanations and designing solutions, engaging in argument, and obtaining, evaluating and communicating information; and to use these practices to demonstrate understanding of the core ideas.

The performance expectations in ESS2: Earth’s Systems, help students formulate an answer to the question: “How and why is Earth constantly changing?” The ESS2 Disciplinary Core Idea from the NRC Framework is broken down into five sub-ideas: Earth materials and systems, plate tectonics and large-scale system interactions, the roles of water in Earth’s surface processes, weather and climate, and biogeology. For the purpose of the NGSS, biogeology has been addressed within the life science standards. Students develop models and explanations for the ways that feedbacks between different Earth systems control the appearance of Earth’s surface. Central to this is the tension between internal systems, which are largely responsible for creating land at Earth’s surface, and the sun-driven surface systems that tear down the land through weathering and erosion. Students begin to examine the ways that human activities cause feedbacks that create changes to other systems. Students understand the system interactions that control weather and climate, with a major emphasis on the mechanisms and implications of climate change. Students model the flow of energy between different components of the weather system and how this affects chemical cycles such as the carbon cycle. The crosscutting concepts of cause and effect, energy and matter, structure and function and stability and change are called out as organizing concepts for these disciplinary core ideas. In the ESS2 performance expectations, students are expected to demonstrate proficiency in developing and using models, planning and carrying out investigations, analyzing and interpreting data, and engaging in argument; and to use these practices to demonstrate understanding of the core ideas.

The performance expectations in ESS3: Earth and Human Activity help students formulate an answer to the question: “How do Earth’s surface processes and human activities affect each other?” The ESS3 Disciplinary Core Idea from the NRC Framework is broken down into four sub-ideas: natural resources, natural hazards, human impact on Earth systems, and global climate change. Students understand the complex and significant interdependencies between humans and the rest of Earth’s systems through the impacts of natural hazards, our dependencies on natural resources, and the significant environmental impacts of human activities. Engineering and technology figure prominently here, as students use mathematical thinking and the analysis of geoscience data to examine and construct solutions to the many challenges facing long-term human sustainability on Earth. The crosscutting concepts of cause and effect, systems and system models, and stability and change are called out as organizing concepts for these disciplinary core ideas. In the ESS3 performance expectations, students are expected to demonstrate proficiency in developing and using analyzing and interpreting data, mathematical and computational thinking, constructing explanations and designing solutions and engaging in argument; and to use these practices to demonstrate understanding of the core ideas. Adapted from: nextgenscience.org

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| Topic: Age of the Earth |
| Driving Questions: What evidence supports the accepted age of the Earth? |
| Crosscutting Concept: Stability and Change; Structure and function |
| Science and Engineering Practices: Constructing Explanation and Designing Solutions ; Engaging in Argument from Evidence |
| Performance Expectation: [HS-ESS1-6](http://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/HS-ESS1-6%20Evidence%20Statements%20June%202015%20asterisks.pdf) ; [HS-ESS2-5](http://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/HS-ESS2-5%20Evidence%20Statements%20June%202015%20asterisks.pdf) |
| Level 4 | Level 3 | Level 2 | Level 1 |
| In addition to score 3.0 performance, the student demonstrates in-depth inferences and applications that go beyond what was taught. | ***In response to observed phenomena, students will…***1. Use reasoning and evidence from ancient Earth materials, meteorites, and other planetary surfaces to account for Earth's formation and age. [HS-ESS1-6](http://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/HS-ESS1-6%20Evidence%20Statements%20June%202015%20asterisks.pdf)
2. Plan and conduct an investigation to explain how water changes surface features (erosion investigation: mechanical and/or chemical). [HS-ESS2-5](http://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/HS-ESS2-5%20Evidence%20Statements%20June%202015%20asterisks.pdf)

