Spearfish School District Curriculum Pacing Guide 2023-24
Earth Science

Science and Engineering Practices

- Developing and Using Models
- Planning and Carrying out Investigations
- Analyzing and Interpreting Data
- Argumentation from Evidence
- Scientific Explanations
- Mathematics and Computation

Cross Cutting Concepts

- Patterns
- Scale, Proportion, and Quantity
- Systems and System Models
- Cause and Effect
- Energy and Matter
- Stability and Change
- Structure and Function

Disciplinary Core Ideas

The Core ideas of the High School Physical Science standards include:

- Matter and Its Interactions
- Motion and Stability: Forces and Interactions
- Energy

The Core ideas of the High School Life Science standards include:

- Ecosystems: Interactions, Energy, and Dynamics
- Heredity: Inheritance and Variation of Traits
- Biological Unity and Diversity

The Core ideas of the High School Earth and Space Science standards include:

- Earth's Place in the Universe
- Earth's Systems

- Earth and Human Activity

Spearfish School District Curriculum Pacing Guide 2023-24

9 -12 Earth Science

Instructional Focus **Minerals and Rocks**	Focus Summary
1 **Minerals** 1. What is a Mineral? 2. Types of Minerals Suggested Time Frame: **1.0 week**	Minerals are an integral part of daily life.
2 **Igneous Rocks** 1. What are Igneous Rocks 2. Classification of Igneous Rocks Suggested Time Frame: **1.0 week**	Igneous rocks were the first rocks to form as Earth cooled from a molten mass to the crystalline rocks of the early crust.
3 **Sedimentary and Metamorphic Rocks** 1. Formation of Sedimentary Rocks 2. Types of Sedimentary Rocks 3. Metamorphic Rocks Suggested Time Frame: **1.0 week**	Most rocks are formed from preexisting rocks through external and internal geologic processes.
4 **Weathering, Erosion, and Soil** 1. Weathering 2. Erosion and Deposition 3. Soil Suggested Time Frame: **1.0 week**	Weathering and erosion are agents of change on Earth's surface.

Spearfish School District Curriculum Pacing Guide 2023-24

9 -12 Earth Science

Instructional Focus	Dimensions Cross Cutting Concepts Disciplinary Core Ideas Science and Engineering Practices	Targeted Standards based Essential Skills & Concepts				Learning Goals / Essential Questions For Instructional Focus	Essential Vocabulary	Resources
		PS	LS	ESS	ED			

1 **<u>Minerals</u>** 1. What is a Mineral? 2. Types of Minerals Time Frame: 1.0 week **2** **<u>Igneous Rocks</u>** 1. What are Igneous Rocks 2. Classification of Igneous Rocks Time Frame: 1.0 week **3** **<u>Sedimentary and Metamorphic Rocks</u>** 1. Formation of Sedimentary Rocks 2. Types of Sedimentary Rocks 3. Metamorphic Rocks Time Frame: 1.0 week **4** **<u>Weathering, Erosion, and Soil</u>** 4. Weathering	☒Patterns ☐Scale, Proportion, and Quantity ☒Systems and System Models ☒Cause and Effect ☒Energy and Matter ☒Stability and Change ☒Structure and Function ☒ Matter and Its Interactions ☐Motion and Stability: Forces and Interactions ☐Energy ☐From Molecules to Organisms: Structures and Processes ☐Ecosystems: Interactions, Energy, and Dynamics ☒Earth's Place in the Universe ☒Earth's Systems	**1** No applicable Earth Science standards **2** No applicable Earth Science standards **3** No applicable Earth Science standard **4** <u>HS-ESS2-4:</u> Plan and carry out an investigation of the properties of water and its effects on Earth materials and surface processes.	**1** 1. How are minerals defined? 2. How do minerals form? 3. How are minerals classified? 4. What are the major groups of minerals? 5. How are minerals used? **2** 1. How do igneous rocks form? 2. How can the composition of magna be described? 3. What are the factors that affect how rocks melt and crystallize? 4. What are the different types and textures of igneous rocks? 5. How do the cooling rates affect the grain sizes in igneous rocks? 6. What are some of the uses of igneous rocks? **3** 1. How are sedimentary rocks formed? 2. What is the process of lithification? 3. What are the main features of sedimentary rocks? 4. How can the different types of clastic sedimentary rocks be described? 5. How do chemical sedimentary rocks form? 6. What are biochemical sedimentary rocks? 7. What are the different types and causes of metamorphism? 8. How are metamorphic textures described? 9. How do mineral and compositional changes occur during metamorphism? 10. How are rocks classified using the rock cycle? **4** 1. How do mechanical and chemical weathering differ?	**1** Mineral Crystal Luster Hardness Cleavage Fracture Streak Specific gravity Silicate **2** Lava Igneous rock Partial melting Fractional crystallization Intrusive rock Extrusive rock Basaltic rock Granitic rock Texture Pegmatite **3** Sediment Lithification Cementation Bedding Graded bedding Cross-bedding Clastic sedimentary rock Clastic Porosity Evaporate Foliated Nonfoliated Regional metamorphism Contact metamorphism	**1** • Textbook: "McGraw Hill Inspire Earth Sciencee" • Computer labs/simulations • Variety of rocks and minerals **2** • Textbook: "McGraw Hill Inspire Earth Sciencee" • Computer labs/simulations • Variety of rocks and minerals **3** • Textbook: "McGraw Hill Inspire Earth Sciencee" • Computer labs/simulations • Variety of rocks and minerals **4** • Textbook: "McGraw Hill Inspire Earth Sciencee" • Computer labs/simulations • Variety of rocks and minerals

