



DYNAMIC LEARNING MAPS

PRELIMINARY ESSENTIAL
ELEMENTS
FOR
SCIENCE

DECEMBER 15, 2014

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Background on the Dynamic Learning Maps Preliminary Essential Elements for Science

The Dynamic Learning Maps (DLM) Preliminary Essential Elements for Science (Pre-EEs) are specific statements of knowledge and skills linked to the grade-span expectations identified in the Next Generation Science Standards (NGSS) and represent the most frequently assessed alternate standards in DLM Science states. As such, this preliminary set of Essential Elements addresses a small number of science standards, representing a breadth, but not depth, of coverage across the entire standards framework. (Note: NGSS codes are used to provide a general education link to the DLM Essential Elements.) The purpose of the DLM Essential Elements is to build a bridge from the content in the NGSS standards framework to academic expectations for students with the most significant cognitive disabilities. This version of the DLM Pre-EEs will provide content for science assessments developed in 2014-2016. The DLM Science Consortium intends to develop a learning map based on research about how students learn science content and engage in scientific and engineering practices in the next phase of the project. After a learning map is built and pilot and field test data are gathered, these preliminary Essential Elements will be aligned to the map with revisions and additions as appropriate.

The DLM Pre-EES were developed in a four-stage process from August to December, 2014.

Table 1. Timeline for DLM Pre-EEs Development

	Draft	Development	Timeline
1	Essential Elements created by DLM and reviewed internally		08/28/14 – 08/29/14
2	Face-to-face state educator review		10/14/14 – 10/15/14
3	States conduct reviews in-state		10/27/14 – 11/07/14
4	Final state review of Essential Elements		11/18/14 – 12/03/14

The development of the first draft began with guidance from the DLM Science states to develop Essential Elements for three grade spans: elementary school (represented by grade 5 standards), middle school, and high school (including Essential Elements appropriate for end-of-course high school biology). A crosswalk of DLM states' science standards identified common cross-grade topics in the domains of physical science, life science (from which the high school biology topics were identified), and earth/space science. Most states' science standards included scientific investigation practices, typically integrated

into the core content areas. States selected core content for Essential Element development that is common across states; shows strong progressions across grades; and is most important for students with significant cognitive disabilities to be prepared for college, career, or community life. The DLM science standards framework approved for Pre-EEs development identified the number of standards to address by grade and domain.

Table 2. Count of state standards to address in Pre-EEs development.

	Physical Science	Life Science	Earth/Space Science
<i>Elementary School</i>	4	2	3
<i>Middle School</i>	4	4	6
<i>High School</i>	4	5	6
<i>High School Biology</i>	N/A	10	N/A

Another important consideration for Essential Element development concerned the number of linkage levels to include in the Pre-EEs. The DLM Essential Elements for English language arts and mathematics contain five linkage levels. It was recommended that the Pre-EEs use three levels, which would allow for development of the science map to support additional linkage levels that are based on research and evidence.

Table 3. Linkage level comparison.

Linkage Levels for ELA and Mathematics				
Initial	Distal Precursor	Proximal Precursor	Target (grade level EE)	Successor
Preliminary Linkage Levels for Science				
Initial	Precursor	Target		

The first draft of the Pre-EEs was compiled by DLM staff and then reviewed internally by an expert panel of science and special education consultants, which resulted in a second draft. The second draft was presented to representatives from each state education agency and the educators and content specialists they selected. Sixteen experts in science, as well as seventeen individuals with expertise in instruction for students with significant cognitive disabilities from across five states, reviewed the draft documents. This review resulted in significant changes that:

- clarified the science concepts that are the essential targets for measurement,

- revised verbs to convey clear statement of what the student should do related to Scientific and Engineering Practices,
- focused on universal access issues,
- revised the Essential Elements to be more measurable,
- aligned the linkage levels with the target Essential Elements and across the grade span and refined *Initial* and *Precursor* levels, and
- provided *examples* within the Essential Element statements.

A third draft was then reviewed internally by each state, considering these guiding questions:

1. Do the Essential Elements fit within the topics and core ideas that are the framework for the DLM system?
2. Do the Essential Elements in each topic support student learning over time?
3. Are the Essential Elements and linkage level learning targets clearly defined?
4. Do the linkage levels represent the learning target content at appropriately reduced levels of breadth and depth?

A final discussion and consensus vote by participating states in December, 2014, resulted in these Pre-EEs.

Format of the Dynamic Learning Maps Preliminary Essential Elements for Science

The Pre-EEs are presented by grade level and domain in a format that contains the following information for each Essential Element.

Grade Span (e.g., Elementary, Middle School, High School)

Format	Explanation
Domain: (e.g., Physical, Life, or Earth/Space)	<p><u>Science Framework:</u> This information shows how the Essential Element links to general education grade-level science standards, using linking codes from the NGSS framework.</p>
Core Idea:	
Topic:	
State Standard for General Education:	
Essential Element: Target Level Description:	<p><u>Essential Element:</u> These are the three levels of the Pre-EEs.</p>
Precursor Level Description:	
Initial Level Description:	
Connections to Science Practices	<p><u>Connections:</u> Essential Elements are connected to specific science practices and concepts. In addition, some science Essential Elements have important connections to DLM Essential Elements in ELA and math, which are listed here when available.</p>
Connections to Crosscutting Concepts	
Connections to DLM ELA Essential Elements	
Connections to DLM Mathematics Essential Elements	

Preliminary Essential Elements for Elementary

Elementary

<p>Domain: Physical</p>
<p>Core Idea: PS1: Matter and Its Interactions</p>
<p>Topic: PS1.A: Structure and Properties of Matter</p>
<p>State Standard for General Education: 5-PS1-2: Measure & graph quantities to provide evidence that, regardless of the type of change that occurs when heating, cooling, or mixing substances, the total weight of matter is conserved.</p>
<p>Essential Element: EE.5-PS1-2 Target Level: Measure and compare weights of substances before and after heating, cooling, or mixing substances to show that weight of matter is conserved.</p>
<p>Precursor Level: Compare the weight of an object before and after it changes from a liquid to a solid and from a solid to a liquid.</p>
<p>Initial Level: Recognize the change in state from liquid to solid or from solid to liquid of the same material.</p>
<p>Connections to Science Practices Using Mathematics and Computational Thinking</p>
<p>Connections to Crosscutting Concepts Scale, Proportion, and Quantity</p>
<p>Connections to ELA Essential Elements EE.W.5.7: Conduct short research projects using 2 or more sources. EE.W.5.8: Gather and sort relevant information on a topic from print or digital sources into given categories.</p>
<p>Connections to Mathematics Essential Elements EE.5.NBT.1: Compare numbers up to 99 using base 10 models. EE.5.NF.B.7: Apply and extend previous understandings of multiplication and division to multiply and divide fractions. EE.5.MD.A.1.b: Use standard units to measure weight and length.</p>