Potential Phenomena: Why are there so many craters on other planets/moons yet there are very few on Earth? | ***In response to observed phenomena, students will…***A1. Use the ratio of parent to daughter atoms produced during radioactive decay as a means for determining ages of lunar rocks, meteorites and Earth’s oldest rocks to support the age of the Earth and solar system.A2. Explain how we can use other objects in our solar system to learn about learn about the Earth (impact craters, planetary surface features and composition). A3. Explain how Earth changes occur the same way now as in the past (uniformitarianism). B1. Explain how a lack of impact craters and younger age of most rocks on Earth compared to other bodies in the solar system can be attributed to eroding forces on Earth’s surface. B2. Conduct an investigation to observe how the structure of water causes mechanical (stream table) and chemical weathering and erosion (rocks in different pH).Recognize or recall specific vocabulary such as: Radiometric dating, half-life, isotope, radioactive decay, impact craters, meteorites, uniformitarianism, erosion, mechanical weathering, chemical weathering | Student’s performance reflects insufficient progress towards foundational skills and knowledge. |

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| Topic: History of the Earth |
| Driving Questions: How are changes in the atmosphere linked to changes in other systems on Earth? |
| Crosscutting Concept: Stability and Change |
| Science and Engineering Practices: Engaging in Argument from Evidence |
| Performance Expectation: [HS-ESS2-7](http://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/HS-ESS2-7%20Evidence%20Statements%20June%202015%20asterisks.pdf) |
| Level 4 | Level 3 | Level 2 | Level 1 |
| In addition to score 3.0 performance, the student demonstrates in-depth inferences and applications that go beyond what was taught. | ***In response to observed phenomena, students will…***1. Construct an argument based on evidence about the relationship between changes in life on Earth, changes in the Earth’s surface and changes in the atmosphere throughout time. [**HS-ESS2-7**](http://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/HS-ESS2-7%20Evidence%20Statements%20June%202015%20asterisks.pdf)

Potential Phenomena: What was the first life on Earth like? | ***In response to observed phenomena, students will…***A1. Describe the atmospheric composition after Earth’s formation and how it changed throughout time.A2. Describe evidence for emergence of photosynthetic organismsA3. Describe the effect of the presence of oxygen (ozone layer) on evolution and chemical weathering.A4. Identify causal links and feedback mechanisms between changes in the biosphere and other Earth systemsRecognize or recall specific vocabulary such as: Atmosphere, photosynthesis, oxygen, carbon dioxide, nitrogen, weathering, evolution | Student’s performance reflects insufficient progress towards foundational skills and knowledge. |

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| Topic: Origin of the Universe |
| Driving Questions: What evidence supports the Big Bang theory as the origin of the universe?  |
| Crosscutting Concept: Energy and Matter |
| Science and Engineering Practices: Constructing Explanations and Designing Solutions |
| Performance Expectation: [HS-ESS1-2](http://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/HS-ESS1-2%20Evidence%20Statements%20June%202015%20asterisks.pdf)  |
| Level 4 | Level 3 | Level 2 | Level 1 |
| In addition to score 3.0 performance, the student demonstrates in-depth inferences and applications that go beyond what was taught. | ***In response to observed phenomena, students will…***1. Construct an explanation of the Big Bang theory using astronomical evidence of light spectra, motion of distant galaxies and the composition of matter in the universe ([HS-ESS1-2](http://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/HS-ESS1-2%20Evidence%20Statements%20June%202015%20asterisks.pdf)).

