# Sixth Grade English Language Arts Standards

| **Strand:** Reading Standards for Literature **Grade Level:** 6 |
|---|
| **Substrands & Standards** |
| **Key Ideas and Details**<br>1. Cite textual evidence to support analysis of what the text says explicitly as well as inferences drawn from the text.<br>2. Determine a theme or central idea of a text and how it is conveyed through particular details; provide a summary of the text distinct from personal opinions or judgments.<br>3. Describe how a particular story's or drama's plot unfolds in a series of episodes as well as how the characters respond or change as the plot moves toward a resolution. |
| **Craft and Structure**<br>4. Determine the meaning of words and phrases as they are used in a text, including figurative and connotative meanings; analyze the impact of a specific word choice on meaning and tone. (See grade 6 Language standards 4-6 for additional expectations).<br>5. Analyze how a particular sentence, chapter, scene, or stanza fits into the overall structure of a text and contributes to the development of the theme, setting, or plot.<br>6. Explain how an author develops the point of view of the narrator or speaker in a text. |
| **Integration of Knowledge and Ideas**<br>7. Compare and contrast the experience of reading a story, drama, or poem to listening to or viewing an audio, video, or live version of the text, including contrasting what they "see" and "hear" when reading the text to what they perceive when they listen or watch.<br>8. (Not applicable to literature)<br>9. Compare and contrast texts in different forms or genres (e.g., stories and poems; historical novels and fantasy stories) in terms of their approaches to similar themes and topics. |
| **Range of Reading and Level of Text Complexity**<br>10. By the end of the year, read and comprehend literature, including stories, dramas, and poems, in the grades 6–8 text complexity band proficiently, with scaffolding as needed at the high end of the range. |

| **Strand:** Reading Standards for Informational Text **Grade Level:** 6 |
|---|
| **Substrands & Standards** |
| **Key Ideas and Details**<br>1. Cite textual evidence to support analysis of what the text says explicitly as well as inferences drawn from the text.<br>2. Determine a central idea of a text and how it is conveyed through particular details; provide a summary of the text distinct from personal opinions or judgments.<br>3. Analyze in detail how a key individual, event, or idea is introduced, illustrated, and elaborated in a text (e.g., through examples or anecdotes). |
| **Craft and Structure**<br>4. Determine the meaning of words and phrases as they are used in a text, including figurative, connotative, and technical meanings. (See grade 6 Language standards 4-6 for additional expectations.)<br>5. Analyze how a particular sentence, paragraph, chapter, or section fits into the overall structure of a text and contributes to the development of the ideas.<br>a. Analyze the use of text features (e.g., graphics, headers, captions) in popular media.<br>6. Determine an author's point of view or purpose in a text and explain how it is conveyed in the text. |
| **Integration of Knowledge and Ideas**<br>7. Integrate information presented in different media or formats (e.g., visually, quantitatively) as well as in words to develop a coherent understanding of a topic or issue.<br>8. Trace and evaluate the argument and specific claims in a text, distinguishing claims that are supported by reasons and evidence from claims that are not.<br>9. Compare and contrast one author's presentation of events with that of another (e.g., a memoir written by and a biography on the same person). |
| **Range of Reading and Level of Text Complexity**<br>10. By the end of the year, read and comprehend literary nonfiction in the grades 6–8 text complexity band proficiently, with scaffolding as needed at the high end of the range. |

| **Strand:** Writing Standards **Grade Level:** 6 |
|---|
| **Substrands & Standards** |

# Sixth Grade English Language Arts Standards

**Text Types and Purposes**

1. Write arguments to support claims with clear reasons and relevant evidence.
a. Introduce claim(s) and organize the reasons and evidence clearly.
b. Support claim(s) with clear reasons and relevant evidence, using credible sources and demonstrating an understanding of the topic or text.
c. Use words, phrases, and clauses to clarify the relationships among claim(s) and reasons.
d. Establish and maintain a formal style.
e. Provide a concluding statement or section that follows from the argument presented.
2. Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content.
a. Introduce a topic or thesis statement; organize ideas, concepts, and information, using strategies such as definition, classification, comparison/contrast, and cause/effect; include formatting (e.g., headings), graphics (e.g., charts, tables), and multimedia when useful to aiding comprehension.
b. Develop the topic with relevant facts, definitions, concrete details, quotations, or other information and examples.
c. Use appropriate transitions to clarify the relationships among ideas and concepts.
d. Use precise language and domain-specific vocabulary to inform about or explain the topic.
e. Establish and maintain a formal style.
f. Provide a concluding statement or section that follows from the information or explanation presented.
3. Write narratives to develop real or imagined experiences or events using effective technique, relevant descriptive details, and well-structured event sequences.
a. Engage and orient the reader by establishing a context and introducing a narrator and/or characters; organize an event sequence that unfolds naturally and logically. b. Use narrative techniques, such as dialogue, pacing, and description, to develop experiences, events, and/or characters.
c. Use a variety of transition words, phrases, and clauses to convey sequence and signal shifts from one time frame or setting to another.
d. Use precise words and phrases, relevant descriptive details, and sensory language to convey experiences and events.
e. Provide a conclusion that follows from the narrated experiences or events.

**Production and Distribution of Writing**

4. Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. (Grade-specific expectations for writing types are defined in standards 1–3.)
5. With some guidance and support from peers and adults, develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach. (Editing for conventions should demonstrate command of Language standards 1–3 up to and including grade 6 on page 30.)
6. Use technology, including the Internet, to produce and publish writing as well as to interact and collaborate with others; demonstrate sufficient command of keyboarding skills to type a minimum of three pages in a single sitting.

**Research to Build and Present Knowledge**

7. Conduct short research projects to answer a question, drawing on several sources and refocusing the inquiry when appropriate.
8. Gather relevant information from multiple prints and digital sources; assess the credibility of each source; and quote or paraphrase the data and conclusions of others while avoiding plagiarism and providing basic bibliographic information for sources.
9. Draw evidence from literary or informational texts to support analysis, reflection, and research.
a. Apply *grade 6 Reading standards* to literature (e.g., "Compare and contrast texts in different forms or genres [e.g., stories and poems; historical novels and fantasy stories] in terms of their approaches to similar themes and topics").
b. Apply *grade 6 Reading standards* to literary nonfiction (e.g., "Trace and evaluate the argument and specific claims in a text, distinguishing claims that are supported by reasons and evidence from claims that are not").

**Range of Writing**

10. Write routinely over extended time frames (time for research, reflection, and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences.

**Strand:** Speaking and Listening Standards **Grade Level:** 6

**Substrands & Standards**

**Comprehension and Collaboration**

1. Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on *grade 6 topics, texts, and issues*, building on others' ideas and expressing their own clearly.
a. Come to discussions prepared, having read or studied required material; explicitly draw on that preparation by referring to evidence on the topic, text, or issue to probe and reflect on ideas under discussion.
b. Follow rules for collegial discussions, set specific goals and deadlines, and define individual roles as needed.
c. Pose and respond to specific questions with elaboration and detail by making comments that contribute to the topic, text, or issue under discussion.
d. Review the key ideas expressed and demonstrate understanding of multiple perspectives through reflection and paraphrasing.
2. Interpret information presented in diverse media and formats (e.g., visually, quantitatively, orally) and explain how it contributes to a topic, text, or issue under study.
3. Delineate a speaker's argument and specific claims, distinguishing claims that are supported by reasons and evidence from claims that are not.

**Presentation of Knowledge and Ideas**

4. Present claims and findings (e.g., argument, narrative, informative, response to literature presentations), sequencing ideas logically and using pertinent descriptions, facts, and details and nonverbal elements to accentuate main ideas or themes; use appropriate eye contact, adequate volume, and clear pronunciation.
a. Plan and deliver an informative/explanatory presentation that: develops a topic with relevant facts, definitions, and concrete details; uses appropriate transitions to clarify relationships; uses precise language and domain specific vocabulary; and provides a strong conclusion.
5. Include multimedia components (e.g., graphics, images, music, sound) and visual displays in presentations to clarify information.
6. Adapt speech to a variety of contexts and tasks, demonstrating command of formal English when indicated or appropriate. (See grade 6 Language standards 1 and 3 for specific expectations.)

**Strand:** Language Standards **Grade Level:** 6

**Substrands & Standards**

**Conventions of Standard English**

1. Demonstrate command of the conventions of standard English grammar and usage when writing or speaking.
a. Ensure that pronouns are in the proper case (subjective, objective, possessive).
b. Use all pronouns, including intensive pronouns (e.g., *myself, ourselves*) correctly.
c. Recognize and correct inappropriate shifts in pronoun number and person.
d. Recognize and correct vague pronouns (i.e., ones with unclear or ambiguous antecedents).
e. Recognize variations from standard English in their own and others' writing and speaking, and identify and use strategies to improve expression in conventional language.
2. Demonstrate command of the conventions of standard English capitalization, punctuation, and spelling when writing.
a. Use punctuation (commas, parentheses, dashes) to set off nonrestrictive/parenthetical elements.
b. Spell correctly.

Knowledge of Language

3. Use knowledge of language and its conventions when writing, speaking, reading, or listening.
a. Vary sentence patterns for meaning, reader/listener interest, and style.
b. Maintain consistency in style and tone.

Vocabulary Acquisition and Use

4. Determine or clarify the meaning of unknown and multiple meaning words and phrases based *on grade 6 reading and content*, choosing flexibly from a range of strategies.
a. Use context (e.g., the overall meaning of a sentence or paragraph; a word's position or function in a sentence) as a clue to the meaning of a word or phrase.
b. Use common, grade-appropriate Greek or Latin affixes and roots as clues to the meaning of a word (e.g., *audience, auditory, audible*).
c. Consult reference materials (e.g., dictionaries, glossaries, thesauruses), both print and digital, to find the pronunciation of a word or determine or clarify its precise meaning or its part of speech.
d. Verify the preliminary determination of the meaning of a word or phrase (e.g., by checking the inferred meaning in context or in a dictionary).
5. Demonstrate understanding of figurative language, word relationships, and nuances in word meanings.
a. Interpret figures of speech (e.g., personification) in context.
b. Use the relationship between particular words (e.g., cause/ effect, part/whole, item/category) to better understand each of the words.
c. Distinguish among the connotations (associations) of words with similar denotations (definitions) (e.g., *stingy, scrimping, economical, unwasteful, thrifty*).
6. Acquire and use accurately grade-appropriate general academic and domain-specific words and phrases; gather vocabulary knowledge when considering a word or phrase important to comprehension or expression.

# Sixth Grade Math Standards

## Ratios and Proportional Relationships 6.RP

**Understand ratio concepts and use ratio reasoning to solve problems.**

1. Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities. *For example, "The ratio of wings to beaks in the bird house at the zoo was 2:1, because for every 2 wings there was 1 beak." "For every vote candidate A received, candidate C received nearly three votes."*
2. Understand the concept of a unit rate *alb* associated with a ratio *a:b* with *b :t* 0, and use rate language in the context of a ratio relationship. *For example, "This recipe has a ratio of 3 cups of flour to 4 cups of sugar, so there is 3/4 cup of flour for each cup of sugar." "We paid $75 for 15 hamburgers, which is a rate of $5 per hamburger."*
3. Use ratio and rate reasoning to solve real-world and mathematical problems, e.g., by reasoning about tables of equivalent ratios, tape diagrams, double number line diagrams, or equations.
    a. Make tables of equivalent ratios relating quantities with whole number measurements, find missing values in the tables, and plot the pairs of values on the coordinate plane. Use tables to compare ratios.
    b. Solve unit rate problems including those involving unit pricing and constant speed. *For example, if it took 7 hours to mow 4 lawns, then at that rate, how many lawns could be mowed in 35 hours? At what rate were lawns being mowed?*
    c. Find a percent of a quantity as a rate per 100 (e.g., 30% of a quantity means 30/100 times the quantity); solve problems involving finding the whole, given a part and the percent.
    d. Use ratio reasoning to convert measurement units; manipulate and transform units appropriately when multiplying or dividing quantities.

## The Number System 6NS

**Apply and extend previous understandings of multiplication and division to divide fractions by fractions.**

1. Interpret and compute quotients of fractions, and solve word problems involving division of fractions by fractions, e.g., by using visual fraction models and equations to represent the problem. *For example, create a story context for (2/3} + {3/4} and use a visual fraction model to show the quotient; use the relationship between multiplication and division to explain that (2/3) + {3/4) = 8/9 because 3/4 of 8/9 is 2/3. {In general, (a/b)+ (c/d) = ad/be.) How much chocolate will each person get if 3 people share 1/2 lb of chocolate equally? How many 3/4-cup servings are in 2/3 of a cup of yogurt? How wide is a rectangular strip of land with length 3/4 mi and area 1/2 square mi?*

**Compute fluently with multi-digit numbers and find common factors and multiples.**

2. Fluently divide multi-digit numbers using the standard algorithm.
3. Fluently add, subtract, multiply, and divide multi-digit decimals using the standard algorithm for each operation.
4. Find the greatest common factor of two whole numbers less than or equal to 100 and the least common multiple of two whole numbers less than or equal to 12. Use the distributive property to express a sum of two whole numbers 1-100 with a common factor as a multiple of a sum of two whole numbers with no common factor. *For example, express 36 + 8 as 4 {9 + 2).*

**Apply and extend previous understandings of numbers to the system of rational numbers.**

5. Understand that positive and negative numbers are used together to describe quantities having opposite directions or values (e.g., temperature above/below zero, elevation above/below sea level, credits/debits, positive/negative electric charge); use positive and negative numbers to represent quantities in real-world contexts, explaining the meaning of 0 in each situation.
6. Understand a rational number as a point on the number line. Extend number line diagrams and coordinate axes familiar from previous grades to represent points on the line and in the plane with negative number coordinates.
    a. Recognize opposite signs of numbers as indicating locations on opposite sides of 0 on the number line; recognize that the opposite of the opposite of a number is the number itself, e.g., -(-3) = 3, and that 0 is its own opposite.
    b. Understand signs of numbers in ordered pairs as indicating locations in quadrants of the coordinate plane; recognize that when two ordered pairs differ only by signs, the locations of the points are related by reflections across one or both axes.
    c. Find and position integers and other rational numbers on a horizontal or vertical number line diagram; find and position pairs of integers and other rational numbers on a coordinate plane.
7. Understand ordering and absolute value of rational numbers.
    a. Interpret statements of inequality as statements about the relative position of two numbers on a number line diagram. *For example, interpret -3 > -7 as a statement that -3 is located to the right of -7 on a number line oriented from left to right.*
    b. Write, interpret, and explain statements of order for rational numbers in real-world contexts. *For example, write -3c > -rc to express the fact that -3·c is warmer than -rc.*
    c. Understand the absolute value of a rational number as its distance from 0 on the number line; interpret absolute value as magnitude for a positive or negative quantity in a real-world situation. *For example, for an*

*account balance of -30 dollars, write /–30/ =30 to describe the size of the debt in dollars.*

d. Distinguish comparisons of absolute value from statements about order. *For example, recognize that an account balance less than –30 dollars represents a debt greater than 30 dollars.*

8. Solve real-world and mathematical problems by graphing points in all four quadrants of the coordinate plane. Include use of coordinates and absolute value to find distances between points with the same first coordinate or the same second coordinate.

## Expressions and Equations 6.EE

**Apply and extend previous understandings of arithmetic to algebraic expressions.**

1. Write and evaluate numerical expressions involving whole-number exponents.
2. Write, read, and evaluate expressions in which letters stand for numbers.
   a. Write expressions that record operations with numbers and with letters standing for numbers. *For example, express the calculation "Subtract y from 5" as 5 – y.*
   b. Identify parts of an expression using mathematical terms (sum, term, product, factor, quotient, coefficient); view one or more parts of an expression as a single entity. *For example, describe the expression 2 (8 + 7) as a product of two factors; view {8 + 7} as both a single entity and a sum of two terms.*
   c. Evaluate expressions at specific values of their variables. Include expressions that arise from formulas used in real-world problems. Perform arithmetic operations, including those involving whole-number exponents, in the conventional order when there are no parentheses to specify a particular order (Order of Operations). *For example, use the formulas* $V = s^3$ *and* $A = 6\ s^2$ *to find the volume and surface area of a cube with sides of lengths= 1/2.*
3. Apply the properties of operations to generate equivalent expressions. *For example, apply the distributive property to the expression 3 (2 + x) to produce the equivalent expression 6 + 3x; apply the distributive property to the expression 24x + 18y to produce the equivalent expression 6 (4x + 3y}; apply properties of operations to y + y + y to produce the equivalent expression 3y.*
4. Identify when two expressions are equivalent (i.e., when the two expressions name the same number regardless of which value is substituted into them). *For example, the expressions y + y + y and 3y are equivalent because they name the same number regardless of which number y stands for.*

**Reason about and solve one-variable equations and inequalities.**

5. Understand solving an equation or inequality as a process of answering a question: which values from a specified set, if any, make the equation or inequality true? Use substitution to determine whether a given number in a specified set makes an equation or inequality true.
6. Use variables to represent numbers and write expressions when solving a real-world or mathematical problem; understand that a variable can represent an unknown number, or, depending on the purpose at hand, any number in a specified set.
7. Solve real-world and mathematical problems by writing and solving equations of the form $x + p = q$ and $px = q$ for cases in which $p$, $q$ and $x$ are all nonnegative rational numbers.
8. Write an inequality of the form $x > c$ or $x < c$ to represent a constraint or condition in a real-world or mathematical problem. Recognize that inequalities of the form $x > c$ or $x < c$ have infinitely many solutions; represent solutions of such inequalities on number line diagrams.

**Represent and analyze quantitative relationships between dependent and independent variables.**

9. Use variables to represent two quantities in a real-world problem that change in relationship to one another; write an equation to express one quantity, thought of as the dependent variable, in terms of the other quantity, thought of as the independent variable. Analyze the relationship between the dependent and independent variables using graphs and tables, and relate these to the equation. *For example, in a problem involving motion at constant speed, list and graph ordered pairs of distances and times, and write the equation d = 65t to represent the relationship between distance and time.*

## Geometry 6.G

**Solve real-world and mathematical problems involving area, surface area, and volume.**

1. Find the area of right triangles, other triangles, special quadrilaterals, and polygons by composing into rectangles or decomposing into triangles and other shapes; apply these techniques in the context of solving real-world and mathematical problems.
2. Find the volume of a right rectangular prism with fractional edge lengths by packing it with unit cubes of the appropriate unit fraction edge lengths, and show that the volume is the same as would be found by multiplying the edge lengths of the prism. Apply the formulas $V = l\ w\ h$ and $V = b\ h$ to find volumes of right rectangular prisms with fractional edge lengths in the context of solving real-world and mathematical problems.

3. Draw polygons in the coordinate plane given coordinates for the vertices; use coordinates to find the length of a side joining points with the same first coordinate or the same second coordinate. Apply these techniques in the context of solving real-world and mathematical problems.
4. Represent three-dimensional figures using nets made up of rectangles and triangles, and use the nets to find the surface area of these figures. Apply these techniques in the context of solving real-world and mathematical problems.

**Develop understanding of statistical variability.**

1. Recognize a statistical question as one that anticipates variability in the data related to the question and accounts for it in the answers. *For example, How old am is not a statistical question, but How old are the students in my school is a statistical question because one anticipates variability in students' ages.*
2. Understand that a set of data collected to answer a statistical question has a distribution which can be described by its center, spread, and overall shape.
3. Recognize that a measure of center for a numerical data set summarizes all of its values with a single number, while a measure of variation describes how its values vary with a single number.

**Summarize and describe distributions.**

4. Display numerical data in plots on a number line, including dot plots, histograms, and box plots.
5. Summarize numerical data sets in relation to their context, such as by:
    a. Reporting the number of observations.
    b. Describing the nature of the attribute under investigation, including how it was measured and its units of measurement.
    c. Giving quantitative measures of center (median and/or mean) and variability (interquartile range and/or mean absolute deviation), as well as describing any overall pattern and any striking deviations from the overall pattern with reference to the context in which the data were gathered.
    d. Relating the choice of measures of center and variability to the shape of the data distribution and the context in which the data were gathered.

# Sixth Grade English Language Development Standards

| Elaboration on Critical Principles for Developing Language & Cognition in Academic Contexts<br>Part I: Interacting in Meaningful Ways | | | | |
|---|---|---|---|---|
| **Texts and Discourse in Context** | **English Language Development Level Continuum** | | | |
| **Part I, strands 1–8 Corresponding Common Core State Standards for English Language Arts:**<br>1. SL.6.1,6; L.6.3,6<br>2. W.6.6; WHST.6.6; SL.6.2; L.6.3,6<br>3. W.6.1; WHST.6.1; SL.6.1,4,6; L.6.3,6<br>4. W.6.4-5; WHST.6.4-5; SL.6.6; L.6.1,3,6<br>5. SL.6.1,3,6; L.6.1,3,6<br>6. RL.6.1-7,9-10; RI.6.1-10; RH.6.1-10; RST.6.1-10; SL.6.2; L.6.1,3,6<br>7. RL.6.4-5; RI.6.4,6,8; RH.6.4-6,8; RST.6.4-6,8; SL.6.3; L.6.3,5-6<br>8. RL.6.4-5; RI.6.4-5; RH.6.4-5; RST.6.4-5; SL.6.3; L.6.3,5-6<br><br>**Purposes for using language include:** Describing, entertaining, informing, interpreting, analyzing, recounting, explaining, persuading, negotiating, justifying, evaluating, etc.<br>**Text types include:**<br>**Informational text types include:** description (e.g., science log entry); procedure (e.g., how to solve a mathematics problem); recount (e.g., autobiography, science experiment results); information report (e.g., science or history report); explanation (e.g., how or why something happened); exposition (e.g., opinion); response (e.g., literary analysis); etc.<br>**Literary text types include:** stories (e.g., fantasy, legends, fables); drama (e.g., readers' theater); poetry; retelling a story; etc.<br>**Audiences include:** Peers (one-to-one) Small group (one-to-group) Whole group (one-to-many) | A. Collaborative | **Emerging**<br>***1. Exchanging information/ideas***<br>Engage in conversational exchanges and express ideas on familiar topics by asking and answering *yes-no* and *wh-* questions and responding using simple phrases.<br>***2. Interacting via written English***<br>Engage in short written exchanges with peers and collaborate on simple written texts on familiar topics, using technology when appropriate.<br>***3. Supporting opinions and persuading others***<br>Negotiate with or persuade others in conversations (e.g., to gain and hold the floor or ask for clarification) using basic learned phrases (e.g., *I think . . . , Would you please repeat that?*), as well as open responses.<br>***4. Adapting language choices***<br>Adjust language choices according to social setting (e.g., classroom, break time) and audience (e.g., peers, teacher).<br>***5. Listening actively***<br>Demonstrate active listening in oral presentation activities by asking and answering basic questions with prompting and substantial support.<br>***6. Reading/viewing closely***<br>a) Explain ideas, phenomena, processes, and text relationships (e.g., compare/contrast, cause/effect, problem/solution) based on close reading of a variety of grade-level texts and viewing of multimedia with substantial support.<br>b) Express inferences and conclusions drawn based on close reading of grade-level texts and viewing of multimedia using some frequently used verbs (e.g., *shows that, based on*).<br>c) Use knowledge of morphology (e.g., affixes, roots, and base words), context, reference materials, and visual cues to determine the meaning of unknown and multiple-meaning words on familiar topics.<br>***7. Evaluating language choices***<br>Explain how well writers and speakers use language to support ideas and arguments with detailed evidence (e.g., identifying the precise vocabulary used to present evidence, or the phrasing used to signal a shift in meaning) with substantial support.<br>***8. Analyzing language choices***<br>Explain how phrasing or different common words with similar meaning (e.g., choosing to use the word *cheap* versus the phrase *a good saver*) produce different effects on the audience. | **Expanding**<br>***1. Exchanging information/ideas***<br>Contribute to class, group, and partner discussions by following turn-taking rules, asking relevant questions, affirming others, adding relevant information, and paraphrasing key ideas.<br>***2. Interacting via written English***<br>Engage in longer written exchanges with peers and collaborate on more detailed written texts on a variety of topics, using technology when appropriate.<br>***3. Supporting opinions and persuading others***<br>Negotiate with or persuade others in conversations (e.g., to provide counter- arguments) using an expanded set of learned phrases (*I agree with X, but . . .*), as well as open responses.<br>***4. Adapting language choices***<br>Adjust language choices according to purpose (e.g., explaining, persuading, entertaining), task, and audience.<br>***5. Listening actively***<br>Demonstrate active listening in oral presentation activities by asking and answering detailed questions with occasional prompting and moderate support.<br>***6. Reading/viewing closely***<br>a) Explain ideas, phenomena, processes, and text relationships (e.g., compare/contrast, cause/effect, problem/solution) based on close reading of a variety of grade-level texts and viewing of multimedia with moderate support.<br>b) Express inferences and conclusions drawn based on close reading of grade- level texts and viewing of multimedia using a variety of verbs (e.g., *suggests that, leads to*).<br>c) Use knowledge of morphology (e.g., affixes, roots, and base words), context, reference materials, and visual cues to determine the meaning of unknown and multiple-meaning words on familiar and new topics.<br>***7. Evaluating language choices***<br>Explain how well writers and speakers use specific language to present ideas or support arguments and provide detailed evidence (e.g., showing the clarity of the phrasing used to present an argument) with moderate support.<br>***8. Analyzing language choices***<br>Explain how phrasing, different words with similar meaning (e.g., describing a character as *stingy* versus *economical*), or figurative language (e.g., *The room was depressed and gloomy.*) produce shades of meaning and different effects on the audience. | **Bridging**<br>***1. Exchanging information/ideas*** Contribute to class, group, and partner discussions by following turn- taking rules, asking relevant questions, affirming others, adding relevant information and evidence, paraphrasing key ideas, building on responses, and providing useful feedback.<br>***2. Interacting via written English***<br>Engage in extended written exchanges with peers and collaborate on complex written texts on a variety of topics, using technology when appropriate.<br>***3. Supporting opinions and persuading others***<br>Negotiate with or persuade others in conversations using appropriate register (e.g., to reflect on multiple perspectives) using a variety of learned phrases, indirect reported speech (e.g., *I heard you say X, and Gabriel just pointed out* Y), as well as open responses.<br>***4. Adapting language choices***<br>Adjust language choices according to task (e.g., facilitating a science experiment, providing peer feedback on a writing assignment), purpose, task, and audience.<br>***5. Listening actively***<br>Demonstrate active listening in oral presentation activities by asking and answering detailed questions with minimal prompting and support.<br>***6. Reading/viewing closely***<br>a) Explain ideas, phenomena, processes, and text relationships (e.g., compare/contrast, cause/effect, problem/solution) based on close reading of a variety of grade-level texts and viewing of multimedia with light support.<br>b) Express inferences and conclusions drawn based on close reading of grade-level texts and viewing of multimedia using a variety of precise academic verbs (e.g., *indicates that, influences*).<br>c) Use knowledge of morphology (e.g., affixes, roots, and base words), context, reference materials, and visual cues to determine the meaning, including figurative and connotative meanings, of unknown and multiple- meaning words on a variety of new topics. different effects on the audience.<br>***7. Evaluating language choices***<br>Explain how well writers and speakers use specific language resources to present ideas or support arguments and provide detailed evidence (e.g., identifying the specific language used to present ideas and claims that are well supported and distinguishing them from those that are not) with light support.<br>***8. Analyzing language choices***<br>Explain how phrasing, different words with similar meaning (e.g., *stingy- economical-unwasteful-thrifty*), or figurative language (e.g., *The room was depressed and gloomy.*) produce shades of meaning, nuances, and different effects on the audience. |

