

Grades PreK-2 Science Crosswalk of 2016 MA STE Standards to 2001/2006 Standards

2016 MA STE Standards	Relative grade 2001/6 standard is found in 2016 STE standards	2001/6 STE Standard
ESS. Earth and Space Science		ESS. Earth and Space Science
ESS1. Earth's Place in the Universe		
PreK-ESS1-1(MA). Demonstrate awareness that the moon can be seen in the daytime and at night, and of the different apparent shapes of the moon over a month. Clarification Statement: The names of moon phases	in earlier grades	3-5.ESS.15. Describe the changes that occur in the observable shape of the moon over the course of a month.
PreK-ESS1-2(MA). Observe and use evidence to describe that the sun is in different places in the sky during the day.	in earlier grades	3-5.ESS.14. Recognize that the earth revolves around (orbits) the sun in a year's time and that the earth rotates on its axis once approximately every 24 hours. Make connections between the rotation of the earth and day/night, and the apparent movement of the sun, moon, and stars across the sky.
1-ESS1-1. Use observations of the sun, moon, and stars to describe that each appears to rise in one part of the sky, appears to move across the sky, and appears to set.	in earlier grades	3-5.ESS.14. Recognize that the earth revolves around (orbits) the sun in a year's time and that the earth rotates on its axis once approximately every 24 hours. Make connections between the rotation of the earth and day/night, and the apparent movement of the sun, moon, and stars across the sky.
1-ESS1-2. Analyze provided data to identify relationships among seasonal patterns of change, including sunrise and sunset time changes, seasonal temperature and rainfall or snowfall patterns, and seasonal changes to the environment. Clarification Statement: Examples of seasonal changes to the environment can include foliage changes, bird migration, and differences in amount of insect activity.	same in earlier grades	PreK-2.ESS.5. Identify some events around us that have repeating patterns, including the seasons of the year, day and night. 3-5.LS.7. Give examples of how changes in the environment (drought, cold) have caused some plants and animals to die or move to new locations (migration).
Note: 2-ESS1-1 from NGSS is not included.	na	
ESS2. Earth's Systems		
PreK-ESS2-1(MA). Raise questions and engage in discussions about how different types of local environments (including water) provide homes for different kinds of living things.	same	PreK-2.ESS.1. Recognize that water, rocks, soil, and living organisms are found on the earth's surface.
PreK-ESS2-2(MA). Observe and classify non-living materials, natural and human made, in the local environment.	same	PreK-2.ESS.1. Recognize that water, rocks, soil, and living organisms are found on the earth's surface.
PreK-ESS2-3(MA). Explore and describe different places water is found in the local environment.	same	PreK-2.ESS.1. Recognize that water, rocks, soil, and living organisms are found on the earth's surface.
PreK-ESS2-4(MA). Use simple instruments to collect and record data on elements of daily weather, including sun or clouds, wind, snow or rain, and higher or lower temperature.	in earlier grades	3-5.ESS.7 Distinguish among the various forms of precipitation (rain, snow, sleet, and hail), making connections to the weather in a particular place and time.
PreK-ESS2-5(MA). Describe how local weather changes from day to day and over the seasons and recognize patterns in those changes. Clarification Statement: Descriptions of the weather can include sunny, cloudy, rainy, warm, windy, and snowy.	same	PreK-2.ESS.3. Describe the weather changes from day to day and over the seasons.
PreK-ESS2-6(MA). Provide examples of the impact of weather on living things. Clarification statement: Make connections between the weather and what they wear and can do and the weather and the needs of plants and animals for water and shelter.	na	
K-ESS2-1. Use and share quantitative observations of local weather conditions to describe patterns over time. Clarification Statements: Examples of quantitative observations could include numbers of sunny, windy, and rainy days in a month, and relative temperature. Quantitative observations should be limited to whole numbers.	same	PreK-2.ESS.3. Describe the weather changes from day to day and over the seasons.

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K-ESS2-2. Construct an argument supported by evidence for how plants and animals (including humans) can change the environment. Clarification Statement: Examples of plants and animals changing their environment could include a squirrel digs holes in the ground and tree roots that break concrete.	in earlier grades	3-5.LS.10. Give examples of how organisms can cause changes in their environment to ensure survival. Explain how some of these changes may affect the ecosystem.
2-ESS2-1. Compare the effectiveness of multiple solutions designed to slow or prevent wind or water from changing the shape of the land.* Clarification Statements: Solutions to be compared could include different designs of dikes and windbreaks to hold back wind and water, and different designs for using shrubs, grass, and trees to hold back the land. Solutions can be generated or provided.	na	
2-ESS2-2. Map the shapes and types of landforms and bodies of water in an area. Clarification Statement: Examples of types of landforms can include hills, valleys, river banks, and dunes. Examples of water bodies can include streams, ponds, bays, and rivers. Quantitative scaling in models is not expected.	na	
2-ESS2-3. Use examples obtained from informational sources to explain that water is found in the ocean, rivers and streams, lakes and ponds, and may be solid or liquid.	same	PreK-2.ESS.1. Recognize that water, rocks, soil, and living organisms are found on the earth's surface.
2-ESS2-4(MA). Observe how blowing wind and flowing water can move Earth materials from one place to another and change the shape of a landform. Clarification Statement: Examples of types of landforms can include hills, valleys, river banks, and dunes.	na	
ESS3. Earth and Human Activity		
PreK-ESS3-1(MA). Engage in discussion and raise questions using examples about local resources, (including soil and water) humans use to meet their needs.	na	
PreK-ESS3-2(MA). Observe and discuss the impact of people's activities on the local environment.	na	
Note: K-ESS3-1 from NGSS is not included.	na	
K-ESS3-2. Obtain information about the purpose of weather forecasting to prepare for, and respond to, different types of local weather.	na	
K-ESS3-3. Communicate solutions to reduce the amount of natural resources an individual uses.* Clarification Statement: Examples of solutions could include reusing paper to reduce the number of trees cut down and recycling cans and bottles to reduce the amount of plastic or metal used.	na	
ETS. Technology/Engineering		
ETS:1 Engineering Design		
1.K-2-ETS1-1. Ask questions, make observations, and gather information about a situation people want to change that can be solved by developing or improving an object or tool.*	in earlier grades	3-5.TE.2.1. Identify a problem that reflects the need for shelter, storage, or convenience.

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1.K-2-ETS1-2. Generate multiple solutions to a design problem and make a drawing (plan) to represent one or more of the solutions.*	in earlier grades	3-5.TE.2.2. Describe different ways in which a problem can be represented, e.g., sketches, diagrams, graphic organizers, and lists.
2.K-2-ETS1-3. Analyze data from tests of two objects designed to solve the same design problem to compare the strengths and weaknesses of how each object performs.* Clarification Statements: Data can include observations and be either qualitative or quantitative. Examples can include how different objects insulate	na	
LS. Life Science		
LS1 From Molecules to Organisms: Structures and Processes		
PreK-LS1-1(MA). Compare, using descriptions and drawings, the external body parts of animals (including humans) and plants and explain functions of some of the observable body parts. Clarification Statement: Examples can include comparison of humans and horses: humans have two legs and horses four, but both use legs to move.	in earlier grades	3-5.LS.1. Classify plants and animals according to the physical characteristics that they share.
PreK-LS1-2(MA). Explain that most animals have five senses they use to gather information about the world around them.	same	PreK-2.LS.6. Recognize that people and other animals interact with the environment through their senses of sight, hearing, touch, smell, and taste.
PreK-LS1-3(MA). Use their five senses in their exploration and play to gather information.	same	PreK-2.LS.6. Recognize that people and other animals interact with the environment through their senses of sight, hearing, touch, smell, and taste.
K-LS1-1. Observe and communicate that animals (including humans) and plants need food, water, and air to survive. Animals get food from plants or other animals. Plants make their own food and need light to live and grow.	same	PreK-2.LS.1. Recognize that animals (including humans) and plants are living things that grow, reproduce, and need food, air, and water.
K-LS1-2(MA). Recognize that all plants and animals grow and change over time.	same	PreK-2.LS.3. Recognize that plants and animals have life cycles, and that life cycles vary for different living things.
1-LS1-1. Use evidence to explain that (a) different animals use their body parts and senses in different ways to see, hear, grasp objects, protect themselves, move from place to place, and seek, find, and take in food, water and air, and (b) plants have roots, stems, leaves, flowers and fruits that are used to take in water and air, and other nutrients. and produce food for the plant. Clarification Statement: Descriptions are not expected to include mechanisms such as the process of photosynthesis.	same	PreK-2.LS.6. Recognize that people and other animals interact with the environment through their senses of sight, hearing, touch, smell, and taste.
1-LS1-2. Obtain information to compare ways in which the behavior of different animal parents and their offspring help the offspring to survive. Clarification Statement: Examples of behaviors could include the signals that offspring make (such as crying, cheeping, and other vocalizations) and the responses of the parents (such as feeding, comforting, and protecting the offspring).	in earlier grades	3-5.LS.8. Describe how organisms meet some of their needs in an environment by using behaviors (patterns of activities) in response to information (stimuli) received from the environment. Recognize that some animal behaviors are instinctive (e.g., turtles burying their eggs), and others are learned (e.g., humans building fires for warmth, chimpanzees learning how to use tools).
LS2. Ecosystems: Interactions, Energy, and Dynamics		
PreK-LS2-1(MA). Use evidence from animals and plants to define several characteristics of living things that distinguish them from non-living things.	same	PreK-2.LS.2. Differentiate between living and nonliving things. Group both living and nonliving things according to the characteristics that they share.

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PreK-LS2-2(MA). Using evidence from the local environment, explain how familiar plants and animals meet their needs where they live. Clarification Statements: Basic needs include water, food, air, shelter, and, for most plants, light. Examples of evidence can include squirrels gathering nuts for the winter and plants growing in the presence of sun and water. The local environment includes the area around the student's school, home, or adjacent community.	same	PreK-2.LS.8. Identify the ways in which an organism's habitat provides for its basic needs (plants require air, water, nutrients, and light; animals require food, water, air, and shelter).
PreK-LS2-3(MA). Give examples from the local environment of how animals and plants are dependent on one another to meet their basic needs.	same	PreK-2.LS.8. Identify the ways in which an organism's habitat provides for its basic needs (plants require air, water, nutrients, and light; animals require food, water, air, and shelter).
Note: 2-LS2-1 is included in other standards, including K-LS1-1 and 2-LS2-3(MA). 2-LS2-2 from NGSS is not included.	na	
2-LS2-3(MA). Develop and use models to compare how plants and animals depend on their surroundings and other living things to meet their needs in the places they live. Clarification Statement: Animals need food, water, air, shelter, and favorable temperature; plants need sufficient light, water, minerals, favorable temperature and animals or other mechanisms to disperse seeds.	same	PreK-2.ESS.4. Recognize that the sun supplies heat and light to the earth and is necessary for life.
LS3.Hereditry: Inheritance and Variation of Traits		
PreK-LS3-1(MA). Use observations to explain that young plants and animals are like but not exactly like their parents. Clarification Statement: Examples of observations include puppies that look similar but not exactly the same as their parents.	same	PreK-2.LS.4. Describe ways in which many plants and animals closely resemble their parents in observed appearance.
PreK-LS3-2(MA). Use observations to recognize differences and similarities among themselves and their friends.	na	
1-LS3-1. Use information from observations (first-hand and from media) to identify similarities and differences among individual plants or animals of the same kind. Clarification Statements: Examples of observations could include that leaves from the same kind of plant are the same shape but can differ in size. Inheritance, animals that undergo metamorphosis, or hybrids are not expected.	same	PreK-2.LS.4. Describe ways in which many plants and animals closely resemble their parents in observed appearance.
LS4. Biological Evolution: Unity and Diversity		
2-LS4-1. Use texts, media, or local environments to observe and compare (a) different kinds of living things in an area, and (b) differences in the kinds of living things living in different types of areas. Clarification Statements: Examples of areas to compare can include temperate forest, desert, tropical rain forest, grassland, arctic, and aquatic. Specific animal and plant names in specific areas are not expected.	na	
PS. Physical Science		
PS1: Matter and its Interactions		
PreK-PS1-1(MA). Raise questions and investigate the differences between liquids and solids and develop awareness that a liquid can become a solid and vice versa.	same	PreK-2.PS.2. Identify objects and materials as solid, liquid, or gas. Recognize that solids have a definite shape and that liquids and gases take the shape of their container.
	in earlier grades	3-5.PS.3. Describe how water can be changed from one state to another by adding or taking away heat.

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PreK-PS1-2(MA). Investigate natural and human-made objects to describe, compare, sort, and classify objects based on observable physical characteristics, uses, and whether something is manufactured or occurs in nature.	in earlier grades	3-5.TE.1.1. Identify materials used to accomplish a design task based on a specific property, e.g., strength, hardness, and flexibility.
PreK-PS1-3(MA). Differentiate between the properties of an object and those of the material of which it is made.	same	PreK-2.PS.1. Sort objects by observable properties such as size, shape, color, weight, and texture.
	in earlier grades	3-5.TE.1.1. Identify materials used to accomplish a design task based on a specific property, e.g., strength, hardness, and flexibility.
	in earlier grades	3-5.PS.1. Differentiate between properties of objects (e.g., size, shape, weight) and properties of materials (e.g., color, texture, hardness).
PreK-PS1-4(MA). Recognize through investigation that physical objects and materials can change under different circumstances. Clarification Statement: Changes include building up or breaking apart, mixing, dissolving, and changing state.	same	PreK-2.PS.2. Identify objects and materials as solid, liquid, or gas. Recognize that solids have a definite shape and that liquids and gases take the shape of their container.
K-PS1-1(MA). Investigate and communicate the idea that different kinds of materials can be a solid or liquid depending on temperature. Clarification Statements: Materials chosen must exhibit solid and liquid states in a reasonable temperature range for kindergarten students (e.g., 0-80°F), such as water, crayons, or glue sticks. Only a qualitative description of temperature, such as hot, warm, and cool, is expected.	in earlier grades	3-5.PS.2. Compare and contrast solids, liquids, and gases based on the basic properties of each of these states of matter.
	in earlier grades	3-5.PS.3. Describe how water can be changed from one state to another by adding or taking away heat.
2-PS1-1. Describe and classify different kinds of materials by observable properties of color, flexibility, hardness, texture, and absorbency.	same	PreK-2.PS.1. Sort objects by observable properties such as size, shape, color, weight, and texture.
	in earlier grades	3-5.TE.1.1. Identify materials used to accomplish a design task based on a specific property, e.g., strength, hardness, and flexibility.
2-PS1-2. Test different materials and analyze the data obtained to determine which materials have the properties that are best suited for an intended purpose.* Clarification Statements: Examples of properties could include, color, flexibility, hardness, texture, and absorbency. Data should focus on qualitative and relative observations.	same	PreK-2.TE.1.1. Identify and describe characteristics of natural materials (e.g., wood, cotton, fur, wool) and human-made materials (e.g., plastic, Styrofoam).
	same	PreK-2.TE.1.2. Identify and explain some possible uses for natural materials (e.g., wood, cotton, fur, wool) and human-made materials (e.g., plastic, Styrofoam).
2-PS1-3. Analyze a variety of evidence to conclude that when a chunk of material is cut or broken into pieces, each piece is still the same material and, however small each piece is, has weight. Show that the material properties of a small set of pieces do not change when the pieces are used to build larger objects. Clarification Statements: Materials should be pure substances or microscopic mixtures that appear contiguous at observable scales. Examples of pieces could include blocks, building bricks, or other assorted small objects.	in earlier grades	3-5.PS.1. Differentiate between properties of objects (e.g., size, shape, weight) and properties of materials (e.g., color, texture, hardness).
2-PS1-4. Construct an argument with evidence that some changes to materials caused by heating or cooling can be reversed and some cannot. Clarification Statements: Examples of reversible changes could include materials such as water and butter at different temperatures. Examples of irreversible changes could include cooking an egg, freezing a plant leaf, and burning paper.	in earlier grades	3-5.PS.3. Describe how water can be changed from one state to another by adding or taking away heat.

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PS2. Motion and Stability: Forces and Interactions		
PreK-PS2-1(MA). Using evidence, discuss ideas about what is making something move the way it does and how some movements can be controlled.	same	PreK-2.PS.3. Describe the various ways that objects can move, such as in a straight line, zigzag, back-and-forth, round-and-round, fast, and slow.
PreK-PS2-2(MA). Through experience, develop awareness of factors that influence whether things stand or fall. Clarification Statement: Examples of factors in children's construction play include using a broad foundation when building, considering the strength of materials, and using balanced weight distribution in a block building.	same	PreK-2.PS.5. Recognize that under some conditions, objects can be balanced.
K-PS2-1. Compare the effects of different strengths or different directions of pushes and pulls on the motion of an object. Clarification Statements: Examples of pushes or pulls could include a string attached to an object being pulled, a person pushing an object, a person stopping a rolling ball, and two objects colliding and pushing each other. Comparisons should be on different relative strengths or different directions, not both at the same time. Non-contact pushes or pulls such as those produced by magnets are not expected.	same	PreK-2.PS.4. Demonstrate that the way to change the motion of an object is to apply a force (give it a push or a pull). The greater the force, the greater the change in the motion of the object.
Note: K-PS2-2 from NGSS is not included.	na	
PS3: Energy		
K-PS3-1. Make observations to determine that sunlight warms materials on Earth's surface. Clarification Statements: Examples of materials on Earth's surface could include sand, soil, rocks, and water. Measures of temperature should be limited to relative measures such as warmer/cooler.	same	PreK-2.ESS.4. Recognize that the sun supplies heat and light to the earth and is necessary for life.
K-PS3-2. Use tools and materials to design and build a prototype of a structure that will reduce the warming effect of sunlight on an area.*	same	PreK-2.TE.1.3. Identify and describe the safe and proper use of tools and materials (e.g., glue, scissors, tape, ruler, paper, toothpicks, straws, spools) to construct simple structures.
	in earlier grades	3-5.TE.1.2. Identify and explain the appropriate materials and tools (e.g., hammer, screwdriver, pliers, tape measure, screws, nails, and other mechanical fasteners) to construct a given prototype safely.
2-PS3-1(MA). Design and conduct an experiment to show the effects of friction on the relative temperature and speed of objects that rub against each other. Clarification Statement: Examples could include an object sliding on rough vs. smooth surfaces. Observations of temperature and speed should be qualitative.	na	
PS4: Waves and Their Applications in Technologies for Information Transfer		
PreK-PS4-1(MA). Investigate sounds made by different objects and materials and discuss explanations about what is causing the sounds. Through play and investigations, identify ways to manipulate different objects and materials that make sound to change volume and pitch.	in earlier grades	3-5.PS.11. Recognize that sound is produced by vibrating objects and requires a medium through which to travel. Relate the rate of vibration to the pitch of the sound.
PreK-PS4-2(MA). Connect daily experiences and investigations to demonstrate the relationships between the size and shape of shadows, the objects creating the shadow, and the light source.	na	
1-PS4-1. Demonstrate that vibrating materials can make sound and that sound can make materials vibrate. Clarification Statements: Examples of vibrating materials that make sound could include tuning forks, a stretched string or rubber band, and a drum head. Examples of how sound can make materials vibrate could include holding a piece of paper near a speaker making sound and holding an object near a vibrating tuning fork.	in earlier grades	3-5.PS.11. Recognize that sound is produced by vibrating objects and requires a medium through which to travel. Relate the rate of vibration to the pitch of the sound.
Note: 1-PS4-2 from NGSS is not included.	na	

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1-PS4-3. Conduct an investigation to determine the effect of placing materials that allow light to pass through them, allow only some light through them, block all the light, or redirect light when put in the path of a beam of light. Clarification Statements: Effects can include some or all light passing through, creation of a shadow, or redirecting light. Quantitative measures are not expected.	in earlier grades	3-5.PS.12. Recognize that light travels in a straight line until it strikes an object or travels from one medium to another, and that light can be reflected, refracted, and absorbed.
1-PS4-4. Use tools and materials to design and build a device that uses light or sound to send a signal over a distance.* Clarification Statements: Examples of devices could include a light source to send signals, paper cup and string "telephones," and a pattern of drum beats. Technological details for how communication devices work are not expected.	na	
		2001/6 PreK-2 standards with no alignment to 2016
	na	PreK-2.ESS.2. Understand that air is a mixture of gases that is all around us and that wind is moving air.
		PreK-2.ETS.1.3. Identify and describe the safe and proper use of tools and materials (e.g., glue, scissors, tape, ruler, paper, toothpicks, straws, spools) to construct simple structures.
	na	PreK-2.TE.2.1. Identify tools and simple machines used for a specific purpose, e.g., ramp, wheel, pulley, lever.
	na	PreK-2.TE.2.2. Describe how human beings use parts of the body as tools (e.g., teeth for cutting, hands for grasping and catching), and compare their use with the ways in which animals use those parts of their bodies.
	na	PreK-2.LS.7. Recognize changes in appearance that animals and plants go through as the seasons change.

