Overview of Grades PreK-8 Science Crosswalk of 2001/2006 Standards to DRAFT Revised Standards

Current Grade PreK-2 Standards	Alignment of current to draft revised standards	Relative grade current is found in draft revised
ESS		
PreK-2.ESS.1.	partial	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
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
Draft revised grade PreK-2 standards that are in addition to current standards		
	additional	PreK-ESS1-2.
	additional	PreK-ESS2-6.
	additional	2-ESS2-1.
	additional	2-ESS2-2.
	additional	2-ESS2-4(MA).
	additional	PreK-ESS3-1.
	additional	PreK-ESS3-2.
	additional	K-ESS3-2.
	additional	K-ESS3-3.
	additional	Gr2.K-2-ETS1-3.
	additional	PreK-LS3-2.
	additional	2-LS4-1.
	additional	2-PS3-1(MA).
	additional	PreK-PS4-2.

Current Grade 3-5 Standards	Alignment of current to draft revised standards	Relative grade current is found in draft revised
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.	partial	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.	not included	na
3-5.ESS.12.	partial	same
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.	comparable	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
Draft revised 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	Gr4.3-5-ETS2-1(MA).
	additional	Gr4.3-5-ETS2-2(MA).
	additional	5-LS2-2(MA).
	additional	3-LS4-3.
	additional	3-LS4-5(MA).
	additional	3-PS2-1.
	additional	4-PS3-1.

Current Grade 6-8 Standards	Alignment of current to draft revised standards	Relative grade current is found in draft revised
ESS		
6-8.ESS.1.	comparable	in earlier grades
6-8.ESS.2.	partial	same
6-8.ESS.3.	comparable	same
6-8.ESS.4.	comparable	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
6-8.TE.3.1.	comparable	same & earlier
6-8.TE.3.2.	partial	same
6-8.TE.3.3.	partial	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.	not included	na
6-8.TE.5.3.	partial	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.	included in later grades	in later grades
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 & earlier
6-8.LS.15.	comparable	same & earlier
6-8.LS.16.	partial	in earlier grades
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.	not included	na
6-8.PS.12.	not included	na
6-8.PS.13.	comparable	same
6-8.PS.14.	comparable	same
6-8.PS.15.	comparable	same
6-8.PS.16.	partial	same
Draft revised grade 6-8 standards that are in addition to current standards		
	additional	7.MS-PS3-1.
	additional	7.MS-ESS3-1.
	additional	7.MS-ESS3-4.
	additional	8.MS-ESS3-5.
	additional	6.MS-ETS1-1.
	additional	6.MS-ETS2-4(MA).
	additional	8.MS-ETS2-5(MA).
	additional	8.MS-ETS2-7(MA).
	additional	7.MS-LS1-4.
	additional	8.MS-LS1-5.
	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 DRAFT Revised Standards

Current HS ESS Standards	Alignment of current to draft revised standards	Relative grade current is found in draft revised
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.	comparable	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.	partial	same
HS.ESS.3.3.	not included	na
HS.ESS.3.4.	partial	in earlier grades
HS.ESS.3.5.	comparable	in earlier grades
HS.ESS.3.6.	partial	in earlier grades
HS.ESS.3.7.	comparable	in earlier grades
HS.ESS.3.8.	comparable	same & earlier
HS.ESS.3.9.	comparable	same
HS.ESS.3.10.	partial	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
Draft revised high school standards that are in addition to current standards		
	additional	HS-ESS1-3.
	additional	HS-ESS1-7(MA).
	additional	HS-ESS3-1.
	additional	HS-ESS3-2.
	additional	HS-ESS3-3.
	additional	HS-ESS3-5.

Current HS Biology Standards	Alignment of current to draft revised standards	Relative grade current is found in draft revised
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.	partial	same
HS.LS.2.6.	partial	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
HS.LS.3.5.	partial	same
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.	partial	same
HS.LS.6.3.	comparable	same & earlier
HS.LS.6.4.	partial	same
Draft revised high school standards that are in addition to current standards		
	additional	HS-LS2-6.

Current HS Chemistry Standards	Alignment of current to draft revised standards	Relative grade current is found in draft revised
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.	partial	same
HS.Chem.2.4.	partial	same
HS.Chem.2.5.	not included	na
HS.Chem.2.6.	partial	same
HS.Chem.2.7.	comparable	same
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.	partial	same
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
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
Note: No draft revised high school standards are in addition to current standards		

Current HS Intro Physics Standards	Alignment of current to draft revised standards	Relative grade current is found in draft revised
HS.IP.1.1.	not included	na
HS.IP.1.2.	not included	na
HS.IP.1.3.	not included	na
HS.IP.1.4.	comparable	same & earlier
HS.IP.1.5.	comparable	same
HS.IP.1.6.	not included	na
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.	partial	in earlier grades
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.	partial	same & earlier
HS.IP.3.4.	comparable	same
HS.IP.4.1.	partial	same & earlier
HS.IP.4.2.	partial	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.	partial	same
HS.IP.5.4.	comparable	same
HS.IP.5.5.	partial	same
HS.IP.5.6.	partial	same & earlier
HS.IP.6.1.	comparable	same
HS.IP.6.2.	not included	na
Draft revised high school standards that are in addition to current standards		
	additional	HS-PS4-5.

Current HS Tech/Eng Standards	Alignment of current to draft revised standards	Relative grade current is found in draft revised
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.	not included	na
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.	not included	na
HS.TE.5.2.	not included	na
HS.TE.5.3.	not included	na
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
Draft revised high school standards that are in addition to current standards		
	additional	HS-ETS1-2.
		HS-ETS4-1(MA).

Grades PreK-2 Science Crosswalk of 2001/2006 Standards to DRAFT Revised Standards

2001/6 Standard	Degree of alignment of current to draft revised	Relative grade current is found in revised	Draft Revised MA Standards December 2013	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.	partial	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.	Draft revised 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 their local environment.	Draft revised standard does not specify types of materials.
			PreK-ESS2-3(MA). Explore and describe different places water is found in the local environment.	Draft revised standard focuses on water only.
			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.	Draft revised 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 Statement: Examples of quantitative observations could include numbers of sunny, windy and rainy days in a month, and relative temperature.] [Assessment Boundary: Assessment of quantitative observations 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 Statement: Examples of materials on Earth's surface could include sand, soil, rocks, and water] [Assessment Boundary: Assessment of temperature is limited to relative measures such as warmer/cooler.]	Draft revised 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 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 Statement: Examples of properties could include, color, strength, flexibility, hardness, texture, and absorbency.] [Assessment Boundary: Assessment is limited to qualitative and relative observations.]	Draft revised standard does not specify the particular materials to be considered.
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 Statement: Examples of properties could include, color, strength, flexibility, hardness, texture, and absorbency.] [Assessment Boundary: Assessment is limited to qualitative and relative observations.]	Draft revised 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 prototype of a structure that will reduce the warming effect of sunlight on an area.*	Draft revised standard does not specify the particular tools and materials expected, and limits to structures for one particular purpose.

Grades PreK-2 Science Crosswalk of 2001/2006 Standards to DRAFT Revised Standards

2001/6 Standard	Degree of alignment of current to draft revised	Relative grade current is found in revised	Draft Revised MA Standards December 2013	Comments on alignment
			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 Statement: Examples of devices could include a light source to send signals, paper cup and string "telephones," and a pattern of drum beats.] [Assessment Boundary: Assessment does not include technological details for how communication devices work.]	Draft revised 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	PreK-LS1-2(MA). Recognize that all plants and animals grow and change over time.	Draft revised 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.	Draft revised standard does not include reproduction.
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 have a life cycle: a. most plants begin as seeds, develop and grow, make more seeds, and die; and b. animals are born, develop and grow, produce young, and die.	
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 Statement: Examples of observations could include leaves from the same kind of plant are the same shape but can differ in size.] [Assessment Boundary: Assessment does not include inheritance or animals that undergo metamorphosis or hybrids.]	Draft revised standard does not specify comparison to parents.
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		Comparable draft revised standard found in grade 3 (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-LS1-3(MA). Explain that most animals have 5 senses they use to gather information about the world around them.	
			PreK-LS1-4(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 nutrients, water and air, produce food (sugar), and make new plants. [Assessment Boundary: Descriptions are not expected to include mechanisms.]	Draft revised 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 Statement: 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.	Draft revised 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**

Grades PreK-2 Science Crosswalk of 2001/2006 Standards to DRAFT Revised Standards

2001/6 Standard	Degree of alignment of current to draft revised	Relative grade current is found in revised	Draft Revised MA Standards December 2013	Comments on alignment
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.	Draft revised standard does not specify which properties.
			2-PS1-1. Describe and classify different kinds of materials by observable properties of color, strength, 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 about the differences between liquids and solids and develop awareness that a liquid can become a solid and vice versa.	Draft revised 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, or changing state.]	Draft revised standard does not specify solids, liquids or gases but does include changing state.
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.	Draft revised 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 Statement: 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.] [Assessment Boundary: Assessment is limited to different relative strengths or different directions, but not both at the same time. Assessment does not include non-contact pushes or pulls such as those produced by magnets.]	
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.]	
			Draft revised 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). Understand 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	2-ESS2-1. Compare the effectiveness of multiple solutions designed to slow or prevent wind or water from changing the shape of the land.* [Clarification Statement: 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 Statement: Examples of types of landforms can include hills, valleys, river banks, and dunes. Examples of water bodies can include streams, ponds, and rivers.] [Assessment Boundary: Assessment does not include quantitative scaling in models.]	
	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	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	K-ESS3-2. Obtain information about the purpose of weather forecasting to prepare for, and respond to, different types of local weather.	
	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.]	

Grades PreK-2 Science Crosswalk of 2001/2006 Standards to DRAFT Revised Standards

2001/6 Standard	Degree of alignment of current to draft revised	Relative grade current is found in revised	Draft Revised MA Standards December 2013	Comments on alignment
	additional	na	Gr2.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.*	
	additional	na	PreK-LS3-2(MA). Use observations to recognize differences and similarities among themselves and their friends.	
	additional	na	2-LS4-1. Use texts and media to 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 Statement: Examples of areas to compare might include temperate forest, desert, tropical rain forest, grassland, arctic, and aquatic] [Assessment Boundary: Assessment does not include specific animal and plant names in specific areas.]	
	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 Statement: Examples could include an object sliding on rough vs. smooth surfaces.] [Assessment Boundary: Observations of temperature and speed are qualitative.]	
	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.	

Grades 3-5 Science Crosswalk of 2001/2006 Standards to DRAFT Revised Standards

2001/6 Standard	Degree of alignment of current to draft revised	Relative grade current is found in revised	Draft Revised MA Standards December 2013	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 to identify substances based on their unique properties, including color, hardness, reflectivity, electrical conductivity, thermal conductivity, response to magnetic forces, and solubility. [Clarification Statement: Examples of substances to be identified could include baking soda and other powders, metals, minerals, and liquids.] [Assessment Boundary: Assessment does not include density or distinguishing mass and weight.]	
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 to identify substances based on their unique properties, including color, hardness, reflectivity, electrical conductivity, thermal conductivity, response to magnetic forces, and solubility. [Clarification Statement: Examples of substances to be identified could include baking soda and other powders, metals, minerals, and liquids.] [Assessment Boundary: Assessment does not include density or distinguishing mass and weight.]	Draft revised 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		Partial alignment to draft revised standard 8.MS-ESS2-1 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 Statement: Mechanical weathering can include frost wedging, abraision, and tree root wedging. Erosion can include movement by blowing wind, flowing water, and moving ice.] [Assessment Boundary: Assessment does not include chemical processes.]	Draft revised 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 of a food web to describe the movement of matter among producers, primary and secondary consumers, decomposers, and the air and soil in the environment: a. show that plants make sugars and plant materials from sunlight and matter in the air and soil; b. show that some animals eat plants for food and other animals eat the animals that eat plants; 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. Waste includes matter in the form of gasses (such as air), liquids (such as water), or solids (such as minerals or nutrients).] [Assessment Boundary: Assessment does not include molecular explanations.]	Draft revised standard does not focus on soil formation 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 Statement: Examples of data could include average temperature, precipitation, wind direction and wind speed.] [Assessment Boundary: Graphical displays are limited to pictographs and bar graphs. Assessment does not include climate change.]	
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.	partial	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 Statement: Examples of data could include average temperature, precipitation, wind direction and wind speed.] [Assessment Boundary: Graphical displays are limited to pictographs and bar graphs. Assessment does not include climate change.]	Draft revised standard does not include specific types of precipation.
		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.	Draft revised 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		Partial alignment to draft revised 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 the role of ocean in weather but not the jet stream.