# Sixth Grade English Language Development Standards

| Elaboration on Critical Principles for Developing Language & Cognition in Academic Contexts<br>Part I: Interacting in Meaningful Ways | | | | |
|---|---|---|---|---|
| **Texts and Discourse in Context** | **English Language Development Level Continuum** | | | |
| | | **Emerging** | **Expanding** | **Bridging** |
| **Part I, strands 9–12 Corresponding Common Core State Standards for English Language Arts**<br>9. SL.6.4-6; L.6.1,3,5,6<br>10. W.6.1-10; WHST.6.1-10; L.6.1-3,6<br>11. W.6.1,4,8-10; WHST.6.1,4,8-10; SL.6.3,6; L.6.1-3,6<br>12. RL.6.1-4; RI.6.1,2,4; W.6.1-10; WHST.6.1-10; SL.6.1,2,4,6; L.6.3-6<br>**Purposes for using language include:** Describing, entertaining, informing, interpreting, analyzing, recounting, explaining, persuading, negotiating, justifying, evaluating, etc.<br>**Text types include: Informational text types include:** description (e.g., science log entry); procedure (e.g., how to solve a mathematics problem); recount (e.g., autobiography, science experiment results); information report (e.g., science or history report); explanation (e.g., how or why something happened); exposition (e.g., opinion); response (e.g., literary analysis); etc.<br>**Literary text types include:** stories (e.g., fantasy, legends, fables); drama (e.g., readers' theater); poetry; retelling a story; etc.<br>**Audiences include:** Peers (one-to-one) Small group (one-to-group) Whole group (one-to-many) | **B. Productive** | ***9. Presenting***<br>Plan and deliver brief oral presentations on a variety of topics and content areas<br>***10. Writing***<br>a) Write short literary and informational texts (e.g., an argument for protecting the rainforests) collaboratively (e.g., with peers) and independently.<br>b) Write brief summaries of texts and experiences using complete sentences and key words (e.g., from notes or graphic organizers).<br>***11. Justifying/arguing***<br>a) Justify opinions by providing some textual evidence (e.g., quoting from the text) or relevant background knowledge with substantial support.<br>b) Express attitude and opinions or temper statements with some basic modal expressions (e.g., *can, has to*).<br>***12. Selecting language resources*** a) Use a select number of general academic words (e.g., *author, chart*) and domain-specific words (e.g., *scene, cell, fraction*) to create some precision while speaking and writing.<br>b) Use knowledge of morphology to appropriately select affixes in basic ways (e.g., *She likes* X.). | ***9. Presenting***<br>Plan and deliver longer oral presentations on a variety of topics and content areas, using details and evidence to support ideas.<br>***10. Writing***<br>a) Write longer literary and informational texts (e.g., an argument for protecting the rainforests) collaboratively (e.g., with peers) and independently using appropriate text organization.<br>b) Write increasingly concise summaries of texts and experiences using complete sentences and key words (e.g., from notes or graphic organizers).<br>***11. Justifying/arguing***<br>a) Justify opinions or persuade others by providing relevant textual evidence (e.g., quoting from the text or referring to what the text says) or relevant background knowledge with moderate support.<br>b) Express attitude and opinions or temper statements with a variety of familiar modal expressions (e.g., *maybe/probably, can/could, must*).<br>***12. Selecting language resources*** a) Use a growing set of academic words (e.g., *author, chart, global, affect*), domain-specific words (e.g., *scene, setting, plot, point of view, fraction, cell membrane, democracy*), synonyms, and antonyms to create precision and shades of meaning while speaking and writing.<br>b) Use knowledge of morphology to appropriately select affixes in a growing number of ways to manipulate language (e.g., *She likes* X. *That's impossible.*). | ***9. Presenting***<br>Plan and deliver longer oral presentations on a variety of topics and content areas, using reasoning and evidence to support ideas, as well as growing understanding of register.<br>***10. Writing***<br>a) Write longer and more detailed literary and informational texts (e.g., an argument for protecting the rainforests) collaboratively (e.g., with peers) and independently using appropriate text organization and growing understanding of register.<br>b) Write clear and coherent summaries of texts and experiences using complete and concise sentences and key words (e.g., from notes or graphic organizers).<br>***11. Justifying/arguing***<br>a) Justify opinions or persuade others by providing detailed and relevant textual evidence (e.g., quoting from the text directly or referring to specific textual evidence) or relevant background knowledge with light support.<br>b) Express attitude and opinions or temper statements with nuanced modal expressions (e.g., *probably/certainly/definitely, should/would, might*) and phrasing (e.g., *In my opinion . . .*).<br>***12. Selecting language resources***<br>a) Use an expanded set of general academic words (e.g., *affect, evidence, demonstrate, reluctantly*), domain-specific words (e.g., *scene, setting, plot, point of view, fraction, cell membrane, democracy*), synonyms, antonyms, and figurative language to create precision and shades of meaning while speaking and writing.<br>b) Use knowledge of morphology to appropriately select affixes in a variety of ways to manipulate language (e.g., changing *observe -> observation, reluctant -> reluctantly, produce -> production,* etc.). |

# Sixth Grade English Language Development Standards

| Elaboration on Critical Principles for Developing Language & Cognition in Academic Contexts<br>Part II: Learning About How English Works | | | | |
|---|---|---|---|---|
| **Texts and Discourse in Context** | **English Language Development Level Continuum** | | | |
| | | **Emerging** | **Expanding** | **Bridging** |
| **Part II, strands 1–2 Corresponding Common Core State Standards for English Language Arts:**<br>1. RL.6.5; RI.6.5; RH.6.5; RST.6.5; W.6.1-5,10; WHST.6.1-2,4-5,10; SL.6.4<br>2. RI.6.5; RH.6.5; RST.6.5; W.6.1-5,10; WHST.6.1-2,4-5,10; L.6.1,3-6<br>**Purposes for using language include:** Describing, entertaining, informing, interpreting, analyzing, recounting, explaining, persuading, negotiating, justifying, evaluating, etc.<br>**Text types include: Informational text types include:** description (e.g., science log entry); procedure (e.g., how to solve a mathematics problem); recount (e.g., autobiography, science experiment results); information report (e.g., science or history report); explanation (e.g., how or why something happened); exposition (e.g., opinion); response (e.g., literary analysis); etc.<br>**Literary text types include:** stories (e.g., fantasy, legends, fables); drama (e.g., readers' theater); poetry; retelling a story; etc.<br>**Audiences include:** Peers (one-to-one) Small group (one-to-group) Whole group (one-to-many | **A. Structuring Cohesive Texts** | ***1. Understanding text structure***<br>Apply basic understanding of how different text types are organized to express ideas (e.g., how a narrative is organized sequentially with predictable stages versus how arguments are organized around ideas) to comprehending texts and writing basic texts.<br>***2. Understanding cohesion***<br>a) Apply basic understanding of language resources for referring the reader back or forward in text (e.g., how pronouns refer back to nouns in text) to comprehending texts and writing basic texts.<br>b) Apply basic understanding of how ideas, events, or reasons are linked throughout a text using a select set of everyday connecting words or phrases (e.g., *first/next, at the beginning*) to comprehending texts and writing basic texts. | ***1. Understanding text structure***<br>Apply growing understanding of how different text types are organized to express ideas (e.g., how a narrative is organized sequentially with predictable stages versus how arguments are structured logically around reasons and evidence) to comprehending texts and writing texts with increasing cohesion.<br>***2. Understanding cohesion***<br>a) Apply growing understanding of language resources for referring the reader back or forward in text (e.g., how pronouns or synonyms refer back to nouns in text) to comprehending texts and writing texts with increasing cohesion.<br>b) Apply growing understanding of how ideas, events, or reasons are linked throughout a text using a variety of connecting words or phrases (e.g., *for example, in the first place, as a result, on the other hand*) to comprehending texts and writing texts with increasing cohesion. | ***1. Understanding text structure***<br>Apply increasing understanding of how different text types are organized to express ideas (e.g., how a historical account is organized chronologically versus how arguments are structured logically around reasons and evidence) to comprehending texts and writing cohesive texts.<br>***2. Understanding cohesion***<br>a) Apply increasing understanding of language resources for referring the reader back or forward in text (e.g., how pronouns, synonyms, or nominalizations refer back to nouns in text) to comprehending texts and writing cohesive texts.<br>b) Apply increasing understanding of how ideas, events, or reasons are linked throughout a text using an increasing variety of academic connecting and transitional words or phrases (e.g., *consequently, specifically, however, moreover*) to comprehending texts and writing cohesive texts. |

| Elaboration on Critical Principles for Developing Language & Cognition in Academic Contexts<br>Part II: Learning About How English Works | | | | |
|---|---|---|---|---|
| **Texts and Discourse in Context** | **English Language Development Level Continuum** | | | |
| | | **Emerging** | **Expanding** | **Bridging** |
| **Part II, strands 1–2 Corresponding Common Core State Standards for English Language Arts:**<br>3. W.6.5; WHST.6.5; SL.6.6; L.6.1,3-6<br>4. W.6.5; WHST.6.5; SL.6.6; L.6.1,3-6<br>5. W.6.4-5; WHST.6.4-5; SL.6.6; L.6.1,3-6<br>**Purposes for using language include:** Describing, entertaining, informing, interpreting, analyzing, recounting, explaining, persuading, negotiating, justifying, evaluating, etc.<br>**Text types include: Informational text types include:** description (e.g., science log entry); procedure (e.g., how to solve a mathematics problem); recount (e.g., autobiography, science experiment results); information report (e.g., science or history report); explanation (e.g., how or why something happened); exposition (e.g., opinion); response (e.g., literary analysis); etc.<br>**Literary text types include:** stories (e.g., fantasy, legends, fables); drama (e.g., readers' theater); poetry; retelling a story; etc.<br>**Audiences include:** Peers (one-to-one) Small group (one-to-group) Whole group (one-to-many | **B. Expanding & Enriching Ideas** | ***3. Using verbs and verb phrases***<br>Use a variety of verb types (e.g., doing, saying, being/having, thinking/feeling), tenses (e.g., present, past, future), and aspects for the text type and discipline (e.g., simple past and past progressive for recounting an experience) on familiar topics. (e.g., simple, progressive) appropriate<br>***4. Using nouns and noun phrases***<br>Expand noun phrases in simple ways (e.g., adding a sensory adjective to a noun) in order to enrich the meaning of sentences and add details about ideas, people, things, etc.<br>***5. Modifying to add details***<br>Expand sentences with simple adverbials (e.g., adverbs, adverb phrases, prepositional phrases) to provide details (e.g., time, manner, place, cause) about a familiar activity or process. | ***3. Using verbs and verb phrases***<br>Use various verb types (e.g., doing, saying, being/having, thinking/feeling, reporting), tenses (e.g., present, past, future), and aspects (e.g., simple, progressive, perfect) appropriate for the task, text type, and discipline (e.g., simple present for literary analysis) on an increasing variety of topics.<br>***4. Using nouns and noun phrases***<br>Expand noun phrases in a variety of ways (e.g., adding comparative/ superlative adjectives to noun phrases or simple clause embedding) in order to enrich the meaning of sentences and add details about ideas, people, things, etc.<br>***5. Modifying to add details***<br>Expand sentences with an increasing variety of adverbials (e.g., adverbs, adverb phrases, prepositional phrases) to provide details (e.g., time, manner, place, cause) about a familiar or new activity or process. | ***3. Using verbs and verb phrases***<br>Use various verb types (e.g., doing, saying, being/having, thinking/feeling, reporting), tenses (e.g., present, past, future), and aspects (e.g., simple, progressive, perfect) appropriate for the task, text type, and discipline (e.g., the present perfect to describe previously made claims or conclusions) on a variety of topics.<br>***4. Using nouns and noun phrases*** Expand noun phrases in an increasing variety of ways (e.g., adding comparative/superlative and general academic adjectives to noun phrases or more complex clause embedding) in order to enrich the meaning of sentences and add details about ideas, people, things, etc.<br>***5. Modifying to add details***<br>Expand sentences with a variety of adverbials (e.g., adverbs, adverb phrases and clauses, prepositional phrases) to provide details (e.g., time, manner, place, cause) about a variety of familiar and new activities and processes. |

# Sixth Grade English Language Development Standards

| Elaboration on Critical Principles for Developing Language & Cognition in Academic Contexts<br>Part II: Learning About How English Works | | | | |
|---|---|---|---|---|
| **Texts and Discourse in Context** | **English Language Development Level Continuum** | | | |
| **Part II, strands 1–2 Corresponding Common Core State Standards for English Language Arts:**<br>6. W.6.1-5; WHST.6.1-2,4-5; SL.6.4,6; L.6.1,3-6<br>7. W.6.1-5; WHST.6.1-2,4-5; SL.6.4,6; L.6.1,3-6<br>**Purposes for using language include:** Describing, entertaining, informing, interpreting, analyzing, recounting, explaining, persuading, negotiating, justifying, evaluating, etc.<br>**Text types include: Informational text types include:** description (e.g., science log entry); procedure (e.g., how to solve a mathematics problem); recount (e.g., autobiography, science experiment results); information report (e.g., science or history report); explanation (e.g., how or why something happened); exposition (e.g., opinion); response (e.g., literary analysis); etc.<br>**Literary text types include:** stories (e.g., fantasy, legends, fables); drama (e.g., readers' theater); poetry; retelling a story; etc.<br>**Audiences include:** Peers (one-to-one) Small group (one-to-group) Whole group (one-to-many) | **C. Connecting & Condensing Ideas** | **Emerging**<br>***6. Connecting ideas***<br>Combine clauses in a few basic ways to make connections between and join ideas (e.g., creating compound sentences using *and, but, so*).<br>***7. Condensing ideas***<br>Condense ideas in simple ways (e.g., by compounding verbs, adding prepositional phrases, or through simple embedded clauses or other ways of condensing as in, This is a story about a girl. The girl changed the world. →This is a story about a girl *who changed the world.*) to create precise and detailed sentences. | **Expanding**<br>***6. Connecting ideas***<br>Combine clauses in an increasing variety of ways (e.g., creating compound and complex sentences) to make connections between and join ideas, for example, to express a reason (e.g., *He stayed at home on Sunday to study for Monday's exam*) or to make a concession (e.g., *She studied all night even though she wasn't feeling well*).<br>***7. Condensing ideas***<br>Condense ideas in an increasing variety of ways (e.g., through various types of embedded clauses and other ways of condensing, as in, Organic vegetables are food. They're made without chemical fertilizers. They're made without chemical insecticides. → Organic vegetables are foods *that are made without chemical fertilizers or insecticides.*) to create precise and detailed sentences. | **Bridging**<br>***6. Connecting ideas***<br>Combine clauses in a wide variety of ways (e.g., creating compound and complex sentences) to make connections between and join ideas, for example, to express a reason (e.g., *He stayed at home on Sunday to study for Monday's exam*), to make a concession (e.g., *She studied all night even though she wasn't feeling well*), or to link two ideas that happen at the same time (e.g., *The students worked in groups while their teacher walked around the room*).<br>***7. Condensing ideas***<br>Condense ideas in a variety of ways (e.g., through various types of embedded clauses, ways of condensing, and nominalization as in, They *destroyed* the rainforest. Lots of animals *died.* → The *destruction* of the rainforest led to *the death* of many animals.) to create precise and detailed sentences. |

| Elaboration on Critical Principles for Developing Language & Cognition in Academic Contexts<br>Part III: Using Foundational Literacy Skills | |
|---|---|
| **Foundational Literacy Skills:**<br><br>**Literacy in an Alphabetic Writing System**<br>• Print concepts<br>• Phonological awareness<br>• Phonics & word recognition<br>• Fluency | See Appendix A for information on teaching reading foundational skills to English learners of various profiles based on age, native language, native language writing system, schooling experience, and literacy experience and proficiency. Some considerations are:<br><br>• Native language and literacy (e.g., phoneme awareness or print concept skills in native language) should be assessed for potential transference to English language and literacy.<br>• Similarities between native language and English should be highlighted (e.g., phonemes or letters that are the same in both languages).<br>• Differences between native language and English should be highlighted (e.g., some phonemes in English may not exist in the student's native language; native language syntax may be different from English syntax). |

# Sixth Grade History/Social Studies Standards

## WORLD HISTORY AND GEOGRAPHY: ANCIENT CIVILIZATIONS

*Students in sixth grade expand their understanding of history by studying the people and events that ushered in the dawn of the major Western and non-Western ancient civilizations. Geography is of special significance in the development of the human story. Continued emphasis is placed on the everyday lives, problems, and accomplishments of people, their role in developing social, economic, and political structures, as well as in establishing and spreading ideas that helped transform the world forever. Students develop higher levels of critical thinking by considering why civilizations developed where and when they did, why they became dominant, and why they declined. Students analyze the interactions among the various cultures, emphasizing their enduring contributions and the link, despite time, between the contemporary and ancient worlds.*

**6.1 Students describe what is known through archaeological studies of the early physical and cultural development of humankind from the Paleolithic era to the agricultural revolution.**

1. Describe the hunter-gatherer societies, including the development of tools and the use of fire.
2. Identify the locations of human communities that populated the major regions of the world and describe how humans adapted to a variety of environments.
3. Discuss the climatic changes and human modifications of the physical environment that gave rise to the domestication of plants and animals and new sources of clothing and shelter.

- **Web Links**
  - **http://museums.ncl.ac.uk/flint/images/timeline.jpg**
    Time line
  - **http://museum.agropolis.fr/english/pages/expos/fresque/la_fresque.htm**
    Time line of man creating fire, hunting and gathering
  - **http://www.unitedstreaming.com**
    - Toward Civilization
    - World History: Pre-History
    - Understanding Fire
    - Culture Clash: New World Meets Old
    - Mysteries of Cave Art
    - Neanderthal – the rise and fall of the human species

**6.2 Students analyze the geographic, political, economic, religious, and social structures of the early civilizations of Mesopotamia, Egypt, and Kush.**

1. Locate and describe the major river systems and discuss the physical settings that supported permanent settlement and early civilizations.
2. Trace the development of agricultural techniques that permitted the production of economic surplus and the emergence of cities as centers of culture and power.
3. Understand the relationship between religion and the social and political order in Mesopotamia and Egypt.
4. Know the significance of Hammurabi's Code.
5. Discuss the main features of Egyptian art and architecture.
6. Describe the role of Egyptian trade in the eastern Mediterranean and Nile valley.
7. Understand the significance of Queen Hatshepsut and Ramses the Great.
8. Identify the location of the Kush civilization and describe its political, commercial, and cultural relations with Egypt.
9. Trace the evolution of language and its written forms.

- **Web Links**
  - **http://museums.ncl.ac.uk/flint/menu.html**
    Explore the lives of hunters and gatherers
  - **http://www.nemo.nu/ibisportal/0egyptintro/**
    Absolute Egyptology – has information about the dynasties and gives timelines
  - **http://www.akhet.co.uk/**
    Akhet Egyptology
  - **http://www.beshay.com/paphist.html**
    Papyrus – How it's made (one of Egypt's major exports)
  - **http://www.lfelem.lfc.edu/resources/sstudies/SS5thgrade.html**
    Resources for Ancient Egypt, Ancient Greece and Ancient Rome

- **http://www.ancientegypt.co.uk/menu.html**
  Life in Ancient Egypt and the importance of the Nile
- **http://www.ancientscripts.com/ws.html**
  History of writing, compare writing of ancient civilizations
- **http://www.unitedstreaming.com**
  - Ancient civilization: Balancing the budget(developing an economy based on trade)
  - Mesopotamia: From Nomads to Farmers
  - Mesopotamia: The Development of written language
  - Ancient Egypt: The Gift of the Nile
  - Ancient Egyptian Civilization
  - Living History: Living in Ancient Egypt

**6.3 Students analyze the geographic, political, economic, religious, and social structures of the Ancient Hebrews.**

1. Describe the origins and significance of Judaism as the first monotheistic religion.
2. Describe how the ideas of the Hebrew traditions are reflected in the moral and ethical traditions of Western civilization.
3. Discuss the locations of the settlements and movements of Hebrew peoples.
4. Discuss how Judaism survived and developed despite the continuing dispersion of much of the Jewish population from Jerusalem and the rest of Israel after the destruction of the second Temple in A.D. 70.

➢ **Web Links**

- **http://www.historyforkids.org/learn/religion/jews/index.htm**
  History of Judaism
- **http://score.rims.k12.ca.us/activity/ancient_hebrews/**
  Ancient Israelites: click: beliefs (Hebrew Bible: Tour of the Dead Sea scrolls)
  Resources – maps, archaeology, timelines and Jewish history
- **http://www.pbs.org/wnet/heritage/timeline.html**
  Timeline – Heritage: Civilization and the Jews
- **http://score.rims.k12.ca.us/activity/maccabees/**
  The Maccabees and their place in Jewish history (lessons and resources)
- **http://www.unitedstreaming.com**
  - Ancient Hebrews: A Virtual Museum
  - America's Roots

**6.4 Students analyze the geographic, political, economic, religious, and social structures of the early civilizations of Ancient Greece.**

1. Discuss the connections between geography and the development of city-states in the region of the Aegean Sea, including patterns of trade and commerce among Greek city-states and within the wider Mediterranean region.
2. Trace the transition from tyranny and oligarchy to early democratic forms of government and back to dictatorship in ancient Greece, including the significance of the invention of the idea of citizenship.
3. State the key differences between Athenian, or direct, democracy and representative democracy.
4. Explain the significance of Greek mythology to the everyday life of people in the region and how Greek literature continues to permeate our literature and language today, drawing from Greek mythology and epics, such as Homer's *Iliad* and *Odyssey,* and from *Aesop's Fables.*
5. Outline the founding, expansion, and political organization of the Persian Empire.
6. Compare and contrast life in Athens and Sparta, with emphasis on their roles in the Persian and Peloponnesian Wars.
7. Trace the rise of Alexander the Great and the spread of Greek culture eastward and into Egypt.
8. Describe the enduring contributions of important Greek figures in the arts and sciences

➢ **Web Links**

- **http://www.historyforkids.org/learn/greeks/index.htm**
  Ancient Greece (explore culture, religion, economy and more) – Teacher preview first
- **http://library.thinkquest.org/CR0210200/ancient_greece/greece.htm**
  Ancient Greece – Fact pages (history of Greece, timeline, Alexander the Great, Olympic Games)
- **http://carlos.emory.edu/ODYSSEY/GREECE/homepg.html**
  Ancient Greece: architecture and government (first documented democracy)
- **http://www.mrdowling.com/701greece.html**
  The Cradle of Western Civilization

- **http://www.mnsu.edu/emuseum/prehistory/aegean/index.shtml**
  The classes of Athens and the culture of Sparta
- **http://web.archive.org/web/20041130011055/http:/history.evansville.net/greece.html**
  Greece: The Development of Western Civilization (maps, art and resources)
- **http://www.unitedstreaming.com**
  - World History: Ancient Civilizations (segments on Homer's Odyssey and Alexander the Great)
  - Living History: Living in Ancient Greece
  - Greece: The Birthplace of Western Civilization
  - Athens: The Birthplace of Democracy

**6.5 Students analyze the geographic, political, economic, religious, and social structures of the early civilizations of India.**

1. Locate and describe the major river system and discuss the physical setting that supported the rise of this civilization.
2. Discuss the significance of the Aryan invasions.
3. Describe the origins and significance of Hinduism.
4. Outline the social structure of the caste system.
5. Describe the origins and significance of Buddha and how Buddhism spread in India, Ceylon, and Central Asia.
6. Describe the growth of the Maurya empire and the political and moral achievements of the emperor Asoka.
7. Discuss important aesthetic and intellectual traditions.

