Course: Astronomy Solar/Galactic Honors- 2020910

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BASIC INFORMATION

Course Title:	Astronomy Solar/Galactic Honors
Course Number:	2020910
Course Abbreviated Title:	ASTR S/G HON
Course Path:	**Section:** Grades PreK to 12 Education Courses **Grade Group:** Grades 9 to 12 and Adult Education Courses **Subject:** Science **SubSubject:** Earth/Space Sciences
Number of Credits:	One credit (1)
Course length:	Year (Y)
Course Type:	Core
Course Level:	3
Status:	Draft - Board Approval Pending
General Notes:	While the content focus of this course is consistent with the Astronomy Solar/Galactic course, students will explore these concepts in greater depth. In general, the academic pace and rigor will be greatly increased for honors level course work. Laboratory investigations that include the use of scientific inquiry, research, measurement, problem solving, laboratory apparatus and technologies, experimental procedures, and safety procedures are an integral part of this course. The National Science Teachers Association (NSTA) recommends that at the high school level, all students should be in the science lab or field, collecting data every week. School laboratory investigations (labs) are defined by the National Research Council (NRC) as an experience in the laboratory, classroom, or the field that provides students with opportunities to interact directly with natural phenomena or with data collected by others using tools, materials, data collection techniques, and models (NRC, 2006, p. 3). Laboratory investigations in the high school classroom should help all students develop a growing understanding of the complexity and ambiguity of empirical work, as well as the skills to calibrate and troubleshoot equipment used to make observations. Learners should understand measurement error; and have the skills to aggregate, interpret, and present the resulting data (National Research Council, 2006, p.77; NSTA, 2007). **Special Notes:** Instructional Practices Teaching from a range of complex text is optimized when teachers in all subject areas implement the following strategies on a routine basis: 1. Ensuring wide reading from complex text that varies in length. 2. Making close reading and rereading of texts central to lessons. 3. Emphasizing text-specific complex questions, and cognitively complex tasks, reinforce focus on the text and cultivate independence. 4. Emphasizing students supporting answers based upon evidence from the text. 5. Providing extensive research and writing opportunities (claims and evidence).

STANDARDS (80)

LACC.1112.RST.1.1:	Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account.
LACC.1112.RST.1.2:	Determine the central ideas or conclusions of a text; summarize complex concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms.
LACC.1112.RST.1.3:	Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text.
LACC.1112.RST.2.4:	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 11–12 texts and topics.
LACC.1112.RST.2.5:	Analyze how the text structures information or ideas into categories or hierarchies, demonstrating understanding of the information or ideas.

LACC.1112.RST.2.6:	Analyze the author's purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, identifying important issues that remain unresolved.
LACC.1112.RST.3.7:	Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.
LACC.1112.RST.3.8:	Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information.
LACC.1112.RST.3.9:	Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.
LACC.1112.RST.4.10:	By the end of grade 12, read and comprehend science/technical texts in the grades 11–12 text complexity band independently and proficiently.
MACC.912.S-ID.1.2:	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. Remarks/Examples In grades 6 – 8, students describe center and spread in a data distribution. Here they choose a summary statistic appropriate to the characteristics of the data distribution, such as the shape of the distribution or the existence of extreme data points.
MACC.912.S-ID.1.3:	Interpret differences in shape, center, and spread in the context of the data sets, accounting for possible effects of extreme data points (outliers). Remarks/Examples In grades 6 – 8, students describe center and spread in a data distribution. Here they choose a summary statistic appropriate to the characteristics of the data distribution, such as the shape of the distribution or the existence of extreme data points.
LACC.1112.SL.1.1:	Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grades 11–12 topics, texts, and issues, building on others' ideas and expressing their own clearly and persuasively. a. Come to discussions prepared, having read and researched material under study; explicitly draw on that preparation by referring to evidence from texts and other research on the topic or issue to stimulate a thoughtful, well-reasoned exchange of ideas. b. Work with peers to promote civil, democratic discussions and decision-making, set clear goals and deadlines, and establish individual roles as needed. c. Propel conversations by posing and responding to questions that probe reasoning and evidence; ensure a hearing for a full range of positions on a topic or issue; clarify, verify, or challenge ideas and conclusions; and promote divergent and creative perspectives. d. Respond thoughtfully to diverse perspectives; synthesize comments, claims, and evidence made on all sides of an issue; resolve contradictions when possible; and determine what additional information or research is required to deepen the investigation or complete the task.
LACC.1112.SL.1.2:	Integrate multiple sources of information presented in diverse formats and media (e.g., visually, quantitatively, orally) in order to make informed decisions and solve problems, evaluating the credibility and accuracy of each source and noting any discrepancies among the data.
LACC.1112.SL.1.3:	Evaluate a speaker's point of view, reasoning, and use of evidence and rhetoric, assessing the stance, premises, links among ideas, word choice, points of emphasis, and tone used.
LACC.1112.SL.2.4:	Present information, findings, and supporting evidence, conveying a clear and distinct perspective, such that listeners can follow the line of reasoning, alternative or opposing perspectives are addressed, and the organization, development, substance, and style are appropriate to purpose, audience, and a range of formal and informal tasks.
LACC.1112.SL.2.5:	Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest.
LACC.1112.WHST.3.8:	Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the specific task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation.
LACC.1112.WHST.3.9:	Draw evidence from informational texts to support analysis, reflection, and research.
LACC.1112.WHST.4.10:	Write routinely over extended time frames (time for 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.
LACC.1112.WHST.1.1:	Write arguments focused on *discipline-specific content.* a. Introduce precise, knowledgeable claim(s), establish the significance of the claim(s), distinguish the claim(s) from alternate or opposing claims, and create an organization that logically sequences the claim(s), counterclaims, reasons, and evidence. b. Develop claim(s) and counterclaims fairly and thoroughly, supplying the most relevant data and evidence for each while pointing out the strengths and limitations of both claim(s) and counterclaims in a discipline-