Elementary

<p>Domain: Physical</p>
<p>Core Idea: PS1: Matter and Its Interactions</p>
<p>Topic: PS1.A: Structure and Properties of Matter</p>
<p>State Standard for General Education: 5-PS1-3: Make observations and measurement to identify materials based on their properties.</p>
<p>Essential Element: EE.5-PS1-3 Target Level: Make observations and measurements to identify materials based on their properties (e.g., weight, shape, texture, bouyancy, color, or magnetism).</p>
<p>Precursor Level: Classify materials by physical properties. (e.g., weight, shape, texture, bouyancy, color, or magnetism).</p>
<p>Initial Level: Match materials with similar physical properties.</p>
<p>Connections to Science Practices Planning and Carrying out Investigations</p>
<p>Connections to Crosscutting Concepts Scale, Proportion, and Quantity</p>
<p>Connections to ELA Essential Elements EE.W.5.7: Conduct short research projects using 2 or more sources. EE.W.5.8: Gather and sort relevant information on a topic from print or digital sources into given categories.</p>
<p>Connections to Mathematics Essential Elements EE.5.MD.A.1: Use standard units to measure weight and length.</p>

Elementary

<p>Domain: Physical</p>
<p>Core Idea: PS2: Motion and Stability: Forces and Interactions</p>
<p>Topic: PS2.B: Types of Interactions</p>
<p>State Standard for General Education: 5-PS2-1: Support an argument that the gravitational force exerted by Earth on objects is directed down.</p>
<p>Essential Element: EE.5-PS2-1 Target Level: Demonstrate that the gravitational force exerted by Earth on objects is directed down.</p>
<p>Precursor Level: Predict the direction an object will go when dropped.</p>
<p>Initial Level: Recognize the direction an object will go when dropped.</p>
<p>Connections to Science Practices Engaging in Argument from Evidence</p>
<p>Connections to Crosscutting Concepts Cause and Effect</p>
<p>Connections to ELA Essential Elements EE.RI.5.1: Identify words in the text to answer a question about explicit information. EE.RI.5.9: Compare and contrast details gained from two texts on the same topic. EE.W.5.1: Write opinions about topics or text (introduce a topic or text and state an opinion about it, provide reasons to support the opinion).</p>
<p>Connections to Mathematics Essential Elements N/A</p>

Elementary

<p>Domain: Physical</p>
<p>Core Idea: PS3: Energy</p>
<p>Topic: PS3.D: Energy in Chemical Processes and Everyday Life</p>
<p>State Standard for General Education: 5-PS3-1: Use models to describe that energy in animals' food (used for body repair, growth, motion, and to maintain body warmth) was once energy from the Sun.</p>
<p>Essential Element: EE.5-PS3-1 Target Level: Create a model to describe that energy in animals' food was once energy from the Sun.</p>
<p>Precursor Level: Use models to describe that plants capture energy from sunlight.</p>
<p>Initial Level: Identify simple models that show that plants need sunlight to grow.</p>
<p>Connections to Science Practices Developing and Using Models</p>
<p>Connections to Crosscutting Concepts Energy and Matter</p>
<p>Connections to ELA Essential Elements EE.RI.5.7: Locate information in print or digital sources. EE.SL.5.5: Select or create audio recordings and visual/tactile displays to enhance a presentation.</p>
<p>Connections to Mathematics Essential Elements N/A</p>

Elementary

<p>Domain: Life</p>
<p>Core Idea: LS1: From Molecules to Organisms: Structures and Processes</p>
<p>Topic: LS1.C: Organization for Matter and Energy Flow in Organisms</p>
<p>State Standard for General Education: 5-LS1-1: Support an argument that plants get the materials they need for growth chiefly from air and water.</p>
<p>Essential Element: EE.5-LS1-1 Target Level: Provide evidence that plants need air and water to grow.</p>
<p>Precursor Level: Provide evidence that plants grow.</p>
<p>Initial Level: Distinguish things that grow from things that don't grow.</p>
<p>Connections to Science Practices Engaging in Argument from Evidence</p>
<p>Connections to Crosscutting Concepts Energy and Matter</p>
<p>Connections to ELA Essential Elements EE.RI.5.1: Identify words in the text to answer a question about explicit information. EE.RI.5.9: Compare and contrast details gained from two texts on the same topic. EE.W.5.1: Write opinions about topics or text (introduce a topic or text and state an opinion about it, provide reasons to support the opinion).</p>
<p>Connections to Mathematics Essential Elements EE.5.MD.1.b: Use standard units to measure weight and length of objects.</p>

Elementary

<p>Domain: Life</p>
<p>Core Idea: LS2: Ecosystems: Interactions, Energy, and Dynamics</p>
<p>Topic: LS2.A: Interdependent Relationships in Ecosystems</p>
<p>State Standard for General Education: 5-LS2-1: Develop a model to describe the movement of matter among plants, animals, decomposers, and the environment.</p>
<p>Essential Element: EE.5-LS2-1 Target Level: Create a model that shows the movement of matter (e.g., plant growth, eating, composting) through living things.</p>
<p>Precursor Level: Identify a model that shows the movement of matter from plants to animals (e.g. food chain/food web).</p>
<p>Initial Level: Identify common human foods.</p>
<p>Connections to Science Practices Developing and Using Models</p>
<p>Connections to Crosscutting Concepts Systems and System Models</p>
<p>Connections to ELA Essential Elements EE.RI.5.7: Locate information in print or digital sources. EE.SL.5.5: Select or create audio recordings and visual/tactile displays to enhance a presentation.</p>
<p>Connections to Mathematics Essential Elements N/A</p>

Elementary

<p>Domain: Earth and Space</p>
<p>Core Idea: ESS1: Earth's Place in the Universe</p>
<p>Topic: ESS1.B: Earth and the Solar System</p>
<p>State Standard for General Education: 5-ESS1-2: Represent data in graphical displays to reveal patterns of daily changes in length and direction of shadows, day and night, and the seasonal appearance of some stars in the night sky.</p>
<p>Essential Element: EE.5-ESS1-2 Target Level: Represent and interpret data on a picture, line, or bar graph to show seasonal patterns in the length of daylight hours.</p>
<p>Precursor Level: Recognize patterns about length of daylight hours over time (e.g., week to week, month to month).</p>
<p>Initial Level: Order events in daily routine including sunrise and sunset.</p>
<p>Connections to Science Practices Analyzing and Interpreting Data</p>
<p>Connections to Crosscutting Concepts Patterns</p>
<p>Connections to ELA Essential Elements EE.SL.5.5: Select or create audio recordings and visual/tactile displays to enhance a presentation.</p>
<p>Connections to Mathematics Essential Elements EE.5.NBT.2: Use the number of zeros in numbers that are powers of 10 to determine which values are equal, greater than, or less than. EE.5.G.2: Sort two-dimensional figures and identify the attributes (angles, number of sides, corners, color) they have in common.</p>

