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

2001/6 Grade PreK-2 Standards	Alignment of current to 2016 standards	Relative grade 2001/6 is found in 2016
ESS		
PreK-2.ESS.1.	comparable	same
PreK-2.ESS.2.	not included	na
PreK-2.ESS.3.	comparable	same
PreK-2.ESS.4.	comparable	same
PreK-2.ESS.5.	comparable	same
TE		
PreK-2.TE.1.1.	partial	same
PreK-2.TE.1.2.	partial	same
PreK-2.TE.1.3.	partial	same
PreK-2.TE.2.1.	not included	na
PreK-2.TE.2.2.	not included	na
LS		
PreK-2.LS.1.	partial	same & later
PreK-2.LS.2.	comparable	same
PreK-2.LS.3.	comparable	same
PreK-2.LS.4.	comparable	same
PreK-2.LS.5.	included in later grades	in later grades
PreK-2.LS.6.	comparable	same
PreK-2.LS.7.	not included	na
PreK-2.LS.8.	comparable	same
PS		
PreK-2.PS.1.	comparable	same
PreK-2.PS.2.	partial	same
PreK-2.PS.3.	partial	same
PreK-2.PS.4.	comparable	same
PreK-2.PS.5.	comparable	same
2016 grade PreK-2 standards that are in addition to current standards		
	additional	PreK-ESS1-2(MA)
	additional	PreK-ESS2-6(MA)
	additional	2-ESS2-1.
	additional	2-ESS2-2.
	additional	2-ESS2-4(MA)
	additional	PreK-ESS3-1(MA)
	additional	PreK-ESS3-2(MA)
	additional	K-ESS3-2.
	additional	K-ESS3-3.
	additional	2.K-2-ETS1-3.
	additional	PreK-LS3-2(MA)
	additional	2-LS4-1.
	additional	2-PS3-1(MA).
	additional	PreK-PS4-2(MA)
	additional	PreK-LS1-1(MA

2001/6 Grade 3-5 Standards	Alignment of current to 2016 standards	Relative grade 2001/6 is found in 2016
ESS		
3-5.ESS.1.	partial	same
3-5.ESS.2.	partial	same
3-5.ESS.3.	included in later grades	in later grades
3-5.ESS.4.	comparable	same
3-5.ESS.5.	not included	na
3-5.ESS.6.	comparable	same
3-5.ESS.7.	comparable	same & earlier
3-5.ESS.8.	included in later grades	in later grades
3-5.ESS.9.	comparable	same
3-5.ESS.10.	comparable	same
3-5.ESS.11.	included in later grades	in later grades
3-5.ESS.12.	partial	same & later
3-5.ESS.13.	comparable	same
3-5.ESS.14.	comparable	same & earlier
3-5.ESS.15.	partial	in earlier grades
TE		
3-5.TE.1.1.	comparable	same & earlier
3-5.TE.1.2.	partial	in earlier grades
3-5.TE.1.3.	not included	na
3-5.TE.2.1.	partial	same & earlier
3-5.TE.2.2.	comparable	same & earlier
3-5.TE.2.3.	comparable	same
3-5.TE.2.4.	not included	na
LS		
3-5.LS.1.	partial	in earlier grades
3-5.LS.2.	partial	same
3-5.LS.3.	comparable	same
3-5.LS.4.	comparable	same
3-5.LS.5.	comparable	same
3-5.LS.6.	partial	same
3-5.LS.7.	comparable	same & earlier
3-5.LS.8.	partial	in earlier grades
3-5.LS.9.	partial	same
3-5.LS.10.	comparable	same & earlier
3-5.LS.11.	comparable	same
PS		
3-5.PS.1.	comparable	same & earlier
3-5.PS.2.	comparable	same & earlier
3-5.PS.3.	comparable	same & earlier
3-5.PS.4.	partial	same
3-5.PS.5.	comparable	same
3-5.PS.6.	included in later grades	in later grades
3-5.PS.7.	comparable	same
3-5.PS.8.	included in later grades	in later grades
3-5.PS.9.	comparable	same
3-5.PS.10.	comparable	same
3-5.PS.11.	partial	in earlier grades
3-5.PS.12.	partial	same & earlier
2016 grade 3-5 standards that are in addition to current standards		
	additional	5-ESS1-1.
	additional	5-ESS2-2.
	additional	3-ESS3-1.
	additional	4-ESS3-2.
	additional	5-ESS3-1.
	additional	5-ESS3-2(MA)
	additional	5-LS2-2(MA)
	additional	3-LS4-3.
	additional	3-LS4-5(MA)
	additional	3-PS2-1.
	additional	4-PS3-1.
	additional	5.3-5-ETS3-1(MA)
	additional	5.3-5-ETS3-2(MA)
	additional	3.3-5-ETS1-2

2001/6 Grade 6-8 Standards	Alignment of 2001/6 to 2016 standards	Relative grade 2001/6 is found in 2016
ESS		
6-8.ESS.1.	comparable	in earlier grades
6-8.ESS.2.	partial	same & later
6-8.ESS.3.	comparable	same
6-8.ESS.4.	partial	same
6-8.ESS.5.	comparable	same
6-8.ESS.6.	comparable	same & earlier
6-8.ESS.7.	comparable	same
6-8.ESS.8.	partial	same & earlier
6-8.ESS.9.	comparable	same
6-8.ESS.10.	not included	na
6-8.ESS.11.	comparable	same
6-8.ESS.12.	comparable	same
TE		
6-8.TE.1.1.	comparable	same
6-8.TE.1.2.	partial	same
6-8.TE.1.3.	comparable	same
6-8.TE.2.1.	comparable	same & earlier
6-8.TE.2.2.	comparable	same
6-8.TE.2.3.	comparable	same
6-8.TE.2.4.	comparable	same
6-8.TE.2.5.	comparable	same
6-8.TE.2.6.	comparable	same & later
6-8.TE.3.1.	comparable	same & earlier
6-8.TE.3.2.	partial	same
6-8.TE.3.3.	comparable	same
6-8.TE.3.4.	not included	na
6-8.TE.4.1.	included in later grades	in later grades
6-8.TE.4.2.	not included	na
6-8.TE.4.3.	not included	na
6-8.TE.4.4.	comparable	same
6-8.TE.5.1.	comparable	same
6-8.TE.5.2.	partial	same
6-8.TE.5.3.	comparable	same
6-8.TE.5.4.	partial	same
6-8.TE.6.1.	partial	same
6-8.TE.6.2.	not included	na
6-8.TE.6.3.	comparable	same
6-8.TE.6.4.	included in later grades	in later grades
6-8.TE.7.1.	not included	na
6-8.TE.7.2.	not included	na
LS		
6-8.LS.1.	not included	na
6-8.LS.2.	partial	same
6-8.LS.3.	partial	same
6-8.LS.4.	comparable	same
6-8.LS.5.	comparable	same
6-8.LS.6.	partial	same
6-8.LS.7.	comparable	same & earlier
6-8.LS.8.	partial	same
6-8.LS.9.	comparable	same
6-8.LS.10.	partial	same
6-8.LS.11.	comparable	same
6-8.LS.12.	comparable	same
6-8.LS.13.	comparable	same
6-8.LS.14.	comparable	same
6-8.LS.15.	comparable	same & earlier
6-8.LS.16.	partial	same, earlier, later
6-8.LS.17.	comparable	same
6-8.LS.18.	comparable	same
PS		
6-8.PS.1.	partial	same & earlier
6-8.PS.2.	comparable	same
6-8.PS.3.	not included	na
6-8.PS.4.	comparable	same & earlier
6-8.PS.5.	comparable	same
6-8.PS.6.	comparable	same
6-8.PS.7.	comparable	same
6-8.PS.8.	comparable	same & earlier
6-8.PS.9.	partial	same
6-8.PS.10.	comparable	same & earlier
6-8.PS.11.	partial	same & earlier
6-8.PS.12.	included in later grades	in later grades
6-8.PS.13.	comparable	same
6-8.PS.14.	comparable	same
6-8.PS.15.	comparable	same
6-8.PS.16.	partial	same & later
2016 grade 6-8 standards that are in addition to current standards		
	additional	8.MS-ESS3-1.
	additional	7.MS-ESS3-4.
	additional	8.MS-ESS3-5.
	additional	6.MS-ETS1-1.
	additional	8.MS-ETS2-4(MA).
	additional	7.MS-LS1-4.
	additional	7.MS-LS2-6(MA).
	additional	8.MS-LS4-5.
	additional	6.MS-PS4-3.

Overview of High School Science Crosswalk of 2001/2006 Standards to 2016 MA STE Standards

2001/6 HS ESS Standards	Alignment of 2001/6 to 2016 standards	Relative grade 2001/6 is found in 2016
HS.ESS.1.1.	partial	same & earlier
HS.ESS.1.2.	partial	same
HS.ESS.1.3.	partial	same & earlier
HS.ESS.1.4.	partial	same & earlier
HS.ESS.1.5.	comparable	in earlier grades
HS.ESS.1.6.	partial	in earlier grades
HS.ESS.1.7.	partial	in earlier grades
HS.ESS.1.8.	partial	same
HS.ESS.2.1.	partial	in earlier grades
HS.ESS.2.2.	partial	same
HS.ESS.3.1.	comparable	same & earlier
HS.ESS.3.2.	comparable	same
HS.ESS.3.3.	not included	na
HS.ESS.3.4.	partial	in earlier grades
HS.ESS.3.5.	partial	in earlier grades
HS.ESS.3.6.	partial	in earlier grades
HS.ESS.3.7.	partial	in earlier grades
HS.ESS.3.8.	comparable	same & earlier
HS.ESS.3.9.	comparable	same
HS.ESS.3.10.	comparable	in earlier grades
HS.ESS.3.11.	partial	same
HS.ESS.3.12.	not included	na
HS.ESS.4.1.	comparable	same
HS.ESS.4.2.	comparable	same & earlier
HS.ESS.4.3.	not included	na
2016 high school standards that are in addition to current standards		
	additional	HS-ESS3-1.
	additional	HS-ESS3-2.
	additional	HS-ESS3-3.
	additional	HS-ESS3-5.

2001/6 HS Biology Standards	Alignment of 2001/6 to 2016 standards	Relative grade 2001/6 is found in 2016
HS.LS.1.1.	comparable	same
HS.LS.1.2.	partial	same
HS.LS.1.3.	partial	same
HS.LS.2.1.	partial	in earlier grades
HS.LS.2.2.	not included	na
HS.LS.2.3.	not included	na
HS.LS.2.4.	comparable	same
HS.LS.2.5.	comparable	same
HS.LS.2.6.	comparable	same
HS.LS.2.7.	partial	same
HS.LS.2.8.	partial	same
HS.LS.3.1.	comparable	same
HS.LS.3.2.	comparable	same
HS.LS.3.3.	comparable	same & earlier
HS.LS.3.4.	partial	same & earlier
HS.LS.3.5.	partial	same & earlier
HS.LS.3.6.	partial	in earlier grades
HS.LS.4.1.	partial	same & earlier
HS.LS.4.2.	partial	same
HS.LS.4.3.	partial	same
HS.LS.4.4.	partial	same
HS.LS.4.5.	partial	same
HS.LS.4.6.	comparable	same
HS.LS.4.7.	partial	same
HS.LS.4.8.	comparable	same
HS.LS.5.1.	comparable	same
HS.LS.5.2.	partial	same
HS.LS.5.3.	comparable	same
HS.LS.6.1.	partial	same
HS.LS.6.2.	comparable	same
HS.LS.6.3.	comparable	same & earlier
HS.LS.6.4.	comparable	same
2016 high school standards that are in addition to current standards		
	additional	HS-LS2-6.
	additional	HS-LS3-4(MA)