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ESS. Earth and Space Science		
ESS1. Earth's Place in the Universe		
<p>4-ESS1-1. Use evidence from a given landscape that includes simple landforms and rock layers to support a claim about the role of erosion or deposition in the formation of the landscape over long periods of time. Clarification Statements: Examples of evidence and claims could include rock layers with shell fossils above rock layers with plant fossils and no shells, indicating a change from deposition on land to deposition in water over time; and a canyon with rock layers in the walls and a river in the bottom, indicating that a river eroded the rock over time. Examples of simple landforms can include valleys, hills, mountains, plains, and canyons. Focus should be on relative time. State Assessment Boundary: Specific details of the mechanisms of rock formation or specific rock formations and layers are not expected in state assessment</p>	<p>same</p> <p>in earlier grades</p>	<p>3-5.ESS.12. Give examples of how the surface of the earth changes due to slow processes such as erosion and weathering, and rapid processes such as landslides, volcanic eruptions, and earthquakes.</p> <p>6-8.ESS.6. Describe and give examples of ways in which the earth's surface is built up and torn down by natural processes, including deposition of sediments, rock formation, erosion, and weathering.</p> <p>HS.ESS.3.1. Explain how physical and chemical weathering leads to erosion and the formation of soils and sediments, and creates various types of landscapes. Give examples that show the effects of physical and chemical weathering on the environment.</p>
<p>5-ESS1-1. Use observations, first-hand and from various media, to argue that the sun is a star that appears larger and brighter than other stars because it is closer to the Earth. State Assessment Boundary: Other factors that affect apparent brightness (such as stellar masses, age, or stage) are not expected in state assessment.</p>	<p>na</p>	
<p>5-ESS1-2. Use a model to communicate Earth's relationship to the Sun, Moon, and stars that explain (a) why people on Earth experience day and night, (b) patterns in daily changes in length and direction of shadows over a day, and (c) changes in the apparent position of the Sun, Moon, and stars at different times during a day, over a month, and over a year. Clarification Statement: Models should illustrate that the Earth, Sun, and Moon are spheres; include orbits of the Earth around the sun and of the Moon around Earth; and demonstrate Earth's rotation about its axis. State Assessment Boundary: Causes of lunar phases or seasons, or use of Earth's tilt are not expected in state assessment.</p>	<p>same</p>	<p>3-5.ESS.13. Recognize that the earth is part of a system called the "solar system" that includes the sun (a star), planets, and many moons. The earth is the third planet from the sun in our solar system.</p> <p>3-5.ESS.14. Recognize that the earth revolves around (orbits) the sun in a year's time and that the earth rotates on its axis once approximately every 24 hours. Make connections between the rotation of the earth and day/night, and the apparent movement of the sun, moon, and stars across the sky.</p>
ESS2. Earth's Systems		
<p>3-ESS2-1. Use graphs and tables of local weather data to describe and predict typical weather during a particular season in an area. Clarification Statements: Examples of weather data could include temperature, amount and type of precipitation(e.g., rain, snow), wind direction, and wind speed. Graphical displays should focus on pictographs and bar graphs. State Assessment Boundary: An understanding of climate change is not expected in state assessment.</p>	<p>same</p> <p>same</p>	<p>3-5.ESS.6. Explain how air temperature, moisture, wind speed and direction, and precipitation make up the weather in a particular place and time.</p> <p>3-5.ESS.7 Distinguish among the various forms of precipitation (rain, snow, sleet, and hail), making connections to the weather in a particular place and time.</p>
<p>3-ESS2-2. Obtain and summarize information about the climate of different regions of the world to illustrate that typical weather conditions over a year vary by region. Clarification Statement: Examples of information can include climate data (average temperature, average precipitation, average wind speed) or comparative descriptions of seasonal weather for different regions. State Assessment Boundary: An understanding of climate change is not expected in state assessment.</p>	<p>same</p>	<p>3-5.ESS.9. Differentiate between weather and climate.</p>
<p>4-ESS2-1. Make observations and collect data to provide evidence that rocks, soils and sediments are broken into smaller pieces through mechanical weathering and moved around through erosion. Clarification Statements: Mechanical weathering can include frost wedging, abrasion, and tree root wedging. Erosion can include movement by blowing wind, flowing water, and moving ice. State Assessment Boundary: Chemical processes are not expected in state assessment.</p>	<p>same</p> <p>same</p> <p>in earlier grades</p>	<p>3-5.ESS.4. Explain and give examples of the ways in which soil is formed (the weathering of rock by water and wind and from the decomposition of plant and animal remains).</p> <p>6-8.ESS.6. Describe and give examples of ways in which the earth's surface is built up and torn down by natural processes, including deposition of sediments, rock formation, erosion, and weathering.</p> <p>HS.ESS.3.1. Explain how physical and chemical weathering leads to erosion and the formation of soils and sediments, and creates various types of landscapes. Give examples that show the effects of physical and chemical weathering on the environment.</p>
<p>4-ESS2-2. Analyze and interpret maps of Earth's mountain ranges, deep ocean trenches, volcanoes and earthquake epicenters to describe patterns of these features and their locations relative to boundaries between continents and oceans.</p>	<p>in earlier grades</p>	<p>6-8.ESS.1. Recognize, interpret, and be able to create models of the earth's common physical features in various mapping representations, including contour maps.</p>

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5-ESS2-1. Use a model to describe the cycling of water on Earth through a watershed through evaporation, precipitation, absorption, surface runoff, condensation. State Assessment Boundary: Transpiration or explanations of mechanisms that drive the cycle are not expected in state assessment.	same	3-5.ESS.10. Describe how water on earth cycles in different forms and in different locations, including underground and in the atmosphere.
5-ESS2-2. Describe and graph the relative amounts of salt water in the ocean; fresh water in lakes, rivers, and ground water; and fresh water frozen in glaciers and polar ice caps to provide evidence about the availability of fresh water in Earth's biosphere. State Assessment Boundary: Inclusion of the atmosphere is not expected in state assessment.	na	HS.ESS.3.5. Describe the processes of the hydrologic cycle, including evaporation, condensation, precipitation, surface runoff and groundwater percolation, infiltration, and transpiration.
ESS3. Earth and Human Activity		
3-ESS3-1. Evaluate the merit of a design solution that reduces the impacts of weather.* Clarification Statement: Examples of design solutions to reduce weather-related hazard could include a barrier to prevent flooding, a wind resistant roof, and a lightning rod.	na	
4-ESS3-1. Obtain information to describe that energy and fuels humans use are derived from natural resources and that some energy and fuel sources are renewable and some are not. Clarification Statements: Examples of renewable energy resources could include wind energy, water behind dams, tides, and sunlight. Non-renewable energy resources are fossil fuels and nuclear materials.	in earlier grades	HS.ESS.2.1. Recognize, describe, and compare renewable energy resources (e.g., solar, wind, water, biomass) and nonrenewable energy resources (e.g., fossil fuels, nuclear energy).
4-ESS3-2. Evaluate different solutions to reduce the impacts of a natural event such as an earthquake, blizzard, or flood on humans.* Clarification Statement: Examples of solutions could include a proposal for an earthquake resistant building or a constructed wetland to mitigate flooding.	na	
5-ESS3-1. Obtain and combine information about ways communities reduce the impact on the Earth's resources and environment by changing an agricultural, industrial, or community practice or process. Clarification Statement: Examples of changed practices or processes include treating sewage, reducing the amounts of materials used, capturing polluting emissions from factories or power plants, and preventing runoff from agricultural activities. State Assessment Boundary: Climate change or social science aspects of practices such as regulation or policy are not expected in state assessment.	na	
5-ESS3-2(MA). Test a simple system designed to filter particulates out of water and propose one change to the design to improve it.*	na	
ETS: Technology/Engineering		
ETS:1 Engineering Design		
3.3-5-ETS1-1. Define a simple design problem that reflects a need or a want. Include criteria for success and constraints on materials, time, or cost that a potential solution must meet.*	same	3-5.TE.1.1. Identify materials used to accomplish a design task based on a specific property, e.g., strength, hardness, and flexibility. 3-5.TE.2.1. Identify a problem that reflects the need for shelter, storage, or convenience.
3.3-5-ETS1-2. Generate several possible solutions to a design problem. Compare each solution based on how well each is likely to meet the criteria and constraints of the design problem.* Clarification Statement: Examples of design problems can include adapting a switch on a toy for children who have a motor coordination disability, designing a way to clear or collect debris or trash from a storm drain, or creating safe moveable playground equipment for a new recess game.	in earlier grades	6-8.TE.2.1. Identify and explain the steps of the engineering design process, i.e., identify the need or problem, research the problem, develop possible solutions, select the best possible solution(s), construct a prototype, test and evaluate, communicate the solution(s), and redesign.
3.3-5-ETS1-4(MA). Gather information using various informational resources on possible solutions to a design problem. Present different representations of a design solution. * Clarification Statements: Examples of informational resources can include books, videos, and websites. Examples of representations can include graphic organizers, sketches, models, and prototypes.	same	3-5.TE.2.2. Describe different ways in which a problem can be represented, e.g., sketches, diagrams, graphic organizers, and lists.
4.3-5-ETS1-3. Plan and carry out tests of one or more elements of a given model or prototype in which variables are controlled and failure points are considered to identify which elements need to be improved. Apply the results of tests to redesign a model or prototype.* Clarification Statements: Examples of design features can include materials, size, shape, and weight.	in earlier grades	6-8.TE.2.1. Identify and explain the steps of the engineering design process, i.e., identify the need or problem, research the problem, develop possible solutions, select the best possible solution(s), construct a prototype, test and evaluate, communicate the solution(s), and redesign.

Grades 3-5 Science Crosswalk of 2016 MA STE Standards to 2001/2006 Standards

2016 MA STE standards	Relative grade 2001/6 standard is found in 2016 STE standards	2001/6 STE Standard
4.3-5-ETS1-5(MA). Evaluate relevant design features that must be considered in building a model or prototype of a solution to a given design problem.*	same	3-5.TE.2.3. Identify relevant design features (e.g., size, shape, weight) for building a prototype of a solution to a given problem.
ETS:3 Technological Systems		
5.3-5-ETS3-1(MA). Use informational text to provide examples of improvements to existing technologies (innovations) and the development of new technologies (inventions). Recognize that technology is any modification of the natural or designed world done to fulfill human needs or wants.	na	
5.3-5-ETS3-2(MA). Use sketches or drawings to show how each part of a product or device relates to other parts in the product or device.*	na	
LS. Life Science		
LS1 From Molecules to Organisms: Structures and Processes		
3-LS1-1. Use simple graphical representations to show that different types of organisms have unique and diverse life cycles. Describe that all organisms have birth, growth, reproduction, and death in common but there are a variety of ways in which these happen. Clarification Statements: Examples can include different ways plants and animals begin (e.g., sprout from a seed, born from an egg), grow (e.g., increase in size and weight, produce new part), reproduce (e.g., develop seeds and spores, root runners, mate and lay eggs that hatch), and die (e.g., length of life). Plant life cycles should focus on those of flowering plants. Describing variation in organism life cycles should focus on comparisons of the general stages of each, not specifics. State Assessment Boundary: Detailed descriptions of any one organism's cycle, the differences of "complete metamorphosis" or "incomplete metamorphosis", or details of human reproduction are not expected in state assessment.	same	3-5.LS.3. Recognize that plants and animals go through predictable life cycles that include birth, growth, development, reproduction, and death.
	same	3-5.LS.4. Describe the major stages that characterize the life cycle of the frog and butterfly as they go through metamorphosis.
4-LS1-1. Construct an argument that animals and plants have internal and external structures that support their survival, growth, behavior, and reproduction. Clarification Statements: Animal structures can include legs, wings, fins, feathers, trunks, claws, horns, antennae, eyes, ears, nose, heart, stomach, lung, brain, and skin. Plant structures can include leaves, roots, stems, bark, branches, flowers, fruit and seeds. State Assessment Boundary: State assessment will be limited to macroscopic structures.	same	3-5.LS.2. Identify the structures in plants (leaves, roots, flowers, stem, bark, wood) that are responsible for food production, support, water transport, reproduction, growth, and protection.
Note: 4-LS1-2 from NGSS is not included.	na	
5-LS1-1. Ask testable questions about the process by which plants use air, water, and energy from the sunlight to produce sugars and plant materials needed for growth and reproduction. State Assessment Boundary: The chemical formula or molecular details about the process of photosynthesis are not expected in the state assessment.	same	3-5.LS.11. Describe how energy derived from the sun is used by plants to produce sugars (photosynthesis) and is transferred within a food chain from producers (plants) to consumers to decomposers.
	in earlier grades	6-8.LS.16. Recognize that producers (plants that contain chlorophyll) use the energy from sunlight to make sugars from carbon dioxide and water through a process called photosynthesis. This food can be used immediately, stored for later use, or used by other organisms.

Grades 3-5 Science Crosswalk of 2016 MA STE Standards to 2001/2006 Standards

2016 MA STE standards	Relative grade 2001/6 standard is found in 2016 STE standards	2001/6 STE Standard
LS2. Ecosystems: Interactions, Energy, and Dynamics		
[Note: 3-LS2-1 from NGSS is not included]		
5-LS2-1. Develop a model to describe the movement of matter among producers, consumers, decomposers, and the air, water, and soil in the environment (a) show that plants produce sugars and plant materials, (b) show that animals can eat plants and/or other animals for food, and (c) show that some organisms, including fungi and bacteria, break down dead organisms and recycle some materials back to the air and soil. Clarification Statement: Emphasis is on matter moving throughout the ecosystem. State Assessment Boundary: Molecular explanations, or distinctions among primary, secondary, and tertiary consumers, are not expected in state assessment.	na	3-5.ESS.4. Explain and give examples of the ways in which soil is formed (the weathering of rock by water and wind and from the decomposition of plant and animal remains). 3-5.LS.11. Describe how energy derived from the sun is used by plants to produce sugars (photosynthesis) and is transferred within a food chain from producers (plants) to consumers to decomposers.
5-LS2-2(MA). Compare at least two designs for a composter to determine which is most likely to encourage decomposition of materials.* Clarification Statement: Measures or evidence of decomposition should be on qualitative descriptions or comparisons.	na	6-8.LS.14. Explain the roles and relationships among producers, consumers, and decomposers in the process of energy transfer in a food web. 6-8.LS.15. Explain how dead plants and animals are broken down by other living organisms and how this process contributes to the system as a whole. 6-8.LS.16. Recognize that producers (plants that contain chlorophyll) use the energy from sunlight to make sugars from carbon dioxide and water through a process called photosynthesis. This food can be used immediately, stored for later use, or used by other organisms.
LS3.Heridity: Inheritance and Variation of Traits		
3-LS3-1. Provide evidence, including through the analysis of data, that plants and animals have traits inherited from parents and that variation of these traits exist in a group of similar organisms. Clarification Statements: Examples of inherited traits that vary can include the color of fur, shape of leaves, length of legs, and size of flowers. Focus should be on non-human examples. State Assessment Boundary: Genetic mechanisms of inheritance or prediction of traits are not expected in state assessment	same	3-5.LS.5. Differentiate between observed characteristics of plants and animals that are fully inherited (e.g., color of flower, shape of leaves, color of eyes, number of appendages) and characteristics that are affected by the climate or environment (e.g., browning of leaves due to too much sun, language spoken).
3-LS3-2. Distinguish between inherited characteristics and those characteristics that result from a direct interaction with the environment. Give examples of characteristics of living organisms that are influenced by both inheritance and the environment. Clarification Statements: Examples of the environment affecting a characteristic could include normally tall plants stunted because they were grown with insufficient water or light, a lizard missing a tail due to a predator and a pet dog becoming overweight because it is given too much food and little exercise. Focus should be on non-human examples.	in earlier grades	6-8.LS.7. Recognize that every organism requires a set of instructions that specifies its traits. These instructions are stored in the organism's chromosomes. Heredity is the passage of these instructions from one generation to another.
3-LS4-1. Use fossils to describe types of organisms and their environments that existed long ago and compare those to living organisms and their environments. Recognize that most kinds of plants and animals that once lived on Earth are no longer found anywhere. Clarification Statement: Comparisons should focus on physical or observable features. State Assessment Boundary: Identification of specific fossils, or specific present day plants and animals, dynamic processes, or genetics are not expected in state assessment.	same	3-5.LS.5. Differentiate between observed characteristics of plants and animals that are fully inherited (e.g., color of flower, shape of leaves, color of eyes, number of appendages) and characteristics that are affected by the climate or environment (e.g., browning of leaves due to too much sun, language spoken).
LS4. Biological Evolution: Unity and Diversity		
3-LS4-2. Use evidence to construct an explanation for how the variations in characteristics among individuals within the same species may provide advantages to these individuals in their survival and reproduction. Clarification Statements: Examples can include rose bushes of the same species, one with slightly longer thorns than the other which may prevent its predation by deer and color variation within a species that may provide advantages so one organism may be more likely to survive and therefore more likely to leave offspring. Examples of evidence could include needs and characteristics of the organisms and habitats involved.	in later grades	PreK-2.LS.5. Recognize that fossils provide us with information about living things that inhabited the earth years ago.
3-LS4-3. Construct an argument with evidence that in a particular environment some organisms can survive well, some survive less well, and some cannot survive. Clarification Statement: Examples of evidence could include needs and characteristics of the organisms and habitats involved.	same	3-5.LS.6. Give examples of how inherited characteristics may change over time as adaptations to changes in the environment that enable organisms to survive, e.g., shape of beak or feet, placement of eyes on head, length of neck, shape of teeth, color.
3-LS4-3. Construct an argument with evidence that in a particular environment some organisms can survive well, some survive less well, and some cannot survive. Clarification Statement: Examples of evidence could include needs and characteristics of the organisms and habitats involved.	na	

Grades 3-5 Science Crosswalk of 2016 MA STE Standards to 2001/2006 Standards

2016 MA STE standards	Relative grade 2001/6 standard is found in 2016 STE standards	2001/6 STE Standard
3-LS4-4. Analyze and interpret given data about changes in a habitat and describe how the changes may affect the ability of organisms that live in that habitat to survive and reproduce. Clarification Statements: Changes should include changes to landforms, distribution of water, climate, and availability of resources. Changes in the habitat could range in time from a season to a decade. While it is understood that ecological changes are complex, the focus should be on a single change to the habitat.	same	3-5.LS.7. Give examples of how changes in the environment (drought, cold) have caused some plants and animals to die or move to new locations (migration). 3-5.LS.9. Recognize plant behaviors, such as the way seedlings' stems grow toward light and their roots grow downward in response to gravity. Recognize that many plants and animals can survive harsh environments because of seasonal behaviors, e.g., in winter, some trees shed leaves, some animals hibernate, and other animals migrate. 3-5.LS.10. Give examples of how organisms can cause changes in their environment to ensure survival. Explain how some of these changes may affect the ecosystem.
3-LS4-5(MA). Provide evidence to support a claim that the survival of a population is dependent upon reproduction. State Assessment Boundary: Details of reproduction are not expected in state assessment.	na	
PS. Physical Science		PS. Physical Science
PS1: Matter and its Interactions		
5-PS1-1. Use a model of matter to explain common phenomena involving gases, and phase changes between gas and liquid, and between liquid and solid. Clarification Statement: Examples of common phenomena the model should be able to describe include adding air to expand a balloon, compressing air in a syringe, and evaporating water from a salt water solution. State Assessment Boundary: Atomic-scale mechanism of evaporation and condensation or defining the unseen particles are not expected in state assessment.	same	3-5.PS.2. Compare and contrast solids, liquids, and gases based on the basic properties of each of these states of matter.
	same	3-5.PS.3. Describe how water can be changed from one state to another by adding or taking away heat.
5-PS1-2. Measure and graph the weights (masses) of substances before and after a reaction or phase change to provide evidence that regardless of the type of change that occurs when heating, cooling, or combining substances, the total weight (mass)of matter is conserved. Clarification Statement: Assume that reactions with any gas production are conducted in a closed system. State Assessment Boundary: Distinguishing mass and weight is not expected in state assessment.	in earlier grades	6-8.PS.4. Explain and give examples of how mass is conserved in a closed system. 6-8.PS.10. Differentiate between physical changes and chemical changes.
5-PS1-3. Make observations and measurements of substances to describe characteristic properties of each, including color, hardness, reflectivity, electrical conductivity, thermal conductivity, response to magnetic forces, and solubility. Clarification Statements: Emphasis is on describing how each substance has a unique set of properties. Examples of substances could include baking soda and other powders, metals, minerals, and liquids. State Assessment Boundary: Density, distinguishing mass and weight or specific tests or procedures are not expected in state assessment.	same	3-5.ESS.1 Give a simple explanation of what a mineral is and some examples, e.g., quartz, mica. 3-5.ESS.2. Identify the physical properties of minerals (hardness, color, luster, cleavage, and streak), and explain how minerals can be tested for these different physical properties. 3-5.PS.1. Differentiate between properties of objects (e.g., size, shape, weight) and properties of materials (e.g., color, texture, and density). 3-5.PS.7. Identify and classify objects and materials that conduct electricity and objects and materials that are insulators of electricity. 3-5.PS.10. Identify and classify objects and materials that a magnet will attract and objects and materials that a magnet will not attract.
5-PS1-4. Conduct an experiment to determine whether the mixing of two or more substances results in new substances with new properties (a chemical reaction) or not (a mixture).	in earlier grades	6-8.PS.8. Differentiate between mixtures and pure substances. 6-8.PS.10. Differentiate between physical changes and chemical changes.
PS2: Motion and Stability: Forces and Interactions		
3-PS2-1. Provide evidence to explain the effect of multiple forces, including friction, on an object. Include balanced forces that do not change the motion of the object and unbalanced forces that do change the motion of the object. Clarification Statements: Descriptions of force magnitude should be qualitative and relative. Force due to gravity is appropriate but only as a force that pulls objects down. State Assessment Boundaries: Quantitative force magnitude is not expected in state assessment. State assessment will be limited to one variable at a time: number, size, or direction of forces.	in earlier grades	6-8.PS.11. Explain and give examples of how the motion of an object can be described by its position, direction of motion, and speed.
Note: 3-PS2-2 from NGSS is not included.	na	
3-PS2-3. Conduct an investigation to determine the nature of the forces between two magnets based on their orientations and distance relative to each other. Clarification Statement: Focus should be on forces produced by magnetic objects that are easily manipulated.	same	3-5.PS.9. Recognize that magnets have poles that repel and attract each other.
3-PS2-4. Define a simple design problem that can be solved by using interactions between magnets.* Clarification Statement: Examples of problems could include constructing a latch to keep a door shut and creating a device to keep two moving objects from touching each other.	same	3-5.PS.9. Recognize that magnets have poles that repel and attract each other.