	appropriate form that anticipates the audience's knowledge level, concerns, values, and possible biases. c. Use words, phrases, and clauses as well as varied syntax to link the major sections of the text, create cohesion, and clarify the relationships between claim(s) and reasons, between reasons and evidence, and between claim(s) and counterclaims. d. Establish and maintain a formal style and objective tone while attending to the norms and conventions of the discipline in which they are writing. e. Provide a concluding statement or section that follows from or supports the argument presented.
LACC.1112.WHST.1.2:	Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes. a. Introduce a topic and organize complex ideas, concepts, and information so that each new element builds on that which precedes it to create a unified whole; include formatting (e.g., headings), graphics (e.g., figures, tables), and multimedia when useful to aiding comprehension. b. Develop the topic thoroughly by selecting the most significant and relevant facts, extended definitions, concrete details, quotations, or other information and examples appropriate to the audience's knowledge of the topic. c. Use varied transitions and sentence structures to link the major sections of the text, create cohesion, and clarify the relationships among complex ideas and concepts. d. Use precise language, domain-specific vocabulary and techniques such as metaphor, simile, and analogy to manage the complexity of the topic; convey a knowledgeable stance in a style that responds to the discipline and context as well as to the expertise of likely readers. e. Provide a concluding statement or section that follows from and supports the information or explanation provided (e.g., articulating implications or the significance of the topic).
LACC.1112.WHST.2.4:	Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.
LACC.1112.WHST.2.5:	Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience.
LACC.1112.WHST.2.6:	Use technology, including the Internet, to produce, publish, and update individual or shared writing products in response to ongoing feedback, including new arguments or information.
LACC.1112.WHST.3.7:	Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.
MACC.912.F-IF.2.4:	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.* Remarks/Examples **Algebra 1, Unit 2**: For F.IF.4 and 5, focus on linear and exponential functions. **Algebra 1 Assessment Limits and Clarifications** i) Tasks have a real-world context. ii) Tasks are limited to linear functions, quadratic functions, square root functions, cube root functions, piecewise-defined functions (including step functions and absolute value functions), and exponential functions with domains in the integers. Compare note (ii) with standard F-IF.7. The function types listed here are the same as those listed in the Algebra I column for standards F-IF.6 and F-IF.9. **Algebra 2 Assessment Limits and Clarifications** i) Tasks have a real-world context ii) Tasks may involve polynomial, exponential, logarithmic, and trigonometric functions. Compare note (ii) with standard F-IF.7. The function types listed here are the same as those listed in the Algebra II column for standards F-IF.6 and F-IF.9.
MACC.912.F-IF.3.7:	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. Remarks/Examples Algebra 1, Unit 2: For F.IF.7a, 7e, and 9 focus on linear and exponentials functions. Include comparisons of two functions presented algebraically. For example, compare the growth of two linear functions, or two exponential functions such as $y=3^n$ and $y=100^2$
MACC.912.G-MG.1.2:	Apply concepts of density based on area and volume in modeling situations (e.g., persons per square mile, BTUs per cubic foot).
MACC.912.N-Q.1.1:	Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays. Remarks/Examples Algebra 1, Unit 1: Working with quantities and the relationships between them provides grounding for work with expressions, equations, and functions.
MACC.912.N-Q.1.3:	Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. Remarks/Examples Algebra 1, Unit 1: Working with quantities and the relationships between them provides grounding for work with expressions, equations, and functions.
MACC.912.S-IC.2.6:	Evaluate reports based on data.
MACC.912.S-ID.1.1:	Represent data with plots on the real number line (dot plots, histograms, and box plots). Remarks/Examples In grades 6 – 8, students describe center and spread in a data distribution. Here they choose a summary statistic appropriate to the characteristics of the data distribution, such as the shape of the distribution or the existence of extreme data points.
MACC.912.S-ID.1.4:	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.
MACC.912.S-ID.2.5:	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.
MACC.912.S-ID.2.6:	Represent data on two quantitative variables on a scatter plot, and describe how the variables are related. a. Fit a function to the data; use functions fitted to data to solve problems in the context of the data. *Use given functions or choose a function suggested by the context. Emphasize linear, quadratic, 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. Remarks/Examples Students take a more sophisticated look at using a linear function to model the relationship between two numerical variables. In addition to fitting a line to data, students assess how well the model fits by analyzing residuals. S.ID.6b should be focused on linear models, but may be used to preview quadratic functions in Unit 5 of this course. **Algebra 1 Assessment Limits and Clarifications** i) Tasks have a real-world context. ii) Exponential functions are limited to those with domains in the integers. **Algebra 2 Assessment Limits and Clarifications** i) Tasks have a real-world context. ii) Tasks are limited to exponential functions with domains not in the integers and trigonometric functions.
SC.912.E.5.10:	Describe and apply the coordinate system used to locate objects in the sky. Remarks/Examples Discuss how scientists determine the location of constellations, celestial spheres, and sky maps. Compare and contrast the celestial coordinate system (equatorial system) to the use of latitude and longitude to specify

