

**LABORATORY-BASED  
PHYSICAL SCIENCE CURRICULUM**

The goal of this curriculum is to increase the number of students meeting state science standards at the high school level. This can be done through this course of study in physical science, which is aligned with state science standards and meets the entrance requirements of post-secondary institutions.

Numbers in parentheses reference the Nebraska Twelfth-Grade Science Standards.

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## SECTION I

## INTRODUCTION TO SCIENCE

Concepts and Skills	Suggested Activities and Resources	Suggested Assessments
<b>Introduction to Science</b> (5 days & 1 day per week throughout the rest of the course)		
<p><b>SC12.1.1 Scientific Inquiry</b></p> <p>SC12.1.1.a Formulate a testable hypothesis supported by prior knowledge to guide an investigation</p> <p>SC12.1.1.b Design and conduct logical and sequential scientific investigations with repeated trials and apply findings to new investigations</p> <p>SC12.1.1.c Identify and manage variables and constraints</p> <p>SC12.1.1.d Select and use lab equipment and technology appropriately and accurately</p> <p>SC12.1.1.e Use tools and technology to make detailed qualitative and quantitative observations</p> <p>SC12.1.1.f Represent and review collected data in a systematic, accurate, and objective manner</p> <p>SC12.1.1.g Analyze and interpret data, synthesize ideas, formulate and evaluate models, and clarify concepts and explanations</p> <p>SC12.1.1.h Use results to verify or refute a hypothesis</p> <p>SC12.1.1.i Propose and/or evaluate possible revisions and alternate explanations</p> <p>SC12.1.1.j Share information, procedures, results, conclusions, and defend findings to a scientific community (peers, science fair audience, policy makers)</p> <p>SC12.1.1.k Evaluate scientific investigations and offer revisions and new ideas as appropriate</p> <p>SC12.1.1.l Use appropriate mathematics in all aspects of scientific inquiry</p>		
<b>A. Features of Inquiry:</b>	<u><a href="#">Science Buddies</a></u>	
<p>1. Engaging in Scientifically Oriented Questions</p> <p>a. Questioning</p> <p>b. Predicting</p> <p>c. Forming Hypotheses [SC12.1.1.a]</p> <p>2. Responding to Questions using Evidence</p> <p>a. Identifying Variables [SC12.1.1.c]</p> <p>b. Designing Experiments</p> <p>i. Understand that larger well-chosen samples produce more accurate estimates of the characteristics of the total population.</p> <p>c. Making Qualitative and Quantitative Observations [SC12.1.1.e]</p> <p>i. Understand that measurement errors may affect results of calculations.</p> <p>d. Recording Data</p> <p>3. Formulating Explanations from Evidence</p> <p>a. Organizing Data [SC12.1.1.f]</p> <p>i. Understand that the way data are displayed affects interpretation.</p> <p>1) Graphs</p> <p>2) Tables</p> <p>3) Calculations</p>	<p><u><a href="http://science.education.nih.gov/supplements/nih6/inquiry/guide/lesson2.htm">http://science.education.nih.gov/supplements/nih6/inquiry/guide/lesson2.htm</a></u></p> <p><u><a href="http://www.nces.ed.gov/nceskids/createagraph">www.nces.ed.gov/nceskids/createagraph</a></u></p>	

