

# NatureMapping and the National Science Education Standards

## NatureMapping Alignment with National Science Education Standards

### Unifying concepts and processes

- ❑ **Systems, order, and organization**
- ❑ **Evidence, models, and explanation**
- ❑ **Change, constancy, and measurement**
- ❑ **Evolution and equilibrium**
- ❑ **Form and function**

Science Content Standards	K-4	5-8	9-12
<p><b>Science as Inquiry</b></p> <p>Content Standard A</p>	<ul style="list-style-type: none"> <li>○ <b>Abilities necessary to do scientific inquiry</b></li> <li>○ <b>Understanding about scientific inquiry</b></li>   <li>○ <b>Abilities necessary to do scientific inquiry</b> <i>NatureMapping applies the following:</i> <b>Ask</b> a question about objects, organisms, and events in the environment: <i>e.g. What lives where I live? (A descriptive question).</i> <b>Plan</b> and conduct a simple investigation: <i>e.g. descriptive field investigation to add data to the model.</i> <b>Employ</b> simple equipment and tools to gather data and extend the senses: <i>e.g. eyes, rulers, binoculars, digital cameras</i> <b>Use</b> data to construct a reasonable explanation <i>e.g. use scatter plots or maps.</i> <b>Communicate</b> investigations and explanations.</li> <li>○ <b>Understanding about scientific inquiry</b> <i>NatureMapping</i> “field investigation” is a means to answer a question, whether asked by a scientist (e.g. What lives where?) or by the student as a result of an initial experience that aroused curiosity. <i>NatureMapping</i> is ideal for use of senses – sight, hearing and smell etc– to describe the natural world – in local settings to develop a descriptive model.</li> </ul>	<ul style="list-style-type: none"> <li>○ <b>Abilities necessary to do scientific inquiry</b></li> <li>○ <b>Understanding about scientific inquiry</b></li>   <li>○ <b>Abilities necessary to do scientific inquiry</b> <i>NatureMapping</i> applies the following: <b>Identify</b> questions that can be answered through scientific investigations: <i>e.g. refer to current natural system models to identify a question to describe or compare.</i> <b>Design</b> and conduct a scientific question: <i>e.g. descriptive and comparative field investigations.</i> <b>Use</b> appropriate tools and techniques to gather, analyze, and interpret data: <i>e.g. eyes binoculars, digital cameras, GPS, PDA’s with Cybertracker sequence, probes</i> <b>Develop</b> descriptions, explanations, predictions, and models using evidence: <i>e.g. use scatter plots or maps.</i> <b>Think</b> critically and logically to make the relationships between evidence and explanations. <b>Recognize</b> and analyze alternative explanations and predictions: <i>e.g. refer to original model to decide if more definition may be added.</i> <b>Communicate</b> scientific procedures and explanations. <b>Use</b> mathematics in all aspects of scientific inquiry.</li> <li>○ <b>Understanding about scientific inquiry</b> <i>NatureMapping</i> applies field investigation as a mode of science inquiry, where observation,</li> </ul>	<ul style="list-style-type: none"> <li>○ <b>Abilities necessary to do scientific inquiry</b></li> <li>○ <b>Understanding about scientific inquiry</b></li>   <li>○ <b>Abilities necessary to do scientific inquiry</b> <i>NatureMapping</i> applies the following: <b>Identify</b> questions &amp; concepts that guide scientific investigations <i>e.g. refer to current natural system models to identify a question to describe, compare or correlate (find a relationship-not cause and effect).</i> <b>Design</b> and conduct scientific investigations: <i>e.g. descriptive, comparative and correlative field investigations.</i> <b>Use</b> technology and math to improve investigations &amp; communications: <i>e.g. eyes, binoculars, digital cameras, telemetry, GPS and GIS, PDA’s with Cybertracker sequence, probes.</i> <b>Formulate</b> and revise scientific explanations &amp; models using logic and evidence <i>e.g. use scatter plots and maps.</i> <b>Recognize</b> and analyze alternative explanations and models: <i>e.g. refer to the original model to decide if more definition and relationships may be added.</i> <b>Communicate</b> and defend a scientific argument</li> <li>○ <b>Understanding about scientific inquiry</b> <i>NatureMapping</i> uses the “Unifying Concepts and</li> </ul>