2001/6 HS Chemistry Standards	Alignment of 2001/6 to 2016 standards	Relative grade 2001/6 is found in 2016
HS.Chem.1.1.	comparable	same & earlier
HS.Chem.1.2.	partial	same
HS.Chem.1.3.	comparable	in earlier grades
HS.Chem.2.1.	not included	na
HS.Chem.2.2.	partial	same
HS.Chem.2.3.	comparable	same
HS.Chem.2.4.	partial	same
HS.Chem.2.5.	not included	na
HS.Chem.2.6.	partial	same (in IP)
HS.Chem.2.7.	partial	same (in ESS & IP)
HS.Chem.3.1.	partial	same
HS.Chem.3.2.	partial	same
HS.Chem.3.3.	comparable	same
HS.Chem.3.4.	comparable	same
HS.Chem.4.1.	comparable	same
HS.Chem.4.2.	not included	na
HS.Chem.4.3.	not included	na
HS.Chem.4.4.	comparable	same
HS.Chem.4.5.	not included	na
HS.Chem.4.6.	not included	na
HS.Chem.5.1.	comparable	same
HS.Chem.5.2.	comparable	same
HS.Chem.5.3.	comparable	same
HS.Chem.5.4.	partial	same
HS.Chem.5.5.	comparable	same
HS.Chem.5.6.	comparable	same
HS.Chem.6.1.	comparable	same
HS.Chem.6.2.	partial	same
HS.Chem.6.3.	comparable	in earlier grades
HS.Chem.6.4.	comparable	same & earlier
HS.Chem.6.5.	comparable	same
HS.Chem.7.1.	comparable	same
HS.Chem.7.2.	comparable	same
HS.Chem.7.3.	comparable	same
HS.Chem.7.4.	partial	same
HS.Chem.7.5.	comparable	same
HS.Chem.7.6.	comparable	same
HS.Chem.8.1.	comparable	same
HS.Chem.8.2.	comparable	same
HS.Chem.8.3.	not included	na
HS.Chem.8.4.	comparable	same
2016 high school standards are in addition to current standards		
	none	

2001/6 HS Intro Physics Standards	Alignment of 2001/6 to 2016 standards	Relative grade 2001/6 is found in 2016
HS.IP.1.1.	not included	na
HS.IP.1.2.	comparable	same
HS.IP.1.3.	partial	same
HS.IP.1.4.	comparable	same & earlier
HS.IP.1.5.	comparable	same
HS.IP.1.6.	partial	same
HS.IP.1.7.	comparable	same
HS.IP.1.8.	not included	na
HS.IP.2.1.	comparable	same
HS.IP.2.2.	comparable	same
HS.IP.2.3.	comparable	same
HS.IP.2.4.	not included	na
HS.IP.2.5.	comparable	same
HS.IP.3.1.	comparable	in earlier grades
HS.IP.3.2.	comparable	same
HS.IP.3.3.	comparable	same & earlier
HS.IP.3.4.	comparable	same
HS.IP.4.1.	partial	same & earlier
HS.IP.4.2.	comparable	same
HS.IP.4.3.	not included	na
HS.IP.4.4.	comparable	same & earlier
HS.IP.4.5.	comparable	same
HS.IP.4.6.	not included	same
HS.IP.5.1.	partial	in earlier grades
HS.IP.5.2.	comparable	same
HS.IP.5.3.	comparable	same
HS.IP.5.4.	comparable	same
HS.IP.5.5.	partial	same
HS.IP.5.6.	comparable	same & earlier
HS.IP.6.1.	comparable	same
HS.IP.6.2.	not included	na
2016 high school standards that are in addition to current standards		
	additional	HS-PS4-5.

2001/6 HS Tech/Eng Standards	Alignment of 2001/6 to 2016 standards	Relative grade 2001/6 is found in 2016
HS.TE.1.1.	partial	same
HS.TE.1.2.	partial	same
HS.TE.1.3.	comparable	same
HS.TE.1.4.	comparable	same
HS.TE.1.5.	partial	same
HS.TE.2.1.	partial	same
HS.TE.2.2.	comparable	same
HS.TE.2.3.	partial	same
HS.TE.2.4.	comparable	same
HS.TE.2.5.	comparable	in earlier grades
HS.TE.2.6.	not included	na
HS.TE.3.1.	comparable	same
HS.TE.3.2.	comparable	same
HS.TE.3.3.	comparable	same
HS.TE.3.4.	not included	na
HS.TE.3.5.	not included	na
HS.TE.4.1.	comparable	same
HS.TE.4.2.	comparable	same
HS.TE.4.3.	comparable	same
HS.TE.4.4.	not included	na
HS.TE.5.1.	comparable	same (in IP)
HS.TE.5.2.	partial	same (in IP)
HS.TE.5.3.	comparable	same (in IP)
HS.TE.5.4.	not included	na
HS.TE.5.5.	not included	na
HS.TE.6.1.	comparable	same
HS.TE.6.2.	comparable	same
HS.TE.6.3.	comparable	in earlier grades
HS.TE.6.4.	not included	na
HS.TE.6.5.	not included	na
HS.TE.7.1.	comparable	same
HS.TE.7.2.	not included	na
HS.TE.7.3.	comparable	same
2016 high school standards that are in addition to current standards		
	additional	HS-ETS1-2.
	additional	HS-ETS4-1(MA).

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

2001/6 Standard	Degree of alignment of 2001/6 standard to 2016 STE standard	Relative grade 2001/6 standard is found in 2016 STE standard	2016 MA STE Standards	Comments on alignment
ESS. Earth and Space Science			**ESS. Earth and Space Science**	**ESS. Earth and Space Science**
PreK-2.ESS.1. Recognize that water, rocks, soil, and living organisms are found on the earth's surface.	comparable	same	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.	2016 STE standard focuses on living things in their environment and does not specify rocks, soil found on earth science.
			PreK-ESS2-2(MA). Observe and classify non-living materials, natural and human made, in the local environment.	2016 STE standard does not specify types of materials.
			PreK-ESS2-3(MA). Explore and describe different places water is found in the local environment.	2016 STE standard focuses on water only.
			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.	2016 STE standard includes soil and humans but not other components of the 2001/16 standard.
			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.	2016 STE standard focuses on water only.
PreK-2.ESS.2. Understand that air is a mixture of gases that is all around us and that wind is moving air.	not included	na		
PreK-2.ESS.3. Describe the weather changes from day to day and over the seasons.	comparable	same	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.	
			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.	
PreK-2.ESS.4. Recognize that the sun supplies heat and light to the earth and is necessary for life.	comparable	same	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.	
			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.	2016 STE standard only emphasizes heat.
PreK-2.ESS.5. Identify some events around us that have repeating patterns, including the seasons of the year, day and night.	comparable	same	1-ESS1-2. Analyze provided data to identify relationships among seasonal patterns of change, including relative 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.	
ETS. Technology/Engineering			**ETS. Technology/Engineering**	**ETS. Technology/Engineering**
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).	partial	same	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.	2016 STE standard does not specify the particular materials to be considered.

2001/6 Standard	Degree of alignment of 2001/6 standard to 2016 STE standard	Relative grade 2001/6 standard is found in 2016 STE standard	2016 MA STE Standards	Comments on alignment
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).	partial	same	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.	2016 STE standard does not specify the particular materials to be considered.
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.	partial	same	K-PS3-2. Use tools and materials to design and build a model of a structure that will reduce the warming effect of sunlight on an area.*	2016 STE standard does not specify the particular tools and materials expected, and limits to structures for one particular purpose.
			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.	2016 STE standard does not specify the particular tools and materials expected, and limits to structures for one particular purpose.
PreK-2.TE.2.1. Identify tools and simple machines used for a specific purpose, e.g., ramp, wheel, pulley, lever.	not included	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.	not included	na		
LS. Life Science			**LS. Life Science**	**LS. Life Science**
PreK-2.LS.1. Recognize that animals (including humans) and plants are living things that grow, reproduce, and need food, air, and water.	partial	same	K-LS1-2(MA). Recognize that all plants and animals grow and change over time.	2016 STE standard does not include reproduction or the needs of living things.
			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.	2016 STE standard does not include reproduction.
	included in later grades	in later grades	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.	2016 STE standard includes reproduction as well as growth.
PreK-2.LS.2. Differentiate between living and nonliving things. Group both living and nonliving things according to the characteristics that they share.	comparable	same	PreK-LS2-1(MA). Use evidence from animals and plants to define several characteristics of living things that distinguish them from non-living things.	
PreK-2.LS.3. Recognize that plants and animals have life cycles, and that life cycles vary for different living things.	comparable	same	K-LS1-2(MA). Recognize that all plants and animals grow and change over time.	
PreK-2.LS.4. Describe ways in which many plants and animals closely resemble their parents in observed appearance.	comparable	same	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.	
			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.	2016 STE standard does not specify comparison to parents.

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

2001/6 Standard	Degree of alignment of 2001/6 standard to 2016 STE standard	Relative grade 2001/6 standard is found in 2016 STE standard	2016 MA STE Standards	Comments on alignment
PreK-2.LS.5. Recognize that fossils provide us with information about living things that inhabited the earth years ago.	included in later grades	in later grades	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.	Comparable alignment to 2016 STE standard 3-LS4-1.
PreK-2.LS.6. Recognize that people and other animals interact with the environment through their senses of sight, hearing, touch, smell, and taste.	comparable	same	PreK-LS1-2(MA). Explain that most animals have five senses they use to gather information about the world around them.	
			PreK-LS1-3(MA). Use their five senses in their exploration and play to gather information.	
			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, 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.	2016 STE standard does not specify all 5 senses.
PreK-2.LS.7. Recognize changes in appearance that animals and plants go through as the seasons change.	not included	na		
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).	comparable	same	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.	
			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.	2016 STE standard is general in its focus, does not specify particulars (such as food, shelter) of the interdependencies.
PS. Physical Science			**PS. Physical Science**	**PS. Physical Science**
PreK-2.PS.1. Sort objects by observable properties such as size, shape, color, weight, and texture.	comparable	same	PreK-PS1-3(MA). Differentiate between the properties of an object and those of the material of which it is made.	2016 STE standard does not specify which properties.
			2-PS1-1. Describe and classify different kinds of materials by observable properties of color, flexibility, hardness, texture, and absorbency.	
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.	partial	same	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.	2016 STE standard does not include gases.
			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.	2016 STE standard does not specify solids, liquids or gases but does include changing state.

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

2001/6 Standard	Degree of alignment of 2001/6 standard to 2016 STE standard	Relative grade 2001/6 standard is found in 2016 STE standard	2016 MA STE Standards	Comments on alignment
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.	partial	same	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.	2016 STE standard requires describing movement but does not specify the types of descriptions.
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.	comparable	same	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 on each other. Comparisons should be on 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	
PreK-2.PS.5. Recognize that under some conditions, objects can be balanced.	comparable	same	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.	
			2016 STE grade PreK-2 standards that are in addition to current standards	
	additional	na	PreK-ESS1-2(MA). Observe and use evidence to describe that the sun is in different places in the sky during the day.	
	additional	na	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.	
	additional	na	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.	
	additional	na	PreK-ESS3-2(MA). Observe and discuss the impact of people's activities on the local environment.	
	additional	na	PreK-LS3-2(MA). Use observations to recognize differences and similarities among themselves and their friends.	
	additional	na	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: human have two legs and horses four, but both use legs to move.	
	additional	na	PreK-PS4-2(MA). Connect daily experience and investigations to demonstrate the relationships between the size and shape of shadows, the objects creating the shadow, and the light source.	
	additional	na	K-ESS3-2. Obtain and use information about weather forecasting to prepare for, and respond to, different types of local weather.	

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

2001/6 Standard	Degree of alignment of 2001/6 standard to 2016 STE standard	Relative grade 2001/6 standard is found in 2016 STE standard	2016 MA STE Standards	Comments on alignment
	additional	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.	
	additional	na	K-PS1-1(MA) Investigate and communicate the idea that different kinds of materials can be 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 qualitative description of temperature, such as hot, warm, and cool, is expected.	
	additional	na	2-ESS2-1. Investigate and 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.	
	additional	na	2-ESS2-2. Map the shapes and types of landforms and bodies of water in an area. Clarification Statements: 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 or contour mapping is not expected	
	additional	na	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.	
	additional	na	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 cold water or how different types of grocery bags perform.	
	additional	na	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.	
	additional	na	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 Statements: Examples could include an object sliding on rough vs. smooth surfaces. Observations of temperature and speed should be qualitative.	