➢ **Web Links**

- **http://www.historyforkids.org/learn/india/index.htm**
  Ancient India (The history behind Islam, Hinduism and Buddhism)
- **http://www.internet-at-work.com/hos_mcgrane/india/eg_india_intro.html#history**
  History of India
- **http://www.buddhanet.net/bt_conts.htm**
  Buddhist Tales for Young and Old
- **http://www.unitedstreaming.com**
  - Sketches of the World: In Search of the Light (segments on Hinduism/Buddhism)
  - Religions of the World: Hinduism
  - The Ancient World

**6.6 Students analyze the geographic, political, economic, religious, and social structures of the early civilizations of China.**

1. Locate and describe the origins of Chinese civilization in the Huang-He Valley during the Shang Dynasty.
2. Explain the geographic features of China that made governance and the spread of ideas and goods difficult and served to isolate the country from the rest of the world.
3. Know about the life of Confucius and the fundamental teachings of Confucianism and Taoism.
4. Identify the political and cultural problems prevalent in the time of Confucius and how he sought to solve them.
5. List the policies and achievements of the emperor Shi Huangdi in unifying northern China under the Qin Dynasty.
6. Detail the political contributions of the Han Dynasty to the development of the imperial bureaucratic state and the expansion of the empire.
7. Cite the significance of the trans-Eurasian "silk roads" in the period of the Han Dynasty and Roman Empire and their locations.
8. Describe the diffusion of Buddhism northward to China during the Han Dynasty.

➢ **Web Links**

- **http://www.historyforkids.org/learn/china/index.htm**
  History of Ancient China – also has links to lessons
- **http://www.cybersleuth-kids.com/sleuth/History/Ancient_Civilizations/China/**
  Empires Past: China (Listing of Qin and Han Dynasties)
- **http://www.historylink101.com/china_history.htm**
  Ancient China – History and maps of Dynasties
- **http://www.unitedstreaming.com**
  - China: From Past to Present: The Silk Road, The Great Wall, Changes in Government
  - China: From Past to Present: Geography, Traditional Religions, and beliefs
  - China: From Past to Present: Life in the Ancient Capital Cities

**6.7 Students analyze the geographic, political, economic, religious, and social structures during the development of Rome.**

1. Identify the location and describe the rise of the Roman Republic, including the importance of such mythical and historical figures as Aeneas, Romulus and Remus, Cincinnatus, Julius Caesar, and Cicero.
2. Describe the government of the Roman Republic and its significance such as a written constitution and three party government, checks and balance and civic duty.
3. Identify the location of and the political and geographic reasons for the growth of Roman territories and expansion of the empire, including how the empire fostered economic growth through the use of currency and trade routes.
4. Discuss the influence of Julius Caesar and Augustus in Rome's transition from republic to empire.
5. Trace the migration of Jews around the Mediterranean region and the effects of their conflict with the Romans, including the Romans' restrictions on their right to live in Jerusalem.
6. Note the origins of Christianity in the Jewish Messianic prophecies, the life and teachings of Jesus of Nazareth as described in the New Testament, and the contribution of St. Paul the Apostle to the definition and spread of Christian beliefs.
7. Describe the circumstances that led to the spread of Christianity in Europe and other Roman territories.
8. Discuss the legacies of Roman art and architecture, technology and science, literature, language, and law.

➢ **Web Links**

- **http://www.historyforkids.org/learn/romans/index.htm**
  History of Rome
- **http://www.mclink.it/n/citrag/roma/doc/civil/ecv_005.htm**
  Eras of government in Ancient Rome
- **http://atschool.eduweb.co.uk/nettsch/time/romans.html**
  Important People - Julius Caesar and Emperors Augustus, Constantine and Claudius
- **http://www.unitedstreaming.com**
  - Ancient Rome: Fall of an Empire
  - Ancient Rome: Rise to Power
  - World History: Ancient Civilizations
  - Ancient Rome: Prosperity and Decline
  - Ancient Rome: Struggles for Power
  - Ancient Rome: Expansion and Conquest
  - Myths and Legends of Ancient Rome
  - The World of Ancient Rome
  - Living History: Living in the Roman Empire

NEXT GENERATION SCIENCE STANDARDS
For States, By States

# Middle School Physical Science

Students in middle school continue to develop understanding of four core ideas in the physical sciences. The middle school performance expectations in the Physical Sciences build on the K – 5 ideas and capabilities to allow learners to explain phenomena central to the physical sciences but also to the life sciences and earth and space science. The performance expectations in physical science blend the core ideas with scientific and engineering practices and crosscutting concepts to support students in developing useable knowledge to explain real world phenomena in the physical, biological, and earth and space sciences. In the physical sciences, performance expectations at the middle school level focus on students developing understanding of several scientific practices. These include developing and using models, planning and conducting investigations, analyzing and interpreting data, using mathematical and computational thinking, and constructing explanations; and to use these practices to demonstrate understanding of the core ideas. Students are also expected to demonstrate understanding of several of engineering practices including design and evaluation.

The performance expectations in **PS1: Matter and its Interactions** help students to formulate an answer to the question, "How do atomic and molecular interactions explain the properties of matter that we see and feel?" by building understanding of what occurs at the atomic and molecular scale. In middle school, the PS1 Disciplinary Core Idea from the *NRC Framework* is broken down into two sub-ideas: the structure and properties of matter, and chemical reactions. By the end of middle school, students will be able to apply understanding that pure substances have characteristic physical and chemical properties and are made from a single type of atom or molecule. They will be able to provide molecular level accounts to explain states of matters and changes between states, that chemical reactions involve regrouping of atoms to form new substances, and that atoms rearrange during chemical reactions. Students are also able to apply an understanding of the design and the process of optimization in engineering to chemical reaction systems. The crosscutting concepts of patterns; cause and effect; scale, proportion and quantity; energy and matter; structure and function; interdependence of science, engineering, and technology; and influence of science, engineering and technology on society and the natural world are called out as organizing concepts for these disciplinary core ideas. In the PS1 performance expectations, students are expected to demonstrate proficiency in developing and using models, analyzing and interpreting data, designing solutions, and obtaining, evaluating, and communicating information. Students use these scientific and engineering practices to demonstrate understanding of the disciplinary core ideas.

The performance expectations in **PS2: Motion and Stability: Forces and Interactions** focuses on helping students understand ideas related to why some objects will keep moving, why objects fall to the ground and why some materials are attracted to each other while others are not. Students answer the question, "How can one describe physical interactions between objects and within systems of objects?" At the middle school level, the PS2 Disciplinary Core Idea from the *NRC Framework* is broken down into two sub-ideas: Forces and Motion and Types of interactions. By the end of middle school, students will be able to apply Newton's Third Law of Motion to relate forces to explain the motion of objects. Students also apply ideas about gravitational, electrical, and magnetic forces to explain a variety of phenomena including beginning ideas about why some materials attract each other while others repel. In particular, students will develop understanding that gravitational interactions are always attractive but that

electrical and magnetic forces can be both attractive and negative. Students also develop ideas that objects can exert forces on each other even though the objects are not in contact, through fields. Students are also able to apply an engineering practice and concept to solve a problem caused when objects collide. The crosscutting concepts of cause and effect; system and system models; stability and change; and the influence of science, engineering, and technology on society and the natural world serve as organizing concepts for these disciplinary core ideas. In the PS2 performance expectations, students are expected to demonstrate proficiency in asking questions, planning and carrying out investigations, and designing solutions, and engaging in argument; and to use these practices to demonstrate understanding of the core ideas.

The performance expectations in **PS3: Energy** help students formulate an answer to the question, "How can energy be transferred from one object or system to another?" At the middle school level, the PS3 Disciplinary Core Idea from the *NRC Framework* is broken down into four sub-core ideas: Definitions of Energy, Conservation of Energy and Energy Transfer, the Relationship between Energy and Forces, and Energy in Chemical Process and Everyday Life. Students develop their understanding of important qualitative ideas about energy including that the interactions of objects can be explained and predicted using the concept of transfer of energy from one object or system of objects to another, and the total change of energy in any system is always equal to the total energy transferred into or out of the system. Students understand that objects that are moving have kinetic energy and that objects may also contain stored (potential) energy, depending on their relative positions. Students will also come to know the difference between energy and temperature, and begin to develop an understanding of the relationship between force and energy. Students are also able to apply an understanding of design to the process of energy transfer. The crosscutting concepts of scale, proportion, and quantity; systems and system models; and energy are called out as organizing concepts for these disciplinary core ideas. The performance expectations in PS3 expect students to demonstrate proficiency in developing and using models, planning investigations, analyzing and interpreting data, and designing solutions, and engaging in argument from evidence; and to use these practices to demonstrate understanding of the core ideas in PS3.

The performance expectations in **PS4: Waves and Their Applications in Technologies for Information Transfer** help students formulate an answer to the question, "What are the characteristic properties of waves and how can they be used?" At the middle school level, the PS4 Disciplinary Core Idea from the *NRC Framework* is broken down into Wave Properties, Electromagnetic Radiation, and Information Technologies and Instrumentation. Students are able to describe and predict characteristic properties and behaviors of waves when the waves interact with matter. Students can apply an understanding of waves as a means to send digital information. The crosscutting concepts of patterns and structure and function are used as organizing concepts for these disciplinary core ideas. The performance expectations in PS4 focus on students demonstrating proficiency in developing and using models, using mathematical thinking, and obtaining, evaluating and communicating information; and to use these practices to demonstrate understanding of the core ideas.

NEXT GENERATION SCIENCE STANDARDS
For States, By States

## Middle School Life Science

Students in middle school develop understanding of key concepts to help them make sense of life science. The ideas build upon students' science understanding from earlier grades and from the disciplinary core ideas, science and engineering practices, and crosscutting concepts of other experiences with physical and earth sciences. There are four life science disciplinary core ideas in middle school: *1) From Molecules to Organisms: Structures and Processes, 2) Ecosystems: Interactions, Energy, and Dynamics, 3) Heredity: Inheritance and Variation of Traits, 4) Biological Evolution: Unity and Diversity.* The performance expectations in middle school blend the core ideas with scientific and engineering practices and crosscutting concepts to support students in developing useable knowledge across the science disciplines. While the performance expectations in middle school life science couple particular practices with specific disciplinary core ideas, instructional decisions should include use of many science and engineering practices integrated in the performance expectations.

The performance expectations in **LS1: *From Molecules to Organisms: Structures and Processes*** help students formulate an answer to the question, "How can one explain the ways cells contribute to the function of living organisms." The LS1 Disciplinary Core Idea from the *NRC Framework* is organized into four sub-ideas: Structure and Function, Growth and Development of Organisms, Organization for Matter and Energy Flow in Organisms, and Information Processing. Students can gather information and use this information to support explanations of the structure and function relationship of cells. They can communicate understanding of cell theory. They have a basic understanding of the role of cells in body systems and how those systems work to support the life functions of the organism. The understanding of cells provides a context for the plant process of photosynthesis and the movement of matter and energy needed for the cell. Students can construct an explanation for how environmental and genetic factors affect growth of organisms. They can connect this to the role of animal behaviors in reproduction of animals as well as the dependence of some plants on animal behaviors for their reproduction. Crosscutting concepts of cause and effect, structure and function, and matter and energy are called out as organizing concepts for the core ideas about processes of living organisms.

The performance expectations in **LS2: *Interactions, Energy, and Dynamics Relationships in Ecosystems*** help students formulate an answer to the question, "How does a system of living and non-living things operate to meet the needs of the organisms in an ecosystem?" The LS2 Disciplinary Core Idea is divided into three sub-ideas: Interdependent Relationships in Ecosystems; Cycles of Matter and Energy Transfer in Ecosystems; and Ecosystem Dynamics, Functioning, and Resilience. Students can analyze and interpret data, develop models, and construct arguments and demonstrate a deeper understanding of resources and the cycling of matter and the flow of energy in ecosystems. They can also study patterns of the interactions among organisms within an ecosystem. They consider biotic and abiotic factors in an ecosystem and the effects these factors have on population. They evaluate competing design solutions for maintaining biodiversity and ecosystem services.

The performance expectations in **LS3: Heredity: Inheritance and Variation of Traits** help students formulate an answer to the question, "How do living organisms pass traits from one generation to the next?" The LS3 Disciplinary Core Idea from the *NRC Framework* includes two sub-ideas: Inheritance of Traits, and Variation of Traits. Students can use models to describe

ways gene mutations and sexual reproduction contribute to genetic variation. Crosscutting concepts of cause and effect and structure and function provide students with a deeper understanding of how gene structure determines differences in the functioning of organisms.

The performance expectations in **LS4: Biological Evolution: Unity and Diversity** help students formulate an answer to the question, "How do organisms change over time in response to changes in the environment?" The LS4 Disciplinary Core Idea is divided into four sub-ideas: Evidence of Common Ancestry and Diversity, Natural Selection, Adaptation, and Biodiversity and Humans. Students can construct explanations based on evidence to support fundamental understandings of natural selection and evolution. They can use ideas of genetic variation in a population to make sense of organisms surviving and reproducing, hence passing on the traits of the species. They are able to use fossil records and anatomical similarities of the relationships among organisms and species to support their understanding. Crosscutting concepts of patterns and structure and function contribute to the evidence students can use to describe biological evolution.

NEXT GENERATION SCIENCE STANDARDS For States, By States

## Middle School Earth and Space Sciences

Students in middle school continue to develop their understanding of the three disciplinary core ideas in the Earth and Space Sciences. The middle school performance expectations in Earth Space Science build on the elementary school ideas and skills and allow middle school students to explain more in-depth phenomena central not only to the earth and space sciences, but to life and physical sciences as well. These performance expectations blend the core ideas with scientific and engineering practices and crosscutting concepts to support students in developing useable knowledge to explain ideas across the science disciplines. While the performance expectations shown in middle school earth and space science couple particular practices with specific disciplinary core ideas, instructional decisions should include use of many practices that lead to the performance expectations.

The performance expectations in **ESS1: Earth's Place in the Universe**, help students formulate an answer to questions such as: "What is Earth's place in the Universe, What makes up our solar system and how can the motion of Earth explain seasons and eclipses, and How do people figure out that the Earth and life on Earth have changed through time?" The ESS1 Disciplinary Core Idea from the *NRC Framework* is broken down into three sub-ideas: the universe and its stars, Earth and the solar system and the history of planet Earth. Students examine the Earth's place in relation to the solar system, Milky Way galaxy, and universe. There is a strong emphasis on a systems approach, using models of the solar *system* to explain astronomical and other observations of the cyclic patterns of eclipses, tides, and seasons. There is also a strong connection to engineering through the instruments and technologies that have allowed us to explore the objects in our solar system and obtain the data that support the theories that explain the formation and evolution of the universe. Students examine geoscience data in order to understand the processes and events in Earth's history. The crosscutting concepts of patterns, scale, proportion, and quantity, and systems and systems modeling are called out as organizing concepts for these disciplinary core ideas. In the ESS1 performance expectations, students are expected to demonstrate proficiency in developing and using models, analyzing data, and constructing explanations and designing solutions; and to use these practices to demonstrate understanding of the core ideas.

The performance expectations in **ESS2: Earth's Systems**, help students formulate an answer to questions such as: "How do the materials in and on Earth's crust change over time, How does the movement of tectonic plates impact the surface of Earth, How does water influence weather, circulate in the oceans, and shape Earth's surface, What factors interact and influence weather, and How have living organisms changed the Earth and how have Earth's changing conditions impacted living organisms?" The ESS2 Disciplinary Core Idea from the *NRC Framework* is broken down into five sub-ideas: Earth materials and systems, plate tectonics and large-scale system interactions, the roles of water in Earth's surface processes, weather and climate, and biogeology. Students understand how Earth's geosystems operate by modeling the flow of energy and cycling of matter within and among different systems. Students investigate the controlling properties of important materials and construct explanations based on the analysis of real geoscience data. Of special importance in both topics are the ways that geoscience processes provide resources needed by society but also cause natural hazards that present risks to society; both involve technological challenges, for the identification and development of resources. Students develop understanding of the factors that control weather. A systems approach is also important here, examining the feedbacks between systems as

energy from the sun is transferred between systems and circulates though the ocean and atmosphere. The crosscutting concepts of patterns, cause and effect, scale proportion and quantity, systems and system models, energy and matter, and stability and change are called out as organizing concepts for these disciplinary core ideas. In the ESS2 performance expectations, students are expected to demonstrate proficiency in developing and using models, planning and carrying out investigations, analyzing and interpreting data, and constructing explanations; and to use these practices to demonstrate understanding of the core ideas.

The performance expectations in **ESS3: Earth and Human Activity** help students formulate an answer to questions such as: "How is the availability of needed natural resources related to naturally occurring processes, How can natural hazards be predicted, How do human activities affect Earth systems, How do we know our global climate is changing?" The ESS3 Disciplinary Core Idea from the *NRC Framework* is broken down into four sub-ideas: natural resources, natural hazards, human impact on Earth systems, and global climate change. Students understand the ways that human activities impacts Earth's other systems. Students use many different practices to understand the significant and complex issues surrounding human uses of land, energy, mineral, and water resources and the resulting impacts of their development. The crosscutting concepts of patterns, cause and effect, and stability and change are called out as organizing concepts for these disciplinary core ideas. In the ESS3 performance expectations, students are expected to demonstrate proficiency in asking questions, developing and using models, analyzing and interpreting data, constructing explanations and designing solutions and engaging in argument; and to use these practices to demonstrate understanding of the core ideas.

NEXT GENERATION SCIENCE STANDARDS
For States, By States

## Middle School Engineering Design

By the time students reach middle school they should have had numerous experiences in engineering design. The goal for middle school students is to define problems more precisely, to conduct a more thorough process of choosing the best solution, and to optimize the final design.

**Defining the problem** with "precision" involves thinking more deeply than is expected in elementary school about the needs a problem is intended to address, or the goals a design is intended to reach. How will the end user decide whether or not the design is successful? Also at this level students are expected to consider not only the end user, but also the broader society and the environment. Every technological change is likely to have both intended and unintended effects. It is up to the designer to try to anticipate the effects it may have, and to behave responsibly in developing a new or improved technology. These considerations may take the form of either criteria or constraints on possible solutions.

**Developing possible solutions** does not explicitly address generating design ideas since students were expected to develop the capability in elementary school. The focus in middle school is on a two stage process of evaluating the different ideas that have been proposed: by using a systematic method, such as a tradeoff matrix, to determine which solutions are most promising, and by testing different solutions, and then combining the best ideas into new solution that may be better than any of the preliminary ideas.

**Improving designs** at the middle school level involves an iterative process in which students test the best design, analyze the results, modify the design accordingly, and then re-test and modify the design again. Students may go through this cycle two, three, or more times in order to reach the optimal (best possible) result.

Connections with other science disciplines help students develop these capabilities in various contexts. For example, in the life sciences students apply their engineering design capabilities to evaluate plans for maintaining biodiversity and ecosystem services (MS-LS2-5). In the physical sciences students define and solve problems involving a number of core ideas in physical science, including: chemical processes that release or absorb energy (MS-PS1-6), Newton's third law of motion (MS-PS2-1), and energy transfer (MS-PS3-3). In the Earth and space sciences students apply their engineering design capabilities to problems related the impacts of humans on Earth systems (MS-ESS3-3).

By the end of 8$^{th}$ grade students are expected to achieve all four performance expectations (MS-ETS1-1, MS-ETS1-2, MS-ETS1-3, and MS-ETS1-4) related to a single problem in order to understand the interrelated processes of engineering design. These include defining a problem by precisely specifying criteria and constraints for solutions as well as potential impacts on society and the natural environment, systematically evaluating alternative solutions, analyzing data from tests of different solutions and combining the best ideas into an improved solution, and developing a model and iteratively testing and improving it to reach an optimal solution. While the performance expectations shown in Middle School Engineering Design couple particular practices with specific disciplinary core ideas, instructional decisions should include use of many practices that lead to the performance expectations.

# MS-PS1 Matter and Its Interactions

## MS-PS1 Matter and Its Interactions

Students who demonstrate understanding can:

**MS-PS1-1.** **Develop models to describe the atomic composition of simple molecules and extended structures.** [Clarification Statement: Emphasis is on developing models of molecules that vary in complexity. Examples of simple molecules could include ammonia and methanol. Examples of extended structures could include sodium chloride or diamonds. 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.]

**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 hydrogen chloride.] [Assessment Boundary: Assessment is limited to analysis of the following properties: density, melting point, boiling point, solubility, flammability, and odor.]

**MS-PS1-3.** **Gather and make sense of information to describe that synthetic materials come from natural resources and impact society.** [Clarification Statement: Emphasis is on natural resources that undergo a chemical process to form the synthetic material. Examples of new materials could include new medicine, foods, and alternative fuels.] [Assessment Boundary: Assessment is limited to qualitative information.]

**MS-PS1-4.** **Develop a model that predicts and describes changes in particle motion, 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 particles could include molecules or inert atoms. Examples of pure substances could include water, carbon dioxide, and helium.]

**MS-PS1-5.** **Develop and use a model to describe how the total number of atoms does not change in a chemical reaction and thus mass is conserved.** [Clarification Statement: Emphasis is on law of conservation of matter and on 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.]

**MS-PS1-6.** **Undertake a design project to construct, test, and modify a device that either releases or absorbs thermal energy by chemical processes.*** [Clarification Statement: Emphasis is on the design, controlling the transfer of energy to the environment, and modification of a device using factors such as type and concentration of a substance. Examples of designs could involve chemical reactions such as dissolving ammonium chloride or calcium chloride.] [Assessment Boundary: Assessment is limited to the criteria of amount, time, and temperature of substance in testing the device.]

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

### Science and Engineering Practices

**Developing and Using Models**

Modeling in 6–8 builds on K–5 and progresses to developing, using and revising models to describe, test, and predict more abstract phenomena and design systems.

- Develop a model to predict and/or describe phenomena. (MS-PS1-1),(MS-PS1-4)
- Develop a model to describe unobservable mechanisms. (MS-PS1-5)

**Analyzing and Interpreting Data**

Analyzing data in 6–8 builds on K–5 and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis.

- Analyze and interpret data to determine similarities and differences in findings. (MS-PS1-2)

**Constructing Explanations and Designing Solutions**

Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific knowledge, principles, and theories.

- Undertake a design project, engaging in the design cycle, to construct and/or implement a solution that meets specific design criteria and constraints. (MS-PS1-6)

**Obtaining, Evaluating, and Communicating Information**

Obtaining, evaluating, and communicating information in 6–8 builds on K–5 and progresses to evaluating the merit and validity of ideas and methods.

- Gather, read, and synthesize information from multiple appropriate sources and assess the credibility, accuracy, and possible bias of each publication and methods used, and describe how they are supported or not supported by evidence. (MS-PS1-3)

---

***Connections to Nature of Science***

**Scientific Knowledge is Based on Empirical Evidence**

- Science knowledge is based upon logical and conceptual connections between evidence and

### Disciplinary Core Ideas

**PS1.A: Structure and Properties of Matter**

- Substances are made from different types of atoms, which combine with one another in various ways. Atoms form molecules that range in size from two to thousands of atoms. (MS-PS1-1)
- Each pure substance has characteristic physical and chemical properties (for any bulk quantity under given conditions) that can be used to identify it. (MS-PS1-2),(MS-PS1-3)
- Gases and liquids are made of molecules or inert atoms that are moving about relative to each other. (MS-PS1-4)
- In a liquid, the molecules are constantly in contact with others; in a gas, they are widely spaced except when they happen to collide. In a solid, atoms are closely spaced and may vibrate in position but do not change relative locations. (MS-PS1-4)
- Solids may be formed from molecules, or they may be extended structures with repeating subunits (e.g., crystals). (MS-PS1-1)
- The changes of state that occur with variations in temperature or pressure can be described and predicted using these models of matter. (MS-PS1-4)

**PS1.B: Chemical Reactions**

- Substances react chemically in characteristic ways. In a chemical process, the atoms that make up the original substances are regrouped into different molecules, and these new substances have different properties from those of the reactants. (MS-PS1-2),(MS-PS1-3),(MS-PS1-5)
- The total number of each type of atom is conserved, and thus the mass does not change. (MS-PS1-5)
- Some chemical reactions release energy, others store energy. (MS-PS1-6)

**PS3.A: Definitions of Energy**

- The term "heat" as used in everyday language refers both to thermal energy (the motion of atoms or molecules within a substance) and the transfer of that thermal energy from one object to another. In science, heat is used only for this second meaning; it refers to the energy transferred due to the temperature difference between two objects. *(secondary to MS-PS1-4)*
- The temperature of a system is proportional to the average internal kinetic energy and potential energy per atom or molecule (whichever is the appropriate building block for the system's material). The details of that relationship depend on the type of atom or molecule and the interactions among the atoms in the material. Temperature is not a direct measure of a system's total thermal energy. The total thermal energy (sometimes called the total internal energy) of a system depends

### Crosscutting Concepts

**Patterns**

- Macroscopic patterns are related to the nature of microscopic and atomic-level structure. (MS-PS1-2)

**Cause and Effect**

- Cause and effect relationships may be used to predict phenomena in natural or designed systems. (MS-PS1-4)

**Scale, Proportion, and Quantity**

- Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small. (MS-PS1-1)

**Energy and Matter**

- Matter is conserved because atoms are conserved in physical and chemical processes. (MS-PS1-5)
- The transfer of energy can be tracked as energy flows through a designed or natural system. (MS-PS1-6)

**Structure and Function**

- Structures can be designed to serve particular functions by taking into account properties of different materials, and how materials can be shaped and used. (MS-PS1-3)

---

***Connections to Engineering, Technology, and Applications of Science***

**Interdependence of Science, Engineering, and Technology**

- Engineering advances have led to important discoveries in virtually every field of science, and scientific discoveries have led to the development of entire industries and engineered systems. (MS-PS1-3)

**Influence of Science, Engineering and Technology on Society and the Natural World**

- The uses of technologies and any limitations on their use are driven by individual or societal needs, desires, and values; by the findings of scientific research; and by differences in such factors as climate, natural

# MS-PS1 Matter and Its Interactions

| | | |
|---|---|---|
| explanations. (MS-PS1-2)<br>**Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena**<br>▪ Laws are regularities or mathematical descriptions of natural phenomena. (MS-PS1-5) | jointly on the temperature, the total number of atoms in the system, and the state of the material. *(secondary to MS-PS1-4)*<br>**ETS1.B: Developing Possible Solutions**<br>▪ A solution needs to be tested, and then modified on the basis of the test results, in order to improve it. *(secondary to MS-PS1-6)*<br>**ETS1.C: Optimizing the Design Solution**<br>▪ Although one design may not perform the best across all tests, identifying the characteristics of the design that performed the best in each test can provide useful information for the redesign process—that is, some of the characteristics may be incorporated into the new design. *(secondary to MS-PS1-6)*<br>▪ The iterative process of testing the most promising solutions and modifying what is proposed on the basis of the test results leads to greater refinement and ultimately to an optimal solution. *(secondary to MS-PS1-6)* | resources, and economic conditions. Thus technology use varies from region to region and over time. (MS-PS1-3) |