Potential Phenomena:What evidence do we have to conclude that the universe is shrinking, expanding or not changing? | ***In response to observed phenomena, students will…***A1. Use evidence from a galaxy’s light spectra to determine its relative motion in the universe. (Describe how 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)A2. Make a conclusion about the motion of the universe based on energy (light shift) versus distance relationship. A3. Describe the existence and implications of cosmic background radiation (energy).A4. Describe how the distribution of elements (matter) is the same throughout the universe, primarily found in stars and interstellar gasses (from the spectra of electromagnetic radiation from stars)A5. Describe how conservation of energy and matter support the evidence for the Big Bang Theory.Recognize or recall specific vocabulary such as: Big Bang theory, wavelength, red shift, visible light spectrum, microwaves, universe, galaxy, element, cosmic radiation | Student’s performance reflects insufficient progress towards foundational skills and knowledge. |

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| Topic: Fusion in the Stars |
| Driving Questions: How do stars produce the elements that compose our universe? |
| Crosscutting Concept: Scale, Proportion and Quality; Energy and Matter |
| Science and Engineering Practices: Developing and Using Models; Obtaining, Evaluating, and Communicating Information |
| Performance Expectation: [HS-ESS1-1](http://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/HS-ESS1-1%20Evidence%20Statements%20June%202015%20asterisks.pdf) ; [HS-ESS1-3](http://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/HS-ESS1-3%20Evidence%20Statements%20June%202015%20asterisks.pdf) |
| Level 4 | Level 3 | Level 2 | Level 1 |
| In addition to score 3.0 performance, the student demonstrates in-depth inferences and applications that go beyond what was taught. | ***In response to observed phenomena, students will…***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 that eventually reaches Earth in the form of radiation. ([**HS-ESS1-1**](http://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/HS-ESS1-1%20Evidence%20Statements%20June%202015%20asterisks.pdf)).
2. Use their model (HR Diagram) to communicate how different elements (matter) are produced throughout the various stages in a star's lifecycle ([**HS-ESS1-3**](http://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/HS-ESS1-3%20Evidence%20Statements%20June%202015%20asterisks.pdf)**).**

Potential Phenomena: How do we know how long the sun (stars) will last?What causes a black hole?Where did the iron in your car come from? | ***In response to observed phenomena, students will…***A1. Construct a model to demonstrate the process of nuclear fusion that includes how hydrogen acts as the sun’s fuel to produce helium and energy. (Describe how lighter elements (hydrogen) through collisions can form other light elements (helium).A2. Discuss how nuclear fusion produces energy in the form of radiation that reaches Earth B1. Use the quantity of hydrogen as a contributing factor to determine the age of a star.B2. Describe how massive elements, up to iron, are produced in cores of stars by a chain of processes of nuclear fusion, which also releases energy, in order to determine the stage a star is in in their lifecycle.B3. Discuss how data from stellar observations is used to create the HR Diagram.Recognize or recall specific vocabulary such as: nuclear fusion, protons, energy, protostar, mainsequence, supernova, neutron stars, red giant, dwarfstars, HR Diagram | Student’s performance reflects insufficient progress towards foundational skills and knowledge. |

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| Topic: Orbital Motion |
| Driving Questions: Why do objects in our solar system orbit the sun? |
| Crosscutting Concept: Scale, Proportion and Quantity |
| Science and Engineering Practices: Using Mathematical and Computational Thinking |
| Performance Expectation: [HS-ESS1-4](http://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/HS-ESS1-4%20Evidence%20Statements%20June%202015%20asterisks.pdf) |
| Level 4 | Level 3 | Level 2 | Level 1 |
| In addition to score 3.0 performance, the student demonstrates in-depth inferences and applications that go beyond what was taught. | ***In response to observed phenomena, students will…***1. Use mathematical or computational representation (Kepler's and Newton's laws) to predict and explain the motion of orbiting objects in the solar system ([**HS-ESS1-4**](http://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/HS-ESS1-4%20Evidence%20Statements%20June%202015%20asterisks.pdf)**).**

