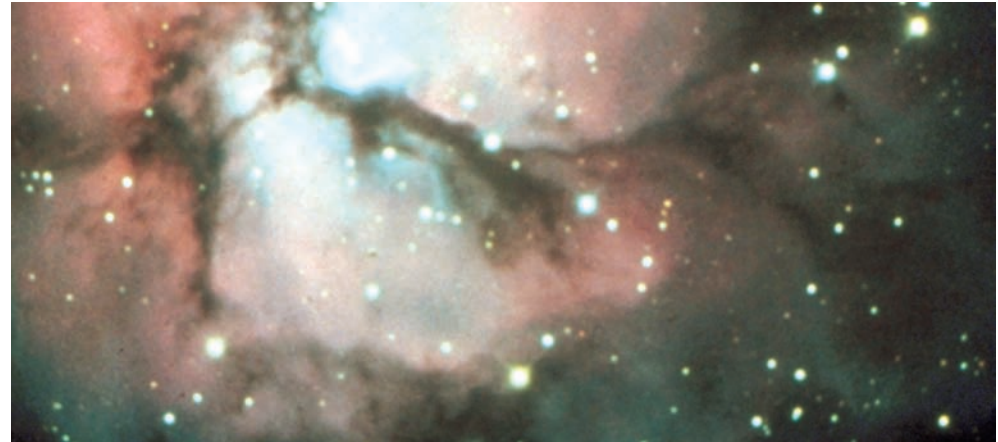


Middle Grades Science 6th Grade Support Document



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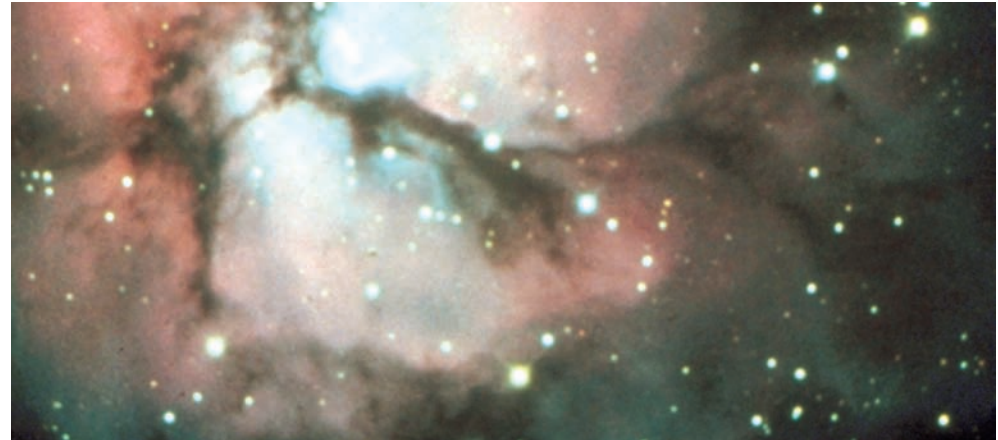
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Middle Grades Science

6th Grade Support Document

Goals 1, 2, and Lithosphere



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PUBLIC SCHOOLS OF
NORTH CAROLINA
Department of Public
Instruction

6th GRADE COMPETENCY GOAL 3

The learner will build an understanding of the geological cycles, forces, processes, and agents which shape the lithosphere.

BIG Ideas

Lithosphere

The Earth has a solid inner core that is surrounded by a liquid outer core. Surrounding the entire dense, metallic core is a thick, hot, convective layer called the mantle. The crust consists of many continental and oceanic plates that have slowly moved and changed positions on the globe throughout geologic time. The movement of these large plates (plate tectonics) has caused the Earth's exposed land surface to change position and shape. Tremendous forces, such as convection, tension and compression, have caused the upper crustal layers to fold and fault. Earthquakes and volcanic activity have resulted along the borders of the plates. These forces, along with weathering and erosion, have caused large quantities of material to be deposited in varying amounts across the globe.

Physical and chemical processes have constantly acted on earth material to form, change, and reform three general types of rock. These processes form minerals, which are substances that consist of certain elements to form compounds that appear to be uniform throughout. Other minerals are pure substances and are made of a single element. Each mineral has unique physical and chemical properties that allow it to be of economic value to humans. Minerals can combine to form rocks. Heat, pressure, erosion, and chemical processes can change rock from one type to another. Earth material can eventually be in the form of any of the rock types found throughout geologic history. This process is known as the rock cycle.

Lithosphere

The upper-most layer of the continental crust is covered by soil. The ingredients in soils can vary from neighborhood to neighborhood and around the Earth. Different soils have different properties and composition of sand, silt, clay and humus. Soils have many properties such as texture, particle size, pH, fertility and ability to hold moisture. Depending upon the combination of properties, soils have a great variability in their ability to support structures and plant growth. Humans have continually decreased the amount of soil that is available through poor land-use methods, soil nutrient depletion, and the construction of structures that cover the soil (such as highways, parking lots and buildings). Structures that cover the soil also affect run-off patterns, which lead to another set of problems.

Technology, such as remote sensing, has allowed humans to better study the human impact on soil quality and erosional processes so that the soil can be protected and preserved. Over time, remote sensing information can tell us how humans are constantly changing the surface of the Earth. Technologies can also assist in finding ways to help prevent erosion. It is important that humans be stewards of the pedosphere.

National Science Education Standards	AAAS Benchmarks
<p>Structure of the Earth System</p> <ul style="list-style-type: none"> • The solid earth is layered with a lithosphere; hot, convecting mantle; and dense metallic core. • Lithospheric plates on the scales of continents and oceans constantly move at rates of centimeters per year in response to movements in the mantle. Major geological events, such as earth quakes, volcanic eruptions, and mountain building, result from these plate motions. • Land forms are the result of a combination of constructive and destructive forces constructive and destructive forces. Constructive forces include crustal deformation, volcanic eruption, and deposition of sediment, while destructive forces include weathering and erosion. • Some changes in the solid earth can be described as the "rock cycle." Old rocks at the earth's surface weather, forming sediments that are buried, then compacted, heated, and often recrystallized into new rock. Eventually, those new rocks may be brought to the surface by the forces that drive plate motions, and the rock cycle continues. • Soil consists of weathered rocks and decomposed organic material from dead plants, animals, and bacteria. Soils are often found in layers, with each having a different chemical composition and texture. 	<p>Processes that Shape the Earth: Changes in the Earth's Surface</p> <ul style="list-style-type: none"> • Some changes in the earth's surface are abrupt (such as earthquakes and volcanic eruptions) while other changes happen very slowly (such as uplift and wearing down of mountains). • The interior of the earth is hot. Heat flow and movement of material within the earth cause earthquakes and volcanic eruptions and create mountains and ocean basins. • The earth's surface is shaped in part by the motion of water (including ice) and wind over very long times, which act to level mountain ranges. • Rives and glacial ice carry off soil and break down rock, eventually depositing the material in sediments or carrying it in solution to the sea. • There are a variety of different land forms on the earth's surface (such as coastlines, rivers, mountains, deltas, and canyons). • Sedimentary rock buried deep enough may be reformed by pressure and heat, perhaps melting and recrystallizing into different kinds of rock. These reformed rock layers may be forced up again to become land surface and even mountains. Subsequently, this new rock too will erode. • Rock bears evidence of the minerals, temperatures, and forces that created it.

