

## EARTH SCIENCE COMMUNITY HS

HSCE	Activities	Resource / Materials	Assessment
<b>Standard E1</b>	<b>INQUIRY, REFLECTION, AND SOCIAL IMPLICATIONS</b>		
<b>Statement E1.1</b>	<b>Scientific Inquiry</b> Science is a way of understanding nature. Scientific research may begin by generating new scientific questions that can be answered through replicable scientific investigations that are logically developed and conducted systematically. Scientific conclusions and explanations result from careful analysis of empirical evidence and the use of logical reasoning. Some questions in science are addressed through indirect rather than direct observation, evaluating the consistency of new evidence with results predicted by models of natural processes. Results from investigations are communicated in reports that are scrutinized through a peer review process.	All of these concepts are practiced throughout the three years of FOS.	
E1.1A	Generate new questions that can be investigated in the laboratory or field.	FOS 1 Traver Creek Project- Inquiry driven testing of Traver Creek: Ecological Assessment including biological survey, chemical analysis of the water, Land use assessment of the watershed.	Three extensive lab reports on the each of the surveys, and a unit test for each. Common assessment is used between all of the teachers who teach the course.
E1.1B	Evaluate the uncertainties or validity of scientific conclusions using an understanding of sources of measurement error, the challenges of controlling variables, accuracy of data analysis, logic of argument, logic of experimental design, and/or the dependence on underlying assumptions.	FOS 2 Life in the Soil Environmental Factors-Enzyme FOS 1 Photosynthetic Rate Lab Salt and Sand Lab Affect of Salt on Ice- Heating Curve Chemical Tests Traver Creek Physical Factors that Affect the Creek	Lab report –Enzyme activity and soil testing- discussion of experimental error. Photosynthesis experiment- lab report, Discussion of experimental error. Conclusions drawn from data are discussed and included in lab report. Benthic collection and data analysis Water quality testing and data analysis. In design of these experiments, students develop their hypothesis and controls.
E1.1C	Conduct scientific investigations using appropriate tools and techniques (e.g., selecting an instrument that measures the	FOS 2—These are student designed and teacher approved experiments. Life in the Soil	All of these are covered in the design of the experiment and their production lab reports with data analysis.

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	desired quantity—length, volume, weight, time interval, temperature—with the appropriate level of precision).	Environmental Factors-Enzyme FOS 1 Photosynthetic Rate Lab Salt and Sand Lab Affect of Salt on Ice- Heating Curve Chemical Tests Traver Creek Physical Factors that Affect the Creek	
E1.1D	Identify patterns in data and relate them to theoretical models.	FOS 1 Traver Creek Project Benthic Collection, Chemical tests and physical assessment data examination from past years	Lab report, data compared over several years, final project incorporates their observations and comparisons in their report conclusions.
E1.1E	Describe a reason for a given conclusion using evidence from an investigation.	FOS 1 Traver Creek Project Benthic Collection, Chemical tests and physical assessment data examination from past years	Lab report, data compared over several years, final project.
E1.1f	Predict what would happen if the variables, methods, or timing of an investigation were changed.	FOS 1 Photosynthetic Rate Lab FOS 2 Cellular Respiration Lab	In the Lab report, the students speculate on whom they would change the lab to reach a more accurate conclusion based on their data analysis.
E1.1g	Based on empirical evidence, explain and critique the reasoning used to draw a scientific conclusion or explanation.	FOS 1 Traver Creek Project Photosynthetic Rate Lab Salt Sand Lab	In their Lab report, students examine their data and compiled class data, draw conclusions based on this data about the investigation.
E1.1h	Design and conduct a systematic scientific investigation that tests a hypothesis. Draw conclusions from data presented in charts or tables.	FOS 1 Traver Creek Project Photosynthetic Rate Lab Salt Sand Lab	All of these are covered in the design of the experiment and their production lab reports with data analysis.
E1.1i	Distinguish between scientific explanations that are regarded as current scientific consensus and the emerging questions that active researchers investigate.	FOS 1 Global Warming	Students examine current understanding of global warming and what the scientific consensus is. Students use this information to generate new questions.
<b>Statement E1.2</b>	<b>Scientific Reflection and Social Implications</b>		

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	<p>The integrity of the scientific process depends on scientists and citizens understanding and respecting the “Nature of Science.” Openness to new ideas, skepticism, and honesty are attributes required for good scientific practice. Scientists must use logical reasoning during investigation design, analysis, conclusion, and communication. Science can produce critical insights on societal problems from a personal and local scale to a global scale. Science both aids in the development of technology and provides tools for assessing the costs, risks, and benefits of technological systems. Scientific conclusions and arguments play a role in personal choice and public policy decisions. New technology and scientific discoveries have had a major influence in shaping human history. Science and technology continue to offer diverse and significant career opportunities.</p>		
E1.2A	<p>Critique whether or not specific questions can be answered through scientific investigations.</p>	<p>FOS 1 Traver Creek Project- environmental assessments. FOS 2 Investigating requirements for the establishment of life on Earth.</p>	<p>During design of experiments, Experimental procedure, student generated questions in the area of Photosynthesis criteria. Student designed experiments to test Soil from the samples they collected for the evidence of life through cellular respiration requirements or products.</p>
E1.2B	<p>Identify and critique arguments about personal or societal issues based on scientific evidence.</p>	<p>FOS 1 Global Warming Project Student research evidence to support a particular theory about Global Warming causes and the possible results of the scenario</p>	<p>Final Global Warming project presentation.</p>

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E1.2C	Develop an understanding of a scientific concept by accessing information from multiple sources. Evaluate the scientific accuracy and significance of the information.	FOS 1 Global Warming Project This project evaluates the pro and con issues surrounding the causes of global warming.	Final project uses the information gathered to support their position– it is rubric graded.
E1.2D	Evaluate scientific explanations in a peer review process or discussion format.	FOS 1 Traver Creek Project FOS 1 Global Warming	Students evaluate their hypothesis on the basis their data of total solids and then test them in a lab format.
E1.2E	Evaluate the future career and occupational prospects of science fields.	FOS 1,2,3 guest speakers Forum career investigation	School-wide career day Career Cruising
E1.2f	Critique solutions to problems, given criteria and scientific constraints.	FOS 1 Global warming Project	Final presentation examining the causes of global warming and actions that people can do to help reduce the impact.
E1.2g	Identify scientific tradeoffs in design decisions and choose among alternative solutions.	Global Warming Project Alternative fuels	Alternative fuels, like bio diesel, are analyzed in their cost savings and environmental damage.
E1.2h	Describe the distinctions between scientific theories, laws, hypotheses, and observations.	FOS 2 Evolution & Plate Tectonics	Issues around the theory of Natural Selection, and the fact of evolution, are included in their essay and in their final project presentation. This also incorporates Plate Tectonics
E1.2i	Explain the progression of ideas and explanations that lead to science theories that are part of the current scientific consensus or core knowledge.	FOS 2 Evolution & Plate Tectonics	In Plate tectonics, the Natural Selection paper, final project presentation, unit test. All of the separate pieces of evidence collected over the last century are included and shown how they collectively Support the theory of Plate Tectonics.
E1.2j	Apply science principles or scientific data to anticipate effects of technological design decisions.	FOS1 Global Warming Project	Data analysis from NOAA and future energy sources/ and conservation used in final presentation
E1.2k	Analyze how science and society interact from a historical, political, economic, or social perspective.	FOS 2 Evolution & Plate Tectonics	Science is shown to be based on testable, reproducible evidence. The current scientific evidence is included in their Natural Selection paper, final project presentation, and unit test.