*Connections to other DCIs in this grade-band:* **MS.PS3.D** (MS-PS1-2),(MS-PS1-6); **MS.LS1.C** (MS-PS1-2),(MS-PS1-5); **MS.LS2.A** (MS-PS1-3); **MS.LS2.B** (MS-PS1-5); **MS.LS4.D** (MS-PS1-3); **MS.ESS2.A** (MS-PS1-2),(MS-PS1-5); **MS.ESS2.C** (MS-PS1-1),(MS-PS1-4); **MS.ESS3.A** (MS-PS1-3); **MS.ESS3.C** (MS-PS1-3)

*Articulation across grade-bands:* **5.PS1.A** (MS-PS1-1); **5.PS1.B** (MS-PS1-2),(MS-PS1-5); **HS.PS1.A** (MS-PS1-1),(MS-PS1-3),(MS-PS1-4),(MS-PS1-6); **HS.PS1.B** (MS-PS1-2),(MS-PS1-4),(MS-PS1-5),(MS-PS1-6); **HS.PS3.A** (MS-PS1-4),(MS-PS1-6); **HS.PS3.B** (MS-PS1-6); **HS.PS3.D** (MS-PS1-6); **HS.LS2.A** (MS-PS1-3); **HS.LS4.D** (MS-PS1-3); **HS.ESS1.A** (MS-PS1-1); **HS.ESS3.A** (MS-PS1-3)

*Common Core State Standards Connections:*

*ELA/Literacy –*

| | |
|---|---|
| **RST.6-8.1** | Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions *(MS-PS1-2),*(MS-PS1-3) |
| **RST.6-8.3** | Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks. (MS-PS1-6) |
| **RST.6-8.7** | Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table). *(MS-PS1-1),*(MS-PS1-2),*(MS-PS1-4),(MS-PS1-5)* |
| **WHST.6-8.7** | Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration. (MS-PS1-6) |
| **WHST.6-8.8** | Gather relevant information from multiple print and digital sources, using search terms effectively; assess the credibility and accuracy of each source; and quote or paraphrase the data and conclusions of others while avoiding plagiarism and following a standard format for citation. (MS-PS1-3) |

*Mathematics –*

| | |
|---|---|
| **MP.2** | Reason abstractly and quantitatively. (MS-PS1-1),(MS-PS1-2),(MS-PS1-5) |
| **MP.4** | Model with mathematics. *(MS-PS1-1),*(MS-PS1-5) |
| **6.RP.A.3** | Use ratio and rate reasoning to solve real-world and mathematical problems. *(MS-PS1-1),(MS-PS1-2),*(MS-PS1-5) |
| **6.NS.C.5** | Understand that positive and negative numbers are used together to describe quantities having opposite directions or values (e.g., temperature above/below zero, elevation above/below sea level, credits/debits, positive/negative electric charge); use positive and negative numbers to represent quantities in real-world contexts, explaining the meaning of 0 in each situation. (MS-PS1-4) |
| **8.EE.A.3** | Use numbers expressed in the form of a single digit times an integer power of 10 to estimate very large or very small quantities, and to express how many times as much one is than the other. *(MS-PS1-1)* |
| **6.SP.B.4** | Display numerical data in plots on a number line, including dot plots, histograms, and box plots. *(MS-PS1-2)* |
| **6.SP.B.5** | Summarize numerical data sets in relation to their context (MS-PS1-2) |

# MS-PS2 Motion and Stability: Forces and Interactions

## MS-PS2 Motion and Stability: Forces and Interactions

Students who demonstrate understanding can:

**MS-PS2-1.** **Apply Newton's Third Law to design a solution to a problem involving the motion of two colliding objects.*** [Clarification Statement: Examples of practical problems could include the impact of collisions between two cars, between a car and stationary objects, and between a meteor and a space vehicle.] [Assessment Boundary: Assessment is limited to vertical or horizontal interactions in one dimension.]

**MS-PS2-2.** **Plan an investigation to provide evidence that the change in an object's motion depends on the sum of the forces on the object and the mass of the object.** [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), frame of reference, and specification of units.] [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.]

**MS-PS2-3.** **Ask questions about data to determine the factors that affect the strength of electric and magnetic forces.** [Clarification Statement: Examples of devices that use electric and magnetic forces could include electromagnets, electric motors, or generators. Examples of data could include the effect of the number of turns of wire on the strength of an electromagnet, or the effect of increasing the number or strength of magnets on the speed of an electric motor.] [Assessment Boundary: Assessment about questions that require quantitative answers is limited to proportional reasoning and algebraic thinking.]

**MS-PS2-4.** **Construct and present arguments using evidence to support the claim that gravitational interactions are attractive and depend on the masses of interacting objects.** [Clarification Statement: Examples of evidence for arguments could include data generated from simulations or digital tools; and charts displaying mass, strength of interaction, distance from the Sun, and orbital periods of objects within the solar system.] [Assessment Boundary: Assessment does not include Newton's Law of Gravitation or Kepler's Laws.]

**MS-PS2-5.** **Conduct an investigation and evaluate the experimental design to provide evidence that fields exist between objects exerting forces on each other even though the objects are not in contact.** [Clarification Statement: Examples of this phenomenon could include the interactions of magnets, electrically-charged strips of tape, and electrically-charged pith balls. Examples of investigations could include first-hand experiences or simulations.] [Assessment Boundary: Assessment is limited to electric and magnetic fields, and limited to qualitative evidence for the existence of fields.]

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

### Science and Engineering Practices

**Asking Questions and Defining Problems**

Asking questions and defining problems in grades 6–8 builds from grades K–5 experiences and progresses to specifying relationships between variables, and clarifying arguments and models.

- Ask questions that can be investigated within the scope of the classroom, outdoor environment, and museums and other public facilities with available resources and, when appropriate, frame a hypothesis based on observations and scientific principles. (MS-PS2-3)

**Planning and Carrying Out Investigations**

Planning and carrying out investigations to answer questions or test solutions to problems in 6–8 builds on K–5 experiences and progresses to include investigations that use multiple variables and provide evidence to support explanations or design solutions.

- Plan an investigation individually and collaboratively, and in the design: identify independent and dependent variables and controls, what tools are needed to do the gathering, how measurements will be recorded, and how many data are needed to support a claim. (MS-PS2-2)
- Conduct an investigation and evaluate the experimental design to produce data to serve as the basis for evidence that can meet the goals of the investigation. (MS-PS2-5)

**Constructing Explanations and Designing Solutions**

Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories.

- Apply scientific ideas or principles to design an object, tool, process or system. (MS-PS2-1)

**Engaging in Argument from Evidence**

Engaging in argument from evidence in 6–8 builds from K–5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed world.

- Construct and present oral and written arguments supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem. (MS-PS2-4)

---

***Connections to Nature of Science***

**Scientific Knowledge is Based on Empirical Evidence**

- Science knowledge is based upon logical and conceptual connections between evidence and explanations. (MS-PS2-2),(MS-PS2-4)

### Disciplinary Core Ideas

**PS2.A: Forces and Motion**

- For any pair of interacting objects, the force exerted by the first object on the second object is equal in strength to the force that the second object exerts on the first, but in the opposite direction (Newton's third law). (MS-PS2-1)
- The motion of an object is determined by the sum of the forces acting on it; if the total force on the object is not zero, its motion will change. The greater the mass of the object, the greater the force needed to achieve the same change in motion. For any given object, a larger force causes a larger change in motion. (MS-PS2-2)
- All positions of objects and the directions of forces and motions must be described in an arbitrarily chosen reference frame and arbitrarily chosen units of size. In order to share information with other people, these choices must also be shared. (MS-PS2-2)

**PS2.B: Types of Interactions**

- Electric and magnetic (electromagnetic) forces can be attractive or repulsive, and their sizes depend on the magnitudes of the charges, currents, or magnetic strengths involved and on the distances between the interacting objects. (MS-PS2-3)
- Gravitational forces are always attractive. There is a gravitational force between any two masses, but it is very small except when one or both of the objects have large mass—e.g., Earth and the sun. (MS-PS2-4)
- Forces that act at a distance (electric, magnetic, and gravitational) can be explained by fields that extend through space and can be mapped by their effect on a test object (a charged object, or a ball, respectively). (MS-PS2-5)

### Crosscutting Concepts

**Cause and Effect**

- Cause and effect relationships may be used to predict phenomena in natural or designed systems. (MS-PS2-3),(MS-PS2-5)

**Systems and System Models**

- Models can be used to represent systems and their interactions—such as inputs, processes and outputs—and energy and matter flows within systems. (MS-PS2-1),(MS-PS2-4),

**Stability and Change**

- Explanations of stability and change in natural or designed systems can be constructed by examining the changes over time and forces at different scales. (MS-PS2-2)

---

***Connections to Engineering, Technology, and Applications of Science***

**Influence of Science, Engineering, and Technology on Society and the Natural World**

- The uses of technologies and any limitations on their use are driven by individual or societal needs, desires, and values; by the findings of scientific research; and by differences in such factors as climate, natural resources, and economic conditions. (MS-PS2-1)

*Connections to other DCIs in this grade-band*: **MS.PS3.A** (MS-PS2-2); **MS.PS3.B** (MS-PS2-2); **MS.PS3.C** (MS-PS2-1); **MS.ESS1.A** (MS-PS2-4); **MS.ESS1.B** (MS-PS2-4); **MS.ESS2.C** (MS-PS2-2),(MS-PS2-4)

*Articulation across grade-bands:* **3.PS2.A** (MS-PS2-1),(MS-PS2-2); **3.PS2.B** (MS-PS2-3),(MS-PS2-5); **5.PS2.B** (MS-PS2-4); **HS.PS2.A** (MS-PS2-1),(MS-PS2-2); **HS.PS2.B** (MS-PS2-3),(MS-PS2-4),(MS-PS2-5); **HS.PS3.A** (MS-PS2-5); **HS.PS3.B** (MS-PS2-2),(MS-PS2-5); **HS.PS3.C** (MS-PS2-5); **HS.ESS1.B** (MS-PS2-2),(MS-PS2-4)

*Common Core State Standards Connections:*

*ELA/Literacy –*

# MS-PS2 Motion and Stability: Forces and Interactions

| | |
|---|---|
| **RST.6-8.1** | Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions *(MS-PS2-1),(MS-PS2-3)* |
| **RST.6-8.3** | Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks. *(MS-PS2-1),*(MS-PS2-2)*,(MS-PS2-5)* |
| **WHST.6-8.1** | Write arguments focused on *discipline-specific content.* (MS-PS2-4) |
| **WHST.6-8.7** | Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration. *(MS-PS2-1),*(MS-PS2-2)*,(MS-PS2-5)* |
| *Mathematics –* | |
| **MP.2** | Reason abstractly and quantitatively. (MS-PS2-1),(MS-PS2-2),(MS-PS2-3) |
| **6.NS.C.5** | Understand that positive and negative numbers are used together to describe quantities having opposite directions or values; use positive and negative numbers to represent quantities in real-world contexts, explaining the meaning of 0 in each situation. (MS-PS2-1) |
| **6.EE.A.2** | Write, read, and evaluate expressions in which letters stand for numbers. *(MS-PS2-1),(MS-PS2-2)* |
| **7.EE.B.3** | Solve multi-step real-life and mathematical problems posed with positive and negative rational numbers in any form, using tools strategically. Apply properties of operations to calculate with numbers in any form; convert between forms as appropriate; and assess the reasonableness of answers using mental computation and estimation strategies. *(MS-PS2-1),(MS-PS2-2)* |
| **7.EE.B.4** | Use variables to represent quantities in a real-world or mathematical problem, and construct simple equations and inequalities to solve problems by reasoning about the quantities. *(MS-PS2-1),(MS-PS2-2)* |

# MS-PS3 Energy

## MS-PS3 Energy

Students who demonstrate understanding can:

**MS-PS3-1.** **Construct and interpret graphical displays of data to describe the relationships of kinetic energy to the mass of an object and to the speed of an object.** [Clarification Statement: Emphasis is on descriptive relationships between kinetic energy and mass separately from kinetic energy and speed. Examples could include riding a bicycle at different speeds, rolling different sizes of rocks downhill, and getting hit by a wiffle ball versus a tennis ball.]

**MS-PS3-2.** **Develop a model to describe that when the arrangement of objects interacting at a distance changes, different amounts of potential energy are stored in the system.** [Clarification Statement: Emphasis is on relative amounts of potential energy, not on calculations of potential energy. 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 classmate's hair. 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.]

**MS-PS3-3.** **Apply scientific principles to design, construct, and test a device that either minimizes or maximizes 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.]

**MS-PS3-4.** **Plan an investigation to determine the relationships among the energy transferred, the type of matter, the mass, and the change in the average kinetic energy of the particles as measured by the temperature of the sample.** [Clarification Statement: Examples of experiments could include comparing final water temperatures after different masses of ice melted in the same volume of water with the same initial temperature, the temperature change of samples of different materials with the same mass as they cool or heat in the environment, or the same material with different masses when a specific amount of energy is added.] [Assessment Boundary: Assessment does not include calculating the total amount of thermal energy transferred.]

**MS-PS3-5.** **Construct, use, and present arguments to support the claim that when the kinetic energy of an object changes, energy is transferred to or from the object.** [Clarification Statement: Examples of empirical evidence used in arguments could include an inventory or other representation of the energy before and after the transfer in the form of temperature changes or motion of object.] [Assessment Boundary: Assessment does not include calculations of energy.]

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

### Science and Engineering Practices

**Developing and Using Models**

Modeling in 6–8 builds on K–5 and progresses to developing, using and revising models to describe, test, and predict more abstract phenomena and design systems.

- Develop a model to describe unobservable mechanisms. (MS-PS3-2)

**Planning and Carrying Out Investigations**

Planning and carrying out investigations to answer questions or test solutions to problems in 6–8 builds on K–5 experiences and progresses to include investigations that use multiple variables and provide evidence to support explanations or design solutions.

- Plan an investigation individually and collaboratively, and in the design: identify independent and dependent variables and controls, what tools are needed to do the gathering, how measurements will be recorded, and how many data are needed to support a claim. (MS-PS3-4)

**Analyzing and Interpreting Data**

Analyzing data in 6–8 builds on K–5 and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis.

- Construct and interpret graphical displays of data to identify linear and nonlinear relationships. (MS-PS3-1)

**Constructing Explanations and Designing Solutions**

Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories.

- Apply scientific ideas or principles to design, construct, and test a design of an object, tool, process or system. (MS-PS3-3)

**Engaging in Argument from Evidence**

Engaging in argument from evidence in 6–8 builds on K–5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed worlds.

- Construct, use, and present oral and written arguments supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon. (MS-PS3-5)

---

***Connections to Nature of Science***

**Scientific Knowledge is Based on Empirical Evidence**

- Science knowledge is based upon logical and conceptual connections between evidence and explanations (MS-PS3-4),(MS-PS3-5)

### Disciplinary Core Ideas

**PS3.A: Definitions of Energy**

- Motion energy is properly called kinetic energy; it is proportional to the mass of the moving object and grows with the square of its speed. (MS-PS3-1)
- A system of objects may also contain stored (potential) energy, depending on their relative positions. (MS-PS3-2)
- Temperature is a measure of the average kinetic energy of particles of matter. The relationship between the temperature and the total energy of a system depends on the types, states, and amounts of matter present. (MS-PS3-3),(MS-PS3-4)

**PS3.B: Conservation of Energy and Energy Transfer**

- When the motion energy of an object changes, there is inevitably some other change in energy at the same time. (MS-PS3-5)
- The amount of energy transfer needed to change the temperature of a matter sample by a given amount depends on the nature of the matter, the size of the sample, and the environment. (MS-PS3-4)
- Energy is spontaneously transferred out of hotter regions or objects and into colder ones. (MS-PS3-3)

**PS3.C: Relationship Between Energy and Forces**

- When two objects interact, each one exerts a force on the other that can cause energy to be transferred to or from the object. (MS-PS3-2)

**ETS1.A: Defining and Delimiting an Engineering Problem**

- The more precisely a design task's criteria and constraints can be defined, the more likely it is that the designed solution will be successful. Specification of constraints includes consideration of scientific principles and other relevant knowledge that is likely to limit possible solutions. *(secondary to MS-PS3-3)*

**ETS1.B: Developing Possible Solutions**

- A solution needs to be tested, and then modified on the basis of the test results in order to improve it. There are systematic processes for evaluating solutions with respect to how well they meet criteria and constraints of a problem. *(secondary to MS-PS3-3)*

### Crosscutting Concepts

**Scale, Proportion, and Quantity**

- Proportional relationships (e.g. speed as the ratio of distance traveled to time taken) among different types of quantities provide information about the magnitude of properties and processes. (MS-PS3-1),(MS-PS3-4)

**Systems and System Models**

- Models can be used to represent systems and their interactions – such as inputs, processes, and outputs – and energy and matter flows within systems. (MS-PS3-2)

**Energy and Matter**

- Energy may take different forms (e.g. energy in fields, thermal energy, energy of motion). (MS-PS3-5)
- The transfer of energy can be tracked as energy flows through a designed or natural system. (MS-PS3-3)

*Connections to other DCIs in this grade-band*: **MS.PS1.A** (MS-PS3-4); **MS.PS1.B** (MS-PS3-3); **MS.PS2.A** (MS-PS3-1),(MS-PS3-4),(MS-PS3-5); **MS.ESS2.A** (MS-PS3-3); **MS.ESS2.C** (MS-PS3-3),(MS-PS3-4); **MS.ESS2.D** (MS-PS3-3),(MS-PS3-4); **MS.ESS3.D** (MS-PS3-4)

*Articulation across grade-bands:* **4.PS3.B** (MS-PS3-1),(MS-PS3-3); **4.PS3.C** (MS-PS3-4),(MS-PS3-5); **HS.PS1.B** (MS-PS3-4); **HS.PS2.B** (MS-PS3-2); **HS.PS3.A** (MS-PS3-1),(MS-PS3-4),(MS-PS3-5); **HS.PS3.B** (MS-PS3-1),(MS-PS3-2),(MS-PS3-3),(MS-PS3-4),(MS-PS3-5); **HS.PS3.C** (MS-PS3-2)

*Common Core State Standards Connections:*

# MS-PS3 Energy

| | |
|---|---|
| *ELA/Literacy –* | |
| **RST.6-8.1** | Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions *(MS-PS3-1),(MS-PS3-5)* |
| **RST.6-8.3** | Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks. *(MS-PS3-3),*(MS-PS3-4*)* |
| **RST.6-8.7** | Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table). (MS-PS3-1) |
| **WHST.6-8.1** | Write arguments focused on discipline content. *(MS-PS3-5)* |
| **WHST.6-8.7** | Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration. (MS-PS3-3),*(MS-PS3-4)* |
| **SL.8.5** | Integrate multimedia and visual displays into presentations to clarify information, strengthen claims and evidence, and add interest. *(MS-PS3-2)* |
| *Mathematics –* | |
| **MP.2** | Reason abstractly and quantitatively. (MS-PS3-1),(MS-PS3-4),(MS-PS3-5) |
| **6.RP.A.1** | Understand the concept of ratio and use ratio language to describe a ratio relationship between two quantities. (MS-PS3-1),*(MS-PS3-5)* |
| **6.RP.A.2** | Understand the concept of a unit rate a/b associated with a ratio a:b with b ≠ 0, and use rate language in the context of a ratio relationship. *(MS-PS3-1)* |
| **7.RP.A.2** | Recognize and represent proportional relationships between quantities. (MS-PS3-1),*(MS-PS3-5)* |
| **8.EE.A.1** | Know and apply the properties of integer exponents to generate equivalent numerical expressions. (MS-PS3-1) |
| **8.EE.A.2** | Use square root and cube root symbols to represent solutions to equations of the form x2 = p and x3 = p, where p is a positive rational number. Evaluate square roots of small perfect squares and cube roots of small perfect cubes. Know that √2 is irrational. *(MS-PS3-1)* |
| **8.F.A.3** | Interpret the equation y = mx + b as defining a linear function, whose graph is a straight line; give examples of functions that are not linear. (MS-PS3-1),*(MS-PS3-5)* |
| **6.SP.B.5** | Summarize numerical data sets in relation to their context. *(MS-PS3-4)* |

# MS-PS4 Waves and Their Applications in Technologies for Information Transfer

## MS-PS4 Waves and Their Applications in Technologies for Information Transfer

Students who demonstrate understanding can:

**MS-PS4-1.** **Use mathematical representations to describe a simple model for waves that includes how the amplitude of a wave is related to the energy in a wave.** [Clarification Statement: Emphasis is on describing waves with both qualitative and quantitative thinking.] [Assessment Boundary: Assessment does not include electromagnetic waves and is limited to standard repeating waves.]

**MS-PS4-2.** **Develop and use a model to describe that waves are reflected, absorbed, or transmitted through various materials.** [Clarification Statement: Emphasis is on both light and mechanical waves. Examples of models could include drawings, simulations, and written descriptions.] [Assessment Boundary: Assessment is limited to qualitative applications pertaining to light and mechanical waves.]

**MS-PS4-3.** **Integrate qualitative scientific and technical information to support the claim that digitized signals are a more reliable way to encode and transmit information than analog signals.** [Clarification Statement: Emphasis is on a basic understanding that waves can be used for communication purposes. Examples could include using fiber optic cable to transmit light pulses, radio wave pulses in wifi devices, and conversion of stored binary patterns to make sound or text on a computer screen.] [Assessment Boundary: Assessment does not include binary counting. Assessment does not include the specific mechanism of any given device.]

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

### Science and Engineering Practices

**Developing and Using Models**

Modeling in 6–8 builds on K–5 and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems.

- Develop and use a model to describe phenomena. (MS-PS4-2)

**Using Mathematics and Computational Thinking**

Mathematical and computational thinking at the 6–8 level builds on K–5 and progresses to identifying patterns in large data sets and using mathematical concepts to support explanations and arguments.

- Use mathematical representations to describe and/or support scientific conclusions and design solutions. (MS-PS4-1)

**Obtaining, Evaluating, and Communicating Information**

Obtaining, evaluating, and communicating information in 6-8 builds on K-5 and progresses to evaluating the merit and validity of ideas and methods.

- Integrate qualitative scientific and technical information in written text with that contained in media and visual displays to clarify claims and findings. (MS-PS4-3)

---

***Connections to Nature of Science***

**Scientific Knowledge is Based on Empirical Evidence**

- Science knowledge is based upon logical and conceptual connections between evidence and explanations. (MS-PS4-1)

### Disciplinary Core Ideas

**PS4.A: Wave Properties**

- A simple wave has a repeating pattern with a specific wavelength, frequency, and amplitude. (MS-PS4-1)
- A sound wave needs a medium through which it is transmitted. (MS-PS4-2)

**PS4.B: Electromagnetic Radiation**

- When light shines on an object, it is reflected, absorbed, or transmitted through the object, depending on the object's material and the frequency (color) of the light. (MS-PS4-2)
- The path that light travels can be traced as straight lines, except at surfaces between different transparent materials (e.g., air and water, air and glass) where the light path bends. (MS-PS4-2)
- A wave model of light is useful for explaining brightness, color, and the frequency-dependent bending of light at a surface between media. (MS-PS4-2)
- However, because light can travel through space, it cannot be a matter wave, like sound or water waves. (MS-PS4-2)

**PS4.C: Information Technologies and Instrumentation**

- Digitized signals (sent as wave pulses) are a more reliable way to encode and transmit information. (MS-PS4-3)

### Crosscutting Concepts

**Patterns**

- Graphs and charts can be used to identify patterns in data. (MS-PS4-1)

**Structure and Function**

- Structures can be designed to serve particular functions by taking into account properties of different materials, and how materials can be shaped and used. (MS-PS4-2)
- Structures can be designed to serve particular functions. (MS-PS4-3)

---

***Connections to Engineering, Technology, and Applications of Science***

**Influence of Science, Engineering, and Technology on Society and the Natural World**

- Technologies extend the measurement, exploration, modeling, and computational capacity of scientific investigations. (MS-PS4-3)

---

***Connections to Nature of Science***

**Science is a Human Endeavor**

- Advances in technology influence the progress of science and science has influenced advances in technology. (MS-PS4-3)

*Connections to other DCIs in this grade-band:* **MS.LS1.D** (MS-PS4-2)

*Articulation across grade-bands:* **4.PS3.A** (MS-PS4-1); **4.PS3.B** (MS-PS4-1); **4.PS4.A** (MS-PS4-1); **4.PS4.B** (MS-PS4-2); **4.PS4.C** (MS-PS4-3); **HS.PS4.A** (MS-PS4-1),(MS-PS4-2),(MS-PS4-3); **HS.PS4.B** (MS-PS4-1),(MS-PS4-2); **HS.PS4.C** (MS-PS4-3); **HS.ESS1.A** (MS-PS4-2); **HS.ESS2.A** (MS-PS4-2); **HS.ESS2.C** (MS-PS4-2); **HS.ESS2.D** (MS-PS4-2)

*Common Core State Standards Connections:*

*ELA/Literacy –*

| | |
|---|---|
| **RST.6-8.1** | Cite specific textual evidence to support analysis of science and technical texts. (MS-PS4-3) |
| **RST.6-8.2** | Determine the central ideas or conclusions of a text; provide an accurate summary of the text distinct from prior knowledge or opinions. *(MS-PS4-3)* |
| **RST.6-8.9** | Compare and contrast the information gained from experiments, simulations, video, or multimedia sources with that gained from reading a text on the same topic. (MS-PS4-3) |
| **WHST.6-8.9** | Draw evidence from informational texts to support analysis, reflection, and research. (MS-PS4-3) |
| **SL.8.5** | Integrate multimedia and visual displays into presentations to clarify information, strengthen claims and evidence, and add interest. *(MS-PS4-1),(MS-PS4-2)* |

*Mathematics –*

| | |
|---|---|
| **MP.2** | Reason abstractly and quantitatively. (MS-PS4-1) |
| **MP.4** | Model with mathematics. (MS-PS4-1) |
| **6.RP.A.1** | Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities. (MS-PS4-1) |
| **6.RP.A.3** | Use ratio and rate reasoning to solve real-world and mathematical problems. (MS-PS4-1) |
| **7.RP.A.2** | Recognize and represent proportional relationships between quantities. (MS-PS4-1) |
| **8.F.A.3** | Interpret the equation y = mx + b as defining a linear function, whose graph is a straight line; give examples of functions that are not linear. *(MS-PS4-1)* |

# MS-LS1 From Molecules to Organisms: Structures and Processes

## MS-LS1 From Molecules to Organisms: Structures and Processes

Students who demonstrate understanding can:

**MS-LS1-1.** **Conduct an investigation to provide evidence that living things are made of cells; either one cell or many different numbers and types of cells.** [Clarification Statement: Emphasis is on developing evidence that living things are made of cells, distinguishing between living and non-living things, and understanding that living things may be made of one cell or many and varied cells.]