National Science Education Standards	AAAS Benchmarks
<p data-bbox="226 280 401 310">Lithosphere</p> <p data-bbox="226 345 642 375">Structure of the Earth System</p> <ul data-bbox="184 378 1031 1247" style="list-style-type: none"><li data-bbox="184 378 1031 548">• Natural environments may contain substances (for example, radon and lead) that are harmful to human beings. Maintaining environmental health involves establishing or monitoring quality standards related to use of soil, water, and air.<li data-bbox="184 581 1031 751">• The crustal plates range in thickness from a few to more than 100 kilometers. Ocean floors are the tops of thin oceanic plates that spread outward from mid-ocean rift zones; land surfaces are the tops of thicker, less-dense continental plates.<li data-bbox="184 751 1031 922">• Students should organize materials and other resources, plan their work, make good use of group collaboration where appropriate, choose suitable tools and techniques, and work with appropriate measurement methods to ensure adequate accuracy.<li data-bbox="184 954 1031 1060">• Scientists formulate and test their explanations of nature using observation, experiments, and theoretical and mathematical models.<li data-bbox="184 1060 1031 1247">• Challenges emerge from the knowledge that the products, processes, technologies and inventions of society can result in pollution and environmental degradation and can involve some level of risk to human health or to the survival of other species.	<p data-bbox="1102 280 1276 310">Lithosphere</p> <p data-bbox="1056 337 1644 367">Physical health: Maintaining Good Health</p> <ul data-bbox="1102 370 1902 508" style="list-style-type: none"><li data-bbox="1102 370 1902 508">• The environment may contain dangerous levels of substances that are harmful to human beings. Therefore, the good health of individuals require monitoring the soil, air, and water and taking steps to make them safe. <p data-bbox="1056 540 1413 570">Physical health: Disease</p> <ul data-bbox="1102 573 1902 711" style="list-style-type: none"><li data-bbox="1102 573 1902 711">• The length and quality of human life are influenced by many factors, including sanitation, diet, medical care, sex, genes, environmental conditions, and personal health behaviors. <p data-bbox="1056 743 1560 773">Evolution of Life: Natural Selection</p> <ul data-bbox="1102 776 1818 841" style="list-style-type: none"><li data-bbox="1102 776 1818 841">• Changes in environmental conditions can affect the survival of individual organisms and entire species. <p data-bbox="1056 873 1875 902">Issues in Technology: decisions About Using Technology</p> <ul data-bbox="1102 906 1860 1044" style="list-style-type: none"><li data-bbox="1102 906 1860 1044">• New technologies increase some risks and decrease others. Some of the same technologies that have improved the length and quality of life for many people have also brought new risks.

National Science Education Standards	AAAS Benchmarks
<p>Lithosphere</p> <ul style="list-style-type: none">• Human activities can induce hazards through resource acquisition, urban growth, land-use decisions, and waste disposal. Such activities can accelerate many natural changes.	<p>Lithosphere</p> <p>Agricultural Technology</p> <ul style="list-style-type: none">• In agriculture, as in all technologies, there are always trade-offs to be made...Specializing in one crop may risk disaster if changes in weather or increases in pest populations wipe out that crop. Also, the soil may be exhausted of some nutrients, which can be replenished by rotating the right crops.

NC Science SCS	Content Elaboration	Ideas for exploration	Web Resources
<p>3.01 Evaluate the forces that shape the lithosphere including: Crustal plate movement. Folding and faulting. Deposition. Volcanic activity. Earthquakes.</p>	<p>The lithosphere is made up of plates that constantly move at rates of centimeter per year in response to currents of heated magma in the mantle. Forces responsible for Earth's surface features can be but are not limited to:</p> <ul style="list-style-type: none"> • Wind • Water • Gravity • Volcanism • Compression • Shear <p>Of these, compression forces, shear forces, and volcanism result from plate movement.</p>	<p>Density Cylinder for demonstration on one of the major differences in the layers of the Earth which is density.</p> <p>Using Google Earth, visit the coast of California, Hawaii, the Mississippi delta area, and the Rocky Mountains. Have students generate a graphic that compares and contrasts the land.</p>	<p>http://www.windows.ucar.edu/tour/link=/earth/InteriorStructure/overview.html</p> <p>Windows to the Universe- wonderful site- available in both English and Spanish</p> <p>http://pubs.usgs.gov/publications/ext/dynamic.html</p> <p>USGS publication-excellent publication about tectonics and Earth's interior.</p>
<p>3.02 Examine earthquake and volcano patterns.</p>	<p>In general, earthquakes tend to happen near or on plate boundaries where movement is occurring. Volcanoes almost always happen on plate boundaries and over or near weak areas in the earth's crust.</p> <p>Earthquakes and volcanoes are created at the boundaries between some plates.</p>	<p>Use a web-driven map server to map earthquakes and volcanoes in real time.</p> <p>Watch videos on related earthquake and volcanoes. Generate a list of Essential Questions on topic for students to focus on.</p>	

NC Science SCS	Content Elaboration	Ideas for exploration	Web Resources
<p>3.03 Explain the model for the interior of the earth.</p>	<p>Earth is made up of 4 different layers:</p> <ul style="list-style-type: none"> • Inner core • Outer core • Mantel • Crust <p>Seismologists have studied how wave energy travels through the different layers of Earth.</p> <p>Waves have characteristics:</p> <ul style="list-style-type: none"> • Frequency • Wavelength • Amplitude • Speed <p>During an earthquake, energy is released into the Earth as:</p> <ul style="list-style-type: none"> • Primary waves • Secondary waves • Surface waves 	<p>Read aloud <u>A Journey to the Center of the Earth</u>.</p> <p>Think of an Éclair!! It is a tube-filled cream puff that has a cream or custard filling and is usually iced with chocolate. How is the composition of an Éclair like the composition of the Earth? Think of three other items that compare to the composition of the Earth. Record these in your science journal and include diagrams labeled.</p>	<p><u>http://www.sciencecourseware.com/eec/Earthquake/</u></p> <p>Students can become virtual seismologists! Students use online tools to measure earthquake waves, wave speed, and amplitude. The site offers several ways that teachers could differentiate the content based on reading levels and math skills.</p>

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 Lithosphere

NC Science SCS	Content Elaboration	Ideas for exploration	Web Resources
<p>3.04 Describe the processes which form and the uses of earth materials.</p> <p>Rock cycle. Minerals. Characteristics of rocks. Economic use of rocks and minerals. Value of gems and precious metals. Common gems, minerals, precious metals and rocks found in N.C.</p> <p>3.05 Analyze soil properties that can be observed and measured to predict soil quality including: Color. Horizon profile.</p>	<p>Forces deep inside Earth and at the surface produce a slow cycle that builds, destroys, and changes the rocks in the crust. Plate movements start the rock cycle by helping to form magma, the source of igneous rocks. Plate movements also cause faulting, folding and other motions of the crust that help to form sedimentary and metamorphic rock.</p> <p>Minerals form as hot magma cools inside the crust, or as lava hardens on the surface. When these liquids cool to a solid state, they form crystals. When elements and compounds that are dissolved in water leave a solution, crystallization of minerals occurs. Minerals are the source of gemstones, metals and a variety of materials used to make many products.</p> <p>Soil is a mixture of:</p> <ul style="list-style-type: none"> • Rock particles • Minerals • Decayed organic material • Water • Air 	<p>Invite a Certified Gemologist to come to class as a guest speaker.</p> <p>Watch: <u>Splendid Stone</u> by National Geographic's</p> <p><u>Boulder to Soil</u></p> <p><u>From Mud Pies to Bricks</u></p> <p><u>Soil Horizon</u></p>	<p>www.mii.org</p> <p>Wealth of resources on minerals and elements found in Earth</p> <p>http://geology.enr.stae.nc.us</p> <p>North Carolina Geological Survey website. Find a wealth of information regarding NC rock and mineral resources.</p> <p>http://www.windows.ucar.edu/tour/link=/earth/geology/min_intro.html</p> <p>This site is available in 3 levels of understanding and in Spanish. Great site for a number of topics.</p> <p>www.GLOBE.gov</p> <p>Check the Resource link for Soils information, activities, and additional links</p>

