

## Treasure Coast Science Scope and Sequence 2012-2013

Course: Marine Science I Honors Course Code: 2002510

Quarter: 1A

**Topic(s) of Study:** Approaches to Science

**Bodies of Knowledge:** Nature of Science

**Standard(s):** 1: The Practice of Science, 2: The Characteristics of Scientific Knowledge, 3: The Roles of Theories, Laws, Hypotheses and Models, 4: 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 it play in the generation and validation of scientific knowledge?

[Concept Map\(s\): Click here](#)

[Resources: Click here](#)

[Syllabus: Click here](#)

[CCSS Literacy Standards: Click here](#)

NGSSS	OUTLINE OF CONTENT (CONCEPT/SKILLS)	TARGETS
<p>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</p> <ol style="list-style-type: none"> <li>1. pose questions about the natural world,</li> <li>2. conduct systematic <u>observations</u>,</li> <li>3. examine books and other sources of information to see what is already known,</li> <li>4. review what is known in <u>light</u> of empirical evidence,</li> <li>5. plan <u>investigations</u>,</li> <li>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),</li> </ol>	<p>I What is science?</p> <ol style="list-style-type: none"> <li>A. Science is the study of the natural world around us               <ol style="list-style-type: none"> <li>1. Pure Science</li> <li>2. Pseudoscience                   <ol style="list-style-type: none"> <li>a. Astrology</li> <li>b. Phrenology</li> </ol> </li> <li>3. Provides an empirically-based perspective to inform society's decision making</li> </ol> </li> <li>B. Scientists come from all walks of life and they explore questions that arise in a variety of ways:               <ol style="list-style-type: none"> <li>1. Observation                   <ol style="list-style-type: none"> <li>a. Can lead to inference which can be studied</li> <li>b. Examples:</li> </ol> </li> <li>2. Empirical Evidence</li> <li>3. Systematic Investigations                   <ol style="list-style-type: none"> <li>a. Field investigation                       <ol style="list-style-type: none"> <li>i. Descriptive</li> <li>ii. Comparative</li> <li>iii. Correlative</li> </ol> </li> </ol> </li> </ol> </li> </ol>	<ul style="list-style-type: none"> <li>• Define a scientific problem or question based on the specific body of knowledge correlated to the Marine Science I Honors course. (I)</li> <li>• Explain the difference between an experiment and other types of scientific investigations. (I)</li> <li>• Use appropriate reference materials to support scientific investigations of various types, such as systematic observation or experiments. (I)</li> <li>• Describe the creative means scientists must use to design an investigation. (I)</li> <li>• Explain that science is based on evidence based facts. (I)</li> <li>• Develop a hypothesis with one independent variable (tested variable). (I)</li> <li>• Distinguish between dependent variables (outcome variable), independent variables (tested variable), controls, and variables that are held constant in a variety of activities. (I, VI)</li> <li>• Develop hypotheses and determine what data should be collected to test the hypothesis.(I, VI)</li> <li>• Determine tools and methods that should be used to collect valid data. (I, VI)</li> </ul>

