Course: Physical Science Honors
Course Code: 2003320

Quarter: 1

Topic(s) of Study: Approaches to Science

Bodies of Knowledge: Nature of Science

Standards: The Practice of Science, The Characteristics of Scientific Knowledge, The Role of Theories, Laws, Hypotheses, and Models , Science and Society

Essential Questions: How do scientists design an investigation to answer a scientific question and communicate their findings? Why is scientific argumentation necessary in scientific inquiry and what role does in play in the generation and validation of scientific knowledge?

RESOURCES COMMON CORE PACING GUIDE

Next Generation Sunshine State Standards	Outline of Content/Concept	Targets
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(Cognitive Complexity: High): 1. Pose questions about the natural world, 2. Conduct systematic observations, 3. Examine books and other sources of information to see what is already known, 4. Review what is known in light of empirical evidence, 5. Plan investigations, 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), 7. Pose answers, explanations, or descriptions of events 8. Generate explanations that explicate or describe natural phenomena (inferences)	**I. What is science?** A. Science is the study of the natural world around us 1. Pure Science 2. Pseudoscience a. Astrology b. Phrenology 3. Answers questions that deal with the natural world unlike religion, art, and philosophy 4. Provides an empirically-based perspective to inform society's decision making B. Scientists come from all walks of life and they explore questions that arise in a variety of ways: 1. Observation a. Can lead to inference which can be studied 2. Empirical Evidence 3. Systematic Investigations a. Field investigation i. Descriptive ii. Comparative iii. Correlative b. Controlled Investigations 4. Experimentation	• Define a scientific problem or question based on the specific body of knowledge correlated to the physical science honors course. • Develop a hypothesis with one independent variable (tested variable). • Determine tools and methods that should be used to collect valid data. • Distinguish between dependent variables (outcome variable), independent variables (tested variable), controls, and variables that are held constant in a variety of activities. • Determine how data will be collected to analyze the data. • Collect, organize, and analyze data sets, determine the best format for the data and present visual summaries from the following: bar graphs, line graphs, scatter plots, cumulative frequency graphs.

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. **SC.912.N.1.2** Describe and explain what characterizes science and its methods. Cognitive Complexity: Moderate **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. Cognitive Complexity: Low **SC.912.N.1.4** Identify sources of information and assess their reliability according to the strict standards of scientific investigation. Cognitive Complexity: High **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. Cognitive Complexity: Moderate **SC.912.N.1.6** Describe how scientific inferences are drawn from scientific observations and provide examples from the content being studied. Cognitive Complexity: Moderate **SC.912.N.1.7** Recognize the role of creativity in constructing scientific questions, methods and explanations. Cognitive Complexity: Low	5. Inquiry 6. Research a. Quantitative b. Qualitative 7. Lab Safety C. Scientists finding are presented as 1. Theories 2. Laws 3. Models: a. Visual/Physical b. Conceptual c. Mathematical d. Benefits e. Limitations 4. Must be replicable by other scientists around the world D. Scientists communicate their findings with the scientific community 1. Debate 2. Confirmation E. Research background information on topic 1. Address reliable research materials 2. Address how to cite sources accurately 3. Address Plagiarism F. Scientific knowledge is open to change 1. It is reexamined with rigor 2. Becomes stronger with each examination 3. Becomes more durable through experimentation 4. Increases with increased technology **II. Scientists background can** 1. Influence their inferences based on data 2. Strengthen current lines of thinking through debate and argumentation 3. Generate new testable ideas	• Calculate and determine the % error of the data. • Collect and organize data in charts, tables, and graphics. • Describe the effects of technology on environmental quality. • Students will be able to determine the difference between an experiment and other scientific investigations. • Explain that science is based on evidence based facts. • Differentiate between science and pseudoscience. • Explain why models are used in science to observe processes that happen too slowly, too quickly, or are too small or vast for direct observation. • Give examples of visual/physical, mathematical, and conceptual models as used in science. • Describe the limitations and misconceptions perceived by models. • Identify reliable sources of information and assess their reliability according to the strict standards of scientific investigation while conducting research. • Use appropriate reference materials to support scientific investigations of various types, such as systematic observation or experiment. • Explain why scientific investigations should be replicable. • Conduct, discuss, and compare similar investigations by working cooperatively in groups. • Recognize systematic inference as one form of scientific investigation.