NC Science SCS	Content Elaboration	Ideas for exploration	Web Resources
<p>Infiltration. Soil temperature. Structure. Consistency. Texture. Particle size. pH. Fertility. Soil moisture.</p> <p>3.06 Evaluate ways in which human activities have affected Earth's pedosphere and the measures taken to control the impact: Vegetative cover. Agriculture. Land use. Nutrient balance. Soil as a vector.</p>	<p>Soil forms as rock is broken down by weathering and mixes with other materials on the surface.</p> <p>Soil can be conserved through:</p> <ul style="list-style-type: none"> • Contour plowing • Conservation plowing • Crop rotation 	<p><u>Soil Texture</u></p> <p><u>Soil as Sponges: How Much Water Does Soil Hold?</u></p> <p><u>Soil Ph</u></p> <p><u>Soil Temperature</u></p> <p><u>Mystery Soil</u></p> <p><u>Soil—How much do we have to use?</u></p> <p>Explain in your science journal –How practicing good stewardship of the soil helps maintain fertile soil for future generations? Create a power point presentation on George Washington Carver and how he promoted soil conservation.</p>	<p>http://soil.gsfc.nasa.gov/index.html</p> <p>Kids Soil Science Page. Great site for teachers and students. Tons of resources, games, support links, etc.</p> <p>Refer to website above for this objective.</p>

Soil- How much do we have to use?

Engage

Get an apple and ask if this is the Earth how much of the apple is our topsoil used to grow food for the world.

Explore

Cut away $\frac{3}{4}$ of the apple and set this part aside! Ask the students-- what do you think this represents?
(Apple represents the Earth and $\frac{3}{4}$ of the earth is water)

Hold up $\frac{1}{4}$ of the apple for the children to see. Say half of this $\frac{1}{4}$ of Earth is desert. We cannot grow crops in the desert.
So cut the piece you have in half and put to the side.

$\frac{3}{4}$'s of this amount is rocky and cannot be used to produce food. So cut the piece you have in fourths, to represent rocky land and put the three pieces over to the side.

The piece remaining is $\frac{1}{32}$ of the Earth. Trim off the peel! Of this $\frac{1}{32}$, we have precious inches of topsoil to grow crops to feed our world.

Adapted from- How much soil is there? Also available as an applet on this website – <http://soil.gsfc.nasa.gov/index.html>

Density Cylinder

Lab: Demonstration on one of the major differences in the layers of the Earth which is density.

Pour cooking oil, liquid soap, a super saturated Epsom salt solution (colored with food coloring), and alcohol. Each liquid will form a layer in order of density not in the order that they were poured into the cylinder.

How did the layers form?

What makes the liquids different and alike?

What does density mean?

What is the mathematical formula for density?

Extension

Have students drop a glass bead through the density column and time how long it takes for the bead to travel in each layer. Relate this information to earthquake wave energy and how it travels through the various layers of earth's interior.

Boulder to Soil

Engage:

Ask what is a boulder?

Where would you find a boulder?

Think-Pair-Share on the questions above!

Explore:

Pretend you are a large boulder sitting atop a mountain range in Western North Carolina.

Experiment:

Draw a sequence of stages that you would go through to become fertile soil in the valleys of Eastern North Carolina. For each stage you draw, describe what natural processes are affecting you. You should have at least four stages. Ultimately, tell how humans might use or abuse you as soil.

Elaborate:

Create a power point presentation to support your stages.

Assessment:

Peer assess the power point presentation using the rubric in the Strategies book-pages 60-61

Adapted from www.globe.gov

Mud Pies to Bricks

Engage:

Begin the investigation by making or showing students a mud pie. Challenge students to create the perfect mud pie during the investigation.

Explore:

Ask students to examine the soil carefully using their eyes, hands, and a magnifying glass. Make a list of the things students observed about the soil. For example: different size, shape, and color of grains, other soil materials such as sticks or leaves, "dustiness", weight, etc. Ask students if they think the soil would be different if all of the particles were alike or if some parts were missing. How would it be different? Starting with the largest mesh sieves, sift the soil. Place what does not go through the sieve in one pile-these are the largest particles. Ask students to examine the two piles. How are they alike and different? Can they think of reasons why different size particles would be good for different things? Take the soil that passed through the sieve and sift it through the next smaller mesh screens. Students will now have several piles of soil separated by the size of the particles. Ask students to identify words that describe the different piles of soil they now have. Identify the concept of particle size: sand, silt and clay. Words might include: powdery, rough, smooth, dusty, etc.

Explain:

Discuss with students the importance of soil as a building material. Ask students to identify things that are built with soil. Example: concrete sidewalks, brick buildings. Have students describe how they would make a brick using the soil they have. Ask students to describe the characteristics of a good mud pie or brick. For example: harness, cracking, resistance to breaking or water, etc. Ask students to guess which pile of soil would make the best mud pie or brick. Why did they choose the pile of soil that they did? What will happen to each pile when water is added to it? Have students make mud pies or bricks from the soil in each pile by adding water then molding by hand or putting into a mold like an egg carton. Dry completely in the sun or in a warm place. Ask students to test the mud pies or bricks that they made for breaking, cracking, smoothness, etc. List what is good or bad about each one.

Elaborate:

Challenge students to create the perfect mud pie or brick by combining different amounts of the soil particles they sifted out. Additional sand, clay or organic material may be provided, especially if your original soil did not contain very much of one of these elements.

From Mud Pies to Brick

Have students measure or weigh the different ingredients and write a “recipe” so that they can compare with other students or recreate their creation. Students can figure out the percent weight of each soil component in their recipe. Have students answer the following questions:

- What happens when the dried bricks get wet? Research how abode houses are protected from rain.
- Examine a piece of broken brick. What soil elements can you identify? Why are bricks water resistant?

Adapted from GLOBE Soil Investigations – www.globe.gov

Soil Horizons/Profile

Engage:

Tell students that they will be investigating soil just as soil scientists do. In this activity, students will be using an auger to remove soil samples to a depth of 1 meter. Students will identify the soil horizons.