	locations on Earth. Recognize the use of right ascension and declination in the location of objects in space, including stars and constellations.
SC.912.E.5.11:	Distinguish the various methods of measuring astronomical distances and apply each in appropriate situations. Remarks/Examples Determine which units of measurement are appropriate to describe distance (e.g. astronomical units, parallax, and light years). CCSS Connections: MACC.K12.MP.5: Use appropriate tools strategically; and MACC.K12.MP.6: Attend to precision.
SC.912.E.5.7:	Relate the history of and explain the justification for future space exploration and continuing technology development. Remarks/Examples Identify examples of historical space exploration (e.g. telescopes, high altitude balloons, lunar landers, deep-space probes, space station) that had significant impact on current space exploration and recognize the importance of continued exploration in space.
SC.912.E.5.8:	Connect the concepts of radiation and the electromagnetic spectrum to the use of historical and newly-developed observational tools. Remarks/Examples Describe how frequency is related to the characteristics of electromagnetic radiation and recognize how spectroscopy is used to detect and interpret information from electromagnetic radiation sources.
SC.912.E.5.9:	Analyze the broad effects of space exploration on the economy and culture of Florida. Remarks/Examples Recognize the economic, technical and social benefits of spinoff technology developed through the space program.
SC.912.E.6.2:	Connect surface features to surface processes that are responsible for their formation. Remarks/Examples Identify various landforms (e.g. dunes, lakes, sinkholes, aquifers) and describe how they form (erosion, physical/chemical weathering, and deposition). Explain how sea level changes over time have exposed and inundated continental shelves, created and destroyed inland seas, and shaped the surface of the Earth.
SC.912.E.7.7:	Identify, analyze, and relate the internal (Earth system) and external (astronomical) conditions that contribute to global climate change. Remarks/Examples Explain the possible natural (e.g. increased global temperature, wildfires, volcanic dust) and anthropogenic mechanisms (e.g. air pollution, acid rain, greenhouse gases, burning of fossil fuels) and the effects of these mechanisms on global climate change.
SC.912.N.1.1:	Define a problem based on a specific body of knowledge, for example: biology, chemistry, physics, and earth/space science, and do the following: 1. **Pose questions about the natural world,** (Articulate the purpose of the investigation and identify the relevant scientific concepts). 2. **Conduct systematic observations,** (Write procedures that are clear and replicable. Identify observables and examine relationships between test (independent) variable and outcome (dependent) variable. Employ appropriate methods for accurate and consistent observations; conduct and record measurements at appropriate levels of precision. Follow safety guidelines). 3. **Examine books and other sources of information to see what is already known,** 4. **Review what is known in light of empirical evidence,** (Examine whether available empirical evidence can be interpreted in terms of existing knowledge and models, and if not, modify or develop new models). 5. **Plan investigations,** (Design and evaluate a scientific investigation). 6. **Use tools to gather, analyze, and interpret data (this includes the use of measurement in metric and other systems, and also the generation and interpretation of graphical representations of data, including data tables and graphs),** (Collect data or evidence in an organized way. Properly use instruments, equipment, and materials (e.g., scales, probeware, meter sticks, microscopes, computers) including set-up, calibration, technique, maintenance, and storage). 7. **Pose answers, explanations, or descriptions of events,** 8. **Generate explanations that explicate or describe natural phenomena (inferences),** 9. **Use appropriate evidence and reasoning to justify these explanations to others,** 10. **Communicate results of scientific investigations, and** 11. **Evaluate the merits of the explanations produced by others.** Remarks/Examples Common Core State Standards (CCSS) Connections for 6-12 Literacy in Science