Grades 3-5 Science Crosswalk of 2001/2006 Standards to DRAFT Revised Standards

2001/6 Standard	Degree of alignment of current to draft revised	Relative grade current is found in revised	Draft Revised MA Standards December 2013	Comments on alignment
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.	
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 between the geosphere, biosphere, hydrosphere, and atmosphere through evaporation, precipitation, surface runoff, condensation, transpiration, and runoff. [Assessment Boundary: Assessment does not include explanations of mechanisms that drive the cycle.]	
3-5.ESS.11. Give examples of how the cycling of water, both in and out of the atmosphere, has an effect on climate.	not included	na		
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. Construct a claim with evidence that changes to a landscape due to erosion and deposition over long periods of time result in rock layers and landforms that can be interpreted today. 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. [Clarification Statement: 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.] [Assessment Boundary: Assessment does not include specific knowledge of the mechanisms of rock formation or memorization of specific rock formations and layers. Assessment is limited to relative time.]	Draft revised standard focuses on "slow processes" but does not include "rapid processes" such as landslides, volcanoes, and earthquakes. These are, however, included in the draft revised standard MS-ESS3-2.
		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 Statement: Mechanical weathering can include frost wedging, abraision, and tree root wedging. Erosion can include movement by blowing wind, flowing water, and moving ice.] [Assessment Boundary: Assessment does not include chemical processes.]	Draft revised standard focuses on "slow processes" but does not include "rapid processes" such as landslides, volcanoes, and earthquakes. Draft revised standards 7.MS-ESS2-2 distinquishes processes that happen at different scales; MS-ESS3-2 include rapid processes.
		in later grades		Partial alignment to draft revised standard 7.MS-ESS2-2 which distinquishes processes that happen at different scales; and MS-ESS3-2 which includes rapid processes.
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 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 position of the sun, moon and constellations at different times during a day, over a month, and over a year. [Clarification Statement: Any model used 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 Earth’s rotation about its axis.] [Assessment Boundary: Assessment does not include causes of seasons nor expect use of Earth’s tilt.]	
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 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 position of the sun, moon and constellations at different times during a day, over a month, and over a year. [Clarification Statement: Any model used 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 Earth’s rotation about its axis.] [Assessment Boundary: Assessment does not include causes of seasons nor expect use of Earth’s tilt.]	
		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.	Draft revised 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. [Assessment Boundary: Assessment does not include names for moon phases or sequencing moon phases.]	Draft revised 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**

Grades 3-5 Science Crosswalk of 2001/2006 Standards to DRAFT Revised Standards

2001/6 Standard	Degree of alignment of current to draft revised	Relative grade current is found in revised	Draft Revised MA Standards December 2013	Comments on alignment
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	Gr3.3-5-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.*	Draft revised standard does not focus on material properties.
			5-PS1-3. Make observations and measurements to identify substances based on their unique properties, including color, hardness, reflectivity, electrical conductivity, thermal conductivity, response to magnetic forces, and solubility. [Clarification Statement: Examples of substances to be identified could include baking soda and other powders, metals, minerals, and liquids.] [Assessment Boundary: Assessment does not include density or distinguishing mass and weight.]	Draft revised 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.	Draft revised 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.	Draft revised 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, strength, flexibility, hardness, texture, and absorbency.	Draft revised 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 prototype of a structure that will reduce the warming effect of sunlight on an area.*	Draft revised standard includes use of tools to build a (specific) prototype but does not specify the set of tools. This list of tools is specified in a later draft revised standard 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	Gr3.3-5-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.*	Draft revised standard is broader in scope; the 2001/6 standard focuses on shelter, storage, or convenience.
		in earlier grades	Gr1.K-2-ETS1-1. Ask questions, make observations, and gather information about a situation people want to change in order to define a simple design problem that can be solved by developing or improving an object or tool.*	Draft revised standard is broader in scope; the 2001/6 standard focuses on shelter, storage, or convenience.
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	Gr3.3-5-ETS1-4(MA). Gather information using various informational resources on possible solutions to a design problem. Present different representations of a design solution. * [Clarification Statement: Examples of informational resources can include books, videos, and websites. Examples of representations can include graphic organizers, sketches, models, and prototypes.]	
		in earlier grades	Gr1.K-2-ETS1-2. Generate multiple solutions to a design problem and make a drawing (plan) to represent one or more of the solutions.*	Draft revised 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	Gr4.3-5-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.* [Clarification Statement: Examples of design features can include size, shape, and weight.]	
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.]	Draft revised standard does not emphasize classification although classification is needed to complete the standard.
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.	comparable	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 Statement: External animal structures might include legs, wings, feathers, trunks, claws, horns and antennae. Animal organs might include eyes, ears, nose, heart, stomach, lung, brain, and skin. Plant structures might include leaves, roots, stems, bark, branches, and flowers.] [Assessment Boundary: Assessment is limited to macroscopic structures.]	Draft revised standard includes basic functions of plant structures but does not specify the particular functions of food production, support, water transport, reproduction, growth, and protection. Draft revised standard additionally includes animals.

Grades 3-5 Science Crosswalk of 2001/2006 Standards to DRAFT Revised Standards

2001/6 Standard	Degree of alignment of current to draft revised	Relative grade current is found in revised	Draft Revised MA Standards December 2013	Comments on alignment
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 species 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 Statement: Examples can include different ways plants and animals are born (e.g., sprout from a seed, born from an egg), grow (e.g., increase in size and weight, produce new part), reproduce (e.g., develop seeds and spores, root runners, mate and lay eggs that hatch) and die (e.g., length of life).] [Assessment Boundary: Assessment of plant life cycles is limited to those of flowering plants. Assessment of animal life cycles is focused on a comparison of the stages, not on a detailed description of any one organism's cycle, nor the differences of "complete metamorphosis" and "incomplete metamorphosis". Assessment does not include details of human reproduction.]	
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 species 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 Statement: Examples can include different ways plants and animals are born (e.g., sprout from a seed, born from an egg), grow (e.g., increase in size and weight, produce new part), reproduce (e.g., develop seeds and spores, root runners, mate and lay eggs that hatch) and die (e.g., length of life).] [Assessment Boundary: Assessment of plant life cycles is limited to those of flowering plants. Assessment of animal life cycles is focused on a comparison of the stages, not on a detailed description of any one organism's cycle, nor the differences of "complete metamorphosis" and "incomplete metamorphosis". Assessment does not include details of human reproduction.]	Draft revised standard includes life cycles but does not specify frogs and butterflies.
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 Statement: Examples of inherited traits that vary can include the color of fur, shape of leaves, length of legs, and size of flowers. Assessment Boundary: Assessment does not include genetic mechanisms of inheritance nor prediction of traits. Assessment is limited to non-human examples.]	Draft revised 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 with insufficient water or light are stunted; a lizard missing a tail due to a predator; and, a pet dog that is given too much food and little exercise may become overweight.]	
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 Statement: Examples might include rose bushes of the same species, one with slightly longer thorns than the other which may prevent its predation by deer; and color variation within a species that may provide advantages so one organism may be more likely to survive and therefore more likely to leave offspring such as rock pocket mice. Examples of evidence could include needs and characteristics of the organisms and habitats involved.]	Draft revised 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 data about changes in the environment in an area and describe how the changes may affect the ability of organisms that live in that area to survive and reproduce. [Clarification Statement: Environmental changes should include changes to landforms, distribution of water, climate, and availability of resources. Changes in the environment could range in time from a season to decades. Data should be provided.] [Assessment Boundary: Assessment is limited to a single environmental change, however, it is understood that environmental changes are complex.]	Draft revised 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 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.]	Draft revised standard focuses on seasonal changes and includes migration as an example.

Grades 3-5 Science Crosswalk of 2001/2006 Standards to DRAFT Revised Standards

2001/6 Standard	Degree of alignment of current to draft revised	Relative grade current is found in revised	Draft Revised MA Standards December 2013	Comments on alignment
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).]	Draft revised 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 data about changes in the environment in an area and describe how the changes may affect the ability of organisms that live in that area to survive and reproduce. [Clarification Statement: Environmental changes should include changes to landforms, distribution of water, climate, and availability of resources. Changes in the environment could range in time from a season to decades. Data should be provided.] [Assessment Boundary: Assessment is limited to a single environmental change, however, it is understood that environmental changes are complex.]	Draft revised standard does not include plant behaviors and has a slightly different focus.
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 data about changes in the environment in an area and describe how the changes may affect the ability of organisms that live in that area to survive and reproduce. [Clarification Statement: Environmental changes should include changes to landforms, distribution of water, climate, and availability of resources. Changes in the environment could range in time from a season to decades. Data should be provided.] [Assessment Boundary: Assessment is limited to a single environmental change, however, it is understood that environmental changes are complex.]	Draft revised 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 digs 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. Support an argument with evidence that plants get the materials they need for growth chiefly through a process in which they use air, water, and energy from the sun to produce sugars and plant materials for growth and reproduction. [Assessment Boundary: The chemical formula or details about the process of photosynthesis is not expected.]	Draft revised standard just includes materials from photosynthesis.
			5-LS2-1. Develop a model of a food web to describe the movement of matter among producers, primary and secondary consumers, decomposers, and the air and soil in the environment: a. show that plants make sugars and plant materials from sunlight and matter in the air and soil; b. show that some animals eat plants for food and other animals eat the animals that eat plants; 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. Waste includes matter in the form of gasses (such as air), liquids (such as water), or solids (such as minerals or nutrients).] [Assessment Boundary: Assessment does not include molecular explanations.]	
			5-PS3-1. Use a model to describe that the food animals digest: a. contains energy that was once energy from the sun, and b. provides energy and materials for body repair, growth, motion, body warmth, and reproduction. [Clarification Statement: Examples of models could include diagrams and flow charts.] [Assessment Boundary: Details of photosynthesis or respiration are not expected.]	Draft revised standard does not specify photosynthesis.
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	same	5-PS1-3. Make observations and measurements to identify substances based on their unique properties, including color, hardness, reflectivity, electrical conductivity, thermal conductivity, response to magnetic forces, and solubility. [Clarification Statement: Examples of substances to be identified could include baking soda and other powders, metals, minerals, and liquids.] [Assessment Boundary: Assessment does not include density or distinguishing mass and weight.]	Draft revised standard does not include difference between object properties and material properties.
		in earlier grades	PreK-PS1-3(MA). Differentiate between the properties of an object and those of the material of which it is made.	Draft revised standard differentiates object and material properties but does not list particular properties.

Grades 3-5 Science Crosswalk of 2001/2006 Standards to DRAFT Revised Standards

2001/6 Standard	Degree of alignment of current to draft revised	Relative grade current is found in revised	Draft Revised MA Standards December 2013	Comments on alignment
			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 Statement: 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.]	Draft revised standard requires an understanding of material properties but does not list particular properties.
3-5.PS.2. Compare and contrast solids, liquids, and gases based on the basic properties of each of these states of matter.	comparable	same	5-PS1-1. Use a model of matter as made of particles too small to be seen to explain common phenomena involving gasses, phase changes between gas and liquid, and dissolving. [Clarification Statement: Examples of common phenomena the model should be able to describe include adding air to expand a basketball, compressing air in a syringe, dissolving sugar in water, and evaporating salt water.] [Assessment Boundary: Assessment does not include the atomic-scale mechanism of evaporation and condensation or defining the unseen particles.]	Draft revised standard does not include solids.
		in earlier grades	K-PS1-1(MA). Design and conduct an experiment to test the idea that different kinds of materials can be a solid or liquid depending on temperature. [Clarification Statement: 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.] [Assessment Boundary: Only a qualitative description of temperature, such as hot, warm, and cool, is expected.]	Draft revised standard does not include gases.
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 model of matter as made of particles too small to be seen to explain common phenomena involving gasses, phase changes between gas and liquid, and dissolving. [Clarification Statement: Examples of common phenomena the model should be able to describe include adding air to expand a basketball, compressing air in a syringe, dissolving sugar in water, and evaporating salt water.] [Assessment Boundary: Assessment does not include the atomic-scale mechanism of evaporation and condensation or defining the unseen particles.]	Draft revised standard does not include solids nor 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.	Draft revised standard does not include gasses, nor specifies heat.
			K-PS1-1(MA). Design and conduct an experiment to test the idea that different kinds of materials can be a solid or liquid depending on temperature. [Clarification Statement: 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.] [Assessment Boundary: Only a qualitative description of temperature, such as hot, warm, and cool, is expected.]	Draft revised 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 Statement: 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.]	
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. [Assessment Boundary: Assessment does not include quantitative measurements of energy.]	Draft revised standard does not include magnetic. 2001/6 standard focuses on energy causing motion or change; the draft revised standard focuses on transfer of energy.
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.] [Assessment Boundary: Assessment does not include analysis of forces nor quantitative measurements of energy.]	Draft revised 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 motion energy to electrical energy or uses stored energy to cause motion or produce light or sound.*	Other forms included in other draft revised standards, except magnetic.
			5-PS3-1. Use a model to describe that the food animals digest: a. contains energy that was once energy from the sun, and b. provides energy and materials for body repair, growth, motion, body warmth, and reproduction. [Clarification Statement: Examples of models could include diagrams and flow charts.] [Assessment Boundary: Details of photosynthesis or respiration are not expected.]	Draft revised standard only includes transfer from sunlight to chemical (food) energy. But other forms included in other draft standards, except magnetic.

Grades 3-5 Science Crosswalk of 2001/2006 Standards to DRAFT Revised Standards

2001/6 Standard	Degree of alignment of current to draft revised	Relative grade current is found in revised	Draft Revised MA Standards December 2013	Comments on alignment
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		Draft revised standard HS-PS2-9(MA) includes series and parallel circuits.
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 to identify substances based on their unique properties, including color, hardness, reflectivity, electrical conductivity, thermal conductivity, response to magnetic forces, and solubility. [Clarification Statement: Examples of substances to be identified could include baking soda and other powders, metals, minerals, and liquids.] [Assessment Boundary: Assessment does not include density or distinguishing mass and weight.]	Draft revised standard does not specifically call out insulators.
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		Draft revised standard MS-PS2-3 includes factors that influence electromagnets, but does not include application.
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. [Assessment Boundary: Assessment is limited to forces produced by magnetic objects that can be manipulated by students.]	
			3-PS2-4. Define a simple design problem that can be solved by applying the use of the 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.]	Draft revised 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 to identify substances based on their unique properties, including color, hardness, reflectivity, electrical conductivity, thermal conductivity, response to magnetic forces, and solubility. [Clarification Statement: Examples of substances to be identified could include baking soda and other powders, metals, minerals, and liquids.] [Assessment Boundary: Assessment does not include density or distinguishing mass and weight.]	
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.	Draft revised stanadrd 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 Statement: 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 matter vibrate could include holding a piece of paper near a speaker making sound and holding an object near a vibrating tuning fork.]	Draft revised standard does not include a medium through which to travel or relating pitch to vibration. The concept of a medium is introducted in draft revised standard 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 bounce off an object and enter the eye for the object to be seen. [Assessment Boundary: Assessment does not include knowledge of specific colors reflected and seen, the cellular mechanisms of vision, or how the retina works.]	Draft revised standard does not include refraction, absorption or medium.
		in earlier grades	1-PS4-3. 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 Statement: Effects can include some or all light passing through, creation of a shadow, or redirecting light.] [Assessment Boundary: Assessment does not include quantitative measures.]	Draft revised standard does not distinquish refraction and reflection; materials are the media but not specifically called out as such. The later draft revised standard MS-PS4-2 is a comparable standard to the 2001/06 3-5.PS.12.
			Draft revised grade 3-5 standards that are in addition to current standards	
	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 the Earth. [Assessment Boundary: Assessment does not include other factors that affect apparent brightness (such as stellar masses, age, stage).]	