Grades 3-5 Science Crosswalk of 2016 MA STE Standards to 2001/2006 Standards

2016 MA STE standards	Relative grade 2001/6 standard is found in 2016 STE standards	2001/6 STE Standard
5-PS2-1. Support an argument with evidence that the gravitational force exerted by Earth on objects is directed toward the Earth's center. State Assessment Boundary: Mathematical representations of gravitational force are not expected in state assessment.	in earlier grades	6-8.ESS.8. Recognize that gravity is a force that pulls all things on and near the earth toward the center of the earth. Gravity plays a major role in the formation of the planets, stars, and solar system and in determining their motions. 6-8.PS.1. Differentiate between weight and mass, recognizing that weight is the amount of gravitational pull on an object.
PS3: Energy		
4-PS3-1. Use evidence to construct an explanation relating the speed of an object to the energy of that object. State Assessment Boundaries: State assessment will be limited to analysis of kinetic energy. Accounting for mass, quantitative measures of changes in the speed of an object, or any precise or quantitative definition of energy is not expected in state assessment.	na	
4-PS3-2. Make observations to show that energy can be transferred from place to place by sound, light, heat, and electric currents. Clarification Statement: Evidence of energy being transferred can include vibrations felt a small distance from a source, a solar powered toy that moves when placed in direct light, warming a metal object on one end and observing the other end getting warm, and a wire carrying electric energy from a battery to light a bulb. State Assessment Boundary: Quantitative measurements of energy are not expected in state assessment.	same	3-5.PS.4. Identify the basic forms of energy (light, sound, heat, electrical, and magnetic). Recognize that energy is the ability to cause motion or create change.
4-PS3-3. Ask questions and predict outcomes about the changes in energy that occur when objects collide. Clarification Statement: Changes in energy can include a change in the object's motion, position, and the generation of heat and/or sound. State Assessment Boundary: Analysis of forces or quantitative measurements of energy are not expected in state assessment.	same	3-5.PS.5. Give examples of how energy can be transferred from one form to another.
4-PS3-4. Apply scientific principles of energy and motion to test and refine a device that converts motion energy to electrical energy or uses stored energy to cause motion or produce light or sound.* Clarification Statement: Sources of stored energy can include water in a bucket or a weight suspended at a height, and a battery.	same	3-5.PS.5. Give examples of how energy can be transferred from one form to another. 3-5.PS.4. Identify the basic forms of energy (light, sound, heat, electrical, and magnetic). Recognize that energy is the ability to cause motion or create change.
5-PS3-1. Use a model to describe that the food animals digest (a) contains energy that was once energy from the sun, and (b) provides energy and materials for body repair, growth, motion, body warmth, and reproduction. Clarification Statement: Examples of models could include diagrams and flow charts. State Assessment Boundary: Details of cellular respiration, ATP or molecular details of the process of photosynthesis or respiration are not expected in state assessment.	same	3-5.LS.11. Describe how energy derived from the sun is used by plants to produce sugars (photosynthesis) and is transferred within a food chain from producers (plants) to consumers to decomposers. 3-5.PS.5. Give examples of how energy can be transferred from one form to another.
PS4: Waves and Their Applications in Technologies for Information Transfer		
4-PS4-1. Develop a model of a simple mechanical wave (including sound) to communicate that waves (a) are regular patterns of motion along which energy travels and (b) can cause objects to move. Clarification Statement: Examples of models could include diagrams, analogies, and physical models. State Assessment Boundary: Interference effects, electromagnetic waves, non-periodic waves are not expected in state assessment.	in earlier grades	HS.IP.4.1 Describe the measurable properties of waves (velocity, frequency, wavelength, amplitude, period) and explain the relationships among them. Recognize examples of simple harmonic motion.
4-PS4-2. Develop a model to describe that light must reflect off an object and enter the eye for the object to be seen. State Assessment Boundary: Specific colors reflected and seen, the cellular mechanisms of vision, angles of incidence or how the retina works are not expected in state assessment.	same	3-5.PS.12. Recognize that light travels in a straight line until it strikes an object or travels from one medium to another, and that light can be reflected, refracted, and absorbed.
4-PS4-3. Develop and compare multiple ways to transfer information through encoding, sending, receiving, and decoding a pattern.* Clarification Statement: Examples of solutions could include drums sending coded information through sound waves, using a grid of 1s and 0s representing black and white to send information about a picture, and using Morse code to send text.	in earlier grades	6-8.TE.3.1. Identify and explain the components of a communication system, i.e., source, encoder, transmitter, receiver, decoder, storage, retrieval, and destination.
2001/06 grade 3-5 standards with no alignment to 2016 STE standards		
	na	3-5.ESS.5. Recognize and discuss the different properties of soil, including color, texture (size of particles), the ability to retain water, and the ability to support the growth of plants.
		3-5.TE.1.3. Identify and explain the difference between simple and complex machines, e.g., hand can opener that includes multiple gears, wheel, wedge, gear, and lever.
	na	3-5.TE.2.4. Compare natural systems with mechanical systems that are designed to serve similar purposes, e.g., a bird's wings as compared to an airplane's wings.

2016 MA STE Standards	Relative grade 2001/6 standard is found in 2016 STE standards	2001/6 STE Standard
ESS. Earth and Space Science		ESS. Earth and Space Science
ESS1. Earth's Place in the Universe		
6.MS-ESS1-1a. Develop and use a model of the Earth-sun-moon system to explain the causes of lunar phases and eclipses of the sun and moon. Clarification Statement: Examples of models can be physical, graphical, or conceptual and should emphasize relative positions and distances.	same in earlier grades	6-8.ESS.9. Describe lunar and solar eclipses, the observed moon phases, and tides. Relate them to the relative positions of the earth, moon, and sun. HS.ESS.4.2. Describe the influence of gravity and inertia on the rotation and revolution of orbiting bodies. Explain the Sun-Earth-moon relationships (e.g., day, year, solar/lunar eclipses, tides).
8.MS-ESS1-1b. Develop and use a model of the Earth-Sun system to explain the cyclical pattern of seasons, which includes Earth's tilt and differential intensity of sunlight on different areas of Earth across the year. Clarification Statement: Examples of models can be physical, graphical, or conceptual.	same in earlier grades	6-8.ESS.11. Explain how the tilt of the earth and its revolution around the sun result in an uneven heating of the earth, which in turn causes the seasons. HS.ESS.1.5. Explain how the revolution of Earth around the Sun and the inclination of Earth on its axis cause Earth's seasonal variations (equinoxes and solstices).
8.MS-ESS1-2. Explain the role of gravity in ocean tides, the orbital motions of planets, their moons, and asteroids in the solar system. State Assessment Boundary: Kepler's laws of orbital motion or the apparent retrograde motion of the planets as viewed from Earth are not expected in state assessment.	same	6-8.ESS.8. Recognize that gravity is a force that pulls all things on and near the earth toward the center of the earth. Gravity plays a major role in the formation of the planets, stars, and solar system and in determining their motions. 6-8.ESS.9. Describe lunar and solar eclipses, the observed moon phases, and tides. Relate them to the relative positions of the earth, moon, and sun.
Note: MS-ESS1-3 from NGSS is not included.	na	
6.MS-ESS1-4. Analyze and interpret rock layers and index fossils to determine the relative ages of rock formations that result from processes occurring over long periods of time. Clarification Statements: Analysis includes laws of superposition and crosscutting relationships limited to minor displacement faults that offset layers. Processes that occur over long periods of time include changes in rock types through weathering, erosion, heat, and pressure. State Assessment Boundary: Strata sequences that have been reordered or overturned, names of specific periods or epochs and events within them, or the identification and naming of minerals or rock types are not expected in state assessment.	in earlier grades	HS.ESS.3.7. Describe the absolute and relative dating methods used to measure geologic time, such as index fossils, radioactive dating, law of superposition, and crosscutting relationships.
6.MS-ESS1-5(MA). Use graphical displays to illustrate that the Earth and its solar system are one of many in the Milky Way galaxy, which is one of billions of galaxies in the universe. Clarification Statement: Graphical displays can include maps, charts, graphs, or data tables.	same	6-8.ESS.12 Recognize that the universe contains many billions of galaxies, and that each galaxy contains many billions of stars.
ESS2. Earth's Systems		
8.MS-ESS2-1. Use a model to illustrate that energy from Earth's interior drives convection that cycles Earth's crust leading to melting, crystallization, weathering, and deformation of large rock formations, including generation of ocean sea floor at ridges, submergence of ocean sea floor at trenches, mountain building, and active volcanic chains. Clarification Statement: The emphasis is on large-scale cycling resulting from plate tectonics.	same	6-8.ESS.2. Describe the layers of the earth, including the lithosphere, the hot convecting mantle, and the dense metallic core. 6-8.ESS.5. Describe how the movement of the earth's crustal plates causes both slow changes in the earth's surface (e.g., formation of mountains and ocean basins) and rapid ones (e.g., volcanic eruptions and earthquakes). 6-8.ESS.6. Describe and give examples of ways in which the earth's surface is built up and torn down by natural processes, including deposition of sediments, rock formation, erosion, and weathering.
	in earlier grades	HS.ESS.1.1. Identify Earth's principal sources of internal and external energy, such as radioactive decay, gravity, and solar energy. HS.ESS.3.6. Describe the rock cycle, and the processes that are responsible for the formation of igneous, sedimentary, and metamorphic rocks. Compare the physical properties of these rock types and the physical properties of common rock-forming minerals. HS.ESS.3.8. Trace the development of a lithospheric plate from its growth at a divergent boundary (mid-ocean ridge) to its destruction at a convergent boundary HS.ESS.3.10. Relate earthquakes, volcanic activity, tsunamis, mountain building, and tectonic uplift to plate movements.
	in later grades	3-5.ESS.3. Identify the three categories of rocks (metamorphic, igneous, and sedimentary) based on how they are formed, and explain the natural and physical processes that create these rocks.

2016 MA STE Standards	Relative grade 2001/6 standard is found in 2016 STE standards	2001/6 STE Standard
<p>7.MS-ESS2-2. Construct an explanation based on evidence for how Earth's surface has changed over scales that range from local to global in size. Clarification Statements: Examples of processes occurring over large, global spatial scales include plate motion, formation of mountains and ocean basins and ice ages. Examples of changes occurring over small, local spatial scales include earthquakes and seasonal weathering and erosion.</p>	same	6-8.ESS.5. Describe how the movement of the earth's crustal plates causes both slow changes in the earth's surface (e.g., formation of mountains and ocean basins) and rapid ones (e.g., volcanic eruptions and earthquakes).
	same	6-8.ESS.7. Explain and give examples of how physical evidence, such as fossils and surface features of glaciation, supports theories that the earth has evolved over geologic time.
	in later grades	3-5.ESS.12. Give examples of how the surface of the earth changes due to slow processes such as erosion and weathering, and rapid processes such as landslides, volcanic eruptions, and earthquakes.
	same	6-8.LS.17. Identify ways in which ecosystems have changed throughout geologic time in response to physical conditions, interactions among organisms, and the actions of humans. Describe how changes may be catastrophes such as volcanic eruptions or ice storms.
<p>6.MS-ESS2-3. Analyze and interpret maps showing the distribution of fossils and rocks, continental shapes, and seafloor structures to provide evidence that Earth's plates have moved great distances, collided, and spread apart. Clarification Statement: Maps may show similarities of rock and fossil types on different continents, the shapes of the continents (including continental shelves), and the locations of ocean structures (such as ridges, fracture zones, and trenches), similar to Wegner's visuals. State Assessment Boundary: Mechanisms for plate motion or paleomagnetic anomalies in oceanic and continental crust are not expected in state assessment.</p>	same	6-8.ESS.5. Describe how the movement of the earth's crustal plates causes both slow changes in the earth's surface (e.g., formation of mountains and ocean basins) and rapid ones (e.g., volcanic eruptions and earthquakes).
		6-8.ESS.7. Explain and give examples of how physical evidence, such as fossils and surface features of glaciation, supports theories that the earth has evolved over geologic time.
<p>7.MS-ESS2-4. Develop a model to explain how the energy of the Sun and Earth's gravity drive the cycling of water, including changes of state, as it moves through multiple pathways in Earth's hydrosphere. Clarification Statement: Examples of models can be conceptual or physical. State Assessment Boundary: A quantitative understanding of the latent heats of vaporization and fusion is not expected in state assessment.</p>	in earlier grades	HS.ESS.3.5. Describe the processes of the hydrologic cycle, including evaporation, condensation, precipitation, surface runoff and groundwater percolation, infiltration, and transpiration.
<p>8.MS-ESS2-5. Interpret basic weather data to identify patterns in air mass interactions and the relationship of those patterns to weather. Clarification Statements: Data includes temperature, pressure, humidity, precipitation, and wind. Examples of patterns can include air masses flow from regions of high pressure to low pressure, and how sudden changes in weather can result when different air masses collide. Data can be provided to students (such as weather maps, data tables, diagrams, and visualizations) or obtained through field observations or laboratory experiments. State Assessment Boundary: Specific names of cloud types or weather symbols used on weather maps are not expected in state assessment.</p>	in later grades	3-5.ESS.8. Describe how global patterns such as the jet stream and water currents influence local weather in measurable terms such as temperature, wind direction and speed, and precipitation.
	in earlier grades	HS.ESS.1.3. Explain how the transfer of energy through radiation, conduction, and convection contributes to global atmospheric processes, such as storms, winds, and currents.
	in earlier grades	HS.ESS.1.6. Describe the various conditions associated with frontal boundaries and cyclonic storms (e.g., thunderstorms, winter storms [nor'easters], hurricanes, tornadoes) and their impact on human affairs, including storm preparations.
<p>8.MS-ESS2-6. Describe how interactions involving the ocean affect weather and climate on a regional scale, including the influence of the ocean temperature as mediated by energy input from the Sun and energy loss due to evaporation or redistribution via ocean currents. Clarification Statement: A regional scale includes a state or multi-state perspective. State Assessment Boundary: Koppen Climate Classification names are not expected in state assessment.</p>	same	6-8.ESS.4. Explain the relationship among the energy provided by the sun, the global patterns of atmospheric movement, and the temperature differences among water, land, and atmosphere.
	in later grades	3-5.ESS.11. Give examples of how the cycling of water, both in and out of the atmosphere, has an effect on climate.
		3-5.ESS.8. Describe how global patterns such as the jet stream and water currents influence local weather in measurable terms such as temperature, wind direction and speed, and precipitation.
	in earlier grades	<p>HS.ESS.1.4. Provide examples of how the unequal heating of Earth and the Coriolis effect influence global circulation patterns, and show how they impact Massachusetts weather and climate (e.g., global winds, convection cells, land/sea breezes, mountain/valley breezes).</p> <p>HS.ESS.1.7. Explain the dynamics of oceanic currents, including upwelling, deep-water currents, the Labrador Current and the Gulf Stream, and their relationship to global circulation within the marine environment and climate.</p>
<p>ESS3. Earth and Human Activity</p>		
<p>8.MS-ESS3-1. Analyze and interpret data to explain why the Earth's mineral and fossil fuel resources are unevenly distributed as a result of geologic processes. Clarification Statement: Examples of uneven distributions of resources can include where petroleum is generally found (locations of the burial of organic marine sediments and subsequent geologic traps), and where metal ores are generally found (locations of past volcanic and hydrothermal activity).</p>	na	

2016 MA STE Standards	Relative grade 2001/6 standard is found in 2016 STE standards	2001/6 STE Standard
7.MS-ESS3-2. Obtain and communicate information on how data of past geologic events are analyzed for patterns and used to forecast the location and likelihood of future catastrophic events. Clarification Statements: Geologic events include earthquakes, volcanic eruptions, floods, and landslides. Examples of data typically analyzed can include the locations, magnitudes, and frequencies of the natural hazards. State Assessment Boundary: Active analysis of data or forecasting is not expected in state assessment.	in later grades	3-5.ESS.12. Give examples of how the surface of the earth changes due to slow processes such as erosion and weathering, and rapid processes such as landslides, volcanic eruptions, and earthquakes.
Note: MS-ESS3-3 from NGSS has been merged with 7.MS-ESS3-4.	na	
7.MS-ESS3-4. Construct an argument supported by evidence that human activities and technologies can mitigate the impact of increases in human population and per capita consumption of natural resources on the environment. Clarification Statements: Arguments should be based on examining historical data such as population graphs, natural resource distribution maps, and water quality studies over time. Examples of negative impacts can include changes to the amount and quality of natural resources such as water, mineral, and energy supplies.	na	
8.MS-ESS3-5. Examine and interpret data to describe the role that human activities have played in causing the rise in global temperatures over the past century. Clarification Statements: Examples of human activities include fossil fuel combustion, deforestation, and agricultural activity. Examples of evidence can include tables, graphs, and maps of global and regional temperatures; atmospheric levels of gases such as carbon dioxide and methane; and the rates of human activities.	na	
ETS: Technology/Engineering		ETS: Technology/Engineering
ETS:1 Engineering Design		
6.MS-ETS1-1. Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution. Include potential impacts on people and the natural environment that may limit possible solutions.*	na	
7.MS-ETS1-2. Evaluate competing solutions to a given design problem using a decision matrix to determine how well each meets the criteria and constraints of the problem. Use a model of each solution to evaluate how variations in one or more design features, including size, shape, weight, or cost, may affect the function or effectiveness of the solution.*	same	6-8.TE.2.1. Identify and explain the steps of the engineering design process, i.e., identify the need or problem, research the problem, develop possible solutions, select the best possible solution(s), construct a prototype, test and evaluate, communicate the solution(s), and redesign.
	same	6-8.TE.2.5. Explain how such design features as size, shape, weight, function, and cost limitations would affect the construction of a given prototype.
Note: MS-ETS1-3 from NGSS is not included.	na	
7.MS-ETS1-4. Generate and analyze data from iterative testing and modification of a proposed object, tool, or process to optimize the object, tool, or process for its intended purpose.*	same	6-8.TE.2.1. Identify and explain the steps of the engineering design process, i.e., identify the need or problem, research the problem, develop possible solutions, select the best possible solution(s), construct a prototype, test and evaluate, communicate the solution(s), and redesign.
6.MS-ETS1-5(MA). Create visual representations of solutions to a design problem. Accurately interpret and apply scale and proportion to visual representations.* Clarification Statements: Examples of visual representations can include sketches, scaled drawings, and orthographic projections. Examples of scale can include ¼" = 1', 1 cm = 1 m.	same	6-8.TE.2.2. Demonstrate methods of representing solutions to a design problem, e.g., sketches, orthographic projections, multiview drawings.
6.MS-ETS1-6(MA). Communicate a design solution to an intended user, including design features and limitations of the solution. Clarification Statement: Examples of intended users can include students, parents, teachers, manufacturing personnel, engineers, and customers.	same	6-8.TE.2.1. Identify and explain the steps of the engineering design process, i.e., identify the need or problem, research the problem, develop possible solutions, select the best possible solution(s), construct a prototype, test and evaluate, communicate the solution(s), and redesign. 6-8.TE.3.2. Identify and explain the appropriate tools, machines, and electronic devices (e.g., drawing tools, computer-aided design, and cameras) used to produce and/or reproduce design solutions (e.g., engineering drawings, prototypes, and reports).
7.MS-ETS1-7(MA). Construct a prototype of a solution to a given design problem.*	same	6-8.TE.2.1. Identify and explain the steps of the engineering design process, i.e., identify the need or problem, research the problem, develop possible solutions, select the best possible solution(s), construct a prototype, test and evaluate, communicate the solution(s), and redesign.
		6-8.TE.2.3. Describe and explain the purpose of a given prototype.
ETS:2 Materials, Tools and Manufacturing		
6.MS-ETS2-1(MA). Analyze and compare properties of metals, plastics, wood and ceramics, including flexibility, ductility, hardness, thermal conductivity, electrical conductivity, and melting point.	same	6-8.TE.1.1. Given a design task, identify appropriate materials (e.g., wood, paper, plastic, aggregates, ceramics, metals, solvents, adhesives) based on specific properties and characteristics (e.g., strength, hardness, and flexibility).
	in earlier grades	HS.Chem.1.1. Identify and explain physical properties (e.g., density, melting point, boiling point, conductivity, malleability) and chemical properties (e.g., the ability to form new substances). Distinguish between chemical and physical changes.
6.MS-ETS2-2(MA). Given a design task, select appropriate materials based on specific properties needed in the construction of a solution. Clarification Statement: Examples of materials can include metals, plastics, wood, and ceramics.*	same	6-8.TE.1.1. Given a design task, identify appropriate materials (e.g., wood, paper, plastic, aggregates, ceramics, metals, solvents, adhesives) based on specific properties and characteristics (e.g., strength, hardness, and flexibility).