\*\* How do these laws prove planets/ objects do not orbit in perfect circles?Potential Phenomena: Why did the asteroid belt form the way it did and why does it stay in its orbit?Why don't planets get pulled into the sun or fly off into space? What causes comets to speed up and slow down as they move? What causes a comet’s tail? | ***In response to observed phenomena, students will…***A1. Use focal distance and ellipses’ major axis length to determine eccentricity of an objects orbit in space (e=f/d) (Kepler’s 1st law)A2. Describe how distance from the sun impacts the velocity of an object’s orbit in space (Kepler’s 2nd law)A3. Describe how distance from a star is proportional to the orbital period. (yr2=AU3) (Kepler’s 3rd law)A4. Describe the relationship of scale, proportion and quantity in the context of gravitational attraction (Newton’s Laws). Recognize or recall specific vocabulary such as: Revolution, orbit, orbital period, ellipse, focus, eccentricity, area, gravity, mass, acceleration, inertia | Student’s performance reflects insufficient progress towards foundational skills and knowledge. |

End of Semester 1

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| Topic: Plate Tectonics |
| Driving Questions: How and why has the Earth’s surface changed over time? |
| Crosscutting Concept: Patterns; Stability and Change; Energy and Matter |
| Science and Engineering Practices: Engaging in Argument from Evidence; Developing and using models |
| Performance Expectation: [HS-ESS1-5;](http://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/HS-ESS1-5%20Evidence%20Statements%20June%202015%20asterisks.pdf) [HS-ESS2-1;](http://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/HS-ESS2-1%20Evidence%20Statements%20June%202015%20asterisks.pdf) [HS-ESS2-3](http://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/HS-ESS2-3%20Evidence%20Statements%20June%202015%20asterisks.pdf) |
| Level 4 | Level 3 | Level 2 | Level 1 |
| In addition to score 3.0 performance, the student demonstrates in-depth inferences and applications that go beyond what was taught. | ***In response to observed phenomena, students will…***1. Develop a model based on evidence of Earth’s interior that shows how matter cycles in the process of thermal convection. [**HS-ESS2-3**](http://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/HS-ESS2-3%20Evidence%20Statements%20June%202015%20asterisks.pdf)
2. Develop a model to illustrate how Earth’s internal and surface processes form continental and ocean-floor features. [**HS-ESS2-1**](http://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/HS-ESS2-1%20Evidence%20Statements%20June%202015%20asterisks.pdf)
3. Evaluate evidence of the past and current movements of continental and oceanic crust and the theory of plate tectonics to explain the ages of crustal rocks. [**HS-ESS1-5**](http://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/HS-ESS1-5%20Evidence%20Statements%20June%202015%20asterisks.pdf)

Potential Phenomenon:<https://www.ngssphenomena.com/#/divingbetweencontinents/> How can fossils of weak swimmers be found on two continents separated by an ocean? Oceanic crust younger than continental crust. Why?Earth’s crust is moving! Why? | ***In response to observed phenomena, students will…***A1: Describe the role of thermal energy in the cycling of matter in Earth's interior (convection).B1: Explain how the internal process of convection moves plates, resulting in the appearance of volcanoes, mountains, trenches, ridges, which can change Earth’s surface over time.B2: Explain how the external processes such as weathering and erosion can change Earth’s surface over time.C1: Use patterns to explain the relationship between the type and location of plate boundaries.C2: Use patterns to describe the relative age of oceanic and continental crustal rocks.Recognize or recall specific vocabulary such as: plate tectonics, continental drift, plate boundaries, mid-ocean ridge, trench, subduction zone, orogeny, convergent, divergent, transform, density, convection | Student’s performance reflects insufficient progress towards foundational skills and knowledge. |