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5. Erosion and Deposition 6. Soil Time Frame: 1.0 week	☒Earth and Human Activity ☒Developing and Using Models ☐Planning and Carrying out Investigations ☒Analyzing and Interpreting Data ☐Argumentation from Evidence ☒Scientific Explanations ☐Mathematics and Computation		2. What are the different factors that affect mechanical and chemical weathering? 3. What variables affect the rate of weathering? 4. What is the relationship of gravity to all agents of erosion? 5. What features are characteristic of the different types of erosion? 6. How do living and nonliving things impact the processes of weathering and erosion? 7. How does soil form? 8. What are the different soil horizons in a soil profile? 9. What factors affect soil formation?	Hydrothermal metamorphism Rock cycle **4** Weathering Mechanical weathering Frost wedging Chemical weathering Oxidation Erosion Deposition Rill erosion Gully erosion Soil Soil profile Soil horizon	

Assessments: How do my students demonstrate their understanding and how do I measure their learning?

Formative: quiz, worksheets, discussion, research projects

Summative: unit tests, classroom activities

Spearfish School District Curriculum Pacing Guide 2023-24

9 -12 Earth Science

Instructional Focus **Physical Geology**	Focus Summary
1 **Plate Tectonics** 1. Drifting Continents 2. Seafloor Spreading 3. Plate Boundaries Suggested Time Frame: **1.5 week**	Most geologic activity occurs at the boundaries between tectonic plates.
2 **Volcanism** 1. Volcanoes 2. Eruptions 3. Intrusive Activity Suggested Time Frame: **1.5 week**	Volcanoes develop from magma moving upward from deep within the Earth.
3 **Earthquakes** 1. Forces Within the Earth 2. Seismic Waves and Earth's Interior 3. Measuring and Locating Earthquakes 4. Earthquakes and Society Suggested Time Frame: **1.5 week**	Earthquakes are natural vibrations of the ground, some of which are caused by movement along fractures in Earth's crust.
4 **Mountain Building** 1. Crust-Mantle Relationship 2. Orogeny 3. Other Types of Mountain Building Suggested Time Frame: **1.5 week**	Mountains form through dynamic processes which crumple, fold, and create faults in Earth's crust.