2016 MA STE Standards	Relative grade 2001/6 standard is found in 2016 STE standards	2001/6 STE Standard
6.MS-ETS2-3(MA). Choose and safely use appropriate measuring tools, hand tools, fasteners and common hand-held power tools used to construct a prototype.* Clarification Statements: Examples of measuring tools include a tape measure, a meter stick, and a ruler. Examples of hand tools include a hammer, a screwdriver, a wrench, and pliers. Examples of fasteners include nails, screws, nuts and bolts, staples, glue, and tape. Examples of common power tools include jig saw, drill, and sander.	same	6-8.TE.1.2. Identify and explain appropriate measuring tools, hand tools, and power tools used to hold, lift, carry, fasten, and separate, and explain their safe and proper use. 6-8.TE.1.3. Identify and explain the safe and proper use of measuring tools, hand tools, and machines (e.g., band saw, drill press, sander, hammer, screwdriver, pliers, tape measure, screws, nails, and other mechanical fasteners) needed to construct a prototype of an engineering design. 6-8.TE.2.4. Identify appropriate materials, tools, and machines needed to construct a prototype of a given engineering design.
8.MS-ETS2-4(MA). Use informational text to illustrate that materials maintain their composition under various kinds of physical processing; however, some material properties may change if a process changes the particulate structure of a material. Clarification Statements: Examples of physical processing can include cutting, forming, extruding, and sanding. Examples of changes in material properties can include a non-magnetic iron material becoming magnetic after hammering and a plastic material becoming rigid (less elastic) after heat treatment.	na	
8.MS-ETS2-5(MA). Present information that illustrates how a product can be created using basic processes in manufacturing systems, including forming, separating, conditioning, assembling, finishing, quality control, and safety. Compare the advantages and disadvantages of human vs. computer control of these processes.	same	6-8.TE.4.4. Explain basic processes in manufacturing systems, e.g., cutting, shaping, assembling, joining, finishing, quality control, and safety.
ETS:3 Technological Systems		
7.MS-ETS3-1(MA). Explain the function of a communication system and the role of its components, including a source, encoder, transmitter, receiver, decoder, and storage.	same	6-8.TE.3.1. Identify and explain the components of a communication system, i.e., source, encoder, transmitter, receiver, decoder, storage, retrieval, and destination.
7.MS-ETS3-2(MA). Compare the benefits and drawbacks of different communication systems. Clarification Statements: Examples of communications systems can include radio, television, print, and the Internet. Examples of benefits and drawbacks can include speed of communication, distance or range, number of people reached, audio only vs. audio and visual, and one-way vs. two-way communication.	in earlier grades	HS.TE.6.3. Explain how the various components (source, encoder, transmitter, receiver, decoder, destination, storage, and retrieval) and processes of a communication system function.
7.MS-ETS3-3(MA). Research and communicate information about how transportation systems are designed to move people and goods using a variety of vehicles and devices. Identify and describe subsystems of a transportation vehicle, including structural, propulsion, guidance, suspension, and control subsystems. Clarification Statements: Examples of design elements include vehicle shape to maximize cargo or passenger capacity, terminals, travel lanes, and communications/controls. Examples of vehicles can include a car, sailboat, and small airplane.	same	6-8.TE.6.1. Identify and compare examples of transportation systems and devices that operate on or in each of the following: land, air, water, and space. 6-8.TE.6.3. Identify and describe three subsystems of a transportation vehicle or device, i.e., structural, propulsion, guidance, suspension, control, and support.
7.MS-ETS3-4(MA). Show how the components of a structural system work together to serve a structural function or maintain an environment for a particular human use. Provide examples of physical structures and relate their design to their intended use. Clarification Statements: Examples of components of a structural system could include foundation, decking, wall, and roofing. Explanations of function should include identifications of live vs. dead loads and forces of tension, torsion, compression, and shear. Examples of uses include carrying loads and forces across a span (such as a bridge), providing livable space (such as a house or office building), and providing specific environmental conditions (such as a greenhouse or cold storage). State Assessment Boundary: Calculations of magnitude or direction of loads and forces are not expected in state assessment.	same	6-8.TE.5.1. Describe and explain parts of a structure, e.g., foundation, flooring, decking, wall, roofing systems. 6-8.TE.5.2. Identify and describe three major types of bridges (e.g., arch, beam, and suspension) and their appropriate uses (e.g., site, span, resources, and load). 6-8.TE.5.3. Explain how the forces of tension, compression, torsion, bending, and shear affect the performance of bridges. 6-8.TE.5.4. Describe and explain the effects of loads and structural shapes on bridges.
7.MA-ETS3-5(MA). Use the concept of systems engineering to model inputs, processes, outputs, and feedback among components of a transportation, structural, or communication system.	same	6-8.TE.2.6. Identify the five elements of a universal systems model: goal, inputs, processes, outputs, and feedback.
LS. Life Science		
LS1 From Molecules to Organisms: Structures and Processes		
6.MS-LS1-1. Provide evidence that organisms (unicellular and multicellular) are made of cells. Clarification Statement: Evidence can be drawn from multiple types of organisms, such as plants, animals, and bacteria.	same	6-8.LS.2. Recognize that all organisms are composed of cells, and that many organisms are single-celled (unicellular), e.g., bacteria, yeast. In these single-celled organisms, one cell must carry out all of the basic functions of life.

2016 MA STE Standards	Relative grade 2001/6 standard is found in 2016 STE standards	2001/6 STE Standard
<p>6.MS-LS1-2. Develop and use a model to describe how parts of cells contribute to the cellular functions of obtaining food, water and other nutrients from its environment, disposing of wastes, and providing energy for cellular processes. Clarification Statements: Emphasis of functions is on basic survival needs. Parts of plant and animal cells include (a) the nucleus which contains a cell's genetic material and regulates its activities (b) chloroplasts which produce necessary food (sugar) and oxygen through photosynthesis (in plants); (c) mitochondria, which releases energy from food through cellular respiration; (d) vacuoles, which store materials, including water, nutrients, and waste; (e) the cell membrane, which is a selective barrier that enables nutrients to enter the cell and wastes to be expelled; and (f) the cell wall, which provides structural support (in plants). State Assessment Boundary: Specific biochemical steps or chemical processes, ATP, or active transport processes involving the cell membrane, or identifying or comparing different types of cells are not expected in state assessment.</p>	<p>same</p>	<p>6-8.LS.3. Compare and contrast plant and animal cells, including major organelles (cell membrane, cell wall, nucleus, cytoplasm, chloroplasts, mitochondria, vacuoles).</p> <p>6-8.LS.16. Recognize that producers (plants that contain chlorophyll) use the energy from sunlight to make sugars from carbon dioxide and water through a process called photosynthesis. This food can be used immediately, stored for later use, or used by other organisms.</p>
<p>6.MS-LS1-3. Construct an argument supported by evidence that the body systems interact to carry out essential functions of life. Clarification Statements: Emphasis is on the function and interactions of the body systems, not specific body parts or organs. An argument should convey that different types of cells can join together to form specialized tissues, which in turn may form organs that work together as body systems. Body systems to be included are the circulatory, digestive, respiratory, excretory, muscular/skeletal, and nervous systems. Essential functions of life include obtaining food and other nutrients (water, oxygen, minerals), releasing energy from food, removing wastes, responding to stimuli, maintaining internal conditions, and growing and developing. An example of interacting systems could include the respiratory system taking oxygen from the environment which the circulatory system delivers to cells for cellular respiration, or the digestive system taking in nutrients which the circulatory system transports to cells around the body. State Assessment Boundary: The mechanism of one body system independent of others, or the biochemical processes involved in body systems are not expected in state assessment. Describing the function or comparing different types of cells, tissues or organs are not expected in state assessment.</p>	<p>in earlier grades</p>	<p>HS.LS.2.1. Relate cell parts/organelles (plasma membrane, nuclear envelope, nucleus, nucleolus, cytoplasm, mitochondrion, endoplasmic reticulum, Golgi apparatus, lysosome, ribosome, vacuole, cell wall, chloroplast, cytoskeleton, centriole, cilium, flagellum, pseudopod) to their functions. Explain the role of cell membranes as a highly selective barrier (diffusion, osmosis, facilitated diffusion, active transport).</p>
<p>7.MS-LS1-4. Explain, based on evidence, how characteristic animal behaviors and specialized plant structures increase the probability of successful reproduction of animals and plants. Clarification Statements: Examples of animal behaviors that affect the probability of animal reproduction could include nest building to protect young from cold, herding of animals to protect young from predators, and vocalization and colorful plumage to attract mates for breeding. Examples of animal behaviors that affect the probability of plant reproduction could include (a) transferring pollen or seeds and (b) creating conditions for seed germination and growth. Examples of plant structures that affect the probability of plant reproduction could include bright flowers attracting butterflies that transfer pollen, flower nectar, and odors that attract insects that transfer pollen, and hard shells on nuts that squirrels bury. State Assessment Boundary: Natural selection is not expected in state assessment.</p>	<p>same</p>	<p>6-8.LS.4. Recognize that within cells, many of the basic functions of organisms (e.g., extracting energy from food and getting rid of waste) are carried out. The way in which cells function is similar in all living organisms.</p>
<p>6.MS-LS1-3. Construct an argument supported by evidence that the body systems interact to carry out essential functions of life. Clarification Statements: Emphasis is on the function and interactions of the body systems, not specific body parts or organs. An argument should convey that different types of cells can join together to form specialized tissues, which in turn may form organs that work together as body systems. Body systems to be included are the circulatory, digestive, respiratory, excretory, muscular/skeletal, and nervous systems. Essential functions of life include obtaining food and other nutrients (water, oxygen, minerals), releasing energy from food, removing wastes, responding to stimuli, maintaining internal conditions, and growing and developing. An example of interacting systems could include the respiratory system taking oxygen from the environment which the circulatory system delivers to cells for cellular respiration, or the digestive system taking in nutrients which the circulatory system transports to cells around the body. State Assessment Boundary: The mechanism of one body system independent of others, or the biochemical processes involved in body systems are not expected in state assessment. Describing the function or comparing different types of cells, tissues or organs are not expected in state assessment.</p>	<p>same</p>	<p>6-8.LS.6. Identify the general functions of the major systems of the human body (digestion, respiration, reproduction, circulation, excretion, protection from disease, and movement, control, and coordination) and describe ways that these systems interact with each other.</p>
<p>Note: MS-LS1-6 from NGSS is not included.</p>	<p>na</p>	
<p>8.MS-LS1-5. Construct an argument based on evidence for how environmental and genetic factors influence the growth of organisms. Clarification Statements: Examples of local environmental conditions could include availability of food, light, space, and water. Examples of genetic factors could include the genes responsible for size differences in different breeds of dogs, such as great danes and chihuahuas. Examples of environmental factors could include drought decreasing plant growth, fertilizer increasing plant growth, and fish growing larger in large ponds than they do in small ponds. Examples of both genetic and environmental factors could include different varieties of plants growing at different rates in different conditions. State Assessment Boundary: Methods of reproduction, genetic mechanisms, gene regulation, biochemical processes, or natural selection are not expected in state assessment.</p>	<p>na</p>	<p>6-8.LS.10. Give examples of ways in which genetic variation and environmental factors are causes of evolution and the diversity of organisms.</p>
<p>Note: MS-LS1-8 from NGSS is not included.</p>	<p>na</p>	
<p>8.MS-LS1-7. Use informational text to describe that food molecules, including carbohydrates, proteins, and fats, are broken down and rearranged through chemical reactions forming new molecules that support cell growth or release of energy. State Assessment Boundary: Specific details of the chemical reaction for cellular respiration, biochemical steps of breaking down food, or the resulting molecules (e.g., carbohydrates are broken down into monosaccharides) are not expected in state assessment.</p>	<p>in earlier grades</p>	<p>HS.LS.4.1. Explain generally how the digestive system (mouth, pharynx, esophagus, stomach, small and large intestines, rectum) converts macromolecules from food into smaller molecules that can be used by cells for energy and for repair and growth.</p>

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LS2. Ecosystems: Interactions, Energy, and Dynamics		
7.MS-LS2-1. Analyze and interpret data to provide evidence for the effects of periods of abundant and scarce resources on the growth of organisms and the size of populations in an ecosystem.	same	6-8.LS.17. Identify ways in which ecosystems have changed throughout geologic time in response to physical conditions, interactions among organisms, and the actions of humans. Describe how changes may be catastrophes such as volcanic eruptions or ice storms.
7.MS-LS2-2. Describe how relationships among and between organisms in an ecosystem can be competitive, predatory, parasitic, and mutually beneficial and that these interactions are found across multiple ecosystems. Clarification Statement: Emphasis is on describing consistent patterns of interactions in different ecosystems in terms of relationships among and between organisms.	same	6-8.LS.13 Give examples of ways in which organisms interact and have different functions within an ecosystem that enable the ecosystem to survive.
	in earlier grades	HS.LS.6.3. Use a food web to identify and distinguish producers, consumers, and decomposers, and explain the transfer of energy through trophic levels. Describe how relationships among organisms (predation, parasitism, competition, commensalism, mutualism) add to the complexity of biological communities.
7.MS-LS2-3. Develop a model to describe that matter and energy are transferred among living and nonliving parts of an ecosystem and that both matter and energy are conserved through these processes. Clarification Statements: Cycling of matter should include the role of photosynthesis, cellular respiration, and decomposition, as well as transfer among producers, consumers (primary, secondary, and tertiary), and decomposers. Models may include food webs and food chains. State Assessment Boundary: Cycling of specific atoms (such as carbon or oxygen), or the biochemical steps of photosynthesis, cellular respiration, and decomposition are not expected in state assessment.	same	6-8.LS.15. Explain how dead plants and animals are broken down by other living organisms and how this process contributes to the system as a whole.
7.MS-LS2-4. Analyze data to provide evidence that disruptions (natural or human-made) to any physical or biological component of an ecosystem can lead to shifts in all its populations. Clarification Statement: Focus should be on ecosystems characteristics varying over time, including disruptions such as hurricanes, floods, wildfires, oil spills, and construction.	same	6-8.LS.17. Identify ways in which ecosystems have changed throughout geologic time in response to physical conditions, interactions among organisms, and the actions of humans. Describe how changes may be catastrophes such as volcanic eruptions or ice storms.
7.MS-LS2-5. Evaluate competing design solutions for protecting an ecosystem. Discuss benefits and limitations of each design.* Clarification Statements: Examples of design solutions could include water, land, and species protection and the prevention of soil erosion. Examples of design solution constraints could include scientific, economic, and social considerations.	same	6-8.LS.13 Give examples of ways in which organisms interact and have different functions within an ecosystem that enable the ecosystem to survive.
7.MS-LS2-6(MA). Explain how changes to the biodiversity of an ecosystem—the variety of species found in the ecosystem—may limit the availability of resources humans use. Clarification Statement: Examples of resources can include food, energy, medicine, and clean water.	na	
LS3.Heredity: Inheritance and Variation of Traits		
8.MS-LS3-1. Develop and use a model to describe that structural changes to genes (mutations) may or may not result in changes to proteins, and if there are changes to proteins there may be harmful, beneficial, or neutral changes to traits. Clarification Statements: An example of a beneficial change to the organism may be a strain of bacteria becoming resistant to an antibiotic. A harmful change could be the development of cancer; a neutral change may change the hair color of an organism with no direct consequence. State Assessment Boundary: Specific changes at the molecular level (e.g., amino acid sequence change), mechanisms for protein synthesis, or specific types of mutations are not expected in state assessment.	in earlier grades	HS.LS.3.3. Explain how mutations in the DNA sequence of a gene may or may not result in phenotypic change in an organism. Explain how mutations in gametes may result in phenotypic changes in offspring.
8.MS-LS3-2. Construct an argument based on evidence for how asexual reproduction results in offspring with identical genetic information and sexual reproduction results in offspring with genetic variation. Compare and contrast advantages and disadvantages of asexual and sexual reproduction. Clarification Statements: Examples of an advantage of sexual reproduction can include genetic variation when the environment changes or a disease is introduced, while examples of an advantage of asexual reproduction can include not using energy to find a mate and fast reproduction rates. Examples of a disadvantage of sexual reproduction can include using resources to find a mate, while a disadvantage in asexual reproduction can be the lack of genetic variation when the environment changes or a disease is introduced.	same	6-8.LS.7. Recognize that every organism requires a set of instructions that specifies its traits. These instructions are stored in the organism's chromosomes. Heredity is the passage of these instructions from one generation to another.
		6-8.LS.9. Compare sexual reproduction (offspring inherit half of their genes from each parent) with asexual reproduction (offspring is an identical copy of the parent's cell).
	in earlier grades	HS.LS.3-4 Distinguish among observed inheritance patterns caused by several types of genetic traits (dominant, recessive, codominant, sex-linked, polygenic, incomplete dominance, multiple alleles).
8.MS-LS3-3(MA). Communicate through writing and in diagrams that chromosomes, contain many distinct genes, and that each gene holds the instructions for the production of specific proteins, which in turn affects the traits of an individual. State Assessment Boundary: Specific changes at the molecular level or mechanisms for protein synthesis are not expected in state assessment.	same	6-8.LS.7. Recognize that every organism requires a set of instructions that specifies its traits. These instructions are stored in the organism's chromosomes. Heredity is the passage of these instructions from one generation to another.
		6-8.LS.8. Recognize that hereditary information is contained in genes located in the chromosomes of each cell. A human cell contains about 30,000 different genes on 23 different chromosomes.