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<p>7. pose answers, explanations, or descriptions of events,</p> <p>8. generate explanations that explicate or describe natural phenomena (inferences),</p> <p>9. use appropriate evidence and reasoning to justify these explanations to others,</p> <p>10. communicate results of scientific <u>investigations</u>, and</p> <p>11. evaluate the merits of the explanations produced by others.</p> <p>SC.912.N.1.2 Describe and explain what characterizes science and its methods. Cognitive Complexity: Moderate</p> <p>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</p> <p>SC.912.N.1.4 Identify sources of information and assess their reliability according to the strict standards of scientific investigation. Cognitive Complexity: High</p> <p>SC.912.N.1.5 Describe and provide examples of how similar investigations conducted in</p>	<p>b. Controlled Investigations</p> <p>4. Experimentation</p> <p>5. Inquiry</p> <p>6. Research</p> <p>    a. Quantitative</p> <p>    b. Qualitative</p> <p>7. Lab equipment/ tools and chemicals</p> <p>    a. Lab safety</p> <p>    b. MSDS sheets</p> <p>C. Scientists findings are presented as</p> <p>    1. Theories</p> <p>    2. Laws</p> <p>    3. Models</p> <p>        a. Visual/Physical</p> <p>        b. Conceptual</p> <p>        c. Mathematical</p> <p>        d. Benefits</p> <p>        e. Limitations</p> <p>    4. Must be replicable by other scientists around the world</p> <p>D. Scientists communicate their findings with the scientific community</p> <p>    1. Debate</p> <p>    2. Confirmation</p> <p>E. Research background information on topic</p> <p>    1. Address reliable research materials</p> <p>    2. Address how to cite sources accurately</p> <p>    3. Address Plagiarism</p> <p>F. Scientific knowledge is open to change</p> <p>    1. It is reexamined</p>	<ul style="list-style-type: none"> <li>• Determine how data will be collected to analyze the data. (I, VI)</li> <li>• Determine appropriate and consistent standards of measurement for the data to be collected in a survey or experiment. (I, VI)</li> <li>• 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. (I, VI)</li> <li>• Calculate and determine the % error of the data. (I, VI)</li> <li>• Explain why scientific investigations should be replicable. (I, VI)</li> <li>• Conduct, discuss, and compare similar investigations by working cooperatively in groups. (I, VI)</li> <li>• Collect and organize data in charts, tables, and graphics. (I, VI)</li> <li>• Present individual or group data after a scientific investigation, analyze the evidence, and reach a class consensus.(I, VI)</li> <li>• Justify conclusions based upon all the available evidence, not on expressed opinions. (I, VI)</li> <li>• Recognize that scientists who make contributions to scientific knowledge come from all kinds of backgrounds and possess varied talents, interests, and goals. (II)</li> <li>• Identify reliable sources of information and assess their reliability according to the strict standards of scientific investigation while conducting research. (II)</li> <li>• Distinguish the difference between a scientific law and theory vs. a societal law. (III, IV)</li> <li>• Describe the role consensus plays in the historical development of a theory in marine science. (III, IV)</li> <li>• Recognize systematic inference as one</li> </ul>
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<p>many parts of the world result in the same outcome. Cognitive Complexity: Moderate</p> <p>SC.912.N.1.6 Describe how scientific <u>inferences</u> are drawn from scientific <u>observations</u> and provide examples from the content being studied Cognitive Complexity: Moderate</p> <p>SC.912.N.1.7 Recognize the role of creativity in constructing scientific questions, methods and explanations. Cognitive Complexity: Low</p> <p>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</p> <p>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</p> <p>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</p>	<p>with rigor</p> <ol style="list-style-type: none"> <li>2. Becomes stronger with each examination</li> <li>3. Becomes more durable through experimentation</li> </ol> <p>G. Branches of Science</p> <p>II Scientists background can</p> <ol style="list-style-type: none"> <li>A. Influence their inferences based on data</li> <li>B. Strengthen current lines of thinking through debate and argumentation</li> <li>C. Generate new testable ideas</li> </ol> <p>III Theory</p> <ol style="list-style-type: none"> <li>A. Culmination of many investigations</li> <li>B. Draws together the current evidence on a particular phenomenon</li> <li>C. Represents the most powerful explanation scientists have to offer.</li> <li>D. Will never become laws of science</li> <li>E. Well supported <b>explanation</b></li> </ol> <p>IV Laws</p> <ol style="list-style-type: none"> <li>A. Descriptions of particular relationships under specific conditions in nature</li> <li>B. Do not offer explanations for these relationships</li> <li>C. Well supported <b>descriptions</b></li> </ol>	<p>form of scientific investigation.(I, VI)</p> <ul style="list-style-type: none"> <li>• Differentiate between science and pseudoscience. (I)</li> <li>• 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. (I)</li> <li>• Give examples of visual/physical, mathematical, and conceptual models as used in science. (I)</li> <li>• Describe the limitations and misconceptions perceived by models. (I)</li> <li>• Recognize, identify and know how to safely and accurately use lab equipment.(I)</li> <li>• 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). (I)</li> <li>• Identify and find the following information such as chemical name, hazardous components, health hazards, first aid and emergency procedures using MSDS sheets. (I)</li> <li>• Identify protective clothing worn in the lab: safety goggles, aprons, gloves. (I)</li> <li>• Recognize that different types of wastes are disposed of in specific ways. (I)</li> <li>• Recognize the importance of the lab safety contract and explain why parent and student signatures are required. (I)</li> <li>• Distinguish science from other activities involving thought. (I)</li> <li>• Explain that scientific knowledge is durable because it is open to change as new evidence or interpretations are encountered. (I)</li> <li>• Distinguish between a scientific theory and a general claim. (III)</li> <li>• Distinguish between laws and theories by understanding that laws describe <i>the what</i> and theories explain <i>the why</i>.</li> </ul>
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<p>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</p> <p>SC.912.N.3.1 Explain that a scientific <u>theory</u> is the culmination of many scientific <u>investigations</u> drawing together all the <u>current</u> evidence concerning a substantial range of phenomena; thus, a scientific <u>theory</u> represents the most powerful explanation <u>scientists</u> have to offer. Cognitive Complexity: High</p> <p>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</p> <p>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</p> <p>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. Cognitive Complexity: High</p> <p>MA.912.S.1.2 Determine appropriate and consistent</p>	<p>V Costs and benefits of alternative strategies for problem solving</p> <ol style="list-style-type: none"> <li>A. Human</li> <li>B. Economic</li> <li>C. Environmental</li> </ol> <p>VI Experimental Design</p> <ol style="list-style-type: none"> <li>A. Ask a question</li> <li>B. Plan investigation             <ol style="list-style-type: none"> <li>1. Identify independent variable (<b>test variable</b>)</li> <li>2. Determine the dependent variable (<b>outcome variable</b>)</li> <li>3. Identify constants</li> <li>4. Ensure you have a control group</li> </ol> </li> <li>C. Research background information on topic             <ol style="list-style-type: none"> <li>1. Address appropriate research materials</li> <li>2. Address how to cite sources accurately</li> <li>3. Address plagiarism</li> </ol> </li> <li>D. Collect and record data             <ol style="list-style-type: none"> <li>1. Graphs</li> <li>2. Charts</li> <li>3. Visual representations</li> </ol> </li> <li>E. Share findings             <ol style="list-style-type: none"> <li>1. Draw conclusions using data</li> <li>2. Uses repeated trials</li> <li>3. Discuss, compare and negotiate methods used, results obtained, and explanations among groups of students conducting the same investigation.</li> </ol> </li> </ol>	<p>(III, IV)</p> <ul style="list-style-type: none"> <li>• Compare and contrast the terms that describe examples of scientific knowledge such as: theory, law, hypothesis, and model. (III, IV)</li> <li>• Give examples of how advances in technology have affected scientific theories and laws. (III, IV)</li> <li>• Distinguish the difference between a scientific law and theory vs. a societal law. (III, IV)</li> <li>• Describe the role consensus plays in the historical development of a theory in biology. (III, IV)</li> </ul>
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<p>standards of measurement for the data to be collected in a survey or experiment. Cognitive Complexity: Moderate</p> <p>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 and cumulative frequency (ogive) graphs. Cognitive Complexity: High</p>	<p>4. Ask new questions and develop new investigations</p> <p>A. TEACHER NOTE: Refer to ISEF (International Science and Engineering Fair) forms on resource page.</p>	
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## Treasure Coast Science Scope and Sequence 2012-2013

