Massachusetts Department of Elementary and Secondary Education

Prerequisite Content Standards: Secondary Grades (6-12)

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Secondary Grades (6-12)
English Language Arts and Literacy

Grade 6
Reading Literature [RL]
1. Cite textual evidence to support analysis of what a text states explicitly as well as inferences drawn from the text, quoting or paraphrasing as appropriate. (See grade 6 Writing Standard 8 for more on quoting and paraphrasing.)
2. Determine a theme or central idea of a text and how it is conveyed through particular details; provide a summary of a text distinct from personal opinions or judgments.
4. Determine the meaning of words and phrases as they are used in a text, including figurative, connotative, and technical meanings; explain how word choice affects meaning and tone. (See grade 6 Language standards 4-6 on applying knowledge of vocabulary to reading.)

Reading Informational Text [RI]
1. Cite textual evidence to support analysis of what a text states explicitly as well as inferences drawn from the text, quoting or paraphrasing as appropriate. (See grade 6 Writing Standard 8 for more on quoting and paraphrasing.)
2. Determine a text's central idea(s) and how particular details help convey the idea(s); provide a summary of a text distinct from personal opinions or judgments.
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
10. Independently and proficiently read and comprehend literature **and** literary nonfiction representing a variety of genres, cultures, and perspectives and exhibiting complexity appropriate for at least grade 6.

Writing [W]

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 above.)
9. Draw evidence from literary or informational texts to support written analysis, interpretation, reflection, and research, applying one or more grade 6 standards for Reading Literature or Reading Informational Text as needed.

Language [L]

1. Demonstrate command of the conventions of standard English grammar and usage when writing or speaking; retain and further develop language skills learned in previous grades. (See grade 6 Writing Standard 5 and Speaking and Listening Standard 6 on strengthening writing and presentations by applying knowledge of conventions.)

Sentence Structure, Variety, and Meaning

   a. Use simple, compound, complex, and compound-complex sentences to communicate ideas clearly and to add variety to writing.
   b. Explain the function of phrases and clauses in general, how phrases and clauses differ, and how their use conveys a particular meaning in a specific written or spoken sentence.
   c. Place or rearrange phrases and clauses within a sentence, recognizing and correcting misplaced and dangling modifiers
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, recognizing that some words have commonly accepted variations (e.g., donut/doughnut).

Grade 7
Reading Literature [RL]

1. Cite several pieces of textual evidence to support analysis of what a text states explicitly as well as inferences drawn from the text, quoting or paraphrasing as appropriate. (See grade 7 Writing Standard 8 for more on quoting and paraphrasing.)
2. Determine a theme or central idea of a text and analyze its development over the course of the text; provide an objective summary of a text.
4. Determine the meaning of words and phrases as they are used in a text, including figurative and connotative meanings; analyze the impact of specific word choices on meaning, tone, or mood, including the impact of repeated use of particular images. (See grade 7 Language Standards 4–6 on applying knowledge of vocabulary to reading.)

Reading Informational Text [RI]

1. Cite several pieces of textual evidence to support analysis of what a text states explicitly as well as inferences drawn from the text, quoting or paraphrasing as appropriate. (See grade 7 Writing Standard 8 for more on quoting and paraphrasing.)
2. Determine a text's central idea(s) and analyze its/their development over the course of the text; provide an objective summary of a text.
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.
10. Independently and proficiently read and comprehend literature **and** literary nonfiction representing a variety of genres, cultures, and perspectives and exhibiting complexity appropriate for at least grade 7.

Writing [W]

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.)
9. Draw evidence from literary or informational texts to support written analysis, interpretation, reflection, and research, applying one or more grade 7 Standards for Reading Literature or Reading Informational Text as needed.

Language [L]

1. Demonstrate command of the conventions of standard English grammar and usage when writing or speaking; retain and further develop language skills learned in previous grades. (See grade 7 Writing Standard 5 and Speaking and Listening Standard 6 on strengthening writing and presentations by applying knowledge of conventions.)
   Sentence Structure, Variety, and Meaning

   a. Use phrases and clauses to communicate ideas precisely, with attention to skillful use of verb tenses to add clarity.
   b. Recognize and correct vague pronouns (those that have unclear or ambiguous antecedents).[17]
   c. Recognize and correct inappropriate shifts in pronoun number and person in sentences with multiple clauses and phrases.
   d. Recognize that changing the placement of a phrase or clause can add variety, emphasize particular relationships among ideas, or alter the meaning of a sentence or paragraph.[17]
2. Demonstrate command of the conventions of standard English capitalization, punctuation, and spelling when writing.
   a. Use a comma to separate coordinate adjectives (e.g., *a fascinating, enjoyable movie*).
   b. Spell correctly, recognizing that some words have commonly accepted variations (e.g., donut/doughnut).

Grade 8
Reading Literature [RL]

1. Cite the textual evidence that most strongly supports analysis of what a text states explicitly as well as inferences drawn from the text, quoting or paraphrasing as appropriate. (See grade 8 Writing Standard 8 for more on quoting and paraphrasing.)
2. Determine a theme or central idea of a text and analyze its development over the course of the text, including its relationship to the characters, setting, and plot; provide an objective summary of a text
4. Determine the meaning of words and phrases as they are used in a text, including figurative and connotative meanings; analyze the impact of specific word choices on meaning, tone, or mood, including the impact of allusion and irony. (See grade 8 Language Standards 4–6 on applying knowledge of vocabulary to reading.)

Reading Informational Text [RI]

1. Cite the textual evidence that most strongly supports an analysis of what a text states explicitly as well as inferences drawn from the text, quoting or paraphrasing as appropriate. (See grade 8 Writing Standard 8 for more on quoting and paraphrasing.)
2. Determine a text's central idea(s) and analyze its/their development over the course of the text,
   including relationships to supporting ideas; provide an objective summary of a text.
8. Delineate and evaluate the argument and specific claims in a text, assessing whether the reasoning is sound and the evidence is relevant and sufficient; recognize when irrelevant evidence is introduced.
10. Independently and proficiently read and comprehend literature **and** literary nonfiction representing a variety of genres, cultures, and perspectives and exhibiting complexity appropriate for at least grade 8.

Writing [W]

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 above.)
9. Draw evidence from literary or informational texts to support written analysis, interpretation, reflection, and research, applying one or more grade 8 standards for Reading Literature or Reading Informational Text as needed.

Language [L]

1. Demonstrate command of the conventions of standard English grammar and usage when writing or speaking; retain and further develop language skills learned in previous grades. (See grade 8 Writing Standard 5 and Speaking and Listening Standard 6 on strengthening writing and presentations by applying knowledge of conventions.)
   Sentence Structure, Variety, and Meaning

       a. Coordinate phrases and clauses in simple, compound, complex, and compound-complex sentences, with emphasis on agreement of pronouns and their antecedents.

       b. Form and use verbs in the active and passive voices and the indicative, imperative, interrogative, conditional, and subjunctive moods to communicate a particular meaning.

2. Demonstrate command of the conventions of standard English capitalization, punctuation, and spelling when writing.

       a. Use punctuation (comma, ellipsis, dash) to indicate a pause or break.

       b. Use an ellipsis to indicate an omission. Spell correctly, recognizing that some words have commonly accepted variations (e.g., donut/doughnut).

Grades 9-10

Reading Literature [RL]

1. Cite strong and thorough textual evidence to support analysis of what a text states explicitly as well as inferences drawn from the text.

2. Determine a theme or central idea of a text and analyze in detail its development over the course of the text, including how it emerges and is shaped and refined by specific details; provide an objective summary of a text.

4. Determine the figurative or connotative meaning(s) of words and phrases as they are used in a text; analyze the impact of words with multiple meanings, as well as symbols or metaphors that extend throughout a text and shape its meaning. (See grades 9–10 Language Standards 4–6 on applying knowledge of vocabulary to reading.)

Reading Informational Text [RI]

1. Cite strong and thorough textual evidence to support analysis of what a text states explicitly as well as inferences drawn from the text.

2. Determine a central idea of a text and analyze its development over the course of the text, including how it emerges and is shaped and refined by specific details; provide an objective summary of a text.