	For Students in Grades 9-10 LACC.910.RST.1.1 Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions. LACC.910.RST.1.3 Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks attending to special cases or exceptions defined in the text. LACC.910.RST.3.7 Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words. LACC.910.WHST.1.2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes. LACC.910.WHST.3.9 Draw evidence from informational texts to support analysis, reflection, and research. For Students in Grades 11-12 LACC.1112.RST.1.1 Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. LACC.1112.RST.1.3 Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text. LACC.1112.RST.3.7 Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem. LACC.1112.WHST.1.2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes. LACC.1112.WHST.3.9 Draw evidence from informational texts to support analysis, reflection, and research. Common Core State Standards (CCSS) Connections for Mathematical Practices MACC.K12.MP.1: Make sense of problems and persevere in solving them. MACC.K12.MP.2: Reason abstractly and quantitatively. MACC.K12.MP.3: Construct viable arguments and critique the reasoning of others. [Viable arguments include evidence.] MACC.K12.MP.4: Model with mathematics. MACC.K12.MP.5: Use appropriate tools strategically. MACC.K12.MP.6: Attend to precision. MACC.K12.MP.7: Look for and make use of structure. MACC.K12.MP.8: Look for and express regularity in repeated reasoning.
SC.912.N.1.2:	Describe and explain what characterizes science and its methods. Remarks/Examples Science is characterized by empirical observations, testable questions, formation of hypotheses, and experimentation that results in stable and replicable results, logical reasoning, and coherent theoretical constructs. CCSS Connections: MACC.K12.MP.3: Construct viable arguments and critique the reasoning of others.
SC.912.N.1.3:	Recognize that the strength or usefulness of a scientific claim is evaluated through scientific argumentation, which depends on critical and logical thinking, and the active consideration of alternative scientific explanations to explain the data presented. Remarks/Examples Assess the reliability of data and identify reasons for inconsistent results, such as sources of error or uncontrolled conditions. CCSS Connections: MACC.K12.MP.2: Reason abstractly and quantitatively; MACC.K12.MP.3: Construct viable arguments and critique the reasoning of others
SC.912.N.1.4:	Identify sources of information and assess their reliability according to the strict standards of scientific investigation. Remarks/Examples Read, interpret, and examine the credibility and validity of scientific claims in different sources of information, such as scientific articles, advertisements, or media stories. Strict standards of science include controlled variables, sufficient sample size, replication of results, empirical and measurable evidence, and the concept of falsification. CCSS Connections: LACC.910.RST.1.1 / LACC.1112.RST.1.1.
SC.912.N.1.5:	Describe and provide examples of how similar investigations conducted in many parts of the world result in the same outcome. Remarks/Examples Recognize that contributions to science can be made and have been made by people from all over the world.
SC.912.N.1.6:	Describe how scientific inferences are drawn from scientific observations and provide examples from the content