Grades 3-5 Science Crosswalk of 2001/2006 Standards to DRAFT Revised Standards

2001/6 Standard	Degree of alignment of current to draft revised	Relative grade current is found in revised	Draft Revised MA Standards December 2013	Comments on alignment
	additional	na	5-ESS2-2. Describe and graph the amounts and percentages 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. [Clarification Statement: Nearly all of Earth's available water is in the ocean; most fresh water is in glaciers or underground.] [Assessment Boundary: Assessment does not include the atmosphere.]	
	additional	na	3-ESS3-1. Evaluate the merit of a design solution that reduces the impacts of weather-related hazard.* [Clarification Statement: Examples of design solutions to weather-related hazard could include a barrier to prevent flooding, a wind resistant roof, and a lighting rod.]	
	additional	na	4-ESS3-2. Evaluate the design of a solution on its potential to reduce the impacts of an earthquake, flood, tsunami or volcanic eruption on humans.* [Clarification Statement: Examples of solutions could include a proposal for an earthquake resistant building and improved monitoring of volcanic activity.]	
	additional	na	5-ESS3-1. Obtain and combine information about ways communities reduce the impact on the Earth's resources and environment by changing an agricultural, industrial, or community practice or process. [Clarification Statement: Examples of changed practices or processes include treating sewage, reducing the amounts of materials used, capturing polluting emissions from factories or power plants, and preventing runoff from agricultural activities.] [Assessment Boundary: Assessment does not include social science aspects of practices such as regulation or policy.]	
	additional	na	5-ESS3-2(MA). Test a simple system designed to filter an impurity out of water and propose one change to the design to improve it.* [Clarification Statement: Examples of impurities could include particulates or bacteria.]	
	additional	na	Gr4.3-5-ETS2-1(MA). Recognize that technology is any modification of the natural or designed world done to fulfill human needs or wants. These modifications can be improvements to existing technologies or the development of new technologies.*	
	additional	na	Gr4.3-5-ETS2-2(MA). Describe that technological products or devices are made up of parts. 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.* [Assessment Boundary: Assessment is limited to qualitative descriptions or comparisons of decomposition.]	
	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 organisms 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. [Assessment Boundary: Assessment does not address details of reproduction.]	
	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. [Assessment Boundary: Assessment is limited to one variable at a time: number, size, or direction of forces. Assessment does not include quantitative force magnitude, only qualitative and relative. All descriptions of gravity are limited to a force that pulls objects down.]	
	additional	na	4-PS3-1. Use evidence to construct an explanation relating the speed of an object to the energy of that object. [Assessment Boundary: Assessment does not include quantitative measures of changes in the speed of an object or on any precise or quantitative definition of energy, nor account for mass.]	

Grades 6-8 Science Crosswalk of 2001/2006 Standards to DRAFT Revised Standards

2001/6 Standard	Degree of alignment of current to draft revised	Relative grade current is found in revised	Draft Revised MA Standards December 2013	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..	Draft revised 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. Develop and use a model to illustrate that energy from the Earth's interior drives convection which 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 that includes changes in rock types through erosion, heat and pressure.] [Assessment Boundary: Assessment does not include specific mechanisms of plate tectonics, the identification and naming of minerals or rock types, nor rote memorization of the "rock cycle".]	Draft revised standard only focuses on convection in earth's interior but does not include layers of the earth.
	included in later grades	in later grades		Comparable draft revised 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). 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.	comparable	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: Emphasis of ocean circulation is on the transfer of heat by the global ocean convection cycle, which is constrained by the Coriolis effect and the outlines of continents. A regional scale includes a state or multi-state perspective.] [Assessment Boundary: Assessment does not include Koppen Climate Classification names.]	Draft revised standard focuses more on ocean rather than global wind patters.
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).] [Assessment Boundary: Paleomagnetic anomalies in oceanic and continental crust are not assessed. Does not include mechanisms for plate motion.]	Drafts revised standard does not explicate processes; it focuses on the movement (and collision of plates).
			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 and operate at times ranging from fractions of a second to billions of years. [Clarification Statement: Examples of processes occurring over large spatial and time scales include plate motion and impact of ice ages. Examples of changes occurring over small spatial and time scales include earthquakes and seasonal weathering and erosion.]	Draft revised standard focuses on different times scales but does not specify movement of plates.
			8.MS-ESS2-1. Develop and use a model to illustrate that energy from the Earth's interior drives convection which 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 that includes changes in rock types through erosion, heat and pressure.] [Assessment Boundary: Assessment does not include specific mechanisms of plate tectonics, the identification and naming of minerals or rock types, nor rote memorization of the "rock cycle".]	Draft revised standard does not include distinction between fast and slow and does not specify earthquakes.

Grades 6-8 Science Crosswalk of 2001/2006 Standards to DRAFT Revised Standards

2001/6 Standard	Degree of alignment of current to draft revised	Relative grade current is found in revised	Draft Revised MA Standards December 2013	Comments on alignment
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. Develop and use a model to illustrate that energy from the Earth's interior drives convection which 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 that includes changes in rock types through erosion, heat and pressure.] [Assessment Boundary: Assessment does not include specific mechanisms of plate tectonics, the identification and naming of minerals or rock types, nor rote memorization of the "rock cycle".]	Draft revised standard does not include deposition.
		in earlier grades	4-ESS1-1. Construct a claim with evidence that changes to a landscape due to erosion and deposition over long periods of time result in rock layers and landforms that can be interpreted today. 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. [Clarification Statement: 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.] [Assessment Boundary: Assessment does not include specific knowledge of the mechanisms of rock formation or memorization of specific rock formations and layers. Assessment is limited to relative time.]	Draft revised standard does not include weathering.
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).] [Assessment Boundary: Paleomagnetic anomalies in oceanic and continental crust are not assessed. Does not include mechanisms for plate motion.]	Draft revised standard does not include glaciation or changes in environment/climate.
			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 and operate at times ranging from fractions of a second to billions of years. [Clarification Statement: Examples of processes occurring over large spatial and time scales include plate motion and impact of ice ages. Examples of changes occurring over small spatial and time scales include earthquakes and seasonal weathering and erosion.]	Draft revised standard includes changes in plate motion and ice ages (climate).
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. [Assessment Boundary: Assessment does not include Kepler's Laws of orbital motion or the apparent retrograde motion of the planets as viewed from Earth.]	Draft revised 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 the Earth's center. [Assessment Boundary: Assessment does not include mathematical representation of gravitational force.]	Draft revised 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.]	Draft revised 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. [Assessment Boundary: Assessment does not include Kepler's Laws of orbital motion or the apparent retrograde motion of the planets as viewed from Earth.]	Draft revised standard does not include eclipses or phases.

Grades 6-8 Science Crosswalk of 2001/2006 Standards to DRAFT Revised Standards

2001/6 Standard	Degree of alignment of current to draft revised	Relative grade current is found in revised	Draft Revised MA Standards December 2013	Comments on alignment
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 the Earth's tilt and differential intensity of sunlight on different areas of Earth across the year. [Clarification Statement: Examples of models can be physical, graphical, or conceptual.]	
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 the Earth and its solar system are part of 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 stiffness, strength, ductility, hardness, thermal conductivity, electrical conductivity, and melting point.	Draft revised 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 power tools used to construct a prototype.* [Clarification Statement: 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.]	Draft revised standard does not include the range of specific tools and 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 power tools used to construct a prototype.* [Clarification Statement: 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.2.1. 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.]	Draft revised standard only includes communication.
			7.MS-ETS1-2. Evaluate competing solutions to a given design problem using a systematic process 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.*	Draft revised 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.*	Draft revised standard only includes evaluation and redesign.

Grades 6-8 Science Crosswalk of 2001/2006 Standards to DRAFT Revised Standards

2001/6 Standard	Degree of alignment of current to draft revised	Relative grade current is found in revised	Draft Revised MA Standards December 2013	Comments on alignment
			7.MS-ETS1-7(MA). Construct a prototype of a solution to a given design problem.*	Draft revised standard only includes constructing a prototype.
		in earlier grades	Gr3.3-5-ETS1-2. Generate several possible solutions to a design problem. Compare each solution based on how well each is likely to meet the criteria and constraints of the design problem.*	Draft revised standard does not include the full engineering design process.
			Gr4.3-5-ETS1-3. Plan and carry out tests of one or more elements of a model or prototype in which variables are controlled and failure points are considered to identify which elements need to be improved. Apply the results of tests to redesign a model or prototype.*	Draft revised 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 Statement: Examples of visual representations can include sketches, scaled drawings, and orthographic projections. Examples of scale can include ¼'' = 1'0'', 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 power tools used to construct a prototype.* [Clarification Statement: 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 systematic process 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.MA-ETS3-5(MA). Use the concept of systems engineering to: a. analyze how components of a transportation, structural or communication system work together or affect each other, and b. model the inputs, processes, outputs, and feedback of a technological system.	
	included in later grades	In later grades		Partial alignment to draft revised 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.	Retrieval and destination are not included in the draft revised standard.
		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.]	Draft revised 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.]	Draft revised 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.	partial	same	7.MS-ETS3-2(MA). Compare the benefits and drawbacks of four different communication systems: radio, television, print, and internet.	Draft revised standard is not as broad as the current standard (more limited).
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		
6-8.TE.4.1. Describe and explain the manufacturing systems of custom and mass production.	included in later grades	In later grades		Partial alignment to draft revised standard HS-ETS2-3(MA) which includes both custom and mass production but focused on costs and benefits rather than manufacturing systems per se.

Grades 6-8 Science Crosswalk of 2001/2006 Standards to DRAFT Revised Standards

2001/6 Standard	Degree of alignment of current to draft revised	Relative grade current is found in revised	Draft Revised MA Standards December 2013	Comments on alignment
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-ETS2-6(MA). Describe how a product can be created using basic processes in manufacturing systems, including forming, separating, conditioning, assembling, finishing, quality control, and safety.	
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 or maintain an environment for a particular human use. Provide examples of physical structures and relate their design to their intended use. [Clarification Statement: 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), or providing specific environmental conditions (such as a greenhouse or cold storage). Examples of components of a structural system could include foundation, decking, wall, roofing, inputs (such as heat or AC), and feedback mechanisms.]	
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).	not included	na		
6-8.TE.5.3. Explain how the forces of tension, compression, torsion, bending, and shear affect the performance of bridges.	partial	same	7.MS-ETS3-4(MA). Show how the components of a structural system work together to serve a structural function or maintain an environment for a particular human use. Provide examples of physical structures and relate their design to their intended use. [Clarification Statement: 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), or providing specific environmental conditions (such as a greenhouse or cold storage). Examples of components of a structural system could include foundation, decking, wall, roofing, inputs (such as heat or AC), and feedback mechanisms.]	Draft revised standard includes some analysis of forces on a bridge, but does not include the specific types of forces.
	included in later grades	In later grades		Comparable draft revised standard HS-ETS3-4(MA).
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 or maintain an environment for a particular human use. Provide examples of physical structures and relate their design to their intended use. [Clarification Statement: 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), or providing specific environmental conditions (such as a greenhouse or cold storage). Examples of components of a structural system could include foundation, decking, wall, roofing, inputs (such as heat or AC), and feedback mechanisms.]	Draft revised standard includes some analysis of forces on a bridge, but does not include the specific types of forces.
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 Statement: Examples of design elements include vehicle shape and cargo or passenger capacity, terminals, travel lanes, and communications/controls. Examples of vehicles can include a car, sailboat, and small airplane.]	Draft revised 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 Statement: Examples of design elements include vehicle shape and 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 DRAFT Revised Standards

2001/6 Standard	Degree of alignment of current to draft revised	Relative grade current is found in revised	Draft Revised MA Standards December 2013	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		Comparable draft revised 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 life.	partial	same	6.MS-LS1-1. Provide evidence that organisms (unicellular and multicellular) are made of cells. [Clarification Statement: Evidence can be drawn from multiple types of organisms, such as plants, animals and bacteria.]	Draft revised 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 the ways parts of cells contribute to key cellular functions of obtaining nutrients and water from its environment, disposing of waste, and producing energy: a. the nucleus contains genetic information (DNA) which regulates a cell's activities; b. chloroplasts are the site of photosynthesis which produces necessary glucose and oxygen; c. mitochondria facilitate cellular respiration (energy production); d. vacuoles store materials, including water, nutrients and waste; e. the cell membrane is a protective barrier that enables nutrients to enter the cell and wastes to be expelled; and f. the cell wall provides structural support to some types of cells. [Clarification Statement: Functions should focus on basic survival needs.] [Assessment Boundary: Assessment does not include specific biochemical steps or chemical processes, ATP, or active transport through the cell membrane.]	Draft revised 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 the ways parts of cells contribute to key cellular functions of obtaining nutrients and water from its environment, disposing of waste, and producing energy: a. the nucleus contains genetic information (DNA) which regulates a cell's activities; b. chloroplasts are the site of photosynthesis which produces necessary glucose and oxygen; c. mitochondria facilitate cellular respiration (energy production); d. vacuoles store materials, including water, nutrients and waste; e. the cell membrane is a protective barrier that enables nutrients to enter the cell and wastes to be expelled; and f. the cell wall provides structural support to some types of cells. [Clarification Statement: Functions should focus on basic survival needs.] [Assessment Boundary: Assessment does not include specific biochemical steps or chemical processes, ATP, or active transport through the cell membrane.]	
6-8.LS.5. Describe the hierarchical organization of multicellular organisms from cells to tissues to organs to systems to organisms.	included in later grades	in later grades		Comparable draft revised standard in HS-LS1-2.
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	7.MS-LS1-3. Develop an argument supported by evidence that the body systems interact to carry out key body functions, including providing nutrients and oxygen to cells, removing carbon dioxide and waste from cells and the body, controlling body motion/activity and coordination, and protecting the body. [Clarification Statement: Body systems to be included are the circulatory, excretory, digestive, respiratory, muscular/skeletal and nervous systems. Emphasis is on the function and interactions of the body systems, not specific body parts or organs.] [Assessment Boundary: Assessment does not include the mechanism of one body system independent of others.]	Draft revised standard does not include reproduction or immune systems.