Spearfish School District Curriculum Pacing Guide 2023-24

9 -12 Earth Science

Instructional Focus	Dimensions Cross Cutting Concepts Disciplinary Core Ideas Science and Engineering Practices	Targeted Standards based Essential Skills & Concepts				Learning Goals / Essential Questions For Instructional Focus	Essential Vocabulary	Resources
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Suggested time frame: **1** 1. Drifting Continents 2. Seafloor Spreading 3. Plate Boundaries Time Frame: **1.5 week** **2** 1. Volcanoes 2. Eruptions 3. Intrusive Activity Time Frame: **1.5 week** **3** 1. Forces Within the Earth 2. Seismic Waves and Earth's Interior 3. Measuring and Locating Earthquakes 4. Earthquakes and Society Time Frame: **1.5 week** **4**	☒Patterns ☒Scale, Proportion, and Quantity ☒Systems and System Models ☒Cause and Effect ☐Energy and Matter ☒Stability and Change ☒Structure and Function ☐ Matter and Its Interactions ☒Motion and Stability: Forces and Interactions ☐Energy ☐From Molecules to Organisms: Structures and Processes ☐Ecosystems: Interactions, Energy, and Dynamics ☐Earth's Place in the Universe ☒Earth's Systems	**1** HS-ESS1-5: Evaluate evidence of the past and current movements of continental and oceanic crust and the theory of plate tectonics to explain the ages of crustal rocks HS-ESS2-2: Develop a model based on evidence of Earth's interior to describe the cycling of matter by thermal convection. **2** HS-ESS2-2: Develop a model based on evidence of Earth's interior to describe the cycling of matter by thermal convection. HS-ESS2-3: Use a model to describe how variations in the flow of energy into and out of Earth's systems result in changes in climate **3** HS-ESS2-1: Analyze geoscience data to make the claim that one change to Earth's surface can create feedback that cause changes to other Earth systems. **4** HS-ESS2-1: Analyze geoscience data to make the claim that one change to Earth's surface can create feedback that cause changes to other Earth systems.	**1** 1. What are the lines of evidence that led Wegener to suggest that Earth's continents have moved? 2. How does evidence of ancient climates support continental drift? 3. Why was continental drift not accepted when it was first proposed? 4. What evidence led to the discovery of seafloor spreading? 5. What is the significance of magnetic patterns on the seafloor? 6. How is the process of seafloor spreading explained? 7. How does the movement of Earth's tectonic plates result in many geologic features? 8. What are the three types of plate boundaries and the features associated with them? 9. What are the processes associated with subduction zones? 10. How is the process of convection explained? 11. How is convection in the mantle related to the movements of tectonic plates? 12. What are the processes of ridge push and slab pull? **2** 1. How do plate tectonics influence the formation of volcanoes? 2. Where are the major zones of volcanism? 3. What are the parts of a volcano? 4. How do volcanic landforms differ? 5. How does magma type influence a volcano's explosivity? 6. What kinds of material are ejected by volcanic eruptions?	**1** Continental drift Pangaea Magnetic reversal Paleomagnetism Seafloor spreading Tectonic plate Divergent boundary Rift valley Convergent boundary Subduction Transform boundary Ridge push Slab pull **2** Volcanism Hot spot Fissure Crater Caldera Shield volcano Cinder cone Composite volcano Tephra Pyroclastic flow Pluton Batholith Stock Laccolith Sill Dike **3** Stress Strain Elastic deformation Plastic deformation Fault Seismic wave Primary wave	**1** • Textbook: "McGraw Hill Inspire Earth Sciencee" • Computer labs/simulations • Variety of rocks and minerals • Actively learn **2** • Textbook: "McGraw Hill Inspire Earth Sciencee" • Computer labs/simulations • Variety of rocks and minerals **3** • Textbook: "McGraw Hill Inspire Earth Sciencee" • Computer labs/simulations • Variety of rocks and minerals **4** • Textbook: "McGraw Hill Inspire Earth Sciencee" • Computer labs/simulations • Variety of rocks and minerals • Actively learn

1. Crust-Mantle Relationship 2. Orogeny 3. Other Types of Mountain Building Time Frame: **1.5 week**	☐Earth and Human Activity ☒Developing and Using Models ☐Planning and Carrying out Investigations ☒Analyzing and Interpreting Data ☐Argumentation from Evidence ☒Scientific Explanations ☐Mathematics and Computation		7. What are the different types of intrusive rock bodies? 8. What geologic process result in intrusive rocks that appear at Earth's surface? **3** 1. How are stress and strain defined as they apply to rocks? 2. What are the three types of movement of faults? 3. What are the three types of seismic waves? 4. How have seismic waves been used to determine the structure and composition of Earth's interior? 5. What are earthquake magnitude and intensity and how are they measured? 6. Where are Earth's seismic belts? 7. What factors affect the amount of damage caused by an earthquake? **4** 1. How can the elevation distribution of Earth's surface be described? 2. What is isostasy and how does it pertain to Earth's mountains? 3. How does Earth's crust respond to the addition and removal of mass? 4. What are orogenic processes? 5. How are the different types of mountains that form along convergent plate boundaries described? 6. What are the processes associated with non-boundary mountains? 7. How are mountains ranges that form along ocean ridges formed? **8.** How do uplifted and fault-block mountains differ?	Secondary wave Surface wave Focus Epicenter Seismometer Seismogram Richter scale Magnitude Amplitude Moment magnitude scale Modified Mercalli scale Soil liquidification Tsunami Seismic gap **4** Topography Isostasy Root Isostatic rebound Orogeny Compressive force Uplifted mountain Plateau Fault block mountain	