Concepts and Skills	Suggested Activities and Resources	Suggested Assessments
<p>b. Interpreting Evidence [SC12.1.1.g]</p> <ol style="list-style-type: none"> <li>i. Evaluate the reasonableness of answers to problems. [SC12.1.2]</li> <li>ii. Understand that a correlation between two variables does not mean that either one causes the other.</li> <li>iii. Compare data for two groups by using averages and ranges of values.</li> <li>iv. Describe rate of change by comparing one measured quantity to another measured quantity.</li> <li>v. Investigate and describe how different characteristics, properties, or relationships within a system change as their dimensions increase or decrease.</li> </ol> <p>c. Creating Models</p> <ol style="list-style-type: none"> <li>i. Create a physical, mental, or mathematical model to show how objects and processes are connected [SC12.1.1.1]</li> </ol>		
<p>4. Connecting Explanations to Scientific Knowledge</p> <ol style="list-style-type: none"> <li>a. Inferring</li> <li>b. Connecting to Existing Models [SC12.1.1.g] <ol style="list-style-type: none"> <li>i. Test the usefulness of the model by comparing its predictions to actual observations.</li> </ol> </li> <li>c. Defending Findings <ol style="list-style-type: none"> <li>i. Evaluate the reasonableness of answers to problems.</li> </ol> </li> </ol> <p>5. Communicating and Justifying Explanations [SC12.1.1.j]</p> <ol style="list-style-type: none"> <li>a. Communicating Explanations</li> <li>b. Defending Explanations</li> <li>c. Publishing</li> <li>d. Determining Applications</li> <li>e. Asking Further Questions</li> </ol>		
	<ul style="list-style-type: none"> <li>• Logical arguments</li> <li>• Science versus what is not scientific (belief based)</li> <li>• Sample size and validity</li> <li>• Communicate results in a scientific format</li> </ul> <p>A step in time – Construct a Pendulum that has a period of one second. This culminates in a class competition.</p> <p>Egg Bungee Jump – This application of Hooke’s Law allows students to collect, graph and interpret data. Students culminate this activity by bungee jumping a raw egg as close to the floor without hitting the floor.</p>	<p>Directed Project</p> <ul style="list-style-type: none"> <li>• Discuss examples of final projects.</li> <li>• Discuss possible topics</li> <li>• Formulate a project proposal</li> <li>• Establish a timeline for components completion.</li> <li>• Complete sample inquiry projects as a class.</li> <li>• Keep a journal of project progress.</li> </ul>

Concepts and Skills	Suggested Activities and Resources	Suggested Assessments
<p>6. Change, constancy, and measurement [SC12.1.1.d]</p> <ul style="list-style-type: none"> <li>a. Compare data <ul style="list-style-type: none"> <li>i. Measurement errors and results</li> </ul> </li> <li>b. Rate of change by comparing one measured quantity to another measured quantity <ul style="list-style-type: none"> <li>i. Scientific notation</li> </ul> </li> </ul> <p>7. Evidence, models, and explanation [SC12.1.1.b]</p> <ul style="list-style-type: none"> <li>a. Understand that the way data are displayed affects interpretation.</li> <li>b. Evaluate the reasonableness of answers to problems.</li> <li>c. Sample Activity: Collect data, such as mass vs. volume of different substances. <ul style="list-style-type: none"> <li>i. Create a physical, mental, or mathematical model to show how objects and processes are connected.</li> <li>ii. Test the usefulness of the model by comparing its predictions to actual observations.</li> <li>iii. Understand that a correlation between two variables does not mean that either one causes the other.</li> </ul> </li> </ul> <p>8. Technological Design [SC12.1.1.d]</p> <ul style="list-style-type: none"> <li>a. Propose designs and choose between alternative solutions of a problem. [SC12.1.1.i]</li> <li>b. Implement the selected solution.</li> <li>c. Evaluate the solution and its consequences.</li> <li>d. Communicate the problem, process, and solution.</li> </ul>		
<p><b>SC12.1.2 Nature of Science</b></p> <ul style="list-style-type: none"> <li>SC12.1.2.a Recognize that scientific explanations must be open to questions, possible modifications, and must be based upon historical and current scientific knowledge</li> <li>SC12.1.2.b Describe how society influences the work of scientists and how science, technology, and current scientific discoveries influence and change society</li> <li>SC12.1.2.c Recognize that the work of science results in incremental advances, almost always building on prior knowledge, in our understanding of the world [SC12.1.2.a]</li> <li>SC12.1.2.d Research and describe the difficulties experienced by scientific innovators who had to overcome commonly held beliefs of their times to reach conclusions that we now take for granted</li> </ul>		
<p><b>SC12.1.3 Technology</b></p> <ul style="list-style-type: none"> <li>SC12.1.3.a Propose designs and choose between alternative solutions of a problem</li> <li>SC12.1.3.b Assess the limits of a technical design</li> <li>SC12.1.3.c Implement the selected solution</li> <li>SC12.1.3.d Evaluate the solution and its consequences</li> <li>SC12.1.3.e Communicate the problem, process, and solution</li> <li>SC12.1.3.f Compare and contrast the reasons for the pursuit of science and the pursuit of technology</li> <li>SC12.1.3.g Explain how science advances with the introduction of new technology</li> <li>SC12.1.3.h Recognize creativity, imagination, and a good knowledge base are all needed to advance the work of science and engineering</li> </ul>		