Grades 6-8 Science Crosswalk of 2001/2006 Standards to DRAFT Revised Standards

2001/6 Standard	Degree of alignment of current to draft revised	Relative grade current is found in revised	Draft Revised MA Standards December 2013	Comments on alignment
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. Develop and use a model 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 Statement: Examples of models can include Punnett squares, diagrams, and simulations. 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.]	Draft revised standard does not explicate heredity but the concept is needed; also does not include chromosomes.
			8.MS-LS3-3(MA). Communicate through writing and in diagrams that chromosomes contain many distinct genes, and that each chromosome pair contains two alleles that can be the same or different from each other. Illustrate that each gene holds the instructions for the production of specific proteins, which in turn affects the traits of an individual. [Assessment Boundary: Assessment does not include specific changes at the molecular level or mechanisms for protein synthesis.]	Draft revised 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 Statement: Examples of inherited traits that vary can include the color of fur, shape of leaves, length of legs, and size of flowers. Assessment Boundary: Assessment does not include genetic mechanisms of inheritance nor prediction of traits. Assessment is limited to non-human examples.]	Draft revised 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 chromosome pair contains two alleles that can be the same or different from each other. Illustrate that each gene holds the instructions for the production of specific proteins, which in turn affects the traits of an individual. [Assessment Boundary: Assessment does not include specific changes at the molecular level or mechanisms for protein synthesis.]	Draft revised standard does not include 30000 genes/23 chromosomes.
			8.MS-LS3-4(MA). Develop and use a model to show that in sexually reproducing organisms individuals have two of each chromosome, and hence two alleles of each gene, one acquired (randomly) from each parent. [Clarification Statement: Examples of models can include Punnett squares, diagrams, and simulations.] [Assessment Boundary: Assessment should only include dominant-recessive pattern of inheritance.]	Draft revised standard does not include 30000 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. Develop and use a model 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 Statement: Examples of models can include Punnett squares, diagrams, and simulations. 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 in sexually reproducing organisms individuals have two of each chromosome, and hence two alleles of each gene, one acquired (randomly) from each parent. [Clarification Statement: Examples of models can include Punnett squares, diagrams, and simulations.] [Assessment Boundary: Assessment should only include dominant-recessive pattern of inheritance.]	

Grades 6-8 Science Crosswalk of 2001/2006 Standards to DRAFT Revised Standards

2001/6 Standard	Degree of alignment of current to draft revised	Relative grade current is found in revised	Draft Revised MA Standards December 2013	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. Include evidence showing that: 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 over time, their environments have changed.	Draft revised standard does indicate diversity of organisms.
			8.MS-LS4-4. Explain the mechanism 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 Statement: Explanations should include simple probability statements and proportional reasoning.]	Draft revised standard does not cover diversity of organisms.
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. Include evidence showing that: 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 over time, their environments have changed.	
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 infer patterns of environmental change resulting in extinction and changes to life forms throughout the history of the Earth. [Clarification Statement: Examples of evidence include sets of fossils that indicate an environment, anatomical structures that indicate the function of an organism in the environment, and fossilized tracks that indicate behavior of organisms.] [Assessment Boundary: Assessment does not include the names of individual species, geological eras in the fossil record, nor mechanisms for extinction or speciation.]	
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.]	Draft revised 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 Statement: 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.]	
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-LS2-7(MA). Construct a model of a food web to explain that energy is transferred among producers, primary, secondary, and tertiary consumers, and decomposers as they interact within an ecosystem. [Clarification Statement: Student should be able to predict changes in relative sizes of populations based on food webs.]	
		in earlier grades	5-LS2-1. Develop a model of a food web to describe the movement of matter among producers, primary and secondary consumers, decomposers, and the air and soil in the environment: a. show that plants make sugars and plant materials from sunlight and matter in the air and soil; b. show that some animals eat plants for food and other animals eat the animals that eat plants; 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. Waste includes matter in the form of gasses (such as air), liquids (such as water), or solids (such as minerals or nutrients).] [Assessment Boundary: Assessment does not include molecular explanations.]	Draft revised standard has an emphasis on matter, not energy as in 2006 standard.

Grades 6-8 Science Crosswalk of 2001/2006 Standards to DRAFT Revised Standards

2001/6 Standard	Degree of alignment of current to draft revised	Relative grade current is found in revised	Draft Revised MA Standards December 2013	Comments on alignment
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 the cycling of matter among living and nonliving parts of an ecosystem including through the process of photosynthesis and cellular respiration. [Clarification Statement: Emphasis is on a general understanding of cycling of matter in an ecosystem.] [Assessment Boundary: Assessment does not include cycling of specific atoms (such as carbon or oxygen), nor the biochemical steps of photosynthesis or cellular respiration.]	Draft revised standard does not explicitly cover decomposers.
		in earlier grades	5-LS2-1. Develop a model of a food web to describe the movement of matter among producers, primary and secondary consumers, decomposers, and the air and soil in the environment: a. show that plants make sugars and plant materials from sunlight and matter in the air and soil; b. show that some animals eat plants for food and other animals eat the animals that eat plants; 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. Waste includes matter in the form of gasses (such as air), liquids (such as water), or solids (such as minerals or nutrients).] [Assessment Boundary: Assessment does not include molecular explanations.]	
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. Support an argument with evidence that plants get the materials they need for growth chiefly through a process in which they use air, water, and energy from the sun to produce sugars and plant materials for growth and reproduction. [Assessment Boundary: The chemical formula or details about the process of photosynthesis is not expected.]	Draft revised standard does not cover carbon dioxide or water; nor does it include the use of food by others.
			5-LS2-1. Develop a model of a food web to describe the movement of matter among producers, primary and secondary consumers, decomposers, and the air and soil in the environment: a. show that plants make sugars and plant materials from sunlight and matter in the air and soil; b. show that some animals eat plants for food and other animals eat the animals that eat plants; 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. Waste includes matter in the form of gasses (such as air), liquids (such as water), or solids (such as minerals or nutrients).] [Assessment Boundary: Assessment does not include molecular explanations.]	Draft revised standard does not cover carbon dioxide or water; nor does it include the use of food by plants.
	included in later grades	in later grades		Partial alignment to draft revised standard HS-LS1-5. Does not include use of food by plants or others.
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 infer patterns of environmental change resulting in extinction and changes to life forms throughout the history of the Earth. [Clarification Statement: Examples of evidence include sets of fossils that indicate an environment, anatomical structures that indicate the function of an organism in the environment, and fossilized tracks that indicate behavior of organisms.] [Assessment Boundary: Assessment does not include the names of individual species, geological eras in the fossil record, nor mechanisms for extinction or speciation.]	Draft revised 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 number of organisms (size of populations) in an ecosystem.	Draft revised 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.]	Draft revised standard includes changes to ecosystems (including due to humans) but does not include geologic time.

Grades 6-8 Science Crosswalk of 2001/2006 Standards to DRAFT Revised Standards

2001/6 Standard	Degree of alignment of current to draft revised	Relative grade current is found in revised	Draft Revised MA Standards December 2013	Comments on alignment
			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 and operate at times ranging from fractions of a second to billions of years. [Clarification Statement: Examples of processes occurring over large spatial and time scales include plate motion and impact of ice ages. Examples of changes occurring over small spatial and time scales include earthquakes and seasonal weathering and erosion.]	Draft revised 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. Include evidence showing that: 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 over time, their environments have changed.	
			8.MS-LS4-4. Explain the mechanism 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 Statement: Explanations should include simple probability statements and proportional reasoning.]	Draft revised draft standard does not specifically call out diversity of species.
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 interactions are attractive and are only noticeable when one or both of the objects have a very large mass. [Clarification Statement: Examples of objects with very large masses include the Earth, Sun, and other planets.] [Assessment Boundary: Assessment does not include Newton's Law of Gravitation or Kepler's Laws.]	Draft revised 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 the Earth's center. [Assessment Boundary: Assessment does not include mathematical representation of gravitational force.]	Draft revised 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. Measure the mass and volume of regular and irregular shaped objects and calculate their density.	
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 substances are rearranged during a chemical reaction to form new molecules 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.] [Assessment Boundary: Assessment does not include the use of atomic masses, balancing symbolic equations, or intermolecular forces.]	Draft revised standard does not specify mass.
		in earlier grades	5-PS1-2. Measure and graph the weights 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 of matter is conserved. [Clarification Statement: Assume that reactions with any gas production are conducted in a closed system.] [Assessment Boundary: Assessment does not include distinguishing mass and weight.]	

Grades 6-8 Science Crosswalk of 2001/2006 Standards to DRAFT Revised Standards

2001/6 Standard	Degree of alignment of current to draft revised	Relative grade current is found in revised	Draft Revised MA Standards December 2013	Comments on alignment
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 elements combine in a multitude of ways to produce substances which make up all of the living and nonliving things that we encounter. [Clarification Statement: Examples of molecular-level models could include drawings, 3D ball and stick structures, or computer representations showing different molecules with different types of atoms.] [Assessment Boundary: Assessment does not include valence electrons and bonding energy, discussing the ionic nature of subunits of complex structures, or a complete depiction of all individual atoms in a complex molecule or extended structure.]	
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 elements combine in a multitude of ways to produce substances which make up all of the living and nonliving things that we encounter. [Clarification Statement: Examples of molecular-level models could include drawings, 3D ball and stick structures, or computer representations showing different molecules with different types of atoms.] [Assessment Boundary: Assessment does not include valence electrons and bonding energy, discussing the ionic nature of subunits of complex structures, or a complete depiction of all individual atoms in a complex molecule or extended structure.]	
			8.MS-PS1-9(MA). Present evidence to support the claims that: a. substances are composed of molecules, compounds or atoms; and b. atoms form molecules or compounds that range in size from two to thousands of atoms.	
6-8.PS.7. Give basic examples of elements and compounds.	comparable	same	8.MS-PS1-1. Develop a model to describe that elements combine in a multitude of ways to produce substances which make up all of the living and nonliving things that we encounter. [Clarification Statement: Examples of molecular-level models could include drawings, 3D ball and stick structures, or computer representations showing different molecules with different types of atoms.] [Assessment Boundary: Assessment does not include valence electrons and bonding energy, discussing the ionic nature of subunits of complex structures, or a complete depiction of all individual atoms in a complex molecule or extended structure.]	
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 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.	Draft revised 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 Statement: 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.]	Draft revised standard does not specify melting and boiling point but these are used a basis for identifying 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 Statement: Examples of reactions could include burning sugar or steel wool, fat reacting with	
		in earlier grades	5-PS1-2. Measure and graph the weights 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 of matter is conserved. [Clarification Statement: Assume that reactions with any gas production are conducted in a closed system.] [Assessment Boundary: Assessment does not include distinguishing mass and weight.]	Draft revised 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.	Draft revised 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.	not included	na		
6-8.PS.12. Graph and interpret distance vs. time graphs for constant speed.	not included	na		

Grades 6-8 Science Crosswalk of 2001/2006 Standards to DRAFT Revised Standards

2001/6 Standard	Degree of alignment of current to draft revised	Relative grade current is found in revised	Draft Revised MA Standards December 2013	Comments on alignment
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 position of objects interacting at a distance and their relative potential energy in the system. [Clarification Statement: Examples of objects within systems interacting at varying distances could include: the 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.] [Assessment Boundary: Assessment is limited to two objects and electric, magnetic, and gravitational interactions, and does not include calculations of potential energy.]	Draft revised standard only includes potential energy.
			7.MS-PS3-5. Present evidence to support the claim that when the motion 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.] [Assessment Boundary: Assessment does not include calculations of energy.]	Draft revised standard includes a specific case of transfer of kinetic energy but not the broader context of any transformation.
			7.MS-PS3-7(MA). Describe the relationship between kinetic and potential energy and describe conversions from one form to another. [Clarification Statement: Types of kinetic energy include motion, sound, and radiation; 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 Styrofoam cup.] [Assessment Boundary: Assessment does not include calculating the total amount of thermal energy transferred, nor account for specific heat.]	
			7.MS-PS3-4. 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. [Assessment Boundary: Assessment does not include calculating the total amount of thermal energy transferred nor calculations of specific heat.]	
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 Statement: 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 Styrofoam cup.] [Assessment Boundary: Assessment does not include calculating the total amount of thermal energy transferred, nor account for specific heat.]	Draft revised standard adds an element of engineering design; does not cover equilibrium.
	included in later grades	in later grades		Comparable draft revised standard that includes equilibrium found in HS-PS3-4a.
			Draft revised grade 6-8 standards that go beyond/add to current standards	
	additional	na	7.MS-PS3-1. Construct and interpret data and graphs to describe the relationships among kinetic energy, mass, and speed of an object. [Clarification Statement: Examples could include riding a bicycle at different speeds and rolling different size rocks downhill.] [Assessment Boundary: Assessment is limited to relationships between kinetic energy vs. mass and kinetic energy vs. speed separate from each other.]	

Grades 6-8 Science Crosswalk of 2001/2006 Standards to DRAFT Revised Standards

2001/6 Standard	Degree of alignment of current to draft revised	Relative grade current is found in revised	Draft Revised MA Standards December 2013	Comments on alignment
	additional	na	7.MS-ESS3-1. Interpret data to explain why the Earth's mineral, fossil fuel, and groundwater resources are unevenly distributed as a result of geologic processes. [Clarification Statement: Examples of uneven distributions of resources can include petroleum (locations of the burial of organic marine sediments and subsequent geologic traps), metal ores (locations of past volcanic and hydrothermal activity associated with subduction zones), and soil (locations of active weathering and/or deposition of rock).]	
	additional	na	7.MS-ESS3-4. Construct an argument supported by evidence that activities and technologies can be engineered to mitigate the negative impact of increases in human population and per capita consumption of natural resources on the environment. [Clarification Statement: 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 Statement: Examples human activities include fossil fuel combustion, cement production, 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.*	
	additional	na	6.MS-ETS2-4(MA). Analyze the shape, form, size and materials of a designed object to infer the function for which it was designed.	
	additional	na	8.MS-ETS2-5(MA). Recognize 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 Statement: 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, or.]	
	additional	na	8.MS-ETS2-7(MA). Recognize that processes that transform materials into products can be controlled by humans or by computers. [Clarification Statement: Computer-aided processes are robotic or automated manufacturing.]	
	additional	na	7.MS-LS1-4. Explain, based on evidence, how characteristic animal behaviors as well as specialized plant structures increase the probability of successful reproduction of animals and plants respectively. [Clarification Statement: Examples of animal behaviors that affect the probability of animal reproduction could include nest building to protect young from cold, herding of animals to protect young from predators, and vocalization of animals and colorful plumage to attract mates for breeding. Examples of animal behaviors that affect the probability of plant reproduction could include transferring pollen or seeds; and, 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.] [Assessment Boundary: Assessment does not include natural selection.]	