8. Delineate and evaluate the argument and specific claims in a text, assessing whether the reasoning is valid and the evidence is relevant and sufficient; identify false statements or incomplete truths and fallacious reasoning.

10. Independently and proficiently read and comprehend **literary texts** and **literary nonfiction** representing a variety of genres, cultures, and perspectives and exhibiting complexity appropriate for the grade/course.

Writing [W]

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 above.)

9. Draw evidence from literary or informational texts to support written analysis, interpretation, reflection, and research, applying one or more grades 9–10 Standards for Reading Literature or Reading Informational Text as needed.

Language [L]

1. Demonstrate command of the conventions of standard English grammar and usage when writing or speaking; retain and further develop language skills learned in previous grades. (See grades 9–10 Writing Standard 5 and Speaking and Listening Standard 6 on strengthening writing and presentations by applying knowledge of conventions.)
   Sentence Structure, Variety, and Meaning

   a. Manipulate and rearrange clauses and phrases in sentences, paying attention to agreements of pronouns and their antecedents, logical use of verb tenses, and variety in sentence patterns.

   b. Use various types of phrases (noun, verb, adjectival, participial, prepositional) and clauses (independent, dependent, noun, relative, adverbial) to convey specific meanings and add variety and interest to writing or presentations.

   c. Use parallel structure as a technique for creating coherence in sentences, paragraphs, and larger pieces of writing.[19]

2. Demonstrate command of the conventions of standard English capitalization, punctuation, and spelling when writing.

   a. Use a semicolon (and perhaps a conjunctive adverb) to link two or more closely related independent clauses.

   b. Use a colon to introduce a list or quotation.

   c. Spell correctly, recognizing that some words have commonly accepted variations (e.g., catalog/catalogue).

Grades 11-12

Reading Literature [RL]

1. Cite strong and thorough textual evidence to support analysis of what a text states explicitly as well as inferences drawn from the text, including determining where the text leaves matters uncertain.

2. Determine two or more themes or central ideas of a text and analyze their development over the course of the text, including how they interact and build on one another to produce a complex account; provide an objective summary of a text.

4. Determine the figurative or connotative meaning(s) of words and phrases as they are used in a text; analyze the impact of specific words or rhetorical patterns (e.g., how the language evokes a sense of time and place, how shifts in rhetorical patterns signal new perspectives). (See grades 11–12 Language Standards 4–6 on applying knowledge of vocabulary to reading.)

Reading Informational Text [RI]

1. Cite strong and thorough textual evidence to support analysis of what a text states explicitly as well as inferences drawn from the text, including determining where the text leaves matters uncertain.

2. Determine two or more central ideas of a text and analyze their development over the course of the text, including how they interact and build on one another to provide a complex analysis; provide an objective summary of a text.

8. Delineate and evaluate the reasoning in seminal historical texts, including the application of constitutional principles and use of legal reasoning (e.g., in U.S. Supreme Court majority opinions and dissents) and the premises, purposes, and arguments in works of public advocacy (e.g., *The Federalist*, presidential addresses).

10. Independently and proficiently read and comprehend **literary texts** and **literary nonfiction** representing a variety of genres, cultures, and perspectives and exhibiting complexity appropriate for the grade/course.

Writing [W]

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 above.)

9. Draw evidence from literary or informational texts to support written analysis, interpretation, reflection, and research, applying one or more grades 11–12 standards for Reading Literature or Reading Informational Text as needed.

Language [L]

1. Demonstrate command of the conventions of standard English grammar and usage when writing or speaking; retain and further develop language skills learned in previous grades. (See grades 11–12 Writing Standard 5 and Speaking and Listening Standard 6 on strengthening writing and presentations by applying knowledge of conventions.)
   Word Usage

   a. Apply the understanding that usage is a matter of convention, can change over time, and is sometimes contested.

   b. Resolve issues of complex or contested usage, consulting references (e.g., *Merriam-Webster's Dictionary of English Usage*, *Garner's Modern American Usage*) as needed.

2. Demonstrate command of the conventions of standard English capitalization, punctuation, and spelling when writing.

   a. Observe hyphenation conventions.

   b. Spell correctly, recognizing that some words have commonly accepted variations (e.g., catalog/catalogue).

Science and Technology/Engineering

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Grade 6

Earth and Space Sciences   6.MS-ESS
6.MS-ESS1-1a. Develop and use a model of the Earth-Sun-Moon system to explain the causes of lunar phases and eclipses of the Sun and Moon.
6.MS-ESS2-3. Analyze and interpret maps showing the distribution of fossils and rocks, continental shapes, and seafloor structures to provide evidence that Earth's plates have moved great distances, collided, and spread apart.

Life Science   6.MS-LS
6.MS-LS1-2. Develop and use a model to describe how parts of cells contribute to the cellular functions of obtaining food, water, and other nutrients from its environment, disposing of wastes, and providing energy for cellular processes.
6.MS-LS1-3. Construct an argument supported by evidence that the body systems interact to carry out essential functions of life.

Physical Science   6.MS-PS
6.MS-PS1-7(MA). Use a particulate model of matter to explain that density is the amount of matter (mass) in a given volume. Apply proportional reasoning to describe, calculate, and compare relative densities of different materials.
6.MS-PS4-2. Use diagrams and other models to show that both light rays and mechanical waves are reflected, absorbed, or transmitted through various materials.

Technology/Engineering   6.MS-ETS
6.MS-ETS1-1. Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution. Include potential impacts on people and the natural environment that may limit possible solutions.*

Grade 7

Earth and Space Sciences   7.MS-ESS

7.MS-ESS2-2. Construct an explanation based on evidence for how Earth's surface has changed over scales that range from local to global in size.

Life Science   7.MS-LS

7.MS-LS2-3. Develop a model to describe that matter and energy are transferred among living and nonliving parts of an ecosystem and that both matter and energy are conserved through these processes.

Physical Science   7.MS-PS

7.MS-PS2-5. Use scientific evidence to argue that fields exist between objects with mass, between magnetic objects, and between electrically charged objects that exert force on each other even though the objects are not in contact.

7.MS-PS3-3. Apply scientific principles of energy and heat transfer to design, construct, and test a device to minimize or maximize thermal energy transfer.*

7.MS-PS3-7(MA). Use informational text to describe the relationship between kinetic and potential energy and illustrate conversions from one form to another.

Technology/Engineering   7.MS-ETS

7.MS-ETS1-2. Evaluate competing solutions to a given design problem using a decision matrix to determine how well each meets the criteria and constraints of the problem. Use a model of each solution to evaluate how variations in one or more design features, including size, shape, weight, or cost, may affect the function or effectiveness of the solution.*

Grade 8

Earth and Space Sciences   8.MS-ESS

8.MS-ESS1-1b. Develop and use a model of the Earth-Sun system to explain the cyclical pattern of seasons, which includes Earth's tilt and differential intensity of sunlight on different areas of Earth across the year.

8.MS-ESS2-1. Use a model to illustrate that energy from Earth's interior drives convection that cycles Earth's crust, leading to melting, crystallization, weathering, and deformation of large rock formations, including generation of ocean sea floor at ridges, submergence of ocean sea floor at trenches, mountain building, and active volcanic chains.

8.MS-ESS3-5. Examine and interpret data to describe the role that human activities have played in causing the rise in global temperatures over the past century.

Life Science   8.MS-LS

8.MS-LS1-7. Use informational text to describe that food molecules, including carbohydrates, proteins, and fats, are broken down and rearranged through chemical reactions forming new molecules that support cell growth and/or release of energy.

8.MS-LS3-1. Develop and use a model to describe that structural changes to genes (mutations) may or may not result in changes to proteins, and if there are changes to proteins there may be harmful, beneficial, or neutral changes to traits.

8.MS-LS4-4. Use a model to describe the process of natural selection, in which genetic variations of some traits in a population increase some individuals' likelihood of surviving and reproducing in a changing environment. Provide evidence that natural selection occurs over many generations.

Physical Science   8.MS-PS

8.MS-PS1-4. Develop a model that describes and predicts changes in particle motion, relative spatial arrangement, temperature, and state of a pure substance when thermal energy is added or removed.

8.MS-PS2-2. Provide evidence that the change in an object's speed depends on the sum of the forces on the object (the net force) and the mass of the object.