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<b>Standard E2</b>	<b>EARTH SYSTEMS</b>		
<b>Statement E2.1</b>	<b>Earth Systems Overview</b> The Earth is a system consisting of four major interacting components: geosphere (crust, mantle, and core), atmosphere (air), hydrosphere (water), and biosphere (the living part of Earth). Physical, chemical, and biological processes act within and among the four components on a wide range of time scales to continuously change Earth's crust, oceans, atmosphere, and living organisms. Earth elements move within and between the lithosphere, atmosphere, hydrosphere, and biosphere as part of geochemical cycles.	These 4 components are explored over two years in FOS 1 and and FOS 2. The projects that fulfill these standards are: FOS 1 Traver Creek project, Geologic and Glacial History of Ann Arbor, Global Warming, Daily Weather. For FOS 2: Plate Tectonics and Evolution; and Astronomy.	Voyages Through Time- (VTT) An Integrated Curriculum <a href="http://www.voyagesthroughtime.org/curriculum/scope.html">http://www.voyagesthroughtime.org/curriculum/scope.html</a>
E2.1A	Explain why the Earth is essentially a closed system in terms of matter.	FOS 2 Evolution & Plate Tectonics, Astronomy FOS 1 Traver Creek Project	VTT- Cosmic Evolution Unit <a href="http://www.voyagesthroughtime.org/curriculum/scope.html">http://www.voyagesthroughtime.org/curriculum/scope.html</a>  Big bang theory is incorporated in final astronomy unit test and project. Ionic chemistry of Creek water, double displacement lab report, and unit test. Matter is neither created or destroyed by ordinary means.
E2.1B	Analyze the interactions between the major systems (geosphere, atmosphere, hydrosphere, biosphere) that make up the Earth.	FOS 2 Evolution & Plate Tectonics-recycling the Earth's crust FOS 1 Traver Creek Project Weather Project- Scaling the Atmosphere	-ES Textbook Ch. 17, McDougal/Littell, <i>Earth Science</i> (ES) <a href="http://www.classzone.com/vpg_ebooks/ml_earthscience_na/ml_earthscience_na_main.cfm?mlauthtoken=605742797&amp;authtoken=605742797&amp;&amp;">http://www.classzone.com/vpg_ebooks/ml_earthscience_na/ml_earthscience_na_main.cfm?mlauthtoken=605742797&amp;authtoken=605742797&amp;&amp;</a>  VTT- Planet Evolution <a href="http://www.voyagesthroughtime.org/curriculum/scope.html">http://www.voyagesthroughtime.org/curriculum/scope.html</a>  The environmental effects of climate change and impact on evolution of life is evaluated in the Final project, unit test.  Scaling atmosphere activity- the composition of the atmospheric layers and weather is included in the unit test and final project.

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E2.1C	Explain, using specific examples, how a change in one system affects other Earth systems.	FOS 2 Evolution & Plate Tectonics- Climate FOS 1 Traver Creek Project Weather Project-Atmosphere Changes	VTT- Planet Evolution <a href="http://www.voyagesthroughtime.org/curriculum/scope.html">http://www.voyagesthroughtime.org/curriculum/scope.html</a>	Changes in climate affects the diversity of life, endanger habitat are examined and included in the <i>unit tests</i> and <i>final projects</i> on Natural Selection, Global Warming and Weather events.
<b>Statement E2.2</b>	<b>Energy in Earth Systems</b> Energy in Earth systems can exist in a number of forms (e.g., thermal energy as heat in the Earth, chemical energy stored as fossil fuels, mechanical energy as delivered by tides) and can be transformed from one state to another and move from one reservoir to another. Movement of matter and its component elements, through and between Earth's systems, is driven by Earth's internal (radioactive decay and gravity) and external (Sun as primary) sources of energy. Thermal energy is transferred by radiation, convection, and conduction. Fossil fuels are derived from plants and animals of the past, are nonrenewable and, therefore, are limited in availability. All sources of energy for human consumption (e.g., solar, wind, nuclear, ethanol, hydrogen, geothermal, hydroelectric) have advantages and disadvantages.	The different forms of energy and their transformations are included in projects throughout the 3year sequence of FOS. Below are some examples where the specific objectives are covered.		
E2.2A	Describe the Earth's principal sources of internal and external energy (e.g., radioactive decay, gravity, solar energy).	FOS 2 Cosmology Project-Formation of the Earth- Solar System- Universe Dating material through radioactive decay for dating fossils, and the Global Atmosphere projects dating core samples	Voyages Through Time Curriculum (VTT) NSF and SETI developers	Final project FOS 2- origin of the universe. FOS 2- incorporate in plate tectonics; dating plates and movement of them over time. Lab Activity and unit test.
E2.2B	Identify differences in the origin and use of renewable (e.g., solar, wind, water, biomass) and nonrenewable (e.g., fossil fuels, nuclear [U-235]) sources of energy.	FOS 1 Global Atmosphere Project Student study alternative energy sources and their effects on the atmosphere.		Lab activities, final presentation, unit tests all evaluate the use of different forms of energy and their environmental impact.
E2.2C	Describe natural processes in which heat	FOS 1		Unit test, final projects in Weather,

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	transfer in the Earth occurs by conduction, convection, and radiation.	Global Warming Project-Climate Weather Project-Forces that drive the atmosphere Glaciology Project FOS 2 Plate Tectonics and Evolution	Glacial Geology, Plate Tectonics. For example, students describe the flow of energy from the sun
E2.2D	Identify the main sources of energy to the climate system.	FOS 1 Global Warming Project-Climate Weather Project	Unit test, final projects in Weather, Glacial geology. Global Warming
E2.2e	Explain how energy changes form through Earth systems.	FOS 1 Global Warming Project Weather Project	Greenhouse effect lab activity. Unit quiz.
E2.2f	Explain how elements exist in different compounds and states as they move from one reservoir to another.	FOS 1 Traver Creek Project- Periodic Table, Chemical testing in Traver Creek Global Warming Project	FOS 1-Chemical Change Lab. Unit test.
<b>Statement E2.3</b>	<b>Biogeochemical Cycles</b> The Earth is a system containing essentially a fixed amount of each stable chemical atom or element. Most elements can exist in several different states and chemical forms; they move within and between the geosphere, atmosphere, hydrosphere, and biosphere as part of the Earth system. The movements can be slow or rapid. Elements and compounds have significant impacts on the biosphere and have important impacts on human health.	FOS 1 Traver Creek Project	Lab activities, final report
E2.3A	Explain how carbon exists in different forms such as limestone (rock), carbon dioxide (gas), carbonic acid (water), and animals (life) within Earth systems and how those forms can be beneficial or harmful to humans.	FOS 1 Traver Creek Project- Chemical testing FOS 1 Glacier Project FOS 1 Global Warming Project	FOS 1-Lab Activity- Chemical Changes; Lab- Biogeochemical cycle; different types of air pollution and their effects on life .
E2.3b	Explain why small amounts of some chemical forms may be beneficial for life	FOS 1 Traver Creek Project-Benthics and their	FOS 1-Creek water testing analysis and extensive lab report. And, FOS 2-