Grades 6-8 Science Crosswalk of 2001/2006 Standards to DRAFT Revised Standards

2001/6 Standard	Degree of alignment of current to draft revised	Relative grade current is found in revised	Draft Revised MA Standards December 2013	Comments on alignment
	additional	na	8.MS-LS1-5. Construct a scientific explanation based on evidence for how environmental and genetic factors influence the growth of organisms. [Clarification Statement: Examples of local environmental conditions could include availability of food, light, space, and water. Examples of genetic factors could include the genes responsible for size differences in different breeds of dogs, such as Great Danes and Chihuahuas. Examples of environmental factors could include drought decreasing plant growth, fertilizer increasing plant growth, and fish growing larger in large ponds than they do in small ponds. Examples of both genetic and environmental factors could include different varieties of plants growing at different rates in different conditions.] [Assessment Boundary: Assessment does not include methods of reproduction, genetic mechanisms, gene regulation, biochemical processes, or natural selection.]	
	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. [Assessment Boundary: Assessment does not include binary counting nor the specific mechanism of any given device.]	

High School Earth Space Science Crosswalk of 2001/2006 Standards to DRAFT Revised Standards

2001/6 Standard	Degree of alignment of current to draft revised	Relative grade current is found in revised	Draft Revised MA Standards December 2013	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 by thermal convection. [Clarification Statement: 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.]	Draft revised standard only includes internal energy.
		in earlier grades	8.MS-ESS2-1. Develop and use a model to illustrate that energy from the Earth's interior drives convection which 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 that includes changes in rock types through erosion, heat and pressure.] [Assessment Boundary: Assessment does not include specific mechanisms of plate tectonics, the identification and naming of minerals or rock types, nor rote memorization of the "rock cycle".]	Draft revised 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 result in changes in climate. [Clarification Statement: Examples of the causes of climate change differ by timescale, over 1-10 years: large volcanic eruption, ocean circulation; 10-100s of years: changes in human activity, ocean circulation, solar output; 10-100s of thousands of years: changes to Earth's orbit and the orientation of its axis; and 10-100s of millions of years: long-term changes in atmospheric composition.] [Assessment Boundary: Assessment of the results of changes in climate is limited to changes in surface temperatures, precipitation patterns, glacial ice volumes, sea levels, and biosphere distribution.]	Draft revised standard does not specify electromagnetic radiation and is limited to impact on climate.
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 result in changes in climate. [Clarification Statement: Examples of the causes of climate change differ by timescale, over 1-10 years: large volcanic eruption, ocean circulation; 10-100s of years: changes in human activity, ocean circulation, solar output; 10-100s of thousands of years: changes to Earth's orbit and the orientation of its axis; and 10-100s of millions of years: long-term changes in atmospheric composition.] [Assessment Boundary: Assessment of the results of changes in climate is limited to changes in surface temperatures, precipitation patterns, glacial ice volumes, sea levels, and biosphere distribution.]	Draft revised 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). Explain how thermal energy is transferred out of hotter regions or objects and into colder ones by convection, conduction and radiation.	Draft revised 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 weather. [Clarification Statement: Data includes temperature, pressure, humidity, precipitation, and wind. Examples of patterns can include air masses flow from regions of high pressure to low pressure, how sudden changes in weather can result when different air masses collide. Data can be provided to students (such as weather maps, diagrams, and visualizations) or obtained through field observations or laboratory experiments.] [Assessment Boundary: Assessment does not include recalling the names of cloud types or weather symbols used on weather maps or the reported diagrams from weather stations.]	Draft revised standard includes atmospheric processes but does not inclue transfer of energy per se.

High School Earth Space Science Crosswalk of 2001/2006 Standards to DRAFT Revised Standards

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 result in changes in climate. [Clarification Statement: Examples of the causes of climate change differ by timescale, over 1-10 years: large volcanic eruption, ocean circulation; 10-100s of years: changes in human activity, ocean circulation, solar output; 10-100s of thousands of years: changes to Earth's orbit and the orientation of its axis; and 10-100s of millions of years: long-term changes in atmospheric composition.] [Assessment Boundary: Assessment of the results of changes in climate is limited to changes in surface temperatures, precipitation patterns, glacial ice volumes, sea levels, and biosphere distribution.]	Draft revised 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: Emphasis of ocean circulation is on the transfer of heat by the global ocean convection cycle, which is constrained by the Coriolis effect and the outlines of continents. A regional scale includes a state or multi-state perspective.] [Assessment Boundary: Assessment does not include Koppen Climate Classification names.]	Draft revised 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 the Earth's tilt and differential intensity of sunlight on different areas of Earth across the year. [Clarification Statement: Examples of models can be physical, graphical, or conceptual.]	Draft revised standard does not include 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 weather. [Clarification Statement: Data includes temperature, pressure, humidity, precipitation, and wind. Examples of patterns can include air masses flow from regions of high pressure to low pressure, how sudden changes in weather can result when different air masses collide. Data can be provided to students (such as weather maps, diagrams, and visualizations) or obtained through field observations or laboratory experiments.] [Assessment Boundary: Assessment does not include recalling the names of cloud types or weather symbols used on weather maps or the reported diagrams from weather stations.]	Draft revised standard does not include impact on human affairs.
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: Emphasis of ocean circulation is on the transfer of heat by the global ocean convection cycle, which is constrained by the Coriolis effect and the outlines of continents. A regional scale includes a state or multi-state perspective.] [Assessment Boundary: Assessment does not include Koppen Climate Classification names.]	Draft revised 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.	comparable	same	HS-ESS2-2. Analyze geoscience data to make the claim that one change to Earth's surface can create feedbacks that cause changes to other Earth's systems. [Clarification Statement: Examples should include climate feedbacks, such as how an increase in greenhouse gases causes a rise in global temperatures that melts glacial ice, which reduces the amount of sunlight reflected from Earth's surface, increasing surface temperatures and further reducing the amount of ice. Examples could also be taken from other system interactions, such as 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; or how the loss of wetlands causes a decrease in local humidity that further reduces the wetland extent.]	
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 Statement: Examples of renewable energy resources could include wind energy, water behind dams, and sunlight; non-renewable energy resources are fossil fuels and fissile materials.]	Draft revised standard does not explicitly compare types of energy resources.

High School Earth Space Science Crosswalk of 2001/2006 Standards to DRAFT Revised Standards

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 the gradual atmospheric and climatic changes due to carbon capture and oxygen release by plants and due to increased carbon dioxide generation through human activity.	Draft revised 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 Statement: Examples of mechanical mechanisms involving water include stream transportation and deposition, erosion using variations in soil moisture content, or 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) or melt generation (based on water lowering the melting temperature of most solids).]	Draft revised standard is focused the role of water in weathering and erosion while the 2001/06 standard is broader.
		in earlier grades	4-ESS1-1. Construct a claim with evidence that changes to a landscape due to erosion and deposition over long periods of time result in rock layers and landforms that can be interpreted today. 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. [Clarification Statement: 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.] [Assessment Boundary: Assessment does not include specific knowledge of the mechanisms of rock formation or memorization of specific rock formations and layers. Assessment is limited to relative time.]	Draft revised 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 by water, ice, wind, and vegetation. [Clarification Statement: Mechanical weathering can include frost wedging, abraision, and tree root wedging. Erosion can include movement by blowing wind, flowing water, and moving ice.] [Assessment Boundary: Assessment does not include chemical processes.]	Draft revised standard includes mechanical weathering, but not chemical weathering, nor a focus on landscapes.
HS.ESS.3.2. Describe the carbon cycle.	partial	same	HS-ESS2-6. Use a model to describe the gradual atmospheric and climatic changes due to carbon capture and oxygen release by plants and due to increased carbon dioxide generation through human activity.	Draft revised standard requires an understanding of the carbon cycle but does not state it.
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.] [Assessment Boundary: A quantitative understanding of the latent heats of vaporization and fusion is not assessed.]	Draft revised 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 on Earth between the geosphere, biosphere, hydrosphere, and atmosphere through evaporation, precipitation, surface runoff, condensation, transpiration, and runoff. [Assessment Boundary: Assessment does not include explanations of mechanisms that drive the cycle.]	Draft revised standard does not specifically mention watersheds but does includes aspects of water moving through an area or system.
HS.ESS.3.5. Describe the processes of the hydrologic cycle, including evaporation, condensation, precipitation, surface runoff and groundwater percolation, infiltration, and transpiration.	comparable	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.] [Assessment Boundary: A quantitative understanding of the latent heats of vaporization and fusion is not assessed.]	Draft revised standard is about the hydrologic cycle but does explicate the specific components.
			5-ESS2-1. Use a model to describe the cycling of water on Earth between the geosphere, biosphere, hydrosphere, and atmosphere through evaporation, precipitation, surface runoff, condensation, transpiration, and runoff. [Assessment Boundary: Assessment does not include explanations of mechanisms that drive the cycle.]	

High School Earth Space Science Crosswalk of 2001/2006 Standards to DRAFT Revised Standards

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. Develop and use a model to illustrate that energy from the Earth's interior drives convection which 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 that includes changes in rock types through erosion, heat and pressure.] [Assessment Boundary: Assessment does not include specific mechanisms of plate tectonics, the identification and naming of minerals or rock types, nor rote memorization of the "rock cycle".]	Draft revised 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.	comparable	in earlier grades	6.MS-ESS1-4. Analyze and interpret rock layers and index fossils to determine the relative ages of rock formations. Explain that these sources of evidence, along with radiometric dating, are used to construct the geologic time scale of Earth's history. [Clarification Statement: Analysis includes Laws of Superposition and Crosscutting Relationships. Not all organisms are fossilized.] [Assessment Boundary: Assessment is limited to minor displacement faults that offset layers and does not include strata sequences that have been reordered or overturned. Assessment does not include recalling the names of specific periods or epochs and events within them, nor specifics of 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) 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).]	Draft revised standard does not specify actions at the boundaries of plates.
		in earlier grades	8.MS-ESS2-1. Develop and use a model to illustrate that energy from the Earth's interior drives convection which 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 that includes changes in rock types through erosion, heat and pressure.] [Assessment Boundary: Assessment does not include specific mechanisms of plate tectonics, the identification and naming of minerals or rock types, nor rote memorization of the "rock cycle".]	
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 Statement: 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.	partial	in earlier grades	8.MS-ESS2-1. Develop and use a model to illustrate that energy from the Earth's interior drives convection which 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 that includes changes in rock types through erosion, heat and pressure.] [Assessment Boundary: Assessment does not include specific mechanisms of plate tectonics, the identification and naming of minerals or rock types, nor rote memorization of the "rock cycle".]	Draft revised standard does not include tsunamis or earthquakes specifically.
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 by thermal convection. [Clarification Statement: 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.]	Draft revised standard does not include locating earthquake epicenters.

High School Earth Space Science Crosswalk of 2001/2006 Standards to DRAFT Revised Standards

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 Statement: Kepler's Laws apply to human-made satellites as well as planets, moons and other objects.] [Assessment Boundary: Calculations involving Kepler's Laws of orbital motions sshould not deal with more than two bodies, nor involve calculus.]	Draft revised 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.]	Draft revised 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		
			Draft revised high school standards that are in addition to current standards	
	additional	na	HS-ESS1-3. 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. [Assessment Boundary: Details of the many different nucleosynthesis pathways for stars of differing masses are not assessed.]	
	additional	na	HS-ESS1-7(MA). 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.	
	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 Statement: 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 Statement: 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, or atmosphere and ocean composition).] [Assessment Boundary: Assessment is limited to one example of a climate change and its associated impacts.]	

High School Life Science Crosswalk of 2001/2006 Standards to DRAFT Revised Standards