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

2001/6 Standard	Degree of alignment of 2001/6 standard to 2016 STE standard	Relative grade 2001/6 standard is found in 2016 STE standard	2016 MA STE Standards	Comments on alignment
ESS. Earth and Space Science			**ESS. Earth and Space Science**	**ESS. Earth and Space Science**
3-5.ESS.1 Give a simple explanation of what a mineral is and some examples, e.g., quartz, mica.	partial	same	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.	2016 STE standard focuses on each substance (e.g., mineral vs. metal vs. baking soda) having unique properties.
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.	partial	same	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 Statement: 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.	2016 STE standard does not specify tests or the particular set of properties.
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.	included in later grades	in later grades	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.	Partial alignment to 2016 STE standard 6.MS-ESS1-4 which includes changes in rock type due to erosion, heat and pressure, although the focus of the standard is much broader.
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).	comparable	same	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 by water, ice, wind, and vegetation. Clarification Statements: Mechanical weathering processes 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.	2016 STE standard includes a broader focus on weathering and erosion but does not include as much detail about the formation and composition of soil, including decomposition of plant and animal remains.
			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 to: (a) show that plants produce sugars and plant materials; (b) show that animals 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 are not expected in state assessment.	2016 STE standard does not focus on soil formation per se but does highlight decomposition of organic materials into the soil.
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.	not included	na		
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.	comparable	same	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.	2016 STE standard adds context of the season.

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

2001/6 Standard	Degree of alignment of 2001/6 standard to 2016 STE standard	Relative grade 2001/6 standard is found in 2016 STE standard	2016 MA STE Standards	Comments on alignment
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.	comparable	same	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.	
		in earlier grades	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.	2016 STE standard includes rain and snow, but not sleet and hail.
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.	included in later grades	in later grades	8.MS-ESS2-5. Interpret basic weather data to identify patterns in air mass interactions and the relationship of those patterns to local 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 in weather maps, data tables, diagrams, or 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.	Partial alignment to 2016 STE standard 8.MS-ESS2-5 which includes air mass interactions (but does not specify jet stream) and the particular factors, but does not include water currents, and partial alignment to 8.MS-ESS2-6 which includes the role of ocean in weather but not the jet stream.
			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.	
3-5.ESS.9. Differentiate between weather and climate.	comparable	same	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.	
3-5.ESS.10. Describe how water on earth cycles in different forms and in different locations, including underground and in the atmosphere.	comparable	same	5-ESS2-1. Use a model to describe the cycling of water on Earth through a watershed between the geosphere, biosphere, hydrosphere, and atmosphere through evaporation, precipitation, absorption, surface runoff, and condensation, and transpiration. State Assessment Boundary: Transpiration or explanations of mechanisms that drive the cycle are not expected in state assessment.	
3-5.ESS.11. Give examples of how the cycling of water, both in and out of the atmosphere, has an effect on climate.	included in later grades	in later grades	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.	Partial alignment to 8.MSESS2-6.

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

2001/6 Standard	Degree of alignment of 2001/6 standard to 2016 STE standard	Relative grade 2001/6 standard is found in 2016 STE standard	2016 MA STE Standards	Comments on alignment
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.	partial	same	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.	2016 STE standard focuses on "slow processes" but does not include "rapid processes" such as landslides, volcanoes, and earthquakes. These are, however, included in the 2016 STE standard 7.MS-ESS3-2. 2016 STE standard is not about particular or specific events such as landslides or an eruption.
			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 processes 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.	2016 STE standard focuses on "slow processes" but does not include "rapid processes" such as landslides, volcanoes, and earthquakes. 2016 STE standards 7.MS-ESS2-2 distinguishes processes that happen at different scales; 7.MS-ESS3-2 include rapid processes.
		in later grades	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 scales include plate motion and ice ages. Examples of changes occurring over small, local spatial scales include earthquakes and seasonal weathering and erosion.	Partial alignment to 2016 STE standard 7.MS-ESS2-2 which distinguishes processes that happen at different scales; and 7.MS-ESS3-2 which includes rapid processes.
			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.	
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.	comparable	same	5-ESS1-2. Use a model to communicate Earth's relationship to the Sun, Moon, and other 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.	

2001/6 Standard	Degree of alignment of 2001/6 standard to 2016 STE standard	Relative grade 2001/6 standard is found in 2016 STE standard	2016 MA STE Standards	Comments on alignment
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.	comparable	same	5-ESS1-2. Use a model to communicate Earth's relationship to the Sun, Moon, and other 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.	
		in earlier grades	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.	2016 STE standard only includes apparent movement across the sky.
3-5.ESS.15. Describe the changes that occur in the observable shape of the moon over the course of a month.	partial	in earlier grades	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 or sequencing of moon phases is not expected.	2016 STE PreK standard does not include sequencing of the observable shape of the moon over the course of a month.
ETS: Technology/Engineering			**ETS: Technology/Engineering**	**ETS: Technology/Engineering**
3-5.TE.1.1. Identify materials used to accomplish a design task based on a specific property, e.g., strength, hardness, and flexibility.	comparable	same	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.*	2016 STE standard does not focus on material properties.
			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	2016 STE standard does not include the application to a design task.
		in earlier grades	PreK-PS1-2(MA). Investigate the 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.	2016 STE standard does not include difference of manufactured or natural.
			PreK-PS1-3(MA). Differentiate between the properties of an object and those of the material of which it is made.	2016 STE standard includes material properties but not the specific list or for a design task purpose.
			2-PS1-1. Describe and classify different kinds of materials by observable properties of color, flexibility, hardness, texture, and absorbency.	2016 STE standard includes properties listed in the 2001/06 standard, but not for a design task.
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.	partial	in earlier grades	K-PS3-2. Use tools and materials to design and build a model of a structure that will reduce the warming effect of sunlight on an area.*	2016 STE standard includes use of tools to build a prototype but does not specify the set of tools. This list of tools is specified in a later 2016 STE standard 6.MS-ETS2-3(MA).
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.	not included	na		
3-5.TE.2.1. Identify a problem that reflects the need for shelter, storage, or convenience.	partial	same	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.*	2016 STE standard is broader in scope; the 2001/6 standard focuses on shelter, storage, or convenience.
		in earlier grades	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.*	2016 STE standard is broader in scope; the 2001/6 standard focuses on shelter, storage, or convenience.

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

2001/6 Standard	Degree of alignment of 2001/6 standard to 2016 STE standard	Relative grade 2001/6 standard is found in 2016 STE standard	2016 MA STE Standards	Comments on alignment
3-5.TE.2.2. Describe different ways in which a problem can be represented, e.g., sketches, diagrams, graphic organizers, and lists.	comparable	same	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.	
		in earlier grades	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.*	2016 STE standard focuses only on drawings (sketches).
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.	comparable	same	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.*	
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.	not included	na		
LS. Life Science			**LS. Life Science**	**LS. Life Science**
3-5.LS.1. Classify plants and animals according to the physical characteristics that they share.	partial	in earlier grades	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 having two legs and horses four, but both use legs to move.	2016 STE standard does not emphasize classification.
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.	partial	same	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.	2016 STE standard includes basic functions of plant structures but does not specify the full set of particular functions included in the 2001/06 standard.
3-5.LS.3. Recognize that plants and animals go through predictable life cycles that include birth, growth, development, reproduction, and death.	comparable	same	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, 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" and "incomplete metamorphosis", or details of human reproduction are not expected in state assessment.	
3-5.LS.4. Describe the major stages that characterize the life cycle of the frog and butterfly as they go through metamorphosis.	comparable	same	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 a new part), reproduce (e.g., develop seeds, 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" and "incomplete metamorphosis" or details of human reproduction are not expected in state assessment.	2016 STE standard includes life cycles but does not specify frogs and butterflies. 2016 STE standard focuses on comparison of stages of different organisms, not specifics of individual organisms.

2001/6 Standard	Degree of alignment of 2001/6 standard to 2016 STE standard	Relative grade 2001/6 standard is found in 2016 STE standard	2016 MA STE Standards	Comments on alignment
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).	comparable	same	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.	2016 STE standard does not differentiate traits inherited from traits affected by the environment.
			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 Statement: Examples of the environment affecting a characteristic could include normally tall plants grown 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.	
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.	partial	same	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 produce offspring. Examples of evidence could include needs and characteristics of the organisms and habitats involved.	2016 STE standard does not include adaptation over time; it focuses on the importance of variation for survival.
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).	comparable	same	3-LS4-4. Analyze and interpret given data about changes in 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.	2016 STE standard is broader in nature and does not specify migration.
		in earlier grades	1-ESS1-2. Analyze provided data to identify relationships among seasonal patterns of change, including relative 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.	2016 STE standard focuses on seasonal changes and includes migration as an example.
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).	partial	in earlier grades	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).	2016 STE standard does not include behavior as instinctive vs. behavior as learned, nor include response to stimuli, and only focuses on parent and offspring.
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.	partial	same	3-LS4-4. Analyze and interpret given data about changes in 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.	2016 STE standard does not include plant behaviors.

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

2001/6 Standard	Degree of alignment of 2001/6 standard to 2016 STE standard	Relative grade 2001/6 standard is found in 2016 STE standard	2016 MA STE Standards	Comments on alignment
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.	comparable	same	3-LS4-4. Analyze and interpret given data about changes in 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.	2016 STE standard does not call out the causal reason for change; does not specify the changes caused by organisms.
		in earlier grades	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 digging holes in the ground and tree roots can break concrete.	
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.	comparable	same	5-LS1-1. Ask testable questions about the process by which plants use air, water, and energy from 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 state assessment.	2016 STE standard just includes materials from photosynthesis.
			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 are not expected in state assessment.	
			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 nutrients for life processes, including 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.	2016 STE standard does not specify photosynthesis.

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

2001/6 Standard	Degree of alignment of 2001/6 standard to 2016 STE standard	Relative grade 2001/6 standard is found in 2016 STE standard	2016 MA STE Standards	Comments on alignment
PS. Physical Science			**PS. Physical Science**	**PS. Physical Science**
3-5.PS.1. Differentiate between properties of objects (e.g., size, shape, weight) and properties of materials (e.g., color, texture, hardness).	comparable	in earlier grades	PreK-PS1-3(MA). Differentiate between the properties of an object and those of the material of which it is made.	2016 STE standard differentiates object and material properties but does not list particular properties.
			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.	2016 STE standard requires an understanding of material properties but does not list particular properties.
		same	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 assessments.	
3-5.PS.2. Compare and contrast solids, liquids, and gases based on the basic properties of each of these states of matter.	comparable	in earlier grades	K-PS1-1(MA). Investigate and communicate the idea that different kinds of materials can be 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.	2016 STE standard does not include gases.
		same	5-PS1-1. Use a particle 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 unseen particles are not expected in state assessment.	
3-5.PS.3. Describe how water can be changed from one state to another by adding or taking away heat.	comparable	same	5-PS1-1. Use a particle 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 unseen particles are not expected in state assessment.	2016 STE standard does not specify heat.
		in earlier grades	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.	2016 STE standard does not include gasses, nor specifies heat.
			K-PS1-1(MA). Investigate and communicate the idea that different kinds of materials can be 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.	2016 STE standard does not include gasses, nor specifies heat transfer per se.
			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.	