## SECTION II

## MATTER

Concepts and Skills	Suggested Activities and Resources	Suggested Assessments
<p><b>SC12.2.1 Matter</b> (30 days)</p> <p>SC12.2.1.a Recognize bonding occurs when outer electrons are transferred (ionic) or shared (covalent)</p> <p>SC12.2.1.b Describe the energy transfer associated with phase changes between solids, liquids, and gases</p> <p>SC12.2.1.c Describe the three normal states of matter (solid, liquid, gas) in terms of energy, particle arrangement, particle motion, and strength of bond between molecules</p> <p>SC12.2.1.d Recognize a large number of chemical reactions involve the transfer of either electrons (oxidation/reduction) or hydrogen ions (acid/base) between reacting ions, molecules, or atoms</p> <p>SC12.2.1.e Identify factors affecting rates of chemical reactions (temperature, particle size, surface area)</p> <p>SC12.2.1.f Recognize the charges and relative locations of subatomic particles (neutrons, protons, electrons)</p> <p>SC12.2.1.g Describe properties of atoms, ions, and isotopes</p> <p>SC12.2.1.h Describe the organization of the periodic table of elements with respect to patterns of physical and chemical properties</p>		
<p><b>A. Properties and Structure of Matter</b> [SC12.2.1]</p> <ul style="list-style-type: none"> <li>Investigate and understand that atoms interact with one another by transferring or sharing electron.</li> <li>Investigate and explain the periodic table of elements in terms of repeating patterns of physical and chemical properties.</li> <li>Investigate and describe how the structure of an atom determines the chemical properties of an element. [SC12.2.1.g]</li> <li>Investigate and describe how the interactions among the molecules of a compound determine its physical and chemical properties.</li> </ul>		
<ol style="list-style-type: none"> <li>Investigate and use changes in energy to explain the differences among states of matter. [SC12.2.1.b] <ol style="list-style-type: none"> <li>Phase changes [SC12.2.1.c]</li> </ol> </li> <li>Protons, neutrons, and electrons [SC12.2.1.f]</li> <li>Periodic Table [SC12.2.1.h] <ol style="list-style-type: none"> <li>Investigate properties of some elements</li> <li>Examine patterns in the periodic table</li> <li>Valence electrons</li> <li>Properties of metals versus nonmetals</li> </ol> </li> <li>Describe properties of atoms, ions, and isotopes. [SC12.2.1.g]</li> </ol>	<p><a href="#">Factors Affecting the Rate of chemical Change Lab</a> [SC12.2.1.e]</p> <p><a href="#">Temperature and the Rate of a Chemical Reaction</a> [SC12.2.1.e]</p> <p><a href="#">Build an Atom</a> [SC12.2.1.f] – Build an atom out of protons, neutrons, and electrons, and see how the elements, charge, and mass change.</p> <p><a href="#">Isotopes and Atomic Mass</a> [SC12.2.1.g] – Use this simulation to learn about isotopes and abundance relates to the average atomic mass of an element.</p>	<p>Lab Write Up</p> <p>Internet Research</p>