2001/6 Standard	Degree of alignment of current to draft revised	Relative grade current is found in revised	Draft Revised MA Standards December 2013	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 and revise an explanation based on evidence that macromolecules are primarily composed of six elements, where carbon, hydrogen, and oxygen atoms from carbohydrates may combine with nitrogen, sulfur, and phosphorus to form large carbon-based molecules. [Clarification Statement: Large carbon-based molecules included are proteins, carbohydrates, amino acids, nucleic acids, and lipids.] [Assessment Boundary: Assessment does not include the details of the specific chemical reactions or identification of specific macromolecules.]	
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. Explain that genes are regions in the DNA that code for proteins, which carry out the essential functions of life. Construct a model of transcription and translation to explain the roles of DNA and RNA in coding the instructions for polypeptides, which make up proteins. Explain that different classes of proteins regulate and carry out the essential functions of life. [Clarification Statement: Four classes of proteins that regulate and carry out the essential functions of life include: enzymes (speeding up chemical reactions), structural proteins (providing structure and enabling movement), hormones (sending signals between cells), and antibodies (fighting disease).] [Assessment Boundary: Assessment does not include specific names of proteins or rote memorization of steps of transcription and translation.]	Draft revised standard only includes proteins.
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. Explain that genes are regions in the DNA that code for proteins, which carry out the essential functions of life. Construct a model of transcription and translation to explain the roles of DNA and RNA in coding the instructions for polypeptides, which make up proteins. Explain that different classes of proteins regulate and carry out the essential functions of life. [Clarification Statement: Four classes of proteins that regulate and carry out the essential functions of life include: enzymes (speeding up chemical reactions), structural proteins (providing structure and enabling movement), hormones (sending signals between cells), and antibodies (fighting disease).] [Assessment Boundary: Assessment does not include specific names of proteins or rote memorization of steps of transcription and translation.]	Draft revised standard does not include factors that affect 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	6.MS-LS1-2. Develop and use a model to describe the ways parts of cells contribute to key cellular functions of obtaining nutrients and water from its environment, disposing of waste, and producing energy: a. the nucleus contains genetic information (DNA) which regulates a cell's activities; b. chloroplasts are the site of photosynthesis which produces necessary glucose and oxygen; c. mitochondria facilitate cellular respiration (energy production); d. vacuoles store materials, including water, nutrients and waste; e. the cell membrane is a protective barrier that enables nutrients to enter the cell and wastes to be expelled; and f. the cell wall provides structural support to some types of cells. [Clarification Statement: Functions should focus on basic survival needs.] [Assessment Boundary: Assessment does not include specific biochemical steps or chemical processes, ATP, or active transport through the cell membrane.]	Draft revised 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 carbon dioxide and water into oxygen and chemical energy stored in the bonds of glucose and other carbohydrates. [Clarification Statement: Emphasis is on illustrating inputs and outputs of matter (including ATP) 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.] [Assessment Boundary: Assessment does not include specific biochemical steps of light reactions or the Calvin Cycle, or chemical structures of molecules.]	Draft revised 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. Contrast this process to anaerobic cellular respiration and compare the amount of energy released in each process. [Clarification Statement: Emphasis is on the conceptual understanding of the inputs and outputs of the process of cellular respiration, lactic acid fermentation and alcoholic fermentation. Students should understand that molecules other than glucose can be broken down to release energy in the form of ATP. Examples of models could include diagrams, chemical equations, and conceptual models.] [Assessment Boundary: Assessment should not include identification of the steps or specific processes involved in either aerobic or anaerobic cellular respiration.]	Draft revised standard does not include photosynthesis.
HS.LS.2.5. Explain the important role that ATP serves in metabolism.	partial	same	HS-LS1-5. Use a model to illustrate how photosynthesis uses light energy to transform carbon dioxide and water into oxygen and chemical energy stored in the bonds of glucose and other carbohydrates. [Clarification Statement: Emphasis is on illustrating inputs and outputs of matter (including ATP) 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.] [Assessment Boundary: Assessment does not include specific biochemical steps of light reactions or the Calvin Cycle, or chemical structures of molecules.]	Draft standard does not explicitly call out the role of ATP in metabolism.
			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. Contrast this process to anaerobic cellular respiration and compare the amount of energy released in each process. [Clarification Statement: Emphasis is on the conceptual understanding of the inputs and outputs of the process of cellular respiration, lactic acid fermentation and alcoholic fermentation. Students should understand that molecules other than glucose can be broken down to release energy in the form of ATP. Examples of models could include diagrams, chemical equations, and conceptual models.] [Assessment Boundary: Assessment should not include identification of the steps or specific processes involved in either aerobic or anaerobic cellular respiration.]	Draft standard does not explicitly call out the role of ATP in metabolism.
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.	partial	same	HS-LS1-4. Explain why the cell cycle is necessary for the growth, maintenance, and repair of multicellular organisms. Model the major events of the cell cycle, including cell growth, DNA replication, preparation for division, separation of chromosomes, and separation of cell contents [Assessment Boundary: Assessment does not include specific gene control mechanisms or rote memorization of steps of mitosis.]	Draft revised standard does not include asexual reproduction.
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. Ask questions to clarify relationships about how DNA in the form of chromosomes is passed from parents to offspring through the processes of meiosis and fertilization in sexual reproduction. [Assessment Boundary: Assessment does not include rote memorization of the phases of meiosis or the biochemical mechanism of specific steps in the process.]	Draft revised standard does not call for specific components of meiosis.
HS.LS.2.8. Compare and contrast a virus and a cell in terms of genetic material and reproduction.	partial	same	HS-LS1-9(MA). Research and communicate information about features of virus and bacteria reproduction and adaptation to explain their ability to survive in a wide variety of environments. [Clarification Statement: Key features include the speed of reproduction which produces many generations in a short time, allowing for rapid adaptation.]	Draft revised 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-LS1-8(MA). Explain how the structure of DNA, including its spiral shape and paired nucleotides, is related to its function of storing and transmitting hereditary information.	
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. Explain that genes are regions in the DNA that code for proteins, which carry out the essential functions of life. Construct a model of transcription and translation to explain the roles of DNA and RNA in coding the instructions for polypeptides, which make up proteins. Explain that different classes of proteins regulate and carry out the essential functions of life. [Clarification Statement: Four classes of proteins that regulate and carry out the essential functions of life include: enzymes (speeding up chemical reactions), structural proteins (providing structure and enabling movement), hormones (sending signals between cells), and antibodies (fighting disease).] [Assessment Boundary: Assessment does not include specific names of proteins or rote memorization of steps of transcription and translation.]	Draft revised standard does not include DNA replication.
			HS-LS1-4. Explain why the cell cycle is necessary for the growth, maintenance, and repair of multicellular organisms. Model the major events of the cell cycle, including cell growth, DNA replication, preparation for division, separation of chromosomes, and separation of cell contents [Assessment Boundary: Assessment does not include specific gene control mechanisms or rote memorization of steps of mitosis.]	Draft revised standard just includes DNA replication, not the specifics or details.

			HS-LS3-1. Ask questions to clarify relationships about how DNA in the form of chromosomes is passed from parents to offspring through the processes of meiosis and fertilization in sexual reproduction. [Assessment Boundary: Assessment does not include rote memorization of the phases of meiosis or the biochemical mechanism of specific steps in the process.]	Draft revised standard does not specify transcription and translation.
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 inheritable genetic variations may result from: a. new genetic combinations through meiosis; b. mutations that occur during replication; and/or c. mutations caused by environmental factors. Recognize that in general, only mutations that occur in gametes can be passed to offspring. [Clarification Statement: New genetic combinations through meiosis occur via the processes of crossing over and random segregation of chromosomes.] [Assessment Boundary: Assessment does not include rote memorization of the phases of meiosis nor identification of specific types of mutations.]	Draft revised standard does not specify phenotypic change.
			HS-LS3-3. Explain that: a. genes have variations (alleles) that code for specific variants of a protein (or RNA), and therefore specific traits of an individual; b. an individual's characteristics (phenotype) result, in part, from complex relationships among the various proteins (and RNAs) expressed by one or more genes; and c. the environment can affect the variation and distribution of expressed traits in a population. [Clarification Statement: An example of the role of the environment in expressed traits in an individual can include the likelihood of developing inherited diseases (i.e. heart disease, cancer) in relation to exposure to environmental toxins and lifestyle; an example in populations can include the maintenance of the allele for sickle-cell anemia in high frequency in malaria-effected regions of the globe, such as Africa, because it confers partial resistance to malaria.] [Assessment Boundary: Assessment does not include Hardy-Weinberg calculations.]	Draft revised standard does not include mutations but does include phenotypic changes.
		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 Statement: 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.] [Assessment Boundary: Assessment does not include specific changes at the molecular level (e.g., amino acid sequence change), mechanisms for protein synthesis, or specific types of mutations.]	Draft revised standard does not include mutations in gametes and 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 inheritable genetic variations may result from: a. new genetic combinations through meiosis; b. mutations that occur during replication; and/or c. mutations caused by environmental factors. Recognize that in general, only mutations that occur in gametes can be passed to offspring. [Clarification Statement: New genetic combinations through meiosis occur via the processes of crossing over and random segregation of chromosomes.] [Assessment Boundary: Assessment does not include rote memorization of the phases of meiosis nor identification of specific types of mutations.]	Draft revised standard does not include specific 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 inheritable genetic variations may result from: a. new genetic combinations through meiosis; b. mutations that occur during replication; and/or c. mutations caused by environmental factors. Recognize that in general, only mutations that occur in gametes can be passed to offspring. [Clarification Statement: New genetic combinations through meiosis occur via the processes of crossing over and random segregation of chromosomes.] [Assessment Boundary: Assessment does not include rote memorization of the phases of meiosis nor identification of specific types of mutations.]	Draft revised standard does not include patterns of inheritance.
HS.LS.3.6. Use a Punnett Square to determine the probabilities for genotype and phenotype combinations in monohybrid crosses.	partial	in earlier grades	8.MS-LS3-2. Develop and use a model 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 Statement: Examples of models can include Punnett squares, diagrams, and simulations. 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.]	Draft revised standard includes using Punnett squares to identify combinations but does not highlight probabilities.

High School Life Science Crosswalk of 2001/2006 Standards to DRAFT Revised Standards

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 hierarchical organization of interacting systems that provide specific functions within animals. Use the model to illustrate that: a. different types of cells contain different sets of proteins which enables the cells to perform specific functions; b. specialized cells work together to form specialized tissues, which in turn join to form specialized organs; and c. specialized organs work together to form the body systems that coordinate to carry out the essential functions of life. [Clarification Statement: Emphasis is on functions at the organism system level such as nutrient uptake, water delivery, and organism movement in response to neural stimuli. Animal body systems include circulatory, excretory, digestive, respiratory, muscular/skeletal, endocrine and nervous systems. Examples of interacting systems could include an artery depending on the proper function of elastic tissue and smooth muscle to regulate and deliver the proper amount of blood within the circulatory system.] [Assessment Boundary: Assessment does not include interactions and functions at the molecular or chemical reaction level. Assessment does not include the identification of specific proteins in cells. Assessment is limited to include major organs, such a lungs, stomach, small intestine, liver, heart and kidneys.]	Draft revised standard does not include the specific elements (or their function) of the system.
		in earlier grades	8.MS-LS1-7. Describe that food molecules, including carbohydrates, proteins and fats, are broken down and rearranged through chemical reactions forming new molecules that support growth and/or release of energy. [Clarification Statement: Emphasis is on describing that molecules are broken apart and rearranged and that in these processes result in cell growth and energy release.] [Assessment Boundary: Assessment does not include details of the chemical reactions for respiration, biochemical steps of breaking down food, or the resulting molecules (e.g., carbohydrates are broken down into monosaccharides).]	Draft revised standard does not include the digestive system but does include 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 hierarchical organization of interacting systems that provide specific functions within animals. Use the model to illustrate that: a. different types of cells contain different sets of proteins which enables the cells to perform specific functions; b. specialized cells work together to form specialized tissues, which in turn join to form specialized organs; and c. specialized organs work together to form the body systems that coordinate to carry out the essential functions of life. [Clarification Statement: Emphasis is on functions at the organism system level such as nutrient uptake, water delivery, and organism movement in response to neural stimuli. Animal body systems include circulatory, excretory, digestive, respiratory, muscular/skeletal, endocrine and nervous systems. Examples of interacting systems could include an artery depending on the proper function of elastic tissue and smooth muscle to regulate and deliver the proper amount of blood within the circulatory system.] [Assessment Boundary: Assessment does not include interactions and functions at the molecular or chemical reaction level. Assessment does not include the identification of specific proteins in cells. Assessment is limited to include major organs, such a lungs, stomach, small intestine, liver, heart and kidneys.]	Draft revised standard does not include the specific elements (or their function) of the system.
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 hierarchical organization of interacting systems that provide specific functions within animals. Use the model to illustrate that: a. different types of cells contain different sets of proteins which enables the cells to perform specific functions; b. specialized cells work together to form specialized tissues, which in turn join to form specialized organs; and c. specialized organs work together to form the body systems that coordinate to carry out the essential functions of life. [Clarification Statement: Emphasis is on functions at the organism system level such as nutrient uptake, water delivery, and organism movement in response to neural stimuli. Animal body systems include circulatory, excretory, digestive, respiratory, muscular/skeletal, endocrine and nervous systems. Examples of interacting systems could include an artery depending on the proper function of elastic tissue and smooth muscle to regulate and deliver the proper amount of blood within the circulatory system.] [Assessment Boundary: Assessment does not include interactions and functions at the molecular or chemical reaction level. Assessment does not include the identification of specific proteins in cells. Assessment is limited to include major organs, such a lungs, stomach, small intestine, liver, heart and kidneys.]	Draft revised standard does not include the specific elements (or their function) 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 hierarchical organization of interacting systems that provide specific functions within animals. Use the model to illustrate that: a. different types of cells contain different sets of proteins which enables the cells to perform specific functions; b. specialized cells work together to form specialized tissues, which in turn join to form specialized organs; and c. specialized organs work together to form the body systems that coordinate to carry out the essential functions of life. [Clarification Statement: Emphasis is on functions at the organism system level such as nutrient uptake, water delivery, and organism movement in response to neural stimuli. Animal body systems include circulatory, excretory, digestive, respiratory, muscular/skeletal, endocrine and nervous systems. Examples of interacting systems could include an artery depending on the proper function of elastic tissue and smooth muscle to regulate and deliver the proper amount of blood within the circulatory system.] [Assessment Boundary: Assessment does not include interactions and functions at the molecular or chemical reaction level. Assessment does not include the identification of specific proteins in cells. Assessment is limited to include major organs, such a lungs, stomach, small intestine, liver, heart and kidneys.]	Draft revised standard does not include the specific elements (or their function) 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 hierarchical organization of interacting systems that provide specific functions within animals. Use the model to illustrate that: a. different types of cells contain different sets of proteins which enables the cells to perform specific functions; b. specialized cells work together to form specialized tissues, which in turn join to form specialized organs; and c. specialized organs work together to form the body systems that coordinate to carry out the essential functions of life. [Clarification Statement: Emphasis is on functions at the organism system level such as nutrient uptake, water delivery, and organism movement in response to neural stimuli. Animal body systems include circulatory, excretory, digestive, respiratory, muscular/skeletal, endocrine and nervous systems. Examples of interacting systems could include an artery depending on the proper function of elastic tissue and smooth muscle to regulate and deliver the proper amount of blood within the circulatory system.] [Assessment Boundary: Assessment does not include interactions and functions at the molecular or chemical reaction level. Assessment does not include the identification of specific proteins in cells. Assessment is limited to include major organs, such a lungs, stomach, small intestine, liver, heart and kidneys.]	Draft revised standard does not include the specific elements (or their function) of the system.
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, and hence two alleles of each gene, one acquired (randomly) from each parent. [Clarification Statement: Examples of models can include Punnett squares, diagrams, and simulations.] [Assessment Boundary: Assessment should only include dominant-recessive pattern of inheritance.]	Draft revised 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 hierarchical organization of interacting systems that provide specific functions within animals. Use the model to illustrate that: a. different types of cells contain different sets of proteins which enables the cells to perform specific functions; b. specialized cells work together to form specialized tissues, which in turn join to form specialized organs; and c. specialized organs work together to form the body systems that coordinate to carry out the essential functions of life. [Clarification Statement: Emphasis is on functions at the organism system level such as nutrient uptake, water delivery, and organism movement in response to neural stimuli. Animal body systems include circulatory, excretory, digestive, respiratory, muscular/skeletal, endocrine and nervous systems. Examples of interacting systems could include an artery depending on the proper function of elastic tissue and smooth muscle to regulate and deliver the proper amount of blood within the circulatory system.] [Assessment Boundary: Assessment does not include interactions and functions at the molecular or chemical reaction level. Assessment does not include the identification of specific proteins in cells. Assessment is limited to include major organs, such a lungs, stomach, small intestine, liver, heart and kidneys.]	Draft revised standard does not include the specific elements (or their function) 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 feedback mechanisms promote (through positive feedback) or inhibit (through negative feedback) activities within an organism to maintain homeostasis. [Clarification Statement: Examples could include heart rate response to exercise and recovery, insulin production and inhibition in response to blood sugar levels, stomate response to moisture and temperature, and root development in response to water levels.] [Assessment Boundary: Assessment does not include sub-cellular processes involved in the feedback mechanism nor interactions at the molecular level.]	
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 documented laboratory and field observations.	