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

2001/6 Standard	Degree of alignment of 2001/6 standard to 2016 STE standard	Relative grade 2001/6 standard is found in 2016 STE standard	2016 MA STE Standards	Comments on alignment
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.	partial	same	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.	2016 STE standards do not include magnetic. 2001/6 standards focuses on energy causing motion or change; the 2016 STE standard focuses on transfer of energy. National Research Council explicit to not define energy at elementary grades.
			4-PS3-4. Apply scientific principles of energy and motion to test and refine a device that converts kinetic 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.	2016 STE standards do not include magnetic. 2001/6 standards focuses on energy causing motion or change; the 2016 STE standard focuses on transfer of energy. National Research Council explicit to not define energy at elementary grades.
3-5.PS.5. Give examples of how energy can be transferred from one form to another.	comparable	same	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 expected in state assessment.	2016 STE standard only includes one type of transfer: mechanical. But other forms included in other draft standards, except magnetic.
			4-PS3-4. Apply scientific principles of energy and motion to test and refine a device that converts kinetic 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.	
			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 nutrients for life processes, including 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.	2016 STE standard only includes transfer from sunlight to chemical (food) energy. But other forms included in other draft standards, except magnetic.
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.	included in later grades	in later grades	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, 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.	Partial alignment to 2016 STE standard HS-PS2-9(MA) which includes series and parallel circuits. Partial alignment to 4-PS3-2 or 4-PS3-4
3-5.PS.7. Identify and classify objects and materials that conduct electricity and objects and materials that are insulators of electricity.	comparable	same	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 assessments.	2016 STE standard does not specifically call out insulators but it is implied in use of electrical conductivity. 2016 STE standard focused more on properties of substances including its conductivity.
3-5.PS.8. Explain how electromagnets can be made, and give examples of how they can be used.	included in later grades	in later grades	7.MS-PS2-3. Analyze data to describe the effect of distance and magnitude of electric charge on the strength of electric forces. Clarification Statement: Includes both attractive and repulsive forces. State Assessment Boundaries: 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.	Partial alignment to 2016 STE standard 7.MS-PS2-3 which includes factors that influence electromagnets.

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

2001/6 Standard	Degree of alignment of 2001/6 standard to 2016 STE standard	Relative grade 2001/6 standard is found in 2016 STE standard	2016 MA STE Standards	Comments on alignment
3-5.PS.9. Recognize that magnets have poles that repel and attract each other.	comparable	same	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.	
			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.	2016 STE standard requires use of magnetic interactions but does not specify poles.
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.	comparable	same	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.	
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.	partial	in earlier grades	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.	2016 STE standard does not explicitly relate pitch to vibration but does require students to use that principle.
			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.	2016 STE standard does not include a medium through which to travel or relating pitch to vibration. The concept of a medium is introduced in 2016 STE standard 6.MS-PS4-2.
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.	partial	same	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 and reflection, or how the retina works are not expected in state assessment.	2016 STE standard does not include refraction, absorption or medium.
		in earlier grades	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.	2016 STE standard does not distinguish refraction and reflection; materials are the media but not specifically called out as such. The later 2016 STE standard 6.MS-PS4-2 is a comparable standard to the 2001/06 3-5.PS.12.
			2016 STE grade 3-5 standards that are in addition to current standards	
	additional	na	3-ESS3-1. Evaluate the merit of a design solution that reduces the damage caused by weather.* Clarification Statement: Examples of design solutions to reduce weather-related damage could include a barrier to prevent flooding, a wind-resistant roof, and a lightning rod.	
	additional	na	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 different organisms (species) and habitats involved.	
	additional	na	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.	

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

2001/6 Standard	Degree of alignment of 2001/6 standard to 2016 STE standard	Relative grade 2001/6 standard is found in 2016 STE standard	2016 MA STE Standards	Comments on alignment
	additional	na	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.	
	additional	na	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 an earthquake-resistant building or a constructed wetland to mitigate flooding.	
	additional	na	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 are not expected in state assessment.	
	additional	na	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 Earth. State Assessment Boundary: Other factors that affect apparent brightness (such as stellar masses, age, or stage) are not expected in state assessment.	
	additional	na	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.	
	additional	na	5-ESS3-1. Obtain and combine information about ways communities reduce human 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.	
	additional	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.*	
	additional	na	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.	
	additional	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.*	
	additional	na	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 of decomposition.	

2001/6 Standard	Degree of alignment of 2001/6 standard to 2016 STE standard	Relative grade 2001/6 standard is found in 2016 STE standard	2016 MA STE Standards	Comments on alignment
ESS. Earth and Space Science			**ESS. Earth and Space Science**	**ESS. Earth and Space Science**
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.	comparable	in earlier grades	4-ESS2-2. Analyze and interpret maps of Earth's mountain ranges, deep ocean trenches, and the placement of volcanoes and earthquakes to describe patterns of these features and their locations relative to boundaries between continents and oceans.	2016 STE standard does not specifically mention contour maps.
6-8.ESS.2. Describe the layers of the earth, including the lithosphere, the hot convecting mantle, and the dense metallic core.	partial	same	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.	2016 STE standard only focuses on convection in earth's interior but does not include layers of the earth.
	included in later grades	in later grades	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.	Comparable 2016 STE standard in HS-ESS2-3.
6-8.ESS.3. Differentiate among radiation, conduction, and convection, the three mechanisms by which heat is transferred through the earth's system.	comparable	same	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.	
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.	partial	same	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.	2016 STE standard focuses more on ocean rather than global wind patterns.
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).	comparable	same	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 Wegener's visuals. State Assessment Boundary: Mechanisms for plate motion or paleomagnetic anomalies in oceanic and continental crust are not expected in state assessment.	
			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.	
			8.MS-ESS2-1. Use a model to illustrate that energy from the 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.	2016 STE standard does not include distinction between fast and slow and does not specify 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.	comparable	same	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.	2016 STE standard does not include deposition.
		in earlier grades	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.	2016 STE standard does not include weathering.

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

2001/6 Standard	Degree of alignment of 2001/6 standard to 2016 STE standard	Relative grade 2001/6 standard is found in 2016 STE standard	2016 MA STE Standards	Comments on alignment
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.	comparable	same	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 Wegener's visuals. State Assessment Boundary: Mechanisms for plate motion or paleomagnetic anomalies in oceanic and continental crust are not expected in state assessment.	2016 STE standard does not include glaciation.
			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.	2016 STE standard does not include fossils.
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.	partial	same	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.	2016 STE standard does not include formation.
		in earlier grades	5-PS2-1. Support an argument with evidence that the gravitational force exerted by Earth on objects is directed toward Earth's center. State Assessment Boundary: Mathematical representation of gravitational force is not expected in state assessment.	2016 STE standard only includes gravity as a force toward Earth's center.
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.	comparable	same	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.	2016 STE standard does not include tides.
			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.	2016 STE standard does not include eclipses or phases.
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).	not included	na		
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.	comparable	same	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 or graphical.	
6-8.ESS.12 Recognize that the universe contains many billions of galaxies, and that each galaxy contains many billions of stars.	comparable	same	6.MS-ESS1-5(MA). Use graphical displays to illustrate that 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.	
ETS: Technology/Engineering			**ETS: Technology/Engineering**	**ETS: Technology/Engineering**
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).	comparable	same	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.	2016 STE standard does not include application in a design task.
			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.	
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.	partial	same	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.	2016 STE standard does not include the range of specific purposes.
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.	comparable	same	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.	

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

2001/6 Standard	Degree of alignment of 2001/6 standard to 2016 STE standard	Relative grade 2001/6 standard is found in 2016 STE standard	2016 MA STE Standards	Comments on alignment
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.	comparable	same	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.	2016 STE standard only includes communication.
			7.MS-ETS1-2. Evaluate competing solutions to a given design problem using a design 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.*	2016 STE standard only includes identifying solution, testing and evalulating.
			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.*	2016 STE standard only includes evaluation and redesign.
			7.MS-ETS1-7(MA). Construct a prototype of a solution to a given design problem.*	2016 STE standard only includes constructing a prototype.
		in earlier grades	3.3-5-ETS1-2. Generate several possible solutions to a given 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.	2016 STE standard does not include the full engineering design process.
			4.3-5-ETS1-3. Plan and carry out tests of one or more design features of a given model or prototype in which variables are controlled and failure points are considered to identify which features need to be improved. Apply the results of tests to redesign a model or prototype.* Clarification Statement: Examples of design features can include materials, size, shape, and weight.	2016 STE standard does not include the full engineering design process.
6-8.TE.2.2. Demonstrate methods of representing solutions to a design problem, e.g., sketches, orthographic projections, multiview drawings.	comparable	same	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.	
6-8.TE.2.3. Describe and explain the purpose of a given prototype.	comparable	same	7.MS-ETS1-7(MA). Construct a prototype of a solution to a given design problem.*	
6-8.TE.2.4. Identify appropriate materials, tools, and machines needed to construct a prototype of a given engineering design.	comparable	same	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.	
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.	comparable	same	7.MS-ETS1-2. Evaluate competing solutions to a given design problem using a design 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.*	
6-8.TE.2.6. Identify the five elements of a universal systems model: goal, inputs, processes, outputs, and feedback.	comparable	same	7.MS-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.	
	included in later grades	In later grades	HS-ETS3-1(MA). Model a technological system in which the output of one subsystem becomes the input to other subsystems.	Partial alignment to 2016 STE standard HS-ETS3-1(MA).
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.	comparable	same	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.	2016 STE standard does not include retrieval and destination.
		in earlier grades	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 1's and 0's representing black and white to send information about a picture, and using Morse code to send text.	2016 STE standard does not include parts of a communication system per se.
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).	partial	same	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.	2016 STE standard does not include specific components or products.
6-8.TE.3.3. Identify and compare communication technologies and systems, i.e., audio, visual, printed, and mass communication.	comparable	same	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 Internet. Examples of benefits and drawbacks can include speed of communication, distance or range, number of people reached, audio only vs. audio and visual, or one way vs. two way communication.	
6-8.TE.3.4. Identify and explain how symbols and icons (e.g., international symbols and graphics) are used to communicate a message.	not included	na		

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

2001/6 Standard	Degree of alignment of 2001/6 standard to 2016 STE standard	Relative grade 2001/6 standard is found in 2016 STE standard	2016 MA STE Standards	Comments on alignment
6-8.TE.4.1. Describe and explain the manufacturing systems of custom and mass production.	included in later grades	In later grades	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.	Partial alignment to 2016 STE standard HS-ETS2-3(MA) which includes both custom and mass production but focused on costs and benefits rather than manufacturing systems per se.
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.	not included	na		
6-8.TE.4.3. Describe a manufacturing organization, e.g., corporate structure, research and development, production, marketing, quality control, distribution.	not included	na		
6-8.TE.4.4. Explain basic processes in manufacturing systems, e.g., cutting, shaping, assembling, joining, finishing, quality control, and safety.	comparable	same	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.	
6-8.TE.5.1. Describe and explain parts of a structure, e.g., foundation, flooring, decking, wall, roofing systems.	comparable	same	7.MS-ETS3-4(MA). Show how the components of a structural system work together to serve a structural function. 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 identification 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 or forces are not expected in state assessment.	
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).	partial	same	7.MS-ETS3-4(MA). Show how the components of a structural system work together to serve a structural function. 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 identification 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 or forces are not expected in state assessment.	2016 STE standard includes bridges as an example, but does not specify the specific types.
6-8.TE.5.3. Explain how the forces of tension, compression, torsion, bending, and shear affect the performance of bridges.	comparable	same	7.MS-ETS3-4(MA). Show how the components of a structural system work together to serve a structural function. 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 identification 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 or forces are not expected in state assessment.	
6-8.TE.5.4. Describe and explain the effects of loads and structural shapes on bridges.	partial	same	7.MS-ETS3-4(MA). Show how the components of a structural system work together to serve a structural function. 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 identification 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 or forces are not expected in state assessment.	2016 STE standard includes some analysis of forces on a bridge, but does not include structural shapes.
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.	partial	same	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.	2016 STE standard is not focused on operation in different contexts and does not include space.
6-8.TE.6.2. Given a transportation problem, explain a possible solution using the universal systems model.	not included	na		
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.	comparable	same	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.	