Elementary

<p>Domain: Earth and Space</p>
<p>Core Idea: ESS2: Earth's Systems</p>
<p>Topic: ESS2.A: Earth Materials and Systems</p>
<p>State Standard for General Education: 5-ESS2-1: Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact.</p>
<p>Essential Element: EE.5-ESS2-1 Target Level: Develop a model showing how water (hydrosphere) affects the living things (biosphere) found in a region.</p>
<p>Precursor Level: Recognize how water (hydrosphere) affects people in a region (e.g., floods, droughts, mudslide, tourism, and recreation).</p>
<p>Initial Level: Anticipates routine (e.g., clothes to wear, activities to do) to follow when it is raining.</p>
<p>Connections to Science Practices Developing and Using Models</p>
<p>Connections to Crosscutting Concepts Systems and System Models</p>
<p>Connections to ELA Essential Elements EE.RI.5.7: Locate information in print or digital sources. EE.SL.5.5: Select or create audio recordings and visual/tactile displays to enhance a presentation.</p>
<p>Connections to Mathematics Essential Elements EE.5.G.2: Sort two-dimensional figures and identify the attributes (angles, number of sides, corners, color) they have in common.</p>

Elementary

<p>Domain: Earth and Space</p>
<p>Core Idea: ESS3: Earth and Human Activity</p>
<p>Topic: ESS3.C: Human Impacts on Earth Systems</p>
<p>State Standard for General Education: 5-ESS3-1: Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment.</p>
<p>Essential Element: EE.5-ESS3-1 Target Level: Use information to describe how people can help protect the Earth's resources and how that affects the environment.</p>
<p>Precursor Level: Compare two methods people can use to help protect the Earth's resources.</p>
<p>Initial Level: Identify one way to protect a resource of Earth (e.g., put paper in the recycling bin).</p>
<p>Connections to Science Practices Obtaining, Evaluating, and Communicating Information</p>
<p>Connections to ELA Essential Elements EE.RI.5.1: Identify words in the text to answer a question about explicit information. EE.RI.5.7: Locate information in print or digital sources. EE.RI.5.9: Compare and contrast details gained from two texts on the same topic. EE.W.5.8: Gather and sort relevant information on a topic from print or digital sources into given categories.</p>
<p>Connections to Mathematics Essential Elements N/A</p>

Preliminary Essential Elements for Middle School

Middle School

Domain: Physical
Core Idea: PS1: Matter and Its Interactions
Topic: PS1.A: Structure and Properties of Matter
State Standard for General Education: MS-PS1-2: Analyze and interpret data on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred.
Essential Element: EE.MS-PS1-2 Target Level: Interpret and analyze data on the properties (e.g., color, texture, odor, and state of matter) of substances before and after chemical changes have occurred (e.g., burning sugar or burning steel wool, rust, effervescent tablets).
Precursor Level: Gather data on the properties (e.g., color, texture, odor, and state of matter) of substances before and after chemical changes have occurred (e.g., burning sugar or burning steel wool, rust, effervescent tablets).
Initial Level: Observe and identify examples of change (e.g. state of matter, color, temperature, and odor).
Connections to Science Practices Analyzing and Interpreting Data
Connections to Crosscutting Concepts Patterns
Connections to ELA Essential Elements N/A
Connections to Mathematics Essential Elements EE.6.SP.5: Summarize data distributions shown in graphs or tables. EE.1.MD.4: Organize data into categories by sorting.

Middle School

Domain: Physical
Core Idea: PS2: Motion and Stability: Forces and Interactions
Topic: PS2.A: Forces and Motion
State Standard for General Education: MS-PS2-2: Plan an investigation to provide evidence that the change in an object's motion depends on the sum of the forces on the object and the mass of the object.
Essential Element: EE.MS-PS2-2 Target Level: Investigate and predict the change in motion of objects based on the forces acting on those objects.
Precursor Level: Investigate and identify ways to change the motion of an object (e.g., change an incline's slope to make an object go slower, faster, farther).
Initial Level: Identify ways to change the movement of an object (e.g., faster, slower, stop).
Connections to Science Practices Planning and Carrying Out Investigations
Connections to Crosscutting Concepts Stability and Change
Connections to ELA Essential Elements N/A
Connections to Mathematics Essential Elements EE.6.EE.1-2: Identify equivalent number sentences. EE.7.EE.4: Use the concept of equality with models to solve one-step addition and subtraction equations.

Middle School

Domain: Physical
Core Idea: PS3: Energy
Topic: PS3.B: Conservation of Energy and Energy Transfer
State Standard for General Education: MS-PS3-3: Apply scientific principles to design, construct, and test a device that either minimizes or maximizes thermal energy transfer.
Essential Element: EE.MS-PS3-3 Target Level: Test and refine a device (e.g., foam cup, insulated box, or thermos) to either minimize or maximize thermal energy transfer (e.g., keeping liquids hot or cold, preventing liquids from freezing, keeping hands warm in cold temperatures).
Precursor Level: Investigate objects/materials, and predict their ability to maximize or minimize thermal energy transfer.
Initial Level: Identify objects/materials used to minimize or maximize thermal energy transfer (e.g., gloves, vacuum flask, insulated hot pad holder or foam cup).
Connections to Science Practices Constructing Explanations and Designing Solutions
Connections to Crosscutting Concepts Energy and Matter
Connections to ELA Essential Elements N/A
Connections to Mathematics Essential Elements N/A

Middle School

Domain: Physical
Core Idea: PS4: Waves and Their Applications in Technologies for Information Transfer
Topic: PS4.A: Wave Properties
State Standard for General Education: MS-PS4-2: Develop and use a model to describe that waves are reflected, absorbed, or transmitted through various materials.
Essential Element: EE.MS-PS4-2 Target Level: Use a model to show how light waves (e.g., light through a water glass, light on colored objects) or sound waves are reflected, absorbed, or transmitted through various materials (e.g., water, air, table).
Precursor Level: Investigate changes in vibrations and sources of sound in everyday life.
Initial Level: Use a model to recognize that sound waves are transmitted by vibrations.
Connections to Science Practices Developing and Using Models
Connections to Crosscutting Concepts Structure and Function
Connections to ELA Essential Elements EE.SL.8.5: Include multimedia and visual information into presentations.
Connections to Mathematics Essential Elements 6.SP.5: Summarize data in distributions shown in graphs or tables.

Middle School

Domain: Life
Core Idea: LS1: From Molecules to Organisms: Structures and Processes
Topic: LS1.A: Structure and Function
State Standard for General Education: MS-LS1-3: Use argument supported by evidence for how the body is a system of interacting subsystems composed of groups of cells.
Essential Element: EE.MS-LS1-3 Target Level: Make a claim about how a structure (e.g., organs and organ systems) and its related function supports survival of animals (circulatory, digestive, and respiratory systems).
Precursor Level: Use a model to demonstrate how organs are connected in major organ systems.
Initial Level: Recognize major organs of animals.
Connections to Science Practices Engaging in Argument from Evidence
Connections to Crosscutting Concepts Systems and System Models
Connections to ELA Essential Elements N/A
Connections to Mathematics Essential Elements N/A