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<p>8.MS-LS3-4(MA). Develop and use a model to show that in sexually reproducing organisms individuals have two of each chromosome in their cell nuclei, and hence two variants (alleles) of each gene that can be the same or different from each other, with one random assortment of each chromosome passed down to offspring from both parents. Clarification Statements: Examples of models can include Punnett squares, diagrams (simple pedigrees), and simulations. State assessment will limit inheritance patterns to dominant-recessive alleles only.</p>	same	<p>6-8.LS.8. Recognize that hereditary information is contained in genes located in the chromosomes of each cell. A human cell contains about 30,000 different genes on 23 different chromosomes.</p> <p>6-8.LS.9. Compare sexual reproduction (offspring inherit half of their genes from each parent) with asexual reproduction (offspring is an identical copy of the parent's cell).</p>	
	in earlier grades	<p>HS.LS.3.5. Describe how Mendel's laws of segregation and independent assortment can be observed through patterns of inheritance (e.g., dihybrid crosses).</p> <p>HS.LS.3.6. Use a Punnett Square to determine the probabilities for genotype and phenotype combinations in monohybrid crosses.</p> <p>HS.LS.4.6. Recognize that the sexual reproductive system allows organisms to produce offspring that receive half of their genetic information from their mother and half from their father, and that sexually produced offspring resemble, but are not identical to, either of their parents.</p>	
	<p>LS4. Biological Evolution: Unity and Diversity</p>		
<p>6.MS-LS4-1. Analyze and interpret evidence from the fossil record to describe organisms and their environment, extinctions, and changes to life forms throughout the history of the Earth. Clarification Statement: Examples of evidence include sets of fossils that indicate a specific type of environment, anatomical structures that indicate the function of an organism in the environment, and fossilized tracks that indicate behavior of organisms. State Assessment Boundary: Names of individual species, geological eras in the fossil record, or mechanisms for extinction or speciation are not expected in state assessment.</p>	same	<p>6-8.LS.12. Relate the extinction of species to a mismatch of adaptation and the environment.</p> <p>6-8.LS.17. Identify ways in which ecosystems have changed throughout geologic time in response to physical conditions, interactions among organisms, and the actions of humans. Describe how changes may be catastrophes such as volcanic eruptions or ice storms.</p>	
<p>6.MS-LS4-2. Construct an argument using anatomical structures to support evolutionary relationships among and between fossil organisms and modern organisms. Clarification Statements: Evolutionary relationships include (a) some organisms have similar traits with similar functions because they were inherited from a common ancestor, (b) some organisms have similar traits that serve similar functions because they live in similar environments, and (c) some organisms have traits inherited from common ancestors that no longer serve their original function because their environments are different than their ancestors' environments.</p>	same	<p>6-8.LS.10. Give examples of ways in which genetic variation and environmental factors are causes of evolution and the diversity of organisms.</p> <p>6-8.LS.11. Recognize that evidence drawn from geology, fossils, and comparative anatomy provides the basis of the theory of evolution.</p> <p>6-8.LS.18. Recognize that biological evolution accounts for the diversity of species developed through gradual processes over many generations.</p>	
	<p>Note: MS-LS4-3 from NGSS is not included.</p>		
	na		
<p>8.MS-LS4-4. Use a model to describe the process of natural selection, in which genetic variations of some traits in a population increase some individuals' likelihood of surviving and reproducing in a changing environment. Provide evidence that natural selection occurs over many generations. Clarification Statements: The model should include simple probability statements and proportional reasoning. Examples of evidence can include Darwin's finches, necks of giraffes, and peppered moths. State Assessment Boundary: Specific conditions that lead to natural selection are not expected in state assessment.</p>	same	<p>6-8.LS.18. Recognize that biological evolution accounts for the diversity of species developed through gradual processes over many generations.</p>	
<p>8.MS-LS4-5. Synthesize and communicate information about artificial selection, or the ways in which humans have changed the inheritance of desired traits in organisms. Clarification Statement: Emphasis is on the influence of humans on genetic outcomes in artificial selection (such as genetic modification, animal husbandry, and gene therapy).</p>	na		
<p>Note: MS-LS4-6 from NGSS is not included.</p>			
	na		

2016 MA STE Standards	Relative grade 2001/6 standard is found in 2016 STE standards	2001/6 STE Standard
PS. Physical Science		
PS1: Matter and its Interactions		
8.MS-PS1-1. Develop a model to describe that (a) atoms combine in a multitude of ways to produce pure substances which make up all of the living and nonliving things that we encounter (b) atoms form molecules and compounds that range in size from two to thousands of atoms and (c) mixtures are composed of different proportions of pure substances. Clarification Statement: Examples of molecular-level models could include drawings, three dimensional ball and stick structures, and computer representations showing different molecules with different types of atoms. State Assessment Boundary: Valence electrons and bonding energy, the ionic nature of subunits of complex structures, complete depiction of all individual atoms in a complex molecule or extended structure, or calculations of proportions in mixtures are not expected in state assessment.	same	6-8.PS.5. Recognize that there are more than 100 elements that combine in a multitude of ways to produce compounds that make up all of the living and nonliving things that we encounter. 6-8.PS.6. Differentiate between an atom (the smallest unit of an element that maintains the characteristics of that element) and a molecule (the smallest unit of a compound that maintains the characteristics of that compound). 6-8.PS.7. Give basic examples of elements and compounds.
8.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. Clarification Statements: Examples of reactions could include burning sugar or steel wool, fat reacting with sodium hydroxide, and mixing zinc with HCl. Properties of substances include density, melting point, boiling point, solubility, flammability, and odor.	same	6-8.PS.9. Recognize that a substance (element or compound) has a melting point and a boiling point, both of which are independent of the amount of the sample. 6-8.PS.10. Differentiate between physical changes and chemical changes.
Note: MS-PS1-3 from NGSS is not included.	na	HS.Chem.1.1. Identify and explain physical properties (e.g., density, melting point, boiling point, conductivity, malleability) and chemical properties (e.g., the ability to form new substances). Distinguish between chemical and physical changes.
8.MS-PS1-4. Develop a model that describes and predicts changes in particle motion, relative spatial arrangement, temperature, and state of a pure substance when thermal energy is added or removed. Clarification Statements: Emphasis is on qualitative molecular-level models of solids, liquids, and gases to show that adding or removing thermal energy increases or decreases kinetic energy of the particles until a change of state occurs. Examples of models could include drawings and diagrams. Examples of pure substances could include water, carbon dioxide, and helium.	same	6-8.PS.15. Explain the effect of heat on particle motion through a description of what happens to particles during a change in phase.
8.MS-PS1-5. Use a model to explain that substances are rearranged during a chemical reaction to form new substances with new properties. Explain that the atoms present in the reactants are all present in the products and thus the total number of atoms is conserved. Clarification Statement: Examples of models can include physical models or drawings, including digital forms, that represent atoms. State Assessment Boundary: Use of atomic masses, molecular weights, balancing symbolic equations, or intermolecular forces is not expected in state assessment.	in earlier grades	HS.Chem.1-3 Describe the three major states of matter (solid, liquid, gas) in terms of energy, particle motion, and phase transitions. HS.Chem. 6-3 Using the kinetic molecular theory, describe and contrast the properties of gases, liquids, and solids. Explain, at the molecular level, the behavior of matter as it undergoes phase transitions. HS-IP.3.3. Describe the relationship between average molecular kinetic energy and temperature. Recognize that energy is absorbed when a substance changes from a solid to a liquid to a gas, and that energy is released when a substance changes from a gas to a liquid to a solid. Explain that relationships among evaporation, condensation, cooling, and warming.
6.MS-PS1-6. Plan and conduct an experiment involving exothermic and endothermic chemical reactions to measure and describe the release or absorption of thermal energy. Clarification Statements: Emphasis is on describing transfer of energy to and from the environment. Examples of chemical reactions could include dissolving ammonium chloride or calcium chloride.	same	6-8.PS.4 Explain and give examples of how mass is conserved in a closed system.
6.MS-PS1-7(MA). Use a particulate model of matter to explain that density is the amount of matter (mass) in a given volume. Apply proportional reasoning to describe, calculate, and compare relative densities of different materials.	in earlier grades	HS.Chem.6-4. Describe the law of conservation of energy. Explain the difference between an endothermic process and an exothermic process.
6.MS-PS1-8(MA). Conduct an experiment to show that many materials are mixtures of pure substances that can be separated by physical means into their component pure substances. Clarification Statement: Examples of common mixtures include salt water, oil and vinegar, milk, and air.	same	6-8.PS.2. Differentiate between volume and mass. Define density. 6-8.PS.8. Differentiate between mixtures and pure substances.

2016 MA STE Standards	Relative grade 2001/6 standard is found in 2016 STE standards	2001/6 STE Standard
PS2: Motion and Stability: Forces and Interactions		
8.MS-PS2-1. Develop a model that demonstrates Newton’s third law involving the motion of two colliding objects. State Assessment Boundary: State assessment will be limited to vertical or horizontal interactions in one dimension.	in earlier grades	HS-IP.1.4. Interpret and apply Newton’s three laws of motion.
8.MS-PS2-2. Provide evidence that the change in an object’s motion depends on the sum of the forces on the object (the net force) and the mass of the object. Clarification Statement: Emphasis is on balanced (Newton’s first law) and unbalanced forces in a system, qualitative comparisons of forces, mass, and changes in motion (Newton’s second law) in one dimension. State Assessment Boundaries: State assessment will be limited to forces and changes in motion in one dimension in an inertial reference frame and to change in one variable at a time. The use of trigonometry is not expected in state assessment.	in earlier grades	HS-IP.1.4. Interpret and apply Newton’s three laws of motion.
7.MS-PS2-3. Analyze data to describe the effect of distance and magnitude of electric charge on the size of electric forces. Clarification Statement: Includes both attractive and repulsive forces. State Assessment Boundary: State assessment will be limited to proportional reasoning. Calculations using Coulomb’s law or interactions of sub-atomic particles are not expected in state assessment.	in later grades	3-5.PS.8. Explain how electromagnets can be made, and give examples of how they can be used.
	in earlier grades	HS-IP.5.1. Recognize that an electric charge tends to be static on insulators and can move on and in conductors. Explain that energy can produce a separation of charges. HS-IP.5.6. Recognize that moving electric charges produce magnetic forces and moving magnets produce electric forces. Recognize that the interplay of electric and magnetic forces is the basis for electric motors, generators, and other technologies.
6.MS-PS2-4. Use evidence to support the claim that gravitational forces between objects are attractive and are only noticeable when one or both of the objects have a very large mass. Clarification Statement: Examples of objects with very large masses include the Earth, Sun, and other planets. State Assessment Boundary: Newton’s Law of Gravitation or Kepler’s Laws are not expected in state assessment.	same	6-8.PS.1. Differentiate between weight and mass, recognizing that weight is the amount of gravitational pull on an object.
7.MS-PS2-5. Use scientific evidence to argue that fields exist between objects with mass, between magnetic objects, and between electrically charged objects that exert force on each other even though the objects are not in contact. Clarification Statement: Emphasis is on evidence that demonstrates the existence of fields, limited to gravitational, electric, and magnetic fields. State Assessment Boundary: Calculations of force are not expected in state assessment.	in earlier grades	HS-IP.5.1. Recognize that an electric charge tends to be static on insulators and can move on and in conductors. Explain that energy can produce a separation of charges.
PS3: Energy		
7.MS-PS3-1. Construct and interpret data and graphs to describe the relationships among kinetic energy, mass, and speed of an object. Clarification Statements: Examples could include riding a bicycle at different speeds and rolling different sized rocks downhill. Consider relationships between kinetic energy vs. mass and kinetic energy vs. speed separate from each other; emphasis is on the difference between the linear and exponential relationships. State Assessment Boundary: Calculation or manipulation of the formula for kinetic energy is not expected in state assessment.	same	6-8.PS.11. Explain and give examples of how the motion of an object can be described by its position, direction of motion, and speed.
7.MS-PS3-2. Develop a model to describe the relationship between the relative position of objects interacting at a distance and their relative potential energy in the system. Clarification Statements: Examples of objects within systems interacting at varying distances could include Earth and either a roller coaster cart at varying positions on a hill or objects at varying heights on shelves, changing the direction/orientation of a magnet, and a balloon with static electrical charge being brought closer to a stream of water. Examples of models could include representations, diagrams, pictures, and written descriptions of systems. State Assessment Boundary: State Assessment will be limited to two objects and electric, magnetic, and gravitational interactions and to interactions of two objects at a time. Calculations of potential energy are not expected in state assessment.	same	6-8.PS.13. Differentiate between potential and kinetic energy. Identify situations where kinetic energy is transformed into potential energy and vice versa.

2016 MA STE Standards	Relative grade 2001/6 standard is found in 2016 STE standards	2001/6 STE Standard
7.MS-PS3-3. Apply scientific principles of energy and heat transfer to design, construct, and test a device to minimize or maximize thermal energy transfer.* Clarification Statement: Examples of devices could include an insulated box, a solar cooker, and a vacuum flask. State Assessment Boundary: Accounting for specific heat or calculations of the total amount of thermal energy transferred is not expected in state assessment	same	6-8.PS.14. Recognize that heat is a form of energy and that temperature change results from adding or taking away heat from a system.
	same	6-8.PS.16. Give examples of how heat moves in predictable ways, moving from warmer objects to cooler ones until they reach equilibrium.
	in earlier grades	HS-IP.3.1. Explain how heat energy is transferred by convection, conduction, and radiation.
7.MS-PS3-4. Conduct an investigation to determine the relationships among the energy transferred, how well the type of matter retains or radiates heat, the mass, and the change in the average kinetic energy of the particles as measured by the temperature of the sample. State Assessment Boundary: Calculations of specific or the total amount of thermal energy transferred are not expected in state assessment.	same	6-8.PS.14. Recognize that heat is a form of energy and that temperature change results from adding or taking away heat from a system.
		6-8.PS.16. Give examples of how heat moves in predictable ways, moving from warmer objects to cooler ones until they reach equilibrium.
	in earlier grades	HS-IP.3.3. Describe the relationship between average molecular kinetic energy and temperature. Recognize that energy is absorbed when a substance changes from a solid to a liquid to a gas, and that energy is released when a substance changes from a gas to a liquid to a solid. Explain the relationships among evaporation, condensation, cooling, and warming.
7.MS-PS3-5. Present evidence to support the claim that when the kinetic energy of an object changes, energy is transferred to or from the object. Clarification Statement: Examples of empirical evidence could include an inventory or other representation of the energy before and after the transfer in the form of temperature changes or motion of an object. State Assessment Boundary: Calculations of energy are not expected in state assessment.	same	6-8.PS.13. Differentiate between potential and kinetic energy. Identify situations where kinetic energy is transformed into potential energy and vice versa.
7.MS-PS3-6(MA). Use a model to explain how thermal energy is transferred out of hotter regions or objects and into colder ones by convection, conduction, and radiation.	same	6-8.ESS.3. Differentiate among radiation, conduction, and convection, the three mechanisms by which heat is transferred through the earth's system.
	in earlier grades	HS-IP.3.1. Explain how heat energy is transferred by convection, conduction, and radiation.
	in earlier grades	HS.ESS.1.3. Explain how the transfer of energy through radiation, conduction, and convection contributes to global atmospheric processes, such as storms, winds, and currents.
7.MS-PS3-7(MA). Use informational text to describe the relationship between kinetic and potential energy and illustrate conversions from one form to another. Clarification Statement: Types of kinetic energy include motion, sound, thermal, and light; types of potential energy include gravitational, elastic, and chemical.	same	6-8.PS.13. Differentiate between potential and kinetic energy. Identify situations where kinetic energy is transformed into potential energy and vice versa.
PS4: Waves and Their Applications in Technologies for Information Transfer		
6.MS-PS4-1. Use diagrams of a simple wave to explain that (a) a wave has a repeating pattern with a specific amplitude, frequency, and wavelength and (b) the amplitude of a wave is related to the energy of the wave. State Assessment Boundaries: Electromagnetic waves are not expected in state assessment. State assessment will be limited to standard repeating waves.	in earlier grades	HS-IP.4.1. Describe the measurable properties of waves (velocity, frequency, wavelength, amplitude, period) and explain the relationships among them. Recognize examples of simple harmonic motion.
6.MS-PS4-2. Use diagrams and other models to show that both light rays and mechanical waves are reflected, absorbed, or transmitted through various materials. Clarification Statements: Materials may include solids, liquids, and gases. Mechanical waves (including sound) need a material (medium) through which they are transmitted. Examples of models could include drawings, simulations, and written descriptions. State Assessment Boundary: State assessment will be limited to qualitative applications.	in earlier grades	HS-IP.4.4. Describe qualitatively the basic principles of reflection and refraction of waves.
6.MS-PS4-3. Present qualitative scientific and technical information to support the claim that digitized signals (sent as wave pulses representing 0s and 1s) can be used to encode and transmit information. State Assessment Boundary: Binary counting or the specific mechanism of any given device are not expected in state assessment.	na	

Grades 6-8 Science Crosswalk of 2016 MA STE Standards to 2001/2006 Standards

2016 MA STE Standards	Relative grade 2001/6 standard is found in 2016 STE standards	2001/6 STE Standard
2001/06 grade 6-8 standards with no alignment to 2016 STE standards		
	na	6-8.ESS.10. Compare and contrast properties and conditions of objects in the solar system (i.e., sun, planets, and moons) to those on Earth (i.e., gravitational force, distance from the sun, speed, movement, temperature, and atmospheric conditions).
	na	6-8.TE.3.4. Identify and explain how symbols and icons (e.g., international symbols and graphics) are used to communicate a message.
	na	6-8.TE.4.2. Explain and give examples of the impacts of interchangeable parts, components of mass-produced products, and the use of automation, e.g., robotics.
	na	6-8.TE.4.3. Describe a manufacturing organization, e.g., corporate structure, research and development, production, marketing, quality control, distribution.
	na	6-8.TE.6.2. Given a transportation problem, explain a possible solution using the universal systems model.
	na	6-8.TE.7.1. Explain examples of adaptive or assistive devices, e.g., prosthetic devices, wheelchairs, eyeglasses, grab bars, hearing aids, lifts, braces.
	na	6-8.TE.7.2. Describe and explain adaptive and assistive bioengineered products, e.g., food, bio-fuels, irradiation, integrated pest management.
	na	6-8.LS.1. Classify organisms into the currently recognized kingdoms according to characteristics that they share. Be familiar with organisms from each kingdom.
	na	6-8.PS.3. Recognize that the measurement of volume and mass requires understanding of the sensitivity of measurement tools (e.g., rulers, graduated cylinders, balances) and knowledge and appropriate use of significant digits.
	na	6-8.PS.11. Explain and give examples of how the motion of an object can be described by its position, direction of motion, and speed.

2016 MA STE Standards	Relative grade 2001/6 standards is found in 2016 STE standards	2001/6 STE Standard
ESS. Earth and Space Science		ESS. Earth and Space Science
ESS1. Earth's Place in the Universe		
HS-ESS1-1. Use informational text to explain that the life span of the sun over approximately 10 billion years is a function of nuclear fusion in its core. Communicate that stars, through nuclear fusion over their lifecycle, produce elements from helium to iron and release energy that eventually reaches Earth in the form of radiation. State Assessment Boundary: Specific stages of the life of a star, details of nucleosynthesis pathways for stars of differing masses, or calculations of energy released are not expected in state assessment.	same	HS.Chem.2.7. Compare and contrast nuclear fission and nuclear fusion.
HS-ESS1-2. Describe the astronomical evidence for the Big Bang theory, including the red shift of light from the motion of distant galaxies as an indication that the universe is currently expanding, the cosmic microwave background as the remnant radiation from the Big Bang, and the observed composition of ordinary matter of the universe, primarily found in stars and interstellar gases, which matches that predicted by the Big Bang theory (3/4 hydrogen and 1/4 helium).	same	HS.ESS.4.1. Explain the Big Bang Theory and discuss the evidence that supports it, such as background radiation and relativistic Doppler effect (i.e., "red shift").
Note: HS-ESS1-3 has been merged with HS-ESS1-1.		
HS-ESS1-4. Use Kepler's laws to predict the motion of orbiting objects in the solar system. Describe how orbits may change due to the gravitational effects from, or collisions with, other objects in the solar system. Clarification Statements: Kepler's laws apply to human-made satellites as well as planets, moons and other objects. Calculations involving Kepler's laws of orbital motions should not deal with more than two bodies, nor involve calculus.	same	HS.ESS.4.2. Describe the influence of gravity and inertia on the rotation and revolution of orbiting bodies. Explain the Sun-Earth-moon relationships (e.g., day, year, solar/lunar eclipses, tides).
HS-ESS1-5. Evaluate evidence of the past and current movements of continental and oceanic crust, the theory of plate tectonics, and relative densities of oceanic and continental rocks to explain why continental rocks are generally much older than rocks of the ocean floor. Clarification Statement: Examples include the ages of oceanic crust (less than 200 million years old) increasing with distance from mid-ocean ridges (a result of plate spreading at divergent boundaries) and the ages of North American continental crust (which can be older than 4 billion years) increasing with distance away from a central ancient core (a result of past plate interactions at convergent boundaries).	same	HS.ESS.3.8. Trace the development of a lithospheric plate from its growth at a divergent boundary (mid-ocean ridge) to its destruction at a convergent boundary
Note: HS-ESS1-6 from NGSS is not included. HS-ESS1-3 has been combined with HS-ESS1-1.	na	
ESS2. Earth's Systems		
Note: HS-ESS2-1 has been merged with MS-ESS2-1.	na	
HS-ESS2-2. Analyze geoscience data to make the claim that one change to Earth's hydrosphere can create feedbacks that cause changes to other Earth's systems. Clarification Statement: Examples can include how decreasing the amount of glacial ice reduces the amount of sunlight reflected from Earth's surface, increasing surface temperatures and further reducing the amount of ice; how the loss of ground vegetation causes an increase in water runoff and soil erosion; how dammed rivers increase groundwater recharge, decrease sediment transport, and increase coastal erosion; and how the loss of wetlands causes a decrease in local humidity that further reduces the wetland extent.	same	HS.ESS.1.8. Read, interpret, and analyze a combination of ground-based observations, satellite data, and computer models to demonstrate Earth systems and their interconnections.
HS-ESS2-3. Use a model based on evidence of Earth's interior to describe the cycling of matter due to the outward flow of energy from Earth's interior and gravitational movement of denser materials toward the center. Clarification Statement: Emphasis is on both a two-dimensional model of Earth, with radial layers determined by density, and a three-dimensional model, which is controlled by gravity and thermal convection. Examples of evidence include maps of Earth's three-dimensional structure obtained from seismic waves, records of the rate of change of Earth's magnetic field (as constraints on convection in the outer core), and identification of the composition of Earth's layers from high-pressure laboratory experiments.	same	HS.ESS.1.1. Identify Earth's principal sources of internal and external energy, such as radioactive decay, gravity, and solar energy.
	same	HS.ESS.3.9. Explain the relationship between convection currents in Earth's mantle and the motion of the lithospheric plates.
	same	HS.ESS.3.11. Explain how seismic data are used to reveal Earth's interior structure and to locate earthquake epicenters.