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| Topic: Natural Resources |
| Driving Questions: How do natural resources impact humans and how do humans impact natural resources? |
|  Crosscutting Concept: Cause and Effect  |
| Science and Engineering Practices: Constructing Explanations and Designing Solutions ; Engaging in Argument from Evidence |
| Performance Expectation: [HS-ESS3-1](http://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/HS-ESS3-1%20Evidence%20Statements%20June%202015%20asterisks.pdf) ; [HS-ESS3-2](http://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/HS-ESS3-2%20Evidence%20Statements%20June%202015%20asterisks.pdf) |
| Level 4 | Level 3 | Level 2 | Level 1 |
| In addition to score 3.0 performance, the student demonstrates in-depth inferences and applications that go beyond what was taught. | ***In response to observed phenomena, students will…***1. Construct an explanation based on evidence for how the availability of natural resources has influenced human activity. [HS-ESS3-1](http://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/HS-ESS3-1%20Evidence%20Statements%20June%202015%20asterisks.pdf)
2. Construct an explanation based on evidence for how the occurrence of natural hazards has influenced human activity. [HS-ESS3-1](http://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/HS-ESS3-1%20Evidence%20Statements%20June%202015%20asterisks.pdf)
3. Construct an explanation based on evidence for how changes in climate has influenced human activity. [HS-ESS3-1](http://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/HS-ESS3-1%20Evidence%20Statements%20June%202015%20asterisks.pdf)
4. Evaluate design solutions using evidence for acquiring and conserving natural resources (examples: strip mining, fracking, recycling, and others). [HS-ESS3-2](http://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/HS-ESS3-2%20Evidence%20Statements%20June%202015%20asterisks.pdf)

Potential Phenomena: Why did people settle in Iowa?What is causing Oklahoma to have some many earthquakes (Oklahoma experienced 907 magnitude 3+ earthquakes in 2015, 585 magnitude 3+ earthquakes in 2014 and 109 in 2013)? | ***In response to observed phenomena, students will…***A. Describe the cause and effect relationship of natural resource availability on different locations.B. Describe the cause and effect relationship of natural hazards on distribution and size of populations in different regions.C. Describe how changes in climate affect human activity (example: agriculture) and human population size and migration.D1. Identify societal needs for specific energy and mineral resources.D2. Evaluate the costs and benefits of extracting or developing the energy reserve or mineral resource.D3. Evaluate the costs and benefits of recycling or reusing the mineral resource.Recognize or recall specific vocabulary such as: natural resource, natural hazard, climate, migration, environment, mineral resources, recycling | Student’s performance reflects insufficient progress towards foundational skills and knowledge. |

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| Topic: Carbon Cycle |
| Driving Questions: How does carbon move through the various components of Earth’s systems? |
| Crosscutting Concept: Energy and Matter |
| Science and Engineering Practices: Developing and Using Models |
| Performance Expectation: [HS-ESS2-6](http://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/HS-ESS2-6%20Evidence%20Statements%20June%202015%20asterisks.pdf) |
| Level 4 | Level 3 | Level 2 | Level 1 |
| In addition to score 3.0 performance, the student demonstrates in-depth inferences and applications that go beyond what was taught. | ***In response to observed phenomena, students will…***1. Develop a quantitative model to describe the cycling of carbon among the hydrosphere, atmosphere, geosphere, and biosphere. ([HS-ESS2-6](http://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/HS-ESS2-6%20Evidence%20Statements%20June%202015%20asterisks.pdf) )

Potential Phenomena: Where did the carbon in your body come from? <http://nasawavelength.org/list/1142> | ***In response to observed phenomena, students will…***A1. Use the law of conservation of matter to describe how carbon is conserved in a closed system.A2. Model carbon cycling from one sphere to another.A3. Describe the role of plants in carbon capture.A4. Describe how humans can alter carbon levels in the atmosphere.Recognize or recall specific vocabulary such as: carbon, law of conservation of matter, hydrosphere, atmosphere, geosphere, biosphere, photosynthesis | Student’s performance reflects insufficient progress towards foundational skills and knowledge. |