Middle School

<p>Domain: Life</p>
<p>Core Idea: LS1: From Molecules to Organisms</p>
<p>Topic: LS1.B: Growth and Development of Organisms</p>
<p>State Standard for General Education: MS-LS1-5: Construct a scientific explanation based on evidence for how environmental and genetic factors influence the growth of organisms.</p>
<p>Essential Element: EE.MS-LS1-5 Target Level: Interpret data to show that environmental resources (e.g., food, light, space, water) influence growth of organisms (e.g., drought decreasing plant growth, fertilizer increasing plant growth, different varieties of plant seeds growing at different rates in different conditions, fish growing larger in large ponds than small ponds).</p>
<p>Precursor Level: Identify factors that influence growth of organisms.</p>
<p>Initial Level: Match organisms to their habitats.</p>
<p>Connections to Science Practices Constructing Explanations and Designing Solutions</p>
<p>Connections to Crosscutting Concepts Cause and Effect</p>
<p>Connections to ELA Essential Elements N/A</p>
<p>Connections to Mathematics Essential Elements EE.6.SP.1-2: Display data on a graph or table that shows variability in the data.</p>

Middle School

<p>Domain: Life</p>
<p>Core Idea: LS2: Ecosystems: Interactions, Energy, and Dynamics</p>
<p>Topic: LS2.A: Interdependent Relationships in Ecosystems</p>
<p>State Standard for General Education: MS-LS2-2: Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems.</p>
<p>Essential Element: EE.MS-LS2-2 Target Level: Use models of food chains/webs to identify producers and consumers in aquatic and terrestrial ecosystems.</p>
<p>Precursor Level: Classify animals based on what they eat (e.g., herbivore, omnivore, carnivore).</p>
<p>Initial Level: Identify food that animals eat.</p>
<p>Connections to Science Practices Constructing Explanations and Designing Solutions</p>
<p>Connections to Crosscutting Concepts Patterns</p>
<p>Connections to ELA Essential Elements EE.SL.8.1: Engage in collaborative discussions: (a) Come to discussions prepared to share information previously studied, (b) Follow simple rules and carry out assigned roles during discussions, (c) Remain on the topic of the discussion when asking or answering questions or making other contributions to a discussion, (d) Acknowledge new information expressed by others in a discussion and relate it to own ideas. EE.SL.8.4: Present descriptions, facts, or details supporting specific points made on a topic.</p>
<p>Connections to Mathematics Essential Elements EE.6.SP.5: Summarize data distributions shown in graphs or tables.</p>

Middle School

<p>Domain: Life</p>
<p>Core Idea: LS3: Heredity: Inheritance and Variation of Traits</p>
<p>Topic: LS3.B: Variation of Traits</p>
<p>State Standard for General Education: MS-LS3-2: Develop and use a model to describe why asexual reproduction results in offspring with identical genetic information and sexual reproduction results in offspring with genetic variation.</p>
<p>Essential Element: EE.MS-LS3-2 Target Level: Make a claim supported by evidence that offspring inherit traits from their parents.</p>
<p>Precursor Level: Identify similarities and differences between plant and animal parents and their offspring (e.g., eye color, hair/fur color, height, leaf shape, and/or markings).</p>
<p>Initial Level: Recognize that organisms differ within same species (e.g., dogs, chickens, oaks that differ in color and size).</p>
<p>Connections to Science Practices Developing and Using Models</p>
<p>Connections to Crosscutting Concepts Cause and Effect</p>
<p>Connections to ELA Essential Elements EE.SL.8.5: Include multimedia and visual information into presentations.</p>
<p>Connections to Mathematics Essential Elements EE.6.SP.5: Summarize data distributions shown in graphs or tables.</p>

Middle School

<p>Domain: Earth and Space</p>
<p>Core Idea: ESS1: Earth's Place in the Universe</p>
<p>Topic: ESS1.B: Earth and the Solar System</p>
<p>State Standard for General Education: MS-ESS1-1: Develop and use a model of the Earth-Sun-Moon system to describe the cyclic patterns of lunar phases, eclipses of the Sun and Moon, and seasons.</p>
<p>Essential Element: EE.MS-ESS1-1 Target Level: Use an Earth-Sun-Moon model to show that Earth's orbit around the Sun corresponds to a calendar year and the orbit of the Moon around Earth corresponds to a month.</p>
<p>Precursor Level: Use a model to show that Earth's Moon moves around Earth, and Earth and its Moon move around the Sun.</p>
<p>Initial Level: Recognize models of the Earth, Moon, and Sun system.</p>
<p>Connections to Science Practices Developing and Using Models</p>
<p>Connections to Crosscutting Concepts Patterns</p>
<p>Connections to ELA Essential Elements EE.SL.8.5: Include multimedia and visual information into presentations.</p>
<p>Connections to Mathematics Essential Elements EE.6.RP.1: Demonstrate a simple ratio relationship. EE.4.OA.5: Use repeating patterns to make predictions. EE.5.OA.3: Identify and extend numerical patterns.</p>

Middle School

<p>Domain: Earth and Space</p>
<p>Core Idea: ESS2: Earth's Systems</p>
<p>Topic: ESS2.A: Earth's Materials and Systems</p>
<p>State Standard for General Education: MS-ESS2-1: Develop a model to describe the cycling of Earth's materials and the flow of energy that drives this process.</p>
<p>Essential Element: EE.MS-ESS2-1 Target Level: Use a model to describe the change within the rock cycle between igneous, metamorphic, and sedimentary rock.</p>
<p>Precursor Level: Use a model to describe the change from igneous to sedimentary rock.</p>
<p>Initial Level: Identify the process that forms igneous rock (e.g., volcanoes).</p>
<p>Connections to Science Practices Developing and Using Models</p>
<p>Connections to Crosscutting Concepts Stability and Change</p>
<p>Connections to ELA Essential Elements EE.SL.8.5: Include multimedia and visual information into presentations.</p>
<p>Connections to Mathematics Essential Elements N/A</p>

Middle School

<p>Domain: Earth and Space</p>
<p>Core Idea: ESS2: Earth's Systems</p>
<p>Topic: ESS2.A: Earth's Materials and Systems</p>
<p>State Standard for General Education: MS-ESS2-2: Construct an explanation based on evidence for how geoscience processes have changed Earth's surface at varying time and spatial scales.</p>
<p>Essential Element: EE.MS-ESS2-2 Target Level: Explain how geoscience processes that occur daily (e.g., wind, rain, runoff) slowly change the surface of Earth, while catastrophic events (e.g., earthquakes, tornadoes, floods) can quickly change the surface of Earth.</p>
<p>Precursor Level: Identify geoscience processes (e.g., wind, rain, runoff) that have an impact on landforms (e.g., landslides, erosion such as gullies).</p>
<p>Initial Level: Identify differences in weather conditions from day to day.</p>
<p>Connections to Science Practices Constructing Explanations and Designing Solutions</p>
<p>Connections to Crosscutting Concepts Scale, Proportion, and Quantity</p>
<p>Connections to ELA Essential Elements EE.SL.8.5: Include multimedia and visual information into presentations.</p>
<p>Connections to Mathematics Essential Elements EE.6.EE.5-7: Match an equation to a real-world problem in which variables are used to represent numbers. EE.7.EE.4: Use the concept of equality with models to solve one-step addition and subtraction equations.</p>