Explore:

Obtain 15 soil containers (enough for 5 horizons). The opening of each container should be large enough so that you can easily transfer a soil sample from the auger to the container without losing any of it. The soil sample will need to be dried. Label each container. Weigh each container in which the soil will be dried. Record the weight of each container. Provide a lid or other means to seal each container for transport of the samples from the field to the classroom. With the auger technique, students display the vertical soil profile on a horizontal surface (the ground). A Dutch auger is best for most soil, especially for rocky, clayey, and dense soils. A sand auger is needed if your soil is very sandy in texture. Identify an area where you can dig four auger holes where the soil profiles should be similar. Spread a plastic sheet on the ground next to where you will dig your first hole. Assemble a profile of the top 1 meter of the soil by removing successive samples from the ground with the auger and laying them end-to-end as follows:

- Turn the auger one complete revolution (360 degrees) to dig into the ground.
- Remove the auger with the sample in it from the hole.
- Hold the auger over the plastic sheet.
- Transfer the sample from the auger to the plastic sheet as gently as possible. Place the top of this sample just below the bottom of the previous sample.
- Measure the depth of the hole. Adjust the sample on the plastic sheet so that its bottom is no further from the top of the soil profile than its depth.

Divide students into cooperative groups and ask them to observe their soil profile. Starting from the top and moving down to the bottom, observe the soil profile closely to identify where there are changes in the appearance of the soil. Look carefully for any distinguishing characteristics like different colors, roots, the size and number of stones, small light or dark nodules (called concretions), worms or other small animals and insects, worm channels, and anything else that is noticeable. Mark the location of each of these changes or boundaries by sticking a nail, golf tee, chop stick, or other marker into the soil profile you have constructed. Sometimes it is difficult to identify differences in horizons because the properties of the whole soil profile are very similar. In this case, there may be only a few very thick horizons present. Do your best to record exactly what you observe in the field.

Soil Profile

Measure the top and bottom depths for each horizon to the nearest cm and record them in the Soil characterization Data Work Sheet. If horizons are very thin, (< 3 cm from top to bottom) do not describe them as separate horizons, but combine them with the horizon above or below instead.

Explain:

Have each student draw and color a diagram of their soil profile in their science notebook. Students should indicate the different horizons they find in the soil profile. Display one example from each group. Ask students to compare the similarities and differences of each soil profile. Ask each student group to explain how they determined the different horizons in the soil profile.

Elaborate:

Display a transparency of a soil horizon and ask the students to compare it to the ones that they studied.

Evaluation:

Assess student's science notebooks for the data collected and the drawings of the soil profile. Ask each student to write down how they determined the location of the different horizons in their soil profiles.

Adapted from GLOBE Soil Investigations – www.globe.gov

Soil Texture

Engage:

The texture of a soil refers to the amount of sand, silt, and clay in a soil sample. The composition of these determines the way the soil feels when you rub it between your fingers. The texture differs depending on the amount of sand, silt, and clay in the soil sample. Sand particles are the largest with sizes up to 2mm while clay particles are smaller than .002mm. Particles greater than 2mm are called stones or gravels and are not considered to be soil material. Even though they are small, the differences among sand, silt, and clay particles can be felt, and each has its own characteristics. Sand feels gritty, silt feels smooth, and clay feels sticky. Usually a combination of these three different size particles is found in a soil sample. Soil scientists use charts called Textural Triangles to help determine what percent of sand, silt and clay are in a soil sample. Using Textural Triangles 1 and 2 to help you, follow these steps to identify your soil's texture.

Explore:

Use the soils brought in from their yards or gardens from the Soil Consistency lab to create these small eggs of soil to use in this experiment.

Demonstrate the following technique to the class. Take a sample of soil about the size of a small egg and add enough water to moisten it. Work it between your fingers until it is the same moisture throughout. Then, squeeze it between your thumb and forefinger in a snapping motion to try to form a ribbon of soil. If the soil feels extremely sticky (sticks to your hands and is hard to work), stiff, and requires a lot of thumb and finger pressure to form a ribbon, it is likely composed of mostly clay particles. Classify it as clay, as shown on Textural Triangle 1.

If the soil feels sticky and a little softer to squeeze, it probably has fewer clay particles. Classify it as a clay loam.

If the soil is soft, smooth, and easy to squeeze, and is at most slightly sticky, classify it as a loam.

Once the soil has been classified as clay, clay loam, or loam, refine the classification by determining the relative amounts of sand and silt.

If the soil feels very smooth, with no sandy grittiness, add the word "silt" or "silty" to your classification, such as "silty clay", or "silty loam", as shown on Textural Triangle 2. This means that your soil sample has more silt-size particles than sand-size particles.

If the soil feels very gritty, add the term "sandy" to your soil classification, such as "sandy clay". This means your soil sample has more sand size particles than silt size particles.

Soil Texture

If the soil feels neither very gritty nor very smooth, even if you can feel some sand in your sample, keep your original classification unchanged. This means your soil sample has about the same amounts of sand and silt size particles, and in the case of a clay, it may have a very few of either.

When feeling the soil texture, try to add the same amount of water to each sample so that you can more accurately compare one texture to the other. The soil texture can feel differently depending on how wet or dry it is. The amount of organic matter in the soil can also change how it feels. Generally, the darker the soil color is, the more organic matter is in it.

Explain:

Have the teams of students create a data sheet with the name of the soil textures that the team has agreed upon. Also, note whether the sample was dry, wet, or moist when it was examined, and whether it contained a lot of organic matter (for instance if it was on the surface and had a very dark color).

Elaborate:

Compare the teams data sheets. Have the students write in their science journal why they think the soil textures are alike and different.

Evaluation:

Possible portfolio

Adapted from GLOBE Soil Investigations –www.globe.gov

Soil Consistency

Engage:

Give each student group a section from one of the soil profiles. Ask them to determine the consistency of the soil.

Explore:

Take a section from the soil horizon. Record on the data work sheet whether the section is moist, wet or dry. If the soil is very dry, moisten the face of the profile by squirting water on it, and then remove a section for determining consistence. Holding the section between your thumb and forefinger, gently squeeze it until it pops or falls apart. Record one of the following categories of soil section consistency on the data sheet.

- Loose: You have trouble picking out a single section and the structure falls apart before you handle it.
- Friable: The section breaks with a small amount of pressure.
- Firm: The section breaks when you apply a good amount of pressure and the section dents your fingers before it breaks.
- Extremely firm: the section can't be crushed with your fingers (you need a hammer!)

Explain:

Ask students to write how their group determined the soil consistency of the section their group analyzed.

Elaborate:

Have the students draw a picture and color the types of soil that made up their soil section.

Evaluation:

Ask students to bring in soil from around their house. Not processed soil. Providing a hand lens ask the students to describe their soils consistency and provide evidence for their hypothesis.

Soils as Sponges: How Much Water Does Soil Hold?

Engage:

Students will get the mass of a wet sponge, squeeze it to remove water and get the mass of the dry sponge. This helps students understand that objects can hold water and that the amount can be measured. Students then transfer this concept to soil, getting the mass of wet and dry soil samples, and then apply this wet/dry comparison to other objects, such as leaves and fruit.

Explore and Explain:

In this activity, students measure the moisture in several objects, before and after drying. They do these experiments in five stages of increasing difficulty.

Stage 1—Squeeze water from sponges

Students get the mass of a wet sponge, squeeze the water out and get the mass of it, then get the mass of the dry sponge. Doing this, the students see that, in essence; wet sponge=dry sponge + water. Squeezing is a very visible and immediate way to release water.