Concepts and Skills	Suggested Activities and Resources	Suggested Assessments
5. Transferring and sharing of electrons [SC12.2.1.a] a. Bonding [SC12.2.1.d] i. Ionic ii. Covalent iii. Metallic	Predict the Properties of Element 114 Students use periodic data of known elements within the group to predict the molecular weight, density, and mass of element 114. Students then search the internet to compare their predictions to the most current information. Lab 7 Relationships Among Elements Laboratory Manual Science Interactions Course III, Glencoe Please, Set a Table! Science Discovery Activity <i>Science Interactions Course III, Glencoe</i> <a href="#">Ready to Use Chemistry Activities</a> (Handwerker - Publisher: Center for Applied Research in Education ISBN: 0-87628-438-1) <a href="#">Shows a periodic table, click on element to find history and properties</a> <a href="#">Interactive table of elements</a>	
<b>B. Understanding of Chemical Reactions</b> [SC12.2.1.d] <ul style="list-style-type: none"> <li>• Investigate and describe common chemical reactions. [SC12.2.3.d]</li> <li>• Investigate and describe the change of energy as a result of chemical reactions. [SC12.2.3.k]</li> <li>• Investigate and describe how electrons are involved in bond formation during chemical reactions. [SC12.2.1.d]</li> </ul> Investigate and describe the factors influencing the rates of chemical reactions including catalysts. [SC12.2.1.e]		
1. Common chemical reactions [SC12.2.1.d] a. Synthesis b. Decomposition c. Single replacement d. Double replacement e. Combustion  2. Endothermic versus exothermic reactions a. Entropy [SC12.2.3.k]	<a href="#">Endothermic/Exothermic Lab</a> [SC12.2.3.k] Exothermic Reaction Lab – Zinc and Hydrochloric Acid [SC12.2.3.k] – <a href="#">Sample Lab</a> Endothermic Reaction Lab – Sodium Bicarbonate and Vinegar [SC12.2.3.k] – <a href="#">Sample Lab</a>	Lab Summary  Balancing Equations Work Sheets

<b>Concepts and Skills</b>	<b>Suggested Activities and Resources</b>	<b>Suggested Assessments</b>
3. Catalysts, Temperature, Physical State, Surface Area Exposure, Concentration [SC12.2.1.e]	<p>Reaction Types Students will move from station to station to carry out each of the common types of chemical reactions. Students will write formulas for the reactions they observe.</p> <p>Activity 14: Sour Chemistry <i>Real World Math with the CBL System</i>, Brueningsen, et al, 1994, ISBN 1-886309-03-5</p> <p>Lemon juice is neutralized with effervescent antacids. Data is collected using a pH probe and CBL system. Students analyze data using a math model.</p>	

## SECTION III

## ENERGY

Concepts and Skills	Suggested Activities and Resources	Suggested Assessments
<p><b>SC12.2.3 Energy</b> (25 days)</p> <p>SC12.2.3.a Describe mechanical wave properties (speed, wavelength, frequency, amplitude) and how waves travel through a medium</p> <p>SC12.2.3.b Recognize that the energy in waves can be changed into other forms of energy</p> <p>SC12.2.3.c Recognize that light can behave as a wave (diffraction and interference)</p> <p>SC12.2.3.d Distinguish between temperature (a measure of the average kinetic energy of atomic or molecular motion) and heat (the quantity of thermal energy that transfers due to a change in temperature)</p> <p>SC12.2.3.e Compare and contrast methods of heat transfer and the interaction of heat with matter via conduction, convection, and radiation</p> <p>SC12.2.3.f Recognize that the production of electromagnetic waves is a result of changes in the motion of charges or by a changing magnetic field</p> <p>SC12.2.3.g Compare and contrast segments of the electromagnetic spectrum (radio, micro, infrared, visible, ultraviolet, x-rays, gamma) based on frequency and wavelength</p> <p>SC12.2.3.h Recognize that nuclear reactions (fission, fusion, radioactive decay) convert a fraction of the mass of interacting particles into energy, and this amount of energy is much greater than the energy in chemical interactions</p> <p>SC12.2.3.i Interpret the law of conservation of energy to make predictions for the outcome of an event</p> <p>SC12.2.3.j Identify that all energy can be considered to be either kinetic, potential, or energy contained by a field (e.g. electromagnetic waves)</p> <p>SC12.2.3.k Identify endothermic and exothermic reactions</p>		
<p><b>A. Types of Energy</b></p> <ul style="list-style-type: none"> <li>• Kinetic (energy due to motion)</li> <li>• Potential (energy due to position)</li> <li>• Mechanical (kinetic + potential)</li> <li>• Thermal [SC12.2.3.d]</li> <li>• Temperature (average kinetic energy)</li> <li>• Heat (quantity of thermal energy)</li> <li>• Chemical</li> <li>• Electromagnetic</li> <li>• Nuclear</li> </ul>		
<p>1. Thermal Energy [SC12.2.3.d]</p>	<p><a href="#">Molecular Kinetic Theory</a> [SC12.2.3.d]</p> <p><a href="#">Magnetic Fields</a> [SC12.2.3.f]</p> <p><a href="#">Home-Made Generator</a></p>	