**MS-LS1-2.** **Develop and use a model to describe the function of a cell as a whole and ways parts of cells contribute to the function.** [Clarification Statement: Emphasis is on the cell functioning as a whole system and the primary role of identified parts of the cell, specifically the nucleus, chloroplasts, mitochondria, cell membrane, and cell wall.] [Assessment Boundary: Assessment of organelle structure/function relationships is limited to the cell wall and cell membrane. Assessment of the function of the other organelles is limited to their relationship to the whole cell. Assessment does not include the biochemical function of cells or cell parts.]

**MS-LS1-3.** **Use argument supported by evidence for how the body is a system of interacting subsystems composed of groups of cells.** [Clarification Statement: Emphasis is on the conceptual understanding that cells form tissues and tissues form organs specialized for particular body functions. Examples could include the interaction of subsystems within a system and the normal functioning of those systems.] [Assessment Boundary: Assessment does not include the mechanism of one body system independent of others. Assessment is limited to the circulatory, excretory, digestive, respiratory, muscular, and nervous systems.]

**MS-LS1-4.** **Use argument based on empirical evidence and scientific reasoning to support an explanation for how characteristic animal behaviors and specialized plant structures affect the probability of successful reproduction of animals and plants respectively.** [Clarification Statement: Examples of 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 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.]

**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 large breed cattle and species of grass affecting growth of organisms. Examples of evidence could include drought decreasing plant growth, fertilizer increasing plant growth, different varieties of plant seeds growing at different rates in different conditions, and fish growing larger in large ponds than they do in small ponds.] [Assessment Boundary: Assessment does not include genetic mechanisms, gene regulation, or biochemical processes.]

**MS-LS1-6.** **Construct a scientific explanation based on evidence for the role of photosynthesis in the cycling of matter and flow of energy into and out of organisms.** [Clarification Statement: Emphasis is on tracing movement of matter and flow of energy.] [Assessment Boundary: Assessment does not include the biochemical mechanisms of photosynthesis.]

**MS-LS1-7.** **Develop a model to describe how food is rearranged through chemical reactions forming new molecules that support growth and/or release energy as this matter moves through an organism.** [Clarification Statement: Emphasis is on describing that molecules are broken apart and put back together and that in this process, energy is released.] [Assessment Boundary: Assessment does not include details of the chemical reactions for photosynthesis or respiration.]

**MS-LS1-8.** **Gather and synthesize information that sensory receptors respond to stimuli by sending messages to the brain for immediate behavior or storage as memories.** [Assessment Boundary: Assessment does not include mechanisms for the transmission of this information.]

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

### Science and Engineering Practices

**Developing and Using Models**

Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems.

- Develop and use a model to describe phenomena. (MS-LS1-2)
- Develop a model to describe unobservable mechanisms. (MS-LS1-7)

**Planning and Carrying Out Investigations**

Planning and carrying out investigations in 6-8 builds on K-5 experiences and progresses to include investigations that use multiple variables and provide evidence to support explanations or solutions.

- Conduct an investigation to produce data to serve as the basis for evidence that meet the goals of an investigation. (MS-LS1-1)

**Constructing Explanations and Designing Solutions**

Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific knowledge, principles, and theories.

- Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. (MS-LS1-5),(MS-LS1-6)

**Engaging in Argument from Evidence**

Engaging in argument from evidence in 6–8 builds on K–5 experiences and progresses to constructing a convincing

### Disciplinary Core Ideas

**LS1.A: Structure and Function**

- All living things are made up of cells, which is the smallest unit that can be said to be alive. An organism may consist of one single cell (unicellular) or many different numbers and types of cells (multicellular). (MS-LS1-1)
- Within cells, special structures are responsible for particular functions, and the cell membrane forms the boundary that controls what enters and leaves the cell. (MS-LS1-2)
- In multicellular organisms, the body is a system of multiple interacting subsystems. These subsystems are groups of cells that work together to form tissues and organs that are specialized for particular body functions. (MS-LS1-3)

**LS1.B: Growth and Development of Organisms**

- Animals engage in characteristic behaviors that increase the odds of reproduction. (MS-LS1-4)
- Plants reproduce in a variety of ways, sometimes depending on animal behavior and specialized features for reproduction. (MS-LS1-4)
- Genetic factors as well as local conditions affect the growth of the adult plant. (MS-LS1-5)

**LS1.C: Organization for Matter and Energy Flow in Organisms**

- Plants, algae (including phytoplankton), and many microorganisms use the energy from light to make sugars (food) from carbon dioxide from the atmosphere and water through the process of photosynthesis, which also releases oxygen. These sugars can be used immediately or stored for growth or later use. (MS-LS1-6)

### Crosscutting Concepts

**Cause and Effect**

- Cause and effect relationships may be used to predict phenomena in natural systems. (MS-LS1-8)
- Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability. (MS-LS1-4),(MS-LS1-5)

**Scale, Proportion, and Quantity**

- Phenomena that can be observed at one scale may not be observable at another scale. (MS-LS1-1)

**Systems and System Models**

- Systems may interact with other systems; they may have sub-systems and be a part of larger complex systems. (MS-LS1-3)

**Energy and Matter**

- Matter is conserved because atoms are conserved in physical and chemical processes. (MS-LS1-7)
- Within a natural system, the transfer of energy drives the motion and/or cycling of matter. (MS-LS1-6)

**Structure and Function**

- Complex and microscopic structures and systems can be visualized, modeled, and used to describe how their function depends on the relationships among its parts, therefore complex natural structures/systems can be analyzed to determine how they function. (MS-LS1-2)

---

***Connections to Engineering, Technology, and Applications of Science***

# MS-LS1 From Molecules to Organisms: Structures and Processes

argument that supports or refutes claims for either explanations or solutions about the natural and designed world(s).

- Use an oral and written argument supported by evidence to support or refute an explanation or a model for a phenomenon. (MS-LS1-3)
- Use an oral and written argument supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem. (MS-LS1-4)

**Obtaining, Evaluating, and Communicating Information**

Obtaining, evaluating, and communicating information in 6-8 builds on K-5 experiences and progresses to evaluating the merit and validity of ideas and methods.

- Gather, read, and synthesize information from multiple appropriate sources and assess the credibility, accuracy, and possible bias of each publication and methods used, and describe how they are supported or not supported by evidence. (MS-LS1-8)

---

***Connections to Nature of Science***

**Scientific Knowledge is Based on Empirical Evidence**

- Science knowledge is based upon logical connections between evidence and explanations. (MS-LS1-6)

- Within individual organisms, food moves through a series of chemical reactions in which it is broken down and rearranged to form new molecules, to support growth, or to release energy. (MS-LS1-7)

**LS1.D: Information Processing**

- Each sense receptor responds to different inputs (electromagnetic, mechanical, chemical), transmitting them as signals that travel along nerve cells to the brain. The signals are then processed in the brain, resulting in immediate behaviors or memories. (MS-LS1-8)

**PS3.D: Energy in Chemical Processes and Everyday Life**

- The chemical reaction by which plants produce complex food molecules (sugars) requires an energy input (i.e., from sunlight) to occur. In this reaction, carbon dioxide and water combine to form carbon-based organic molecules and release oxygen. *(secondary to MS-LS1-6)*
- Cellular respiration in plants and animals involve chemical reactions with oxygen that release stored energy. In these processes, complex molecules containing carbon react with oxygen to produce carbon dioxide and other materials. *(secondary to MS-LS1-7)*

**Interdependence of Science, Engineering, and Technology**

- Engineering advances have led to important discoveries in virtually every field of science, and scientific discoveries have led to the development of entire industries and engineered systems. (MS-LS1-1)

---

***Connections to Nature of Science***

**Science is a Human Endeavor**

- Scientists and engineers are guided by habits of mind such as intellectual honesty, tolerance of ambiguity, skepticism, and openness to new ideas. (MS-LS1-3)

*Connections to other DCIs in this grade-band:* **MS.PS1.B** (MS-LS1-6),(MS-LS1-7); **MS.LS2.A** (MS-LS1-4),(MS-LS1-5); **MS.LS3.A** (MS-LS1-2); **MS.ESS2.A** (MS-LS1-6)

*Articulation to DCIs across grade-bands:* **3.LS1.B** (MS-LS1-4),(MS-LS1-5); **3.LS3.A** (MS-LS1-5); **4.LS1.A** (MS-LS1-2); **4.LS1.D** (MS-LS1-8); **5.PS3.D** (MS-LS1-6),(MS-LS1-7); **5.LS1.C** (MS-LS1-6),(MS-LS1-7); **5.LS2.A** (MS-LS1-6); **5.LS2.B** (MS-LS1-6),(MS-LS1-7); **HS.PS1.B** (MS-LS1-6),(MS-LS1-7); **HS.LS1.A** (MS-LS1-1),(MS-LS1-2),(MS-LS1-3),(MS-LS1-8); **HS.LS1.C** (MS-LS1-6),(MS-LS1-7); **HS.LS2.A** (MS-LS1-4),(MS-LS1-5); **HS.LS2.B** (MS-LS1-6),(MS-LS1-7); **HS.LS2.D** (MS-LS1-4); **HS.ESS2.D** (MS-LS1-6)

*Common Core State Standards Connections:*

*ELA/Literacy –*

| | |
|---|---|
| **RST.6-8.1** | Cite specific textual evidence to support analysis of science and technical texts. (MS-LS1-3),(MS-LS1-4),(MS-LS1-5),(MS-LS1-6) |
| **RST.6-8.2** | Determine the central ideas or conclusions of a text; provide an accurate summary of the text distinct from prior knowledge or opinions. *(MS-LS1-5),(MS-LS1-6)* |
| **RI.6.8** | Trace and evaluate the argument and specific claims in a text, distinguishing claims that are supported by reasons and evidence from claims that are not. (MS-LS1-3),(MS-LS1-4) |
| **WHST.6-8.1** | Write arguments focused on discipline content. (MS-LS1-3),(MS-LS1-4) |
| **WHST.6-8.2** | Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content. *(MS-LS1-5),*(MS-LS1-6) |
| **WHST.6-8.7** | Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration. (MS-LS1-1) |
| **WHST.6-8.8** | Gather relevant information from multiple print and digital sources; assess the credibility of each source; and quote or paraphrase the data and conclusions of others while avoiding plagiarism and providing basic bibliographic information for sources. (MS-LS1-8) |
| **WHST.6-8.9** | Draw evidence from informational texts to support analysis, reflection, and research. (MS-LS1-5),(MS-LS1-6) |
| **SL.8.5** | Integrate multimedia and visual displays into presentations to clarify information, strengthen claims and evidence, and add interest. *(MS-LS1-2),(MS-LS1-7)* |

*Mathematics –*

| | |
|---|---|
| **6.EE.C.9** | Use variables to represent two quantities in a real-world problem that change in relationship to one another; write an equation to express one quantity, thought of as the dependent variable, in terms of the other quantity, thought of as the independent variable. Analyze the relationship between the dependent and independent variables using graphs and tables, and relate these to the equation. *(MS-LS1-1),(MS-LS1-2),(MS-LS1-3),(MS-LS1-6)* |
| **6.SP.A.2** | Understand that a set of data collected to answer a statistical question has a distribution which can be described by its center, spread, and overall shape. *(MS-LS1-4),(MS-LS1-5)* |
| **6.SP.B.4** | Summarize numerical data sets in relation to their context. *(MS-LS1-4),(MS-LS1-5)* |

# MS-LS2 Ecosystems: Interactions, Energy, and Dynamics

## MS-LS2 Ecosystems: Interactions, Energy, and Dynamics

Students who demonstrate understanding can:

**MS-LS2-1. Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem.** [Clarification Statement: Emphasis is on cause and effect relationships between resources and growth of individual organisms and the numbers of organisms in ecosystems during periods of abundant and scarce resources.]

**MS-LS2-2. Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems.** [Clarification Statement: Emphasis is on predicting consistent patterns of interactions in different ecosystems in terms of the relationships among and between organisms and abiotic components of ecosystems. Examples of types of interactions could include competitive, predatory, and mutually beneficial.]

**MS-LS2-3. Develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem.** [Clarification Statement: Emphasis is on describing the conservation of matter and flow of energy into and out of various ecosystems, and on defining the boundaries of the system.] [Assessment Boundary: Assessment does not include the use of chemical reactions to describe the processes.]

**MS-LS2-4. Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations.** [Clarification Statement: Emphasis is on recognizing patterns in data and making warranted inferences about changes in populations, and on evaluating empirical evidence supporting arguments about changes to ecosystems.]

**MS-LS2-5. Evaluate competing design solutions for maintaining biodiversity and ecosystem services.*** [Clarification Statement: Examples of ecosystem services could include water purification, nutrient recycling, and prevention of soil erosion. Examples of design solution constraints could include scientific, economic, and social considerations.]

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

### Science and Engineering Practices

**Developing and Using Models**

Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems.

- Develop a model to describe phenomena. (MS-LS2-3)

**Analyzing and Interpreting Data**

Analyzing data in 6–8 builds on K–5 experiences and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis.

- Analyze and interpret data to provide evidence for phenomena. (MS-LS2-1)

**Constructing Explanations and Designing Solutions**

Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories.

- Construct an explanation that includes qualitative or quantitative relationships between variables that predict phenomena. (MS-LS2-2)

**Engaging in Argument from Evidence**

Engaging in argument from evidence in 6–8 builds on K–5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed world(s).

- Construct an oral and written argument supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem. (MS-LS2-4)
- Evaluate competing design solutions based on jointly developed and agreed-upon design criteria. (MS-LS2-5)

---

***Connections to Nature of Science***

**Scientific Knowledge is Based on Empirical Evidence**

- Science disciplines share common rules of obtaining and evaluating empirical evidence. (MS-LS2-4)

### Disciplinary Core Ideas

**LS2.A: Interdependent Relationships in Ecosystems**

- Organisms, and populations of organisms, are dependent on their environmental interactions both with other living things and with nonliving factors. (MS-LS2-1)
- In any ecosystem, organisms and populations with similar requirements for food, water, oxygen, or other resources may compete with each other for limited resources, access to which consequently constrains their growth and reproduction. (MS-LS2-1)
- Growth of organisms and population increases are limited by access to resources. (MS-LS2-1)
- Similarly, predatory interactions may reduce the number of organisms or eliminate whole populations of organisms. Mutually beneficial interactions, in contrast, may become so interdependent that each organism requires the other for survival. Although the species involved in these competitive, predatory, and mutually beneficial interactions vary across ecosystems, the patterns of interactions of organisms with their environments, both living and nonliving, are shared. (MS-LS2-2)

**LS2.B: Cycle of Matter and Energy Transfer in Ecosystems**

- Food webs are models that demonstrate how matter and energy is transferred between producers, consumers, and decomposers as the three groups interact within an ecosystem. Transfers of matter into and out of the physical environment occur at every level. Decomposers recycle nutrients from dead plant or animal matter back to the soil in terrestrial environments or to the water in aquatic environments. The atoms that make up the organisms in an ecosystem are cycled repeatedly between the living and nonliving parts of the ecosystem. (MS-LS2-3)

**LS2.C: Ecosystem Dynamics, Functioning, and Resilience**

- Ecosystems are dynamic in nature; their characteristics can vary over time. Disruptions to any physical or biological component of an ecosystem can lead to shifts in all its populations. (MS-LS2-4)
- Biodiversity describes the variety of species found in Earth's terrestrial and oceanic ecosystems. The completeness or integrity of an ecosystem's biodiversity is often used as a measure of its health. (MS-LS2-5)

**LS4.D: Biodiversity and Humans**

- Changes in biodiversity can influence humans' resources, such as food, energy, and medicines, as well as ecosystem services that humans rely on—for example, water purification and recycling. *(secondary to MS-LS2-5)*

**ETS1.B: Developing Possible Solutions**

- There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem. *(secondary to MS-LS2-5)*

### Crosscutting Concepts

**Patterns**

- Patterns can be used to identify cause and effect relationships. (MS-LS2-2)

**Cause and Effect**

- Cause and effect relationships may be used to predict phenomena in natural or designed systems. (MS-LS2-1)

**Energy and Matter**

- The transfer of energy can be tracked as energy flows through a natural system. (MS-LS2-3)

**Stability and Change**

- Small changes in one part of a system might cause large changes in another part. (MS-LS2-4),(MS-LS2-5)

---

***Connections to Engineering, Technology, and Applications of Science***

**Influence of Science, Engineering, and Technology on Society and the Natural World**

- The use of technologies and any limitations on their use are driven by individual or societal needs, desires, and values; by the findings of scientific research; and by differences in such factors as climate, natural resources, and economic conditions. Thus technology use varies from region to region and over time. (MS-LS2-5)

---

***Connections to Nature of Science***

**Scientific Knowledge Assumes an Order and Consistency in Natural Systems**

- Science assumes that objects and events in natural systems occur in consistent patterns that are understandable through measurement and observation. (MS-LS2-3)

**Science Addresses Questions About the Natural and Material World**

- Scientific knowledge can describe the consequences of actions but does not necessarily prescribe the decisions that society takes. (MS-LS2-5)

*Connections to other DCIs in this grade-band*: **MS.PS1.B** (MS-LS2-3); **MS.LS1.B** (MS-LS2-2); **MS.LS4.C** (MS-LS2-4); **MS.LS4.D** (MS-LS2-4); **MS.ESS2.A** (MS-LS2-3),(MS-LS2-4); **MS.ESS3.A** (MS-LS2-1),(MS-LS2-4); **MS.ESS3.C** (MS-LS2-1),(MS-LS2-4),(MS-LS2-5)

*Articulation across grade-bands:* **1.LS1.B** (MS-LS2-2); **3.LS2.C** (MS-LS2-1),(MS-LS2-4); **3.LS4.D** (MS-LS2-1),(MS-LS2-4); **5.LS2.A** (MS-LS2-1),(MS-LS2-3); **5.LS2.B** (MS-LS2-3); **HS.PS3.B** (MS-LS2-3); **HS.LS1.C** (MS-LS2-3); **HS.LS2.A** (MS-LS2-1),(MS-LS2-2),(MS-LS2-5); **HS.LS2.B** (MS-LS2-2),(MS-LS2-3); **HS.LS2.C** (MS-LS2-4),(MS-LS2-5); **HS.LS2.D** (MS-LS2-2); **HS.LS4.C** (MS-LS2-1),(MS-LS2-4); **HS.LS4.D** (MS-LS2-1),(MS-LS2-4),(MS-LS2-5); **HS.ESS2.A** (MS-LS2-3); **HS.ESS2.E** (MS-LS2-4); **HS.ESS3.A** (MS-LS2-1),(MS-LS2-5);

# MS-LS2 Ecosystems: Interactions, Energy, and Dynamics

**HS.ESS3.B** (MS-LS2-4); **HS.ESS3.C** (MS-LS2-4),(MS-LS2-5); **HS.ESS3.D** (MS-LS2-5)

*Common Core State Standards Connections:*

*ELA/Literacy –*

| | |
|---|---|
| **RST.6-8.1** | Cite specific textual evidence to support analysis of science and technical texts. (MS-LS2-1),(MS-LS2-2),(MS-LS2-4) |
| **RST.6-8.7** | Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table). (MS-LS2-1) |
| **RST.6-8.8** | Distinguish among facts, reasoned judgment based on research findings, and speculation in a text. (MS-LS2-5) |
| **RI.8.8** | Trace and evaluate the argument and specific claims in a text, assessing whether the reasoning is sound and the evidence is relevant and sufficient to support the claims. (MS-LS-4),(MS-LS2-5) |
| **WHST.6-8.1** | Write arguments to support claims with clear reasons and relevant evidence. (MS-LS2-4) |
| **WHST.6-8.2** | Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content. (MS-LS2-2) |
| **WHST.6-8.9** | Draw evidence from literary or informational texts to support analysis, reflection, and research. (MS-LS2-2),(MS-LS2-4) |
| **SL.8.1** | Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 8 topics, texts, and issues, building on others' ideas and expressing their own clearly. *(MS-LS2-2)* |
| **SL.8.4** | Present claims and findings, emphasizing salient points in a focused, coherent manner with relevant evidence, sound valid reasoning, and well-chosen details; use appropriate eye contact, adequate volume, and clear pronunciation. *(MS-LS2-2)* |
| **SL.8.5** | Include multimedia components and visual displays in presentations to clarify claims and findings and emphasize salient points. *(MS-LS2-3)* |

*Mathematics –*

| | |
|---|---|
| **MP.4** | Model with mathematics. *(MS-LS2-5)* |
| **6.RP.A.3** | Use ratio and rate reasoning to solve real-world and mathematical problems. *(MS-LS2-5)* |
| **6.EE.C.9** | Use variables to represent two quantities in a real-world problem that change in relationship to one another; write an equation to express one quantity, thought of as the dependent variable, in terms of the other quantity, thought of as the independent variable. Analyze the relationship between the dependent and independent variables using graphs and tables, and relate these to the equation. *(MS-LS2-3)* |
| **6.SP.B.5** | Summarize numerical data sets in relation to their context. *(MS-LS2-2)* |

# MS-LS3 Heredity: Inheritance and Variation of Traits

## MS-LS3 Heredity: Inheritance and Variation of Traits

Students who demonstrate understanding can:

**MS-LS3-1. Develop and use a model to describe why structural changes to genes (mutations) located on chromosomes may affect proteins and may result in harmful, beneficial, or neutral effects to the structure and function of the organism.** [Clarification Statement: Emphasis is on conceptual understanding that changes in genetic material may result in making different proteins.] [Assessment Boundary: Assessment does not include specific changes at the molecular level, mechanisms for protein synthesis, or specific types of mutations.]

**MS-LS3-2. Develop and use a model to describe why asexual reproduction results in offspring with identical genetic information and sexual reproduction results in offspring with genetic variation.** [Clarification Statement: Emphasis is on using models such as Punnett squares, diagrams, and simulations to describe the cause and effect relationship of gene transmission from parent(s) to offspring and resulting genetic variation.]

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

### Science and Engineering Practices

**Developing and Using Models**

Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems.

- Develop and use a model to describe phenomena. (MS-LS3-1),(MS-LS3-2)

### Disciplinary Core Ideas

**LS1.B: Growth and Development of Organisms**

- Organisms reproduce, either sexually or asexually, and transfer their genetic information to their offspring. *(secondary to MS-LS3-2)*

**LS3.A: Inheritance of Traits**

- Genes are located in the chromosomes of cells, with each chromosome pair containing two variants of each of many distinct genes. Each distinct gene chiefly controls the production of specific proteins, which in turn affects the traits of the individual. Changes (mutations) to genes can result in changes to proteins, which can affect the structures and functions of the organism and thereby change traits. (MS-LS3-1)
- Variations of inherited traits between parent and offspring arise from genetic differences that result from the subset of chromosomes (and therefore genes) inherited. (MS-LS3-2)

**LS3.B: Variation of Traits**

- In sexually reproducing organisms, each parent contributes half of the genes acquired (at random) by the offspring. Individuals have two of each chromosome and hence two alleles of each gene, one acquired from each parent. These versions may be identical or may differ from each other. (MS-LS3-2)
- In addition to variations that arise from sexual reproduction, genetic information can be altered because of mutations. Though rare, mutations may result in changes to the structure and function of proteins. Some changes are beneficial, others harmful, and some neutral to the organism. (MS-LS3-1)

### Crosscutting Concepts

**Cause and Effect**

- Cause and effect relationships may be used to predict phenomena in natural systems. (MS-LS3-2)

**Structure and Function**

- Complex and microscopic structures and systems can be visualized, modeled, and used to describe how their function depends on the shapes, composition, and relationships among its parts, therefore complex natural structures/systems can be analyzed to determine how they function. (MS-LS3-1)

*Connections to other DCIs in this grade-band:* **MS.LS1.A** (MS-LS3-1); **MS.LS4.A** (MS-LS3-1)

*Articulation across grade-bands:* **3.LS3.A** (MS-LS3-1),(MS-LS3-2); **3.LS3.B** (MS-LS3-1),(MS-LS3-2); **HS.LS1.A** (MS-LS3-1); **HS.LS1.B** (MS-LS3-1),(MS-LS3-2); **HS.LS3.A** (MS-LS3-1),(MS-LS3-2); **HS.LS3-B** (MS-LS3-1),(MS-LS3-2)

*Common Core State Standards Connections:*

*ELA/Literacy –*

| | |
|---|---|
| **RST.6-8.1** | Cite specific textual evidence to support analysis of science and technical texts. *(MS-LS3-1),(MS-LS3-2)* |
| **RST.6-8.4** | Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 6-8 texts and topics. *(MS-LS3-1),(MS-LS3-2)* |
| **RST.6-8.7** | Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table). (MS-LS3-1),(MS-LS3-2) |
| **SL.8.5** | Include multimedia components and visual displays in presentations to clarify claims and findings and emphasize salient points. *(MS-LS3-1),(MS-LS3-2)* |

*Mathematics –*

| | |
|---|---|
| **MP.4** | Model with mathematics. *(MS-LS3-2)* |
| **6.SP.B.5** | Summarize numerical data sets in relation to their context. *(MS-LS3-2)* |

# MS-LS4 Biological Evolution: Unity and Diversity

## MS-LS4 Biological Evolution: Unity and Diversity

Students who demonstrate understanding can:

**MS-LS4-1.** **Analyze and interpret data for patterns in the fossil record that document the existence, diversity, extinction, and change of life forms throughout the history of life on Earth under the assumption that natural laws operate today as in the past.** [Clarification Statement: Emphasis is on finding patterns of changes in the level of complexity of anatomical structures in organisms and the chronological order of fossil appearance in the rock layers.] [Assessment Boundary: Assessment does not include the names of individual species or geological eras in the fossil record.]