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

2001/6 Standard	Degree of alignment of 2001/6 standard to 2016 STE standard	Relative grade 2001/6 standard is found in 2016 STE standard	2016 MA STE Standards	Comments on alignment
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.	included in later grades	In later grades	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	Comparable 2016 STE standard HS-ETS3-6(MA).
6-8.TE.7.1. Explain examples of adaptive or assistive devices, e.g., prosthetic devices, wheelchairs, eyeglasses, grab bars, hearing aids, lifts, braces.	not included	na		
6-8.TE.7.2. Describe and explain adaptive and assistive bioengineered products, e.g., food, bio-fuels, irradiation, integrated pest management.	not included	na		
LS. Life Science			**LS. Life Science**	**LS. Life Science**
6-8.LS.1. Classify organisms into the currently recognized kingdoms according to characteristics that they share. Be familiar with organisms from each kingdom.	not included	na		
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	partial	same	6.MS-LS1-1. Provide evidence that all 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.	2016 STE standard does not specify that one cell must carry out all the functions of life.
6-8.LS.3. Compare and contrast plant and animal cells, including major organelles (cell membrane, cell wall, nucleus, cytoplasm, chloroplasts, mitochondria, vacuoles).	partial	same	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 Statement: 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 release 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, the role of ATP, active transport processes involving the cell membrane, or identifying or comparing different types of cells are not expected in state assessment.	2016 STE standard does not ask for a comparison of plant and animal cells.
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.	comparable	same	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 Statement: 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 release 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, the role of ATP, active transport processes involving the cell membrane, or identifying or comparing different types of cells are not expected in state assessment.	
6-8.LS.5. Describe the hierarchical organization of multicellular organisms from cells to tissues to organs to systems to organisms.	comparable	same	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 functions 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/developing. An example of interacting systems could include the respiratory system taking in 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 Boundaries: 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.	

2001/6 Standard	Degree of alignment of 2001/6 standard to 2016 STE standard	Relative grade 2001/6 standard is found in 2016 STE standard	2016 MA STE Standards	Comments on alignment
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.	partial	same	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 functions 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/developing. An example of interacting systems could include the respiratory system taking in 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 Boundaries: 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.	2016 STE standard does not include reproduction or immune systems.
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.	comparable	same	8.MS-LS3-2. Construct an argument based on evidence to describe 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.	2016 STE standard includes heredity but does not specify chromosomes.
			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.	2016 STE standard does not explicate heredity but the concept is needed.
		in earlier grades	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.	2016 STE standard includes notion of heredity but not other aspects of 2001/06 standard.
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.	partial	same	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 the individual. State Assessment Boundary: Specific changes at the molecular level or mechanisms for protein synthesis are not expected in state assessment.	2016 STE standard does not include 30,000 genes/23 chromosomes.
			8.MS-LS3-4(MA). Develop and use a model to show that sexually reproducing organisms 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 Statement: Examples of models can include Punnett squares, diagrams (e.g., simple pedigrees), and simulations. State Assessment Boundary: State assessment will limit inheritance patterns to dominant-recessive alleles only.	2016 STE standard does not include 30,000 genes/23 chromosomes.
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).	comparable	same	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.	
			8.MS-LS3-4(MA). Develop and use a model to show that sexually reproducing organisms 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 Statement: Examples of models can include Punnett squares, diagrams (e.g., simple pedigrees), and simulations. State Assessment Boundary: State assessment will limit inheritance patterns to dominant-recessive alleles only.	

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

2001/6 Standard	Degree of alignment of 2001/6 standard to 2016 STE standard	Relative grade 2001/6 standard is found in 2016 STE standard	2016 MA STE Standards	Comments on alignment
6-8.LS.10. Give examples of ways in which genetic variation and environmental factors are causes of evolution and the diversity of organisms.	partial	same	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 have are different than their ancestors' environments.	2016 STE standard does indicate diversity of organisms.
			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 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.	2016 STE standard does not address evolution or diversity of organisms specifically.
6-8.LS.11. Recognize that evidence drawn from geology, fossils, and comparative anatomy provides the basis of the theory of evolution.	comparable	same	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 have are different than their ancestors' environments.	
6-8.LS.12. Relate the extinction of species to a mismatch of adaptation and the environment.	comparable	same	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.	
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.	comparable	same	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.	2016 STE standard does not include ecosystem survival.
			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.	2016 STE standard gets at ecosystem survival.
6-8.LS.14. Explain the roles and relationships among producers, consumers, and decomposers in the process of energy transfer in a food web.	comparable	same	7.MS-LS2-3. Develop a model to describe that matter and energy cycle 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, aas 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.	
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.	comparable	same	7.MS-LS2-3. Develop a model to describe that matter and energy cycle 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, aas 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.	
		in earlier grades	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 are not expected in state assessment.	

2001/6 Standard	Degree of alignment of 2001/6 standard to 2016 STE standard	Relative grade 2001/6 standard is found in 2016 STE standard	2016 MA STE Standards	Comments on alignment
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.	partial	in earlier grades	5-LS1-1. Ask testable questions about the process by which plants use air, water, and energy from 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 state assessment.	2016 STE standard does not include carbon dioxide or water; nor does it include the use of food by others.
			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 are not expected in state assessment.	2016 STE standard does not include carbon dioxide or water.
		same	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 Statement: 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 release 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, the role of ATP, active transport processes involving the cell membrane, or identifying or comparing different types of cells are not expected in state assessment.	2016 STE standard focuses on cell organelle and products, not the specific process nor what happens to the "food".
	included in later grades	in later grades	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 molecules are not expected in state assessment.	Comparable alignment to 2016 STE standard HS-LS1-5.
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.	comparable	same	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.	2016 STE standard focuses on environmental change in the context of geologic time but does not includes causes or catastrophes.
			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.	2016 STE standard includes changes to ecosystems due to changing conditions, but does not include geologic time or catastrophes.
			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.	2016 STE standard includes changes to ecosystems (including due to humans) but does not include geologic time.
			7.MS-ESS2-2. Construct an explanation based on evidence for how Earth's surface has changed over scales that range from microscopic to global in size. Clarification Statements: Examples of processes occurring over large spatial scales include plate motion and ice ages. Examples of changes occurring over small spatial scales include earthquakes and seasonal weathering and erosion.	2016 STE standard only includes changes in plate motion and ice ages (climate).
6-8.LS.18. Recognize that biological evolution accounts for the diversity of species developed through gradual processes over many generations.	comparable	same	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 have are different than their ancestors' environments.	
			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.	2016 STE draft standard does not specifically call out diversity of species.

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

2001/6 Standard	Degree of alignment of 2001/6 standard to 2016 STE standard	Relative grade 2001/6 standard is found in 2016 STE standard	2016 MA STE Standards	Comments on alignment
PS. Physical Science			**PS. Physical Science**	**PS. Physical Science**
6-8.PS.1. Differentiate between weight and mass, recognizing that weight is the amount of gravitational pull on an object.	partial	same	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 Sun, Earth, and other planets. State Assessment Boundary: Newton's law of gravitation or Kepler's laws are not expected in state assessment.	2016 STE standard does not differentiate between weight and mass.
		in earlier grades	5-PS2-1. Support an argument with evidence that the gravitational force exerted by Earth on objects is directed toward Earth's center. State Assessment Boundary: Mathematical representation of gravitational force is not expected in state assessment.	2016 STE standard does not differentiate between weight and mass.
6-8.PS.2. Differentiate between volume and mass. Define density.	comparable	same	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.	
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.	not included	na		
6-8.PS.4. Explain and give examples of how mass is conserved in a closed system.	comparable	same	8.MS-PS1-5. Use a model to explain that atoms 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.	2016 STE standard does not specify mass.
		in earlier grades	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.	
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.	comparable	same	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 thousand 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, or 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, or a 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.	
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).	comparable	same	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 thousand 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, or 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, or a complete depiction of all individual atoms in a complex molecule or extended structure, or calculations of proportions in mixtures is not expected in state assessment.	
6-8.PS.7. Give basic examples of elements and compounds.	comparable	same	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 thousand 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, or 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, or a 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.	

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

2001/6 Standard	Degree of alignment of 2001/6 standard to 2016 STE standard	Relative grade 2001/6 standard is found in 2016 STE standard	2016 MA STE Standards	Comments on alignment
6-8.PS.8. Differentiate between mixtures and pure substances.	comparable	same	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 the component pure substances. Clarification Statement: Examples of common mixtures include salt water, oil and vinegar, milk, concrete, and air.	
		in earlier grades	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).	2016 STE standard does not explicitly differentiate the two.
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.	partial	same	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.	2016 STE standard does not specify melting and boiling point as independent of amount but these are used a basis for identifying substances and hence chemical changes.
6-8.PS.10. Differentiate between physical changes and chemical changes.	comparable	same	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.	
		in earlier grades	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.	2016 STE standard does not explicitly differentiate between physical and chemical changes, but includes both.
			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).	2016 STE standard does not explicitly differentiate between physical and chemical changes, but includes both.
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.	partial	same	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: Calculations or manipulation of the formula for kinetic energy is not expected ni state assessment.	2016 STE standard includes speed but not a focus on describing motion broadly.
		in earlier grades	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.	3-PS2-1 includes descriptions of motion from a qualitative perspective.
6-8.PS.12. Graph and interpret distance vs. time graphs for constant speed.	included in later grades	In later grades	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 (entropy change) while assuming the overall energy in the system is conserved. State Assessment Boundary: Calculations involving Gibbs free energy are not expected on state assessment.	Comparable 2016 STE standards HS-PS2-1 includes graphing motion, position, and speed.
6-8.PS.13. Differentiate between potential and kinetic energy. Identify situations where kinetic energy is transformed into potential energy and vice versa.	comparable	same	7.MS-PS3-2. Develop a model to describe the relationship between the relative positions 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 Boundaries: State assessment will be limited to electric, magnetic, and gravitational interactions and to interactions of two objects at a time. Calculations of potential energy are not expected in state assessment.	2016 STE standard only includes potential energy.
			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.	2016 STE standard includes a specific case of transfer of kinetic energy but not the broader context of any transformation.

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

2001/6 Standard	Degree of alignment of 2001/6 standard to 2016 STE standard	Relative grade 2001/6 standard is found in 2016 STE standard	2016 MA STE Standards	Comments on alignment
			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, therma, and light; types of potential energy include gravitational, elastic, and chemical.	
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.	comparable	same	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.	
			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 heat or the total amount of thermal energy transferred are not expected in state assessment.	
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.	comparable	same	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.	
6-8.PS.16. Give examples of how heat moves in predictable ways, moving from warmer objects to cooler ones until they reach equilibrium.	partial	same	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.	2016 STE standard adds an element of engineering design; does not specify equilibrium.
			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 heat or the total amount of thermal energy transferred is not expected in state assessment.	2016 STE standard does not address equilibrium directly.
	included in later grades	in later grades	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 (entropy change) while assuming the overall energy in the system is conserved. State Assessment Boundary: Calculations involving Gibbs free energy are not expected on state assessment.	Comparable 2016 STE standard HS-PS3-4a includes equilibrium.
			2016 STE grade 6-8 standards that go beyond/add to current standards	
	additional	na	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).	
	additional	na	7.MS-ESS3-4. Construct an argument supported by evidence that 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.	
	additional	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.	
	additional	na	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.*	

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

2001/6 Standard	Degree of alignment of 2001/6 standard to 2016 STE standard	Relative grade 2001/6 standard is found in 2016 STE standard	2016 MA STE Standards	Comments on alignment
	additional	na	8.MS-ETS2-4(MA). Use informational texts 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 or a plastic material becoming rigid (less elastic) after heat treatment.	
	additional	na	7.MS-LS1-4. Construct an explanation based on evidence, for 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 vocalizations of animals 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.	
	additional	na	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.	
	additional	na	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).	
	additional	na	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.	