Instructional Focus	Dimensions Cross Cutting Concepts Disciplinary Core Ideas Science and Engineering Practices	Targeted Standards based Essential Skills & Concepts				Learning Goals / Essential Questions For Instructional Focus	Essential Vocabulary	Resources
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Assessments: How do my students demonstrate their understanding and how do I measure their learning?

Formative: quiz, worksheets, discussion, research projects

Summative: unit tests, classroom activities

Spearfish School District Curriculum Pacing Guide 2023-24

9 -12 Earth Science

Instructional Focus **Historical Geology**	Focus Summary
1 **Fossils and the Rock Record** 1. The Rock Record 2. Relative-Age Dating 3. Absolute-Age Dating 4. Fossil Remains Suggested Time Frame: **1 week**	Scientists use several methods to learn about Earth's long history.
2 **The Precambrian Earth** 1. Early Earth 2. Formation of the Crust and Continents 3. Formation of the Atmosphere and Oceans 4. Life on Early Earth Suggested Time Frame: **1 week**	The oceans and atmosphere formed and life began during the three eons of the Precambrian, which spans 90 percent of Earth's history.
3 **The Paleozoic, Mesozoic, and Cenozoic Eras** 1. The Paleozoic Era 2. The Mesozoic Era 3. The Cenozoic Era Suggested Time Frame: **2 week**	Complex life developed and diversified during the three eras of the Phanerozoic Eon as the continents moved into their present positions.

Spearfish School District Curriculum Pacing Guide 2023-24

9 -12 Earth Science

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Suggested time frame: **1** 1. The Rock Record 2. Relative-Age Dating 3. Absolute-Age Dating 4. Fossil Remains Time Frame: **1 week** **2** 1. Early Earth 2. Formation of the Crust and Continents 3. Formation of the Atmosphere and Oceans 4. Life on Early Earth Time Frame: **1 week** **3** 1. The Paleozoic Era 2. The Mesozoic Era	☒Patterns ☒Scale, Proportion, and Quantity ☒Systems and System Models ☐Cause and Effect ☐Energy and Matter ☒Stability and Change ☒Structure and Function ☐ Matter and Its Interactions ☐Motion and Stability: Forces and Interactions ☐Energy ☒From Molecules to Organisms: Structures and Processes ☐Ecosystems: Interactions, Energy, and Dynamics ☐Earth's Place in the Universe ☒Earth's Systems	**1** HS-ESS1-6: Apply scientific reasoning and evidence from ancient Earth materials, meteorites, and other planetary surfaces to construct an account of Earth's formation and early history. HS-ESS2-1: Analyze geoscience data to make the claim that one change to Earth's surface can create feedback that cause changes to other Earth systems. **2** HS-ESS1-6: Apply scientific reasoning and evidence from ancient Earth materials, meteorites, and other planetary surfaces to construct an account of Earth's formation and early history. HS-ESS2-1: Analyze geoscience data to make the claim that one change to Earth's surface can create feedback that cause changes to other Earth systems. **3** 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.	**1** 1. Why do scientists need a geologic time scale? 2. How are eons, eras, periods, and epochs defined? 3. What are the groups of plants and animals that dominated eras of Earth's history? 4. How in uniformitarianism defined and what is its importance to geology? 5. What geologic principles are used to interpret rock sequences and determine relative ages? 6. How do scientists use correlation to understand the history of a region? 7. What are the differences between absolute-age and relative-age dating? 8. How are radioactive elements used to date rocks and other objects? 9. How can scientists use certain non-radioactive materials to date geologic events? 10. What are the methods by which fossils are preserved? 11. How do scientists use index fossils? **12.** How are fossils used to interpret Earth's past physical and biological history? **2** 1. What evidence exists that indicates Earth is 4.6 billion years old? 2. What were the heat sources of early Earth? 3. How did Earth's crust and continents grow during the Precambrian? 4. What was the cause for the increase in oxygen gas in the atmosphere? 5. How do scientists know that atmospheric oxygen existed during the Proterozoic? 6. What was the importance of oxygen and water on early Earth? 7. What is the difference between prokaryotes and eukaryotes?	**1** Geologic time scale Eon Precambrian Era Period Epoch Mass extinction Uniformitarianism Relative-age dating Original horizontality Superposition Cross-cutting relationship Principle of inclusions Uncomformity Correlation Key bed Absolute-age dating Radioactive decay Radiometric dating Half-life Radiocarbon dating Varve Evolution Original preservation Altered hard part Mineral replacement Index fossil **2** Zircon Meteorite Asteroid Differentiation Microcontinent Craton Precambrian Shield Canadian Shield	**1** • Textbook: "McGraw Hill Inspire Earth Sciencee" • Computer labs/simulations • Variety of rocks and minerals • Actively learn **2** • Textbook: "McGraw Hill Inspire Earth Sciencee" • Computer labs/simulations • Variety of rocks and minerals • Actively learn **3** • Textbook: "McGraw Hill Inspire Earth Sciencee" • Computer labs/simulations • Variety of rocks and minerals • Actively learn