Concepts and Skills	Suggested Activities and Resources	Suggested Assessments
<b>B. Interactions of Energy and Matter</b> <ul style="list-style-type: none"> <li>Investigate and understand that all waves possess and transfer energy.</li> <li>Investigate and illustrate how wavelength and frequency of waves are inversely related.</li> <li>Investigate and understand that the energy of waves can be changed into other forms of energy can be transformed into energy, just as other forms of energy can be transformed into wave energy.</li> </ul>		
1. Wave characteristics [SC12.2.3.a] <ol style="list-style-type: none"> <li>Wavelength</li> <li>Frequency</li> <li>Amplitude (crest and trough)</li> </ol> 2. Wave types <ol style="list-style-type: none"> <li>Transverse</li> <li>Longitudinal</li> </ol> 3. Wave Activity	<a href="#">Wave Properties-Inference and Diffraction</a> <a href="#">Wave Inference</a> <a href="#">Making Waves Lab-Diffraction</a> References [SC12.2.3b]: <a href="#">Waves as Energy Transfer</a> <a href="#">Sound and Waves</a> Activity Two: Sounds in Strings <i>Active Physics (It's About Time, Inc.)</i> - Students use a string with varying lengths and masses to create numerous sound frequencies. Students can create a musical presentation based on their findings. <a href="#">Absorb Physics from Crocodile Clips</a> - This is a .com site that sells a more complete program.	Lab Write up
<b>C. Interactions of Energy and Matter</b> [SC12.2.3.a, SC12.2.3.b] <ul style="list-style-type: none"> <li>Investigate and understand that atoms or molecules can be identified by spectrum analysis. (Spectrum discussion).</li> </ul>		
Laws Nature of Light [SC12.2.3.c]		
1. Spectrum analysis; electromagnetic spectrum (radio, micro, IR, visible, UV, x-ray, gamma ray) [SC12.2.3.g] <ol style="list-style-type: none"> <li>Sloan Digital Sky Survey Emission</li> <li>Spectra for stars are shown. Students can use the data available to classify specific types of stars based on spectral data</li> <li><a href="http://cas.sdss.org">http://cas.sdss.org</a></li> </ol>		
<b>D. Conservation of Energy and Increase in Disorder</b> [SC12.2.3.b] <ul style="list-style-type: none"> <li>Understand that the total energy in the universe is constant and can never be destroyed. [SC12.2.3.i]</li> <li>Investigate and distinguish between kinetic energy and potential energy</li> <li>Investigate and describe heat transfer in terms of conduction, convection, and radiation. [SC12.2.3.e]</li> </ul>		
1. Law of Conservation of Energy[SC12.2.3.i] <ol style="list-style-type: none"> <li>Mechanical [SC12.2.3.j]</li> <li>Thermal (conduction, convection, radiation)</li> </ol>		