Middle School

<p>Domain: Earth and Space</p>
<p>Core Idea: ESS2: Earth's Systems</p>
<p>Topic: ESS2.D: Weather and Climate</p>
<p>State Standard for General Education: MS-ESS2-6: Develop and use a model to describe how unequal heating and rotation of Earth cause patterns of atmospheric and oceanic circulation that determine regional climates.</p>
<p>Essential Element: EE.MS-ESS2-6 Target Level: Interpret basic weather information (e.g., radar, map) to make predictions about future conditions (e.g., precipitation, temperature, wind).</p>
<p>Precursor Level: Interpret basic weather information (e.g., radar, map) to compare weather conditions (either over several days at the same location or different locations on the same day).</p>
<p>Initial Level: Interpret basic weather information (e.g., radar, map) to identify weather conditions.</p>
<p>Connections to Science Practices Developing and Using Models</p>
<p>Connections to Crosscutting Concepts Systems and System Models</p>
<p>Connections to ELA Essential Elements EE.SL.8.5: Include multimedia and visual information into presentations.</p>
<p>Connections to Mathematics Essential Elements N/A</p>

Middle School

<p>Domain: Earth and Space</p>
<p>Core Idea: ESS3: Earth and Human Activity</p>
<p>Topic: ESS3.A: Natural Resources</p>
<p>State Standard for General Education: MS-ESS3-1: Construct a scientific explanation based on evidence for how the uneven distributions of Earth's mineral, energy, and groundwater resources are the result of past and current geoscience processes.</p>
<p>Essential Element: EE.MS-ESS3-1 Target Level: Interpret, based on evidence, how the geoscience processes (e.g., weathering, erosion) create resources.</p>
<p>Precursor Level: Identify the geoscience process that produces a natural resource (e.g., solar energy creating wind energy, rock cycle with ores and minerals).</p>
<p>Initial Level: Identify a natural resource (e.g., water, sand, wind).</p>
<p>Connections to Science Practices Constructing Explanations and Designing Solutions</p>
<p>Connections to Crosscutting Concepts Cause and Effect</p>
<p>Connections to ELA Essential Elements N/A</p>
<p>Connections to Mathematics Essential Elements EE.6.EE.5-7: Match an equation to a real-world problem in which variables are used to represent numbers. EE.7.EE.4: Use the concept of equality with models to solve one-step addition and subtraction equations.</p>

Middle School

<p>Domain: Earth and Space</p>
<p>Core Idea: ESS3: Earth and Human Activity</p>
<p>Topic: ESS3.C: Human Impacts on Earth Systems</p>
<p>State Standard for General Education: MS-ESS3-3: Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.</p>
<p>Essential Element: EE.MS-ESS3-3 Target Level: Develop a plan to monitor and minimize a human impact on the local environment (e.g., water, land, pollution).</p>
<p>Precursor Level: Recognize ways in which humans impact the environment (e.g., agriculture, pollution, recycling, city growth).</p>
<p>Initial Level: Recognize resources (e.g., food, water, shelter, air) in the local environment that are important for human life.</p>
<p>Connections to Science Practices Constructing Explanations and Designing Solutions</p>
<p>Connections to Crosscutting Concepts Cause and Effect</p>
<p>Connections to ELA Essential Elements N/A</p>
<p>Connections to Mathematics Essential Elements EE.6.RP.1: Demonstrate a simple ratio relationship. EE.7.RP.1-3: Use a ratio to model or describe a relationship. EE.6.EE.5-7: Match an equation to a real-world problem in which variables are used to represent numbers. EE.7.EE.4: Use the concept of equality.</p>

Preliminary Essential Elements for High School

High School

Domain: Physical
Core Idea: PS1: Matter and Its Interactions
Topic: PS1.A: Structure and Properties of Matter
State Standard for General Education: HS-PS1-2: Construct and revise an explanation for the outcome of a simple chemical reaction based on the outermost electron states of atoms, trends in the periodic table, and knowledge of the patterns of chemical properties.
Essential Element: EE.HS-PS1-2 Target Level: Make a claim supported by evidence to explain patterns of chemical properties that occur in a substance during a common chemical reaction (e.g., baking soda and vinegar).
Precursor Level: Identify the changes that have occurred during a chemical reaction (e.g., metal-rust, paper-burn).
Initial Level: Recognize that a change has occurred during a chemical reaction.
Connections to Science Practices Constructing Explanations and Designing Solutions
Connections to Crosscutting Concepts Patterns
Connections to ELA Essential Elements N/A
Connections to Mathematics Essential Elements N/A

High School

<p>Domain: Physical</p>
<p>Core Idea: PS2: Motion and Stability: Forces and Interactions</p>
<p>Topic: PS2.A: Forces and Motion</p>
<p>State Standard for General Education: HS-PS2-3: Apply scientific and engineering ideas to design, evaluate, and refine a device that minimizes the force on a macroscopic object during a collision.</p>
<p>Essential Element: EE.HS-PS2-3 Target Level: Evaluate the effectiveness of safety devices and design a solution that could minimize the force of a collision.</p>
<p>Precursor Level: Use data to compare the effectiveness of safety devices to determine which best minimizes the force of a collision.</p>
<p>Initial Level: Identify safety equipment devices that minimize force of a collision (e.g., floor mats, helmets, or steel-toed boots).</p>
<p>Connections to Science Practices Constructing Explanations and Designing Solutions</p>
<p>Connections to Crosscutting Concepts Cause and Effect</p>
<p>Connections to ELA Essential Elements N/A</p>
<p>Connections to Mathematics Essential Elements N/A</p>

High School

<p>Domain: Physical</p>
<p>Core Idea: PS3: Energy</p>
<p>Topic: PS3.B: Conservation of Energy and Energy Transfer</p>
<p>State Standard for General Education: HS-PS3-4: Plan and conduct an investigation to provide evidence that the transfer of thermal energy when two components of different temperature are combined within a closed system results in a more uniform energy distribution among the components in the system.</p>
<p>Essential Element: EE.HS-PS3-4 Target Level: Investigate and predict the temperatures of two liquids before and after combining to show uniform energy distribution.</p>
<p>Precursor Level: Compare the temperatures of two liquids of different temperatures before and after combining.</p>
<p>Initial Level: Compare relative difference in temperature (warmth, coldness) of two liquids.</p>
<p>Connections to Science Practices Planning and Carrying Out Investigations</p>
<p>Connections to Crosscutting Concepts Systems and System Models</p>
<p>Connections to ELA Essential Elements N/A</p>
<p>Connections to Mathematics Essential Elements N/A</p>

High School

<p>Domain: Physical</p>
<p>Core Idea: PS4: Waves and Their Applications in Technologies for Information Transfer</p>
<p>Topic: PS4.A: Wave Properties</p>
<p>State Standard for General Education: HS-PS4-5: Communicate technical information about how some technological devices use the principles of wave behavior and wave interactions with matter to transmit and capture information and energy.</p>
<p>Essential Element: EE.HS-PS4-5 Target Level: Make a claim supported by evidence that shows how some devices use light and sound waves to transmit and capture information.</p>
<p>Precursor Level: Identify common devices which use light or sound waves to transmit information.</p>
<p>Initial Level: Identify how common technological devices are used for different purposes.</p>
<p>Connections to Science Practices Obtaining, Evaluating, and Communicating Information</p>
<p>Connections to Crosscutting Concepts Cause and Effect</p>
<p>Connections to ELA Essential Elements N/A</p>
<p>Connections to Mathematics Essential Elements N/A</p>