	<p>The descriptive model provides the basis for explanations through other types of field investigations.</p> <p><i>NatureMapping</i> provides the opportunity for students to represent their findings through descriptive models – in particular through maps – allowing their findings to be reviewed.</p>	<p>description, comparisons and correlations are used to model a natural system.</p> <p><i>NatureMapping</i> collects data, according to the scientific question, and uses math and GIS technology to analyze the data and represent the findings</p>	<p>Processes” to guide scientific inquiry about a natural system, design and interpret field investigations, and evaluate explanations.</p> <p><i>NatureMapping</i> conducts investigations to “discover new aspects of the natural world, explain recently observed phenomena, or test conclusions of prior investigations or predictions of current theories”</p> <p><i>NatureMapping</i> provides descriptive models of current understanding of the natural world, which predict what may be discovered of the known natural world.</p> <p><i>NatureMapping</i> allows the investigator to survey the natural world to develop or add more information to a descriptive model.</p> <p><i>NatureMapping</i> uses tools &amp; technology for observation (chemistry based water quality kits, binoculars, GPS, PDA’s with Cybertracker sequence, probes)</p> <p><i>NatureMapping</i> relies on mathematics to record and report data and results, and technology to manage and analyze data through Excel or Access type files and GIS.</p>
<p><b>Physical Science</b></p> <p>Content Standard B</p> <ul style="list-style-type: none"> <li><input type="checkbox"/> Structure of atoms</li> <li><input type="checkbox"/> Structures and properties of matter</li> <li><input type="checkbox"/> Chemical reactions</li> <li><input type="checkbox"/> Motions and forces</li> <li><input type="checkbox"/> Conservation of energy</li> <li><input type="checkbox"/> Interactions of energy and matter</li> </ul>	<ul style="list-style-type: none"> <li>○ Properties of objects and materials</li> <li>○ Position and motion of objects</li> <li>○ Light, heat, electricity, and magnetism</li> </ul> <p><i>NatureMapping</i> relies on knowledge of physical systems to investigate life systems</p> <ul style="list-style-type: none"> <li>○ Position and motion of objects</li> </ul> <p><i>NatureMapping</i> allows the investigator to learn about the dynamics of flight in birds and the aerodynamic properties of aquatic organisms.</p>	<ul style="list-style-type: none"> <li>○ Properties and changes of properties of matter</li> <li>○ Motion and forces</li> <li>○ Transfer of energy</li> </ul> <p><i>NatureMapping</i> relies on knowledge of physical systems to investigate life systems</p> <ul style="list-style-type: none"> <li>○ Motion and forces</li> </ul> <p><i>NatureMapping</i> allows the investigator to learn about the dynamics of flight in birds and the aerodynamic properties of aquatic organisms (lift, drag, etc.)</p> <ul style="list-style-type: none"> <li>○ Transfer of energy</li> </ul> <p><i>NatureMapping</i> investigations can lead to the study of tropic levels and the transfer of energy up the food pyramid.</p>	<ul style="list-style-type: none"> <li>○ Structure of atoms</li> <li>○ Structure and properties of matter</li> <li>○ Chemical reactions</li> <li>○ Motion and forces</li> <li>○ Conservation of energy and increase in disorder</li> <li>○ Interactions of energy and matter</li> </ul> <p><i>NatureMapping</i> relies on observation tools to measure biodiversity that are based on physical systems understanding: e.g. characteristics of light &amp; optimal systems (binoculars)</p> <ul style="list-style-type: none"> <li>○ Structure and properties of matter</li> </ul> <p><i>NatureMapping</i> can lead to investigations into the physical structure and components of organic materials such as bone, feathers, scales, and fur. <i>NatureMapping</i> can lead to investigations into the strength of</p>