High School Life Science Crosswalk of 2001/2006 Standards to DRAFT Revised Standards

			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: (1) more offspring are produced than can be supported by the environment, (2) there is heritable variation among individuals, and (3) some of these variations lead to differential fitness among individuals as some individuals are better able to compete for limited resources than others. The result is the proliferation of those individuals with advantageous heritable traits that are better able to survive and reproduce in the environment.	
			HS-LS4-3. Explain based on evidence how coevolution and sexual selection can lead to individuals with behavioral, anatomical, and physiological adaptations in a population.	
			HS-LS4-4. Construct an explanation based on evidence for how genetic drift and gene flow together with natural selection lead to populations that have more individuals with behavioral, anatomical, and physiological adaptations.	
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 evidence that demonstrates how changes in environmental conditions may result in the emergence of new species over generations and/or the extinction of other species, and that these processes may occur at different rates depending on the conditions. [Clarification Statement: Examples of the processes occurring at different rates include gradualism versus punctuated equilibrium and background extinction versus mass extinction).]	Draft revised standard does not include anything on classification. Does not specifically define 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 Statement: Examples of biotic factors could include relationships among individuals (e.g., feeding relationships, symbioses, competition) and disease. Examples of abiotic factors could include climate and weather conditions, natural disasters, and availability of resources. Examples of mathematical representations include finding the average, determining trends, and using graphical comparisons of multiple sets of data.] [Assessment Boundary: Assessment is limited to provided data.]	Draft revised standard does include specific references to natural selection and evolution.
			HS-LS4-5. Evaluate evidence that demonstrates how changes in environmental conditions may result in the emergence of new species over generations and/or the extinction of other species, and that these processes may occur at different rates depending on the conditions. [Clarification Statement: Examples of the processes occurring at different rates include gradualism versus punctuated equilibrium and background extinction versus mass extinction).]	Draft revised standard does not specificially 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 Statement: 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.]	Draft revised standard at individual population sizes and 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.	partial	same	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.]	Draft revised standard 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. Explain that atoms, including elements of carbon, oxygen, hydrogen and nitrogen, are conserved even as matter is broken down, recombined, and recycled by organisms in ecosystems. [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.)]	Draft revised standard does not talk about relationships among organisms nor mention specific use of food webs.
		in earlier grades	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.]	Draft revised standard includes only the patterns of interactions between organisms and not other components of the 2001/2006 standard.

High School Life Science Crosswalk of 2001/2006 Standards to DRAFT Revised Standards

			7.MS-LS2-7(MA). Construct a model of a food web to explain that energy is transferred among producers, primary, secondary, and tertiary consumers, and decomposers as they interact within an ecosystem. [Clarification Statement: Student should be able to predict changes in relative sizes of populations based on food webs.]	Draft revised standard includes only the relationships in a food web 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.	partial	same	HS-LS2-3. Construct and revise an explanation based on evidence that the processes of photosynthesis, chemosynthesis, and aerobic and anaerobic respiration are responsible for the cycling of matter and flow of energy through ecosystems. Explain that environmental conditions restrict which reactions can occur. [Clarification Statement: Examples of environmental conditions can include the availability of sunlight or oxygen.] [Assessment Boundary: Assessment does not include the specific chemical processes of photosynthesis, chemosynthesis, of either aerobic respiration or anaerobic respiration.]	Draft revised standard does not specifically require knowledge of the carbon, nitrogen, or water cycles.
			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. Explain that atoms, including elements of carbon, oxygen, hydrogen and nitrogen, are conserved even as matter is broken down, recombined, and recycled by organisms in ecosystems. [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.)]	Draft revised standard does not specifically require knowledge of the carbon, nitrogen, or water cycles.
			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 Statement: The primary forms of carbon include carbon dioxide, hydrocarbons, waste, and biomass. Examples of models could include simulations and mathematical models.] [Assessment Boundary: Assessment does not include the specific chemical steps of photosynthesis, respiration, decomposition, and combustion.]	Draft revised does not include water or nitrogen cycle.
			Draft revised high school standards that are in addition to current standards	
			HS-LS2-6. Evaluate the claims, evidence, and reasoning that in stable conditions the dynamic interactions within an ecosystem 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. Analyze data to provide evidence that ecosystems with greater biodiversity tend to have greater resistance and resilience to change. [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, climate changes, ocean acidification, or sea level rise.]	

High School Chemistry Crosswalk of 2001/2006 Standards to DRAFT Revised Standards

2001/6 Standard	Degree of alignment of current to draft revised	Relative grade current is found in revised	Draft Revised MA Standards December 2013	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 intermolecular interactions are determined by atomic composition and molecular geometry, and for how ions or small molecules arrange into two major types of three-dimensional crystal structures: atom/ionic networks or molecular crystals. [Clarification Statement: Substances include both pure substances in solid, liquid, gas and networked forms (such as graphite) as well as solutions. Examples of bulk properties of substances include composition, melting point and boiling point, vapor pressure, and surface tension.] [Assessment Boundary: Assessment does not include Raoult's law calculations of vapor pressure. Properties of heterogeneous mixtures are not assessed. Names of specific intermolecular forces (such as dipole-dipole) are not assessed.]	Draft revised standard does not include examples of some physical properties listed in the 2001/06 standard. Chemical properties are not included in draft revised 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 Statement: 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.]	Draft revised 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 stiffness, strength, ductility, hardness, thermal conductivity, electrical conductivity, and melting point.	Draft revised 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). Construct an argument to show differences in the atomic composition and molecular geometry of substances that allow for identification, detection, and separation of substances in a mixture. [Clarification Statement: Atomic composition of the atom includes electrostatic attractions and repulsions between the electrons and nucleus and that neutral atoms can have different numbers of neutrons (isotopes).]	Draft revised standard does not include differentiation of heterogeneous and homogeneous mixtures. 2001/6 standard is at the macro-level and draft revised 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 Statement: 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-PS1-11(MA). Construct an argument to show differences in the atomic composition and molecular geometry of substances that allow for identification, detection, and separation of substances in a mixture. [Clarification Statement: Atomic composition of the atom includes electrostatic attractions and repulsions between the electrons and nucleus and that neutral atoms can have different numbers of neutrons (isotopes).]	Draft revised 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.	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 Statement: 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.] [Assessment Boundary: Calculations may involve mass-to-mass stoichiometry and atom economy comparisons, but only for single-step reactions that do not involve complexes.]	Draft revised standard does not specifically include multiple proportions.

High School Chemistry Crosswalk of 2001/2006 Standards to DRAFT Revised Standards

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 and Coulomb's law to explain and predict trends in ionization energies, relative sizes of atoms and ions, and reactivity of pure elements. [Assessment Boundary: Assessment is limited to main group (s and p block) elements.]	Draft revised 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	same (in ESS)	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 Statement: Examples of models include simple qualitative models, such as pictures or diagrams.] [Assessment Boundary: Assessment does not include quantitative calculation of energy released or absorbed. Assessment is limited to alpha, beta, and gamma radioactive decays.]	Draft revised standard does not include the use of nuclear equations or half-life.
HS.Chem.2.7. Compare and contrast nuclear fission and nuclear fusion.	comparable	same (in ESS)	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 Statement: Examples of models include simple qualitative models, such as pictures or diagrams.] [Assessment Boundary: Assessment does not include quantitative calculation of energy released or absorbed. Assessment is limited to alpha, beta, and gamma radioactive decays.]	
		same (in ESS)	HS-ESS1-1. Explain that the life span of the sun over approximately 10 billion years is a function of nuclear fusion in its core.	Draft revised 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 and Coulomb's law to explain and predict trends in ionization energies, relative sizes of atoms and ions, and reactivity of pure elements. [Assessment Boundary: Assessment is limited to main group (s and p block) elements.]	Draft revised 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 and Coulomb's law to explain and predict trends in ionization energies, relative sizes of atoms and ions, and reactivity of pure elements. [Assessment Boundary: Assessment is limited to main group (s and p block) elements.]	Draft revised 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 and Coulomb's law to explain and predict trends in ionization energies, relative sizes of atoms and ions, and reactivity of pure elements. [Assessment Boundary: Assessment is 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 and Coulomb's law to explain and predict trends in ionization energies, relative sizes of atoms and ions, and reactivity of pure elements. [Assessment Boundary: Assessment is limited to main group (s and p block) elements.]	

High School Chemistry Crosswalk of 2001/2006 Standards to DRAFT Revised Standards

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 combination reactions that result in two main classes of binary compounds, ionic and molecular. Account for chemical changes in terms of charge redistribution. [Clarification Statement: Simple combination reactions include synthesis (combination), decomposition, single displacement, double displacement, or combustion.] [Assessment Boundary: Assessment is limited to chemical reactions involving main group (s and p block) elements and combustion reactions.]	Draft revised standard does not include predicting chemical formulas.
			HS-PS1-12(MA). Combine period patterns and Coulomb's law with observational data about ionic substances versus molecular substances to develop a predictive model for ionic versus covalent bonding in binary structures. [Clarification Statement: Observational data include: ionic substances (i.e., have ionic bonds), when pure, are crystalline salts at room temperature (common examples include NaCl, Na2CO3, FE2O3); and substances that are liquids and gasses at room temperature are usually made of molecules which have covalent bonds (common examples include CO2, N2, CH4, H2O, C8H18, C12H22O11).]	
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.	partial	same	HS-PS1-12(MA). Combine period patterns and Coulomb's law with observational data about ionic substances versus molecular substances to develop a predictive model for ionic versus covalent bonding in binary structures. [Clarification Statement: Observational data include: ionic substances (i.e., have ionic bonds), when pure, are crystalline salts at room temperature (common examples include NaCl, Na2CO3, FE2O3); and substances that are liquids and gasses at room temperature are usually made of molecules which have covalent bonds (common examples include CO2, N2, CH4, H2O, C8H18, C12H22O11).]	Draft revised standard does not specifically address polar and nonpolar covalent bonds.
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 different materials to justify why particular classes of substances have specific properties that are useful in the functioning of designed materials.* [Clarification Statement: Examples could include comparing molecules with simple molecular geometries, why electrically conductive materials are often made of metal, foods and household products often contain ionic compounds, materials that need to be flexible but durable are made up of polymers, and pharmaceuticals are designed to interact with specific receptors.] [Assessment Boundary: Assessment is limited to VESPR, polymers, ionic compounds, isomers, and metals.]	
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 Statement: 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.] [Assessment Boundary: 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 combination reactions that result in two main classes of binary compounds, ionic and molecular. Account for chemical changes in terms of charge redistribution. [Clarification Statement: Simple combination reactions include synthesis (combination), decomposition, single displacement, double displacement, or combustion.] [Assessment Boundary: Assessment is limited to chemical reactions involving main group (s and p block) elements and combustion reactions.]	

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 Statement: 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.] [Assessment Boundary: 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 Statement: 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.] [Assessment Boundary: Calculations may involve mass-to-mass stoichiometry and atom economy comparisons, but only for single-step reactions that do not involve complexes.]	Draft revised 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 Statement: 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.] [Assessment Boundary: 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 Statement: 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.] [Assessment Boundary: 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). Communicate a qualitative explanation based on kinetic-molecular theory for why one variable in the combined gas law changes when another is varied. Using kinetic-molecular theory, explain the behavior of gases and the relationship between pressure and volume (Boyle's law), volume and temperature (Charles's law), and pressure and temperature (Gay-Lussac's law). Use the combined gas law to determine changes in pressure, volume, and temperature.	
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). Communicate a qualitative explanation based on kinetic-molecular theory for why one variable in the combined gas law changes when another is varied. Using kinetic-molecular theory, explain the behavior of gases and the relationship between pressure and volume (Boyle's law), volume and temperature (Charles's law), and pressure and temperature (Gay-Lussac's law). Use the combined gas law to determine changes in pressure, volume, and temperature.	Draft revised 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 Statement: 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	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, graphs showing the relative energies of reactants and products, and representations showing energy is conserved.]	Draft revised standard does not specifically address conservation of energy.
			HS-PS3-4b. Provide evidence from literature or available data to illustrate that the transfer of energy within a closed system involves heat (enthalpy change) and rearrangement of the system (entropy change) while the overall energy in the system is conserved.	Draft revised 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 literature or available data to illustrate that the transfer of energy within a closed system involves heat (enthalpy change) and rearrangement of the system (entropy change) while the overall energy in the system is conserved.	
HS.Chem.7.1. Describe the process by which solutes dissolve in solvents.	comparable	same	HS-PS2-7(MA). Construct a model to explain the process by which solutes dissolve in solvents, particularly water, and predict how intermolecular forces affect solubility. [Clarification Statement: Predictions include whether the substance will dissolve based on being polar or nonpolar and ionic or covalent.]	
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 Statement: 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.] [Assessment Boundary: 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-PS1-5. Construct an explanation based on collision theory for why varying conditions influence the rate of a chemical reaction or a dissolving process. Design and test ways to alter various conditions to influence (slow down or accelerate) rates of processes (chemical reactions or dissolving) as they occur.* [Clarification Statement: Explanations should be based on three variables in collision theory: quantity of collisions per unit time, molecular orientation on collision, and energy input needed to induce atomic rearrangements. Conditions that affect these three variables include temperature, pressure, concentrations of reactants, mixing, particle size, surface area, and addition of a catalyst.] [Assessment Boundary: Assessment is 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 intermolecular interactions are determined by atomic composition and molecular geometry, and for how ions or small molecules arrange into two major types of three-dimensional crystal structures: atom/ionic networks or molecular crystals. [Clarification Statement: Substances include both pure substances in solid, liquid, gas and networked forms (such as graphite) as well as solutions. Examples of bulk properties of substances include composition, melting point and boiling point, vapor pressure, and surface tension.] [Assessment Boundary: Assessment does not include Raoult's law calculations of vapor pressure. Properties of heterogeneous mixtures are not assessed. Names of specific intermolecular forces (such as dipole-dipole) are not assessed.]	Draft revised standard does not specifically require comparison of solutions and pure solvents.