Instructional Focus	Dimensions Cross Cutting Concepts Disciplinary Core Ideas Science and Engineering Practices	Targeted Standards based Essential Skills & Concepts PS / LS / ESS / ED	Learning Goals / Essential Questions For Instructional Focus	Essential Vocabulary	Resources
3. The Cenozoic Era Suggested Time Frame: **2 week**	☒Earth and Human Activity ☒Developing and Using Models ☐Planning and Carrying out Investigations ☒Analyzing and Interpreting Data ☒Argumentation from Evidence ☒Scientific Explanations ☐Mathematics and Computation	HS-ESS2-1: Analyze geoscience data to make the claim that one change to Earth's surface can create feedback that cause changes to other Earth systems.	**8.** How are Earth's early multicellular organisms described? **3** 1. How do transgressions and regressions indicate sea-level change? 2. How are changes in Paleozoic life-forms summarized? 3. How did the breakup of Pangaea affect Earth's life-forms and paleogeography? 4. How did the mountains of western North America form? 5. What are possible causes for the extinction of the non-avian dinosaurs and other Mesozoic life-forms? 6. What was the extent of glaciation during the Cenozoic? 7. How can tectonic activity in North America during the Cenozoic be described? **8.** How did climate change affect life-forms during the Cenozoic?	Laurentia Cyanobacteria Stromatolite Banded-iron formation Red bed Amino acid Prokaryote Eukaryote Edicaran biota **3** Paleogeography Passive margin Transgression Regression Cambrian explosion Phytoplankton Amniotic egg Iridium *Homo sapiens* bipedal	

Assessments: How do my students demonstrate their understanding and how do I measure their learning?

Formative: quiz, worksheets, discussion, research projects

Summative: unit tests, classroom activities

Spearfish School District Curriculum Pacing Guide 2023-24

9 -12 Earth Science

Instructional Focus **Natural Resources**	Focus Summary
1 **Earth Resources** 1. Natural Resources 2. Resources From Earth's Crust 3. Air Resources 4. Water Resources Suggested Time Frame: **1 week**	People and other organisms use Earth's resources for everyday use.
2 **Energy Resources** 1. Conventional Energy Sources 2. Alternative Energy Resources 3. Conservation of Energy Resources Suggested Time Frame: **1 week**	People use energy resources, most of which originate from the Sun, for everyday living.
3 **Human Impact on Resources** 1. Populations and the Use of Resources 2. Human Impact on Land Resources 3. Human Impact on Air Resources 4. Human Impact on Water Resources Suggested Time Frame: **2 week**	The use of natural resources can impact Earth's land, air, and water.