1. Soak a sponge in water. Get its mass and record it on a data table. Ask the students how much mass they think it will have when it is dry. Record their estimates.
2. Squeeze the water out of the sponge and get its mass. Record the dry mass on their data table. Discuss with students how their estimates compared with the actual value.
3. Ask the students how much water was in the sponge. See if they can figure out how to calculate this. This amount of water = wet mass of sponge minus the dry mass of the sponge. For example, 200 grams (wet sponge) – 80 grams (dry sponge) = 120 grams of water squeezed out of the sponge.
4. Now repeat the measurements with a different sponge. Have the students keep their data and figure out which sponge can hold the most water.
5. You now have an absolute measure of the water content. Next find the relative measure of water by dividing by the dry sponge mass.
6. To extend this activity, you can collect the squeezed out water from each sponge in a beaker, then get the mass of the water (make sure you deduct the mass of the beaker so that you get just the mass of the water itself). The actual mass of the water should be the same as the calculated mass.
7. In the discussion with the students, make sure they understand the concept of water-holding capacity, and that this differs from one type of sponge to another.

Soil as Sponges

Stage 2—Evaporating water from sponges

Students do the same exercise as above, except they let the sponge sit for several hours or a day to let the water evaporate. When they get the mass of the dry sponge, they should get approximately the same mass as in Stage 1 (although evaporation may have removed more water than the squeezing did)

1. Ask the students what will happen if you leave the wet sponge on a tray overnight instead of squeezing it. If your students understand the concept of evaporation, you can discuss that with them. Otherwise, wait until later in this activity to discuss evaporation.
2. Have the students get the mass of the wet sponge, record the mass, and leave the sponge on a tray, preferably in sunlight. Leave it exposed until the next day.
3. After the sponge has been left out for a day, have the students get the mass of the dry sponge (it should be dry by now).
4. Ask your students where the water went. Older students who understand evaporation will know the answer. Otherwise explain evaporation to the students.
5. Calculate how much water left the sponge during evaporation to find out its water-holding capacity. This figure may be different from what they measured when they squeezed the sponge. Ask them why the numbers are so close (because both squeezing and evaporating removed most of the water). Ask them why the numbers are not exactly the same (because evaporation removes more than squeezing, although it takes longer).

HOMEWORK: Explain to the students that they will soon be measuring how much water soil can hold. Ask them to bring in a soil sample from home or use what they have brought in for the other soil experiments. They should put the soil sample into a plastic sandwich bag, then seal the bag to retain the moisture.

Stage 3- Measuring soil moisture

Now students will transfer the concept of evaporative drying to soil by letting soil samples dry for a day or two. They measure the mass before and after to measure the soil moisture. They compare several soil samples to get a sense of a typical range of values.

1. Have the students put their soil samples (still in the tightly sealed plastic bags) on their desks. Ask them how they might measure the wetness of the soil. In their answers, the central concept to look for is mass of the wet soil, dry it (there are many ways to dry it), and get its mass again, just as they did with the sponge.
2. Have each student or group of students open their sealed baggy, get the mass of the wet soil, and set it aside to dry. Drying may take a day or two.

Soil as Sponges

3. When the soil is dry (have them touch the soil to feel how dry it is), have the students get the mass of the sample again. Ask them how much water evaporated.
4. Introduce the formula for soil water content.

$$\text{Soil water content} = \frac{(\text{wet mass} - \text{dry mass})}{(\text{dry mass} - \text{can mass})} \times 100$$

This is the formula used in the soil moisture protocol. For example, if the wet mass is 100 grams and the dry mass is 90 grams, and the can mass is 30 grams then the soil water content will be:

$$\frac{100\text{g} - 90\text{g}}{90\text{g} - 30\text{g}} = \frac{10}{60} = .167 \quad 100 \times .167 = 16.7$$

5. Have the students calculate the water content of their soil and compare the values. Correct any errors in their calculations. Discuss the range of values and why they think there is such a variety. Have them examine the different soils to help them think about why there is such a range.

In the above activity, students get the mass of the soil every hour, and then graph the results to see whether water evaporates at a constant rate or the evaporation rate changes, such as slowing the closer the soil gets to being dry, or evaporating more quickly when the sun is shining on it. You might also link the discussion with weather factors, such as how quickly the soil might dry on a very dry or humid day.

HOMEWORK: Explain to the students that they will be drying other objects. Ask them to bring to class some fruits, vegetables, or leaves.

Stage 4 – Removing water from other objects

Soil as Sponges

Students transfer this understanding of measuring soil moisture to determine the moisture of other objects, such as fruit or leaves. They experiment with different ways to dry the objects: fans, squeezing, sunlight, salt, etc. They also estimate the wetness value.

1. Have the students show and discuss the objects that they brought in to dry. Have them estimate the water content for each object. Record their estimates, either as individual estimates or as class estimates.
2. Have the students get the mass of each object and record the mass.
3. Brainstorm with the students for ways to dry the objects. Previously they squeezed and evaporated the water. What other ways are there? How could they speed up or slow down the process? Some ideas are: put the objects in direct sunlight; blow a fan over them; put them on a heater; put them in a microwave; pour salt on them; cover them with a plastic container; point a light on them.
4. Select among the techniques and see the results. The more time you have available, the more the students can experiment.
5. After one or more days, when the objects are dry, have the students get the mass of the objects again. Compare the actual values with their estimates. Which results surprised them?

Stage 5 – Using GLOBE visualizations for worldwide soil moisture

Students use the GLOBE visualizations on the web to study a map showing soil moisture in other parts of the world. They discuss why there are differences, and conduct further investigations based on student interest in the topic and the visualizations.

1. Use the GLOBE web page to access and display a map showing soil water content around the world based on the most recent student measurements. This is an exciting opportunity for your students because they will be using soil moisture data from all over the world.
2. You can display the soil water content either as values or as contours (with different colored bands corresponding to certain ranges of soil moisture values).
3. Make sure the students make the connection between their own soil water content measurements and the soil water content readings from other schools around the world.
4. There are many domains of investigation for the students. Here are some examples:
 - What is the range of soil water content values around the world?
 - Where is it the lowest? The highest?
 - Does this vary over time? (examine soil water content maps from other months)
 - What affects the soil water content of the different sites?
 - Do soil water content values depend on recent weather conditions?
 - Compare readings from a desert, rain forest and a farming area.

Soil as Sponges

What areas have about the same level of soil water content as your site?

Elaborate:

Encourage the students to pursue further investigations using the GLOBE soil water content visualizations.

Evaluation:

Bring a set of soil samples to school. Have the students estimate the soil water content. Have them calculate the soil water content (do not remind them on how). Check for reasonableness in their estimates, and watch the process to make sure they do it correctly.

Soil pH

Engage:

Tell the students they will be measuring the soil pH in this investigation. They will need to make this measurement on three samples for each horizon from their soil profiles.

Explore:

In a cup or beaker, mix dried and sieved soil with distilled water in a 1:1 soil to water ratio. For example mix 20g of soil with 20ml of water or mix 50g soil with 50ml of water. Mix enough soil and water so the pH reading can be made in the supernatant. This is the liquid above the settled soil particles. Use a spoon or another utensil but not your hands to transfer the soil. The oils and other materials on your hands may contaminate the pH reading. Stir with a spoon or some other type of stirrer until the soil and water are thoroughly mixed. Stir the soil-water mixture every 3 minutes for 125 minutes. After 15 minutes, allow the mixture to settle until a supernatant forms. This takes about 5 minutes. In a cup or beaker, measure the pH of the water you are using for this activity by dipping the pH paper into the water and comparing the color to the color chart provide with pH paper.

Measure the pH of the supernatant by dipping the pH paper into it (following the procedure given for the pH paper). Record the results on the Soil pH Data Work Sheet created for this experiment.