High School Earth Space Science Crosswalk of 2001/2006 Standards to 2016 MA STE Standards

2001/6 Standard	Degree of alignment of 2001/6 standard to 2016 STE standard	Relative grade 2001/6 standard is found in 2016 STE standard	2016 MA STE Standards	Comments on alignment
ESS. Earth and Space Science			**ESS. Earth and Space Science**	**ESS. Earth and Space Science**
HS.ESS.1.1. Identify Earth's principal sources of internal and external energy, such as radioactive decay, gravity, and solar energy.	partial	same	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 interior. Clarification Statements: 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.	2016 STE standard only includes internal energy.
		in earlier grades	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.	2016 STE standard only includes internal energy.
HS.ESS.1.2. Describe the characteristics of electromagnetic radiation and give examples of its impact on life and Earth's systems.	partial	same	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 Earth's orbit and the orientation of its axis over tens 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 is limited to changes in surface temperatures, precipitation patterns, glacial ice volumes, sea levels, and biosphere distribution in state assessment.	2016 STE standard does not specify electromagnetic radiation and is limited to impact on climate.

High School Earth Space Science Crosswalk of 2001/2006 Standards to 2016 MA STE Standards

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.	partial	same	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 Earth's orbit and the orientation of its axis over tens 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 is limited to changes in surface temperatures, precipitation patterns, glacial ice volumes, sea levels, and biosphere distribution in state assessment.	2016 STE standard includes flow of energy through earth's systems as it relates to climate change, and while examples related to the 2001/06 standard are included, they are not about causes of atmospheric processes per se.
		in earlier grades	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.	2016 STE standard only includes convection, conduction and radiation.
			8.MS-ESS2-5. Interpret basic weather data to identify patterns in air mass interactions and the relationship of those patterns to local 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 in weather maps, data tables, diagrams, or 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.	2016 STE standard includes atmospheric processes but does not include transfer of energy per se.
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).	partial	same	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 Earth's orbit and the orientation of its axis over tens 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 is limited to changes in surface temperatures, precipitation patterns, glacial ice volumes, sea levels, and biosphere distribution in state assessment.	2016 STE standard does not specify global circulation patterns, the Coriolis effect, or Massachusetts weather.
		in earlier grades	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.	2016 STE standard focuses on the role of the ocean but does indicate unequal heating and its impact on weather and climate.
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).	comparable	in earlier grades	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 or graphical.	2016 STE standard does not specify equinoxes and solstices.
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.	partial	in earlier grades	8.MS-ESS2-5. Interpret basic weather data to identify patterns in air mass interactions and the relationship of those patterns to local 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 in weather maps, data tables, diagrams, or 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.	2016 STE standard does not include impact on human affairs.

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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.	partial	in earlier grades	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.	2016 STE standard does not specify the particular currents included in the 2001/06 standard.
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.	partial	same	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.	2016 STE standard does not specify ground-based observations, satellite data, and computer models.
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).	partial	in earlier grades	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.	2016 STE standard does not explicitly compare types of energy resources.
HS.ESS.2.2. Describe the effects on the environment and on the carbon cycle of using both renewable and nonrenewable sources of energy.	partial	same	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 atmospheric and climate changes .	2016 STE standard includes the effects on the carbon cycle from human activity but does not differentiate effects from renewable and nonrenewable sources.
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.	comparable	same	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).	2016 STE standard is focused the role of water in weathering and erosion while the 2001/06 standard is broader.
		in earlier grades	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.	2016 STE standard includes the impact of erosion on landscapes, but not weathering.
			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 processes 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.	2016 STE standard includes mechanical weathering, but not chemical weathering, nor a focus on landscapes.
HS.ESS.3.2. Describe the carbon cycle.	comparable	same	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 atmospheric and climate changes.	
HS.ESS.3.3. Describe the nitrogen cycle.	not included	na		

HS.ESS.3.4. Explain how water flows into and through a watershed. Explain the roles of aquifers, wells, porosity, permeability, water table, and runoff.	partial	in earlier grades	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.	2016 STE standard does not specifically mention watersheds but does includes aspects of water moving through an area or system.
			5-ESS2-1. Use a model to describe the cycling of water through a watershed through evaporation, precipitation, absorption, surface runoff, and condensation. State Assessment Boundary: Transpiration or explanations of mechanisms that drive the cycle are not expected in state assessment.	2016 STE standard does not include some elements of the 2001/06 standard.
HS.ESS.3.5. Describe the processes of the hydrologic cycle, including evaporation, condensation, precipitation, surface runoff and groundwater percolation, infiltration, and transpiration.	partial	in earlier grades	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.	2016 STE standard is about the hydrologic cycle but does not explicate the specific components.
			5-ESS2-1. Use a model to describe the cycling of water on Earth through a watershed between the geosphere, biosphere, hydrosphere, and atmosphere through evaporation, precipitation, absorption, surface runoff, and condensation, and transpiration. State Assessment Boundary: Transpiration or explanations of mechanisms that drive the cycle are not expected in state assessment.	2016 STE standard does not include percolation, infiltration, or transpiration.
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.	partial	in earlier grades	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.	2016 STE standard does not specify particular processes or properties of rock types or minerals.
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.	partial	in earlier grades	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.	2016 STE standard does not include radiometric dating.
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	comparable	same	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).	
		in earlier grades	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.	

HS.ESS.3.9. Explain the relationship between convection currents in Earth's mantle and the motion of the lithospheric plates.	comparable	same	HS-ESS2-3. Use a model based on evidence of Earth's interior to describe the cycling of matter by thermal convection. Clarification Statements: Emphasis is on both a one-dimensional model of Earth, with radial layers determined by density, and a three-dimensional model, which is controlled by mantle convection and the resulting plate tectonics. 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.	
HS.ESS.3.10. Relate earthquakes, volcanic activity, tsunamis, mountain building, and tectonic uplift to plate movements.	comparable	in earlier grades	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.	
HS.ESS.3.11. Explain how seismic data are used to reveal Earth's interior structure and to locate earthquake epicenters.	partial	same	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 interior. Clarification Statements: 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.	2016 STE standard does not include locating earthquake epicenters.
HS.ESS.3.12. Describe the Richter scale of earthquake magnitude and the relative damage that is incurred by earthquakes of a given magnitude.	not included	na		
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").	comparable	same	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).	
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).	comparable	same	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.	2016 STE standard does not include Sun-Earth-moon relationships.
		in earlier grades	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.	2016 STE standard does not address orbiting bodies but does include Sun-Earth-moon relationships.
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.	not included	na		

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			2016 STE high school standards that are in addition to current standards	
	additional	na	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.	
	additional	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).	
	additional	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.	
	additional	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).	

High School Life Science Crosswalk of 2001/2006 Standards to 2016 MA STE Standards

2001/6 Standard	Degree of alignment of 2001/6 standard to 2016 STE standard	Relative grade 2001/6 standard is found in 2016 STE standard	2016 MA STE Standards	Comments on alignment
LS. Life Science			**LS. Life Science**	**LS. Life Science**
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.	comparable	same	HS-LS1-6. Construct an explanation based on evidence that organic molecules are primarily composed of six elements, where carbon, hydrogen, and oxygen atoms from carbohydrates may combine with nitrogen, sulfur, and phosphorus to form monomers that 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.	
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).	partial	same	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.	2016 STE standard only includes proteins and it's primary function.
			HS-LS1-6. Construct an explanation based on evidence that organic molecules are primarily composed of six elements, where carbon, hydrogen, and oxygen atoms from carbohydrates may combine with nitrogen, sulfur, and phosphorus to form monomers that 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.	2016 STE standard includes knowing about each of the four types, but does not include function of each molecule type.

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.	partial	same	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.	2016 STE standard does not include factors that affect enzymes.
			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 molecules are not expected in state assessment.	2016 STE standard focuses on factors that affect the impact of catalysts on rates of reactions, but not on enzymes.
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).	partial	in earlier grades	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 identifications of specific proteins in cells are not expected in state assessment.	2016 STE standard does not include all components of the cell indicated in the 2001/2006 standard.
HS.LS.2.2. Compare and contrast, at the cellular level, the general structures and degrees of complexity of prokaryotes and eukaryotes.	not included	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 (Archaebacteria, Eubacteria, Protista, Fungi, Plantae, Animalia).	not included	na		

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.	comparable	same	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 molecules are not expected in state assessment.	2016 STE standard does not include cellular respiration.
			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 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.	2016 STE standard does not include photosynthesis.
			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 photosynthesis, respiration, decomposition, and combustion are not expected in state assessment.	2016 STE standard includes all components, but at a larger scale than 2001/06 standard.
HS.LS.2.5. Explain the important role that ATP serves in metabolism.	comparable	same	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 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.	
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.	comparable	same	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.	
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.	partial	same	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	2016 STE standard focuses on the role and importance of meiosis, but does not call for specific components such as haploid cells, gametes or diploid zygotes.
HS.LS.2.8. Compare and contrast a virus and a cell in terms of genetic material and reproduction.	partial	same	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 types of viral reproduction (e.g., lytic and lysogenic) are not expected in state assessment.	2016 STE standard does not specifically compare a virus and a cell.

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.	comparable	same	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.	2016 STE standard does not include function in genetic inheritance.
			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.	2016 STE standard includes function of DNA in inheritance.
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.	comparable	same	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.	
			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.	2016 STE standard includes DNA replication, but does not specify details.

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.	comparable	same	HS-LS3-2. Make and defend a claim based on evidence that genetic variations (alleles) may result from (a) new genetic combinations via the processes of crossing over and random segregation of chromosomes during 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 evidence 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.	2016 STE standard includes mutations and resulting variation but does not specify phenotypic change.
		in earlier grades	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.	2016 STE standard focuses on impact of mutations but does not specify gametes or resulting differences in offspring.
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).	partial	same	HS-LS3-2. Make and defend a claim based on evidence that genetic variations (alleles) may result from (a) new genetic combinations via the processes of crossing over and random segregation of chromosomes during 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 evidence 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.	2016 STE standard focuses on inheritance of genetic traits, but does not include specific types.
			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.	2016 STE standard includes only Mendelian inheritance patterns, not the full list from the 2001/06 standards.
		in earlier grades	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.	2016 STE standard includes dominant and recessive patterns but not other types.

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).	partial	same	HS-LS3-2. Make and defend a claim based on evidence that genetic variations (alleles) may result from (a) new genetic combinations via the processes of crossing over and random segregation of chromosomes during 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 evidence 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.	2016 STE standard focuses on inheritance of genetic traits but does not include patterns of inheritance.
		in earlier grades	8.MS-LS3-4(MA). Develop and use a model to show that sexually reproducing organisms 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 Statement: Examples of models can include Punnett squares, diagrams (e.g., simple pedigrees), and simulations. State Assessment Boundary: State assessment will limit inheritance patterns to dominant-recessive alleles only.	2016 STE standard includes concept of two alleles and their role in inheritance.
HS.LS.3.6. Use a Punnett Square to determine the probabilities for genotype and phenotype combinations in monohybrid crosses.	partial	same	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.	
	partial	in earlier grades	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.	2016 STE standard includes using Punnett squares to identify combinations but does not specify calculating probabilities.
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.	partial	same	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 identifications of specific proteins in cells are not expected in state assessment.	2016 STE standard includes the key function of the digestive system and two key parts, but does not include full set of specific parts of the system.
		in earlier grades	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 and/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.	2016 STE standard does not specify the digestive system or use of materials for cell repair, but includes conversion of molecules for energy and growth.
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.	partial	same	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 Statements: 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.	2016 STE standard includes the key function of the circulatory system and two key parts, but does not include full set of specific parts of the system.

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HS.LS.4.3. Explain how the respiratory system (nose, pharynx, larynx, trachea, lungs, alveoli) provides exchange of oxygen and carbon dioxide.	partial	same	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 Statements: 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.	2016 STE standard includes the key function of the respiratory system and two key parts, but does not include full set of specific parts of the system.
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.	partial	same	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 Statements: 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.	2016 STE standard includes the key function of the nervous system and two key parts, but does not include full set of specific parts of the system.
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.	partial	same	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 Statements: 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.	2016 STE standard includes the key function of the circulatory system and two key parts, but does not include full set of specific parts of the system, nor that bones produce blood cells
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.	comparable	same	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's, and hence two variants (alleles) of each gene that can be the same or different from each other, with each chromosome acquired at random from both parents Clarification Statements: Examples of models can include Punnett squares, diagrams, and simulations. Focus should be on dominant-recessive pattern of inheritance.	2016 STE standard does not include offspring not being identical to their parents (this is noted in PreK but not in relation to sexually reproducing organisms).
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.	partial	same	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 Statements: 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.	2016 STE standard includes the key function of the nervous system and two key parts, but does not include full set of specific parts of the system.