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	but are poisonous in large quantities (e.g., dead zone in the Gulf of Mexico, Lake Nyos in Africa, fluoride in drinking water).	Ecosystem FOS 2 Donner Blitzen Project- Testing Soil for life	designing an experiment to test for life in soil that was sampled from their “planet”, and writing the report. Both FOS 1 and 2 also include this on the unit test.
E2.3c	Explain how the nitrogen cycle is part of the Earth system.	FOS 1 Traver Creek Project Nitrogen Cycle and Chemistry of water	Students use <i>Inspiration</i> activity to show the various stages of the geocycles and their relationships.
E2.3d	Explain how carbon moves through the Earth system (including the geosphere) and how it may benefit (e.g., improve soils for agriculture) or harm (e.g., act as a pollutant) society.	FOS 1 Global Warming Project Climatic factors	FOS 1-Essay test on factors and cycles of carbon and impact on climate
<b>Statement E2.4</b>	<b>Resources and Human Impacts on Earth Systems</b> The Earth provides resources (including minerals) that are used to sustain human affairs. The supply of non-renewable natural resources is limited and their extraction and use can release elements and compounds into Earth systems. They affect air and water quality, ecosystems, landscapes, and may have effects on long-term climate. Plans for land use and long-term development must include an understanding of the interactions between Earth systems and human activities.	FOS1-The Traver Creek project looks at our own environment, resources, pollution, and possible remedies. The Global Warming project also examines these issues in the context of our changing atmosphere and its causes.	
E2.4A	Describe renewable and nonrenewable sources of energy for human consumption (electricity, fuels), compare their effects on the environment, and include overall costs and benefits.	FOS 1 Global Warming Project	Alternative Fuels- Problem Solving the Atmosphere. Part of final presentation and unit test.
E2.4B	Explain how the impact of human activities on the environment (e.g., deforestation, air pollution, coral reef destruction) can be understood through the analysis of interactions between the four Earth	FOS 1 Traver Creek Project-Our Local Environment Global Warming Project- Climatic Factors	Project GREEN Observe our local ecology, and describe and compare long term study on change in the environment in lab report; unit test for assessment. There is a biological, physical and chemical assessment done of

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	systems.	FOS 2 Natural Selection and Mass Extinctions- causes and records of species loss in the past and the current extinction.	our local environment  iMovie presentation prepared by students, rubric graded
E2.4c	Explain ozone depletion in the stratosphere and methods to slow human activities to reduce ozone depletion.	FOS 1 Weather Project- Short term affects on human health.	Scaling the Atmosphere lab activity and Unit test
E2.4d	Describe the life cycle of a product, including the resources, production, packaging, transportation, disposal, and pollution.	Developing material	Student compare the energy needed to produce alternatives forms of products; I.E. biodiesel vs. solar power.
<b>Standard E3</b>	<b>THE SOLID EARTH</b>		
<b>Statement E3.p1</b>	<b>Landforms and Soils (<i>prerequisite</i>)</b> Landforms are the result of a combination of constructive and destructive forces. Constructive forces include crustal deformation, volcanic eruptions, and deposition of sediments transported in rivers, streams, and lakes through watersheds. Destructive forces include weathering and erosion. The weathering of rocks and decomposed organic matter result in the formation of soils. <i>(prerequisite)</i>	<i>FOS 1</i> <i>Review in Glacial Climate Project</i>	
E3.p1A	Explain the origin of Michigan landforms. Describe and identify surface features using maps and satellite images. <i>(prerequisite)</i>		
E3.p1B	Explain how physical and chemical weathering leads to erosion and the formation of soils and sediments. <i>(prerequisite)</i>		
E3.p1C	Describe how coastal features are formed by wave erosion and deposition. <i>(prerequisite)</i>		
<b>Statement E3.p2</b>	<b>Rocks and Minerals (<i>prerequisite</i>)</b> Igneous, metamorphic, and sedimentary		

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	rocks are constantly forming and changing through various processes. As they do so, elements move through the geosphere. In addition to other geologic features, rocks and minerals are indicators of geologic and environmental conditions that existed in the past. <i>(prerequisite)</i>			
E3.p2A	Identify common rock-forming minerals (quartz, feldspar, biotite, calcite, hornblende). <i>(prerequisite)</i>			
E3.p2B	Identify common igneous (granite, basalt, andesite, obsidian, pumice), metamorphic (schist, gneiss, marble, slate, quartzite), and sedimentary (sandstone, limestone, shale, conglomerate) rocks and describe the processes that change one kind of rock to another. <i>(prerequisite)</i>			
<b>Statement E3.p3</b>	<b>Basic Plate Tectonics <i>(prerequisite)</i></b> Early evidence for the movement of continents was based on the similarities of coastlines, geology, faunal distributions, and paleoclimatological data across the Atlantic and Indian Oceans. In the 1960s, additional evidence from marine geophysical surveys, seismology, volcanology, and paleomagnetism resulted in the development of the theory of plate tectonics. <i>(prerequisite)</i>	FOS 2 Evolution and Plate Tectonics Project		
E3.p3A	Describe geologic, paleontologic, and paleoclimatologic evidence that indicates Africa and South America were once part of a single continent.	FOS 2 Evolution and Plate Tectonics Project Evidence for plate tectonics is described in the final presentation	Voyages Through Time- (VTT) An Integrated Curriculum- Planetary Evolution <a href="http://www.voyagesthroughtime.org/curriculum/scope.html">http://www.voyagesthroughtime.org/curriculum/scope.html</a>	Final project presentation and unit test. Students present the geologic, paleontologic and paleoclimatologic evidence for plate tectonics. Text book internet activities; and in their final project the long term effects of plate movement are described in terms of natural selection in their final project. Rubric graded.
E3.p3B	Describe the three types of plate	FOS 2	Dynamic Planet	Final project presentation and unit test.

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	boundaries (divergent, convergent, and transform) and geographic features associated with them (e.g., continental rifts and mid-ocean ridges, volcanic and island arcs, deep-sea trenches, transform faults).	Evolution and Plate Tectonics Project	Investigation 4 Movement of Earth's Plates <a href="http://www.agiweb.org/education/ies/dp/invest4.html">http://www.agiweb.org/education/ies/dp/invest4.html</a>	Plate boundaries are part of the evidence to support the theory of plate tectonics.
E3.p3C	Describe the three major types of volcanoes (shield volcano, stratovolcano, and cinder cones) and their relationship to the Ring of Fire.	FOS 2 Evolution and Plate Tectonics Project		Textbook Lab Activity- 3 volcano types.
<b>Statement E3.1</b>	<b>Advanced Rock Cycle</b> Igneous, metamorphic, and sedimentary rocks are indicators of geologic and environmental conditions and processes that existed in the past. These include cooling and crystallization, weathering and erosion, sedimentation and lithification, and metamorphism. In some way, all of these processes are influenced by plate tectonics, and some are influenced by climate.	FOS 1 Glacial Climate Project- Part of the geologic history of Ann Arbor. The various rock types and their formation provide evidence of glacier activity.		
E3.1A	Discriminate between igneous, metamorphic, and sedimentary rocks and describe the processes that change one kind of rock into another.	FOS 1 Glacial Climate Project. Rock type formation and environment.	ES Textbook Ch. 5-6 Lab Activity	Part of final presentation and unit quiz. Used as evidence to support theory of glaciation of Ann Arbor area. Rock Lab Activity.
E3.1B	Explain the relationship between the rock cycle and plate tectonics theory in regard to the origins of igneous, sedimentary, and metamorphic rocks.	FOS 1 Glacial Climate Project FOS 2 Evolution and Plate Tectonics Project	ES Textbook Ch. 5-6 Lab Activity	Part of final presentation and unit quiz. Used as evidence to support theory of glaciation of Ann Arbor area Students make a rock collection and identify the rocks they find explain their origin. Rock Lab Activity.
E3.1c	Explain how the size and shape of grains in a sedimentary rock indicate the environment of formation (including climate) and deposition.	FOS 1 Glacial Climate Project	ES Textbook Ch. 5-6 Lab Activity	Part of final presentation and unit quiz. Student's explanation of the rocks they find and how they show evidence of glaciation. Rock Lab Activity.
E3.1d	Explain how the crystal sizes of igneous rocks indicate the rate of cooling and whether the rock is extrusive or intrusive.	FOS 1 Glacial Climate Project	ES Textbook Ch. 5-6 Lab Activity	Part of final presentation and unit quiz. The most recent formation of bedrock in Mi is through sedimentation. So rocks