			<p>various organic substances such as bones from different animals (ex. birds vs. mammals).</p> <ul style="list-style-type: none"> <li>○ <b>Motion and forces</b> <i>NatureMapping</i> allows the investigator to learn about the dynamics of flight in birds and the aerodynamic properties of aquatic organisms (lift, drag, etc.)</li> <li>○ <b>Conservation of energy and increase in disorder</b> <i>NatureMapping</i> investigations can lead to the study of tropic levels and the transfer of energy up the food pyramid.</li> </ul>
<p><b>Life Science</b></p> <p>Content Standard C</p> <p><b>Develop a deep understanding of</b></p> <ul style="list-style-type: none"> <li>□ The cell</li> <li>□ Molecular basis of heredity</li> <li>□ Biological Evolution</li> <li>□ <b>Interdependence of organisms</b></li> <li>□ <b>Matter, energy, and organization of living systems</b></li> <li>□ <b>Behavior of organisms</b></li> </ul>	<ul style="list-style-type: none"> <li>○ <b>Characteristics of organisms</b></li> <li>○ <b>Life cycles of organisms</b></li> <li>○ <b>Organisms and environments</b></li> <li>○ <b>Characteristics of organisms</b> <i>NatureMapping</i>: observes organism behavior and explores natural system health by determining presence of organisms in a defined setting.</li> <li>○ <b>Life cycles of organisms</b> <i>NatureMapping</i> observes life cycles and uses life cycle knowledge to explain descriptive model of natural system.</li> <li>○ <b>Organisms and environments</b> <i>NatureMapping</i> describes the nature of the organism's environment, including food, water and habitat. Through field investigation over time, <i>NatureMapping</i> describes how the organisms and their habitat are changing.</li> </ul>	<ul style="list-style-type: none"> <li>○ <b>Structure and function in living systems</b></li> <li>○ Reproduction and heredity</li> <li>○ <b>Regulation and behavior</b></li> <li>○ <b>Populations and ecosystems</b></li> <li>○ <b>Diversity and adaptations of organisms</b></li> <li>○ <b>Structure and function in living systems</b> <i>NatureMapping</i> explores structure and function of living systems at the ecosystem level or organization.</li> <li>○ <b>Regulation and behavior</b> <i>NatureMapping</i> indicates the presence/absence of species in an ecosystem, which may be explained through regulation and behavior concepts.</li> <li>○ <b>Populations and ecosystems</b> <i>NatureMapping</i> measures populations of organisms in an ecosystem, and concepts of populations and ecosystems used to explain presence/absence and change.</li> <li>○ <b>Diversity and adaptations of organisms</b> <i>NatureMapping</i> designs research to measure and monitor biodiversity of a defined area or ecosystem.</li> </ul>	<ul style="list-style-type: none"> <li>○ The cell</li> <li>○ Molecular basis of heredity</li> <li>○ <b>Biological evolution</b></li> <li>○ <b>Interdependence of organisms</b></li> <li>○ <b>Matter, energy, and organization of living systems</b></li> <li>○ Behavior of organisms</li> <li>○ <b>Biological evolution</b> <i>NatureMapping</i>: <i>Assessing biodiversity by identifying species type and distribution through a research project.</i></li> <li>○ <b>The interdependence of organisms</b> <i>NatureMapping</i> analyzes biodiversity through the following: Interactions of organisms Interactions in ecosystems – food chains, webs and pyramids.</li> <li>○ <b>Matter, energy and organization of living systems</b> <i>NatureMapping</i> designs research to investigate biodiversity and human impact of a defined area or ecosystem, and monitors environmental change.</li> </ul>
<p><b>Earth &amp; Space Science</b></p> <p>Content Standard D</p>	<ul style="list-style-type: none"> <li>○ <b>Properties of earth materials</b></li> <li>○ Objects in the sky</li> <li>○ <b>Changes in earth and sky</b></li> <li>○ <b>Properties of earth materials</b> <i>NatureMapping</i> depends on knowledge of landforms, and</li> </ul>	<ul style="list-style-type: none"> <li>○ <b>Structure of the earth system</b></li> <li>○ Earth's history</li> <li>○ <b>Earth in the solar systems</b></li> <li>○ <b>Structure of the earth system</b> <i>NatureMapping</i> research depends on the understanding of natural</li> </ul>	<ul style="list-style-type: none"> <li>○ Energy in the earth system</li> <li>○ <b>Geochemical cycles</b></li> <li>○ Origin and evolution of the earth system</li> <li>○ Origin and evolution of the universe</li> </ul>