High School

<p>Domain: Life</p>
<p>Core Idea: LS1: From Molecules to Organisms: Structures and Processes</p>
<p>Topic: LS1.A: Structure and Function</p>
<p>State Standard for General Education: HS-LS1-2: Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.</p>
<p>Essential Element: EE.HS-LS1-2 Target Level: Use a model to illustrate the organization and interaction of major organs into systems (e.g., circulatory, respiratory, digestive, sensory) in the body to provide specific functions.</p>
<p>Precursor Level: Identify which organs work for a specific function.</p>
<p>Initial Level: Recognize that different organs have different functions.</p>
<p>Connections to Science Practices Developing and Using Models</p>
<p>Connections to Crosscutting Concepts Systems and System Models</p>
<p>Connections to ELA Essential Elements EE.SL.11-12.5: Use digital media strategically (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to support understanding and add interest.</p>
<p>Connections to Mathematics Essential Elements N/A</p>

High School

<p>Domain: Life</p>
<p>Core Idea: LS1: From Molecules to Organisms: Structures and Processes</p>
<p>Topic: LS1.B: Growth and Development of Organisms</p>
<p>State Standard for General Education: HS-LS1-4: Use a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms.</p>
<p>Essential Element: EE.HS-LS1-4 Target Level: Use a model to illustrate how growth occurs when cells multiply.</p>
<p>Precursor Level: Use a model to relate the number of cells to the size of a body.</p>
<p>Initial Level: Recognize that organisms are composed of cells.</p>
<p>Connections to Science Practices Developing and Using Models</p>
<p>Connections to Crosscutting Concepts Systems and System Models</p>
<p>Connections to ELA Essential Elements EE.SL.11-12.5: Use digital media strategically (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to support understanding and add interest.</p>
<p>Connections to Mathematics Essential Elements EE.F-BF.1: Select the appropriate graphical representation (first quadrant) given a situation involving constant rate of change.</p>

High School

<p>Domain: Life</p>
<p>Core Idea: LS2: Ecosystems: Interactions, Energy, and Dynamics</p>
<p>Topic: LS2.A: Interdependent Relationships in Ecosystems</p>
<p>State Standard for General Education: HS-LS2-2: Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales.</p>
<p>Essential Element: EE.HS-LS2-2 Target Level: Use a graphical representation to explain the dependence of an animal population on other organisms for food and their environment for shelter.</p>
<p>Precursor Level: Recognize the relationship between population size and available resources for food and shelter from a graphical representation.</p>
<p>Initial Level: Identify food and shelter needs for familiar wildlife.</p>
<p>Connections to Science Practices Using Mathematics and Computational Thinking</p>
<p>Connections to Crosscutting Concepts Scale, Proportion, and Quantity</p>
<p>Connections to ELA Essential Elements N/A</p>
<p>Connections to Mathematics Essential Elements EE.N-Q.1-3: Express quantities to the appropriate precision of measurement.</p>

High School

<p>Domain: Life</p>
<p>Core Idea: LS3: Heredity: Inheritance and Variation of Traits</p>
<p>Topic: LS3.B: Variation of Traits</p>
<p>State Standard for General Education: HS-LS3-2: Make and defend a claim based on evidence that inheritable genetic variations may result from (1) new genetic combinations through meiosis, (2) viable errors occurring during replication, and/or (3) mutations caused by environmental factors.</p>
<p>Essential Element: EE.HS-LS3-2 Target Level: Defend why reproduction may or may not result in offspring with different traits.</p>
<p>Precursor Level: Make a claim supported by evidence that parents and offspring may have different traits.</p>
<p>Initial Level: Compare traits of parents and offspring.</p>
<p>Connections to Science Practices Engaging in Argument from Evidence</p>
<p>Connections to Crosscutting Concepts Cause and Effect</p>
<p>Connections to ELA Essential Elements N/A</p>
<p>Connections to Mathematics Essential Elements N/A</p>

High School

<p>Domain: Life</p>
<p>Core Idea: LS4: Biological Evolution: Unity and Diversity</p>
<p>Topic: LS4.C: Adaptation</p>
<p>State Standard for General Education: HS-LS4-2: Construct an explanation based on evidence that the process of evolution primarily results from four factors: (1) the potential for a species to increase in number, (2) the heritable genetic variation of individuals in a species due to mutation and sexual reproduction, (3) competition for limited resources, and (4) the proliferation of those organisms that are better able to survive and reproduce in the environment.</p>
<p>Essential Element: EE.HS-LS4-2 Target Level: Explain how the traits of particular species that allow them to survive in their specific environments.</p>
<p>Precursor Level: Identify factors in an environment that require special traits to survive.</p>
<p>Initial Level: Match particular species to their various environments.</p>
<p>Connections to Science Practices Constructing Explanations and Designing Solutions</p>
<p>Connections to Crosscutting Concepts Cause and Effect</p>
<p>Connections to ELA Essential Elements EE.SL.11-12.4: Present an argument on a topic using an organization appropriate to the purpose, audience, and task.</p>
<p>Connections to Mathematics Essential Elements N/A</p>

High School

<p>Domain: Earth and Space</p>
<p>Core Idea: ESS1: Earth's Place in the Universe</p>
<p>Topic: ESS1.B: Earth and the Solar System</p>
<p>State Standard for General Education: HS-ESS1-4: Use mathematical or computational representations to predict the motion of orbiting objects in the solar system.</p>
<p>Essential Element: EE.HS-ESS1-4 Target Level: Use a model of Earth and the Sun to show how Earth's tilt and orbit around the Sun cause changes in seasons.</p>
<p>Precursor Level: Use a model of Earth and sun to show how Earth's positions in its orbit around the Sun correspond with the four seasons.</p>
<p>Initial Level: Identify characteristics of the seasons.</p>
<p>Connections to Science Practices Using Mathematical and Computational Thinking</p>
<p>Connections to Crosscutting Concepts Scale, Proportion, and Quantity</p>
<p>Connections to ELA Essential Elements N/A</p>
<p>Connections to Mathematics Essential Elements EE.N-Q.1-3: Express quantities to the appropriate precision of measurement. EE.A-SSE.1: Identify an algebraic expression involving one arithmetic operation to represent a real-world problem. EE.A-CED.2-4: Solve one-step inequalities.</p>

High School

<p>Domain: Earth and Space</p>
<p>Core Idea: ESS2: Earth's Systems</p>
<p>Topic: ESS2.A: Earth's Materials and Systems</p>
<p>State Standard for General Education: HS-ESS2-1: Develop a model to illustrate how Earth's internal and surface processes operate at different spatial and temporal scales to form continental and ocean-floor features.</p>
<p>Essential Element: EE.HS-ESS2-1 Target Level: Use a model to show how constructive forces (e.g., volcanoes) and destructive mechanisms (e.g., weathering, coastal erosions) change Earth's surface.</p>
<p>Precursor Level: Recognize if processes that change Earth's surface are constructive or destructive.</p>
<p>Initial Level: Recognize changes (e.g., mountain formation, erosion, and glacial changes) that occurred on Earth's surface.</p>
<p>Connections to Science Practices Developing and Using Models</p>
<p>Connections to Crosscutting Concepts Stability and Change</p>
<p>Connections to ELA Essential Elements EE.SL.11-12.5: Use digital media strategically (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to support understanding and add interest.</p>
<p>Connections to Mathematics Essential Elements EE.N-Q.1-3: Express quantities to the appropriate precision of measurement.</p>