Course: Marine Science I Honors

Course Code: 2002510

Quarter: 1B

**Topic(s) of Study:** The Ocean: It's History and Processes

**Bodies of Knowledge:** Nature of Science, Life Science, Earth and Space Science, Physical Science

**Standard(s):** 1: The Practice of Science, 2: The Characteristics of Scientific Knowledge, 3: The Roles of Theories, Laws, Hypotheses and Models, 4: Science and Society, 7: Earth Systems and Patterns, 10: Energy, 17: Interdependence, 18: Matter and Energy Transformation

**Essential Questions:** What were the important developments and discoveries that led to the modern science of marine science? What are the physical properties of water and how do these properties affect the life processes of marine organisms? How do scientists design an investigation to answer a scientific question and communicate their findings?

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NGSSS	OUTLINE OF CONTENT (CONCEPT/SKILLS)	TARGETS
<p>SC.912.L.18.12 Discuss the special properties of water that contribute to Earth's suitability as an environment for life: cohesive behavior, ability to moderate temperature, expansion upon freezing, and versatility as a solvent. Cognitive Complexity: Moderate</p> <p>SC.912.P.10.2 Explore the Law of Conservation of Energy by differentiating among open, closed, and isolated systems and explain that the total energy in an isolated system is a conserved quantity. Cognitive Complexity: High</p> <p>SC.912.E.7.1 Analyze the movement of matter and energy through the different biogeochemical cycles, including water and carbon. Cognitive Complexity: High</p> <p>SC.912.L.17.10 Diagram and explain the biogeochemical</p>	<p>I Historical/Social Implications of Ocean Exploration and Marine Science</p> <p style="padding-left: 20px;">A. Uses for the Sea B. Trade Routes C. Navigation- Charting</p> <p>II Origin of Territorial Waters and Shifts in World Views</p> <p>III Marine Science, Technology, and Society</p> <p style="padding-left: 20px;">A. Ethics B. Research C. Navigation- GPS</p> <p>IV Properties of Matter</p> <p style="padding-left: 20px;">A. Atomic Structure B. Periodic Table C. Radioactivity and Half-Life</p> <p>V Water's Unique Properties</p> <p style="padding-left: 20px;">A. Polar Molecule B. Hydrogen Bonding</p>	<ul style="list-style-type: none"> <li>• Recognize that while most of the planet is covered by ocean, it is not a uniform body of water. (I)</li> <li>• Identify how humans have relied upon and utilized the ocean for thousands of years. (I)</li> <li>• Construct a timeline of ocean events to scale. (I,II)</li> <li>• Describe the scope and methodology of marine science. (III)</li> <li>• Explain safe and humane laboratory practices. (III)</li> <li>• Use current communication technology to interact with the global scientific community. (III)</li> <li>• Investigate the many technologies and tools that scientists use to make observations about ocean processes. (III)</li> <li>• Describe the properties of matter. (IV)</li> <li>• Describe water's unique properties and relate these properties to its chemical structure. (V)</li> <li>• Give examples of how the properties of water affect marine organisms. (V)</li> <li>• Explain the sources of salt in seawater. (VI)</li> </ul>