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			formed through metamorphosis or igneous rock formation occurred elsewhere. Rock Lab Activity.	
E3.1e	Explain how the texture (foliated, nonfoliated) of metamorphic rock can indicate whether it has experienced regional or contact metamorphism.	FOS 1 Glacial Climate Project	ES Textbook Ch. 5-6 Lab Activity	Part of final presentation and unit quiz. The most recent formation of bedrock in Mi is through sedimentation. So rocks formed through metamorphosis or igneous rock formation occurred elsewhere.
<b>Statement E3.2</b>	<b>Interior of the Earth</b> The Earth can also be subdivided into concentric layers based on their physical characteristics: (lithosphere, asthenosphere, lower mantle, outer core, and inner core). The crust and upper mantle compose the rigid lithosphere (plates) that moves over a “softer” asthenosphere (part of the upper mantle). The magnetic field of the Earth is generated in the outer core. The interior of the Earth cannot be directly sampled and must be modeled using data from seismology.	FOS 2 Evolution and Plate Tectonics Project		Part of final presentation and unit quiz
E3.2A	Describe the interior of the Earth (in terms of crust, mantle, and inner and outer cores) and where the magnetic field of the Earth is generated.	FOS 2 Evolution and Plate Tectonics Project Astronomy unit		The formation of the Earth and its layers are tested in the final unit test.
E3.2B	Explain how scientists infer that the Earth has interior layers with discernable properties using patterns of primary ( <i>P</i> ) and secondary ( <i>S</i> ) seismic wave arrivals.	FOS 2 Astronomy unit	Dynamic Planet Investigation 2 <a href="http://www.agiweb.org/education/ies/dp/invest2.html">http://www.agiweb.org/education/ies/dp/invest2.html</a>	Part of final presentation and unit quiz. Earthquake Activity. Earthquakes and their location are part of the geology of the fictitious planet they explore. Earthquakes provide evidence of an active geologic core of the planet.
E3.2C	Describe the differences between oceanic and continental crust (including density, age, composition).	FOS 2 Evolution and Plate Tectonics Project- Structure of the earth.	Geology- <a href="http://www.gpc.edu/~pgore/Earth&amp;Space/GPS/earthinterior.html">http://www.gpc.edu/~pgore/Earth&amp;Space/GPS/earthinterior.html</a>	Part of unit quiz. Internet guide questions.
E3.2d	Explain the uncertainties associated with models of the interior of the Earth and how these models are validated.	FOS 2 Evolution and Plate Tectonics Project	Geology- <a href="http://www.gpc.edu/~pgore/Earth&amp;Space/GPS">http://www.gpc.edu/~pgore/Earth&amp;Space/GPS</a>	Part of unit quiz. Internet guide questions

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<b>Statement E3.3</b>	<p><b>Plate Tectonics Theory</b> The Earth's crust and upper mantle make up the lithosphere, which is broken into large mobile pieces called tectonic plates. The plates move at velocities in units of centimeters per year as measured using the global positioning system (GPS). Motion histories are determined with calculations that relate rate, time, and distance of offset geologic features. Oceanic plates are created at mid-ocean ridges by magmatic activity and cooled until they sink back into the Earth at subduction zones. At some localities, plates slide by each other. Mountain belts are formed both by continental collision and as a result of subduction. The outward flow of heat from Earth's interior provides the driving energy for plate tectonics.</p>	<p>Investigating Earth Systems <a href="http://www.agiweb.org/education/ies/dp/index.html">http://www.agiweb.org/education/ies/dp/index.html</a></p>	<p>USGS-What is Plate Tectonics? <a href="http://geomaps.wr.usgs.gov/parks/pltec/index.html">http://geomaps.wr.usgs.gov/parks/pltec/index.html</a> Plate Tectonic Movement <a href="http://www2.nature.nps.gov/geology/usgsnps/animate/pltecan.html">http://www2.nature.nps.gov/geology/usgsnps/animate/pltecan.html</a></p>
E3.3A	<p>Explain how plate tectonics accounts for the features and processes (sea floor spreading, mid-ocean ridges, subduction zones, earthquakes and volcanoes, mountain ranges) that occur on or near the Earth's surface.</p>	<p>FOS 2 Evolution and Plate Tectonics Project- The theory is explored and evidence leading to its acceptance by scientists. The movement of the plates is also studied in regards to its influence on the evolution of organisms on the various plates. Movement of the plates is also discussed in regards to its influence in the evolution of life through natural selection.</p>	<p>Use above resources</p> <p>Final project and unit test, ES Internet Activity. Earth Science Text questions.</p>
E3.3B	<p>Explain why tectonic plates move using the concept of heat flowing through mantle convection, coupled with the cooling and sinking of aging ocean plates that result from their increased density.</p>	<p>FOS 2 Evolution and Plate Tectonics Project</p>	<p>Dynamic Earth Investigation 3 <a href="http://www.agiweb.org/education/ies/dp/invest3.html">http://www.agiweb.org/education/ies/dp/invest3.html</a></p> <p>Internet Activity, Final project and unit test. Density Currents demonstration.</p>
E3.3C	<p>Describe the motion history of geologic features (e.g., plates, Hawaii) using equations relating rate, time, and distance.</p>	<p>FOS 2 Evolution and Plate Tectonics Project</p>	<p>VTT- Plate Tectonic Unit</p> <p>Internet Activity ES Text, Final project and unit test</p>