Concepts and Skills	Suggested Activities and Resources	Suggested Assessments
<p><b>E. Understanding energy in the earth system [SC12.4.3]</b></p> <ul style="list-style-type: none"> <li>• Investigate and distinguish between internal sources of energy (e.g., radioactive decay and gravitational energy) and external sources of energy (e.g., the sun), and explaining how both provide energy to the earth system.</li> <li>• Investigate and explain how the outward transfer of earth's internal heat drives convection in the mantle that propels the plates comprising the earth's surface.</li> <li>• Investigate and explain how global climate is determined by energy transfer from the sun and is influenced by dynamic processes (e.g., cloud formation and the earth's rotation) and static conditions (e.g., the position of mountain ranges and oceans).</li> </ul>		
<p>1. Energy in the earth system</p> <ol style="list-style-type: none"> <li>a. Core-mantle-crust structure (review)</li> <li>b. Thermal energy in Earth's interior drives the geosphere <ol style="list-style-type: none"> <li>i. Evidence for interior heat <ol style="list-style-type: none"> <li>1) Volcanoes [SC12.4.2.b]</li> <li>2) Deep boreholes: deeper = hotter</li> </ol> </li> <li>ii. Origin of heat in the interior <ol style="list-style-type: none"> <li>1) Residual from bombardment (mechanical energy, friction) [SC12.4.2.b]</li> <li>2) Radioactive decay (25% of heat)</li> </ol> </li> <li>iii. Consequences of hot interior <ol style="list-style-type: none"> <li>1) Heat transfer through mantle to crust [SC12.2.3.e] <ol style="list-style-type: none"> <li>a) Plate tectonics: convection mantle moves the plates carrying oceans and continents [SC12.4.2.a, SC12.4.2.b]</li> </ol> </li> </ol> </li> </ol> </li> <li>c. Solar energy (external) drives the atmosphere [SC12.4.3.b] <ol style="list-style-type: none"> <li>i. Radiant heat (infrared) <ol style="list-style-type: none"> <li>1) Absorption by land and water [SC12.4.3.d]</li> <li>2) Differential heating of surface leads to convection of the atmosphere <ol style="list-style-type: none"> <li>a) Earth's wind (climate) belts [SC12.4.3.d]</li> <li>b) Coriolis effect [SC12.4.3.d]</li> <li>c) Influence of water bodies and land masses (rain shadow, differential absorption, wind deflection, etc.)</li> <li>d) Convection and cloud formation [SC12.4.3.a]</li> </ol> </li> </ol> </li> </ol> </li> </ol>	<p>lava lamp, density tank How to build a density tank (and other resources) <a href="http://kicks2earthspace.wikispaces.com/2012+stuff+to+share">http://kicks2earthspace.wikispaces.com/2012+stuff+to+share</a> <a href="http://serc.carleton.edu/NAGTWorkshops/deepearth/visualizations/mantle_conv.html">http://serc.carleton.edu/NAGTWorkshops/deepearth/visualizations/mantle_conv.html</a> <a href="#">Website for online animations</a></p>	

## SECTION IV

## MOTION AND FORCES

Concepts and Skills	Suggested Activities and Resources	Suggested Assessments
<p><b>SC12.2.2 Motions and Forces</b> (20 days)</p> <p>SC12.2.2.a Describe motion with respect to displacement and acceleration</p> <p>SC12.2.2.b Describe how the law of inertia (Newton’s 1<sup>st</sup> law) is evident in a real-world event</p> <p>SC12.2.2.c Make predictions based on relationships among net force, mass, and acceleration (Newton’s 2<sup>nd</sup> law)</p> <p>SC12.2.2.d Recognize that all forces occur in equal and opposite pairs (Newton’s 3<sup>rd</sup> law)</p> <p>SC12.2.2.e Describe how Newton’s 3rd law of motion is evident in a real-world event</p> <p>SC12.2.2.f Describe gravity as a force that each mass exerts on another mass, which is proportional to the masses and the distance between them</p> <p>SC12.2.2.g Recognize that an attractive or repulsive electric force exists between two charged particles and that this force is proportional to the magnitude of the charges and the distance between them</p>		
<p><b>A. Newton’s Law</b></p>		
<p>1. Law of inertia (1<sup>st</sup>) [SC12.2.2.b]</p> <p>2. Law of constant acceleration (2<sup>nd</sup>) [SC12.2.2.c, SC12.2.2.d]</p> <p>3. Action – reaction (3<sup>rd</sup>) [SC12.2.2.d, SC12.2.2.e]</p> <p>4. Describe motion with respect to displacement and acceleration. [SC12.2.2.a]</p>	<p><a href="#">The Moving Man</a> – Move the little man back and forth with the mouse and plot his motion. Set position, velocity, or acceleration.</p> <p><a href="#">Acceleration Lab</a></p> <p><a href="#">Distance and Displacement</a></p> <p><a href="#">Newton’s 3<sup>rd</sup> Law</a> [SC12.2.2.e]</p> <ul style="list-style-type: none"> <li>• Teacher information on Newton’s Third Law of Motion with real world examples</li> <li>• Demos</li> <li>• Thought problems</li> <li>• Activities: #1 Day at the Races, #2 Reacting to Action</li> </ul> <p><a href="#">Dynamics Activity</a></p> <p><i>TOPS Module 21 Motion</i> – Marson, 1979 – This module contains several activities testing uniform motion, tracking collisions, and Newton’s second law.</p> <p><i>Active Physics Sports</i> – Eisenkraft, 1998, ISBN 1-891629-04-2 – This text has a myriad of activities for students based on motion and sporting activities.</p> <p><i>Physics with Computers</i> – Gastineau, et.al., Vernier Software, 1998 (ISBN 0-918731-99-2) – This source uses interfacing systems to provide data collection and analysis activities to test numerous forms of motion.</p>	