**MS-LS4-2.** **Apply scientific ideas to construct an explanation for the anatomical similarities and differences among modern organisms and between modern and fossil organisms to infer evolutionary relationships.** [Clarification Statement: Emphasis is on explanations of the evolutionary relationships among organisms in terms of similarity or differences of the gross appearance of anatomical structures.]

**MS-LS4-3.** **Analyze displays of pictorial data to compare patterns of similarities in the embryological development across multiple species to identify relationships not evident in the fully formed anatomy.** [Clarification Statement: Emphasis is on inferring general patterns of relatedness among embryos of different organisms by comparing the macroscopic appearance of diagrams or pictures.] [Assessment Boundary: Assessment of comparisons is limited to gross appearance of anatomical structures in embryological development.]

**MS-LS4-4.** **Construct an explanation based on evidence that describes how genetic variations of traits in a population increase some individuals' probability of surviving and reproducing in a specific environment.** [Clarification Statement: Emphasis is on using simple probability statements and proportional reasoning to construct explanations.]

**MS-LS4-5.** **Gather and synthesize information about the technologies that have changed the way humans influence the inheritance of desired traits in organisms.** [Clarification Statement: Emphasis is on synthesizing information from reliable sources about the influence of humans on genetic outcomes in artificial selection (such as genetic modification, animal husbandry, gene therapy); and, on the impacts these technologies have on society as well as the technologies leading to these scientific discoveries.]

**MS-LS4-6.** **Use mathematical representations to support explanations of how natural selection may lead to increases and decreases of specific traits in populations over time.** [Clarification Statement: Emphasis is on using mathematical models, probability statements, and proportional reasoning to support explanations of trends in changes to populations over time.] [Assessment Boundary: Assessment does not include Hardy Weinberg calculations.]

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

### Science and Engineering Practices

**Analyzing and Interpreting Data**

Analyzing data in 6–8 builds on K–5 experiences and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis.

- Analyze displays of data to identify linear and nonlinear relationships. (MS-LS4-3)
- Analyze and interpret data to determine similarities and differences in findings. (MS-LS4-1)

**Using Mathematics and Computational Thinking**

Mathematical and computational thinking in 6–8 builds on K–5 experiences and progresses to identifying patterns in large data sets and using mathematical concepts to support explanations and arguments.

- Use mathematical representations to support scientific conclusions and design solutions. (MS-LS4-6)

**Constructing Explanations and Designing Solutions**

Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories.

- Apply scientific ideas to construct an explanation for real-world phenomena, examples, or events. (MS-LS4-2)
- Construct an explanation that includes qualitative or quantitative relationships between variables that describe phenomena. (MS-LS4-4)

**Obtaining, Evaluating, and Communicating Information**

Obtaining, evaluating, and communicating information in 6–8 builds on K–5 experiences and progresses to evaluating the merit and validity of ideas and methods.

- Gather, read, and synthesize information from multiple appropriate sources and assess the credibility, accuracy, and possible bias of each publication and methods used, and describe how they are supported or not supported by evidence. (MS-LS4-5)

---

***Connections to Nature of Science***

**Scientific Knowledge is Based on Empirical Evidence**

- Science knowledge is based upon logical and conceptual connections between evidence and explanations. (MS-LS4-1)

### Disciplinary Core Ideas

**LS4.A: Evidence of Common Ancestry and Diversity**

- The collection of fossils and their placement in chronological order (e.g., through the location of the sedimentary layers in which they are found or through radioactive dating) is known as the fossil record. It documents the existence, diversity, extinction, and change of many life forms throughout the history of life on Earth. (MS-LS4-1)
- Anatomical similarities and differences between various organisms living today and between them and organisms in the fossil record, enable the reconstruction of evolutionary history and the inference of lines of evolutionary descent. (MS-LS4-2)
- Comparison of the embryological development of different species also reveals similarities that show relationships not evident in the fully-formed anatomy. (MS-LS4-3)

**LS4.B: Natural Selection**

- Natural selection leads to the predominance of certain traits in a population, and the suppression of others. (MS-LS4-4)
- In *artificial* selection, humans have the capacity to influence certain characteristics of organisms by selective breeding. One can choose desired parental traits determined by genes, which are then passed on to offspring. (MS-LS4-5)

**LS4.C: Adaptation**

- Adaptation by natural selection acting over generations is one important process by which species change over time in response to changes in environmental conditions. Traits that support successful survival and reproduction in the new environment become more common; those that do not become less common. Thus, the distribution of traits in a population changes. (MS-LS4-6)

### Crosscutting Concepts

**Patterns**

- Patterns can be used to identify cause and effect relationships. (MS-LS4-2)
- Graphs, charts, and images can be used to identify patterns in data. (MS-LS4-1),(MS-LS4-3)

**Cause and Effect**

- Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability. (MS-LS4-4),(MS-LS4-5),(MS-LS4-6)

---

***Connections to Engineering, Technology, and Applications of Science***

**Interdependence of Science, Engineering, and Technology**

- Engineering advances have led to important discoveries in virtually every field of science, and scientific discoveries have led to the development of entire industries and engineered systems. (MS-LS4-5)

---

***Connections to Nature of Science***

**Scientific Knowledge Assumes an Order and Consistency in Natural Systems**

- Science assumes that objects and events in natural systems occur in consistent patterns that are understandable through measurement and observation. (MS-LS4-1),(MS-LS4-2)

**Science Addresses Questions About the Natural and Material World**

- Scientific knowledge can describe the consequences of actions but does not necessarily prescribe the decisions that society takes. (MS-LS4-5)

*Connections to other DCIs in this grade-band:* **MS.LS2.A** (MS-LS4-4),(MS-LS4-6); **MS.LS2.C** (MS-LS4-6); **MS.LS3.A** (MS-LS4-2),(MS-LS4-4); **MS.LS3.B** (MS-LS4-2),(MS-LS4-4),(MS-LS4-6); **MS.ESS1.C** (MS-LS4-1),(MS-LS4-2),(MS-LS4-6); **MS.ESS2.B** (MS-LS4-1)

# MS-LS4 Biological Evolution: Unity and Diversity

*Articulation across grade-bands:* **3.LS3.B** (MS-LS4-4); **3.LS4.A** (MS-LS4-1),(MS-LS4-2); **3. LS4.B** (MS-LS4-4); **3.LS4.C** (MS-LS4-6); **HS.LS2.A** (MS-LS4-4),(MS-LS4-6); **HS.LS2.C** (MS-LS4-6); **HS.LS3.B** (MS-LS4-4),(MS-LS4-5),(MS-LS4-6); **HS.LS4.A** (MS-LS4-1),(MS-LS4-2),(MS-LS4-3); **HS.LS4.B** (MS-LS4-4),(MS-LS4-6); **HS.LS4.C** (MS-LS4-4),(MS-LS4-5),(MS-LS4-6); **HS.ESS1.C** (MS-LS4-1),(MS-LS4-2)

*Common Core State Standards Connections:*

*ELA/Literacy –*

| | |
|---|---|
| **RST.6-8.1** | Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions *(MS-LS4-1),*(MS-LS4-2),*(MS-LS4-3),(MS-LS4-4),*(MS-LS4-5) |
| **RST.6-8.7** | Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table). (MS-LS4-1),(MS-LS4-3) |
| **RST.6-8.9** | Compare and contrast the information gained from experiments, simulations, video, or multimedia sources with that gained from reading a text on the same topic. *(MS-LS4-3),(MS-LS4-4)* |
| **WHST.6-8.2** | Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content. (MS-LS4-2),(MS-LS4-4) |
| **WHST.6-8.8** | Gather relevant information from multiple print and digital sources; assess the credibility of each source; and quote or paraphrase the data and conclusions of others while avoiding plagiarism and providing basic bibliographic information for sources. *(MS-LS4-5)* |
| **WHST.6-8.9** | Draw evidence from informational texts to support analysis, reflection, and research. (MS-LS4-2),(MS-LS4-4) |
| **SL.8.1** | Engage effectively in a range of collaborative discussions (one-on-one, in groups, teacher-led) with diverse partners on grade 6 topics, texts, and issues, building on others' ideas and expressing their own clearly. *(MS-LS4-2),(MS-LS4-4)* |
| **SL.8.4** | Present claims and findings, emphasizing salient points in a focused, coherent manner with relevant evidence, sound valid reasoning, and well-chosen details; use appropriate eye contact, adequate volume, and clear pronunciation. *(MS-LS4-2),(MS-LS4-4)* |

*Mathematics –*

| | |
|---|---|
| **MP.4** | Model with mathematics. (MS-LS4-6) |
| **6.RP.A.1** | Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities. *(MS-LS4-4),(MS-LS4-6)* |
| **6.SP.B.5** | Summarize numerical data sets in relation to their context. *(MS-LS4-4),(MS-LS4-6)* |
| **6.EE.B.6** | Use variables to represent numbers and write expressions when solving a real-world or mathematical problem; understand that a variable can represent an unknown number, or, depending on the purpose at hand, any number in a specified set. *(MS-LS4-1),(MS-LS4-2)* |
| **7.RP.A.2** | Recognize and represent proportional relationships between quantities. *(MS-LS4-4),(MS-LS4-6)* |

# MS-ESS1 Earth's Place in the Universe

## MS-ESS1 Earth's Place in the Universe

Students who demonstrate understanding can:

**MS-ESS1-1. Develop and use a model of the Earth-sun-moon system to describe the cyclic patterns of lunar phases, eclipses of the sun and moon, and seasons.** [Clarification Statement: Examples of models can be physical, graphical, or conceptual.]

**MS-ESS1-2. Develop and use a model to describe the role of gravity in the motions within galaxies and the solar system.** [Clarification Statement: Emphasis for the model is on gravity as the force that holds together the solar system and Milky Way galaxy and controls orbital motions within them. Examples of models can be physical (such as the analogy of distance along a football field or computer visualizations of elliptical orbits) or conceptual (such as mathematical proportions relative to the size of familiar objects such as students' school or state).] [Assessment Boundary: Assessment does not include Kepler's Laws of orbital motion or the apparent retrograde motion of the planets as viewed from Earth.]

**MS-ESS1-3. Analyze and interpret data to determine scale properties of objects in the solar system.** [Clarification Statement: Emphasis is on the analysis of data from Earth-based instruments, space-based telescopes, and spacecraft to determine similarities and differences among solar system objects. Examples of scale properties include the sizes of an object's layers (such as crust and atmosphere), surface features (such as volcanoes), and orbital radius. Examples of data include statistical information, drawings and photographs, and models.] [Assessment Boundary: Assessment does not include recalling facts about properties of the planets and other solar system bodies.]

**MS-ESS1-4. Construct a scientific explanation based on evidence from rock strata for how the geologic time scale is used to organize Earth's 4.6-billion-year-old history.** [Clarification Statement: Emphasis is on how analyses of rock formations and the fossils they contain are used to establish relative ages of major events in Earth's history. Examples of Earth's major events could range from being very recent (such as the last Ice Age or the earliest fossils of homo sapiens) to very old (such as the formation of Earth or the earliest evidence of life). Examples can include the formation of mountain chains and ocean basins, the evolution or extinction of particular living organisms, or significant volcanic eruptions.] [Assessment Boundary: Assessment does not include recalling the names of specific periods or epochs and events within them.]

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

### Science and Engineering Practices

**Developing and Using Models**

Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems.

- Develop and use a model to describe phenomena. (MS-ESS1-1),(MS-ESS1-2)

**Analyzing and Interpreting Data**

Analyzing data in 6–8 builds on K–5 experiences and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis.

- Analyze and interpret data to determine similarities and differences in findings. (MS-ESS1-3)

**Constructing Explanations and Designing Solutions**

Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories.

- Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. (MS-ESS1-4)

### Disciplinary Core Ideas

**ESS1.A: The Universe and Its Stars**

- Patterns of the apparent motion of the sun, the moon, and stars in the sky can be observed, described, predicted, and explained with models. (MS-ESS1-1)
- Earth and its solar system are part of the Milky Way galaxy, which is one of many galaxies in the universe. (MS-ESS1-2)

**ESS1.B: Earth and the Solar System**

- The solar system consists of the sun and a collection of objects, including planets, their moons, and asteroids that are held in orbit around the sun by its gravitational pull on them. (MS-ESS1-2),(MS-ESS1-3)
- This model of the solar system can explain eclipses of the sun and the moon. Earth's spin axis is fixed in direction over the short-term but tilted relative to its orbit around the sun. The seasons are a result of that tilt and are caused by the differential intensity of sunlight on different areas of Earth across the year. (MS-ESS1-1)
- The solar system appears to have formed from a disk of dust and gas, drawn together by gravity. (MS-ESS1-2)

**ESS1.C: The History of Planet Earth**

- The geologic time scale interpreted from rock strata provides a way to organize Earth's history. Analyses of rock strata and the fossil record provide only relative dates, not an absolute scale. (MS-ESS1-4)

### Crosscutting Concepts

**Patterns**

- Patterns can be used to identify cause-and-effect relationships. (MS-ESS1-1)

**Scale, Proportion, and Quantity**

- Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small. (MS-ESS1-3),(MS-ESS1-4)

**Systems and System Models**

- Models can be used to represent systems and their interactions. (MS-ESS1-2)

---

***Connections to Engineering, Technology, and Applications of Science***

**Interdependence of Science, Engineering, and Technology**

- Engineering advances have led to important discoveries in virtually every field of science and scientific discoveries have led to the development of entire industries and engineered systems. (MS-ESS1-3)

---

***Connections to Nature of Science***

**Scientific Knowledge Assumes an Order and Consistency in Natural Systems**

- Science assumes that objects and events in natural systems occur in consistent patterns that are understandable through measurement and observation. (MS-ESS1-1),(MS-ESS1-2)

*Connections to other DCIs in this grade-band:* **MS.PS2.A** (MS-ESS1-1),(MS-ESS1-2); **MS.PS2.B** (MS-ESS1-1),(MS-ESS1-2); **MS.LS4.A** (MS-ESS1-4); **MS.LS4.C** (MS-ESS1-4); **MS.ESS2.A** (MS-ESS1-3)

*Articulation of DCIs across grade-bands:* **3.PS2.A** (MS-ESS1-1),(MS-ESS1-2); **3.LS4.A** (MS-ESS1-4); **3.LS4.C** (MS-ESS1-4); **4.ESS1.C** (MS-ESS1-4); **5.PS2.B** (MS-ESS1-1),(MS-ESS1-2); **5.ESS1.A** (MS-ESS1-2); **5.ESS1.B** (MS-ESS1-1),(MS-ESS1-2),(5-ESS1-3); **HS.PS1.C** (MS-ESS1-4); **HS.PS2.A** (MS-ESS1-1),(MS-ESS1-2); **HS.PS2.B** (MS-ESS1-1),(MS-ESS1-2); **HS.LS4.A** (MS-ESS1-4); **HS.LS4.C** (MS-ESS1-4); **HS.ESS1.A** (MS-ESS1-2); **HS.ESS1.B** (MS-ESS1-1),(MS-ESS1-2),(MS-ESS1-3); **HS.ESS1.C** (MS-ESS1-4); **HS.ESS2.A** (MS-ESS1-3),(MS-ESS1-4)

*Common Core State Standards Connections:*

*ELA/Literacy –*

| | |
|---|---|
| **RST.6-8.1** | Cite specific textual evidence to support analysis of science and technical texts. (MS-ESS1-3),(MS-ESS1-4) |
| **RST.6-8.7** | Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table). (MS-ESS1-3) |
| **WHST.6-8.2** | Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content. (MS-ESS1-4) |
| **SL.8.5** | Include multimedia components and visual displays in presentations to clarify claims and findings and emphasize salient points. *(MS-ESS1-1),(MS-ESS1-2)* |

*Mathematics –*

| | |
|---|---|
| **MP.2** | Reason abstractly and quantitatively. (MS-ESS1-3) |
| **MP.4** | Model with mathematics. *(MS-ESS1-1),(MS-ESS1-2)* |
| **6.RP.A.1** | Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities. *(MS-ESS1-1),(MS-ESS1-2),*(MS-ESS1-3) |

# MS-ESS1 Earth's Place in the Universe

| | |
|---|---|
| **7.RP.A.2** | Recognize and represent proportional relationships between quantities. *(MS-ESS1-1),(MS-ESS1-2),*(MS-ESS1-3) |
| **6.EE.B.6** | Use variables to represent numbers and write expressions when solving a real-world or mathematical problem; understand that a variable can represent an unknown number, or, depending on the purpose at hand, any number in a specified set. *(MS-ESS1-2),(MS-ESS1-4)* |
| **7.EE.B.4** | Use variables to represent quantities in a real-world or mathematical problem, and construct simple equations and inequalities to solve problems by reasoning about the quantities. *(MS-ESS1-2),(MS-ESS1-4)* |

# MS-ESS2 Earth's Systems

## MS-ESS2 Earth's Systems

Students who demonstrate understanding can:

**MS-ESS2-1.** **Develop a model to describe the cycling of Earth's materials and the flow of energy that drives this process.** [Clarification Statement: Emphasis is on the processes of melting, crystallization, weathering, deformation, and sedimentation, which act together to form minerals and rocks through the cycling of Earth's materials.] [Assessment Boundary: Assessment does not include the identification and naming of minerals.]

**MS-ESS2-2.** **Construct an explanation based on evidence for how geoscience processes have changed Earth's surface at varying time and spatial scales.** [Clarification Statement: Emphasis is on how processes change Earth's surface at time and spatial scales that can be large (such as slow plate motions or the uplift of large mountain ranges) or small (such as rapid landslides or microscopic geochemical reactions), and how many geoscience processes (such as earthquakes, volcanoes, and meteor impacts) usually behave gradually but are punctuated by catastrophic events. Examples of geoscience processes include surface weathering and deposition by the movements of water, ice, and wind. Emphasis is on geoscience processes that shape local geographic features, where appropriate.]

**MS-ESS2-3.** **Analyze and interpret data on the distribution of fossils and rocks, continental shapes, and seafloor structures to provide evidence of the past plate motions.** [Clarification Statement: Examples of data include 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.]

**MS-ESS2-4.** **Develop a model to describe the cycling of water through Earth's systems driven by energy from the sun and the force of gravity.** [Clarification Statement: Emphasis is on the ways water changes its state as it moves through the multiple pathways of the hydrologic cycle. Examples of models can be conceptual or physical.] [Assessment Boundary: A quantitative understanding of the latent heats of vaporization and fusion is not assessed.]

**MS-ESS2-5.** **Collect data to provide evidence for how the motions and complex interactions of air masses results in changes in weather conditions.** [Clarification Statement: Emphasis is on how air masses flow from regions of high pressure to low pressure, causing weather (defined by temperature, pressure, humidity, precipitation, and wind) at a fixed location to change over time, and how sudden changes in weather can result when different air masses collide. Emphasis is on how weather can be predicted within probabilistic ranges. Examples of data can be provided to students (such as weather maps, diagrams, and visualizations) or obtained through laboratory experiments (such as with condensation).] [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.]

**MS-ESS2-6.** **Develop and use a model to describe how unequal heating and rotation of the Earth cause patterns of atmospheric and oceanic circulation that determine regional climates.** [Clarification Statement: Emphasis is on how patterns vary by latitude, altitude, and geographic land distribution. Emphasis of atmospheric circulation is on the sunlight-driven latitudinal banding, the Coriolis effect, and resulting prevailing winds; 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. Examples of models can be diagrams, maps and globes, or digital representations.] [Assessment Boundary: Assessment does not include the dynamics of the Coriolis effect.]

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

### Science and Engineering Practices

**Developing and Using Models**

Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems.

- Develop and use a model to describe phenomena. (MS-ESS2-1),(MS-ESS2-6)
- Develop a model to describe unobservable mechanisms. (MS-ESS2-4)

**Planning and Carrying Out Investigations**

Planning and carrying out investigations in 6-8 builds on K-5 experiences and progresses to include investigations that use multiple variables and provide evidence to support explanations or solutions.

- Collect data to produce data to serve as the basis for evidence to answer scientific questions or test design solutions under a range of conditions. (MS-ESS2-5)

**Analyzing and Interpreting Data**

Analyzing data in 6–8 builds on K–5 experiences and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis.

- Analyze and interpret data to provide evidence for phenomena. (MS-ESS2-3)

**Constructing Explanations and Designing Solutions**

Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories.

- Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe nature operate today as they did in the past and will continue to do so in the future. (MS-ESS2-2)

---

***Connections to Nature of Science***

**Scientific Knowledge is Open to Revision in Light of New Evidence**

### Disciplinary Core Ideas

**ESS1.C: The History of Planet Earth**

- Tectonic processes continually generate new ocean sea floor at ridges and destroy old sea floor at trenches. *(HS.ESS1.C GBE) (secondary to MS-ESS2-3)*

**ESS2.A: Earth's Materials and Systems**

- All Earth processes are the result of energy flowing and matter cycling within and among the planet's systems. This energy is derived from the sun and Earth's hot interior. The energy that flows and matter that cycles produce chemical and physical changes in Earth's materials and living organisms. (MS-ESS2-1)
- The planet's systems interact over scales that range from microscopic to global in size, and they operate over fractions of a second to billions of years. These interactions have shaped Earth's history and will determine its future. (MS-ESS2-2)

**ESS2.B: Plate Tectonics and Large-Scale System Interactions**

- Maps of ancient land and water patterns, based on investigations of rocks and fossils, make clear how Earth's plates have moved great distances, collided, and spread apart. (MS-ESS2-3)

**ESS2.C: The Roles of Water in Earth's Surface Processes**

- Water continually cycles among land, ocean, and atmosphere via transpiration, evaporation, condensation and crystallization, and precipitation, as well as downhill flows on land. (MS-ESS2-4)
- The complex patterns of the changes and the movement of water in the atmosphere, determined by winds, landforms, and ocean temperatures and currents, are major determinants of local weather patterns. (MS-ESS2-5)
- Global movements of water and its changes in form are propelled by sunlight and gravity. (MS-ESS2-4)
- Variations in density due to variations in temperature and salinity drive a global pattern of interconnected ocean currents. (MS-ESS2-6)
- Water's movements—both on the land and underground—cause weathering and erosion, which change the land's surface features and create underground formations. (MS-ESS2-2)

**ESS2.D: Weather and Climate**

- Weather and climate are influenced by interactions involving sunlight, the ocean, the atmosphere, ice, landforms, and living things. These interactions vary with latitude, altitude, and local and regional geography, all of which can affect oceanic and atmospheric flow patterns. (MS-ESS2-6)
- Because these patterns are so complex, weather can only be predicted probabilistically. (MS-ESS2-5)
- The ocean exerts a major influence on weather and climate by

### Crosscutting Concepts

**Patterns**

- Patterns in rates of change and other numerical relationships can provide information about natural systems. (MS-ESS2-3)

**Cause and Effect**

- Cause and effect relationships may be used to predict phenomena in natural or designed systems. (MS-ESS2-5)

**Scale Proportion and Quantity**

- Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small. (MS-ESS2-2)

**Systems and System Models**

- Models can be used to represent systems and their interactions—such as inputs, processes and outputs—and energy, matter, and information flows within systems. (MS-ESS2-6)

**Energy and Matter**

- Within a natural or designed system, the transfer of energy drives the motion and/or cycling of matter. (MS-ESS2-4)

**Stability and Change**

- Explanations of stability and change in natural or designed systems can be constructed by examining the changes over time and processes at different scales, including the atomic scale. (MS-ESS2-1)

# MS-ESS2 Earth's Systems

| | | |
|---|---|---|
| ▪ Science findings are frequently revised and/or reinterpreted based on new evidence. (MS-ESS2-3) | absorbing energy from the sun, releasing it over time, and globally redistributing it through ocean currents. (MS-ESS2-6) | |

*Connections to other DCIs in this grade-band:* **MS.PS1.A** (MS-ESS2-1),(MS-ESS2-4),(MS-ESS2-5); **MS.PS1.B** (MS-ESS2-1),(MS-ESS2-2); **MS.PS2.A** (MS-ESS2-5),(MS-ESS2-6); **MS.PS2.B** (MS-ESS2-4); **MS.PS3.A** (MS-ESS2-4),(MS-ESS2-5); **MS.PS3.B** (MS-ESS2-1),(MS-ESS2-5),(MS-ESS2-6); **MS.PS3.D** (MS-ESS2-4); **MS.PS4.B** (MS-ESS2-6); **MS.LS2.B** (MS-ESS2-1),(MS-ESS2-2); **MS.LS2.C** (MS-ESS2-1); **MS.LS4.A** (MS-ESS2-3); **MS.ESS1.B** (MS-ESS2-1); **MS.ESS3.C** (MS-ESS2-1)