	being studied. Remarks/Examples Collect data/evidence and use tables/graphs to draw conclusions and make inferences based on patterns or trends in the data. CCSS Connections: MACC.K12.MP.1: Make sense of problems and persevere in solving them.
SC.912.N.1.7:	Recognize the role of creativity in constructing scientific questions, methods and explanations. Remarks/Examples Work through difficult problems using creativity, and critical and analytical thinking in problem solving (e.g. convergent versus divergent thinking and creativity in problem solving). CCSS Connections: MACC.K12.MP.1: Make sense of problems and persevere in solving them; and MACC.K12.MP.2: Reason abstractly and quantitatively.
SC.912.N.2.1:	Identify what is science, what clearly is not science, and what superficially resembles science (but fails to meet the criteria for science). Remarks/Examples Science is the systematic and organized inquiry that is derived from observations and experimentation that can be verified or tested by further investigation to explain natural phenomena (e.g. Science is testable, pseudo-science is not; science seeks falsifications, pseudo-science seeks confirmations.)
SC.912.N.2.2:	Identify which questions can be answered through science and which questions are outside the boundaries of scientific investigation, such as questions addressed by other ways of knowing, such as art, philosophy, and religion. Remarks/Examples Identify scientific questions that can be disproved by experimentation/testing. Recognize that pseudoscience is a claim, belief, or practice which is presented as scientific, but does not adhere to strict standards of science (e.g. controlled variables, sample size, replicability, empirical and measurable evidence, and the concept of falsification). CCSS Connections: MACC.K12.MP.3: Construct viable arguments and critique the reasoning of others.
SC.912.N.2.3:	Identify examples of pseudoscience (such as astrology, phrenology) in society. Remarks/Examples Determine if the phenomenon (event) can be observed, measured, and tested through scientific experimentation.
SC.912.N.2.4:	Explain that scientific knowledge is both durable and robust and open to change. Scientific knowledge can change because it is often examined and re-examined by new investigations and scientific argumentation. Because of these frequent examinations, scientific knowledge becomes stronger, leading to its durability. Remarks/Examples Recognize that ideas with the most durable explanatory power become established theories, but scientific explanations are continually subjected to change in the face of new evidence. CCSS Connections: MACC.K12.MP.1: Make sense of problems and persevere in solving them; MACC.K12.MP.3: Construct viable arguments and critique the reasoning of others.
SC.912.N.2.5:	Describe instances in which scientists' varied backgrounds, talents, interests, and goals influence the inferences and thus the explanations that they make about observations of natural phenomena and describe that competing interpretations (explanations) of scientists are a strength of science as they are a source of new, testable ideas that have the potential to add new evidence to support one or another of the explanations. Remarks/Examples Recognize that scientific questions, observations, and conclusions may be influenced by the existing state of scientific knowledge, the social and cultural context of the researcher, and the observer's experiences and expectations. Identify possible bias in qualitative and quantitative data analysis.
SC.912.N.3.1:	Explain that a scientific theory is the culmination of many scientific investigations drawing together all the current evidence concerning a substantial range of phenomena; thus, a scientific theory represents the most powerful explanation scientists have to offer. Remarks/Examples Explain that a scientific theory is a well-tested hypothesis supported by a preponderance of empirical evidence. CCSS Connections: MACC.K12.MP.1: Make sense of problems and persevere in solving them; and, MACC.K12.MP.3: Construct viable arguments and critique the reasoning of others.
SC.912.N.3.2:	Describe the role consensus plays in the historical development of a theory in any one of the disciplines of science.