High School

<p>Domain: Earth and Space</p>
<p>Core Idea: ESS2: Earth's Systems</p>
<p>Topic: ESS2.D: Weather and Climate</p>
<p>State Standard for General Education: 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.</p>
<p>Essential Element: EE.HS-ESS2-4 Target Level: Using a model, recognize how the effects of changes in climate can impact human lives.</p>
<p>Precursor Level: Recognize climate changes have occurred (e.g., a change in average temperature, precipitation patterns, glacial ice volumes, sea levels).</p>
<p>Initial Level: Recognize the differences between geographical climates (e.g., Minnesota versus Florida, desert versus rainforest).</p>
<p>Connections to Science Practices Developing and Using Models</p>
<p>Connections to Crosscutting Concepts Cause and Effect</p>
<p>Connections to ELA Essential Elements EE.SL.11-12.5: Use digital media strategically (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to support understanding and add interest.</p>
<p>Connections to Mathematics Essential Elements EE.N-Q.1-3: Express quantities to the appropriate precision of measurement.</p>

High School

<p>Domain: Earth and Space</p>
<p>Core Idea: ESS3: Earth and Human Activity</p>
<p>Topic: ESS3.A: Natural Resources</p>
<p>State Standard for General Education: HS-ESS3-1: Construct an explanation based on evidence on how the availability of natural resources, hazards, and climate have influenced human activity.</p>
<p>Essential Element: EE.HS-ESS3-1 Target Level: Construct an explanation based on evidence for how natural hazards have influenced human activity.</p>
<p>Precursor Level: Recognize how natural hazards (e.g., floods, earthquakes, tornadoes) influence human activity.</p>
<p>Initial Level: Recognize characteristics of natural hazards (e.g., floods, earthquakes, tornadoes).</p>
<p>Connections to Science Practices Constructing Explanations and Designing Solutions</p>
<p>Connections to Crosscutting Concepts Cause and Effect</p>
<p>Connections to ELA Essential Elements N/A</p>
<p>Connections to Mathematics Essential Elements N/A</p>

High School

<p>Domain: Earth and Space</p>
<p>Core Idea: ESS3: Earth and Human Activity</p>
<p>Topic: ESS3.A: Natural Resources</p>
<p>State Standard for General Education: HS-ESS3-2: Evaluate competing design solutions for developing, managing, and utilizing energy and mineral resources based on cost-benefit ratios.</p>
<p>Essential Element: EE.HS-ESS3-2 Target Level: Construct an argument for a strategy to conserve, recycle, or reuse resources.</p>
<p>Precursor Level: Describe the factors that would favor one strategy to conserve, recycle, or reuse resources over another.</p>
<p>Initial Level: Recognize strategies to manage objects (e.g., dispose, repurpose, or recycle).</p>
<p>Connections to Science Practices Engaging in Argument from Evidence</p>
<p>Connections to Crosscutting Concepts N/A</p>
<p>Connections to ELA Essential Elements N/A</p>
<p>Connections to Mathematics Essential Elements N/A</p>

High School

<p>Domain: Earth and Space</p>
<p>Core Idea: ESS3: Earth and Human Activity</p>
<p>Topic: ESS3.C: Human Impacts on Earth Systems</p>
<p>State Standard for General Education: HS-ESS3-3: Create a computational simulation to illustrate the relationships among management of natural resources, the sustainability of human populations, and biodiversity.</p>
<p>Essential Element: EE.HS-ESS3-3 Target Level: Analyze data to determine the effects of a conservation strategy on the level of a natural resource.</p>
<p>Precursor Level: Organize data on the effects of conservation strategies (e.g., using less energy, using rechargeable batteries, recycling or repurposing materials).</p>
<p>Initial Level: Gather data on the effects of a local (e.g., class or school-wide) conservation strategy.</p>
<p>Connections to Science Practices Using Mathematics and Computational Thinking</p>
<p>Connections to Crosscutting Concepts Stability and Change</p>
<p>Connections to ELA Essential Elements N/A</p>
<p>Connections to Mathematics Essential Elements EE.N-Q.1-3: Express quantities to the appropriate precision of measurement.</p>

Preliminary Essential Elements for High School Biology

High School Biology

<p>Domain: Life</p>
<p>Core Idea: LS1: From Molecules to Organisms: Structures and Processes</p>
<p>Topic: LS1.A: Structure and Function</p>
<p>State Standard for General Education: HS-LS1-1: Construct an explanation based on evidence for how the structure of DNA determines the structure of proteins which carry out the essential functions of life through systems of specialized cells.</p>
<p>Essential Element: EE.HS-LS1-1 Target Level: Explain how different organs of the body carry out essential functions of life.</p>
<p>Precursor Level: Indicate the function of major organs of the body.</p>
<p>Initial Level: Identify major organs of the body.</p>
<p>Connections to Science Practices Constructing Explanations and Designing Solutions</p>
<p>Connections to Crosscutting Concepts Structure and Functions</p>
<p>Connections to ELA Essential Elements N/A</p>
<p>Connections to Mathematics Essential Elements N/A</p>

High School Biology (also in general Life Science)

<p>Domain: Life</p>
<p>Core Idea: LS1: From Molecules to Organisms: Structures and Processes</p>
<p>Topic: LS1.A: Structure and Function</p>
<p>State Standard for General Education: HS-LS1-2: Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.</p>
<p>Essential Element: EE.HS-LS1-2 Target Level: Use a model to illustrate the organization and interaction of major organs into systems (e.g., circulatory, respiratory, digestive, sensory) in the body to provide specific functions.</p>
<p>Precursor Level: Identify which organs work for a specific function.</p>
<p>Initial Level: Recognize that different organs have different functions.</p>
<p>Connections to Science Practices Developing and Using Models</p>
<p>Connections to Crosscutting Concepts Systems and System Models</p>
<p>Connections to ELA Essential Elements EE.SL.11-12.5: Use digital media strategically (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to support understanding and add interest.</p>
<p>Connections to Mathematics Essential Elements N/A</p>

High School Biology

<p>Domain: Life</p>
<p>Core Idea: LS1: From Molecules to Organisms</p>
<p>Topic: LS1.A: Structure and Function</p>
<p>State Standard for General Education: HS-LS1-3: Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis.</p>
<p>Essential Element: EE.HS-LS1-3 Target Level: Collect data from an investigation to show how different organisms react to changes (e.g., heart rate increases with exercise, pupils react to light).</p>
<p>Precursor Level: Compare before and after data on changes that occur to an organism.</p>
<p>Initial Level: Identify changes in the data display (e.g. objects, pictures, graphs, charts, etc.).</p>
<p>Connections to Science Practices Planning and Carrying Out Investigations</p>
<p>Connections to Crosscutting Concepts Stability and Change</p>
<p>Connections to ELA Essential Elements N/A</p>
<p>Connections to Mathematics Essential Elements N/A</p>