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E3.3d	Distinguish plate boundaries by the pattern of depth and magnitude of earthquakes.	FOS 2 Evolution and Plate Tectonics Project	Earth Quakes <a href="http://www.tulane.edu/~sanelson/geol1111/earthhint.htm">http://www.tulane.edu/~sanelson/geol1111/earthhint.htm</a>	Internet Activity ES Text, Final project and unit test.
E3.r3e	Predict the temperature distribution in the lithosphere as a function of distance from the mid-ocean ridge and how it relates to ocean depth. <i>(recommended)</i>			
E3.r3f	Describe how the direction and rate of movement for the North American plate has affected the local climate over the last 600 million years. <i>(recommended)</i>	FOS 2 Evolution and Plate Tectonics Project		Final project and unit test. Students choose a continent and follow its path over time. They produce maps as part of their final project.
<b>Statement E3.4</b>	<b>Earthquakes and Volcanoes</b> Plate motions result in potentially catastrophic events (earthquakes, volcanoes, tsunamis, mass wasting) that affect humanity. The intensity of volcanic eruptions is controlled by the chemistry and properties of the magma. Earthquakes are the result of abrupt movements of the Earth. They generate energy in the form of body and surface waves.	FOS 2 Evolution and Plate Tectonics Project ASSET – Voyages Through Time- has many activities that supplement the current textbook.	Virtual Earthquake Activity <a href="http://www.sciencecourseware.org/eec/Earthquake/">http://www.sciencecourseware.org/eec/Earthquake/</a>	
E3.4A	Use the distribution of earthquakes and volcanoes to locate and determine the types of plate boundaries.	FOS 2 Evolution and Plate Tectonics Project	VTT- ASSET curriculum is used throughout this unit.	Internet activity- ES Text. Part of final project demonstrating evidence for plate movement.
E3.4B	Describe how the sizes of earthquakes and volcanoes are measured or characterized.	FOS 2 Evolution and Plate Tectonics Project	ES Textbook Ch. 9 -10 Volcanoes	Internet activity-Virtual EQ
E3.4C	Describe the effects of earthquakes and volcanic eruptions on humans.	FOS 2 Evolution and Plate Tectonics Project	ES Textbook Ch. 9-10 Volcanoes	Internet activity- ES Textbook
E3.4d	Explain how the chemical composition of magmas relates to plate tectonics and affects the geometry, structure, and explosivity of volcanoes.	FOS 2 Evolution and Plate Tectonics Project	ES Textbook Ch. 9-10 Volcanoes	Textbook Lab activity.

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HSCE	Activities	Resource / Materials	Assessment	
E3.4e	Explain how volcanoes change the atmosphere, hydrosphere, and other Earth systems.	FOS 1 Global Warming- current eruptions. FOS 2 Evolution and Plate Tectonics Astronomy project	ES Textbook Ch. 9-10 Volcanoes	The formation of the atmosphere and hydrosphere is incorporated into current climate factors. The formation of the Earth and establishment of the first living organisms is completed with textbook internet activity and in the final project.
E3.4f	Explain why fences are offset after an earthquake, using the elastic rebound theory.	FOS 2 Evolution and Plate Tectonics Project		Internet Activity- evidence for plate movement.
<b>Standard E4</b>	<b>THE FLUID EARTH</b>			
<b>Statement E4.p1</b>	<b>Water Cycle (prerequisite)</b> Water circulates through the crust and atmosphere and in oceans, rivers, glaciers, and ice caps and connects all of the Earth systems. Groundwater is a significant reservoir and source of freshwater on Earth. The recharge and movement of groundwater depends on porosity, permeability, and the shape of the water table. The movement of groundwater occurs over a long period time. Groundwater and surface water are often interconnected. (prerequisite)	Review in FOS 1 Traver Creek Project- analysis of water, physical assessment of land use and biological indicators help determine the ecological health of our watershed.		
E4.p1A	Describe that the water cycle includes evaporation, transpiration, condensation, precipitation, infiltration, surface runoff, groundwater, and absorption. (prerequisite)			
E4.p1B	Analyze the flow of water between the elements of a watershed, including surface features (lakes, streams, rivers, wetlands) and groundwater. (prerequisite)			
E4.p1C	Describe the river and stream types, features, and process including cycles of flooding, erosion, and deposition as they occur naturally and as they are impacted by land use decisions. (prerequisite)			
E4.p1D	Explain the types, process, and beneficial		Watershed Academy	Internet guide sheet investigating

## EARTH SCIENCE COMMUNITY HS

HSCE	Activities	Resource / Materials	Assessment
	functions of wetlands.		wetlands and their functions.
<b>Statement E4.p2</b>	<b>Weather and the Atmosphere (prerequisite)</b> The atmosphere is divided into layers defined by temperature. Clouds are indicators of weather. <i>(prerequisite)</i>	FOS 1 -Weather Project -Global Warming Project- These projects review these objectives, and then are built upon with more depth and data.	Web <a href="http://www.epa.gov/waterstrain/wetlands/">http://www.epa.gov/waterstrain/wetlands/</a>
E4.p2A	Describe the composition and layers of the atmosphere. <i>(prerequisite)</i>		
E4.p2B	Describe the difference between weather and climate. <i>(prerequisite)</i>		
E4.p2C	Explain the differences between fog and dew formation and cloud formation. <i>(prerequisite)</i>		
E4.p2D	Describe relative humidity in terms of the moisture content of the air and the moisture capacity of the air and how these depend on the temperature. <i>(prerequisite)</i>		
E4.p2E	Describe conditions associated with frontal boundaries (cold, warm, stationary, and occluded). <i>(prerequisite)</i>		
E4.p2F	Describe the characteristics and movement across North America of the major air masses and the jet stream. <i>(prerequisite)</i>		
E4.p2G	Interpret a weather map and describe present weather conditions and predict changes in weather over 24 hours. <i>(prerequisite)</i>		
E4.p2H	Explain the primary causes of seasons. <i>(prerequisite)</i>		

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HSCE	Activities	Resource / Materials	Assessment
E4.p2I	Identify major global wind belts (trade winds, prevailing westerlies, and polar easterlies) and that their vertical components control the global distribution of rainforests and deserts. <i>(prerequisite)</i>		
<b>Statement E4.p3</b>	<b>Glaciers <i>(prerequisite)</i></b> Glaciers are large bodies of ice that move under the influence of gravity. They form part of both the rock and water cycles. Glaciers and ice sheets have shaped the landscape of the Great Lakes region. Areas that have been occupied by ice sheets are depressed. When the ice sheet is removed, the region rebounds (see also climate change). <i>(prerequisite)</i>	Reviewed in FOS 1 Glacial Climate Project	
E4.p3A	Describe how glaciers have affected the Michigan landscape and how the resulting landforms impact our state economy. <i>(prerequisite)</i>		
E4.p3B	Explain what happens to the lithosphere when an ice sheet is removed. <i>(prerequisite)</i>		
E4.p3C	Explain the formation of the Great Lakes. <i>(prerequisite)</i>		
<b>Statement E4.1</b>	<b>Hydrogeology</b> Fresh water moves over time between the atmosphere, hydrosphere (surface water, wetlands, rivers, and glaciers), and geosphere (groundwater). Water resources are both critical to and greatly impacted by humans. Changes in water systems will impact quality, quantity, and movement of water. Natural surface water processes shape the landscape everywhere and are affected by human land use decisions.	FOS 1 Traver Creek Project-- analysis of water, physical assessment of land use and biological indicators help determine the ecological health of our watershed.	
E4.1A	Compare and contrast surface water systems (lakes, rivers, streams, wetlands) and groundwater in regard to their relative	FOS 1 Traver Creek Project Michigan's water sources are examined in mapping the local area. Sources of	Virtual River <a href="http://nemo.scienceourseware.org/VirtualRiver">http://nemo.scienceourseware.org/VirtualRiver</a> Material is part of final lab report and recommendations made to protect our water sources.