High School Biology

LS1. From Molecules to Organisms: Structures and Processes

HS-LS1-1. Construct a model of transcription and translation to explain the roles of DNA and RNA that code for proteins that regulate and carry out essential functions of life.

HS-LS1-2. Develop and use a model to illustrate the key functions of animal body systems, including (a) food digestion, nutrient uptake, and transport through the body; (b) exchange of oxygen and carbon dioxide; (c) removal of wastes; and (d) regulation of body processes.

LS2. Ecosystems: Interactions, Energy, and Dynamics

HS-LS2-5. Use a model that illustrates the roles of photosynthesis, cellular respiration, decomposition, and combustion to explain the cycling of carbon in its various forms among the biosphere, atmosphere, hydrosphere, and geosphere.

HS-LS2-7. Analyze direct and indirect effects of human activities on biodiversity and ecosystem health, specifically habitat fragmentation, introduction of non-native or invasive species, overharvesting, pollution, and climate change. Evaluate and refine a solution for reducing the impacts of human activities on biodiversity and ecosystem health.*

LS3. Heredity: Inheritance and Variation of Traits

HS-LS3-1. Develop and use a model to show how DNA in the form of chromosomes is passed from parents to offspring through the processes of meiosis and fertilization in sexual reproduction. **HS-LS3-3.** Apply concepts of probability to represent possible genotype and phenotype combinations in offspring caused by different types of Mendelian inheritance patterns.

LS4. Biological Evolution: Unity and Diversity

HS-LS4-4. Research and communicate information about key features of viruses and bacteria to explain their ability to adapt and reproduce in a wide variety of environments.

HS-LS4-5. Evaluate models that demonstrate how changes in an environment may result in the evolution of a population of a given species, the emergence of new species over generations, or the extinction of other species due to the processes of genetic drift, gene flow, mutation, and natural selection.

High School Chemistry

PS1. Matter and Its Interactions

HS-PS1-2. Use the periodic table model to predict and design simple reactions that result in two main classes of binary compounds, ionic and molecular. Develop an explanation based on given observational data and the electronegativity model about the relative strengths of ionic or covalent bonds.

HS-PS1-4. Develop a model to illustrate the energy transferred during an exothermic or endothermic chemical reaction based on the bond energy difference between bonds broken (absorption of energy) and bonds formed (release of energy).

HS-PS1-7. Use mathematical representations and provide experimental evidence to support the claim that atoms, and therefore mass, are conserved during a chemical reaction. Use the mole concept and proportional relationships to evaluate the quantities (masses or moles) of specific reactants needed in order to obtain a specific amount of product.

HS-PS1-10(MA). Use an oxidation-reduction reaction model to predict products of reactions given the reactants, and to communicate the reaction models using a representation that shows electron transfer (redox). Use oxidation numbers to account for how electrons are redistributed in redox processes used in devices that generate electricity or systems that prevent corrosion.*

PS2. Motion and Stability: Forces and Interactions

HS-PS2-6. Communicate scientific and technical information about the molecular-level structures of polymers, ionic compounds, acids and bases, and metals to justify why these are useful in the functioning of designed materials.*

HS-PS2-8(MA). Use kinetic molecular theory to compare the strengths of electrostatic forces and the prevalence of interactions that occur between molecules in solids, liquids, and gases. Use the combined gas law to determine changes in pressure, volume, and temperature in gases.

PS3. Energy

HS-PS3-4b. Provide evidence from informational text or available data to illustrate that the transfer of energy during a chemical reaction in a closed system involves changes in energy dispersal (entropy change) and heat content (enthalpy change) while assuming the overall energy in the system is conserved.

High School Introductory Physics

PS2. Motion and Stability: Forces and Interactions

HS-PS2-1. Analyze data to support the claim that Newton's second law of motion is a mathematical model describing change in motion (the acceleration) of objects when acted on by a net force.

HS-PS2-3. Apply scientific principles of motion and momentum to design, evaluate, and refine a device that minimizes the force on a macroscopic object during a collision.*

HS-PS2-10(MA). Use free-body force diagrams, algebraic expressions, and Newton's laws of motion to predict changes to velocity and acceleration for an object moving in one dimension in various situations.

PS3. Energy

HS-PS3-1. Use algebraic expressions and the principle of energy conservation to calculate the change in energy of one component of a system when the change in energy of the other component(s) of the system, as well as the total energy of the system including any energy entering or leaving the system, is known. Identify any transformations from one form of energy to another, including thermal, kinetic, gravitational, magnetic, or electrical energy, in the system.

HS-PS3-2. Develop and use a model to illustrate that energy at the macroscopic scale can be accounted for as either motions of particles and objects or energy stored in fields.

PS4. Waves and Their Applications in Technologies for Information Transfer

HS-PS4-5. Communicate technical information about how some technological devices use the principles of wave behavior and wave interactions with matter to transmit and capture information and energy.*

Secondary Grades (6-12)
History and Social Science

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Grade 6 and 7

Grades 6 and 7 form a two-year sequence in which students study regions of the world by examining physical geography, nations in the region today, and selected ancient and classical societies. The standards listed below are pre-requisites for success in grade 8.

Practice Standards
2. Develop focused questions or problem statements and conduct inquiries
3. Organize information and data from multiple primary and secondary sources.

Content Topic 1: Studying complex societies, past and present [6.T1]
1. Explain how different academic fields in the social sciences concentrate on different means of studying societies in the past and present.
2. Give examples of ways in which a current historical interpretation might build on, extend, or reject an interpretation of the past.
3. Give examples of how archaeologists, historians, geographers, economists, and political scientists work as teams to analyze evidence, develop hypotheses, and construct interpretations of ancient and classical civilizations.

Content Topics 6.T2- 7.T4c
Teachers are encouraged to use Practice Standards 2 and 3 to facilitate inquiry-based investigations of a civilization/region not yet studied.

Grade 8: U.S. and MA Government and Civic Life

Practice Standards
1. Demonstrate civic knowledge, skills, and dispositions.
4. Analyze the purpose and point of view of each source; distinguish opinion from fact.
5. Evaluate the credibility, accuracy, and relevance of each source.

Content Topic 4: Rights and responsibilities of a citizen [8.T4]
7. Apply knowledge of the meaning of leadership and the qualities of good leaders to evaluate political leaders at the community, the state and national levels.
8. Explain the importance of individuals working cooperatively with their elected leaders.

9. Explain the importance of public service, and identify career and other opportunities in public service at the local, state, and national levels.
10. Analyze issues involving liberty in conflict with equality or authority, individual rights in conflict with the common good, or majority rule in conflict with minority rights.
11. Examine the varied understandings of the role of elected representatives and discuss those who have demonstrated political courage or those whose actions have failed to live up to the ideals of the Constitution

Content Topic 6: The Structure of Massachusetts state and local government [8.T6]
1. Compare and contrast the functions of state government and national government.
2. Describe provisions of the United States Constitution and the Massachusetts Constitution that define and distribute powers and authority of the federal or state government

Content Topic 7: The Freedom of Press and News/Media Literacy [8.T7]
2. Give examples of how a free press can provide competing information and views about government and politics.
4. Evaluate the benefits and challenges of digital news and social media to a democratic society.
5. Explain methods for evaluating information and opinion in print and online media (e.g., determining the credibility of news articles; analyzing the messages of editorials and op-ed commentaries; assessing the validity of claims and sufficiency of evidence).
6. Analyze the point of view and evaluate the claims of an editorial, editorial cartoon, or op-ed commentary on a public policy issue at the local, state, or national level (e.g., a mayoral or school committee decision, an action by a state legislature or Governor, a vote in Congress or an action by the President).

Grade 9-12

Content Standards
*Secondary HSS courses follow variable scope and sequences; teachers should attempt to **address the Content Standards they have not yet introduced** for their course. The last Topic of each grade is identified here with the assumption that earlier Topics were introduced earlier in the year; however, teachers are encouraged to prioritize Content Standards not yet introduced, and to apply them in connection with Practice Standards 2,3, and 7 to encourage inquiry-based investigations.*

US History I

Practice Standards

2. Develop focused questions or problem statements and conduct inquiries
6. Argue or explain conclusions, using valid reasoning and evidence.
7. Determine next steps and take informed action, as appropriate.