High School Biology (also in general Life Science)

<p>Domain: Life</p>
<p>Core Idea: LS1: From Molecules to Organisms: Structures and Processes</p>
<p>Topic: LS1.B: Growth and Development of Organisms</p>
<p>State Standard for General Education: HS-LS1-4: Use a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms.</p>
<p>Essential Element: EE.HS-LS1-4 Target Level: Use a model to illustrate how growth occurs when cells multiply.</p>
<p>Precursor Level: Use a model to relate the number of cells to the size of a body.</p>
<p>Initial Level: Recognize that organisms are composed of cells.</p>
<p>Connections to Science Practices Developing and Using Models</p>
<p>Connections to Crosscutting Concepts Systems and System Models</p>
<p>Connections to ELA Essential Elements EE.SL.11-12.5: Use digital media strategically (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to support understanding and add interest.</p>
<p>Connections to Mathematics Essential Elements EE.F-BF.1: Select the appropriate graphical representation (first quadrant) given a situation involving constant rate of change.</p>

High School Biology

Domain: Life
Core Idea: LS2: Ecosystems: Interactions, Energy, and Dynamics
Topic: LS2.A: Interdependent Relationships in Ecosystems
State Standard for General Education: HS-LS2-1: Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales.
Essential Element: EE.HS-LS2-1 Target Level: Use a graphical representation to explain changes over time in the population size of an animal species (e.g., currently on the endangered list).
Precursor Level: Use a graphical representation to show changes in population size.
Initial Level: Recognize that there was a change in the population size.
Connections to Science Practices Using Mathematics and Computational Thinking
Connections to Crosscutting Concepts Scale, Proportion, and Quantity
Connections to ELA Essential Elements N/A
Connections to Mathematics Essential Elements EE.N.Q.1-3: Express quantities to the appropriate precision of measurement. EE.S-ID.1-2: Given data, construct a simple graph (line, pie, bar, or picture) or table, and interpret the data.

High School Biology (also in general Life Science)

<p>Domain: Life</p>
<p>Core Idea: LS2: Ecosystems: Interactions, Energy, and Dynamics</p>
<p>Topic: LS2.A: Interdependent Relationships in Ecosystems</p>
<p>State Standard for General Education: HS-LS2-2: Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales.</p>
<p>Essential Element: EE.HS-LS2-2 Target Level: Use a graphical representation to explain the dependence of an animal population on other organisms for food and their environment for shelter.</p>
<p>Precursor Level: Recognize the relationship between population size and available resources for food and shelter from a graphical representation.</p>
<p>Initial Level: Identify food and shelter needs for familiar wildlife.</p>
<p>Connections to Science Practices Using Mathematics and Computational Thinking</p>
<p>Connections to Crosscutting Concepts Scale, Proportion, and Quantity</p>
<p>Connections to ELA Essential Elements N/A</p>
<p>Connections to Mathematics Essential Elements EE.N-Q.1-3: Express quantities to the appropriate precision of measurement.</p>

High School Biology (also in general Life Science)

<p>Domain: Life</p>
<p>Core Idea: LS3: Heredity: Inheritance and Variation of Traits</p>
<p>Topic: LS3.B: Variation of Traits</p>
<p>State Standard for General Education: HS-LS3-2: Make and defend a claim based on evidence that inheritable genetic variations may result from (1) new genetic combinations through meiosis, (2) viable errors occurring during replication, and/or (3) mutations caused by environmental factors.</p>
<p>Essential Element: EE.HS-LS3-2 Target Level: Defend why reproduction may or may not result in offspring with different traits.</p>
<p>Precursor Level: Make a claim supported by evidence that parents and offspring may have different traits.</p>
<p>Initial Level: Compare traits of parents and offspring.</p>
<p>Connections to Science Practices Engaging in Argument from Evidence</p>
<p>Connections to Crosscutting Concepts Cause and Effect</p>
<p>Connections to ELA Essential Elements N/A</p>
<p>Connections to Mathematics Essential Elements N/A</p>

High School Biology (also in general Life Science)

<p>Domain: Life</p>
<p>Core Idea: LS4: Biological Evolution: Unity and Diversity</p>
<p>Topic: LS4.C: Adaptation</p>
<p>State Standard for General Education: HS-LS4-2: Construct an explanation based on evidence that the process of evolution primarily results from four factors: (1) the potential for a species to increase in number, (2) the heritable genetic variation of individuals in a species due to mutation and sexual reproduction, (3) competition for limited resources, and (4) the proliferation of those organisms that are better able to survive and reproduce in the environment.</p>
<p>Essential Element: EE.HS-LS4-2 Target Level: Explain how the traits of particular species that allow them to survive in their specific environments.</p>
<p>Precursor Level: Identify factors in an environment that require special traits to survive.</p>
<p>Initial Level: Match particular species to their various environments.</p>
<p>Connections to Science Practices Constructing Explanations and Designing Solutions</p>
<p>Connections to Crosscutting Concepts Cause and Effect</p>
<p>Connections to ELA Essential Elements EE.SL.11-12.4: Present an argument on a topic using an organization appropriate to the purpose, audience, and task.</p>
<p>Connections to Mathematics Essential Elements N/A</p>

High School Biology

<p>Domain: Life</p>
<p>Core Idea: LS4: Biological Evolution: Unity and Diversity</p>
<p>Topic: LS4.C: Adaptation</p>
<p>State Standard for General Education: HS-LS4-3: Apply concepts of statistics and probability to support explanations that organisms with an advantageous heritable trait tend to increase in proportion to organisms lacking this trait.</p>
<p>Essential Element: EE.HS-LS4-3 Target Level: Interpret data sets to identify an advantageous heritable trait.</p>
<p>Precursor Level: Using data sets, identify organisms that would survive better in certain environment.</p>
<p>Initial Level: Recognize that some organisms survive better in certain environments.</p>
<p>Connections to Science Practices Analyzing and Interpreting Data</p>
<p>Connections to Crosscutting Concepts Patterns</p>
<p>Connections to ELA Essential Elements N/A</p>
<p>Connections to Mathematics Essential Elements N/A</p>

High School Biology

<p>Domain: Life</p>
<p>Core Idea: LS4: Biological Evolution: Unity and Diversity</p>
<p>Topic: LS4.C: Adaptation</p>
<p>State Standard for General Education: HS-LS4-6: Create or revise a simulation to test a solution to mitigate adverse impacts of human activity on biodiversity.</p>
<p>Essential Element: EE.HS-LS4-6 Target Level: Evaluate a strategy to protect a species.</p>
<p>Precursor Level: Using a mathematical model, determine which human actions help or harm a species.</p>
<p>Initial Level: Identify a human activity that has an effect on a species.</p>
<p>Connections to Science Practices Using Mathematics and Computational Thinking</p>
<p>Connections to Crosscutting Concepts Cause and Effect</p>
<p>Connections to ELA Essential Elements N/A</p>
<p>Connections to Mathematics Essential Elements N/A</p>