Concepts and Skills	Suggested Activities and Resources	Suggested Assessments
	<p><i>Middle School Science with Computers</i> – Volz and Sapatka, Vernier Software, 2000 (ISBN 1-929075-08-1) – This reference integrates interfacing systems and lab activities to test a variety of physics activities from the greenhouse effect to ocean floor mapping to various forms of motion.</p>	
<b>B. Gravity</b>		
<ol style="list-style-type: none"> <li>Force of attraction between any two objects [SC12.2.2.f]</li> <li>Distinction between weight and mass</li> </ol>	<a href="#">Gravity Force Lab</a>	
<b>C. Electromagnetic Force [SC12.2.2.g]</b>		
<ol style="list-style-type: none"> <li>Like and unlike charges (+ and -)</li> <li>May be attractive or repulsive</li> <li>Holds atoms together (electrons– and nucleus+)</li> <li>Understand that electromagnetic waves occur when a charged object accelerates.</li> <li>Interactions between electrical and magnetic fields</li> </ol>	<p>Review electrostatic activities  <a href="#">Electrostatics Lab Activities Explained</a>  <a href="#">Electrostatics Experiments</a></p>	

## SECTION V

## ORIGIN OF THE UNIVERSE

Concepts and Skills	Suggested Activities and Resources	Suggested Assessments
<p><b>SC12.4.1 Origin of the Universe (8 days)</b>            SC12.4.1.a Describe the formation of the universe using the Big Bang Theory            SC12.4.1.b Recognize that stars, like the Sun, transform matter into energy by nuclear reactions which leads to the formation of other elements            SC12.4.1.c Describe stellar evolution</p>		
<p><b>A.</b> Big Bang [SC12.4.1.a]            1. Evidence for expanding universe                a. red shift                b. Hubble's Law</p> <p><b>B.</b> Birth and Death of Stars [SC12.2.3.h, SC12.4.1.b, SC12.4.1.c]            1. Hertzsprung-Russell diagram            2. Spectral analysis</p>	<p><a href="#">Sloan Digital Sky Survey</a>            By starting at the basic level several student/ teacher activities exist to challenge students, such as a scavenger hunt through the origin of galaxies and the universe.</p> <p><a href="#">Scale of Universe</a>  <a href="#">Project Earth Science Astronomy</a>            Smith, P. Sean, NSTA Press, 2001, ISBN 0-87355-108-7            "Activity 6" - Using vermiculite and water this model demonstrates the accretion theory when rotating interstellar clouds of gas and dust collapsed under its own gravity.</p> <p><a href="#">Spatial Analysis</a>  <a href="#">Star Basics</a> [SB12.4.b, SC12.4.c]  <a href="#">Life and Death of Stars</a> [SB12.4.1.b, SC12.4.1.c]            Doppler Effect: [SC12.4.1.a]  <a href="#">Explaining the Doppler Effect</a>  <a href="#">The Doppler Effect: Moving Source</a>  <a href="#">AstroCappella: Doppler Shifting</a>  <a href="#">Nuclear Fusion in Stars</a> [SC12.2.3.h, SC12.4.1.c]  <a href="#">Nuclear Fission</a> [SC12.2.3.h] – Start a chain reaction or introduce non-radioactive isotopes to prevent one.</p>	<p>Research paper            Lab Report            Class presentations</p>