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| Topic: Climate |
| Driving Questions: How do feedback loops affect climate? |
| Crosscutting Concept: Stability and Change ; Cause and Effect |
| Science and Engineering Practices: Analyzing and Interpreting Data ; Developing and Using Models |
| Performance Expectation: [HS-ESS2-2](http://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/HS-ESS2-2%20Evidence%20Statements%20June%202015%20asterisks.pdf) ; [HS-ESS2-4](http://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/HS-ESS2-4%20Evidence%20Statements%20June%202015%20asterisks.pdf) |
| Level 4 | Level 3 | Level 2 | Level 1 |
| In addition to score 3.0 performance, the student demonstrates in-depth inferences and applications that go beyond what was taught. | ***In response to observed phenomena, students will…***1. Analyze geoscience data to make the claim that one change to Earth’s surface can create feedbacks that cause changes to other Earth systems. ([HS-ESS2-2](http://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/HS-ESS2-2%20Evidence%20Statements%20June%202015%20asterisks.pdf))
2. Use a model to describe how variations in the flow of energy into and out of Earth’s systems results in changes in climate. ([HS-ESS2-4](http://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/HS-ESS2-4%20Evidence%20Statements%20June%202015%20asterisks.pdf))

Potential Phenomena: Reduction in the amount of polar ice. <https://www.scientificamerican.com/article/arctic-sea-ice-loss-creates-ripple-effects/> | ***In response to observed phenomena, students will…***A1. Use data to see stability and change within feedback loops.A2. Describe feedback loops.B1. Identify the cause and effect relationship between multiple factors that affect climate *(these are some examples: changes in Earth’s orbit, changes in sun’s energy output, extent of vegetation cover, volcanic activity, glaciation, oceanic circulation, atmospheric composition, human activities).*B2. Use a model to represent energy flow. Recognize or recall specific vocabulary such as: positive feedback loops, negative feedback loops, greenhouse gas, greenhouse effect | Student’s performance reflects insufficient progress towards foundational skills and knowledge. |

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| Topic: Climate Change |
| Driving Questions: How can human impact on climate change be reduced? |
| Crosscutting Concept: Stability and Change |
| Science and Engineering Practices: Analyzing and Interpreting Data; Constructing an Explanation |
| Performance Expectation: [HS-ESS3-5](http://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/HS-ESS3-5%20Evidence%20Statements%20June%202015%20asterisks.pdf); [HS-ESS3-4](http://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/HS-ESS3-4%20Evidence%20Statements%20June%202015%20asterisks.pdf) |
| Level 4 | Level 3 | Level 2 | Level 1 |
| In addition to score 3.0 performance, the student demonstrates in-depth inferences and applications that go beyond what was taught. | ***In response to observed phenomena, students will…***1. Analyze global climate models to forecast global or regional climate change and future impacts to Earth systems. ( [**HS-ESS3-5**](http://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/HS-ESS3-5%20Evidence%20Statements%20June%202015%20asterisks.pdf) )
2. Evaluate or refine a technological solution that reduces impacts of human activities on Earth’s systems. ( [**HS-ESS3-4**](http://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/HS-ESS3-4%20Evidence%20Statements%20June%202015%20asterisks.pdf) )

Potential Phenomena:In many locations along the U.S. coastline, flooding is now 300% to more than 900% more frequent than it was 50 years ago. Why? (statistic from <https://www.climate.gov/news-features/understanding-climate/climate-change-global-sea-level>) | ***In response to observed phenomena, students will…***A1. Predict the future effect of climate change on temperature, precipitation and sea level.A2. Relate change in climate to changes in composition of the geosphere, atmosphere, hydrosphere, or cryosphere.B1. Describe the impacts human activity can have on climate.B2. Describe and quantify individual and large scale effects on stability and change in Earth's systems.B3. Identify constraints within a solution.B4. Describe how changes to a solution will increase benefits or decrease cost to people and the environment.Recognize or recall specific vocabulary such as: Geosphere, atmosphere, hydrosphere, cryosphere, climate, pollutants, biomass, diversity, greenhouse gases, greenhouse effect | Student’s performance reflects insufficient progress towards foundational skills and knowledge. |