Content Topic 7: Progressivism and WWI [USI.T7]

Pre-Requisite Content Standards for Success in the Following Grade

1. Explain what Progressivism meant in the early 20th century and analyze a text or images by a Progressive leader (e.g., Jane Addams, William Jennings Bryan, John Dewey, Robert La Follette, Theodore Roosevelt, Margaret Sanger, Upton Sinclair, Lewis Hine, William H. Taft, Ida Tarbell, Woodrow Wilson).
2. Research and analyze one of the following governmental policies of the Progressive Period, determine the problem it was designed to solve, and assess its long and short-term effectiveness: bans against child labor, the development of Indian boarding schools, the Sherman Anti-Trust Act (1890), the Pure Food and Drug Act (1906), the Meat Packing Act (1906), the Federal Reserve Act (1913), the Clayton Anti-Trust Act (1914), the Indian Citizenship Act (1924).
3. Analyze the campaign for, and the opposition to, women's suffrage in the late 19th and early 20th centuries; describe the role of leaders and organizations in achieving the passage of the 19th Amendment (e.g., Carrie Chapman Catt, Alice Paul, Ida B. Wells-Barnett the National Woman Suffrage Association, National Women's Party, League of Women Voters).
4. Analyze the strategies of African Americans to achieve basic civil rights in the early 20th century, and determine the extent to which they met their goals by researching leaders and organizations (e.g., Ida B. Wells-Barnett, W. E. B. DuBois, Marcus Garvey, Booker T, Washington, and the National Association for the Advancement of Colored People).
5. Analyze the causes and course of growing role of the United States in world affairs from the Civil War to World War I, researching and reporting on one of the following ideas, policies, or events, and, where appropriate, including maps, timelines, and other visual resources to clarify connections among nations and events
6. Explain the rationale and events leading to the entry of the U.S. into World War I (e.g., unrestricted submarine warfare, the sinking of the Lusitania, the Zimmerman telegram, the concept of "making the world safe for democracy."
7. Analyze the role played by the U.S. in support of the Allies and in the conduct of the war
8. Explain the course and significance of Woodrow Wilson's wartime diplomacy, including his Fourteen Points, the League of Nations, and the failure of the Versailles Treaty.

US History II

Practice Standards

2. Develop focused questions or problem statements and conduct inquiries
6. Argue or explain conclusions, using valid reasoning and evidence.
7. Determine next steps and take informed action, as appropriate.

Content Topic 5: United States and globalization

1. Using primary sources such as campaign literature and debates, news articles/analyses, editorials, and television coverage, analyze the important policies and events that took place during the presidencies of John F. Kennedy (e.g., the confrontation with Cuba over missile bases, the space exploration program, Kennedy's assassination), Lyndon Johnson (the Great Society programs, the Civil Rights and Voting Rights Acts, the Vietnam War and anti-war movements, the 1965 Immigration and Nationality Act, the assassinations of Martin Luther King, Jr., and Robert F. Kennedy), and Richard Nixon (the creation of the Environmental

Protection Agency, diplomacy with China, détente with the Soviet Union, the Watergate scandal, and Nixon's resignation).

2. Analyze and evaluate the impact of economic liberalism on mid-20th century society, including the legacy of the New Deal on post World War II America, the expansion of American manufacturing and unionism, social welfare programs, and the regulation of major industries such as transportation, energy, communications and finance.

3. Analyze the presidency of Ronald Reagan (1981-1989) and the rise of the conservative movement in American politics, (e.g., policies such as tax rate cuts, anti-communist foreign and defense policies, replacement of striking air traffic controllers with non-union personnel.

4. Analyze how the failure of communist economic policies and U.S.-sponsored resistance to Soviet military and diplomatic initiatives contributed to the fall of the Berlin Wall in 1989 the dissolution of the Soviet Union in 1991, and the end of the Cold War.

5. Analyze some of the major technological and social trends and issues of the late 20th and early 21st centuries (e.g., the computer and technological revolution beginning in the 1980s, scientific and medical discoveries such as DNA research, major immigration and demographic changes such as the rise in Asian and Hispanic immigration).

6. Evaluate the effectiveness of the federal government's response to international terrorism in the 21st century, including the 2001 terrorist attack on the World Trade Center in New York City and the Pentagon near Washington, D.C., the Homeland Security Act, the Foreign Intelligence Surveillance Act, and the Afghanistan and Iraq Wars.

World History I

Practice Standards

2. Develop focused questions or problem statements and conduct inquiries
6. Argue or explain conclusions, using valid reasoning and evidence.
7. Determine next steps and take informed action, as appropriate.

Content Topic 6: Philosophies of Government

1. Identify the origins and the ideals of the European Enlightenment, such as happiness, reason, progress, liberty, and natural rights, and how intellectuals of the movement (e.g., Denis Diderot, Emmanuel Kant, John Locke, Charles de Montesquieu, Jean-Jacques Rousseau, Mary Wollstonecraft, Cesare Beccaria, Voltaire, or social satirists such as Molière and William Hogarth) exemplified these ideals in their work and challenged existing political, economic, social, and religious structures.

2. Explain historical philosophies of government, giving examples from world history: a. the Chinese doctrine of the Mandate of Heaven, in which a ruler must be worthy of the right to rule b. absolute monarchy, in which a monarch holds unlimited power with no checks and balances (e.g., in France of Louis XIV, Spain, Prussia, and Austria) c. enlightened absolutism (e.g., in Russia under Czars Peter the Great and Catherine the Great, in which ideas of the Enlightenment temper absolutism) d. constitutional monarchy, in which a ruler is limited by a written or unwritten constitution (e.g., English traditions beginning with Magna Carta).

3. Explain why England was the exception to the growth of absolutism in Europe. a. the causes, essential events, and effects of the English Civil War and the Glorious Revolution of 1688 b. the

English Bill of Rights and its limits on the power of the monarch to act without the consent of Parliament
4. Explain the development of constitutional democracy following the American Revolution, the United States Constitution (1787), and the Bill of Rights (1791)

World History II

Practice Standards

2. Develop focused questions or problem statements and conduct inquiries
6. Argue or explain conclusions, using valid reasoning and evidence.
7. Determine next steps and take informed action, as appropriate.

Content Topic 7: The Politics of difference: conflicts, genocide and terrorism

1. Distinguish between the concepts of genocide and mass atrocity and analyze the causes of genocide and mass atrocities in the modern world (e.g., conflicts over political power, historical grievances, manipulation of ideas about difference and fear by political forces).
2. Analyze the events, people and conditions that have given rise to international terrorism including the emergence of the global terror network Al-Qaeda, the Taliban in Afghanistan, and ISIS, and evaluate responses by governments and societies to international terrorist activity.

Mathematics

This resource is only to be used during school closure due to COVID-19. The Department identified content standards that are prerequisites for student success in the next grade level. The standards should not be used in connection with MCAS expectations or referenced in preparing students for the MCAS for any grade level. Since most standards will already have been taught prior to the closures, we anticipate that significant time would still be spent on reinforcement as an integral part of opposed to advancing new concepts.

Grade 6

Ratios and Proportional Relationships   6.RP

A. Understand ratio and rate concepts and use ratio and rate reasoning to solve problems.

1. Understand the concept of a ratio including the distinctions between part:part and part:whole and the value of a ratio; part/part and part/whole. 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 two wings there was one beak; For every vote candidate A received, candidate C received nearly three votes, meaning that candidate C received three out of every four votes or ¾ of all votes.

2. Understand the concept of a unit rate a/b associated with a ratio $a:b$ with $b \neq 0$, and use rate language in the context of a ratio relationship, *including the use of units*.

   For example: This recipe has a ratio of three cups of flour to four cups of sugar, so there is ¾ cup of flour for each cup of sugar; We paid $75 for 15 hamburgers, which is a rate of five dollars per hamburger.[1]

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 seven hours to mow four 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 $\frac{30}{100}$ times the quantity); solve problems involving finding the whole, given a part and the percent.

   d. Use ratio reasoning to convert measurement units within and between measurement systems; manipulate and transform units appropriately when multiplying or dividing quantities.