<ul style="list-style-type: none"> <li>❑ <b>Energy &amp; the earth system</b></li> <li>❑ <b>Geochemical cycles</b></li> <li>❑ <b>Origin &amp; evolution of earth system</b></li> <li>❑ Origin and evolution of the universe</li> </ul>	<p><i>being able to read maps and understand earth's natural cycles.</i></p> <ul style="list-style-type: none"> <li>○ <b>Changes in earth and sky</b> <i>NatureMapping measures changes in life forms as a result of earth surface changes. NatureMapping may measure weather data and seasons characteristics for descriptive modeling.</i></li> </ul>	<p><i>cycles: rock and water cycles</i></p> <ul style="list-style-type: none"> <li>○ <b>Earth in the solar systems</b> <i>NatureMapping observation technology depends on an understanding of earth/space systems related to Geographical Information Systems (GIS) using satellite imagery.</i></li> </ul>	<ul style="list-style-type: none"> <li>○ <b>Geochemical cycles</b> <i>NatureMapping research depends on the understanding of geochemical cycles where each element cycles through earth, oceans, atmosphere and organisms – carbon, nitrogen etc</i></li> </ul>
<p><b>Science &amp; Technology</b></p> <p>Content Standard E</p> <ul style="list-style-type: none"> <li>❑ <b>Abilities of technological design</b></li> <li>❑ <b>Understanding science &amp; technology</b></li> <li>❑ <b>Abilities to distinguish between natural objects and objects made by humans</b></li> </ul>	<ul style="list-style-type: none"> <li>○ <b>Abilities to distinguish between natural objects and objects made by humans</b></li> <li>○ <b>Abilities of technological design</b></li> <li>○ <b>Understanding about science and technology</b></li> <li>○ <b>Abilities to distinguish between natural objects and objects made by humans</b> <i>NatureMapping is the study of natural phenomena in the macro environment</i></li> <li>○ <b>Abilities of technological design</b> <i>NatureMapping uses the technology of binoculars and chemical test kits etc. to observe natural phenomena</i></li> <li>○ <b>Understanding about science and technology</b> <i>NatureMapping uses the tools of technology to understand the scientific notion of the natural world as a system</i></li> </ul>	<ul style="list-style-type: none"> <li>○ <b>Abilities of technological design</b></li> <li>○ <b>Understanding about science and technology</b></li> <li>○ <b>Abilities of technological design</b> <i>NatureMapping application:</i> <ul style="list-style-type: none"> <li>➤ Identify problem or design an opportunity – <i>e.g. to understand the natural world as a model of a system.</i></li> <li>➤ Propose designs and choose between alternative solutions: <i>e.g. through field investigation students construct their model for a natural system.</i></li> </ul> </li> <li>○ <b>Understanding about science and technology</b> <ul style="list-style-type: none"> <li>➤ NatureMapping involves several disciplines sciences to understand the natural system – biology to understand life, earth science to understand geography and place, physics to understand use of GIS related technologies, chemistry to understand life's chemical interactions (through water, food, air etc.)</li> <li>➤ NatureMapping uses technology to help solve the challenges of modeling the natural system. (Binoculars, GPS units to determine location, mapping observations with computer programs)</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>○ <b>Abilities of technological design</b></li> <li>○ <b>Understanding about science and technology</b></li> <li>○ <b>Abilities of technological design</b> <i>NatureMapping application:</i> <ul style="list-style-type: none"> <li>➤ Identify problem or design an opportunity: <i>e.g. to understand the natural world as a model with a system.