HS-ESS2-4. Use a model to describe how variations in the flow of energy into and out of Earth's systems over different time scales result in changes in climate. Analyze and interpret data to explain that long-term changes in Earth's tilt and orbit result in cycles of climate change such as Ice Ages. Clarification Statement: Examples of the causes of climate change differ by timescale: large volcanic eruption and ocean circulation over 1-10 years; changes in human activity, ocean circulation and solar output over tens to hundreds of years; changes to orbit and the orientation of its axis over ten to hundreds of thousands of years; and long-term changes in atmospheric composition over tens to hundreds of millions of years. State Assessment Boundary: Changes in climate will be limited to changes in surface temperatures, precipitation patterns, glacial ice volumes, sea levels, and biosphere distribution in state assessment.	same	HS.ESS.1.2. Describe the characteristics of electromagnetic radiation and give examples of its impact on life and Earth's systems.
	same	HS.ESS.1.3. Explain how the transfer of energy through radiation, conduction, and convection contributes to global atmospheric processes, such as storms, winds, and currents.
	same	HS.ESS.1.4. Provide examples of how the unequal heating of Earth and the Coriolis effect influence global circulation patterns, and show how they impact Massachusetts weather and climate (e.g., global winds, convection cells, land/sea breezes, mountain/valley breezes).
HS-ESS2-5. Describe how the chemical and physical properties of water are important in mechanical and chemical mechanisms that affect Earth materials and surface processes. Clarification Statements: Examples of mechanical mechanisms involving water include stream transportation and deposition, erosion using variations in soil moisture content, and frost wedging by the expansion of water as it freezes. Examples of chemical mechanisms involving water include chemical weathering and recrystallization (based on solubility of different materials) and melt generation (based on water lowering the melting temperature of most solids).	same	HS.ESS.3.1. Explain how physical and chemical weathering leads to erosion and the formation of soils and sediments, and creates various types of landscapes. Give examples that show the effects of physical and chemical weathering on the environment.
HS-ESS2-6. Use a model to describe cycling of carbon through the ocean, atmosphere, soil, and biosphere and how increases in carbon dioxide concentrations due to human activity have resulted in gradual atmospheric and climate changes.	same	HS.ESS.2.2. Describe the effects on the environment and on the carbon cycle of using both renewable and nonrenewable sources of energy.
	same	HS.ESS.3.2. Describe the carbon cycle.
Note: HS-ESS2-7 from NGSS is not included.	na	
ESS3. Earth and Human Activity		
HS-ESS3-1. Construct an explanation based on evidence for how the availability of key natural resources and changes due to variations in climate have influenced human activity. Clarification Statements: Examples of key natural resources include access to fresh water (such as rivers, lakes, and groundwater), regions of fertile soils (such as river deltas), high concentrations of minerals and fossil fuels, and biotic resources (such as fisheries and forests). Examples of changes due to variations in climate include changes to sea level and regional patterns of temperature and precipitation.	na	
HS-ESS3-2. Evaluate competing design solutions for minimizing impacts of developing and using energy and mineral resources, and conserving and recycling those resources, based on economic, social and environmental cost-benefit ratios.* Clarification Statement: Examples include developing best practices for agricultural soil use, mining (for metals, coal, tar sands, and oil shales), and pumping (for petroleum and natural gas).	na	
HS-ESS3-3. Illustrate relationships among management of natural resources, the sustainability of human populations, and biodiversity. Clarification Statements: Examples of factors related to the management of natural resources include costs of resource extraction and waste management, per capita consumption, and the development of new technologies. Examples of factors related to human sustainability include agricultural efficiency, levels of conservation, and urban planning. Examples of factors related to biodiversity include habitat use and fragmentation, and land and resource conservation.	na	
Note: HS-ESS3-4 from NGSS is not included	na	
HS-ESS3-5. Analyze results from global climate models to describe how forecasts are made of the current rate of global or regional climate change and associated future impacts to Earth systems. Clarification Statement: Climate model outputs include both climate changes (such as precipitation and temperature) and associated impacts (such as on sea level, glacial ice volumes, and atmosphere and ocean composition).	na	
Note: HS-ESS3-6 from NGSS is not included.	na	
		2001/06 high school standards with no alignment to 2016 STE standards
	na	HS.ESS.3.3. Describe the nitrogen cycle.
	na	HS.ESS.3.12. Describe the Richter scale of earthquake magnitude and the relative damage that is incurred by earthquakes of a given magnitude.
	na	HS.ESS.4.3. Explain how the Sun, Earth, and solar system formed from a nebula of dust and gas in a spiral arm of the Milky Way Galaxy about 4.6 billion years ago.

2016 MA STE Standards	Relative grade 2001/6 standard is found in 2016 standards	2001/6 STE Standard
PS: Chemistry		PS: Chemistry
PS1: Matter and its Interactions		
<p>HS-PS1-1. Use the periodic table as a model to predict the relative properties of main group elements, including ionization energy and relative sizes of atoms and ions, based on the patterns of electrons in the outermost energy level of each element. Use the patterns of valence electron configurations core charge, and Coulomb's law to explain and predict general trends in ionization energies, relative sizes of atoms and ions, and reactivity of pure elements. Clarification Statement: Size of ions should be relevant only for predicting strength of ionic bonding. State Assessment Boundary: State assessment will be limited to main group (s and p block) elements.</p>	same	<p>HS.Chem.2.4. Write the electron configurations for the first twenty elements of the periodic table.</p> <p>HS.Chem.2.2 Describe Rutherford's "gold foil" experiment that led to the discovery of the nuclear atom. Identify the major components (protons, neutrons, and electrons) of the nuclear atom and explain how they interact.</p> <p>HS.Chem.3.1. Explain the relationship of an element's position on the periodic table to its atomic number. Identify families (groups) and periods on the periodic table.</p> <p>HS.Chem.3.2. Use the periodic table to identify the three classes of elements: metals, nonmetals, and metalloids.</p> <p>HS.Chem.3.3. Relate the position of an element on the periodic table to its electron configuration and compare its reactivity to the reactivity of other elements in the table.</p> <p>HS.Chem.3.4. Identify trends on the periodic table (ionization energy, electronegativity, and relative sizes of atoms and ions).</p>
<p>HS-PS1-2. Use the periodic table model to predict and design simple reactions that result in two main classes of binary compounds, ionic and molecular. Develop an explanation based on given observational data and the electronegativity model about the relative strengths of ionic and covalent bonds. Clarification Statements: Simple reactions include synthesis (combination), decomposition, single displacement, double displacement, and combustion. Predictions of reactants and products can be represented using Lewis dot structures, chemical formulas, or physical models. Observational data include that binary ionic substances (i.e., substances that have ionic bonds), when pure, are crystalline salts at room temperature (common examples include NaCl, KI, Fe₂O₃); and substances that are liquids and gases at room temperature are usually made of molecules that have covalent bonds (common examples include CO₂, N₂, CH₄, H₂O, C₈H₁₈).</p>	same	<p>HS.Chem.4.1. Explain how atoms combine to form compounds through both ionic and covalent bonding. Predict chemical formulas based on the number of valence electrons.</p> <p>HS.Chem.5.2. Classify chemical reactions as synthesis (combination), decomposition, single displacement (replacement), double displacement, and combustion.</p>
<p>HS-PS1-3. Cite evidence to relate physical properties of substances at the bulk scale to spatial arrangements, movement, and strength of electrostatic forces among ions, small molecules, or regions of large molecules in the substances. Make arguments to account for how compositional and structural differences in molecules result in different types of intermolecular or intramolecular interactions. Clarification Statements: Substances include both pure substances in solid, liquid, gas, and networked forms (such as graphite). Examples of bulk properties of substances include melting point and boiling point, density, and vapor pressure Types of intermolecular interactions include dipole-dipole (including hydrogen bonding), ion-dipole, and dispersion forces.. State Assessment Boundary: Calculations of vapor pressure by Raoult's law, properties of heterogeneous mixtures, or names and bonding angles in molecular geometries are not expected in state assessment.</p>	same	<p>HS.Chem.1.1. Identify and explain physical properties (e.g., density, melting point, boiling point, conductivity, malleability) and chemical properties (e.g., the ability to form new substances). Distinguish between chemical and physical changes.</p> <p>HS.Chem.7.4. Compare and contrast qualitatively the properties of solutions and pure solvents (colligative properties such as boiling point and freezing point).</p>
<p>HS-PS1-4. Develop a model to illustrate the energy transferred during an exothermic or endothermic chemical reaction based on the bond energy difference between bonds broken (absorption of energy) and bonds formed (release of energy). Clarification Statement: Examples of models may include molecular-level drawings and diagrams of reactions or graphs showing the relative energies of reactants and products. State Assessment Boundary: Calculations using Hess's law are not expected in state assessment.</p>		<p>HS.Chem.6.4. Describe the law of conservation of energy. Explain the difference between an endothermic process and an exothermic process.</p>

<p>HS-PS1-5. Construct an explanation based on kinetic molecular theory for why varying conditions influences the rate of a chemical reaction or a dissolving process. Design and test ways to slow down or accelerate rates of processes (chemical reactions or dissolving) as they occur by altering various conditions.* Clarification Statements: Explanations should be based on three variables in collision theory: (a) quantity of collisions per unit time (b) molecular orientation on collision, and (c) energy input needed to induce atomic rearrangements. Conditions that affect these three variables include temperature, pressure, concentrations of reactants, agitation, particle size, surface area, and addition of a catalyst. State Assessment Boundary: State assessment will be limited to simple reactions in which there are only two reactants and to specifying the change in only one variable at a time.</p>	same	<p>HS.Chem.7.5. Identify the factors that affect the rate of a chemical reaction (temperature, mixing, concentration, particle size, surface area, catalyst).</p> <p>HS.Chem.7.3. Identify and explain the factors that affect the rate of dissolving (e.g., temperature, concentration, surface area, pressure, mixing).</p> <p>HS.LS.1.3. Explain the role of enzymes as catalysts that lower the activation energy of biochemical reactions. Identify factors, such as pH and temperature, that have an effect on enzymes.</p>
<p>HS-PS1-6. Design ways to control the extent of a reaction at equilibrium (relative amount of products to reactants) by altering various conditions using Le Chatelier's principle. Make arguments based on kinetic molecular theory to account for how altering conditions would affect the forward and reverse rates of the reaction until a new equilibrium is established.* Clarification Statement: Conditions that can be altered include temperature, pressure, concentrations of reactants, agitation, particle size, surface area, and addition of a catalyst. State Assessment Boundaries: Calculations of equilibrium constants or concentrations are not expected in state assessment. State assessment will be limited to simple reactions in which there are only two reactants and to specifying the change in only one variable at a time.</p>	same	<p>HS.Chem.7.6. Predict the shift in equilibrium when a system is subjected to a stress (LeChatelier's principle) and identify the factors that can cause a shift in equilibrium (concentration, pressure, volume, temperature).</p>
<p>HS-PS1-7. Use mathematical representations and provide experimental evidence to support the claim that atoms, and therefore mass, are conserved during a chemical reaction. Use the mole concept and proportional relationships to evaluate the quantities (masses or moles) of specific reactants needed in order to obtain a specific amount of product. Clarification Statements: Mathematical representations include balanced chemical equations that represent the laws of conservation of mass and constant composition (definite proportions), mass-to-mass stoichiometry, and calculations of percent yield. Evaluations may involve mass-to-mass stoichiometry and atom economy comparisons, but only for single-step reactions that do not involve complexes.</p>	same	<p>HS.Chem.2.3. Interpret and apply the laws of conservation of mass, constant composition (definite proportions), and multiple proportions.</p> <p>HS.Chem.5.1. Balance chemical equations by applying the laws of conservation of mass and constant composition (definite proportions).</p> <p>HS.Chem.5.3. Use the mole concept to determine number of particles and molar mass for elements and</p> <p>HS.Chem.5.4. Determine percent compositions, empirical formulas, and molecular formulas.</p> <p>HS.Chem.5.5. Calculate the mass-to-mass stoichiometry for a chemical reaction.</p> <p>HS.Chem.5.6. Calculate percent yield in a chemical reaction.</p> <p>HS.Chem.7.2. Calculate concentration in terms of molarity. Use molarity to perform solution dilution and solution stoichiometry.</p>
<p>Note: HS-PS1-8 is found in introductory physics.</p>	na	
<p>HS-PS1-9(MA). Relate the strength of an aqueous acidic or basic solution to the extent of an acid or base reacting with water as measured by the hydronium ion concentration (pH) of the solution. Make arguments about the relative strengths of two acids or bases with similar structure and/or composition. Clarification Statements: Reactions are limited to Arrhenius and Bronsted-Lowry acid-base reaction patterns with monoprotic acids. Comparisons of relative strengths of aqueous acid or base solutions made from similar acid or base substances is limited to arguments based on periodic properties of elements, the electronegativity model of electron distribution, empirical dipole moments, and molecular geometry. Acid or base strength comparisons are limited to homologous series and should include dilution and evaporation of water.</p>	same	<p>HS.Chem.8.1. Define the Arrhenius theory of acids and bases in terms of the presence of hydronium and hydroxide ions in water and the Bronsted-Lowry theory of acids and bases in terms of proton donors and acceptors.</p> <p>HS.Chem.8.2. Relate hydrogen ion concentrations to the pH scale and to acidic, basic, and neutral solutions. Compare and contrast the strengths of various common acids and bases (e.g., vinegar, baking soda, soap, citrus juice).</p>
<p>HS-PS1-10(MA). Use an oxidation-reduction reaction model to predict products of reactions given the reactants, and to communicate the reaction models using a representation that shows electron transfer (redox). Use oxidation numbers to account for how electrons are redistributed in redox processes used in devices that generate electricity or systems that prevent corrosion.* Clarification Statements: Reactions are limited to simple oxidation-reduction reactions that do not require hydronium or hydroxide ions to balance half-reactions.</p>	same	<p>HS.Chem.8.4. Describe oxidation and reduction reactions and give some everyday examples, such as fuel burning and corrosion. Assign oxidation numbers in a reaction.</p>

HS-PS1-11(MA). Design strategies to identify and separate the components of a mixture based on relevant chemical and physical properties. Clarification Statements: Emphasis is on compositional and structural features of components of the mixture. Strategies can include chromatography, distillation, centrifuging, and precipitation reactions. Relevant chemical and physical properties can include melting point, boiling point, conductivity, and density.	same	HS.Chem.1.2. Explain the difference between pure substances (elements and compounds) and mixtures. Differentiate between heterogeneous and homogeneous mixtures.
PS2: Motion and Stability: Forces and Interactions		
Note: HS-PS2-1, HS-PS2-2, HS-PS2-3, HS-PS2-4, HS-PS2-5, HS-PS2-9(MA) and HS-PS2-10(MA) are found in introductory physics.	na	
HS-PS2-6. Communicate scientific and technical information about the molecular-level structures of different materials to justify why particular classes of substances have specific properties that are useful in the functioning of designed materials.* Clarification Statement: Examples could include comparing molecules with simple molecular geometries, analyzing how pharmaceuticals are designed to interact with specific receptors and considering why electrically conductive materials are often made of metal, household cleaning products often contain ionic compounds to make materials soluble in water or materials that need to be flexible but durable are made up of polymers. State Assessment Boundary: State assessment will be limited to comparing substances of the same type with one compositional or structural feature different.	same	HS.Chem.4.4. Use valence-shell electron-pair repulsion theory (VSEPR) to predict the molecular geometry (linear, trigonal planar, and tetrahedral) of simple molecules.
HS-PS2-7(MA). Construct a model to explain how ions dissolve in polar solvents, particularly water. Analyze and compare solubility and conductivity data to determine the extent to which different ionic species dissolve. Clarification Statement: Data for comparison should include different concentrations of solutions with the same ionic species, and similar ionic species dissolved in the same amount of water.	same	HS.Chem.7.1. Describe the process by which solutes dissolve in solvents.
		HS.Chem.7.3. Identify and explain the factors that affect the rate of dissolving (e.g., temperature, concentration, surface area, pressure, mixing).
HS-PS2-8(MA). Use kinetic-molecular theory to compare the strengths of electrostatic forces and the prevalence of interactions that occur between molecules in solids, liquids, and gases. Use the combined gas law to determine changes in pressure, volume, and temperature in gases.	same	HS.Chem.6.1. Using the kinetic molecular theory, explain the behavior of gases and the relationship between pressure and volume (Boyle's law), volume and temperature (Charles's law), pressure and temperature (Gay-Lussac's law), and the number of particles in a gas sample (Avogadro's hypothesis). Use the combined gas law to determine changes in pressure, volume, and temperature.
	same	HS.Chem.6.2. Perform calculations using the ideal gas law. Understand the molar volume at 273 K and 1 atmosphere (STP).
PS3: Energy		
Note: HS-PS3-1, HS-PS3-2, HS-PS3-3, HS-PS3.4a, and HS-PS3.5 are found in introductory physics.	na	
HS-PS3-4b. Provide evidence from informational text or available data to illustrate that the transfer of energy during a chemical reaction in a closed system involves changes in energy dispersal (enthalpy change) and heat content	same	HS.Chem.6.4. Describe the law of conservation of energy. Explain the difference between an endothermic process and an exothermic process.
		HS.Chem.6.5. Recognize that there is a natural tendency for systems to move in a direction of disorder or randomness (entropy).
2001/06 high school standards with no alignment to 2016 STE standards		
	na	HS.Chem.2.1. Recognize discoveries from Dalton (atomic theory), Thomson (the electron), Rutherford (the nucleus), and Bohr (planetary model of atom), and understand how each discovery leads to modern theory.
	na	HS.Chem.2.5. Identify the three main types of radioactive decay (alpha, beta, and gamma) and compare their properties (composition, mass, charge, and penetrating power).
		HS.Chem.4.2. Draw Lewis dot structures for simple molecules and ionic compounds.
	na	HS.Chem.4.3. Use electronegativity to explain the difference between polar and nonpolar covalent bonds.
	na	HS.Chem.4.5. Identify how hydrogen bonding in water affects a variety of physical, chemical, and biological phenomena (e.g., surface tension, capillary action, density, boiling point).
	na	HS.Chem.4.6. Name and write the chemical formulas for simple ionic and molecular compounds, including those that contain the polyatomic ions: ammonium, carbonate, hydroxide, nitrate, phosphate, and sulfate.
	na	HS.Chem.8.3. Explain how a buffer works.