   For example, Malik is making a recipe, but he cannot find his measuring cups! He has, however, found a tablespoon. His cookbook says that 1 cup = 16 tablespoons. Explain how he

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[1] Expectations for unit rates in this grade are limited to non-complex fractions.

could use the tablespoon to measure out the following ingredients: two cups of flour, ½ cup sunflower seed, and 1¼ cup of oatmeal.[2]
  e. Solve problems that relate the mass of an object to its volume.

The Number System   6.NS

A. 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 $(\frac{2}{3}) \div (\frac{3}{4})$ and use a visual fraction model to show the quotient; use the relationship between multiplication and division to explain that $(\frac{2}{3}) \div (\frac{3}{4}) = \frac{8}{9}$ because $\frac{3}{4}$ of $\frac{8}{9}$ is $\frac{2}{3}$. In general, $(\frac{a}{b}) \div (\frac{c}{d}) = \frac{ad}{bc}$. How much chocolate will each person get if three people share ½ lb. of chocolate equally? How many ¾-cup servings are in ⅔ of a cup of yogurt? How wide is a rectangular strip of land with length ¾ mile and area ½ square mile?

B. 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.

C. 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, and positive/negative electric charge). Use positive and negative numbers (whole numbers, fractions, and decimals) to represent quantities in real-world contexts, explaining the meaning of zero 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 zero 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.
  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.

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[2] Example is from the Illustrative Mathematics Project: https://www.illustrativemathematics.org/content-standards/tasks/2174

Expressions and Equations   6.EE

A. 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, and 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 $A = 6s^2$ to find the volume and surface area of a cube with sides of length $s = \frac{1}{2}$.

   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.

B. 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.

C. 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

A. 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.

Statistics and Probability
6.SP

B. Summarize and describe distributions.

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 (range and/or interquartile range), 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.

Grade 7
Ratios and Proportional Relationships   7.RP
A. Analyze proportional relationships and use them to solve real-world and mathematical problems.

    1. Compute unit rates associated with ratios of fractions, including ratios of lengths, areas, and other quantities measured in like or different units.

        For example, if a person walks ½ mile in each ¼ hour, compute the unit rate as the complex fraction ½⁄¼ miles per hour, equivalently 2 miles per hour.

    2. Recognize and represent proportional relationships between quantities.

        a. Decide whether two quantities are in a proportional relationship, e.g., by testing for equivalent ratios in a table, or graphing on a coordinate plane and observing whether the graph is a straight line through the origin.

        b. Identify the constant of proportionality (unit rate) in tables, graphs, equations, diagrams, and verbal descriptions of proportional relationships.

        c. Represent proportional relationships by equations.

        For example, if total cost t is proportional to the number n of items purchased at a constant price p, the relationship between the total cost and the number of items can be expressed as t = pn.

        d. Explain what a point (x, y) on the graph of a proportional relationship means in terms of the situation, with special attention to the points $(0, 0)$ and $(1, r)$ where r is the unit rate.

    3. Use proportional relationships to solve multi-step ratio, rate, and percent problems.

        For example: simple interest, tax, price increases and discounts, gratuities and commissions, fees, percent increase and decrease, percent error.

The Number System   7.NS
A. Apply and extend previous understandings of operations with fractions to add, subtract, multiply, and divide rational numbers.

    1. Apply and extend previous understandings of addition and subtraction to add and subtract integers and other rational numbers; represent addition and subtraction on a horizontal or vertical number line diagram.

        a. Describe situations in which opposite quantities combine to make zero.

        For example: A hydrogen atom has zero charge because its two constituents are oppositely charged; If you open a new bank account with a deposit of $30 and then withdraw $30, you are left with a $0 balance.

        b. Understand $p + q$ as the number located a distance $|q|$ from p, in the positive or negative direction depending on whether q is positive or negative. Show that a number and its opposite have a sum of 0 (are additive inverses). Interpret sums of rational numbers by describing real-world contexts.

        c. Understand subtraction of rational numbers as adding the additive inverse, $p - q = p + (-q)$. Show that the distance between two rational numbers on the number line is the absolute value of their difference, and apply this principle in real-world contexts.

        d. Apply properties of operations as strategies to add and subtract rational numbers.

    2. Apply and extend previous understandings of multiplication and division and of fractions to multiply and divide integers and other rational numbers.

    a. Understand that multiplication is extended from fractions to rational numbers by requiring that operations continue to satisfy the properties of operations, particularly the distributive property, leading to products such as $(-1)(-1) = 1$ and the rules for multiplying signed numbers. Interpret products of rational numbers by describing real-world contexts.

    b. Understand that integers can be divided, provided that the divisor is not zero, and every quotient of integers (with non-zero divisor) is a rational number. If p and q are integers, then
$-(p/q) = (-p)/q = p/(-q)$. Interpret quotients of rational numbers by describing real-world contexts.

    c. Apply properties of operations as strategies to multiply and divide rational numbers.

    d. Convert a rational number to a decimal using long division; know that the decimal form of a rational number terminates in 0s or eventually repeats.

3. Solve real-world and mathematical problems involving the four operations with integers and other rational numbers.[3]

Expressions and Equations   7.EE

A. Use properties of operations to generate equivalent expressions.

1. Apply properties of operations to add, subtract, factor, and expand linear expressions with rational coefficients.
For example, $4x + 2 = 2(2x +1)$ and $-3(x - \frac{5}{3}) = -3x + 5$.

2. Understand that rewriting an expression in different forms in a problem context can shed light on the problem and how the quantities in it are related.
For example, $a + 0.05a = 1.05a$ means that "increase by 5%" is the same as "multiply by 1.05." A shirt at a clothing store is on sale for 20% off the regular price, "p". The discount can be expressed as $0.2p$. The new price for the shirt can be expressed as $p - 0.2p$ or $0.8p$.

B. Solve real-life and mathematical problems using numerical and algebraic expressions and equations.

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.
For example, if a woman making $25 an hour gets a 10% raise, she will make an additional $\frac{1}{10}$ of her salary an hour, or $2.50, for a new salary of $27.50. If you want to place a towel bar 9¾ inches long in the center of a door that is 27½ inches wide, you will need to place the bar about 9 inches from each edge; This estimate can be used as a check on the exact computation.

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.

    a. Solve word problems leading to equations of the form $px + q = r$ and $p(x \div q) = r$, where p, q, and r are specific rational numbers. Solve equations of these forms fluently. Compare an algebraic solution to an arithmetic solution, identifying the sequence of the operations used in each approach.
For example, the perimeter of a rectangle is 54 cm. Its length is 6 cm. What is its width?

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[3] Computations with rational numbers extend the rules for manipulating fractions to complex fractions.

    b. Solve word problems leading to inequalities of the form $px + q > r$ or $px + q < r$, where p, q, and r are specific rational numbers. Graph the solution set of the inequality and interpret it in the context of the problem.
For example, as a salesperson, you are paid $50 per week plus $3 per sale. This week you want your pay to be at least $100. Write an inequality for the number of sales you need to make, and describe the solutions.

    c. Extend analysis of patterns to include analyzing, extending, and determining an expression for simple arithmetic and geometric sequences (e.g., compounding, increasing area), using tables, graphs, words, and expressions.

Geometry 7.G

B. Solve real-life and mathematical problems involving angle measure, area, surface area, and volume.

    4. Circles and measurement:

        a. Know that a circle is a two-dimensional shape created by connecting all of the points equidistant from a fixed point called the center of the circle.

        b. Understand and describe the relationships among the radius, diameter, and circumference of a circle.

        c. Understand and describe the relationship among the radius, diameter, and area of a circle.

        d. Know the formulas for the area and circumference of a circle and use them to solve problems.

        e. Give an informal derivation of the relationship between the circumference and area of a circle.

    6. Solve real-world and mathematical problems involving area, volume, and surface area of two- and three-dimensional objects composed of triangles, quadrilaterals, polygons, cubes, and right prisms.

Statistics and Probability 7.SP

C. Investigate chance processes and develop, use, and evaluate probability models.

    5. Understand that the probability of a chance event is a number between 0 and 1 that expresses the likelihood of the event occurring. Larger numbers indicate greater likelihood. A probability near 0 indicates an unlikely event, a probability around ½ indicates an event that is neither unlikely nor likely, and a probability near 1 indicates a likely event.