	Remarks/Examples Recognize that scientific argument, disagreement, discourse, and discussion create a broader and more accurate understanding of natural processes and events. CCSS Connections: MACC.K12.MP.3: Construct viable arguments and critique the reasoning of others.
SC.912.N.3.3:	Explain that scientific laws are descriptions of specific relationships under given conditions in nature, but do not offer explanations for those relationships. Remarks/Examples Recognize that a scientific theory provides a broad explanation of many observed phenomena while a scientific law describes how something behaves.
SC.912.N.3.4:	Recognize that theories do not become laws, nor do laws become theories; theories are well supported explanations and laws are well supported descriptions. Remarks/Examples Recognize that theories do not become laws, theories explain laws. Recognize that not all scientific laws have accompanying explanatory theories.
SC.912.N.3.5:	Describe the function of models in science, and identify the wide range of models used in science. Remarks/Examples Describe how models are used by scientists to explain observations of nature. CCSS Connections: MACC.K12.MP.4: Model with mathematics.
SC.912.N.4.1:	Explain how scientific knowledge and reasoning provide an empirically-based perspective to inform society's decision making. Remarks/Examples Recognize that no single universal step-by-step scientific method captures the complexity of doing science. A number of shared values and perspectives characterize a scientific approach. MACC.K12.MP.1: Make sense of problems and persevere in solving them, and MACC.K12.MP.2: Reason abstractly and quantitatively.
SC.912.N.4.2:	Weigh the merits of alternative strategies for solving a specific societal problem by comparing a number of different costs and benefits, such as human, economic, and environmental. Remarks/Examples Identify examples of technologies, objects, and processes that have been modified to advance society, and explain why and how they were modified. Discuss ethics in scientific research to advance society (e.g. global climate change, historical development of medicine and medical practices). CCSS Connections: MACC.K12.MP.1: Make sense of problems and persevere in solving them, and MACC.K12.MP.2: Reason abstractly and quantitatively.
SC.912.P.10.10:	Compare the magnitude and range of the four fundamental forces (gravitational, electromagnetic, weak nuclear, strong nuclear). Remarks/Examples Recognize and discuss the effect of each force on the structure of matter and the evidence for it.
SC.912.P.10.11:	Explain and compare nuclear reactions (radioactive decay, fission and fusion), the energy changes associated with them and their associated safety issues. Remarks/Examples Identify the three main types of radioactive decay (alpha, beta, and gamma) and compare their properties (composition, mass, charge, and penetrating power). Explain the concept of half-life for an isotope (e.g. C-14 is used to determine the age of objects) and calculate the amount of a radioactive substance remaining after an integral number of half-lives have passed. Recognize that the energy release per gram of material is much larger in nuclear fusion or fission reactions than in chemical reactions due to the large amount of energy related to small amounts of mass by equation E=mc^2.
SC.912.P.10.18:	Explore the theory of electromagnetism by comparing and contrasting the different parts of the electromagnetic spectrum in terms of wavelength, frequency, and energy, and relate them to phenomena and applications. Remarks/Examples Describe the electromagnetic spectrum (i.e., radio waves, microwaves, infrared, visible light, ultraviolet, X-rays and gamma rays) in terms of frequency, wavelength and energy. Solve problems involving wavelength, frequency, and energy.
SC.912.P.10.19:	Explain that all objects emit and absorb electromagnetic radiation and distinguish between objects that are blackbody radiators and those that are not.
SC.912.P.10.20:	Describe the measurable properties of waves and explain the relationships among them and how these

	properties change when the wave moves from one medium to another. Remarks/Examples Describe the measurable properties of waves (velocity, frequency, wavelength, amplitude, period, reflection and refraction) and explain the relationships among them. Recognize that the source of all waves is a vibration and waves carry energy from one place to another. Distinguish between transverse and longitudinal waves in mechanical media, such as springs and ropes, and on the earth (seismic waves). Describe sound as a longitudinal wave whose speed depends on the properties of the medium in which it propagates.
SC.912.P.10.21:	Qualitatively describe the shift in frequency in sound or electromagnetic waves due to the relative motion of a source or a receiver. Remarks/Examples Describe the apparent change in frequency of waves due to the motion of a source or a receiver (the Doppler effect).
SC.912.P.10.22:	Construct ray diagrams and use thin lens and mirror equations to locate the images formed by lenses and mirrors. Remarks/Examples Use examples such as converging/diverging lenses and convex/concave mirrors. Use a ray diagram to determine the approximate location and size of the image, and the mirror equation to obtain numerical information about image distance and image size.
SC.912.P.10.4:	Describe heat as the energy transferred by convection, conduction, and radiation, and explain the connection of heat to change in temperature or states of matter.
SC.912.P.10.9:	Describe the quantization of energy at the atomic level. Remarks/Examples Explain that when electrons transition to higher energy levels they absorb energy, and when they transition to lower energy levels they emit energy. Recognize that spectral lines are the result of transitions of electrons between energy levels that correspond to photons of light with an energy and frequency related to the energy spacing between levels (Planck's relationship $E = hv$).
SC.912.P.12.2:	Analyze the motion of an object in terms of its position, velocity, and acceleration (with respect to a frame of reference) as functions of time. Remarks/Examples Solve problems involving distance, velocity, speed, and acceleration. Create and interpret graphs of 1-dimensional motion, such as position versus time, distance versus time, speed versus time, velocity versus time, and acceleration versus time where acceleration is constant. CCSS Connections: MACC.912.N-VM.3 (+) Solve problems involving velocity and other quantities that can be represented by vectors.
SC.912.P.12.3:	Interpret and apply Newton's three laws of motion. Remarks/Examples Explain that when the net force on an object is zero, no acceleration occurs; thus, a moving object continues to move at a constant speed in the same direction, or, if at rest, it remains at rest (Newton's first law). Explain that when a net force is applied to an object its motion will change, or accelerate (according to Newton's second law, $F = ma$). Predict and explain how when one object exerts a force on a second object, the second object always exerts a force of equal magnitude but of opposite direction and force back on the first: $F_{1 \text{ on } 2} = -F_{1 \text{ on } 1}$ (Newton's third law).
SC.912.P.12.4:	Describe how the gravitational force between two objects depends on their masses and the distance between them. Remarks/Examples Describe Newton's law of universal gravitation in terms of the attraction between two objects, their masses, and the inverse square of the distance between them.
SC.912.P.12.6:	Qualitatively apply the concept of angular momentum. Remarks/Examples Explain that angular momentum is rotational analogy to linear momentum (e.g. Because angular momentum is conserved, a change in the distribution of mass about the axis of rotation will cause a change in the rotational speed [ice skater spinning]).
SC.912.P.12.7:	Recognize that nothing travels faster than the speed of light in vacuum which is the same for all observers no matter how they or the light source are moving. Remarks/Examples Recognize that regardless of the speed of an observer or source, *in a vacuum* the speed of light is always *c*.
SC.912.P.12.8:	Recognize that Newton's Laws are a limiting case of Einstein's Special Theory of Relativity at speeds that are much smaller than the speed of light. Remarks/Examples