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). Cognitive Complexity: High **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. Cognitive Complexity: High **SC.912.N.2.3** Identify examples of pseudoscience (such as astrology, phrenology) in society. Cognitive Complexity: Low **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. Cognitive Complexity: High **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. Cognitive Complexity: High	**III. Theory** 1. Culmination of many investigations 2. Draws together the current evidence on a particular phenomenon 3. Represents the most powerful explanation scientists have to offer. 4. Will never become laws of science 5. Well supported **explanation** **IV. Laws** 1. Descriptions of particular relationships under specific conditions in nature 2. Are not derived from theories 3. Do not offer explanations for these relationships 4. Well supported **descriptions** **V. Costs and benefits of alternative strategies for problem solving** 1. Human 2. Economic 3. Environmental **VI. Experimental Design** 1. Ask a question 2. Plan investigation a. Identify independent variable (**test variable**) b. Determine the dependent variable (**outcome variable**) c. Identify constants d. Ensure you have a control group 3. Research background information on topic a. Address appropriate research materials 4. Address how to cite	• Describe the creative means scientists must use to design an investigation. • Justify conclusions based upon all the available evidence, not on expressed opinions. • Distinguish science from other activities involving thought. • Explain that scientific knowledge is durable because it is open to change as new evidence or interpretations are encountered. • Recognize, identify and know how to safely and accurately use lab equipment. • Identify the safety equipment in the science lab/classroom (safety shower, fire extinguisher, fire blanket, hood, eye wash, first aid kit, gloves, sharps container, MSDS sheets). • Identify and find the following information such as chemical name, hazardous components, health hazards, first aid and emergency procedures using MSDS sheets. • Identify protective clothing worn in the lab: safety goggles, aprons, gloves. • Recognize that different types of wastes are disposed of in specific ways. • Recognize the importance of the lab safety contract and explain why parent and student signatures are required. • Recognize that scientists who make contributions to scientific knowledge come from all kinds of backgrounds and possess varied talents, interests, and goals. • Distinguish between a scientific theory and a general claim.

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. Cognitive Complexity: High **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. Cognitive Complexity: Moderate **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. Cognitive Complexity: Moderate **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. Cognitive Complexity: Moderate **SC.912.N.3.5** Describe the function of models in science, and identify the wide range of models used in science. Cognitive Complexity: Moderate **SC.912.N.4.1** Explain how scientific knowledge and reasoning provide an empirically- based perspective to inform society's decision making. Cognitive Complexity: Moderate **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,	sources accurately a. Address plagiarism 5. Collect and record data a. Graphs b. Charts c. Visual representations 6. Draw conclusions using data a. Uses repeated trials 7. Share Results a. Discuss, compare and negotiate methods used, results obtained, and explanations among groups of students conducting the same investigation. b. Ask new questions and develop new investigations TEACHER NOTE: Refer to ISEF (International Science and Engineering Fair) forms on resource page.	• Distinguish between laws and theories by understanding that laws describe *what* and theories explain *why.* • Give examples of how advances in technology have affected scientific theories and laws. • Compare and contrast the terms that describe examples of scientific knowledge such as: theory, law, hypothesis, and model.