    8. Find probabilities of compound events using organized lists, tables, tree diagrams, and simulation.

        a. Understand that, just as with simple events, the probability of a compound event is the fraction of outcomes in the sample space for which the compound event occurs.

        b. Represent sample spaces for compound events using methods such as organized lists, tables, and tree diagrams. For an event described in everyday language (e.g., "rolling double sixes"), identify the outcomes in the sample space which compose the event.

        c. Design and use a simulation to generate frequencies for compound events.
For example, use random digits as a simulation tool to approximate the answer to the question: If 40% of donors have type A blood, what is the probability that it will take at least four donors to find one with type A blood?

Grade 8

Expressions and Equations   8.EE

A. Work with radicals and integer exponents.

1. Know and apply the properties of integer exponents to generate equivalent numerical expressions.
   For example, $3^2 \times 3^{-5} = 3^{-3} = \frac{1}{3^3} = \frac{1}{27}$.

2. Use square root and cube root symbols to represent solutions to equations of the form $x^2 = p$ and $x^3 = p$, where p is a positive rational number. Evaluate square roots of small perfect squares and cube roots of small perfect cubes. Know that $\sqrt{2}$ is irrational.

B. Understand the connections between proportional relationships, lines, and linear equations.

5. Graph proportional relationships, interpreting the unit rate as the slope of the graph. Compare two different proportional relationships represented in different ways.
   For example, compare a distance-time graph to a distance-time equation to determine which of two moving objects has greater speed.

C. Analyze and solve linear equations and pairs of simultaneous linear equations.

7. Solve linear equations in one variable.
   a. Give examples of linear equations in one variable with one solution, infinitely many solutions, or no solutions. Show which of these possibilities is the case by successively transforming the given equation into simpler forms, until an equivalent equation of the form $x = a$, $a = a$, or $a = b$ results (where a and b are different numbers).
   b. Solve linear equations with rational number coefficients, including equations whose solutions require expanding expressions using the distributive property and collecting like terms.

8. Analyze and solve pairs of simultaneous linear equations.
   a. Understand that solutions to a system of two linear equations in two variables correspond to points of intersection of their graphs, because points of intersection satisfy both equations simultaneously.
   b. Solve systems of two linear equations in two variables algebraically (using substitution and elimination strategies), and estimate solutions by graphing the equations. Solve simple cases by inspection.
   For example, $3x + 2y = 5$ and $3x + 2y = 6$ have no solution because $3x + 2y$ cannot simultaneously be 5 and 6.
   c. Solve real-world and mathematical problems leading to two linear equations in two variables.
   For example, given coordinates for two pairs of points, determine whether the line through the first pair of points intersects the line through the second pair.

Functions   8.F

A. Define, evaluate, and compare functions.

1. Understand that a function is a rule that assigns to each input exactly one output. The graph of a function is the set of ordered pairs consisting of an input and the corresponding output.[4]

2. Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions).

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[4] Function notation is not required in grade 8.

> For example, given a linear function represented by a table of values and a linear function represented by an algebraic expression, determine which function has the greater rate of change.

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.

> For example, the function $A = s^2$ giving the area of a square as a function of its side length is not linear because its graph contains the points $(1, 1)$, $(2, 4)$ and $(3, 9)$, which are not on a straight line.

B. Use functions to model relationships between quantities.

4. Construct a function to model a linear relationship between two quantities. Determine the rate of change and initial value of the function from a description of a relationship or from two (x, y) values, including reading these from a table or from a graph. Interpret the rate of change and initial value of a linear function in terms of the situation it models, and in terms of its graph or a table of values.

5. Describe qualitatively the functional relationship between two quantities by analyzing a graph (e.g., where the function is increasing or decreasing, linear or nonlinear). Sketch a graph that exhibits the qualitative features of a function that has been described verbally.

Geometry   8.G

A. Understand congruence and similarity using physical models, transparencies, or geometry software.

2. Understand that a two-dimensional figure is congruent to another if the second can be obtained from the first by a sequence of rotations, reflections, and translations. Given two congruent figures, describe a sequence that exhibits the congruence between them.

4. Understand that a two-dimensional figure is similar to another if the second can be obtained from the first by a sequence of rotations, reflections, translations, and dilations. Given two similar two-dimensional figures, describe a sequence that exhibits the similarity between them.

B. Understand and apply the Pythagorean Theorem.

7. Apply the Pythagorean Theorem to determine unknown side lengths in right triangles in real-world and mathematical problems in two and three dimensions.

Statistics and Probability   8.SP

A. Investigate patterns of association in bivariate data.

3. Use the equation of a linear model to solve problems in the context of bivariate measurement data, interpreting the slope and intercept.

> For example, in a linear model for a biology experiment, interpret a slope of 1.5 cm/hr as meaning that an additional hour of sunlight each day is associated with an additional 1.5 cm in mature plant height.

High School Standards for Mathematical Content: By Conceptual Category

Conceptual Category: Number and Quantity [N]

The Real Number System   N-RN

A. Extend the properties of exponents to rational exponents.

1. Explain how the definition of the meaning of rational exponents follows from extending the properties of integer exponents to those values, allowing for a notation for radicals in terms of rational exponents.

   For example, we define $5^{1/3}$ to be the cube root of 5 because we want $(5^{1/3})3 = 5^{(1/3)3}$ to hold, so $(5^{1/3})^3$ must equal 5.

2. Rewrite expressions involving radicals and rational exponents using the properties of exponents.

Conceptual Category: Algebra [A]

Seeing Structure in Expressions   A-SSE

A. Interpret the structure of linear, quadratic, exponential, polynomial, and rational expressions.

1. Interpret expressions that represent a quantity in terms of its context. ★
   a. Interpret parts of an expression, such as terms, factors, and coefficients.
   b. Interpret complicated expressions by viewing one or more of their parts as a single entity.

   For example, interpret $P(1 + r)^n$ as the product of P and a factor not depending on P.

B. Write expressions in equivalent forms to solve problems.

3. Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression.
   a. Factor a quadratic expression to reveal the zeros of the function it defines.
   b. Complete the square in a quadratic expression to reveal the maximum or minimum value of the function it defines.
   c. Use the properties of exponents to transform expressions for exponential functions.

   For example, the expression 1.15^t can be rewritten as $(1.15^{1/12})^{12t} \approx 1.012^{12t}$ to reveal the approximate equivalent monthly interest rate if the annual rate is 15%.

Arithmetic with Polynomials and Rational Expressions   A-APR

A. Perform arithmetic operations on polynomials.

1. Understand that polynomials form a system analogous to the integers, namely, they are closed under certain operations.
   a. Perform operations on polynomial expressions (addition, subtraction, multiplication, division) and compare the system of polynomials to the system of integers when performing operations.
   b. Factor and/or expand polynomial expressions, identify and combine like terms, and apply the Distributive property.

B. Understand the relationship between zeros and factors of polynomials.

3. Identify zeros of polynomials when suitable factorizations are available, and use the zeros to construct a rough graph of the function defined by the polynomial.

Creating Equations   A-CED

A. Create equations that describe numbers or relationships.

1. Create equations and inequalities in one variable and use them to solve problems. (Include equations arising from linear and quadratic functions, and simple root and rational functions and exponential functions.) ★
2. Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales. ★
3. Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or non-viable options in a modeling context. ★
   For example, represent inequalities describing nutritional and cost constraints on combinations of different foods.
4. ᴿearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations. ★
   For example, rearrange Ohm's law V = IR to highlight resistance, R.

Reasoning with Equations and Inequalities   A-REI

B. Solve equations and inequalities in one variable.

3. Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters.
   a. Solve linear equations and inequalities in one variable involving absolute value.
4. Solve quadratic equations in one variable.
   a. Use the method of completing the square to transform any quadratic equation in x into an equation of the form $(x – p)^2 = q$ that has the same solutions. Derive the quadratic formula from this form.
   b. Solve quadratic equations by inspection (e.g., for $x^2 = 49$), taking square roots, completing the square, the quadratic formula, and factoring, as appropriate to the initial form of the equation. Recognize when the quadratic formula gives complex solutions and write them as $a \pm bi$ for real numbers a and b.