*Articulation of DCIs across grade-bands:* **3.PS2.A** (MS-ESS2-4),(MS-ESS2-6); **3.LS4.A** (MS-ESS2-3); **3.ESS2.D** (MS-ESS2-5),(MS-ESS2-6); **3.ESS3.B** (MS-ESS2-3); **4.PS3.B** (MS-ESS2-1),(MS-ESS2-4); **4.ESS1.C** (MS-ESS2-2),(MS-ESS2-3); **4.ESS2.A** (MS-ESS2-1),(MS-ESS2-2); **4.ESS2.B** (MS-ESS2-3); **4.ESS2.E** (MS-ESS2-2); **4.ESS3.B** (MS-ESS2-3); **5.PS2.B** (MS-ESS2-4); **5.ESS2.A** (MS-ESS2-1),(MS-ESS2-2),(MS-ESS2-5),(MS-ESS2-6); **5.ESS2.C** (MS-ESS2-4); **HS.PS1.B** (MS-ESS2-1); **HS.PS2.B** (MS-ESS2-4),(MS-ESS2-6); **HS.PS3.B** (MS-ESS2-1),(MS-ESS2-4),(MS-ESS2-6); **HS.PS3.D** (MS-ESS2-2),(MS-ESS2-6); **HS.PS4.B** (MS-ESS2-4); **HS.LS1.C** (MS-ESS2-1); **HS.LS2.B** (MS-ESS2-1),(MS-ESS2-2); **HS.LS4.A** (MS-ESS2-3); **HS.LS4.C** (MS-ESS2-3); **HS.ESS1.B** (MS-ESS2-6); **HS.ESS1.C** (MS-ESS2-2),(MS-ESS2-3); **HS.ESS2.A** (MS-ESS2-1),(MS-ESS2-2),(MS-ESS2-3),(MS-ESS2-4),(MS-ESS2-6); **HS.ESS2.B** (MS-ESS2-2),(MS-ESS2-3); **HS.ESS2.C** (MS-ESS2-1),(MS-ESS2-2),(MS-ESS2-4),(MS-ESS2-5); **HS.ESS2.D** (MS-ESS2-2),(MS-ESS2-4),(MS-ESS2-5),(MS-ESS2-6); **HS.ESS2.E** (MS-ESS2-1),(MS-ESS2-2); **HS.ESS3.D** (MS-ESS2-2)

*Common Core State Standards Connections:*

*ELA/Literacy –*

| | |
|---|---|
| **RST.6-8.1** | Cite specific textual evidence to support analysis of science and technical texts. (MS-ESS2-2),*(MS-ESS2-3),*(MS-ESS2-5) |
| **RST.6-8.7** | Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table). (MS-ESS2-3) |
| **RST.6-8.9** | Compare and contrast the information gained from experiments, simulations, video, or multimedia sources with that gained from reading a text on the same topic. (MS-ESS2-3),(MS-ESS2-5) |
| **WHST.6-8.2** | Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content. (MS-ESS2-2) |
| **WHST.6-8.8** | Gather relevant information from multiple print and digital sources; assess the credibility of each source; and quote or paraphrase the data and conclusions of others while avoiding plagiarism and providing basic bibliographic information for sources. *(MS-ESS2-5)* |
| **SL.8.5** | Include multimedia components and visual displays in presentations to clarify claims and findings and emphasize salient points. *(MS-ESS2-1),(MS-ESS2-2),(MS-ESS2-6)* |

*Mathematics –*

| | |
|---|---|
| **MP.2** | Reason abstractly and quantitatively. (MS-ESS2-2),(MS-ESS2-3),(MS-ESS2-5) |
| **6.NS.C.5** | Understand that positive and negative numbers are used together to describe quantities having opposite directions or values (e.g., temperature above/below zero, elevation above/below sea level, credits/debits, positive/negative electric charge); use positive and negative numbers to represent quantities in real-world contexts, explaining the meaning of 0 in each situation. (MS-ESS2-5) |
| **6.EE.B.6** | Use variables to represent numbers and write expressions when solving a real-world or mathematical problem; understand that a variable can represent an unknown number, or, depending on the purpose at hand, any number in a specified set. *(MS-ESS2-2),(MS-ESS2-3)* |
| **7.EE.B.4** | Use variables to represent quantities in a real-world or mathematical problem, and construct simple equations and inequalities to solve problems by reasoning about the quantities. *(MS-ESS2-2),(MS-ESS2-3)* |

## MS-ESS3 Earth and Human Activity

Students who demonstrate understanding can:

**MS-ESS3-1.** **Construct a scientific explanation based on evidence for how the uneven distributions of Earth's mineral, energy, and groundwater resources are the result of past and current geoscience processes.** [Clarification Statement: Emphasis is on how these resources are limited and typically non-renewable, and how their distributions are significantly changing as a result of removal by humans. Examples of uneven distributions of resources as a result of past processes include but are not limited to 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).]

**MS-ESS3-2.** **Analyze and interpret data on natural hazards to forecast future catastrophic events and inform the development of technologies to mitigate their effects.** [Clarification Statement: Emphasis is on how some natural hazards, such as volcanic eruptions and severe weather, are preceded by phenomena that allow for reliable predictions, but others, such as earthquakes, occur suddenly and with no notice, and thus are not yet predictable. Examples of natural hazards can be taken from interior processes (such as earthquakes and volcanic eruptions), surface processes (such as mass wasting and tsunamis), or severe weather events (such as hurricanes, tornadoes, and floods). Examples of data can include the locations, magnitudes, and frequencies of the natural hazards. Examples of technologies can be global (such as satellite systems to monitor hurricanes or forest fires) or local (such as building basements in tornado-prone regions or reservoirs to mitigate droughts).]

**MS-ESS3-3.** **Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.*** [Clarification Statement: Examples of the design process include examining human environmental impacts, assessing the kinds of solutions that are feasible, and designing and evaluating solutions that could reduce that impact. Examples of human impacts can include water usage (such as the withdrawal of water from streams and aquifers or the construction of dams and levees), land usage (such as urban development, agriculture, or the removal of wetlands), and pollution (such as of the air, water, or land).]

**MS-ESS3-4.** **Construct an argument supported by evidence for how increases in human population and per-capita consumption of natural resources impact Earth's systems.** [Clarification Statement: Examples of evidence include grade-appropriate databases on human populations and the rates of consumption of food and natural resources (such as freshwater, mineral, and energy). Examples of impacts can include changes to the appearance, composition, and structure of Earth's systems as well as the rates at which they change. The consequences of increases in human populations and consumption of natural resources are described by science, but science does not make the decisions for the actions society takes.]

**MS-ESS3-5.** **Ask questions to clarify evidence of the factors that have caused the rise in global temperatures over the past century.** [Clarification Statement: Examples of factors include human activities (such as fossil fuel combustion, cement production, and agricultural activity) and natural processes (such as changes in incoming solar radiation or volcanic 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. Emphasis is on the major role that human activities play in causing the rise in global temperatures.]

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

### Science and Engineering Practices

**Asking Questions and Defining Problems**

Asking questions and defining problems in grades 6–8 builds on grades K–5 experiences and progresses to specifying relationships between variables, and clarifying arguments and models.

- Ask questions to identify and clarify evidence of an argument. (MS-ESS3-5)

**Analyzing and Interpreting Data**

Analyzing data in 6–8 builds on K–5 and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis.

- Analyze and interpret data to determine similarities and differences in findings. (MS-ESS3-2)

**Constructing Explanations and Designing Solutions**

Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories.

- Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. (MS-ESS3-1)
- Apply scientific principles to design an object, tool, process or system. (MS-ESS3-3)

**Engaging in Argument from Evidence**

Engaging in argument from evidence in 6–8 builds on K–5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed world(s).

- Construct an oral and written argument supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem. (MS-ESS3-4)

### Disciplinary Core Ideas

**ESS3.A: Natural Resources**

- Humans depend on Earth's land, ocean, atmosphere, and biosphere for many different resources. Minerals, fresh water, and biosphere resources are limited, and many are not renewable or replaceable over human lifetimes. These resources are distributed unevenly around the planet as a result of past geologic processes. (MS-ESS3-1)

**ESS3.B: Natural Hazards**

- Mapping the history of natural hazards in a region, combined with an understanding of related geologic forces can help forecast the locations and likelihoods of future events. (MS-ESS3-2)

**ESS3.C: Human Impacts on Earth Systems**

- Human activities have significantly altered the biosphere, sometimes damaging or destroying natural habitats and causing the extinction of other species. But changes to Earth's environments can have different impacts (negative and positive) for different living things. (MS-ESS3-3)
- Typically as human populations and per-capita consumption of natural resources increase, so do the negative impacts on Earth unless the activities and technologies involved are engineered otherwise. (MS-ESS3-3),(MS-ESS3-4)

**ESS3.D: Global Climate Change**

- Human activities, such as the release of greenhouse gases from burning fossil fuels, are major factors in the current rise in Earth's mean surface temperature (global warming). Reducing the level of climate change and reducing human vulnerability to whatever climate changes do occur depend on the understanding of climate science, engineering capabilities, and other kinds of knowledge, such as understanding of human behavior and on applying that knowledge wisely in decisions and activities. (MS-ESS3-5)

### Crosscutting Concepts

**Patterns**

- Graphs, charts, and images can be used to identify patterns in data. (MS-ESS3-2)

**Cause and Effect**

- Relationships can be classified as causal or correlational, and correlation does not necessarily imply causation. (MS-ESS3-3)
- Cause and effect relationships may be used to predict phenomena in natural or designed systems. (MS-ESS3-1),(MS-ESS3-4)

**Stability and Change**

- Stability might be disturbed either by sudden events or gradual changes that accumulate over time. (MS-ESS3-5)

---

***Connections to Engineering, Technology, and Applications of Science***

**Influence of Science, Engineering, and Technology on Society and the Natural World**

- All human activity draws on natural resources and has both short and long-term consequences, positive as well as negative, for the health of people and the natural environment. (MS-ESS3-1),(MS-ESS3-4)
- The uses of technologies and any limitations on their use are driven by individual or societal needs, desires, and values; by the findings of scientific research; and by differences in such factors as climate, natural resources, and economic conditions. Thus technology use varies from region to region and over time. (MS-ESS3-2),(MS-ESS3-3)

---

***Connections to Nature of Science***

**Science Addresses Questions About the Natural and Material World**

- Scientific knowledge can describe the consequences of actions but does not necessarily prescribe the decisions that society takes. (MS-ESS3-4)

*Connections to other DCIs in this grade-band:* **MS.PS1.A** (MS-ESS3-1); **MS.PS1.B** (MS-ESS3-1); **MS.PS3.A** (MS-ESS3-5); **MS.PS3.C** (MS-ESS3-2); **MS.LS2.A** (MS-ESS3-3),(MS-ESS3-4); **MS.LS2.C** (MS-ESS3-3),(MS-ESS3-4); **MS.LS4.D** (MS-ESS3-3),(MS-ESS3-4); **MS.ESS2.D** (MS-ESS3-1)

*Articulation of DCIs across grade-bands:* **3.LS2.C** (MS-ESS3-3),(MS-ESS3-4); **3.LS4.D** (MS-ESS3-3),(MS-ESS3-4); **3.ESS3.B** (MS-ESS3-2); **4.PS3.D** (MS-ESS3-1); **4.ESS3.A** (MS-ESS3-1); **4.ESS3.B** (MS-ESS3-2); **5.ESS3.C** (MS-ESS3-3),(MS-ESS3-4); **HS.PS3.B** (MS-ESS3-1),(MS-ESS3-5); **HS.PS4.B** (MS-ESS3-5); **HS.LS1.C** (MS-ESS3-1); **HS.LS2.A** (MS-ESS3-4); **HS.LS2.C**

# MS-ESS3 Earth and Human Activity

(MS-ESS3-3),(MS-ESS3-4); **HS.LS4.C** (MS-ESS3-3),(MS-ESS3-4); **HS.LS4.D** (MS-ESS3-3),(MS-ESS3-4); **HS.ESS2.A** (MS-ESS3-1),(MS-ESS3-5); **HS.ESS2.B** (MS-ESS3-1),(MS-ESS3-2); **HS.ESS2.C** (MS-ESS3-1),(MS-ESS3-3); **HS.ESS2.D** (MS-ESS3-2),(MS-ESS3-3),(MS-ESS3-5); **HS.ESS2.E** (MS-ESS3-3),(MS-ESS3-4); **HS.ESS3.A** (MS-ESS3-1),(MS-ESS3-4); **HS.ESS3.B** (MS-ESS3-2); **HS.ESS3.C** (MS-ESS3-3),(MS-ESS3-4),(MS-ESS3-5); **HS.ESS3.D** (MS-ESS3-2);(MS-ESS3-3),(MS-ESS3-5)

*Common Core State Standards Connections:*

*ELA/Literacy –*

| | |
|---|---|
| **RST.6-8.1** | Cite specific textual evidence to support analysis of science and technical texts. (MS-ESS3-1),*(MS-ESS3-2),*(MS-ESS3-4),(MS-ESS3-5) |
| **RST.6-8.7** | Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table). (MS-ESS3-2) |
| **WHST.6-8.1** | Write arguments focused on discipline content. (MS-ESS3-4) |
| **WHST.6-8.2** | Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content. (MS-ESS3-1) |
| **WHST.6-8.7** | Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration. (MS-ESS3-3) |
| **WHST.6-8.8** | Gather relevant information from multiple print and digital sources; assess the credibility of each source; and quote or paraphrase the data and conclusions of others while avoiding plagiarism and providing basic bibliographic information for sources. (MS-ESS3-3) |
| **WHST.6-8.9** | Draw evidence from informational texts to support analysis, reflection, and research. (MS-ESS3-1),(MS-ESS3-4) |

*Mathematics –*

| | |
|---|---|
| **MP.2** | Reason abstractly and quantitatively. (MS-ESS3-2),*(MS-ESS3-5)* |
| **6.RP.A.1** | Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities. *(MS-ESS3-3),(MS-ESS3-4)* |
| **7.RP.A.2** | Recognize and represent proportional relationships between quantities. *(MS-ESS3-3),(MS-ESS3-4)* |
| **6.EE.B.6** | Use variables to represent numbers and write expressions when solving a real-world or mathematical problem; understand that a variable can represent an unknown number, or, depending on the purpose at hand, any number in a specified set. *(MS-ESS3-1),(MS-ESS3-2),(MS-ESS3-3),(MS-ESS3-4),(MS-ESS3-5)* |
| **7.EE.B.4** | Use variables to represent quantities in a real-world or mathematical problem, and construct simple equations and inequalities to solve problems by reasoning about the quantities. *(MS-ESS3-1),(MS-ESS3-2),(MS-ESS3-3),(MS-ESS3-4),(MS-ESS3-5)* |

# MS-ETS1 Engineering Design

## MS-ETS1 Engineering Design

Students who demonstrate understanding can:

**MS-ETS1-1.** **Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.**

**MS-ETS1-2.** **Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.**

**MS-ETS1-3.** **Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.**

**MS-ETS1-4.** **Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.**

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

### Science and Engineering Practices

**Asking Questions and Defining Problems**

Asking questions and defining problems in grades 6–8 builds on grades K–5 experiences and progresses to specifying relationships between variables, and clarifying arguments and models.

- Define a design problem that can be solved through the development of an object, tool, process or system and includes multiple criteria and constraints, including scientific knowledge that may limit possible solutions. (MS-ETS1-1)

**Developing and Using Models**

Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems.

- Develop a model to generate data to test ideas about designed systems, including those representing inputs and outputs. (MS-ETS1-4)

**Analyzing and Interpreting Data**

Analyzing data in 6–8 builds on K–5 experiences and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis.

- Analyze and interpret data to determine similarities and differences in findings. (MS-ETS1-3)

**Engaging in Argument from Evidence**

Engaging in argument from evidence in 6–8 builds on K–5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed world.

- Evaluate competing design solutions based on jointly developed and agreed-upon design criteria. (MS-ETS1-2)

### Disciplinary Core Ideas

**ETS1.A: Defining and Delimiting Engineering Problems**

- The more precisely a design task's criteria and constraints can be defined, the more likely it is that the designed solution will be successful. Specification of constraints includes consideration of scientific principles and other relevant knowledge that are likely to limit possible solutions. (MS-ETS1-1)

**ETS1.B: Developing Possible Solutions**

- A solution needs to be tested, and then modified on the basis of the test results, in order to improve it. (MS-ETS1-4)
- There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem. (MS-ETS1-2), (MS-ETS1-3)
- Sometimes parts of different solutions can be combined to create a solution that is better than any of its predecessors. (MS-ETS1-3)
- Models of all kinds are important for testing solutions. (MS-ETS1-4)

**ETS1.C: Optimizing the Design Solution**

- Although one design may not perform the best across all tests, identifying the characteristics of the design that performed the best in each test can provide useful information for the redesign process—that is, some of those characteristics may be incorporated into the new design. (MS-ETS1-3)
- The iterative process of testing the most promising solutions and modifying what is proposed on the basis of the test results leads to greater refinement and ultimately to an optimal solution. (MS-ETS1-4)

### Crosscutting Concepts

**Influence of Science, Engineering, and Technology on Society and the Natural World**

- All human activity draws on natural resources and has both short and long-term consequences, positive as well as negative, for the health of people and the natural environment. (MS-ETS1-1)
- The uses of technologies and limitations on their use are driven by individual or societal needs, desires, and values; by the findings of scientific research; and by differences in such factors as climate, natural resources, and economic conditions. (MS-ETS1-1)

*Connections to MS-ETS1.A: Defining and Delimiting Engineering Problems include:*
**Physical Science:** MS-PS3-3

*Connections to MS-ETS1.B: Developing Possible Solutions Problems include:*
**Physical Science:** MS-PS1-6, MS-PS3-3, **Life Science:** MS-LS2-5

*Connections to MS-ETS1.C: Optimizing the Design Solution include:*
**Physical Science:** MS-PS1-6

*Articulation of DCIs across grade-bands:* **3-5.ETS1.A** (MS-ETS1-1),(MS-ETS1-2),(MS-ETS1-3); **3-5.ETS1.B** (MS-ETS1-2),(MS-ETS1-3),(MS-ETS1-4); **3-5.ETS1.C** (MS-ETS1-1),(MS-ETS1-2),(MS-ETS1-3),(MS-ETS1-4); **HS.ETS1.A** (MS-ETS1-1),(MS-ETS1-2); **HS.ETS1.B** (MS-ETS1-1),(MS-ETS1-2),(MS-ETS1-3),(MS-ETS1-4); **HS.ETS1.C** (MS-ETS1-3),(MS-ETS1-4)

*Common Core State Standards Connections:*

*ELA/Literacy –*

| | |
|---|---|
| **RST.6-8.1** | Cite specific textual evidence to support analysis of science and technical texts. (MS-ETS1-1),*(MS-ETS1-2),(MS-ETS1-3)* |
| **RST.6-8.7** | Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table). (*MS-ETS1-3)* |
| **RST.6-8.9** | Compare and contrast the information gained from experiments, simulations, video, or multimedia sources with that gained from reading a text on the same topic. (MS-ETS1-2),(MS-ETS1-3) |
| **WHST.6-8.7** | Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration. (MS-ETS1-2) |
| **WHST.6-8.8** | Gather relevant information from multiple print and digital sources; assess the credibility of each source; and quote or paraphrase the data and conclusions of others while avoiding plagiarism and providing basic bibliographic information for sources. (MS-ETS1-1) |
| **WHST.6-8.9** | Draw evidence from informational texts to support analysis, reflection, and research. *(MS-ETS1-2)* |
| **SL.8.5** | Include multimedia components and visual displays in presentations to clarify claims and findings and emphasize salient points. *(MS-ETS1-4)* |

*Mathematics –*

| | |
|---|---|
| **MP.2** | Reason abstractly and quantitatively. *(MS-ETS1-1),(MS-ETS1-2),(MS-ETS1-3),(MS-ETS1-4)* |
| **7.EE.3** | Solve multi-step real-life and mathematical problems posed with positive and negative rational numbers in any form (whole numbers, fractions, and decimals), using tools strategically. Apply properties of operations to calculate with numbers in any form; convert between forms as appropriate; and assess the reasonableness of answers using mental computation and estimation strategies. *(MS-ETS1-1),(MS-ETS1-2),(MS-ETS1-3)* |
| **7.SP** | Develop a probability model and use it to find probabilities of events. Compare probabilities from a model to observed frequencies; if the agreement is not good, explain possible sources of the discrepancy. *(MS-ETS1-4)* |

# Sixth Grade Health Standards

## Injury Prevention and Safety

***Standard 1: Essential Concepts***

1.1.S Explain methods to reduce conflict, harassment, and violence.
1.2.S Describe basic first aid and emergency procedures, including those for accidental loss of or injuries to teeth.
1.3.S Describe the risks of gang involvement.
1.4.S Examine disaster preparedness plans for the home and school.
1.5.S Examine the risks of possessing a weapon at home, at school, and in the community.
1.6.S Examine safety procedures when using public transportation and traveling in vehicles.
1.7.S Discuss safety hazards related to Internet usage.
1.8.S Describe hazards related to sun, water, and ice.
1.9.S Describe how the presence of weapons increases the risk of serious violent injuries.

***Standard 2: Analyzing Influences***

2.1.S Analyze the role of self and others in causing or preventing injuries.
2.2.S Analyze influences on both safe and violent behaviors.
2.3.S Analyze personal behaviors that may lead to injuries or cause harm.

***Standard 3: Accessing Valid Information***

3.1.S Identify rules and laws intended to prevent injuries.
3.2.S Demonstrate the ability to ask a trusted adult for help when feeling personally threatened or unsafe, including while using the Internet.

***Standard 4: Interpersonal Communication***

4.1.S Practice effective communication skills to prevent and avoid risky situations.
4.2.S Explain the importance of immediately reporting a weapon that is found or is in the possession of peers.
4.3.S Demonstrate escape strategies for situations in which weapons or other dangerous objects are present.
4.4.S Practice communication and refusal skills to avoid gang involvement.

***Standard 5: Decision Making***

5.1.S Use a decision-making process to determine a safe course of action in risky situations.
5.2.S Use a decision-making process to determine appropriate strategies for responding to bullying and harassment.

***Standard 6: Goal Setting***

6.1.S Develop a personal plan to remain safe and injury-free.

***Standard 7: Practicing Health-Enhancing Behaviors***

7.1.S Practice ways to resolve conflicts nonviolently.
7.2.S Practice safe use of technology.
7.3.S Practice positive alternatives to gang involvement.
7.4.S Practice basic first aid and emergency procedures.

***Standard 8: Health Promotion***

8.1.S Support injury prevention at school, at home, and in the community.
8.2.S Promote a bully-free school and community environment.
8.3.S Encourage others to practice safe behaviors, including the proper use of safety belts when riding in cars, wearing helmets when riding bicycles, and wearing mouth guards when participating in athletic activities.

## Alcohol, Tobacco, and Other Drugs

***Standard 1: Essential Concepts***

1.1.A Explain short- and long-term effects of alcohol, tobacco, inhalant, and other drug use, including social, legal, and economic implications.
1.2.A Identify positive alternatives to alcohol, tobacco, and other drug use.
1.3.A Differentiate between the use and misuse of prescription and nonprescription medicines.
1.4.A Identify the benefits of a tobacco-free environment.
1.5.A Explain the dangers of secondhand smoke.
1.6.A Explain the stages of drug dependence and addiction and the effects of drugs on the adolescent brain.
1.7.A Identify the effects of alcohol, tobacco, and other drug use on physical activity, including athletic performance.

***Standard 2: Analyzing Influences***

2.1.A Describe internal influences that affect the use of alcohol, tobacco, and other drugs.
2.2.A Analyze the influence of marketing and advertising techniques, including the use of role models and how they affect use of alcohol, tobacco, and other drugs.
2.3.A Analyze how impaired judgment and other effects of using alcohol or marijuana impact personal safety, relationships with friends and families, school success, and attainment of present and future goals.
2.4.A Explain how culture and media influence the use of alcohol and other drugs.

***Standard 3: Accessing Valid Information***

3.1.A Identify sources of valid information regarding alcohol, tobacco, and other drug use and abuse.

***Standard 4: Interpersonal Communication***

4.1.A Use effective verbal communication skills to avoid situations where alcohol, tobacco, and other drugs are being used.

4.2.A Demonstrate effective verbal and nonverbal refusal skills to resist the pressure to use alcohol, tobacco, and other drugs.

***Standard 5: Decision Making***

5.1.A Analyze how decisions to use alcohol, tobacco, and other drugs will affect relationships with friends and family.

5.2.A Analyze the kinds of situations involving alcohol, tobacco, and other drugs for which help from an adult should be requested.

5.3.A Analyze the legal, emotional, social, and health consequences of using alcohol and other drugs.

***Standard 6: Goal Setting***

6.1.A Develop personal goals to remain drug-free.

***Standard 7: Practicing Health-Enhancing Behaviors***

7.1.A Practice positive alternatives to using alcohol, tobacco, and other drugs.

***Standard 8: Health Promotion***

8.1.A Practice effective persuasion skills for encouraging others not to use alcohol, tobacco, and other drugs.

## Mental, Emotional, and Social Health

***Standard 1: Essential Concepts***

1.1.M Describe the signs, causes, and health effects of stress, loss, and depression.

1.2.M Summarize feelings and emotions associated with loss and grief.

1.3.M Discuss how emotions change during adolescence.

1.4.M Describe the importance of being aware of one's emotions.

1.5.M Describe the importance of being empathetic to individual differences, including people with disabilities and chronic diseases.

1.6.M Explain why getting help for mental, emotional, and social health problems is appropriate and necessary.

1.7.M Describe the importance of setting personal boundaries for privacy, safety, and expressions of emotions and opinions.

1.8.M Describe the similarities between types of violent behaviors (e.g., bullying, hazing, fighting, and verbal abuse).

1.9.M Discuss the harmful effects of violent behaviors.

***Standard 2: Analyzing Influences***

2.1.M Analyze the external and internal influences on mental, emotional, and social health.

***Standard 3: Accessing Valid Information***

3.1.M Identify sources of valid information and services for getting help with mental, emotional, and social health problems.

3.2.M Discuss the importance of getting help from a trusted adult when it is needed.

***Standard 4: Interpersonal Communication***

4.1.M Practice asking for help with mental, emotional, or social health problems from trusted adults.