</i></li> <li>➤ Propose designs and choose between alternative solutions: <i>e.g. through field investigation students construct their model of a natural system.</i></li> <li>➤ Implement a proposed solution: <i>e.g. field investigation tests how robust the model appears.</i></li> <li>➤ Evaluate the solutions &amp; its consequences: <i>e.g. the model is refined with new information.</i></li> <li>➤ Communicate the problem, process &amp; solution: <i>e.g. report the NatureMapping Project to relevant audiences.</i></li> </ul> </li> <li>○ <b>Understanding About Science and Technology</b> <ul style="list-style-type: none"> <li>➤ NatureMapping involves several science disciplines to understand the natural system – biology to understand life, earth science to understand geography and place, physics to understand use of GIS related technologies, chemistry to understand life's chemical interactions (through water, food, air etc.)</li> <li>➤ NatureMapping uses technology to help solve the challenges of modeling the natural system. (Binoculars, GPS units, Cybertracker sequence &amp; PDA's)</li> </ul> </li> </ul>

<p><b>Science in Personal and Social Perspectives</b></p> <p>Content Standard F</p> <ul style="list-style-type: none"> <li>❑ Personal &amp; community health</li> <li>❑ Population growth</li> <li>❑ Natural Resources</li> <li>❑ Environmental Quality</li> <li>❑ Natural and human-induced hazards</li> <li>❑ Science &amp; technology in local, national, and global challenges</li> </ul>	<ul style="list-style-type: none"> <li>○ <b>Personal health</b></li> <li>○ <b>Characteristics and changes in populations</b></li> <li>○ <b>Types of resources</b></li> <li>○ <b>Changes in environments</b></li> <li>○ <b>Science and technology in local challenges</b></li> </ul> <ul style="list-style-type: none"> <li>○ <b>Personal Health</b> NatureMapping contributes to naturalist studies, and provides opportunities for personal fitness hiking outdoors for research.</li> <li>○ <b>Characteristics and changes in populations</b> NatureMapping researches the size, species, location and behavior of populations</li> <li>○ <b>Types of resources</b> NatureMapping defines the natural resources and their location in local communities</li> <li>○ <b>Changes in environments</b> NatureMapping tracks the changes in habitats (water, land and air) and life in natural environments</li> <li>○ <b>Science and technology in local challenges</b> NatureMapping is applied to real world questions in the local community.</li> </ul>	<ul style="list-style-type: none"> <li>○ <b>Personal health</b></li> <li>○ <b>Populations, resources, and environments</b></li> <li>○ <b>Natural hazards</b></li> <li>○ <b>Risk and benefits</b></li> <li>○ <b>Science and technology in society</b></li> </ul> <ul style="list-style-type: none"> <li>○ <b>Personal health</b> NatureMapping contributes to developing a lifelong interest in nature, and provides opportunities for personal fitness through outdoor investigations</li> <li>○ <b>Populations, resources, and environments</b> NatureMapping research defines populations, components of the living system and models the natural environment of the community.</li> <li>○ <b>Natural hazards</b> NatureMapping projects explore the impacts of natural hazards on natural systems</li> <li>○ <b>Science and technology in society</b> NatureMapping uses rigorous scientific methods for descriptive, comparative and correlative field investigations, which model the natural system.</li> </ul>	<ul style="list-style-type: none"> <li>○ <b>Personal and community health</b></li> <li>○ <b>Population growth</b></li> <li>○ <b>Natural resources</b></li> <li>○ <b>Environmental quality</b></li> <li>○ <b>Natural and human-Science and technology in local challenges</b></li> </ul> <ul style="list-style-type: none"> <li>○ <b>Personal and Community Health</b> NatureMapping contributes to lifelong learning and avocations, and provides opportunities for personal fitness in outdoor settings.</li> <li>○ <b>Population Growth:</b> NatureMapping explores the impacts of human population growth on the natural system by modeling the system.