C. Solve systems of equations.

6. Solve systems of linear equations exactly and approximately (e.g., with graphs), focusing on pairs of linear equations in two variables.

D. Represent and solve equations and inequalities graphically.

10. Understand that the graph of an equation in two variables is the set of all its solutions plotted in the coordinate plane, often forming a curve (which could be a line). Show that any point on the graph of an equation in two variables is a solution to the equation.
11. Explain why the x-coordinates of the points where the graphs of the equations $y = f(x)$ and $y = g(x)$ intersect are the solutions of the equation $f(x) = g(x)$; find the solutions approximately, e.g., using technology to graph the functions, make tables of values, or find successive approximations. Include cases where $f(x)$ and/or $g(x)$ are linear, polynomial, rational, absolute value, exponential, and logarithmic functions. ★
12. Graph the solutions of a linear inequality in two variables as a half-plane (excluding the boundary in the case of a strict inequality), and graph the solution set of a system of linear inequalities in two variables as the intersection of the corresponding half-planes.

Conceptual Category: Functions [F]

Interpreting Functions   F-IF

A. Understand the concept of a function and use function notation.

1. Understand that a function from one set (called the domain) to another set (called the range) assigns to each element of the domain exactly one element of the range. If f is a function and x is an element of its domain, then $f(x)$ denotes the output of f corresponding to the input x. The graph of f is the graph of the equation $y = f(x)$.

2. Use function notation, evaluate functions for inputs in their domains, and interpret statements that use function notation in terms of a context. For example, given a function representing a car loan, determine the balance of the loan at different points in time.

B. Interpret functions that arise in applications in terms of the context (linear, quadratic, exponential, rational, polynomial, square root, cube root, trigonometric, logarithmic).

4. For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship. Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity. ★

6. Calculate and interpret the average rate of change of a function (presented symbolically or as a table) over a specified interval. Estimate the rate of change from a graph. ★

C. Analyze functions using different representations.

7. Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases. ★

   a. Graph linear and quadratic functions and show intercepts, maxima, and minima. ★

   b. Graph square root, cube root, and piecewise-defined functions, including step functions and absolute value functions. ★

   c. Graph polynomial functions, identifying zeros when suitable factorizations are available, and showing end behavior. ★

   d. (+) Graph rational functions, identifying zeros and asymptotes when suitable factorizations are available, and showing end behavior. ★

   e. Graph exponential and logarithmic functions, showing intercepts and end behavior, and trigonometric functions, showing period, midline, and amplitude. ★

8. Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function.

   a. Use the process of factoring and/or completing the square in quadratic and polynomial functions, where appropriate, to show zeros, extreme values, and symmetry of the graph, and interpret these in terms of a context.

   b. Use the properties of exponents to interpret expressions for exponential functions. Apply to financial situations such as identifying appreciation and depreciation rate for the value of a house or car some time after its initial purchase. $V_n = P(1+r)^n$

   For example, identify percent rate of change in functions such as $y = (1.02)^t$, $y = (0.97)^t$, $y = (1.01)^{12t}$, and $y = (1.2)^{t/10}$, and classify them as representing exponential growth or decay.

9. Translate among different representations of functions (algebraically, graphically, numerically in tables, or by verbal descriptions). Compare properties of two functions each represented in a different way.

> For example, given a graph of one polynomial function (including quadratic functions) and an algebraic expression for another, say which has the larger/smaller relative maximum and/or minimum.

10. Given algebraic, numeric and/or graphical representations of functions, recognize the function as polynomial, rational, logarithmic, exponential, or trigonometric.

Building Functions
F-BF

A. Build a function that models a relationship between two quantities.

1. Write a function (linear, quadratic, exponential, simple rational, radical, logarithmic, and trigonometric) that describes a relationship between two quantities. ★

    a. Determine an explicit expression, a recursive process, or steps for calculation from a context. ★

    b. Combine standard function types using arithmetic operations. ★

> For example, build a function that models the temperature of a cooling body by adding a constant function to a decaying exponential, and relate these functions to the model.

    c. (+) Compose functions. ★

> For example, if T(y) is the temperature in the atmosphere as a function of height, and h(t) is the height of a weather balloon as a function of time, then T(h(t)) is the temperature at the location of the weather balloon as a function of time.

2. Write arithmetic and geometric sequences both recursively and with an explicit formula, use them to model situations, and translate between the two forms. ★

B. Build new functions from existing functions.

3. Identify the effect on the graph of replacing $f(x)$ by $f(x) + k$, $kf(x, f(kx)$, and $f(x + k)$ for specific values of k (both positive and negative); find the value of k given the graphs. (Include linear, quadratic, exponential, absolute value, simple rational and radical, logarithmic and trigonometric functions.) Utilize technology to experiment with cases and illustrate an explanation of the effects on the graph. (Include recognizing even and odd functions from their graphs and algebraic expressions for them.)

Linear, Quadratic, and Exponential Models   F-LE

A. Construct and compare linear, quadratic, and exponential models and solve problems.

1. Distinguish between situations that can be modeled with linear functions and with exponential functions. ★

    a. Prove that linear functions grow by equal differences over equal intervals, and that exponential functions grow by equal factors over equal intervals. ★

    b. Recognize situations in which one quantity changes at a constant rate per unit interval relative to another. ★

    c. Recognize situations in which a quantity grows or decays by a constant percent rate per unit interval relative to another. ★

2. Construct linear and exponential functions, including arithmetic and geometric sequences, given a graph, a description of a relationship, or two input-output pairs (including reading these from a table). ★

3. Observe, using graphs and tables, that a quantity increasing exponentially eventually exceeds a quantity increasing linearly, quadratically, or (more generally) as a polynomial function. ★

Trigonometric Functions   F-TF

B. Model periodic phenomena with trigonometric functions.

    5. Choose trigonometric functions to model periodic phenomena with specified amplitude, frequency, and midline. ★

Conceptual Category: Geometry [G]

Congruence

G-CO

A. Experiment with transformations in the plane.

    1. Know precise definitions of angle, circle, perpendicular line, parallel line, and line segment, based on the undefined notions of point, line, distance along a line, and distance around a circular arc.

    2. Represent transformations in the plane using, e.g., transparencies and geometry software; describe transformations as functions that take points in the plane as inputs and give other points as outputs. Compare transformations that preserve distance and angle to those that do not (e.g., translation versus horizontal stretch).

    5. Given a geometric figure and a rotation, reflection, or translation, draw the transformed figure using, e.g., graph paper, tracing paper, or geometry software. Specify a sequence of transformations that will carry a given figure onto another.

Similarity, Right Triangles, and Trigonometry   G-SRT

A. Understand similarity in terms of similarity transformations.

    1. Verify experimentally the properties of dilations given by a center and a scale factor:

        a. A dilation takes a line not passing through the center of the dilation to a parallel line, and leaves a line passing through the center unchanged.

        b. The dilation of a line segment is longer or shorter in the ratio given by the scale factor.

B. Prove theorems involving similarity.

    4. Prove theorems about triangles. Theorems include: a line parallel to one side of a triangle divides the other two proportionally, and conversely; the Pythagorean Theorem proved using triangle similarity.

C. Define trigonometric ratios and solve problems involving right triangles.

    6. Understand that by similarity, side ratios in right triangles are properties of the angles in the triangle, leading to definitions of trigonometric ratios for acute angles.

    7. Explain and use the relationship between the sine and cosine of complementary angles.

    8. Use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems. ★

Circles   G-C

B. Find arc lengths and areas of sectors of circles.

    5. Derive using similarity the fact that the length of the arc intercepted by an angle is proportional to the radius, and define the radian measure of the angle as the constant of proportionality; derive the formula for the area of a sector.

Expressing Geometric Properties with Equations   G-GPE

B. Use coordinates to prove simple geometric theorems algebraically.

4. Use coordinates to prove simple geometric theorems algebraically including the distance formula and its relationship to the Pythagorean Theorem.
    For example, prove or disprove that a figure defined by four given points in the coordinate plane is a rectangle; prove or disprove that the **point (1, $\sqrt{3}$) lies on the circle centered at the origin and containing the point (0, 2).**

5. Prove the slope criteria for parallel and perpendicular lines and use them to solve geometric problems (e.g., find the equation of a line parallel or perpendicular to a given line that passes through a given point).