HS.LS.4.8. Recognize that the body's systems interact to maintain homeostasis. Describe the basic function of a physiological feedback loop.	comparable	same	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.	
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.	comparable	same	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.	
			HS-LS4-2. Construct an explanation based on evidence that the process 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.	
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.	partial	same	HS-LS4-5. Evaluate models that demonstrate how changes in an environment may result in the evolution of a population, 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.	2016 STE standard includes concept of speciation but does not include classification or specifically defines species.
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.	comparable	same	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 (feeding relationships, symbiosis, 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.	2016 STE standard includes biodiversity and genetic diversity but does not include specific references to natural selection.
			HS-LS4-5. Evaluate models that demonstrate how changes in an environment may result in the evolution of a population, 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.	2016 STE standard includes natural selection but does not specifically mention biodiversity.
HS.LS.6.1. Explain how birth, death, immigration, and emigration influence population size.	partial	same	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.	2016 STE standard focuses on factors influencing population sizes, but does not mention the specific factors (birth, immigration, and emmigration) at the ecosystem level.

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.	comparable	same	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.	2016 STE standard includes factors influencing population but does not include biodiversity or invasives.
			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.	2016 STE standard includes factors that influence biodiversity but does not mention population size, speciation, or extinction.
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.	comparable	same	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.)	2016 STE standard focuses on energy transfer through trophic levels but does not talk about relationships among organisms nor mention specific use of food webs.
		in earlier grades	7.MS-LS2-3. Develop a model to describe that matter and energy cycle 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.	2016 STE standard includes only the patterns of interactions between organisms and not other components of the 2001/2006 standard.
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.	comparable	same	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.)	
			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 model. State Assessment Boundary: The specific chemical steps of respiration, decomposition, and combustion are not expected in state assessment.	

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			2016 STE high school standards that are in addition to current standards	
			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 a keystone species, climate changes, ocean acidification, or sea level rise.	
			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 (e.g., 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.	

High School Chemistry Crosswalk of 2001/2006 Standards to 2016 MA STE Standards

2001/6 Standard	Degree of alignment of 2001/6 standard to 2016 STE standard	Relative grade 2001/6 standard is found in 2016 STE standard	2016 MA STE Standards	Comments on alignment
PS: Chemistry			**PS: Chemistry**	**PS: Chemistry**
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.	comparable	same	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 to compare 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, and names and bonding angles in molecular geometries are not expected in state assessment.	2016 STE standard does not include examples of some physical properties listed in the 2001/06 standard. Chemical properties are not included in 2016 STE standard nor is distinguishing between chemical and physical changes.
		in earlier grades	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.	2016 STE standard does not include examples of conductivity or malleability.
			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.	2016 STE standard includes several of the listed physical properties (still does not include example of malleability directly); does not include chemical properties or changes.
HS.Chem.1.2. Explain the difference between pure substances (elements and compounds) and mixtures. Differentiate between heterogeneous and homogeneous mixtures.	partial	same	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.	2016 STE standard does not include differentiation of heterogeneous and homogeneous mixtures. 2001/6 standard is at the macro-level and 2016 STE standard is at the micro-level.
HS.Chem.1.3. Describe the three major states of matter (solid, liquid, gas) in terms of energy, particle motion, and phase transitions.	comparable	in earlier grades	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.	
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.	not included	na		
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.	partial	same	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.	2016 STE standard includes components of an atom and their interaction; does not include Rutherford's experiment.
HS.Chem.2.3. Interpret and apply the laws of conservation of mass, constant composition (definite proportions), and multiple proportions.	comparable	same	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	

HS.Chem.2.4. Write the electron configurations for the first twenty elements of the periodic table.	partial	same	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.	2016 STE standard does not specifically require students to write the complete electron configuration.
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).	not included	na		
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).	partial	in IP	HS-PS1-8. Develop a model to illustrate the changes in the composition of the nucleus of the atom and the energy released or absorbed during the processes of fission, fusion, and radioactive decay. Clarification Statements: Examples of models include simple qualitative models, such as pictures or diagrams. Types of radioactive decays include alpha, beta, and gamma. State Assessment Boundary: Quantitative calculations of energy released or absorbed are not expected in state assessment.	2016 STE standard does not include the use of nuclear equations or half-life.
HS.Chem.2.7. Compare and contrast nuclear fission and nuclear fusion.	partial	in IP	HS-PS1-8. Develop a model to illustrate the changes in the composition of the nucleus of the atom and the energy released or absorbed during the processes of fission, fusion, and radioactive decay. Clarification Statements: Examples of models include simple qualitative models, such as pictures or diagrams. Types of radioactive decays include alpha, beta, and gamma. State Assessment Boundary: Quantitative calculations of energy released or absorbed are not expected in state assessment.	
		same (in ESS)	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 life cycle, 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 the many different nucleosynthesis pathways for stars of differing masses, or calculations of energy released are not expected in state assessment.	2016 STE standard only includes fusion, not fission.
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.	partial	same	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.	2016 STE standard does not specifically require identification of families/groups and periods on the periodic table.
HS.Chem.3.2. Use the periodic table to identify the three classes of elements: metals, nonmetals, and metalloids.	partial	same	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.	2016 STE standard does not specifically require identification of metals, nonmetals, and metalloids.
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.	comparable	same	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.	
HS.Chem.3.4. Identify trends on the periodic table (ionization energy, electronegativity, and relative sizes of atoms and ions).	comparable	same	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.	

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.	comparable	same	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 or 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, Fe_2O_3); and, substances that are liquids and gases at room temperature are usually made of molecules that have covalent bonds (common examples include CO_2, N_2, CH_4, H_2O, C_8H_{18}).	
HS.Chem.4.2. Draw Lewis dot structures for simple molecules and ionic compounds.	not included	na		
HS.Chem.4.3. Use electronegativity to explain the difference between polar and nonpolar covalent bonds.	not included	na		
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.	comparable	same	HS-PS2-6. Communicate scientific and technical information about the molecular-level structures of polymers, ionic compounds, acids and bases, and metals to justify why these 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.	
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).	not included	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.	not included	na		
HS.Chem.5.1. Balance chemical equations by applying the laws of conservation of mass and constant composition (definite proportions).	comparable	same	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 predict the quantities (masses or moles) of specific reactants or products. Clarification Statements: Mathematical representations include balanced chemical equations that represent the laws of conservation of mass and constant composition (definite proportions), percent composition, empirical formulas, mass-to-mass stoichiometry, and calculations of percent yield. Calculations may involve mass-to-mass stoichiometry and atom economy comparisons, but only for single-step reactions that do not involve complexes.	
HS.Chem.5.2. Classify chemical reactions as synthesis (combination), decomposition, single displacement (replacement), double displacement, and combustion.	comparable	same	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 or 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, Fe_2O_3); and, substances that are liquids and gases at room temperature are usually made of molecules that have covalent bonds (common examples include CO_2, N_2, CH_4, H_2O, C_8H_{18}).	
HS.Chem.5.3. Use the mole concept to determine number of particles and molar mass for elements and compounds.	comparable	same	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 predict the quantities (masses or moles) of specific reactants or products. Clarification Statements: Mathematical representations include balanced chemical equations that represent the laws of conservation of mass and constant composition (definite proportions), percent composition, empirical formulas, mass-to-mass stoichiometry, and calculations of percent yield. Calculations may involve mass-to-mass stoichiometry and atom economy comparisons, but only for single-step reactions that do not involve complexes.	

HS.Chem.5.4. Determine percent compositions, empirical formulas, and molecular formulas.	partial	same	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 predict the quantities (masses or moles) of specific reactants or products. Clarification Statements: Mathematical representations include balanced chemical equations that represent the laws of conservation of mass and constant composition (definite proportions), percent composition, empirical formulas, mass-to-mass stoichiometry, and calculations of percent yield. Calculations may involve mass-to-mass stoichiometry and atom economy comparisons, but only for single-step reactions that do not involve complexes.	2016 STE standard does not specifically include molecular formulas.
HS.Chem.5.5. Calculate the mass-to-mass stoichiometry for a chemical reaction.	comparable	same	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 predict the quantities (masses or moles) of specific reactants or products. Clarification Statements: Mathematical representations include balanced chemical equations that represent the laws of conservation of mass and constant composition (definite proportions), percent composition, empirical formulas, mass-to-mass stoichiometry, and calculations of percent yield. Calculations may involve mass-to-mass stoichiometry and atom economy comparisons, but only for single-step reactions that do not involve complexes.	
HS.Chem.5.6. Calculate percent yield in a chemical reaction.	comparable	same	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 predict the quantities (masses or moles) of specific reactants or products. Clarification Statements: Mathematical representations include balanced chemical equations that represent the laws of conservation of mass and constant composition (definite proportions), percent composition, empirical formulas, mass-to-mass stoichiometry, and calculations of percent yield. Calculations may involve mass-to-mass stoichiometry and atom economy comparisons, but only for single-step reactions that do not involve complexes.]	
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.	comparable	same	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.	
HS.Chem.6.2. Perform calculations using the ideal gas law. Understand the molar volume at 273 K and 1 atmosphere (STP).	partial	same	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.	2016 STE standard does not explicate molar volume at standard conditions.
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.	comparable	in earlier grades	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.	

HS.Chem.6.4. Describe the law of conservation of energy. Explain the difference between an endothermic process and an exothermic process.	comparable	in earlier grades	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	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.	2016 STE standard does not specifically address conservation of energy.
			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 (entropy change) while assuming the overall energy in the system is conserved. State Assessment Boundary: Calculations involving Gibbs free energy are not expected in state assessment.	2016 STE standard does not address exothermic and endothermic processes.
HS.Chem.6.5. Recognize that there is a natural tendency for systems to move in a direction of disorder or randomness (entropy).	comparable	same	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 (entropy change) while assuming the overall energy in the system is conserved. State Assessment Boundary: Calculations involving Gibbs free energy are not expected in state assessment.	
HS.Chem.7.1. Describe the process by which solutes dissolve in solvents.	comparable	same	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.	
HS.Chem.7.2. Calculate concentration in terms of molarity. Use molarity to perform solution dilution and solution stoichiometry.	comparable	same	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 predict the quantities (masses or moles) of specific reactants or products. Clarification Statements: Mathematical representations include balanced chemical equations that represent the laws of conservation of mass and constant composition (definite proportions), percent composition, empirical formulas, mass-to-mass stoichiometry, and calculations of percent yield. Calculations may involve mass-to-mass stoichiometry and atom economy comparisons, but only for single-step reactions that do not involve complexes.	
HS.Chem.7.3. Identify and explain the factors that affect the rate of dissolving (e.g., temperature, concentration, surface area, pressure, mixing).	comparable	same	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.	
			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) 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.	
HS.Chem.7.4. Compare and contrast qualitatively the properties of solutions and pure solvents (colligative properties such as boiling point and freezing point).	partial	same	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 to compare 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, and names and bonding angles in molecular geometries are not expected in state assessment.	2016 STE standard does not specifically require comparison of solutions and pure solvents.