## EARTH SCIENCE COMMUNITY HS

HSCE	Activities	Resource / Materials	Assessment
	sizes as Earth's freshwater reservoirs and the dynamics of water movement (inputs and outputs, residence times, sustainability).	pollution, impervious surfaces, etc. are researched.	/
E4.1B	Explain the features and processes of groundwater systems and how the sustainability of North American aquifers has changed in recent history (e.g., the past 100 years) qualitatively using the concepts of recharge, residence time, inputs, and outputs.	FOS 1 Traver Creek Project Sources of freshwater in the US is discussed.-	The decline of the aquifer in the Midwest and how that affects our economy is discussed. Quiz. The effects of global warming and our water supply is part of the project presentation.
E4.1C	Explain how water quality in both groundwater and surface systems is impacted by land use decisions.	FOS 1 Traver Creek Project-	Final presentation- recommendations to preserve the watershed is describe in their final letter – proposal to HRWC.
<b>Statement E4.2</b>	<b>Oceans and Climate</b> Energy from the Sun and the rotation of the Earth control global atmospheric circulation. Oceans redistribute matter and energy around the Earth through currents, waves, and interaction with other Earth systems. Ocean currents are controlled by prevailing winds, changes in water density, ocean topography, and the shape and location of landmasses. Oceans and large lakes (e.g., Great Lakes) have a major effect on climate and weather because they are a source of moisture and a large reservoir of heat. Interactions between oceanic circulation and the atmosphere can affect regional climates throughout the world.	FOS 1 Global Warming Project Glacial Climate Project	
E4.2A	Describe the major causes for the ocean's surface and deep water currents, including the prevailing winds, the Coriolis effect, unequal heating of the earth, changes in water temperature and salinity in high latitudes, and basin shape.	FOS 1 Glacial Climate Project Global Warming Project Weather Project	ES Textbook Ch. 20-22 Activities
E4.2B	Explain how interactions between the	FOS 1	ES Textbook Part of lecture series. Students answer

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HSCE	Activities	Resource / Materials	Assessment
	oceans and the atmosphere influence global and regional climate. Include the major concepts of heat transfer by ocean currents, thermohaline circulation, boundary currents, evaporation, precipitation, climatic zones, and the ocean as a major CO <sub>2</sub> reservoir.	Glacial Climate Project Global Warming Project	Ch. 20-22 Activities  questions, define vocabulary, and use the material in their final projects.
E4.2c	Explain the dynamics (including ocean-atmosphere interactions) of the El Niño-Southern Oscillation (ENSO) and its effect on continental climates.	FOS 1 Global Warming Project Daily Weather Project	ES Textbook Ch. 20  Part of lecture series. Students answer questions, define vocabulary, and use the material in their final projects.
E4.2d	Identify factors affecting seawater density and salinity and describe how density affects oceanic layering and currents.	FOS 1 Global Warming Project	ES Textbook Ch. 24  Part of lecture series. Students answer questions, define vocabulary, and use the material in their final projects.
E4.2e	Explain the differences between maritime and continental climates with regard to oceanic currents.	FOS 1 Weather Project- What is weather? How is weather measured, predicted? What factors affect daily weather?	ES Textbook Ch. 20  Lab activities, project preparation, and unit test are used to measure student mastery.
E4.2f	Explain how the Coriolis effect controls oceanic circulation.	FOS 1 Weather Project- What is weather? How is weather measured, predicted? What factors affect daily weather?	ES Textbook Ch. 19  Lab activities, project preparation, and unit test measure student mastery
E4.r2g	Explain how El Niño affects economies (e.g., in South America). <i>(recommended)</i>		
<b>Statement E4.3</b>	<b>Severe Weather</b> Tornadoes, hurricanes, blizzards, and thunderstorms are severe weather phenomena that impact society and ecosystems. Hazards include downbursts (wind shear), strong winds, hail, lightning, heavy rain, and flooding. The movement of air in the atmosphere is due to differences in air density resulting from variations in temperature. Many weather conditions can be explained by fronts that occur when air masses meet.	FOS 1- Weather Project Students examine extreme weather events and incorporate the objectives in their final project presentation.	
E4.3A	Describe the various conditions of formation associated with severe weather	FOS 1 Weather Project	ES Textbook Ch. 20  Rubric graded. Final presentation, unit test. Students choose a weather event and

## EARTH SCIENCE COMMUNITY HS

HSCE	Activities	Resource / Materials	Assessment
	(thunderstorms, tornadoes, hurricanes, floods, waves, and drought).		Nova- Storm Chasers  describe each of the factors (objectives) and how they relate to their weather phenomena (i.e. tornados). They produce an iMovie and take a unit test on all of the student productions.
E4.3B	Describe the damage resulting from and the social impact of thunderstorms, tornadoes, hurricanes, and floods.	FOS 1 Weather Project	Final presentation, unit quiz
E4.3C	Describe severe weather and flood safety and mitigation.	FOS 1 Weather Project	Final presentation, unit quiz
E4.3D	Describe the seasonal variations in severe weather.	FOS 1 Weather Project	Final presentation, unit quiz
E4.3E	Describe conditions associated with frontal boundaries that result in severe weather (thunderstorms, tornadoes, and hurricanes).	FOS 1 Weather Project	Final presentation, unit quiz, lab activity
E4.3F	Describe how mountains, frontal wedging (including dry lines), convection, and convergence form clouds and precipitation.	FOS 1 Weather Project	Final presentation, unit quiz, lab activity
E4.3g	Explain the process of adiabatic cooling and adiabatic temperature changes to the formation of clouds.	FOS 1 Weather Project	Developing additional material
<b>Standard E5</b>	<b>THE EARTH IN SPACE AND TIME</b>		
<b>Statement E5.p1</b>	<b>Sky Observations (prerequisite)</b> Common sky observations (such as lunar phases) can be explained by the motion of solar system objects in regular and predictable patterns. Our galaxy, observable as the Milky Way, is composed of billions of stars, some of which have planetary systems. Seasons are a result of the tilt of the rotation axis of the Earth. The motions of the moon and Sun affect the phases of the moon and ocean tides. <i>(prerequisite)</i>	FOS 2 Cosmology Project Review of these standards	
E5.p1A	Describe the motions of various celestial bodies and some effects of those motions.		

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HSCE	Activities	Resource / Materials	Assessment
	<i>(prerequisite)</i>		
E5.p1B	Explain the primary cause of seasons. <i>(prerequisite)</i>		
E5.p1C	Explain how a light year can be used as a distance unit. <i>(prerequisite)</i>		
E5.p1D	Describe the position and motion of our solar system in our galaxy. <i>(prerequisite)</i>		
<b>Statement E5.1</b>	<p><b>The Earth in Space</b> Scientific evidence indicates the universe is orderly in structure, finite, and contains all matter and energy. Information from the entire light spectrum tells us about the composition and motion of objects in the universe. Early in the history of the universe, matter clumped together by gravitational attraction to form stars and galaxies. According to the Big Bang theory, the universe has been continually expanding at an increasing rate since its formation about 13.7 billion years ago.</p>	<p>FOS 2 Cosmology Project The objective of this project is to learn about astronomical bodies (planets, moons, stars, galaxies, etc.), how we explore them, how the Universe began and whether life exists outside of our planet. 1. How did the Universe begin and how do planets and stars form? 2. What are the life cycles of stars? 3. What does life (as we know it) need to begin on another planet, and does life exist outside of our planet?</p>	
E5.1A	Describe the position and motion of our solar system in our galaxy and the overall scale, structure, and age of the universe.	FOS 2 Cosmology Project	ES Textbook Ch. 26-27  Textbook activity, rubric graded final project, unit test. Project 1. How did the Universe begin and how do planets and stars form? 2. What are the life cycles of stars? 3. What does life (as we know it) need to begin on another planet, and does life exist outside of our planet?
E5.1b	Describe how the Big Bang theory accounts for the formation of the universe.	FOS 2 Cosmology Project	ES Textbook Ch. 28  Textbook activity, rubric graded final project, unit test. Project 1. How did the Universe begin and how do planets and stars form? 2. What are the life cycles of stars? 3. What does life (as we know it) need to begin on another planet, and does life