economic, and environmental Cognitive Complexity: High **MA.912.S.1.2** Determine appropriate and consistent stands of measurement for the data to be collected in a survey or equipment. Cognitive Complexity: Moderate **MA.912.S.3.2** Collect, organize, and analyze data sets, determine the best format for the data and present visual summaries from the following: bar graphs, line graphs, stem and leaf plots, circle graphs, histograms, box and whisker plots, scatter plots, cumulative frequency (ogive) graphs. Cognitive Complexity: High		
Topic(s) of Study: Environment and Technology **Bodies of Knowledge:** Nature of Science, Life Science & Physical Science **Standards:** Heredity and Reproduction, Interdependence, **Essential Questions:** Why is water essential for life? How have ethical issues affected cloning, gene therapy and stem cell research? How do scientists design an investigation to answer a scientific question and communicate their findings?		
SC.912.L.16.10 Evaluate the impact of biotechnology on the individual, society and the environment, including medical and ethical issues. Cognitive Complexity: High **SC.912.L.17.19** Describe how different natural resources are produced and how their rates of use and renewal limit availability. Cognitive Complexity: Moderate **SC.912.L.17.15** Discuss the effects of technology on environmental quality. Cognitive Complexity: Moderate **SC.912.L.17.16** Discuss the large-scale environmental impacts resulting from human activity, including waste spills, oil spills, runoff, greenhouse gases, ozone	**I. Biotechnology impacts** A. Individually B. Environmentally C. Society 1. Medical 2. Ethical **II. Effects of Environmental Technology on the Environment** • Positive and Negative **III. Human Impact on the Environment** A. Spills (waster, oil) B. Run-off C. Greenhouse gases D. Pollution	• Describe the impact of biotechnology on the individual, society and the environment, including medical and ethical issues • Explain the ethical issues surrounding biotechnology including GMOs and gene therapy • Describe the usefulness of techniques including PCR, gel electrophoresis, and recombinant DNA • Critique potential uses for the information gleaned from sequencing the human genome • Describe some ways that humans impact the environment citing examples • Explain how technology has positively and negatively

depletion, and surface and groundwater pollution. Cognitive Complexity: Moderate **SC.912.L.17.20** Predict the impact of individuals on environmental systems and examine how human lifestyles affect sustainability. Cognitive Complexity: High **SC.912.L.17.13** Discuss the need for adequate monitoring of environmental parameters when making policy decisions. Cognitive Complexity: High		impacted the environment • Explain and summarize changes in human lifestyles that might positively impact the environment
Topic(s) of Study: Atomic Theory and the Periodic Table **Bodies of Knowledge:** Physical Science; Nature of Science **Standards:** Matter, Diversity and Evolution of Living Organisms, **Essential Questions:** How has the understanding of matter and the structure of the atom improved out quality of life? How has the development of the modern periodic table proved to be the most powerful reference tool available to chemists?		
SC.912.P.8.3 Explore the scientific theory of atoms (also known as atomic theory) by describing changes in the atomic model over time and why those changes were necessitated by experimental evidence. Cognitive Complexity: High **SC.912.L.15.2** Discuss the use of molecular clocks to estimate how long ago various groups of organisms diverged evolutionarily from one another. Cognitive Complexity: Moderate **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	**I. Theory of atoms (atomic theory)** A. Explained and illustrated using a model B. Has changed over time with new knowledge and experimental evidence C. The molecular clock can be used to estimate how long ago various groups of organisms diverged evolutionarily from one another **II. Structure of atoms** A. Protons, Neutrons and Electrons 1. Mass 2. Electrical charge 3. Location **III. Periodic Table** A. Arranged by 1. Number of protons	• Construct models of the atom to compare contrast the following atomic theories: Democritus, Dalton, Thomson, Rutherford, and Schrodinger • Explain, evaluate, and/or construct models of the experiments that were used to create the following atomic theories: Democritus (belief), Dalton (The Law of Multiple Proportions), Thomson (Cathode Ray Tube), Rutherford (Apple Radiation and Gold Foil), Bohr (H spectrum), and Schrodinger (Mathematical Equation) • Describe how the use of molecular clocks can estimate how various groups of organisms evolved from one another long ago • Construct a table that compares the three subatomic particles in terms of their charge, mass

within the atom. Cognitive Complexity: High **SC.912.P.8.5** Relate properties of atoms and their position in the periodic table to the arrangement of their electrons. Cognitive Complexity: Moderate **SC.912.P.8.7** Interpret formula representations of molecules and compounds in terms of composition and structure. Cognitive Complexity: Moderate	2. Arrangement of electrons **IV. Chemical bonding** A. Ionic B. Covalent 1. Single 2. Double 3. Triple C. Hydrogen D. Energy involved in formation and breakdown.	(amu), and location within the atom • Correlate chemical properties, reactivity, physical properties, and the number of valence shell electrons with an element's periodic table location • Create electron configurations for the first 18 elements. • Describe the formula of molecules and compounds using examples