HS.Chem.7.5. Identify the factors that affect the rate of a chemical reaction (temperature, mixing, concentration, particle size, surface area, catalyst).	comparable	same	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) 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.	
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).	comparable	same	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 Statements: Conditions that can be altered to affect the extent of a reaction include temperature, pressure, and concentrations of reactants. Conditions that can be altered to affect the rates of a reaction 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.	
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.	comparable	same	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 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.	
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).	comparable	same	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 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.	
HS.Chem.8.3. Explain how a buffer works.	not included	na		
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.	comparable	same	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 Statement: Reactions are limited to simple oxidation-reduction reactions that do not require hydronium or hydroxide ions to balance half-reactions.	
			2016 STE high school standards that go beyond/add to current standards	
			none	

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

2001/6 Standard	Degree of alignment of 2001/6 standard to 2016 STE standard	Relative grade 2001/6 standard is found in 2016 STE standard	2016 MA STE Standards	Comments on alignment
PS: Introductory Physics			**PS: Introductory Physics**	**PS: Introductory Physics**
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).	not included	na		
HS-IP.1.2. Distinguish between displacement, distance, velocity, speed, and acceleration. Solve problems involving displacement, distance, velocity, speed, and constant acceleration.	comparable	same	HS-PS2-10(MA). Use free-body force diagrams and algebraic expressions representing Newton's laws of motion to predict changes to position, 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, average speed, and 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.	
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.	partial	same	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.	2016 STE standard does not focus on graphs although that is an example of how to represent motion.
HS-IP.1.4. Interpret and apply Newton's three laws of motion.	comparable	same	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.	2016 STE standard only includes 2nd law.
		in earlier grades	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.	2016 STE standard includes Newton's third law only, not 1st and 2nd.
			8.MS-PS2-2. Provide evidence that the change in an object's speed 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 aw) and unbalanced forces in a system, qualitative comparisons of forces, mass, and changes in speed (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.	2016 STE standard includes Newton's first and second laws, not the 3rd.
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.	comparable	same	HS-PS2-10(MA). Use free-body force diagrams and algebraic expressions representing Newton's laws of motion to predict changes to position, 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, average speed, and 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.	

HS.IP.1.6 Distinguish qualitatively between static and kinetic friction, and describe their effects on the motion of objects.	partial	same	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.	2016 STE standard does not distinquish between static and kinetic friction.
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.	comparable	same	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, or both are changed. State Assessment Boundaries: State assessment will be limited to systems with two objects. Permittivity of free space is not expected in state assessment.	
HS-IP.1.8. Describe conceptually the forces involved in circular motion.	not included	na		
HS-IP.2.1. Interpret and provide examples that illustrate the law of conservation of energy.	comparable	same	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.	
			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.	2016 STE standard requires the use of conservation of energy but is not explicitly about that.
HS-IP.2.2. Interpret and provide examples of how energy can be converted from gravitational potential energy to kinetic energy and vice versa.	comparable	same	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.	
			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.	2016 STE standard does not call out the particular types of energy.
HS-IP.2.3. Describe both qualitatively and quantitatively how work can be expressed as a change in mechanical energy.	comparable	same	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.	2016 STE Standard focuses on the context of a machine.
HS-IP.2.4. Describe both qualitatively and quantitatively the concept of power as work done per unit time.	not included	na		

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.	comparable	same	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.	
			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.	2016 STE standard does not explicate linear momentum, but requires the use of the concept.
HS-IP.3.1. Explain how heat energy is transferred by convection, conduction, and radiation.	comparable	in earlier grades	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.	2016 STE standard includes transfer but focus is not on the three methods.
			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.	
HS-IP.3.2. Explain how heat energy will move from a higher temperature to a lower temperature until equilibrium is reached.	comparable	same	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.	
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.	comparable	same	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.	2016 STE standard focuses on kinetic theory relating energy and molecular motion, not other components of the 2001/06 standard.
		in earlier grades	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.	2016 STE standard includes energy changes during phase changes, but does not include temperature.
			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 heat or the total amount of thermal energy transferred are not expected in state assessment.	2016 STE standard includes average kinetic energy and temperature, but does not specifically address phase change or relationships among processes.
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.	comparable	same	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 l owere temperature objects results in thermal equilibrium, or a more uniform energy distribution among the objects and that temperature changes necessary to acheive 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	

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.	partial	same	HSPS4-1. Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling within 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.	2016 STE standard does not include period, amplitude or harmonic motion.
		in earlier grades	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.	2016 STE standard does not include velocity or period, does not expect an explanation of the relationships among them, nor simple harmonic motion.
			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, or non-periodic waves are not expected in state assessment.	2016 STE standard does not include all measurable properties of waves, relationships among components, nor harmonic motion. The 2016 STE standard aligns to central concept: "Waves carry energy from place to place without the transfer of matter."
HS-IP.4.2. Distinguish between mechanical and electromagnetic waves.	comparable	same	HSPS4-1. Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling within 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	
HS-IP.4.3. Distinguish between the two types of mechanical waves, transverse and longitudinal.	not included	na		
HS-IP.4.4. Describe qualitatively the basic principles of reflection and refraction of waves.	comparable	same	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 invovling 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.	2016 STE standard only includes electromagnetic waves, not other types.
		in earlier grades	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 gasses. 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.	

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.	comparable	same	HSPS4-1. Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling within 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: Transistions between two media are not expected in state assessment.	
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).	not included	na		
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.	partial	in earlier grades	7.MS-PS2-3. Analyze data to describe the effect of distance and magnitude of electric charge on the strength of electric forces. Clarification Statement: Includes both attractive and repulsive forces. State Assessment Boundaries: 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.	2016 STE standard includes a notion of separation of charges but does not include charge on/in/through insulators or conductors.
			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.	2016 STE standard includes a notion of separation of charges but does not include charge on/in/through insulators or conductors.
HS-IP.5.2. Develop qualitative and quantitative understandings of current, voltage, resistance, and the connections among them (Ohm's law).	comparable	same	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, 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.	
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.	comparable	same	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, 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.	
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).	comparable	same	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, or both are changed. State Assessment Boundaries: State assessment will be limited to systems with two objects. Permittivity of free space is not expected in state assessment.	
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.	partial	same	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, 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.	2016 STE standard does not include power or calculation of power.

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.	comparable	same	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.	
			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.	2016 STE standard does not include application to technologies.
		in earlier grades	7.MS-PS2-3. Analyze data to describe the effect of distance and magnitude of electric charge on the strength of electric forces. Clarification Statement: Includes both attractive and repulsive forces. State Assessment Boundaries: 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.	2016 STE standard includes relationship between electric charge and current to electromagnetic forces, but does not include the application to technologies.
HS-IP.6.1. Recognize that electromagnetic waves are transverse waves and travel at the speed of light through a vacuum.	comparable	same	HSPS4-1. Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling within 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: Transistions between two media are not	
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.	not included	na		
			2016 STE high school standards that are in addition to current standards	
	additional	na	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.	

High School Technology/Engineering Crosswalk of 2001/2006 Standards to 2016 MA STE Standards

2001/6 Standard	Degree of alignment of 2001/6 to 2016 MA STE standard	Relative grade 2001/6 is found in 2016 STE standard	2016 MA STE Standards	Comments on alignment
ETS: Technology/Engineering			**ETS: Technology/Engineering**	**ETS: Technology/Engineering**
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.	partial	same	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.*	2016 MA STE standard only includes evaluating a solution.
			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.*	2016 MA STE standard only includes evaluating a solution.
			HS-ETS1-5(MA). Plan a prototype or design solution using orthographic projections and isometric drawings, using proper scales and proportions.*	2016 MA STE standard only includes planning using diagrams.
			HS-ETS1-6(MA). Document and present solutions that include specifications, performance results, successes and remaining issues, and limitations.*	2016 MA STE standard only includes communicating solutions.
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.	partial	same	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.	2016 MA STE standard does not include specific examples of technologies and how or why they are modified.
HS.TE.1.3. Produce and analyze multi-view drawings (orthographic projections) and pictorial drawings (isometric, oblique, perspective), using various techniques.	comparable	same	HS-ETS1-5(MA). Plan a prototype or design solution using orthographic projections and isometric drawings, using proper scales and proportions.*	
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).	comparable	same	HS-ETS1-5(MA). Plan a prototype or design solution using orthographic projections and isometric drawings, using proper scales and proportions.*	
HS.TE.1.5. Interpret plans, diagrams, and working drawings in the construction of prototypes or models.	partial	same	HS-ETS1-5(MA). Plan a prototype or design solution using orthographic projections and isometric drawings, using proper scales and proportions.*	2016 MA STE standard does not include interpreting alternate plans.
HS.TE.2.1. Identify and explain the engineering properties of materials used in structures (e.g., elasticity, plasticity, R value, density, strength).	partial	same	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. Clarification Statement: Examples of material properties can include resistance to force, density, hardness, and elasticity.	2016 MA STE standard has a different focus; it does not include the context of materials used in structures.
HS.TE.2.2. Distinguish among tension, compression, shear, and torsion, and explain how they relate to the selection of materials in structures.	comparable	same	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.	
HS.TE.2.3. Explain Bernoulli's principle and its effect on structures such as buildings and bridges.	partial	same	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 Bernoullis principle.	2016 MA STE standard does not include context of building and bridges.
HS.TE.2.4. Calculate the resultant force(s) for a combination of live loads and dead loads.	comparable	same	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, sheer, compression, and torsion.	

HS.TE.2.5. Identify and demonstrate the safe and proper use of common hand tools, power tools, and measurement devices used in construction.	comparable	in earlier grades	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 jigsaw, drill, and sander.	
HS.TE.2.6. Recognize the purposes of zoning laws and building codes in the design and use of structures.	not included	na		
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).	comparable	same	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.	
HS.TE.3.2. Explain the differences and similarities between hydraulic and pneumatic systems, and explain how each relates to manufacturing and transportation systems.	comparable	same	HS-ETS4-3(MA). Explain how differences and similarities between hydraulic and pneumatic systems lead to different applications of each in technologies.	
HS.TE.3.3. Calculate and describe the ability of a hydraulic system to multiply distance, multiply force, and effect directional change.	comparable	same	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.	
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.	not included	na		
HS.TE.3.5. Identify and explain sources of resistance (e.g., 45º elbow, 90º elbow, changes in diameter) for water moving through a pipe.	not included	na		
HS.TE.4.1. Differentiate among conduction, convection, and radiation in a thermal system (e.g., heating and cooling a house, cooking).	comparable	same	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.	
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.	comparable	same	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.	
HS.TE.4.3. Explain how environmental conditions such as wind, solar angle, and temperature influence the design of buildings.	comparable	same	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.	
HS.TE.4.4. Identify and explain alternatives to nonrenewable energies (e.g., wind and solar energy conversion systems).	not included	na		
HS.TE.5.1. Explain how to measure and calculate voltage, current, resistance, and power consumption in a series circuit and in a parallel circuit. Identify the instruments used to measure voltage, current, power consumption, and resistance.	comparable	same (in IP)	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, 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.	
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.	partial	same (in IP)	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, 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.	2016 MA STE standard does not include all the circuit components.

HS.TE.5.3. Explain the relationships among voltage, current, and resistance in a simple circuit, using Ohm's law.	comparable	same (in IP)	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, 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.	
HS.TE.5.4. Recognize that resistance is affected by external factors (e.g., temperature).	not included	na		
HS.TE.5.5. Compare and contrast alternating current (AC) and direct current (DC), and give examples of each.	not included	na		
HS.TE.6.1. Explain how information travels through the following media: electrical wire, optical fiber, air, and space.	comparable	same	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).	
HS.TE.6.2. Differentiate between digital and analog signals. Describe how communication devices employ digital and analog technologies (e.g., computers, cell phones).	comparable	same	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).	
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.	comparable	in earlier grades	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.	
HS.TE.6.4. Identify and explain the applications of laser and fiber optic technologies (e.g., telephone systems, cable television, photography).	not included	na		
HS.TE.6.5. Explain the application of electromagnetic signals in fiber optic technologies, including critical angle and total internal reflection.	not included	na		
HS.TE.7.1. Describe the manufacturing processes of casting and molding, forming, separating, conditioning, assembling, and finishing.	comparable	same	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.	
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).	not included	na		
HS.TE.7.3. Describe the advantages of using robotics in the automation of manufacturing processes (e.g., increased production, improved quality, safety).	comparable	same	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.	
			2016 MA STE high school standards that are in addition to current standards	
	additional	na	HS-ETS1-2. Break a complex real-world problem into smaller, more manageable problems that each can be solved using scientific and engineering principles.*	
	additional	na	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.	