2016 MA STE Standards	Relative grade 2001/6 standard is found in 2016 STE standards	2001/6 STE Standard
LS. Life Science		LS. Life Science
LS1. From Molecules to Organisms: Structures and Processes		
<p>HS-LS1-1. Construct a model of transcription and translation to explain the roles of DNA and RNA that code for proteins that regulate and carry out essential functions of life. Clarification Statements: Proteins that regulate and carry out essential functions of life include enzymes (which speed up chemical reactions), structural proteins, (which provide structure and enable movement), and hormones and receptors (which send and receive signals). The model should show the double-stranded structure of DNA, including genes as part of DNA's transcribed strand, with complementary bases on the non-transcribed strand. State Assessment Boundaries: Specific names of proteins or specific steps of transcription and translation are not expected in state assessment. Cell structures included in transcription and translation will be limited to nucleus, nuclear membrane, and ribosomes for state assessment.</p>	same	<p>HS.LS.1.2. Describe the basic molecular structures and primary functions of the four major categories of organic molecules (carbohydrates, lipids, proteins, nucleic acids).</p> <p>HS.LS.1.3. Explain the role of enzymes as catalysts that lower the activation energy of biochemical reactions. Identify factors, such as pH and temperature, that have an effect on enzymes.</p> <p>HS.LS.3.2. Describe the basic process of DNA replication and how it relates to the transmission and conservation of the genetic code. Explain the basic processes of transcription and translation, and how they result in the expression of genes. Distinguish among the end products of replication, transcription, and translation.</p>
<p>HS-LS1-2. Develop and use a model to illustrate the key functions of animal body systems, including (a) food digestion, nutrient uptake and transport through the body, (b) exchange of oxygen and carbon dioxide, (c) removal of wastes, and (d) regulation of body processes. Clarification Statement: Emphasis is on the primary function of the following body systems (and structures): digestive (mouth, stomach, small intestine [villi], large intestine, pancreas), respiratory (lungs [alveoli], diaphragm), circulatory (heart, veins, arteries, capillaries), excretory (kidneys, liver, skin), and nervous (neurons, brain, spinal cord). State Assessment Boundary: Chemical reactions in cells, details of particular structures (such as the structure of the neuron), or the identification of specific proteins in cells are not expected in state assessment.</p>	same	<p>HS.LS.4.1. Explain generally how the digestive system (mouth, pharynx, esophagus, stomach, small and large intestines, rectum) converts macromolecules from food into smaller molecules that can be used by cells for energy and for repair and growth.</p> <p>HS.LS.4.2. Explain how the circulatory system (heart, arteries, veins, capillaries, red blood cells) transports nutrients and oxygen to cells and removes cell wastes. Describe how the kidneys and the liver are closely associated with the circulatory system as they perform the excretory function of removing waste from the blood. Recognize that kidneys remove nitrogenous wastes, and the liver removes many toxic compounds from blood.</p> <p>HS.LS.4.3. Explain how the respiratory system (nose, pharynx, larynx, trachea, lungs, alveoli) provides exchange of oxygen and carbon dioxide.</p> <p>HS.LS.4.4. Explain how the nervous system (brain, spinal cord, sensory neurons, motor neurons) mediates communication among different parts of the body and mediates the body's interactions with the environment. Identify the basic unit of the nervous system, the neuron, and explain generally how it works.</p> <p>HS.LS.4.5. Explain how the muscular/skeletal system (skeletal, smooth and cardiac muscles, bones, cartilage, ligaments, tendons) works with other systems to support the body and allow for movement. Recognize that bones produce blood cells.</p> <p>HS.LS.4.7. Recognize that communication among cells is required for coordination of body functions. The nerves communicate with electrochemical signals, hormones circulate through the blood, and some cells produce signals to communicate only with nearby cells.</p>
<p>HS-LS1-3. Provide evidence that homeostasis maintains internal body conditions through both body-wide feedback mechanisms and small-scale cellular processes. Clarification Statements: Feedback mechanisms include the promotion of a stimulus through positive feedback (e.g., injured tissues releasing chemicals in blood that activate platelets to facilitate blood clotting), and the inhibition of stimulus through negative feedback (e.g., insulin reducing high blood glucose to normal levels). Cellular processes include (a) passive transport and active transport of materials across the cell membrane to maintain specific concentrations of water and other nutrients in the cell, and (b) the role of lysosomes in recycling wastes, macromolecules, and cell parts into monomers. State Assessment Boundary: Interactions at the molecular level (for example, how insulin is produced) are not expected in state assessment.</p>	same	<p>HS.LS.4.8. Recognize that the body's systems interact to maintain homeostasis. Describe the basic function of a physiological feedback loop.</p>

HS-LS1-4. Construct an explanation using evidence for why the cell cycle is necessary for the growth, maintenance, and repair of multicellular organisms. Model the major events of the cell cycle, including (a) cell growth and DNA replication, (b) separation of chromosomes (mitosis), and (c) separation of cell contents. State Assessment Boundary: Specific gene control mechanisms or specific details of each event (e.g., phases of mitosis) are not expected in state assessment.	same	HS.LS.2.6. Describe the cell cycle and the process of mitosis. Explain the role of mitosis in the formation of new cells, and its importance in maintaining chromosome number during asexual reproduction.
		HS.LS.3.2. Describe the basic process of DNA replication and how it relates to the transmission and conservation of the genetic code. Explain the basic processes of transcription and translation, and how they result in the expression of genes. Distinguish among the end products of replication, transcription, and translation.
HS-LS1-5. Use a model to illustrate how photosynthesis uses light energy to transform water and carbon dioxide into oxygen and chemical energy stored in the bonds of sugars and other carbohydrates. Clarification Statements: Emphasis is on illustrating inputs and outputs of matter and the transfer and transformation of energy in photosynthesis by plants and other photosynthesizing organisms. Examples of models could include diagrams, chemical equations, and conceptual models. State Assessment Boundary: Specific biochemical steps of light reactions or the Calvin Cycle, or chemical structures of	same	HS.LS.2.4. Identify the reactants, products, and basic purposes of photosynthesis and cellular respiration. Explain the interrelated nature of photosynthesis and cellular respiration in the cells of photosynthetic organisms.
		HS.LS.2.5. Explain the important role that ATP serves in metabolism.
HS-LS1-6. Construct an explanation based on evidence that organic molecules are primarily composed of six elements, where carbon, hydrogen, and oxygen atoms may combine with nitrogen, sulfur, and phosphorus to form monomers that can further combine to form large carbon-based macromolecules. Clarification Statements: Monomers include amino acids, mono- and disaccharides, nucleotides, and fatty acids. Organic macromolecules include proteins, carbohydrates (polysaccharides), amino acids, nucleic acids, and lipids. State Assessment Boundary: Details of the specific chemical reactions or identification of specific macromolecules are not expected in state assessment.	same	HS.LS.1.1. Recognize that biological organisms are composed primarily of very few elements. The six most common are C, H, N, O, P, and S.
		HS.LS.1-2 Describe the basic molecular structures and primary functions of the four major categories of organic molecules (carbohydrates, lipids, proteins, nucleic acids).
HS-LS1-7. Use a model to illustrate that aerobic cellular respiration is a chemical process whereby the bonds of food molecules and oxygen molecules are broken and new bonds form, resulting in new compounds and a net transfer of energy. Clarification Statements: Emphasis is on the conceptual understanding of the inputs and outputs of the process of aerobic cellular respiration. Examples of models could include diagrams, chemical equations, and conceptual models. The model should include the role of ATP for energy transfer in this process. Food molecules include sugars (carbohydrates), fats (lipids), and proteins. State Assessment Boundary: Identification of the steps or specific processes involved in cellular respiration is not expected in state assessment.	same	HS.LS.2.4. Identify the reactants, products, and basic purposes of photosynthesis and cellular respiration. Explain the interrelated nature of photosynthesis and cellular respiration in the cells of photosynthetic organisms.
		HS.LS.2.5. Explain the important role that ATP serves in metabolism.
LS2. Ecosystems: Interactions, Energy, and Dynamics		
HS-LS2-1. Analyze data sets to support explanations that biotic and abiotic factors affect ecosystem carrying capacity. Clarification Statements: Examples of biotic factors could include relationships among individuals (e.g., feeding relationships, symbioses, competition) and disease. Examples of abiotic factors could include climate and weather conditions, natural disasters, and availability of resources. Example data sets can be derived from simulations or historical data.	same	HS.LS.6.1. Explain how birth, death, immigration, and emigration influence population size.
		HS.LS.6.2. Analyze changes in population size and biodiversity (speciation and extinction) that result from the following: natural causes, changes in climate, human activity, and the introduction of invasive, non-native species.
HS-LS2-2. Use mathematical representations to support explanations that biotic and abiotic factors affect biodiversity, including genetic diversity within a population and species diversity within an ecosystem. Clarification Statements: Examples of biotic factors could include relationships among individuals (e.g., feeding relationships, symbioses, competition) and disease. Examples of abiotic factors could include climate and weather conditions, natural disasters, and availability of resources. Examples of mathematical representations include finding the average, determining trends, and using graphical comparisons of multiple sets of data.	same	HS.LS.5.3. Explain how evolution through natural selection can result in changes in biodiversity through the increase or decrease of genetic diversity within a population.
Note: HS-LS2-3 from NGSS has been merged with HS-LS2-4 and HS-LS2-5.		

<p>HS-LS2-4. Use a mathematical model to describe the transfer of energy from one trophic level to another. Explain how the inefficiency of energy transfer between trophic levels affects the relative number of organisms that can be supported at each trophic level and necessitates a constant input of energy from sunlight or inorganic compounds from the environment. Clarification Statement: The model should illustrate the “10% rule” of energy transfer and show approximate amounts of available energy at each trophic level in an ecosystem (up to five trophic levels.)</p>	<p>same</p>	<p>HS.LS.6.3. Use a food web to identify and distinguish producers, consumers, and decomposers, and explain the transfer of energy through trophic levels. Describe how relationships among organisms (predation, parasitism, competition, commensalism, mutualism) add to the complexity of biological communities.</p> <p>HS.LS.6.4. Explain how water, carbon, and nitrogen cycle between abiotic resources and organic matter in an ecosystem, and how oxygen cycles through photosynthesis and respiration.</p>
<p>HS-LS2-5. Use a model that illustrates the roles of photosynthesis, cellular respiration, decomposition, and combustion to explain the cycling of carbon in its various forms among the biosphere, atmosphere, hydrosphere, and geosphere. Clarification Statements: The primary forms of carbon include carbon dioxide, hydrocarbons, waste (dead organic matter), and biomass (organic materials of living organisms). Examples of models could include simulations and mathematical models. State Assessment Boundary: The specific chemical steps of respiration, decomposition, and combustion are not expected in state assessment.</p>	<p>same</p>	<p>HS.LS.6.4. Explain how water, carbon, and nitrogen cycle between abiotic resources and organic matter in an ecosystem, and how oxygen cycles through photosynthesis and respiration.</p> <p>HS.LS.2.4. Identify the reactants, products, and basic purposes of photosynthesis and cellular respiration. Explain the interrelated nature of photosynthesis and cellular respiration in the cells of photosynthetic organisms.</p>
<p>HS-LS2-6. Analyze data to show ecosystems tend to maintain relatively consistent numbers and types of organisms even when small changes in conditions occur but that extreme fluctuations in conditions may result in a new ecosystem. Construct an argument supported by evidence that ecosystems with greater biodiversity tend to have greater resistance to change and resilience. Clarification Statement: Examples of changes in ecosystem conditions could include modest biological or physical changes, such as moderate hunting or a seasonal flood; and extreme changes, such as volcanic eruption, fires, the decline or loss of keystone species, climate changes, ocean acidification, or sea level rise.</p>	<p>NA</p>	
<p>HS-LS2-7. Analyze direct and indirect effects of human activities on biodiversity and ecosystem health, specifically habitat fragmentation, introduction of non-native or invasive species, overharvesting, pollution, and climate change. Evaluate and refine a solution for reducing the impacts of human activities on biodiversity and ecosystem health.* Clarification Statement: Examples of solutions can include captive breeding programs, habitat restoration, pollution mitigation, energy conservation, and ecotourism.</p>	<p>same</p>	<p>HS.LS.6.2. Analyze changes in population size and biodiversity (speciation and extinction) that result from the following: natural causes, changes in climate, human activity, and the introduction of invasive, non-native species.</p>
<p>Note: HS-LS2-8 from NGSS is not included.</p>	<p>na</p>	
<p>LS3. Heredity: Inheritance and Variation of Traits</p>		
<p>HS-LS3-1. Develop and use a model to show how DNA in the form of chromosomes is passed from parents to offspring through the processes of meiosis and fertilization in sexual reproduction. Clarification Statement: The model should demonstrate that an individual's characteristics (phenotype) result, in part, from interactions among the various proteins expressed by one's genes (genotype). State Assessment Boundary: Identification of specific phases of meiosis or the biochemical mechanisms involved are not expected in state assessment.</p>	<p>same</p>	<p>HS.LS.2.7. Describe how the process of meiosis results in the formation of haploid cells. Explain the importance of this process in sexual reproduction, and how gametes form diploid zygotes in the process of fertilization.</p>

<p>HS-LS3-2. Make and defend a claim based on evidence that inheritable genetic variations may result from (a) new genetic combinations through meiosis, (b) mutations that occur during replication, and/or (c) mutations caused by environmental factors. Recognize that mutations that occur in gametes can be passed to offspring. Clarification Statement: Examples of genetic variation can include the work of McClintock in crossing over of maize chromosomes and the development of cancer due to DNA replication errors and UV ray exposure. State Assessment Boundary: Specific phases of meiosis or identification of specific types of mutations are not expected in state assessment.</p>	<p>same</p>	<p>HS.LS.3.3. Explain how mutations in the DNA sequence of a gene may or may not result in phenotypic change in an organism. Explain how mutations in gametes may result in phenotypic changes in offspring.</p> <p>HS.LS.3-4 Distinguish among observed inheritance patterns caused by several types of genetic traits (dominant, recessive, codominant, sex-linked, polygenic, incomplete dominance, multiple alleles).</p> <p>HS.LS.3.5. Describe how Mendel's laws of segregation and independent assortment can be observed through patterns of inheritance (e.g., dihybrid crosses).</p>
<p>HS-LS3-3. Apply concepts of probability to represent possible genotype and phenotype combinations in offspring caused by different types of Mendelian inheritance patterns. Clarification Statements: Representations can include Punnett squares, diagrams, pedigree charts, and simulations. Inheritance patterns include dominant-recessive, codominance, incomplete dominance, and sex linked.</p>	<p>same</p>	<p>HS.LS.3.5. Describe how Mendel's laws of segregation and independent assortment can be observed through patterns of inheritance (e.g., dihybrid crosses).</p> <p>HS.LS.3.6. Use a Punnett Square to determine the probabilities for genotype and phenotype combinations in monohybrid crosses.</p>
<p>HS-LS3-4(MA). Use scientific information to illustrate that many traits of individuals, and the presence of specific alleles in a population, are due to interactions of genetic factors and environmental factors. Clarification Statements: Examples of genetic factors include the presence of multiple alleles for one gene and multiple genes influencing a trait. An example of the role of the environment in expressed traits in an individual can include the likelihood of developing inherited diseases (i.e., heart disease, cancer) in relation to exposure to environmental toxins and lifestyle; an example in populations can include the maintenance of the allele for sickle-cell anemia in high frequency in malaria-affected regions, because it confers partial resistance to malaria. State Assessment Boundary: Hardy-Weinberg calculations are not expected in state assessment.</p>	<p>same</p>	<p>HS.LS.3.3. Explain how mutations in the DNA sequence of a gene may or may not result in phenotypic change in an organism. Explain how mutations in gametes may result in phenotypic changes in offspring.</p>
<p>LS4. Biological Evolution: Unity and Diversity</p>		
<p>HS-LS4-1. Communicate scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence, including molecular, anatomical, and developmental similarities inherited from a common ancestor (homologies), seen through fossils and laboratory and field observations. Clarification Statement: Examples of evidence can include the work of Margulis on endosymbiosis, examination of genomes, and analyses of vestigial or skeletal structures.</p>	<p>same</p>	<p>HS.LS.5-1 Explain how evolution is demonstrated by evidence from the fossil record, comparative anatomy, genetics, molecular biology, and examples of natural selection.</p>
<p>HS-LS4-2. Construct an explanation based on evidence that Darwin's theory of evolution by natural selection occurs in a population when the following conditions are met: (a) more offspring are produced than can be supported by the environment, (b) there is heritable variation among individuals, and (c) some of these variations lead to differential fitness among individuals as some individuals are better able to compete for limited resources than others. Clarification Statement: Emphasis is on the overall result of an increase in the proportion of those individuals with advantageous heritable traits that are better able to survive and reproduce in the environment.</p>	<p>same</p>	<p>HS.LS.5-1 Explain how evolution is demonstrated by evidence from the fossil record, comparative anatomy, genetics, molecular biology, and examples of natural selection.</p>
<p>Note: HS-LS4-3 from NGSS is merged with HS-LS4-2.</p>		
<p>HS-LS4-4. Research and communicate information about key features of viruses and bacteria to explain their ability to adapt and reproduce in a wide variety of environments. Clarification Statement: Key features include high rate of mutations and the speed of reproduction which produces many generations with high variability in a short time, allowing for rapid adaptation. State assessment Boundary: Specific type of viral reproduction (e.g., lytic and lysogenic) are not expected in state assessment.</p>	<p>na</p>	
<p>HS-LS4-5. Evaluate models that demonstrate how changes in an environment may result in the evolution of a population of a given species, the emergence of new species over generations, or the extinction of other species due to the processes of genetic drift, gene flow, mutation, and natural selection.</p>	<p>same</p>	<p>HS.LS.5.3. Explain how evolution through natural selection can result in changes in biodiversity through the increase or decrease of genetic diversity within a population.</p> <p>HS.LS.5.2. Describe species as reproductively distinct groups of organisms. Recognize that species are further classified into a hierarchical taxonomic system (kingdom, phylum, class, order, family, genus, species) based on morphological, behavioral, and molecular similarities. Describe the role that geographic isolation can play in speciation.</p>
<p>Note: HS-LS4-6 from NGSS is not included.</p>		

2001/06 high school standards with no alignment to 2016 STE standards		
	na	HS.LS.2.2. Compare and contrast, at the cellular level, the general structures and degrees of complexity of prokaryotes and eukaryotes.
	na	HS.LS.2.3. Use cellular evidence (e.g., cell structure, cell number, cell reproduction) and modes of nutrition to describe the six kingdoms (Archaeobacteria, Eubacteria, Protista, Fungi, Plantae, Animalia).
	na	HS.LS. 3.1. Describe the basic structure (double helix, sugar/phosphate, backbone, linked by complementary nucleotide pairs) of DNA, and describe its function in genetic inheritance.