	Recognize that the speed of light in any reference frame is the central postulate of the Special Theory of Relativity. As speeds approach zero, Special Relativity tends towards equivalence with Newton's Laws of Motion.
SC.912.P.12.9:	Recognize that time, length, and energy depend on the frame of reference. Remarks/Examples The energy *E* and the momentum *p* depend on the frame of reference in which they are measured (e.g. Lorentz contraction).
SC.912.P.8.1:	Differentiate among the four states of matter. Remarks/Examples Differentiate among the four states of matter (solid, liquid, gas and plasma) in terms of energy, particle motion, and phase transitions. (Note: Currently five states of matter have been identified.)
SC.912.P.8.4:	Explore the scientific theory of atoms (also known as atomic theory) by describing the structure of atoms in terms of protons, neutrons and electrons, and differentiate among these particles in terms of their mass, electrical charges and locations within the atom. Remarks/Examples Explain that electrons, protons and neutrons are parts of the atom and that the nuclei of atoms are composed of protons and neutrons, which experience forces of attraction and repulsion consistent with their charges and masses. CCSS Connections: MACC.K12.MP.4: Model with mathematics.

RELATED GLOSSARY TERM DEFINITIONS (58)

Acceleration:	Rate of change in velocity, usually expressed in meters per second per second; involves an increase or decrease in speed and/or a change in direction.
Acid:	A substance that increases the H+ concentration when added to a water solution Acids turn blue litmus paper red, have a pH of less than 7, and their aqueous solutions react with bases and certain metals to form salts.
Angular momentum:	A vector quantity that is a measure of the rotational momentum of a rotating body or system, that is equal in classical physics to the product of the angular velocity of the body or system and its moment of inertia with respect to the rotation axis, and that is directed along the rotation axis.
Atom:	The smallest unit of a chemical element that can still retain the properties of that element.
Attraction :	The electric or magnetic force exerted by oppositely charged particles, tending to draw or hold the particles together.
Axis:	The imaginary line on which an object rotates (e.g., Earth's axis runs through Earth between the North Pole and the South Pole); an imaginary straight line that runs through a body; a reference to the line in a coordinate system or graph.
Conduction:	The transmission of heat through a medium and without the motion of the medium.
Convection:	Heat transfer in a gas or liquid by the circulation of currents from one region to another.
Current :	The amount of electric charge flowing past a specified circuit point per unit time.
Deposition:	The process by which sediment is carried by forces (e.g., wind, rain, or water currents) and left in a certain area.
Dune:	A hill or ridge of sand piled up by the wind.
Electromagnetic radiation:	The emission and propagation of the entire range of the electromagnetic spectrum, including: gamma rays, x-rays, ultraviolet radiation, visible light, microwaves, and radio waves.
Electromagnetic spectrum:	The entire range of electromagnetic radiation. At one end of the spectrum are gamma rays, which have the shortest wavelengths and high frequencies. At the other end are radio waves, which have the longest wavelengths and low frequencies. Visible light is near the center of the spectrum.
Electron:	A stable elementary particle in the lepton family having a mass at rest of 9.107 × 10^-28 grams and an electric charge of approximately -1.602 × 10^-19 coulombs. Electrons orbit about the positively charged nuclei of atoms in distinct orbitals of different energy levels, called shells.
Energy:	The capacity to do work.
Environment:	The sum of conditions affecting an organism, including all living and nonliving things in an area, such as plants, animals, water, soil, weather, landforms, and air.
Erosion:	The wearing away of Earth's surface by the breakdown and transportation of rock and soil.
Experiment:	A procedure that is carried out and repeated under controlled conditions in order to discover, demonstrate, or test a hypothesis.