4.2.M Describe how prejudice, discrimination, and bias can lead to violence.

4.3.M Demonstrate ways to communicate respect for diversity.

4.4.M Demonstrate the ability to use steps of conflict resolution.

***Standard 5: Decision Making***

5.1.M Apply a decision-making process to enhance health.

5.2.M Describe situations for which someone should seek help with stress, loss, and depression.

5.3.M Compare and contrast being angry and angry behavior, and discuss the consequences.

***Standard 6: Goal Setting***

6.1.M Make a plan to prevent and manage stress.

6.2.M Describe how personal goals can be affected if violence is used to solve problems.

6.3.M Make a personal commitment to avoid persons, places, or activities that encourage violence or delinquency.

***Standard 7: Practicing Health-Enhancing Behaviors***

7.1.M Carry out personal and social responsibilities appropriately.

7.2.M Practice strategies to manage stress.

7.3.M Practice appropriate ways to respect and include others who are different from oneself.

7.4.M Demonstrate how to use self-control when angry.

***Standard 8: Health Promotion***

8.1.M Encourage a school environment that is respectful of individual differences.

8.2.M Object appropriately to teasing or bullying of peers that is based on personal characteristics and perceived sexual orientation.

# Sixth Grade Physical Education Standards

## STANDARD 1

***Students demonstrate the motor skills and movement patterns needed to perform a variety of physical activities.***

**Manipulative Skills**

1.1 Volley an object repeatedly with a partner, using the forearm pass.
1.2 Strike a ball continuously against a wall and with a partner, using a paddle for the forehand stroke and the backhand stroke.
1.3 Strike an object consistently, using a body part, so that the object travels in the intended direction at the desired height.
1.4 Strike an object consistently, using an implement, so that the object travels in the intended direction at the desired height.
1.5 Dribble and pass a ball to a partner while being guarded.
1.6 Throw an object accurately and with applied force, using the underhand, overhand, and sidearm movement (throw) patterns.

**Rhythmic Skills**

1.7 Perform folk and line dances.
1.8 Develop, refine, and demonstrate routines to music.

**Combinations of Movement Patterns and Skills**

1.9 Combine relationships, levels, speed, direction, and pathways in complex individual and group physical activities.
1.10 Combine motor skills to play a lead-up or modified game.
1.11 Design and perform smooth, flowing sequences of stunts, tumbling, and rhythmic patterns that combine traveling, rolling, balancing, and transferring weight.

## STANDARD 2

***Students demonstrate knowledge of movement concepts, principles, and strategies that apply to the learning and performance of physical activities.***

**Movement Concepts**

2.1 Explain how to increase force based on the principles of biomechanics.
2.2 Explain how impact force is reduced by increasing the duration of impact.
2.3 Analyze and correct errors in movement patterns.
2.4 Provide feedback to a partner to assist in developing and improving movement skills.
2.5 Identify practices and procedures necessary for safe participation in physical activities.

**Manipulative Skills**

2.6 Explain the role of the legs, shoulders, and forearm in the forearm pass.
2.7 Identify the time necessary to prepare for and begin a forehand stroke and a backhand stroke.
2.8 Illustrate how the intended direction of an object is affected by the angle of the implement or body part at the time of contact.
2.9 Identify opportunities to pass or dribble while being guarded.

**Rhythmic Skills**

2.10 Identify steps and rhythm patterns for folk and line dances.
2.11 Explain how movement qualities contribute to the aesthetic dimension of physical activity.

**Combination of Movement Patterns and Skills**

2.12 Develop a cooperative movement game that uses locomotor skills, object manipulation, and an offensive strategy and teach the game to another person.

## STANDARD 3

***Students assess and maintain a level of physical fitness to improve health and performance.***

3.1 Assess the components of health-related physical fitness (muscle strength, muscle endurance, flexibility, aerobic capacity, and body composition) by using a scientifically based health-related fitness assessment.
3.2 Compare individual physical fitness results with research-based standards for good health.
3.3 Develop individual goals for each of the components of health-related physical fitness (muscle strength, muscle endurance, flexibility, aerobic capacity, and body composition).
3.4 Participate in moderate to vigorous physical activity a minimum of four days each week.
3.5 Measure and evaluate changes in health-related physical fitness based on physical activity patterns.
3.6 Monitor the intensity of one's heart rate during physical activity.

## STANDARD 4

***Students demonstrate knowledge of physical fitness concepts, principles, and strategies to improve health and performance.***

4.1 Distinguish between effective and ineffective warm-up and cool-down techniques.
4.2 Develop a one-day personal physical fitness plan specifying the intensity, time, and types of physical activities for each component of health-related physical fitness.
4.3 Identify contraindicated exercises and their adverse effects on the body.
4.4 Classify physical activities as aerobic or anaerobic.
4.5 Explain methods of monitoring heart rate intensity.
4.6 List the long-term benefits of participation in regular physical activity.
4.7 Compile and analyze a log noting the food intake/calories consumed and energy expended through physical activity.

## STANDARD 5

***Students demonstrate and utilize knowledge of psychological and sociological concepts, principles, and strategies that apply to the learning and performance of physical activity.***

**Self-Responsibility**

5.1 Participate productively in group physical activities.
5.2 Evaluate individual responsibility in group efforts.

**Social Interaction**

5.3 Identify and define the role of each participant in a cooperative physical activity.

**Group Dynamics**

5.4 Identify and agree on a common goal when participating in a cooperative physical activity.
5.5 Analyze possible solutions to a movement problem in a cooperative physical activity and come to a consensus on the best solution.

# Sixth Grade Visual And Performing Arts Standards

## DANCE

### 1.0 ARTISTIC PERCEPTION

Development of Motor Skills and Technical Expertise

1.1 Demonstrate focus, physical control, coordination, and accurate reproduction in performing locomotor and axial movement.

1.2 Incorporate a variety of force/energy qualities into executing a full range of movements.

Comprehension and Analysis of Dance Elements

1.3 Identify and use force/energy variations when executing gesture and locomotor and axial movements.

1.4 Use the principles of contrast, unity, and variety in phrasing in dance studies and dances.

Development of Dance Vocabulary

1.5 Describe and analyze movements observed and performed, using appropriate dance vocabulary.

### 2.0 CREATIVE EXPRESSION

Creation/Invention of Dance Movement

2.1 Invent multiple possibilities to solve a given movement problem and develop the material into a short study.

2.2 Compare and demonstrate the difference between imitating movement and creating original material.

Application of Choreographic Principles and Processes to Creating Dance

2.3 Describe and incorporate dance forms in dance studies.

2.4 Demonstrate the ability to coordinate movement with different musical rhythms and styles (e.g., ABA form, canon).

2.5 Use the elements of dance to create short studies that demonstrate the development of ideas and thematic material.

Communication of Meaning in Dance Through Dance Performance

2.6 Demonstrate an awareness of the body as an instrument of expression when rehearsing and performing.

2.7 Revise, memorize, and rehearse dance studies for the purpose of performing for others.

Development of Partner and Group Skills

2.8 Demonstrate an ability to cooperate and collaborate with a wide range of partners and groups (e.g., imitating, leading/following, mirroring, calling/responding, echoing, sequence building).

### 3.0 HISTORICAL AND CULTURAL CONTEXT

Development of Dance

3.1 Compare and contrast features of dances already performed from different countries.

History and Function of Dance

3.2 Explain the importance and function of dance in students' lives.

Diversity of Dance

3.3 Explain the various ways people have experienced dance in their daily lives (e.g., Roman entertainments, Asian religious ceremonies, baby naming in Ghana, Latin American celebrations).

### 4.0 AESTHETIC VALUING

Description, Analysis, and Criticism of Dance

4.1 Apply knowledge of the elements of dance and the craft of choreography to critiquing (spatial design, variety, contrast, clear structure).

4.2 Propose ways to revise choreography according to established assessment criteria.

Meaning and Impact of Dance

4.3 Discuss the experience of performing personal work for others.

4.4 Distinguish the differences between viewing live and recorded dance performances.

### 5.0 CONNECTIONS, RELATIONSHIPS, APPLICATIONS

Connections and Applications Across Disciplines

5.1 Describe how other arts disciplines are integrated into dance performances (e.g., music, lighting, set design).

5.2 Describe the responsibilities a dancer has in maintaining health-related habits (e.g., balanced nutrition, regular exercise, adequate sleep).

Development of Life Skills and Career Competencies

5.3 Identify careers in dance and dance-related fields (e.g., teacher, therapist, videographer, dance critic, choreographer, notator).

## MUSIC

### 1.0 ARTISTIC PERCEPTION

Read and Notate Music

1.1 Read, write, and perform intervals and triads.

1.2 Read, write, and perform rhythmic and melodic notation, using standard symbols for pitch, meter, rhythm, dynamics, and tempo in duple and triple meters.

1.3 Transcribe simple aural examples into rhythmic notation.

1.4 Sight-read simple melodies in the treble clef or bass clef.

Listen to, Analyze, and Describe Music

1.5 Analyze and compare the use of musical elements representing various genres and cultures, emphasizing meter and rhythm.

1.6 Describe larger music forms (sonata-allegro form, concerto, theme and variations).

### 2.0 CREATIVE EXPRESSION

Music Apply Vocal and Instrumental Skills

2.1 Sing a repertoire of vocal literature representing various genres, styles, and cultures with expression, technical accuracy, good posture, tone quality, and vowel shape—written and memorized, by oneself and in ensembles (level of difficulty: 1 on a scale of 1–6).

2.2 Sing music written in two parts.

2.3 Perform on an instrument a repertoire of instrumental literature representing various genres, styles, and cultures with expression, technical accuracy, tone quality, and articulation, by oneself and in ensembles (level of difficulty: 1 on a scale of 1–6).

Compose, Arrange, and Improvise

2.4 Compose short pieces in duple and triple meters.

2.5 Arrange simple pieces for voices or instruments, using traditional sources of sound.

2.6 Improvise simple melodies.

### 3.0 HISTORICAL AND CULTURAL CONTEXT

Role of Music

3.1 Compare music from two or more cultures of the world as to the functions the music serves and the roles of musicians.

3.2 Listen to and describe the role of music in ancient civilizations (e.g., Chinese, Egyptian, Greek, Indian, Roman).

Diversity of Music

3.3 Describe distinguishing characteristics of representative musical genres and styles from two or more cultures.

3.4 Listen to, describe, and perform music of various styles from a variety of cultures.

3.5 Classify by style and genre a number of exemplary musical works and explain the characteristics that make each work exemplary.

### 4.0 AESTHETIC VALUING

Analyze and Critically Assess

4.1 Develop criteria for evaluating the quality and effectiveness of musical performances and compositions, including arrangements and improvisations, and apply the criteria in personal listening and performing.

Derive Meaning

4.2 Explain how various aesthetic qualities convey images, feeling, or emotion.

4.3 Identify aesthetic qualities in a specific musical work.

### 5.0 CONNECTIONS, RELATIONSHIPS, APPLICATIONS

Connections and Applications

5.1 Describe how knowledge of music connects to learning in other subject areas.

Careers and Career-Related Skills

5.2 Identify career pathways in music.

## THEATRE

### 1.0 ARTISTIC PERCEPTION

Development of the Vocabulary of Theatre

1.1 Use the vocabulary of theatre, such as *action/reaction, vocal projection, subtext, theme, mood, design, production values,* and *stage crew*, to describe theatrical experiences.

Comprehension and Analysis of the Elements of Theatre

1.2 Identify how production values can manipulate mood to persuade and disseminate propaganda.

### 2.0 CREATIVE EXPRESSION

Development of Theatrical Skills

2.1 Participate in improvisational activities, demonstrating an understanding of text, subtext, and context.

Creation/Invention in Theatre

2.2 Use effective vocal expression, gesture, facial expression, and timing to create character.

2.3 Write and perform scenes or one-act plays that include monologue, dialogue, action, and setting together with a range of character types.

**3.0 HISTORICAL AND CULTURAL CONTEXT**

Role and Cultural Significance of Theatre

3.1 Create scripts that reflect particular historical periods or cultures.

History of Theatre

3.2 Differentiate the theatrical traditions of cultures throughout the world, such as those in Ancient Greece, Egypt, China, and West Africa.

**4.0 AESTHETIC VALUING**

Critical Assessment of Theatre

4.1 Develop and apply appropriate criteria for evaluating sets, lighting, costumes, makeup, and props.

Derivation of Meaning from Works of Theatre

4.2 Identify examples of how theatre, television, and film can influence or be influenced by politics and culture.

**5.0 CONNECTIONS, RELATIONSHIPS, APPLICATIONS**

Connections and Applications

5.1 Use theatrical skills to communicate concepts or ideas from other curriculum areas, such as a demonstration in history–social science of how persuasion and propaganda are used in advertising.

Careers and Career-Related Skills

5.2 Research career opportunities in media, advertising, marketing, and interactive Web design.

## VISUAL ARTS

**1.0 ARTISTIC PERCEPTION**

Develop Visual Arts Knowledge and Vocabulary

1.1 Identify and describe *all* the elements of art found in selected works of art (e.g., color, shape/form, line, texture, space, value).

1.2 Discuss works of art as to theme, genre, style, idea, and differences in media.

1.3 Describe how artists can show the same theme by using different media and styles.

Analyze Art Elements and Principles of Design

1.4 Describe how balance is effectively used in a work of art (e.g., symmetrical, asymmetrical, radial).

**2.0 CREATIVE EXPRESSION**

Skills, Processes, Materials, and Tools

2.1 Use various observational drawing skills to depict a variety of subject matter.

2.2 Apply the rules of two-point perspective in creating a thematic work of art.

2.3 Create a drawing, using varying tints, shades, and intensities.

Communication and Expression Through Original Works of Art

2.4 Create increasingly complex original works of art reflecting personal choices and in-creased technical skill.

2.5 Select specific media and processes to express moods, feelings, themes, or ideas.

2.6 Use technology to create original works of art.

**3.0 HISTORICAL AND CULTURAL CONTEXT**

Role and Development of the Visual Arts

3.1 Research and discuss the role of the visual arts in selected periods of history, using a variety of resources (both print and electronic).

3.2 View selected works of art from a culture and describe how they have changed or not changed in theme and content over a period of time.

Diversity of the Visual Arts

3.3 Compare, in oral or written form, representative images or designs from at least two selected cultures.

**4.0 AESTHETIC VALUING**

Derive Meaning

4.1 Construct and describe plausible interpretations of what they perceive in works of art.

4.2 Identify and describe ways in which their culture is being reflected in current works of art.

Make Informed Judgments

4.3 Develop specific criteria as individuals or in groups to assess and critique works of art.

4.4 Change, edit, or revise their works of art after a critique, articulating reasons for their changes.

**5.0 CONNECTIONS, RELATIONSHIPS, APPLICATIONS**

Connections and Applications

5.1 Research how art was used in theatrical productions in the past and in the present.

5.2 Research how traditional characters (such as the *trickster*) found in a variety of cultures past and present are represented in illustrations.

5.3 Create artwork containing visual metaphors that express the traditions and myths of selected cultures.

Visual Literacy

5.4 Describe tactics employed in advertising to sway the viewer's thinking and provide examples.

Careers and Career-Related Skills

5.5 Establish criteria to use in selecting works of art for a specific type of art exhibition.

# 6th Grade
# Technology Standards

| ***Level of Skills Definitions*** | | | |
|---|---|---|---|
| ***Observe*** | | *Observation of Teacher Modeling Skills* | |
| ***Basic*** | | *Practicing Skills with Teacher's Guidance* | |
| ***Intermediate*** | | *Practicing Skills with Minimal Teacher Support* | |
| ***Proficient*** | | *Applying Skills Independently* | |
| **#** | **Category** | **Standard** | **Level of Skills** |
| 6.1 | Ethics | Practice respectful and responsible use of technology by abiding by School Technology and Internet Use Policy. | NA |
| 6.2 | Ethics | Demonstrate an understanding of plagiarism and fair use. Copyright Laws of Material. | NA |
| 6.3 | Ethics | Evaluate and use several resources from a variety of information sources to validate accuracy of information. | Na |
| 6.4 | Ethics | Demonstrate an understanding of Internet Safety Procedures. | NA |
| 6.5 | Keyboarding Skills | Use correct technique for key striking and keying by touch. | Advanced |
| 6.6 | Keyboarding Skills | Enter data at a rate of 21-25 words per minute. | Advanced |
| 6.7 | Keyboarding Skills | Identify the location and function of the TAB key. | Advanced |
| 6.8 | Keyboarding Skills | Use both hands simultaneously on the keyboard. | Advanced |
| 6.9 | Keyboarding Skills | Use correct hand-finger, home row, and pairing of fingers. | Advanced |
| 6.10 | Keyboarding Skills | Use left hand on the left side of the keyboard. | Advanced |
| 6.11 | Keyboarding Skills | Use right hand on the right side of the keyboard. | Advanced |
| 6.12 | Keyboarding Skills | Use thumb on the spacebar. | Advanced |
| 6.13 | Keyboarding Skills | Locate, identify and use letter, number, and punctuation keys. | Advanced |
| 6.14 | Keyboarding Skills | Identify keys on the right and left side of the keyboard. | Advanced |
| 6.15 | Keyboarding Skills | Recognize that letters typed on the keyboard are lower case unless the Shift Key is used. | Advanced |
| 6.16 | Keyboarding Skills | Identify the location and function of these keys: Enter, Escape, Spacebar, Shift, Arrows, and Backspace. | Advanced |

# 6th Grade
# Technology Standards

| ***Level of Skills Definitions*** | |
|---|---|
| ***Observe*** | *Observation of Teacher Modeling Skills* |
| ***Basic*** | *Practicing Skills with Teacher's Guidance* |
| ***Intermediate*** | *Practicing Skills with Minimal Teacher Support* |
| ***Proficient*** | *Applying Skills Independently* |

| # | Category | Standard | Level of Skills |
|---|---|---|---|
| 6.17 | Keyboarding Skills | Identify and properly use the mouse. | Advanced |
| 6.18 | Keyboarding Skills | Use correct posture. | Advanced |
| 6.19 | Keyboarding Skills | Use "single-click", "double-click", and "clock-and drag" functions of the mouse. | Advanced |
| 6.20 | Keyboarding Skills | Recognize letters on the keyboard as capital letters. | Advanced |
| 6.21 | Word Processing | Understand and use the cut, copy, and paste information. | Advanced |
| 6.22 | Word Processing | Use correct spacing between words. | Advanced |
| 6.23 | Word Processing | Use correct spacing following punctuation. | Advanced |
| 6.24 | Word Processing | Use Spellcheck. | Advanced |
| 6.25 | Word Processing | Use appropriate items on a menu bar "Print" and "Save". | Advanced |
| 6.26 | Word Processing | Change font, color, and size. | Advanced |
| **6.27** | Word Processing | Name and save a file. | Advanced |
| **6.28** | Word Processing | Add graphics to a composition. | Advanced |
| **6.29** | Word Processing | Insert Header/Footer, Paragraphing Tools, Adjusting alignment. | Advanced |
| **6.30** | Database | Define the term "database" and provide examples from everyday life (Destiny, Telephone directories, etc.). | Advanced |
| **6.31** | Database | Define terms related to databases, such as "record" field, and "search". | Advanced |
| **6.32** | Database | Do simple searches of existing databases. | Advanced |
| **6.33** | Spreadsheet | Demonstrate an understanding of the spreadsheet as a tool to record, organize, and graph information. | Advanced |

6th Grade
Technology Standards

| ***Level of Skills Definitions*** | |
|---|---|
| ***Observe*** | *Observation of Teacher Modeling Skills* |
| ***Basic*** | *Practicing Skills with Teacher's Guidance* |
| ***Intermediate*** | *Practicing Skills with Minimal Teacher Support* |
| ***Proficient*** | *Applying Skills Independently* |

| # | Category | Standard | Level of Skills |
|---|---|---|---|
| **6.34** | Spreadsheet | Identify and explain terms and concepts related to spreadsheets (cell, column, row, values, chart, graphs). | Advanced |
| **6.35** | Spreadsheet | Enter/Edit data in spreadsheets and perform calculations using simple formulas (+, -. *) observing the changes that occur. | Advanced |
| **6.36** | MultiMedia | Create, Edit, and Format Text on a Slide. | Advanced |
| **6.37** | Multimedia | Create a series of slides and organize them to present research or convey an idea. | Advanced |
| **6.38** | Multimedia | Copy and paste or import graphics, change their size and position on the slide (use of transitions, etc.). | Advanced |
| **6.39** | Internet Skills | Demonstrate the ability to use icons on desktop to get to district standard sites: Accelerated Reader, etc. | Advanced |
| **6.40** | Internet Skills | Demonstrate the ability to use a search engine. | Advanced |

# MATERIALS AND RESOURCES
## Sixth Grade

## READING/LANGUAGE ARTS

***Benchmark Advance*** is the basic text for students. The following materials are used:

***Teacher's Resources***
Five Teacher's Resource System Books
Assessment Books
Intervention Resources
ELD Resources
Read-Aloud Handbook
Grammar, Spelling & Vocabulary Workbook
Daily Take-Home Activity Calendars

***Small Group Leveled Texts***
Units 1-10

***Small Group Leveled Texts Teacher Support***
Teacher's Guides & Text Evidence Question Cards Units 1-10
Reader's Theater Handbook

***Small Group Reader's Theater***
Units 1-10

***Texts for ELD***
Student Book – Set of 10

***Texts for Close Reading Consumable Student Book***
Student Books – 1 per student
Teacher Set

***Instructional Minutes:***
Students will receive a minimum of 120 minutes of instruction in language arts per day.

## WRITING

**Write from the Beginning *and Beyond | Thinking Maps®*** is the writing program for students.

The following materials are used:

***Teacher Manuals:***
- Thinking Maps: *A Language for Learning* - with 8 classroom posters
- Thinking Maps: Write from the Beginning and Beyond: *Expository/Informative*
- Thinking Maps: Write from the Beginning and Beyond: *Narrative*
- Thinking Maps: Write from the Beginning and Beyond: *Response to Literature*
- Thinking Maps: Write from the Beginning and Beyond: *Setting the Stage*
- Thinking Maps: Write from the Beginning and Beyond: *Argumentative Writing*

## MATHEMATICS

***Go Math! California Student Edition Multi-Volume Grade*** is the basic text for students. The following materials are used:

***Student Materials:***
- California Student Edition Multi-Volume Grade 6
- Bilingual Mathboard Grade 6
- California Online Interactive Student Edition (includes Personal Math Trainer) Grade 6
- SBAC Test Prep Student Edition Grade 6
- California Downloadable Student Edition PDF Grade 6

***Teacher Resource Materials:***
- California Teacher Edition and Planning Guide Bundle Grade 6
- California Teacher Digital Management Center Grade 6
- California Assessment Guide Blackline Masters Grade 6
- California Reteach Workbook Blackline Masters Grade 6
- California Enrichment Workbook Blackline Masters Grade 6
- Strategic Intervention Teacher Guide Grade 6
- SBAC Test Prep Teacher Edition Grade 6
- Bilingual ExamView CD-ROM Grade 6
- Grab and Go Differentiated Centers Kit Grade 6
- Grab and Go Customized Manipulatives Kit Grade 6
- California Downloadable Student Edition PDF Grade 6

***Instructional Minutes:***
Students will receive a minimum of 60 minutes of instruction in mathematics per day.

## TECHNOLOGY

***Student Programs:***

- Amplify
- Benchmark Universe
- BrainPOP
- BrainPOP ELL
- Go Math!
- Google Classroom
- i-Ready
- MobyMax
- Renaissance Learning
- Typing Agent

## HISTORY/SOCIAL SCIENCE

***Ancient Civilizations*** (Harcourt School Publishers) is the basic text for students. The following materials are used:

***Teacher Editions:***
*Ancient Civilizations*
*California Homework & Practice Book*
*California Success for English Learners*
*Time for Kids Readers*

***One Per Student:***
*Ancient Civilizations*
Homework and Practice Book
Student Edition CD Rom
Student Edition e-book
Interactive Desk Map: California
Interactive Desk Map: U.S.
Interactive Desk Map: World
Graphic Organizers Write-On/Wipe-off Cards

***Teacher Resource Materials:***
California ePlanner with Teachers Edition
Interactive Atlas

***Teacher Resource Materials Continued:***
California Audiotext Collection
California ELA Program Correlation Cards
Picture/Word Cards for Developing Academic Language
California Reading Support and Intervention Book
Social Studies in Action; Resources for the Classroom
Primary Source Collection, Intermediate
TimeLinks; Interactive Time Line package
Time for Kids Readers Collection (1 copy each of 18 titles)
California Assessment Program
Interactive Desk Map Transparencies: California
Interactive Desk Map Transparencies: U.S.
Interactive Desk Map Transparencies: World
California Vocabulary Power
California Vocabulary Transparencies
Music CD Collection
All-In One Planner with Assessment CD-ROM
Online Assessment Quick Start Guide for Teachers

## SCIENCE

Amplify Science is the adopted curriculum. The following materials are used:

### Teacher Editions:

- Microbiome
- Metabolism
- Metabolism Engineering Internship
- Traits and Reproduction
- Thermal Energy
- Ocean, Atmosphere, and Climate
- Weather Patterns
- Earth's Changing Climate
- Earth's Changing Climate Engineering Internship

### One Per Student:

- 1 Investigation notebook per unit

*Investigation notebooks are also available online.

### Teacher Resource Materials:

Science kits for the following units:

- Microbiome (1 box)
- Metabolism (1 box)
- Traits and Reproduction (1 box)
- Thermal Energy (1 box)
- Ocean, Atmosphere, and Climate (2 boxes)
- Weather Patterns (1 box)
- Earth's Changing Climate (1 box)
- Earth's Changing Climate Engineering Internship (1 box)

## PHYSICAL EDUCATION

***SPARK Grades 3 - 6 PE Teacher's Guide***

**Instructional Minutes**

Students will receive a minimum of 200 minutes of instruction in physical education every ten school days.