Geometric Measurement and Dimension   G-GMD

A. Explain volume formulas and use them to solve problems.

1. Give an informal argument for the formulas for the circumference of a circle, area of a circle, volume of a cylinder, pyramid, and cone. *Use dissection arguments, Cavalieri's principle, and informal limit arguments.*

5. Use volume formulas for cylinders, pyramids, cones, and spheres to solve problems.★

Modeling with Geometry   G-MG

A. Apply geometric concepts in modeling situations.

1. Use geometric shapes, their measures, and their properties to describe objects (e.g., modeling a tree trunk or a human torso as a cylinder).★

Conceptual Category: Statistics and Probability [S]

Interpreting Categorical and Quantitative Data   S-ID

A. Summarize, represent, and interpret data on a single count or measurement variable. Use calculators, spreadsheets, and other technology as appropriate.

1. Represent data with plots on the real number line (dot plots, histograms, and box plots).★

2. Use statistics appropriate to the shape of the data distribution to compare center (median, mean) and spread (interquartile range, standard deviation) of two or more different data sets.★

3. Interpret differences in shape, center, and spread in the context of the data sets, accounting for possible effects of extreme data points (outliers).★

4. Use the mean and standard deviation of a data set to fit it to a normal distribution and to estimate population percentages. Recognize that there are data sets for which such a procedure is not appropriate. Use calculators, spreadsheets, and tables to estimate areas under the normal curve.★

B. Summarize, represent, and interpret data on two categorical and quantitative variables.

5. Summarize categorical data for two categories in two-way frequency tables. Interpret relative frequencies in the context of the data (including joint, marginal, and conditional relative frequencies). Recognize possible associations and trends in the data.★

6. Represent data on two quantitative variables on a scatter plot, and describe how the variables are related.★
    a. Fit a linear function to the data and use the fitted function to solve problems in the context of the data. Use functions fitted to data or choose a function suggested by the context. Emphasize linear and exponential models.★
    b. Informally assess the fit of a function by plotting and analyzing residuals.★

      c. Fit a linear function for a scatter plot that suggests a linear association.*

C. Interpret linear models.

7. Interpret the slope (rate of change) and the intercept (constant term) of a linear model in the context of the data.*
8. Compute (using technology) and interpret the correlation coefficient of a linear fit.*
9. Distinguish between correlation and causation.*

Making Inferences and Justifying Conclusions   S-IC

A. Understand and evaluate random processes underlying statistical experiments. Use calculators, spreadsheets, and other technology as appropriate.

4. Understand statistics as a process for making inferences about population parameters based on a random sample from that population.*

The High School Standards for Mathematical Content: Standards by Model Course

The mathematical content standards presented above are organized by Conceptual Categories. The tables below show how these conceptual category content standards are distributed across the eight model courses:

- Algebra I (AI)
- Geometry (GEO)
- Algebra II (AII)
- Math I (MI)
- Math II (MII)
- Math III (MIII)
- Precalculus (PC)
- Advanced Quantitative Reasoning (AQR)

Number and Quantity [N]

	A I	GEO	A II	M I	M II	M III	PC	AQR
The Real Number System (N-RN)								
A. Extend the properties of exponents to rational exponents.								
1	✓				✓			
2	✓				✓			

Statistics and Probability [S]

	A I	GEO	A II	M I	M II	M III	PC	AQR
Interpreting Categorical and Quantitative Data (S-ID)								
A. Summarize, represent, and interpret data on a single count or measurement variable. Use calculators, spreadsheets, and other technology as appropriate.								
1	✓			✓				
2	✓			✓				
3	✓			✓				
4	✓		✓			✓		
B. Summarize, represent, and interpret data on two categorical and quantitative variables.								
5	✓			✓				
6	✓			✓				
a	✓			✓				
b	✓			✓				
c	✓			✓				
C. Interpret linear models.								
7	✓			✓				
8	✓			✓				
9	✓			✓				✓
Making Inferences and Justifying Conclusions (S-IC)								
A. Understand and evaluate random processes underlying statistical experiments.								
1			✓			✓		

ALGEBRA [A]

	A I	GEO	A II	M I	M II	M III	PC	AQR
Seeing Structure in Expressions (A-SSE)								
A. Interpret the structure of expressions.								
1	✓		✓	✓	✓	✓		
a	✓		✓	✓	✓	✓		
b	✓		✓	✓	✓	✓		
B. Write expressions in equivalent forms to solve problems.								
3	✓				✓			
a	✓				✓			
b	✓				✓			
c	✓				✓			
Arithmetic with Polynomials and Rational Expressions (A-APR)								
A. Perform arithmetic operations on polynomials.								
1	✓		✓		✓	✓		
a	✓		✓		✓	✓		
b	✓				✓			
B. Understand the relationship between zeros and factors of polynomials.								
3			✓			✓		
Creating Equations (A-CED)								
A. Create equations that describe numbers or relationships.								
1	✓		✓	✓	✓	✓		
2	✓		✓	✓	✓	✓		
3	✓		✓	✓		✓		
4	✓			✓	✓			
Reasoning with Equations and Inequalities (A-REI)								
	A I	GEO	A II	M I	M II	M III	PC	AQR
B. Solve equations and inequalities in one variable.								
3	✓			✓				
a	✓			✓				
4	✓				✓			
a	✓				✓			
b	✓				✓			
C. Solve systems of equations.								
6	✓			✓				
D. Represent and solve equations and inequalities graphically.								
10	✓			✓				
11	✓		✓	✓		✓		
12	✓			✓				

Functions [F]

	A I	GEO	A II	M I	M II	M III	PC	AQR
Interpreting Functions (F-IF)								
A. Understand the concept of a function and use function notation.								
1	✓			✓				
2	✓			✓				
B. Interpret functions that arise in applications in terms of the context (linear, quadratic, exponential, rational, polynomial, square root, cube root, trigonometric, logarithmic).								
4	✓		✓	✓	✓	✓		
6	✓		✓	✓	✓	✓		
C. Analyze functions using different representations.								
7	✓		✓	✓	✓	✓	✓	
a	✓			✓	✓			
b	✓				✓			
c			✓			✓		
d+			✓			✓		
e	✓		✓	✓		✓	✓	
8	✓		✓		✓	✓		
a	✓		✓		✓	✓		
b	✓				✓	✓		
9	✓		✓	✓	✓	✓		
10			✓			✓		
Building Functions (F-BF)								
A. Build a function that models a relationship between two quantities.								
1	✓		✓	✓	✓	✓	✓	
a	✓			✓	✓			
b	✓		✓	✓	✓	✓		
c+							✓	
2	✓			✓				
B. Build new functions from existing functions.								
3	✓		✓	✓	✓	✓		
Linear, Quadratic, and Exponential Models (F-LE)								
A. Construct and compare linear, quadratic, and exponential models and solve problems.								
1	✓			✓				
a	✓			✓				
b	✓			✓				
c	✓			✓				
2	✓			✓				
3	✓			✓	✓			
B. Interpret expressions for functions in terms of the situation they model.								
5	✓			✓				

Geometry [G]

	A I	GEO	A II	M I	M II	M III	PC	AQR
Congruence (G-CO)								
A. Experiment with transformations in the plane.								
1		✓		✓				
2		✓		✓				
5		✓		✓				
Similarity, Right Triangles, and Trigonometry (G-SRT)								
A. Understand similarity in terms of similarity transformations.								
1		✓			✓			
a		✓			✓			
b		✓			✓			
B. Prove theorems involving similarity.								
4		✓			✓			
C. Define trigonometric ratios and solve problems involving right triangles.								
6		✓			✓			
7		✓			✓			
8		✓			✓			
Circles (G-C)								
B. Find arc lengths and areas of sectors of circles.								
5		✓			✓			
Expressing Geometric Properties with Equations (G-GPE)								
B. Use coordinates to prove simple geometric theorems algebraically.								
4		✓			✓			
5		✓		✓				
Geometric Measurement and Dimension (G-GMD)								
A. Explain volume formulas and use them to solve problems.								
1		✓			✓			
3		✓			✓			
Modeling with Geometry (G-MG)								
A. Apply geometric concepts in modeling situations.								
1		✓				✓		