Explain:

Ask students to brainstorm ideas concerning the importance of soil pH. Have them consider different types of plants growing in different types of soil.

Elaborate:

Have the students fill out the Soil pH Data Work Sheet below:

Date of Sample Collection: _____

Site: _____

pH measurement method (check one): _____ paper, _____ pen, _____ meter

Soil pH

Sample Number 1	Sample Number 2	Sample Number 3
A. pH of water before adding soil _____	A. pH of water before adding soil _____	A. pH of water before adding soil _____
B. pH of soil and water mixture _____	B. pH of soil and water mixture _____	B. pH of soil and water mixture _____

Adapted from GLOBE Soil Investigations

Soil Temperature

Engage:

Tell the students they will be investigating the temperature of soil close to the surface and learn about the insulating capabilities of the soil. They will also detect diurnal changes in soil temperature.

Explore:

Select a relatively flat sunny area. Try to find an area with uniform characteristics across an area having a diameter of 5 m. The ground should not be compacted but can be covered with litter or grass. When making measurements on consecutive days, try to make your reading on days with similar weather conditions and for soil conditions that are typical for the week you are making them. Try to make diurnal readings around the middle of March, June, September, and December. Drill a hole (teacher prepared) in a wooden block so that when the soil thermometer is pushed all the way into this hole 7cm of your probe extends beyond the bottom of the block. This will help students maintain a uniform depth of the 5cm depth measurement.

Calibration:

Check the accuracy of the thermometer every three months. Remember to use the same thermometer so as not to create differences or bias that would make your data impossible to interpret.

How to measure soil temperature!

1. Make a pilot hole of 5cm. Insert a nail that is the same length and diameter as your thermometer.
2. Insert the thermometer to 7cm. Insert the thermometer through your block of wood. Gently push and twist (with your hand covered with cloth or paper towel) the thermometer until the head is resting on the block. Do not force it as this will damage the thermometer.
3. Read the soil temperature at 5cm. Wait at least 2 minutes; read the thermometer again. Wait another minute, and reread the thermometer. Repeat until consecutive readings are within 0.5 – 1.0 degree Celsius of each other. Record this value on the Soil Temperature Data Work Sheet.
4. Remove the thermometer and the block. Use a twisting motion (covered hands) –try not to disturb the soil.
5. Repeat steps 1-4 without the block. Gently push and twist your thermometer fully into the ground using the same hole as before. Instead of depths of 5 and 7 cm, use depths of 10 and 12 respectively. Making use to use safety precautions when pushing or twisting a thermometer.
6. Record your measurements on the Soil Temperature Data Work Sheet.

Soil Temperature

Take three sets of soil temperature measurements at 5 and 10 cm depths. Complete these measurements within 1 hour of local solar noon and within a period of 20 minutes. Record your time to the nearest 10 minutes.

Take diurnal temperature measurements every three months, preferably during March, June, September, and December. Repeat the measurements every 2 to 3 hours on two consecutive days. Try to take at least 5 readings per day. Offset each new reading by at least 10 cm.

Explain:

Construct a table in your science notebook for recording your results or use the Soil Temperature Data Sheet. Discuss the results of the temperature readings.

Evaluate:

Students will record their data in their science notebooks. Ask students to write a paragraph answering the following questions:

How does the temperature of the soil affect plant roots?

How does the temperature of the soil affect earthworms and other living soil organisms?

Adapted from GLOBE Soil Investigation

Unit Assessment: **Mystery Soil**

(Note to teacher: This task should be designed around the tests that were actually done in class. You may add/delete tests and modify directions in order to assess the indicators of learning that you expected students to master).

Other suggestions: TEACHER

- Allow students to select from a menu and only perform a set number of tests
- Have two or more samples so that students can work as a group but each member of the group has a different sample for which he/she is accountable.

The year is 2015 and you are a struggling college student. Your summer job is working in a lab with a soil scientist. Your first assignment is to conduct a series of tests on a sample of soil that came from an unknown source.....possibly from a distant land or another planet.

Conduct the following tests on the soil sample: (modify for specific needs)

- Temperature
- Structure
- Particle Size
- Consistency
- pH
- Fertility
- Texture
- Soil Moisture

Sample Data Table:

Type of Test	What I did	Finds

Mystery Soil

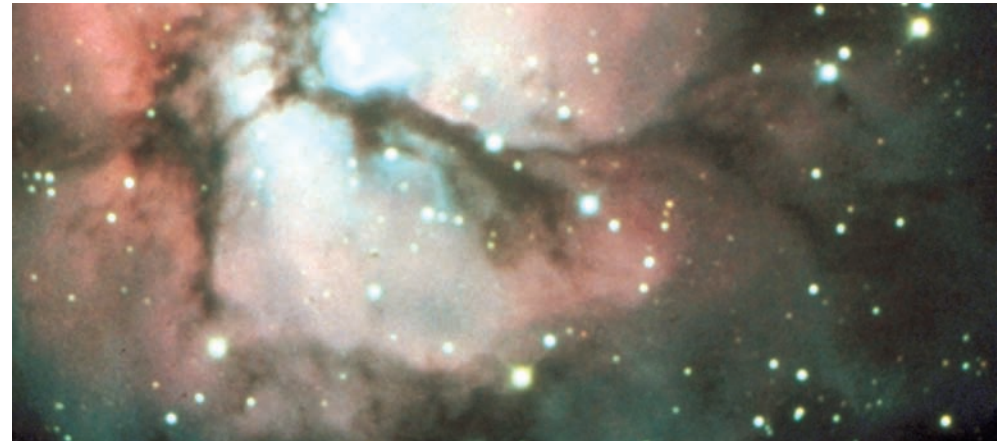
Write a report telling about the quality of the mystery soil you investigated.
Based on the properties you identified, explain one way that the mystery soil can be used. Be sure to provide a rationale for your decision.

Adapted from GLOBE Soil Investigations

Middle Grades Science

6th Grade Support Document

Goals 1, 2, and Cycling of Matter



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6th Grade Competency Goal 4

The learner will investigate the cycling of matter.

Big Ideas

Cycling of Matter

Energy flows through ecosystems in one direction from producer to consumer to consumer, etc., and eventually to decomposer throughout the system. The Sun is our main energy source. Green plants use energy from the Sun, gases from the air and nutrients from the environment to produce food through the process of photosynthesis. Consumers get their energy by eating producer or other consumers or both. Organic matter is transferred from one organism to another and between organisms and their environment, but the transfer of energy and matter is never 100% efficient. Some energy is transferred to the environment in the process.

Decomposers break down dead or decaying organisms for nourishment, but a large part of the matter is returned to the ecosystem to serve as nutrients for other organisms, especially producers.

Water, nitrogen, carbon dioxide and oxygen are substances that are used by organisms and recycled to the environment, sometimes in a different form. Plants use carbon dioxide to produce food and release oxygen to the environment. Animals, as well as plants, use oxygen to carry on bodily processes and release carbon dioxide back into the environment. The Earth ecosystem is a complex, but delicately balanced, system where all organisms depend upon all others to fulfill their role in the system.

Technology has been used throughout history to develop improved methods of supporting growth, development, and reproduction of organisms.