Fission :	The process by which an atomic nucleus splits into two or more large fragments of comparable mass, simultaneously producing additional neutrons and vast amounts of energy; or, a process by which single-cell organisms reproduce asexually.
Force:	A vector quantity that exists between two objects and, when unbalanced by another force, causes changes in velocity of objects in the direction of its application; a push or pull.
Fossil:	A whole or part of an organism that has been preserved in sedimentary rock.
Frame of reference:	A set of coordinate axes in terms of which position or movement may be specified or with reference to which physical laws may be mathematically stated.
Frequency:	The number of cycles or waves per unit time.
Fusion :	The process by which two lighter atomic nuclei combine at extremely high temperatures to form a heavier nucleus and release vast amounts of energy.
Gas:	One of the fundamental states of matter in which the molecules do not have a fixed volume or shape.
Heat:	Energy that transfers between substances because of a temperature difference between the substances; the transfer of energy is always from the warmer substance to the cooler substance
Hypothesis :	A tentative explanation for an observation, phenomenon, or scientific problem that can be tested by further investigation.
Inference :	The act of reasoning from factual knowledge or evidence.
Infrared :	Relating to the invisible part of the electromagnetic spectrum with wavelengths longer than those of visible red light but shorter than those of microwaves.
Investigation :	A systematic process that uses various types of data and logic and reasoning to better understand something or answer a question.
Latitude:	A measure of relative position north or south on the Earth's surface, measured in degrees from the equator, which has a latitude of 0°, with the poles having a latitude of 90° north and south.
Law :	A statement that describes invariable relationships among phenomena under a specified set of conditions.
Light:	Electromagnetic radiation that lies within the visible range.
Liquid:	One of the fundamental states of matter with a definite volume but no definite shape.
Mass:	The amount of matter an object contains.
Matter:	Substance that possesses inertia and occupies space, of which all objects are constituted.
Microscope:	An instrument with lenses and light that is used to observe objects too small to be visible with only the eyes.
Model :	A systematic description of an object or phenomenon that shares important characteristics with the object or phenomenon. Scientific models can be material, visual, mathematical, or computational and are often used in the construction of scientific theories.
Momentum:	A vector quantity that is the product of an object’s mass and velocity.
Motion:	The act or process of changing position and/or direction.
Neutron:	A subatomic particle having zero charge, found in the nucleus of an atom.
Nuclear reaction:	A process, such as fission, fusion, or radioactive decay, in which the structure of an atomic nucleus is altered through release of energy or mass or by being broken apart.
Nucleus:	The center region of an atom where protons and neutrons are located; also a cell structure that contains the cell genetic material of the cell.
Observation :	What one has observed using senses or instruments.
Proton:	A subatomic particle having a positive charge and which is found in the nucleus of an atom.
Radiation:	Emission of energy in the form of rays or waves.
Relativity (special theory of):	The physical theory of space and time developed by Albert Einstein, based on the postulates that all the laws of physics are equally valid in all frames of reference moving at a uniform velocity and that the speed of light from a uniformly moving source is always the same, regardless of how fast or slow the source or its observer is moving. The theory has as consequences the relativistic mass increase of rapidly moving objects, the Lorentz-Fitzgerald contraction, time dilatation, and the principle of mass-energy equivalence.
Scientist:	A person with expert knowledge of one or more sciences, that engages in processes to acquire and communicate knowledge.
Space:	The limitless expanse where all objects and events occur. Outer space is the region of the universe beyond Earth's atmosphere.
Speed of light:	A fundamental physical constant that is the speed at which electromagnetic radiation propagates in a vacuum and that has a value fixed by international convention of 299,792,458 meters per second.
Theory :	A set of statements or principles devised to explain a group of facts or phenomena, especially one that has been repeatedly tested or is widely accepted and can be used to make predictions about natural phenomena.
Ultraviolet :	Relating to electromagnetic radiation having frequencies higher than those of visible light but lower than those of x-rays, approximately 1015 -1016 hertz.

Vacuum:	A space empty of matter.
Variable:	An event, condition, or factor that can be changed or controlled in order to study or test a hypothesis in a scientific experiment.
Velocity:	The time rate at which a body changes its position vector; quantity whose magnitude is expressed in units of distance over time.
Vibration:	A periodic and repetitive movement around an equilibrium point.
Wavelength:	The distance between crests of a wave.
X-ray:	A high-energy stream of electromagnetic radiation having a frequency higher than that of ultraviolet light but less than that of a gamma ray (in the range of approximately 1016 - 1019 hertz).