## SECTION VI

## CYCLES

Concepts and Skills	Suggested Activities and Resources	Suggested Assessments
<b>Cycles</b> (16 days)		
<b>A. Understanding of Geochemical Cycles</b> (5 days) [SC12.4.2.] <ul style="list-style-type: none"> <li>Investigate and diagram how elements and compounds on earth move among reservoirs in the solid earth, oceans, atmosphere, and organisms as part of geochemical cycles. (Water, Rock, Carbon, Nitrogen)</li> </ul>		
1. Reinforce cycle concept [SC12.4.2.a] <ol style="list-style-type: none"> <li>Investigate and understand that atoms and molecules cycle among living and nonliving components of the biosphere.</li> </ol>	Rock Around the Clock Project Earth Science Geology <a href="#">Windows to the Universe</a>	
<b>B. Role of science and technology in local, national, and global challenges.</b> (10 days) [SC12.1.2] <ul style="list-style-type: none"> <li>Understand that knowledge of basic concepts about scientific and technological challenges should precede active debate. [SC12.1.2.a]</li> <li>Investigate and understand that social issues and challenges may affect advancements in science and technology. [SC12.1.2.b]</li> <li>Understand that science and technology are essential social enterprises that indicate what could happen, but not what should happen. [SC12.1.2.c]</li> <li>Social perspectives of global warming issue [12.1.2.d]</li> <li>Role of greenhouse gases (CO<sub>2</sub>, CH<sub>4</sub>, H<sub>2</sub>O) [SC12.4.2.c] <ol style="list-style-type: none"> <li>Evidence for increase and industrial influence</li> <li>Evidence for global temperature increase</li> <li>Examine and understand the societal, cultural, and personal beliefs that influence scientists.</li> <li>Alternatives to fossil fuels: nuclear, renewable (solar, wind, hydro, biomass) [SC12.4.2.c]</li> </ol> </li> <li>Carbon sources (combustion of fossil fuels, volcanoes, respiration) [SC12.4.2.c] <ol style="list-style-type: none"> <li>Short term (human time scale)</li> </ol> </li> <li>Carbon sinks (burial of biomass – coal, limestone, etc.) [SC12.4.2.c] <ol style="list-style-type: none"> <li>Long-term (geological time scale) [SC12.4.3.d]</li> </ol> </li> </ul>	<a href="http://concord.org/activities/mode-ling-earths-climate">http://concord.org/activities/mode-ling-earths-climate</a>	

## SECTION VII

## EARTH'S HISTORY

Concepts and Skills	Suggested Activities and Resources	Suggested Assessments
<b>Earth's History</b> (17 days)		
<b>SC12.4.4 Origin of the earth system</b> a. Contrast the early earth with the planet we live on today. b. Investigate and estimate geologic time by observing rock sequences and using fossils to correlate the sequences at various locations. c. Investigate and relate how the interactions among the solid earth, oceans, atmosphere, and organisms affect the ongoing evolution of the earth.		
1. Explanations for plate movements (Pangaea and older continent-ocean configurations) a. Convection in the mantle b. Origin of the magnetic field [SC12.2.3.f] c. Evidence for plate movement d. Plate tectonics theory	Video showing continent motions Project Earth Science Ford, 2001 "Activity 6: Convection" (A convection cell in water is constructed by students. This model demonstrates how convection plays a role in plate tectonics.)	
2. Earth history and the rock record a. Geologic time scale [SC12.4.4.c] b. Relative dating i. Superposition [1SC2.4.4.a] ii. Fossils [SC12.4.4.b] c. Numerical dating i. Radiometric [SC12.4.4.b] d. Interactions among earth systems in geologic time [SC12.4.3.d]	<a href="#">Earth &amp; Astronomical Science Activities for Grades 5-12</a> ISBN: 0-87628-445-4 (Publisher: The Center for Applied Research in Education) <a href="http://phet.colorado.edu/en/simulations/category/earth-science">http://phet.colorado.edu/en/simulations/category/earth-science</a> <a href="http://kicks2earthspace.wikispaces.com/Geology+Lessons">http://kicks2earthspace.wikispaces.com/Geology+Lessons</a>	