Spearfish School District Curriculum Pacing Guide 2023-24

9 -12 Earth Science

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Suggested time frame: **1** 1. Natural Resources 2. Resources From Earth's Crust 3. Air Resources 4. Water Resources Time Frame: **1 week** **2** 1. Conventional Energy Sources 2. Alternative Energy Resources . Conservation of Energy Resources Time Frame: **1 week** **3** 1. Populations and the Use of Resources 2. Human Impact on Land Resources	☒Patterns ☒Scale, Proportion, and Quantity ☒Systems and System Models ☒Cause and Effect ☒Energy and Matter ☒Stability and Change ☒Structure and Function ☒ Matter and Its Interactions ☐Motion and Stability: Forces and Interactions ☒Energy ☒From Molecules to Organisms: Structures and Processes ☒Ecosystems: Interactions, Energy, and Dynamics ☐Earth's Place in the Universe ☒Earth's Systems	**1** HS-ESS3-1: Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity HS-ESS3-2: Evaluate competing design solutions for developing, managing, and utilizing energy and mineral resources based on cost-benefit ratios.* **2** HS-ESS3-2: Evaluate competing design solutions for developing, managing, and utilizing energy and mineral resources based on cost-benefit ratios.* 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. **3** HS-ESS3-2: Evaluate competing design solutions for developing, managing, and utilizing energy and mineral resources based on cost-benefit ratios.*	**1** 1. What are renewable and nonrenewable resources? 2. What is sustainable yield? 3. How are resources unevenly distributed on Earth? 4. Which materials from Earth's crust are considered natural resources? 5. Why is the need to protect Earth's land surface as a resource important? 6. How is the uneven distribution of resources worldwide explained? 7. How is the atmosphere a resource? 8. How are the carbon and nitrogen cycles illustrated? 9. What are natural sources of air pollution? 10. Why are the properties of water important for life on Earth? 11. How is water distributed and used on Earth? **12.** In what ways can humans reduce the need for freshwater resources? **2** 1. Why is the Sun the source of most energy on Earth? 2. What materials are used as fuels? 3. How does coal form? 4. What are several alternative energy resources? 5. How can the Sun's energy be harnessed? 6. How can water, wind, nuclear, and thermal energy be used to generate electricity? 7. Why might nuclear energy be controversial? 8. How can energy resources be conserved? 9. How can increasing energy efficiency help preserve fossil fuels? **3**	**1** Natural resource Renewable resource Sustainable yield Nonrenewable resource Desertification Aggregate Bedrock Ore tailings Nitrogen-fixing bacteria Pollutant Hydrogen bond Desalination **2** Fuel Biomass fuel Hydrocarbon Peat Fossil fuel Photovoltaic cell Hydroelectr4ic power Geothermal energy Nuclear fission Energy efficiency Cogeneration Sustainable yield **3** Exponential growth Carrying capacity Density-independent factor Density-dependent factor Reclamation Deforestation Pesticide Bioremediation Photochemical smog	**1** • Textbook: "McGraw Hill Inspire Earth Sciencee" • Computer labs/simulations • Variety of rocks and minerals • Actively learn **2** • Textbook: "McGraw Hill Inspire Earth Sciencee" • Computer labs/simulations • Variety of rocks and minerals • Actively learn **3** • Textbook: "McGraw Hill Inspire Earth Sciencee" • Computer labs/simulations • Variety of rocks and minerals • Actively learn

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3. Human Impact on Air Resources 4. Human Impact on Water Resources Time Frame: **2 week**	☒Earth and Human Activity ☒Developing and Using Models ☒Planning and Carrying out Investigations ☒Analyzing and Interpreting Data ☒Argumentation from Evidence ☒Scientific Explanations ☐Mathematics and Computation	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.	1. What is the typical pattern of population growth of organisms? 2. What happens to populations when they reach carrying capacity? 3. What environmental factors affect population growth? 4. How can mineral extraction impact the environment? 5. What are some of the environmental issues created by agriculture and forestry and possible solutions? 6. How does urban development affect soil and water? 7. What is the relationship between the greenhouse effect and global warming? 8. What are the causes and effects of acid precipitation? 9. What are the types and sources of water pollution?	Ozone hole acid precipitation Point source Nonpoint source	

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Summative: unit tests