National Science Education Standards	AAAS Benchmarks
<p data-bbox="176 326 436 358">Cycling of Matter</p> <p data-bbox="176 399 621 431">Populations and Ecosystems</p> <ul data-bbox="226 435 1024 911" style="list-style-type: none"><li data-bbox="226 435 1024 683">• Plants and some microorganisms are producers – they make their own food. All animals, including humans, are consumers, which obtain food by eating other organisms. Decomposers, primarily bacteria and fungi, are consumers that use waste materials and dead organisms for food. Food webs identify the relationships among producers.<li data-bbox="226 727 1024 911">• For ecosystems, the major source of energy is sunlight. Energy entering ecosystems as sunlight is transferred by producers into chemical energy through photosynthesis. That energy then passes from organism to organism in food web. <p data-bbox="176 951 632 984">Structure of the Earth System</p> <ul data-bbox="226 987 1024 1235" style="list-style-type: none"><li data-bbox="226 987 1024 1235">• Water, which covers the majority of earth’s surface, circulates through the crust, oceans, and atmosphere in what is known as the “water cycle.” Water evaporates from the earth’s surface, rises and cools as it moves to higher elevations, condenses as rain or snow, and falls to the surface where it collects in lakes, oceans, soil, and in rocks underground	<p data-bbox="1100 310 1272 342">Lithosphere</p> <p data-bbox="1052 383 1738 448">Flow of Matter and Energy: Flow of Matter in Ecosystems</p> <ul data-bbox="1100 456 1885 1114" style="list-style-type: none"><li data-bbox="1100 456 1885 561">• One of the most general distinctions among organisms is between plants, which use sunlight to make their own food, and animals, which consume energy-rich foods.<li data-bbox="1100 643 1885 708">• Plants use the energy from light to make sugars from carbon dioxide and water.<li data-bbox="1100 789 1885 894">• Organisms that eat plants break down the plant structures to produce the materials and energy they need to survive. Then they are consumed by other organisms.<li data-bbox="1100 976 1885 1114">• One organism may scavenge or decompose another. The cycles continue indefinitely because organisms are decomposed after death to return food materials to the environment.

National Science Education Standards	AAAS Benchmarks
<p>Lithosphere</p> <ul style="list-style-type: none">• Human activities can induce hazards through resource acquisition, urban growth, land-use decisions, and waste disposal. Such activities can accelerate many natural changes.	<p>Lithosphere</p> <p>Agricultural Technology</p> <ul style="list-style-type: none">• In agriculture, as in all technologies, there are always trade-offs to be made...Specializing in one crop may risk disaster if changes in weather or increases in pest populations wipe out that crop. Also, the soil may be exhausted of some nutrients, which can be replenished by rotating the right crops.

NC Science SCS	Content Elaboration	Ideas for exploration	Web Resources
<p>4.01 Describe the flow of energy and matter in natural systems:</p> <ul style="list-style-type: none"> • Energy flows through ecosystems in one direction, from the sun through producers to consumers to decomposers. • Matter is transferred from one organism to another and between organisms and their environments. • Water, nitrogen, carbon dioxide, and oxygen are substances cycled between the living and non-living environments. 	<p>Investigate the role of the sun as a primary energy source.</p> <p>Investigate how plants use the sun's energy in the process of photosynthesis.</p> <p>Explain how energy is transferred from one level of a food web to another.</p> <p>Organic matter is transferred from one organism to another and between organisms and their environment, but the transfer of energy and matter is never 100% efficient. Some energy is transferred to the environment in the process.</p> <p>Investigate the relationship between the carbon-oxygen cycle, the nitrogen cycle, and the water cycle</p>	<p><u>Food Webs</u></p> <p><u>Design Systems</u></p> <p><u>Pyramid Power</u></p> <p><u>Stash the Trash</u></p> <p><u>Menu Game</u></p>	<p>http://soils.gsfc.nasa.gov/index.html.</p> <p>Kids Soil Science Page. Great site for teachers and students. Tons of resources, games, and support links.</p> <p>http://soil.gsfc.nasa.gov/NFTG/NFTGame.htm</p> <p>For a fun game on the Nitrogen Cycle, check the link above.</p> <p>http://www.physicalgeography.net/fundamentals/4e.html</p> <p>Good site for teacher tutorial and support.</p> <p>http://edweb.sdsu.edu/courses/edt/ec670/Cardboard/Board/W/shoeats/board-game-template.htm</p> <p>http://www.eelsinc.org/id62.html</p> <p>Good site for teacher support.</p>

6th Grade
 Middle School Support Document
 Cycling of Matter

NC Science SCS	Content Elaboration	Ideas for exploration	Web Resources
<p>4.02 Evaluate the significant role of decomposers.</p>	<p>Investigate how decomposers return nutrients back to the environment.</p> <p>Explore the importance and role of bacteria in the guts of animals and plant roots as it relates to the recycling of matter.</p>	<p><u>Bread Mold lab</u></p>	<p>http://www.globalchange.umich.edu/globalchange1/current/lectures/kinling/ecosystem/ecosystem.html</p> <p>Excellent site for teachers. Good resource for science information and graphics.</p>

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NC Science SCS	Content Elaboration	Ideas for exploration	Web Resources
<p>4.03 Examine evidence that green plants make food.</p> <ul style="list-style-type: none"> • Photosynthesis is a process carried on by green plants and other organisms containing chlorophyll. • During photosynthesis, light energy is converted into stored energy which the plant, in turn, uses to carry out its life processes. 	<p>During photosynthesis, plants take in carbon dioxide and water and absorb light energy. Specific parts of the plant cell make sugar (glucose) and release oxygen.</p> <p>Explore how carbon dioxide is used in the building of plant materials.</p>	<p>Observe prepared slides of a plant cell –looking especially for the chloroplast where the chlorophyll is contained.</p> <p>Discuss the formula for photosynthesis</p>	<p>http://www.pbs.org/wgbh.nova/met_huselah/photosynthesis.html</p> <p>NOVA site on photosynthesis. Requires FLASH plug in. Additional teacher resources are located at the bottom of the website page.</p> <p>http://www.tpt.org/newtons/9/phyto_sy.html</p> <p>Newton's Apple lesson plan for studying photosynthesis.</p> <p>http://library.thinkquest.org/3715/p_hoto3.html</p> <p>Good tutorial with graphics</p>

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NC Science SCS	Content Elaboration	Ideas for exploration	Web Resources
<p>4.04 Evaluate the significance of photosynthesis to other organisms:</p> <ul style="list-style-type: none"> • The major source of atmospheric oxygen is photosynthesis. • Carbon dioxide is removed from the atmosphere and oxygen is released during photosynthesis. • Green plants are the producers of food that is used directly or indirectly by consumers. 	<p>Water, nitrogen, carbon dioxide and oxygen are substances that are used by organisms and recycled to the environment, sometimes in a different form. Plants use carbon dioxide to produce food and release oxygen to the environment. This process is known as photosynthesis.</p>	<p><u>Making a Terrarium</u></p> <p>Have students make Venn diagrams to show relationships between the various cycles.</p>	<p>http://www.learner.org/resources/series179.html</p> <p>Wonderful site for a number of 6th grade topics. You will need to register to use the site. You will have access to video material online. Check with your IT person to see if you can use these from the website.</p> <p>http://www.tpt.org/newtons/9/phyto-sy.html</p> <p>Same as the site for 4.03</p>
<p>4.05 Evaluate designed systems for ability to enable growth of certain plants and animals.</p>	<p>Items needed to sustain life. Biotic and Abiotic</p> <p>Explore and explain how various agricultural applications work such as:</p> <ul style="list-style-type: none"> • Perma-culture gardening • Hydroponics • Managed forests 	<p>Create a compost pile to use with a possible garden along with a <u>Compost Observation Log</u>. Include moisture, soil temperature, microorganisms, air temperature, date, time of observation, and amount of light.</p>	

FOOD WEBS

Engage:

The "goal" of every organism is to stay alive. Almost all organisms eat a wide variety of prey. This complex set of organism eating other organisms has been called a food chain. It is more accurate to think of it as a food web.