High School Chemistry Crosswalk of 2001/2006 Standards to DRAFT Revised Standards

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 collision theory for why varying conditions influence the rate of a chemical reaction or a dissolving process. Design and test ways to alter various conditions to influence (slow down or accelerate) rates of processes (chemical reactions or dissolving) as they occur.* [Clarification Statement: Explanations should be based on three variables in collision theory: quantity of collisions per unit time, molecular orientation on collision, and energy input needed to induce atomic rearrangements. Conditions that affect these three variables include temperature, pressure, concentrations of reactants, mixing, particle size, surface area, and addition of a catalyst.] [Assessment Boundary: Assessment is 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 collision theory to account for how altering conditions would affect the forward and reverse rates of the reaction until a new equilibrium is established.* [Clarification Statement: Conditions that can be altered include temperature, pressure, concentrations of reactants, mixing, particle size, surface area, and addition of a catalyst.] [Assessment Boundary: Assessment does not include calculating equilibrium constants or concentrations. Assessment is 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). Recognize that the strength of an aqueous acidic or basic solution is determined by the hydronium ion concentration. Use the Arrhenius and Bronsted-Lowry acid-base reaction models and Le Chatelier's principle to predict whether the pH increases or decreases when conditions are modified. Make arguments about the relative strengths	
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). Recognize that the strength of an aqueous acidic or basic solution is determined by the hydronium ion concentration. Use the Arrhenius and Bronsted-Lowry acid-base reaction models and Le Chatelier's principle to predict whether the pH increases or decreases when conditions are modified. Make arguments about the relative strengths of two acids or bases with similar structure and/or composition. [Clarification Statement: Modification of conditions includes dilution of or addition or removal of reactants or products by physical or chemical means. 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, electronegativity model of electron distribution, empirical dipole moments, and molecular geometry.] [Assessment Boundary: Reactions are limited to Arrhenius and Bronsted-Lowry acid-base reaction patterns with monoprotic acids. Acid or base strength comparisons are limited to homologous series.]	
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 periodic properties of elements, an electron distribution model and the periodic table model to design substances that could be used in devices that produce electricity via oxidation-reduction reactions.* [Clarification Statement: Devices may include batteries, fuel cells, electrolysis, and corrosion-protection.] [Assessment Boundary: Reactions are limited to simple oxidation-reduction reactions that do not require hydronium or hydroxide ion to balance half-reactions. Electron distribution models are limited to oxidation numbers accounting.]	
			Draft revised high school standards that go beyond/add to current standards	
	additional	na	HS-PS1-13(MA). Analyze data of the conductivity of pure water versus different solutions of water with another substance dissolved in it to make a claim about the nature of the molecules of the dissolved substances.	

Introductory Physics Crosswalk of 2001/2006 Standards to DRAFT Revised Standards

2001/6 Standard	Degree of alignment of current to draft revised	Relative grade current is found in revised	Draft Revised MA Standards December 2013	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.	not included	na		
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.	not included	na		
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 motion and change in motion (acceleration) of objects with mass when acted on by a net force. Use free-body force diagrams and algebraic expressions representing Newton's laws of motion to predict changes to velocity and acceleration for an object moving in one dimension in various situations. [Clarification Statement: 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, or a moving object being pulled by a constant force. Predictions of changes in motion can be made numerically, graphically, and algebraically using basic equations for velocity, average speed and constant acceleration.]	Draft revised 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. [Assessment Boundary: Assessment is limited to vertical or horizontal interactions in one dimension.]	Draft revised standard includes Newton's third law only, not 1st and 2nd.
			8.MS-PS2-2. Provide evidence that the change in an object's motion depends on the sum of the forces on the object (the net force) and the mass of the object. [Clarification Statement: Emphasis is on balanced (Newton's First Law) and unbalanced forces in a system, qualitative comparisons of forces, mass and changes in motion (Newton's Second Law) in one dimension.] [Assessment Boundary: Assessment is limited to forces and changes in motion in one dimension in an inertial reference frame and to change in one variable at a time. Assessment does not include the use of trigonometry.]	Draft revised 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-PS2-1. Analyze data to support the claim that Newton's second law of motion is a mathematical model describing motion and change in motion (acceleration) of objects with mass when acted on by a net force. Use free-body force diagrams and algebraic expressions representing Newton's laws of motion to predict changes to velocity and acceleration for an object moving in one dimension in various situations. [Clarification Statement: 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, or a moving object being pulled by a constant force. Predictions of changes in motion can be made numerically, graphically, and algebraically using basic equations for velocity, average speed and constant acceleration.]	Draft revised standard does not distinquish between static and kinetic friction.
HS.IP.1.6 Distinguish qualitatively between static and kinetic friction, and describe their effects on the motion of objects.	not included	na		
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; as well as the relative strength comparison between the two forces.] [Assessment Boundary: Assessment is limited to systems with two objects and does not include permittivity of free space.]	
HS-IP.1.8. Describe conceptually the forces involved in circular motion.	not included	na		

Introductory Physics Crosswalk of 2001/2006 Standards to DRAFT Revised Standards

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. [Assessment Boundary: Assessment is limited to systems of two or three components; and to thermal energy, kinetic energy, and/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 Statement: 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.] [Assessment Boundary: Assessment for quantitative evaluations is limited to total output for a given input.]	Draft revised 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. [Assessment Boundary: Assessment is limited to systems of two or three components; and to thermal energy, kinetic energy, and/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 Statement: 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.] [Assessment Boundary: Assessment for quantitative evaluations is limited to total output for a given input.]	Draft revised 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.	partial	in earlier grades	8.MS-ETS4-1(MA). Explain how a machine converts energy, through mechanical means, to do work.	Draft revised standard limits the concept of work to explanation in context of a maching; it does not include quantitative calculations.
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 moving in one dimension 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.]	Draft revised 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 Styrofoam cup.] [Assessment Boundary: Assessment does not include calculating the total amount of thermal energy transferred, nor account for specific heat.]	Draft revised standard includes transfer but focus is not on the three methods.
			7.MS-PS3-6(MA). 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 results in thermal equilibrium, or a more uniform energy distribution among the objects (second law of thermodynamics) and that temperature changes at 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 in either a single phase or during a phase change.]	

Introductory Physics Crosswalk of 2001/2006 Standards to DRAFT Revised Standards

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.	partial	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 Statement: Examples of phenomena at the macroscopic scale could include the conversion of kinetic energy to thermal energy, the gravitational potential energy stored due to position of an object above the earth, and the energy stored (electrical potential) of a charged object's position within an electrical field. Examples of models could include diagrams, drawings, descriptions, and computer simulations.]	Draft revised 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 Statement: 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.]	Draft revised standard does not specifically address relationships among processes.
			7.MS-PS3-4. 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. [Assessment Boundary: Assessment does not include calculating the total amount of thermal energy transferred nor calculations of specific heat.]	Draft revised standard 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 results in thermal equilibrium, or a more uniform energy distribution among the objects (second law of thermodynamics) and that temperature changes at 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 in either a single phase or during a phase change.]	
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 in various media. Recognize that electromagnetic waves can travel through empty space (without a medium). [Clarification Statement: 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 (if applicable).] [Assessment Boundary: Assessment is limited to algebraic relationships and not to include Snell's Law.]	Draft revised standard does not include amplitude or harmonic motion.
		in earlier grades	6.MS-PS4-1. Use diagrams of a simple wave to explain that a wave has a repeating pattern with a specific amplitude, frequency and wavelength. [Assessment Boundary: Assessment does not include electromagnetic waves and is limited to standard repeating waves.]	Draft revised 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 wave to communicate that waves: a. are regular patterns of motion along which energy travels, and b. can differ in amplitude and wavelength. [Clarification Statement: Examples of models could include diagrams, analogies, and physical models using wire to illustrate wavelength and amplitude of waves.] [Assessment Boundary: Assessment is limited to mechanical waves (including sound) and does not include interference effects, electromagnetic waves, non-periodic waves, or quantitative models of amplitude and wavelength.]	Draft revised standard does not include all measurable properties of waves, relationships among components, nor harmonic motion. The draft revised 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.	partial	same	HSPS4-1. Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling in various media. Recognize that electromagnetic waves can travel through empty space (without a medium). [Clarification Statement: 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 (if applicable).] [Assessment Boundary: Assessment is limited to algebraic relationships and not to include Snell's Law.]	Draft revised standard does not explicitly ask for the differentiation between the two types of waves.
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 either by a wave model or a particle model, and that for explaining reflection, refraction, resonance, interference, diffraction and the photoelectric effect, one model is more useful than the other. [Clarification Statement: Includes both transverse (including electromagnetic) and longitudinal mechanical waves.]	Draft revised 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 Statement: 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.] [Assessment Boundary: Assessment is 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 in various media. Recognize that electromagnetic waves can travel through empty space (without a medium). [Clarification Statement: 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 (if applicable).] [Assessment Boundary: Assessment is limited to algebraic relationships and not to include Snell's Law.]	
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. Describe the effect of distance and magnitude of electric charge and current on the size of electromagnetic forces. [Clarification Statement: Includes both attractive and repulsive forces.] [Assessment Boundary: Assessment is limited to proportional reasoning and algebraic thinking.]	Draft revised 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. [Assessment Boundary: Assessment is limited to electric and magnetic fields, and limited to qualitative evidence for the existence of fields.]	Draft revised 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). Analyze simple arrangements of electrical components in both series and parallel circuits. Use appropriate instruments to measure the voltage across and current through a resistor. Use Ohm's Law to determine the resistance in a circuit when given the voltage and current.	
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.	partial	same	HS-PS2-9(MA). Analyze simple arrangements of electrical components in both series and parallel circuits. Use appropriate instruments to measure the voltage across and current through a resistor. Use Ohm's Law to determine the resistance in a circuit when given the voltage and current.	Draft revised standard does not explicate the symbols or specific components.
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; as well as the relative strength comparison between the two forces.] [Assessment Boundary: Assessment is limited to systems with two objects and does not include permittivity of free space.]	
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). Analyze simple arrangements of electrical components in both series and parallel circuits. Use appropriate instruments to measure the voltage across and current through a resistor. Use Ohm's Law to determine the resistance in a circuit when given the voltage and current.	Draft revised 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.	partial	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.	Draft revised standard does not include application.
			HS-PS3-5. Develop and use a model of electric or magnetic fields to illustrate the forces and changes in energy between two magnetically or electrically charged objects changing relative position in a field. [Clarification Statement: 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.]	Draft revised standard does not include application to technologies.

Introductory Physics Crosswalk of 2001/2006 Standards to DRAFT Revised Standards

		in earlier grades	7.MS-PS2-3. Describe the effect of distance and magnitude of electric charge and current on the size of electromagnetic forces. [Clarification Statement: Includes both attractive and repulsive forces.] [Assessment Boundary: Assessment is limited to proportional reasoning and algebraic thinking.]	Draft revised 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 in various media. Recognize that electromagnetic waves can travel through empty space (without a medium). [Clarification Statement: 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 (if applicable).] [Assessment Boundary: Assessment is limited to algebraic relationships and not to include Snell's Law.]	
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		
			Draft revised 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 Statement: 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 interference.] [Assessment Boundary: Assessments are limited to qualitative information. Assessments do not include band theory.]	

High School Technology/Engineering Crosswalk of 2001/2006 Standards to DRAFT Revised Standards

2001/6 Standard	Degree of alignment of current to draft revised	Relative grade current is found in revised	Draft Revised MA Standards December 2013	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.*	Draft revised 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.*	Draft revised 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.*	Draft revised 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.*	Draft revised 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.]	Draft revised 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.*	Draft revised 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. Create and interpret graphs that relate material properties to a desired performance condition a designed object must meet. [Clarification Statement: Examples of material properties can include strength, durability, hardness, and elasticity. Examples of graphs can include graphs of extension vs. load-as for an elastic material, or stiffness vs. temperature-as for metals.]	Draft revised 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 Statement: Examples of structures include bridges, houses, and skyscrapers. Examples of material properties can include elasticity, plasticity, thermal resistance, density, and strength.]	
HS.TE.2.3. Explain Bernoulli's principle and its effect on structures such as buildings and bridges.	partial	same	HS-ETS3-6(MA). Describe how a vehicle or device can be modified to produce a change in lift, drag, friction, thrust, and weight. [Clarification Statement: Examples of vehicles can include cars, boats, airplanes, and rockets. Considerations of lift require consideration of Bernoulli's principle.]	Draft revised 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 Statement: 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.]	

High School Technology/Engineering Crosswalk of 2001/2006 Standards to DRAFT Revised Standards

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 power tools used to construct a prototype.* [Clarification Statement: 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.]	
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 Statement: Examples of open systems can include irrigation, forced hot air system, and air compressors. Examples of closed systems can include forced hot water system 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.	not included	na		
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-ETS4-3(MA). Calculate and describe the ability of a hydraulic system to multiply distance, multiply force, and effect directional change.	
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.	not included	same (in PS)		Comparable draft revised standard is included in Introductory Physics (HS-PS2-9(MA)).
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.	not included	na		
HS.TE.5.3. Explain the relationships among voltage, current, and resistance in a simple circuit, using Ohm's law.	not included	same (in PS)		Comparable draft revised standard is included in Introductory Physics (HS-PS2-9(MA)).
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).	

High School Technology/Engineering Crosswalk of 2001/2006 Standards to DRAFT Revised Standards

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.] [Assessment Boundary: Assessment does not include specific manufacturing machines.]	
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 that 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.]	
			Draft revised 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.]	