## EARTH SCIENCE COMMUNITY HS

HSCE	Activities	Resource / Materials	Assessment
			exits outside of our planet?
E5.1c	Explain how observations of the cosmic microwave background have helped determine the age of the universe.	FOS 2 Cosmology Project	ES Textbook Ch. 28
			Unit test. Project 1. How did the Universe begin and how do planets and stars form? 2. What are the life cycles of stars? 3. What does life (as we know it) need to begin on another planet, and does life exits outside of our planet?
E5.1d	Differentiate between the cosmological and Doppler red shift.	FOS 2 Cosmology Project	ES Textbook Ch. 28
			Textbook activity, unit test. Project 1. How did the Universe begin and how do planets and stars form? 2. What are the life cycles of stars? 3. What does life (as we know it) need to begin on another planet, and does life exits outside of our planet?
<b>Statement E5.2</b>	<b>The Sun</b> Stars, including the Sun, transform matter into energy in nuclear reactions. When hydrogen nuclei fuse to form helium, a small amount of matter is converted to energy. Solar energy is responsible for life processes and weather as well as phenomena on Earth. These and other processes in stars have led to the formation of all the other chemical elements.	FOS 2 Cosmology Project	NASA-Convection <a href="http://sohowww.nascom.nasa.gov/explore/lessons/convection.html">http://sohowww.nascom.nasa.gov/explore/lessons/convection.html</a>
E5.2A	Identify patterns in solar activities (sunspot cycle, solar flares, solar wind).	FOS 2 Cosmology Project Life Cycles of Stars	ES Textbook Ch. 27 Also use VTT Curriculum and Activities
			Solar observation activity.
E5.2B	Relate events on the Sun to phenomena such as auroras, disruption of radio and satellite communications, and power grid disturbances.	FOS 2 Cosmology Project Life Cycles of Stars	ES Textbook Ch. 26 and 28 Also use VTT Curriculum and Activity
			Solar observation activity. Unit test

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HSCE	Activities	Resource / Materials	Assessment	
E5.2C	Describe how nuclear fusion produces energy in the Sun.	FOS 2 Cosmology Project Life Cycles of Stars	ES Textbook Ch. 28 Also use VTT Curriculum and Activity	Final project, rubric graded, unit test
E5.2D	Describe how nuclear fusion and other processes in stars have led to the formation of all the other chemical elements.	FOS 2 Cosmology Project Life Cycles of Stars	ES Textbook Ch. 28 Also use VTT Curriculum and Activity	Final project, rubric graded, unit test
<b>Statement E5.2x</b>	<b>Stellar Evolution</b> Stars, including the Sun, transform matter into energy in nuclear reactions. When hydrogen nuclei fuse to form helium, a small amount of matter is converted to energy. These and other processes in stars have led to the formation of all the other chemical elements. There is a wide range of stellar objects of different sizes and temperatures. Stars have varying life histories based on these parameters.	FOS 2 Cosmology Project		
E5.2e	Explain how the Hertzsprung-Russell (H-R) diagram can be used to deduce other parameters (distance).	FOS 2 Cosmology Project Life Cycles of Stars	ES Textbook Ch. 28	Textbook Lab activity
E5.2f	Explain how you can infer the temperature, life span, and mass of a star from its color. Use the H-R diagram to explain the life cycles of stars.	FOS 2 Cosmology Project Life Cycles of Stars	ES Textbook Ch. 28	Textbook Lab activity
E5.2g	Explain how the balance between fusion and gravity controls the evolution of a star (equilibrium).	FOS 2 Cosmology Project Life Cycles of Stars	ES Textbook Ch. 28	Final project, graded rubric. Apply objectives to their stellar body
E5.2h	Compare the evolution paths of low-moderate-, and high-mass stars using the H-R diagram.	FOS 2 Cosmology Project Life Cycles of Stars	ES Textbook Ch. 28	Textbook Lab activity
<b>Statement E5.3</b>	<b>Earth History and Geologic Time</b> The solar system formed from a nebular cloud of dust and gas 4.6 Ga (billion years ago). The Earth has changed through time and has been affected by both catastrophic	FOS 2 Astronomy and Cosmology Project Evolution and Plate Tectonics		

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HSCE	Activities	Resource / Materials	Assessment
	(e.g., earthquakes, meteorite impacts, volcanoes) and gradual geologic events (e.g., plate movements, mountain building) as well as the effects of biological evolution (formation of an oxygen atmosphere). Geologic time can be determined through both relative and absolute dating.		
E5.3A	Explain how the solar system formed from a nebula of dust and gas in a spiral arm of the Milky Way Galaxy about 4.6 Ga (billion years ago).	FOS 2 Astronomy and Cosmology Project Big Bang theory	ES Textbook Ch. 29  Part of unit project, grade rubric. Unit test.
E5.3B	Describe the process of radioactive decay and explain how radioactive elements are used to date the rocks that contain them.	FOS 2 Astronomy and Cosmology Project Evolution and Plate Tectonics Use radioactive decay as dating method	ES Textbook Ch. 29  VTT Curriculum (SETI, NSF)  Radioactive decay Activity, unit quiz.
E5.3C	Relate major events in the history of the Earth to the geologic time scale, including formation of the Earth, formation of an oxygen atmosphere, rise of life, Cretaceous-Tertiary (K-T) and Permian extinctions, and Pleistocene ice age.	FOS 2 Evolution and Plate Tectonics Mass Extinctions Cosmology	ES Textbook Ch. 29  VTT Curriculum VTT  Posterboard activity tracing the big 5 mass extinctions and their probable causes. Origins of life – Final Astronomy Project
E5.3D	Describe how index fossils can be used to determine time sequence.	FOS 2 Evolution and Plate Tectonics Geologic dating	ES Textbook Ch. 29  VTT Curriculum SETI, NSF  Index fossil activity
<b>Statement E5.3x</b>	<b>Geologic Dating</b> Early methods of determining geologic time, such as the use of index fossils and stratigraphic principles, allowed for the relative dating of geological events. However, absolute dating was impossible until the discovery that certain radioactive isotopes in rocks have known decay rates, making it possible to determine how many years ago a given mineral or rock formed.	FOS 2 Evolution and Plate Tectonics Fossils are dated and show transitional forms from past animals to the present.	Virtual Dating <a href="http://nemo.sciencecourseware.org/VirtualDating/">http://nemo.sciencecourseware.org/VirtualDating/</a>