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<p>cycles of an ecosystem, including water, carbon, and nitrogen cycle. Cognitive Complexity: Moderate</p> <p>SC.912.E.7.9 Cite evidence that the ocean has had a significant influence on climate change by absorbing, storing, and moving heat, carbon, and water. Cognitive Complexity: High</p> <p>SC.912.L.17.2 Explain the general distribution of life in aquatic systems as a function of chemistry, geography, light, depth, salinity, and temperature. Cognitive Complexity: High</p> <p>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</p> <ol style="list-style-type: none"> <li>1. pose questions about the natural world,</li> <li>2. conduct systematic observations,</li> <li>3. examine books and other sources of information to see what is already known,</li> <li>4. review what is known in light of empirical evidence,</li> <li>5. plan investigations,</li> <li>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),</li> </ol>	<p>C. Diffraction D. Specific Heat E. Color Absorption</p> <p>VI Chemical Properties of Seawater</p> <p>A. Salinity and Water Density B. Acidity and Alkalinity</p> <p>VII Law of Conservation of Mass and Energy</p> <p>VIII Matter and Energy in Living Systems of the Ocean</p> <p>A. Biogeochemical Cycles (Carbon, Nitrogen, Water) B. Autotrophy C. Heterotrophy D. Respiration E. Photosynthesis F. Chemosynthesis</p> <p>IX Thermal Properties of Seawater</p> <p>A. Water Temperature B. Ocean Water Density C. Heat Capacity D. Latent Heat of Vaporization E. Thermal Inertia F. Climate Change</p> <p>X Ocean's Energy Resources</p> <p>A. Renewable B. Non-Renewable</p>	<ul style="list-style-type: none"> <li>• Discuss the basic physical properties of a sample of seawater (i.e., temperature, salinity, transparency, density, and pressure). (VI)</li> <li>• Determine whether substances will float or sink in water based on their densities. (VI)</li> <li>• Explain the ability of water to act as a solvent of solids and gases. (VI)</li> <li>• Describe the basic chemical composition of seawater. (VI)</li> <li>• Discuss the sources of variations in the ocean's salinity. (VI)</li> <li>• Create seawater for an aquarium. (VI)</li> <li>• Demonstrate the Law of Conservation of Energy in various scenarios of energy transformation. (VII)</li> <li>• Differentiate between open, closed, and isolated systems. (VII)</li> <li>• Explain the major biogeochemical cycles that relate to the marine environment (carbon, nitrogen, water). (VIII)</li> <li>• Identify the reactants and products of photosynthesis, and note the sources of the reactants in the ocean. (VIII)</li> <li>• Describe how carbon is cycled through Earth's spheres. (VIII)</li> <li>• Analyze chlorophyll imagery, looking for evidence of blooms of phytoplankton that contribute to the food sources of marine animals. (VIII)</li> <li>• Explain how pressure, temperature, density, salinity, and light change with increasing depth. (IX)</li> <li>• Describe the characteristics of some animals that allow them to cope with changes in pressure, temperature, density, salinity, and light. (IX)</li> <li>• Analyze and interpret plots of density, salinity, pressure, and temperature with respect to depth at various locations. (IX)</li> <li>• Describe the oceans' energy in terms of</li> </ul>
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<p>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.</p> <p>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</p> <p>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</p> <p>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</p> <p>SC.912.N.4.2 Weigh the merits of</p>		<p>renewable and nonrenewable resources. (X)</p> <ul style="list-style-type: none"> <li>• Define a scientific problem or question based on the specific body of knowledge correlated to the Marine Science I Honors course. (I-X)</li> <li>• Recognize that scientists who make contributions to scientific knowledge come from all kinds of backgrounds and possess varied talents, interests, and goals. (I-X)</li> <li>• 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. (I-X)</li> <li>• Describe scientific knowledge's impact on societal decisions. (I-X)</li> </ul>
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alternative strategies for solving a specific societal problem by comparing a number of different costs and benefits, such as human, economic, and environmental.

Cognitive Complexity: High

MA.912.S.1.2 Determine appropriate and consistent standards of measurement for the data to be collected in a survey or experiment.

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 and cumulative frequency (ogive) graphs. Cognitive Complexity: High