</li> <li>○ <b>Natural Resources:</b> NatureMapping researches the impact of human population on natural resources</li> <li>○ <b>Environmental Quality:</b> NatureMapping provides the scientific methodology to investigate and model the health of the natural system along with the interactions with economic and social factors through GIS technology.</li> <li>○ <b>Natural and Human Induced Hazards:</b> NatureMapping researches the potential for species related natural hazards.</li> <li>○ <b>Science &amp; Technology:</b> NatureMapping explores the effect of humans on other species through changing habitat e.g. from land use and pollution impacts. The research in NatureMapping also examines the influence of other (macro) life on human society, and the economic potential – through GIS.</li> </ul>
<p><b>History and Nature of Science</b></p> <p>Content Standard G</p>	<ul style="list-style-type: none"> <li>○ <b>Science as a human endeavor</b></li> <li>➤ Every person can contribute to science through NatureMapping</li> <li>➤ There is no limit to how much we can learn about the natural</li> </ul>	<ul style="list-style-type: none"> <li>○ <b>Science as a human endeavor</b></li> <li>○ <b>Nature of science</b></li> <li>○ <b>History of science</b></li> </ul> <ul style="list-style-type: none"> <li>○ <b>Science as a human endeavor</b></li> <li>➤ NatureMapping can lead to a career and a life-long avocation</li> </ul>	<ul style="list-style-type: none"> <li>○ <b>Science as a human endeavor</b></li> <li>○ <b>Nature of scientific knowledge</b></li> <li>○ <b>Historical perspectives</b></li> </ul> <ul style="list-style-type: none"> <li>○ <b>Science as a Human Endeavor</b></li> <li>➤ NatureMapping is a scientific enterprise through individual and</li> </ul>

<ul style="list-style-type: none"> <li>❑ <b>Science as a human endeavor</b></li> <li>❑ <b>Nature of scientific knowledge</b></li> <li>❑ <b>Historical perspectives</b></li> </ul>	<p>systems.</p> <ul style="list-style-type: none"> <li>➤ Men and women can have careers in natural sciences.</li> </ul>	<ul style="list-style-type: none"> <li>➤ NatureMapping relies on scientific habits of mind to build knowledge of the environment.</li> <li>○ <b>Nature of science</b> <ul style="list-style-type: none"> <li>➤ NatureMapping provides observational confirmation of models of natural systems.</li> <li>➤ Scientists consider the work through NatureMapping as credible citizen science providing evidence for natural systems models.</li> <li>➤ NatureMapping uses rigorous field investigation methods to develop models of natural systems that can be questioned by other scientists.</li> </ul> </li> <li>○ <b>History of science</b> <ul style="list-style-type: none"> <li>➤ NatureMapping provides a perspective of science inquiry that pre-dates modern science when civilizations depended on their knowledge and stewardship of the environment for survival.</li> </ul> </li> </ul>	<p>team contribution.</p> <ul style="list-style-type: none"> <li>➤ NatureMapping can lead to a career and a life-long avocation.</li> <li>➤ NatureMapping abides by ethical traditions in science.</li> <li>➤ NatureMapping is a way of viewing the natural world as a part of the human existence/society</li> <li>○ <b>Nature of Scientific Knowledge</b> <ul style="list-style-type: none"> <li>➤ NatureMapping is a way of knowing the macro natural world through <i>field investigation</i> using sound methodology and reasonable explanations.</li> <li>➤ <i>Field investigation</i> is defined as descriptive (observational), comparative and correlative using the natural environment as the laboratory. Experimental confirmation is possible but not essential to understanding the natural world (as a system or model)</li> </ul> </li> <li>○ <b>Historical Perspectives</b> <ul style="list-style-type: none"> <li>➤ NatureMapping contributes scientific knowledge to evolve the understanding of the macro natural world or ecosystem.</li> <li>➤ Contributions by scientists and citizen scientists will help society understand and connect with their macro world</li> </ul> </li> </ul>
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