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HSCE	Activities	Resource / Materials	Assessment	
	Different kinds of radiometric dating techniques exist. Technique selection depends on the composition of the material to be dated, the age of the material, and the type of geologic event that affected the material.			
E5.3e	Determine the approximate age of a sample, when given the half-life of a radioactive substance (in graph or tabular form) along with the ratio of daughter to parent substances present in the sample.	FOS 2 Evolution and Plate Tectonics	ES Textbook Ch. 29 VTT Curriculum SETI NSF	Virtual Dating Activity <a href="http://nemo.sciencecourseware.org/VirtualDating/">http://nemo.sciencecourseware.org/VirtualDating/</a>
E5.3f	Explain why C-14 can be used to date a 40,000 year old tree but U-Pb cannot.	FOS 2 Evolution and Plate Tectonics	ES Textbook Ch. 29 VTT Curriculum SETI NSF	Half-life activity
E5.3g	Identify a sequence of geologic events using relative age dating principles.	FOS 2 Evolution and Plate Tectonics	ES Textbook Ch. 29	Textbook activity
<b>Statement E5.4</b>	<p><b>Climate Change</b> Atmospheric gases trap solar energy that has been reradiated from the Earth's surface (the greenhouse effect). The Earth's climate has changed both gradually and catastrophically over geological and historical time frames due to complex interactions between many natural variables and events. The concentration of greenhouse gases (especially carbon dioxide) has increased due to human industrialization which has contributed to a rise in average global atmospheric temperatures and changes in the biosphere, atmosphere, and hydrosphere. Climates of the past are researched, usually using indirect indicators, to better understand and predict climate change.</p>	<p>FOS 1 Global Warming Project</p> <p>I. Introduction- What is global warming?</p> <p>II. What is the science behind global warming? Include the Greenhouse Effect and the Carbon Cycle</p> <p>III. What are the warning signs and harbingers of this change? (Choose 2 topics from population migration, water resources, government instability, invasive species, health and disease vectors, manufacturing, tourism industry, agriculture, wildlife/plants, etc.)</p> <p>IV. Impact at the Local (City, State, Regional), National, or Global level (Pick only 2)</p> <p>A. Local: What is the impact of global warming on Ann Arbor and Michigan? (Choose 2 topics from invasive species, disease vectors, manufacturing, the Great</p>	<p>PBS Global Warming <a href="http://www.pbs.org/nw/classroom/globalwarming.html">http://www.pbs.org/nw/classroom/globalwarming.html</a></p> <p>Global Warming- Union of Concerned Scientists <a href="http://www.climatehotmap.org/curriculum/climate_change_guide.pdf">http://www.climatehotmap.org/curriculum/climate_change_guide.pdf</a></p> <p>and</p> <p><a href="http://www.ucusa.org/global_warming/">http://www.ucusa.org/global_warming/</a></p>	

## EARTH SCIENCE COMMUNITY HS

HSCE	Activities	Resource / Materials	Assessment	
	<p>Lakes, tourism industry, agriculture, wildlife/plants, etc.)</p> <p>B. What is the impact of global warming on the national level? (Choose 2 topics from population migration, water resources, invasive species, health and disease vectors, manufacturing, tourism industry, agriculture, national parks, wildlife/plants, etc.)</p> <p>C. What is the projected impact of global warming on the entire world? (United Nations, Union of Concerned Scientists) (Choose 2 topics from population migration, water resources, government instability, invasive species, health and disease vectors, manufacturing, tourism industry, agriculture, wildlife/plants, etc.)</p> <p>V. How can we respond or promote solutions to the crisis (choose 2) individually, locally, national, globally?</p>			
E5.4A	Explain the natural mechanism of the greenhouse effect including comparisons of the major greenhouse gases (water vapor, carbon dioxide, methane, nitrous oxide, and ozone).	FOS 1 Global Warming Project	Video-An Inconvenient Truth ES Textbook Ch.21	Lab activity
E5.4B	Describe natural mechanisms that could result in significant changes in climate (e.g., major volcanic eruptions, changes in sunlight received by the earth, meteorite impacts).	FOS 1 Global Warming Project	ES Textbook Ch.21	Final project presentation
E5.4C	Analyze the empirical relationship between the emissions of carbon dioxide, atmospheric carbon dioxide levels and the average global temperature over the past 150 years.	FOS 1 Global Warming Project	-ES Textbook Ch.21 -Paleoclimate and Greenhouse <a href="http://jrscience.wcp.muohio.edu/html/globalchange.html">http://jrscience.wcp.muohio.edu/html/globalchange.html</a>	Lab activity using NOAA Data

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HSCE	Activities	Resource / Materials	Assessment	
E5.4D	Based on evidence of observable changes in recent history and climate change models, explain the consequences of warmer oceans (including the results of increased evaporation, shoreline and estuarine impacts, oceanic algae growth, and coral bleaching) and changing climatic zones (including the adaptive capacity of the biosphere).	FOS 1 Global Warming Project	-ES Textbook Ch.21 -Climate Resource <a href="http://www.nasa.gov/content/goddard/earthhandsun/climate_change.html">http://www.nasa.gov/content/goddard/earthhandsun/climate_change.html</a>	Unit test, final project –rubric graded
E5.4e	Based on evidence from historical climate research (e.g., fossils, varves, ice core data) and climate change models, explain how the current melting of polar ice caps can impact the climatic system .	FOS 1 Global Warming Project Glacial Climate Project	ES Textbook Ch.21 -Paleoclimate and Greenhouse <a href="http://jrscience.wcp.muohio.edu/html/globalchange.htm">http://jrscience.wcp.muohio.edu/html/globalchange.htm</a>	Activity, final project
E5.4f	Describe geologic evidence that implies climates were significantly colder at times in the geologic record (e.g., geomorphology, striations, and fossils).	Glacial Climate Project	Paleoclimate and Greenhouse <a href="http://jrscience.wcp.muohio.edu/html/globalchange.htm">http://jrscience.wcp.muohio.edu/html/globalchange.htm</a>	Final Project
E5.4g	Compare and contrast the heat-trapping mechanisms of the major greenhouse gases resulting from emissions (carbon dioxide, methane, nitrous oxide, fluorocarbons) as well as their abundance and heat trapping capacity.	FOS 1 Global Warming Project	-ES Textbook Ch.21 -NASA- <a href="http://www.nasa.gov/worldbook/global_warming_worldbook.html">http://www.nasa.gov/worldbook/global_warming_worldbook.html</a>	Internet questions and guide sheet
E5.r4h	Use oxygen isotope data to estimate paleotemperature. ( <i>recommended</i> )	FOS 1 Global Warming Project	Greenland Ice Sheet Project 2 <a href="http://www.tufts.edu/as/wright_center/iecws/materials/online_activities/climate_card/pages/page01a.htm">http://www.tufts.edu/as/wright_center/iecws/materials/online_activities/climate_card/pages/page01a.htm</a>	Internet questions and guide sheet
E5.r4i	Explain the causes of short-term climate changes such as catastrophic volcanic eruptions and impact of solar system objects. ( <i>recommended</i> )	FOS 1 Global Warming Project	ES Textbook Ch.21	Final presentation
E5.r4j	Predict the global temperature increase by	FOS 1	ES Textbook	Final presentation

## EARTH SCIENCE COMMUNITY HS

<b>HSCE</b>	<b>Activities</b>	<b>Resource / Materials</b>	<b>Assessment</b>
	2100, given data on the annual trends of CO <sub>2</sub> concentration increase. <i>(recommended)</i>	Global Warming Project	Ch.21