Introductory Physics Crosswalk of 2016 MA STE Standards to 2001/2006 Standards

2016 MA STE Standards	Relative grade 2001/6 standard is found in 2016 STE standards	2001/6 STE standard
PS: Introductory Physics		PS: Introductory Physics
PS1: Matter and its Interactions		
HS-PS1-8. Develop a model to illustrate the energy released or absorbed during the processes of fission, fusion, and radioactive decay. Clarifications Statements: Examples of models include simple qualitative models, such as pictures or diagrams. Types of radioactive decay include alpha, beta, and gamma. State assessment Boundary: Quantitative calculations of energy released or absorbed are not expected in state assessment.	same	HS.Chem.2.6. Describe the process of radioactive decay by using nuclear equations, and explain the concept of half-life for an isotope (for example, C-14 is a powerful tool in determining the age of objects).
Note: HS-PS1-1 through HS-PS1-7 and HS-PS1-9(MA), HS-PS1-10(MA), and HS-PS1-11(MA) are found in		
PS2: Motion and Stability: Forces and Interactions		
HS-PS2-1. Analyze data to support the claim that Newton’s second law of motion is a mathematical model describing change in motion (the acceleration) of objects when acted on by a net force. Clarification Statements: Examples of data could include tables or graphs of position or velocity as a function of time for objects subject to a net unbalanced force, such as a falling object, an object rolling down a ramp, and a moving object being pulled by a constant force. Forces can include contact forces, including friction, and forces acting at a distance, such as gravity and magnetic forces. State Assessment Boundary: Variable forces are not expected in state assessment.	same	HS-IP.1.3. Create and interpret graphs of 1-dimensional motion, such as position vs. time, distance vs. time, speed vs. time, velocity vs. time, and acceleration vs. time where acceleration is constant.
	same	HS-IP.1.4. Interpret and apply Newton’s three laws of motion.
	same	HS-IP.1.5. Use a free-body force diagram to show forces acting on a system consisting of a pair of interacting objects. For a diagram with only co-linear forces, determine the net force acting on a system and between the objects.
	in later grades	HS.IP.1.6 Distinguish qualitatively between static and kinetic friction, and describe their effects on the motion of objects.
HS-PS2-2. Use mathematical representations to show that the total momentum of a system of interacting objects is conserved when there is no net force on the system. Clarification Statement: Emphasis is on the qualitative meaning of the conservation of momentum and the quantitative understanding of the conservation of linear momentum in interactions involving elastic and inelastic collisions between two objects in one dimension.	same	HS-IP.2.5. Provide and interpret examples showing that linear momentum is the product of mass and velocity, and is always conserved (law of conservation of momentum). Calculate the momentum of an object.
HS-PS2-3. Apply scientific principles of motion and momentum to design, evaluate, and refine a device that minimizes the force on a macroscopic object during a collision.* Clarification Statement: Both qualitative evaluations and algebraic manipulations may be used.	same	HS-IP.2.5. Provide and interpret examples showing that linear momentum is the product of mass and velocity, and is always conserved (law of conservation of momentum). Calculate the momentum of an object.
HS-PS2-4. Use mathematical representations of Newton’s law of gravitation and Coulomb’s law to both qualitatively and quantitatively describe and predict the effects of gravitational and electrostatic forces between objects. Clarification Statement: Emphasis is on the relative changes when distance, mass or charge. State Assessment Boundaries: State assessment will be limited to systems with two objects. Permittivity of free space is not expected in state assessment.	same	HS-IP.1.7. Describe Newton’s law of universal gravitation in terms of the attraction between two objects, their masses, and the distance between them.
	same	HS-IP.5.4. Describe conceptually the attractive or repulsive forces between objects relative to their charges and the distance between them (Coulomb’s law).
HS-PS2-5. Provide evidence that an electric current can produce a magnetic field and that a changing magnetic field can produce an electric current. Clarification Statement: Examples of evidence can include movement of a magnetic compass when placed in the vicinity of a current-carrying wire, a magnet passing through a coil that turns on the light of a Faraday flashlight. State Assessment Boundary: Explanations of motors or generators are not expected in state assessment.	same	HS-IP.5.6. Recognize that moving electric charges produce magnetic forces and moving magnets produce electric forces. Recognize that the interplay of electric and magnetic forces is the basis for electric motors, generators, and other technologies.
Note: HS-PS2-6, HS-PS2-7(MA), HS-PS2-8(MA) are found in chemistry.		
	na	

HS-PS2-9(MA). Evaluate simple series and parallel circuits to predict changes to voltage, current, or resistance when simple changes are made to a circuit. Clarification Statements: Predictions of changes can be represented numerically, graphically, or algebraically using Ohm's Law. Simple changes to a circuit may include adding a component, changing the resistance of a load of a component, and adding a parallel path in circuits with batteries and common loads. Simple circuits can be represented in schematic diagrams. State Assessment Boundary: Use of measurement devices and predictions of changes in power are not expected in state assessment.	in later grades	3-5.PS.6. Recognize that electricity in circuits requires a complete loop through which an electrical current can pass, and that electricity can produce light, heat, and sound.
	same	HS-IP.5.2. Develop qualitative and quantitative understandings of current, voltage, resistance, and the connections among them (Ohm's law).
	same	HS-IP.5.3. Analyze simple arrangements of electrical components in both series and parallel circuits. Recognize symbols and understand the functions of common circuit elements (battery, connecting wire, switch, fuse, resistance) in a schematic diagram.
	same	HS-IP.5.5. Explain how electric current is a flow of charge caused by a potential difference (voltage), and how power is equal to current multiplied by voltage.
	same	HS.TE.5.3. Explain the relationships among voltage, current, and resistance in a simple circuit, using Ohm's law.
HS-PS2-10(MA). Use free-body force diagrams and algebraic expressions representing Newton's laws of motion to predict changes to velocity and acceleration for an object moving in one dimension in various situations. Clarification Statements: Predictions of changes in motion can be made numerically, graphically, and algebraically using basic equations for velocity, constant acceleration, and Newton's first and second laws. Forces can include contact forces including friction, and forces acting at a distance, such as gravity and magnetic forces.	same	HS-IP.1.2. Distinguish between displacement, distance, velocity, speed, and acceleration. Solve problems involving displacement, distance, velocity, speed, and constant acceleration.
PS3: Energy		
HS-PS3-1. Use algebraic expressions and the principle of energy conservation to calculate the change in energy of one component of a system when the change in energy of the other component(s) of the system, as well as the total energy of the system including any energy entering or leaving the system, is known. Identify any transformations from one form of energy to another, including thermal, kinetic, gravitational, magnetic, or electrical energy, in the system. Clarification Statement: Systems should be limited to two or three components and to thermal energy, kinetic energy, or the energies in gravitational, magnetic, or electric fields.	same	HS-IP.2.1. Interpret and provide examples that illustrate the law of conservation of energy.
	same	HS-IP.2.2. Interpret and provide examples of how energy can be converted from gravitational potential energy to kinetic energy and vice versa.
HS-PS3-2. Develop and use a model to illustrate that energy at the macroscopic scale can be accounted for as either motions of particles and objects or energy stored in fields. Clarification Statements: Examples of phenomena at the macroscopic scale could include evaporation and condensation, the conversion of kinetic energy to thermal energy, the gravitational potential energy stored due to position of an object above the Earth, and the stored energy (electrical potential) of a charged object's position within an electrical field. Examples of models could include diagrams, drawings, descriptions, and computer simulations.	same	HS-IP.3.3. Describe the relationship between average molecular kinetic energy and temperature. Recognize that energy is absorbed when a substance changes from a solid to a liquid to a gas, and that energy is released when a substance changes from a gas to a liquid to a solid. Explain that relationships among evaporation, condensation, cooling, and warming.
HS-PS3-3. Design and evaluate a device that works within given constraints to convert one form of energy into another form of energy.* Clarification Statements: Emphasis is on both qualitative and quantitative evaluations of devices. Examples of devices could include Rube Goldberg devices, wind turbines, solar cells, solar ovens, and generators. Examples of constraints could include use of renewable energy forms and efficiency. State Assessment Boundary: Quantitative evaluations will be limited to total output for a given input in state assessment.	same	HS-IP.2.1. Interpret and provide examples that illustrate the law of conservation of energy.
	same	HS-IP.2.2. Interpret and provide examples of how energy can be converted from gravitational potential energy to kinetic energy and vice versa.
HS-PS3-4a. Provide evidence that when two objects of different temperature are in thermal contact within a closed system, the transfer of thermal energy from higher-temperature objects to lower-temperature objects results in thermal equilibrium, or a more uniform energy distribution among the objects and that temperature changes necessary to achieve thermal equilibrium depend on the specific heat values of the two substances. Clarification Statement: Energy changes should be described both quantitatively in a single phase ($Q = mc\Delta T$) and conceptually either in a single phase or during a phase change.	same	HS-IP.3.2. Explain how heat energy will move from a higher temperature to a lower temperature until equilibrium is reached.
	in later grades	6-8.PS.16. Give examples of how heat moves in predictable ways, moving from warmer objects to cooler ones until they reach equilibrium.
	same	HS-IP.3.4. Explain the relationships among temperature changes in a substance, the amount of heat transferred, the amount (mass) of the substance, and the specific heat of the substance.
Note: HS-PS3-4b is found in chemistry.	na	

<p>HS-PS3-5. Develop and use a model of magnetic or electric fields to illustrate the forces and changes in energy between two magnetically or electrically charged objects changing relative position in a magnetic or electric field respectively. Clarification Statements: Emphasis is on the change in force and energy as objects move relative to each other. Examples of models could include drawings, diagrams, and texts, such as drawings of what happens when two charges of opposite polarity are near each other.</p>	<p>same</p>	<p>HS-IP.5.6. Recognize that moving electric charges produce magnetic forces and moving magnets produce electric forces. Recognize that the interplay of electric and magnetic forces is the basis for electric motors, generators, and other technologies.</p>
<p>PS4: Waves and Their Applications in Technologies for Information Transfer</p>		
<p>HS-PS4-1. Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling in various media. Recognize that electromagnetic waves can travel through empty space (without a medium) as compared to mechanical waves that require a medium. Clarification Statements: Emphasis is on relationships when waves travel within a medium, and comparisons when a wave travels in different media. Examples of situations to consider could include electromagnetic radiation traveling in a vacuum and glass, sound waves traveling through air and water, and seismic waves traveling through the Earth. Relationships include $v = \lambda f$, $T = 1/f$, and the qualitative comparison of the speed of a transverse (including electromagnetic) or longitudinal mechanical wave in a solid, liquid, gas, or vacuum. State Assessment Boundary: Transitions between two media are not expected in state assessment.</p>	<p>same</p>	<p>HS-IP.4.1. Describe the measurable properties of waves (velocity, frequency, wavelength, amplitude, period) and explain the relationships among them. Recognize examples of simple harmonic motion.</p>
	<p>same</p>	<p>HS-IP.4.2. Distinguish between mechanical and electromagnetic waves.</p>
	<p>same</p>	<p>HS-IP.4.5. Recognize that mechanical waves generally move faster through a solid than through a liquid and faster through a liquid than through a gas.</p>
	<p>same</p>	<p>HS-IP.6.1. Recognize that electromagnetic waves are transverse waves and travel at the speed of light through a vacuum.</p>
<p>Note: HS-PS4-2 from NGSS is not included.</p>	<p>na</p>	
<p>HS-PS4-3. Evaluate the claims, evidence, and reasoning behind the idea that electromagnetic radiation can be described by either a wave model or a particle model, and that for some situations involving resonance, interference, diffraction, refraction or the photoelectric effect, one model is more useful than the other. Clarification Statement: Emphasis is on qualitative reasoning and comparisons of the two models. State Assessment Boundary: Calculations of energy levels or resonant frequencies are not expected in state assessment.</p>	<p>same</p>	<p>HS-IP.4.4. Describe qualitatively the basic principles of reflection and refraction of waves.</p>
<p>Note: HS-PS4-4 from NGSS is not included.</p>	<p>na</p>	
<p>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.* Clarification Statements: Emphasis is on qualitative information and descriptions. Examples of technological devices could include solar cells capturing light and converting it to electricity, medical imaging, and, communications technology. Examples of principles of wave behavior include resonance, photoelectric effect, and constructive and destructive interference. State Assessment Boundary: Band theory is not expected in state assessment.</p>	<p>na</p>	
<p>2001/06 high school standards with no alignment to 2016 STE standards</p>		
	<p>na</p>	<p>HS-IP.1.1. Compare and contrast vector quantities (e.g., displacement, velocity, acceleration force, linear momentum) and scalar quantities (e.g., distance, speed, energy, mass, work).</p>
	<p>na</p>	<p>HS-IP.1.8. Describe conceptually the forces involved in circular motion.</p>
	<p>na</p>	<p>HS-IP.2.4. Describe both qualitatively and quantitatively the concept of power as work done per unit time.</p>
	<p>na</p>	<p>HS-IP.4.3. Distinguish between the two types of mechanical waves, transverse and longitudinal.</p>
		<p>HS-IP.4.6. Describe the apparent change in frequency of waves due to the motion of a source or a receiver (the Doppler effect).</p>
	<p>na</p>	<p>HS-IP.6.2. Describe the electromagnetic spectrum in terms of frequency and wavelength, and identify the locations of radio waves, microwaves, infrared radiation, visible light (red, orange, yellow, green, blue, indigo, and violet), ultraviolet rays, x-rays, and gamma rays on the spectrum.</p>

2016 MA STE Standards	Relative grade 2001/6 is found in 2016 STE standards	2001/6 STE Standard
ETS: Technology/Engineering		
ETS:1 Engineering Design		
HS-ETS1-1. Analyze a major global challenge to specify a design problem that can be improved. Determine necessary qualitative and quantitative criteria and constraints for solutions, including any requirements set by society.* Clarification Statement: Examples of societal requirements can include risk mitigation, aesthetics, ethical considerations, and long-term maintenance costs.	same	HS.TE.1.2. Understand that the engineering design process is used in the solution of problems and the advancement of society. Identify examples of technologies, objects, and processes that have been modified to advance society, and explain why and how they were modified.
HS-ETS1-2. Break a complex real-world problem into smaller, more manageable problems that each can be solved using scientific and engineering principles.*	na	
HS-ETS1-3. Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, aesthetics, and maintenance, as well as social, cultural, and environmental impacts.*	same	HS.TE.1.1. Identify and explain the steps of the engineering design process: identify the problem, research the problem, develop possible solutions, select the best possible solution(s), construct prototypes and/or models, test and evaluate, communicate the solutions, and redesign.
HS-ETS1-4. Use a computer simulation to model the impact of a proposed solution to a complex real-world problem that has numerous criteria and constraints on the interactions within and between systems relevant to the problem.*	same	HS.TE.1.1. Identify and explain the steps of the engineering design process: identify the problem, research the problem, develop possible solutions, select the best possible solution(s), construct prototypes and/or models, test and evaluate, communicate the solutions, and redesign.
HS-ETS1-5(MA). Plan a prototype or design solution using orthographic projections and isometric drawings, using proper scales and proportions.*	same	HS.TE.1.1. Identify and explain the steps of the engineering design process: identify the problem, research the problem, develop possible solutions, select the best possible solution(s), construct prototypes and/or models, test and evaluate, communicate the solutions, and redesign. HS.TE.1.3. Produce and analyze multi-view drawings (orthographic projections) and pictorial drawings (isometric, oblique, perspective), using various techniques. HS.TE.1.4. Interpret and apply scale and proportion to orthographic projections and pictorial drawings (e.g., ¼" = 1'0", 1 cm = 1 m). HS.TE.1.5. Interpret plans, diagrams, and working drawings in the construction of prototypes or models.
HS-ETS1-6(MA). Document and present solutions that include specifications, performance results, successes and remaining issues, and limitations.*	same	HS.TE.1.1. Identify and explain the steps of the engineering design process: identify the problem, research the problem, develop possible solutions, select the best possible solution(s), construct prototypes and/or models, test and evaluate, communicate the solutions, and redesign.
ETS2 Materials, Tools and Manufacturing		
HS-ETS2-1(MA). Determine the best application of manufacturing processes to create parts of desired shape, size, and finish based on available resources and safety. Clarification Statement: Examples of processes can include forming (molding of plastics, casting of metals, shaping, rolling, forging, and stamping), machining (cutting and milling), conditioning (thermal, mechanical, and chemical processes), and finishing. State Assessment Boundary: Specific manufacturing machines are not expected in state assessment.	same	HS.TE.7.1. Describe the manufacturing processes of casting and molding, forming, separating, conditioning, assembling, and finishing.
HS-ETS2-2(MA). Explain how computers and robots can be used at different stages of a manufacturing system, typically for jobs that are repetitive, very small, or very dangerous. Clarification Statement: Examples of stages include design, testing, production, and quality control.	same	HS.TE.7.3. Describe the advantages of using robotics in the automation of manufacturing processes (e.g., increased production, improved quality, safety).
HS-ETS2-3(MA). Compare the costs and benefits of custom versus mass production based on qualities of the desired product, the cost of each unit to produce, the number of units needed.	In later grades	6-8.TE.4.1. Describe and explain the manufacturing systems of custom and mass production.
HS-ETS2-4(MA). Explain how manufacturing processes transform material properties to meet a specified purpose or function. Recognize that new materials can be synthesized through chemical and physical processes that are designed to manipulate material properties to meet a desired performance condition a designed object must meet. Clarification Statement: Examples of material properties can include resistance to force, density, hardness, and elasticity.	same	HS.TE.2.1. Identify and explain the engineering properties of materials used in structures (e.g., elasticity, plasticity, R value, density, strength).
ETS3 Technological Systems		
HS-ETS3-1(MA). Model a technological system in which the output of one subsystem becomes the input to other subsystems.	In later grades	6-8.TE.2.6. Identify the five elements of a universal systems model: goal, inputs, processes, outputs, and feedback.
HS-ETS3-2(MA). Use a model to explain how information transmitted via digital and analog signals travels through the following media: electrical wire, optical fiber, air, and space. Analyze a communication problem and determine the best mode of delivery for the communication(s).	same	HS.TE.6.1. Explain how information travels through the following media: electrical wire, optical fiber, air, and space.
	same	HS.TE.6.2. Differentiate between digital and analog signals. Describe how communication devices employ digital and analog technologies (e.g., computers, cell phones).

HS-ETS3-3(MA). Explain the importance of considering both live loads and dead loads when constructing structures. Calculate the resultant force(s) for a combination of live loads and dead loads for various situations. Clarification Statements: Examples of structures can include buildings, decks, and bridges. Examples of loads and forces include live load, dead load, total load, tension, shear, compression, and torsion.	same	HS.TE.2.4. Calculate the resultant force(s) for a combination of live loads and dead loads.
HS-ETS3-4(MA). Use a model to illustrate how the forces of tension, compression, torsion, and shear affect the performance of a structure. Analyze situations that involve these forces and justify the selection of materials for the given situation based on their properties. Clarification Statements: Examples of structures include bridges, houses, and skyscrapers. Examples of material properties can include elasticity, plasticity, thermal conductivity, density, and resistance to force.	same	HS.TE.2.2. Distinguish among tension, compression, shear, and torsion, and explain how they relate to the selection of materials in
	In later grades	6-8.TE.5.3. Explain how the forces of tension, compression, torsion, bending, and shear affect the performance of bridges.
HS-ETS3-5(MA). Analyze how the design of a building is influenced by thermal conditions such as wind, solar angle, and temperature. Give examples of how conduction, convection, and radiation are considered in the selection of materials for buildings and in the design of a heating system.	same	HS.TE.4.1. Differentiate among conduction, convection, and radiation in a thermal system (e.g., heating and cooling a house, cooking).
	same	HS.TE.4.2. Give examples of how conduction, convection, and radiation are considered in the selection of materials for buildings and in the design of a heating system.
	same	HS.TE.4.3. Explain how environmental conditions such as wind, solar angle, and temperature influence the design of buildings.
HS-ETS3-6(MA). Use informational text to illustrate how a vehicle or device can be modified to produce a change in lift, drag, friction, thrust, and weight. Clarification Statements: Examples of vehicles can include cars, boats, airplanes, and rockets. Considerations of lift require consideration of Bernoulli's principle.	In later grades	6-8.TE.6.4. Identify and explain lift, drag, friction, thrust, and gravity in a vehicle or device, e.g., cars, boats, airplanes, rockets.
	same	HS.TE.2.3. Explain Bernoulli's principle and its effect on structures such as buildings and bridges.
ETS4 Energy and Power Technologies		
HS-ETS4-1(MA). Research and describe various ways that humans use energy and power systems to harness resources to accomplish tasks effectively and efficiently. Clarification Statement: Examples of energy and power systems can include fluid systems such as hydraulics and pneumatics, thermal systems such as heating and cooling, and electrical systems such as electronic devices and residential wiring.	na	
HS-ETS4-2(MA). Use a model to explain differences between open fluid systems and closed fluid systems. Determine when it is more or less appropriate to use one type of system instead of the other. Clarification Statements: Examples of open systems can include irrigation, forced hot air systems, and air compressors. Examples of closed systems can include forced hot water systems and hydraulic brakes.	same	HS.TE.3.1. Explain the basic differences between open fluid systems (e.g., irrigation, forced hot air system, air compressors) and closed fluid systems (e.g., forced hot water system, hydraulic brakes).
HS-ETS4-3(MA). Explain how differences and similarities between hydraulic and pneumatic systems lead to different applications of each in technologies.	same	HS.TE.3.2. Explain the differences and similarities between hydraulic and pneumatic systems, and explain how each relates to manufacturing and transportation systems.
HS-ETS4-4(MA). Calculate and describe the ability of a hydraulic system to multiply distance, multiply force, and effect directional change. Clarification Statement: Emphasis is on the ratio of piston sizes (cross-sectional area) as represented in Pascal's law.	same	HS.TE.3.3. Calculate and describe the ability of a hydraulic system to multiply distance, multiply force, and effect directional change.
HS-ETS4-5(MA). Explain how a machine converts energy, through mechanical means, to do work. Collect and analyze data to determine the efficiency of simple and complex machines.	same	HS-IP.2.3. Describe both qualitatively and quantitatively how work can be expressed as a change in mechanical energy.
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	na	HS.TE.2.6. Recognize the purposes of zoning laws and building codes in the design and use of structures.
	na	HS.TE.3.4. Recognize that the velocity of a liquid moving in a pipe varies inversely with changes in the cross-sectional area of the pipe.
	na	HS.TE.3.5. Identify and explain sources of resistance (e.g., 45° elbow, 90° elbow, changes in diameter) for water moving through a pipe.
	na	HS.TE.4.4. Identify and explain alternatives to nonrenewable energies (e.g., wind and solar energy conversion systems).
	na	HS.TE.5.2. Identify and explain the components of a circuit, including sources, conductors, circuit breakers, fuses, controllers, and loads. Examples of some controllers are switches, relays, diodes, and variable resistors.
	na	HS.TE.5.4. Recognize that resistance is affected by external factors (e.g., temperature).
	na	HS.TE.5.5. Compare and contrast alternating current (AC) and direct current (DC), and give examples of each.
	na	HS.TE.6.4. Identify and explain the applications of laser and fiber optic technologies (e.g., telephone systems, cable television, photography).
	na	HS.TE.6.5. Explain the application of electromagnetic signals in fiber optic technologies, including critical angle and total internal reflection.
	na	HS.TE.7.2. Identify the criteria necessary to select safe tools and procedures for a manufacturing process (e.g., properties of materials, required tolerances, end-uses).