As an example in the open ocean (away from the shore) phytoplankton form the bases of the food web. These microscopic, one-celled plants absorb dissolved nutrients from the water and use sunlight to carry on photosynthesis. These are called **primary producers** because they use light energy to create organic material. Above the primary producers are the **zooplankton** or **first-order consumers**. These organisms need primary producers in order to obtain energy. The next rung on the food web are the **second-order consumers** which is an amazing assortment of animals such as fishes (herrings), squid, jellyfish, larger marine fish, sharks, and mammals. Of course, there are other levels above this. **Third-order consumers** include tunas, seals, sea gulls and **fourth-order consumers** are the orcas and white sharks of the world.

Purpose: To help show how life in the ocean is interconnected, with each student acting as part of a food web.

Materials needed are: one ball of yarn, one index card, safety pin one per student, and a copy of the food web.

Elaborate and Explore:

- Referring to the food web figure, each student decides what organism to be, writes its name on an index card and pins it to his or her shirt. (Instructor needs to check that all types of consumer and producers are represented). Safety reference with the safety pin!!
- Stand in a circle with your students holding a ball of yarn. Start the game by saying "I'm a squid and I need fish larvae for food." Holding one end of the string, pass the ball to a fish larva person. The fish larvae person might say, "I'm a fish larva and I eat diatoms" or "I'm a fish larvae and jellyfish eat me" and, holding some yarn, passes the ball along. Once a student gets the yarn, remind them to hold onto the string before they pass it onto another person.
- Eventually everyone will be all tied together in a tangle of yarn resembling a spider web, which emphasizes the whole point: All living things are connected in some way.
- Now cut the string at some point. The food web is broken. What might happen to the various organisms in the food web?
- Now, cut the string at some point. The food web is broken. What might happen to the various organisms in the food web?

Food Webs

Evaluate:

Have students create a variety of food web diagrams from a variety of environments. Then have each student choose a diagram and remove 1-2 organisms for the food web. In their science journals, have them write what impact this would have on the remaining organisms.

Allow teams to select one "new organism" to introduce into another team's food web. Once this has happened each team should discuss and write on chart paper the impact of the addition of this new organism on the food web.

Design Systems—Creating Honey Holes

Purpose: To investigate the cycling of matter by creating an ecosystem.

Objective: To describe the flow of energy and matter in natural systems.

Engage/Explore:

Collect discarded or storm damaged trees. Sink them in your favorite pond or lake to create structure for some excellent fishing. **Get permission from the land owner for this experiment and have adult supervision.**

Elaborate:

Evergreen trees can provide some of the best, most economical structure to attract and hold schools of crappies, bluegills and bass in your favorite body of water. Freshly cut deciduous trees including willows and pin oak will also attract fish. Other materials that can be used include brush piles and stake beds.

The key to sinking structure is to make sure it is properly weighted and secured to stay put on the bottom. Design a system to hold the tree at the bottom of the pond or lake.

Evaluate:

Research how the trees should be positioned under water (vertical or horizontal). Then continue your research to see what fish populations are attracted by the tree position.

Note:

Public reservoirs are usually controlled by a utility company, local government or the Army Corps of Engineers.

Sketch the shoreline so you can locate the structure during the fishing season. A Global Positioning System unit along with a depth finder can be very helpful in marking and finding your tree under water.

With the proper construction and placement, you should have a first-rate honey hole of your own.

Adapted from Wildlife in North Carolina

PYRAMID POWER

Engage:

Another way of looking at food relationships in the ocean is by depicting how many organisms (or what weight of organisms) are in each food web layer. Because of the shape this relationship invariably takes, it is often called a food pyramid. There are always more organisms at the bottom rung than in the layer above, and always more in that layer than in the next one above that. This is no coincidence; this pattern exists because energy decreases as it flows through the system. Sometimes only as little as 10% of the energy from the “eatee” is stored in the “eater” as flesh; the rest is lost as waste heat or is used by the eater to pursue prey, reproduce or otherwise maintain itself. Because of this energy loss, each successive level contains fewer organisms and their total weight is smaller. Why would the largest mammal and the largest fish in the world eat some of the smallest creatures in the sea? Why don't blue whales and whale sharks eat 300-pound yellow fin tuna or 1,000-pound black marlin? Basically, it's for the same reason that the largest land animals, elephants, eat trees instead of lions. First, there are many more trees than there are lions, so it's really much easier to eat a tree than a lion. Lions have an inconvenient habit of running away if you try to eat them. In addition, while you may eventually catch one, if you are the size of an elephant, you will probably expend more energy running it down than you will gain by eating it. Of less importance, but also to be kept in mind, is that lions tend to bite you if you insist on chewing on them. Trees, on the other hand, are pretty stoic about the process.

Similarly, a blue whale certainly could catch and swallow a big yellow fin tuna or a bottlenose dolphin, but it might take four days to catch one and there's just not any profit margin in that. By comparison, krill are just perfect. They swarm by the millions and can't swim very quickly; the whale can catch them by just opening its mouth and leisurely swimming through.

Explore:

Students will learn how energy is lost as it travels through a food web.

Gather these materials before beginning the lab.

Materials:

20 plastic sandwich bags with 20 crackers or peanuts in each—safety be careful on food allergies!

7 empty plastic sandwich bags

Large pyramid diagram

20 signs on large index cards saying:

Producers: Green Plants

4 signs on large index cards saying:

First-Order Consumers: Herbivores

Pyramid Power

2 signs on large index cards saying:

Second-Order Consumer: Meat Eater (Carnivores)

1 sign on large index card saying:

Third-Order Consumer: Omnivores

Procedure:

- Have 20 students act as “producers” or green plants. Pin or hang the signs on them. Give each one a plastic bag with 20 buttons (seeds) in it, representing 20 energy units. This energy comes to the plant from sunlight and from nutrients and gasses in the water.
- Each “plant” may eat 5 crackers. This represents the amount of energy the plant consumes for respiration and normal growth activity. The remaining 15 energy units are stored in the plant tissue. **Note: There are now 300 unused energy units (stored in the plant tissue) remaining.**
- Next, four students acting as first-order consumers (herbivores) feed on the phytoplankton to get their energy. Each one takes an empty plastic bag and collects 75 energy units (crackers). The 30 remaining energy units are stored in the herbivores as fat, flesh, bones and internal organs. **Note: There are now 120 unused energy units (stored in the animal tissue) remaining.**
- Two students acting as second-order consumers (carnivores) each collect 60 energy units from any of the herbivores. In nature, this could even mean a fight over a catch or the sharing of one. The hunt and generally high respiration of the predator would use up to 30 energy units. Therefore, each carnivore may now eat 30 crackers, the remaining energy units as body tissue. **Note: There are now 60 energy units (stored in the animal tissue) left.**
- One student acting as the top predator (shark, orca, etc) collects all of the remaining 60 energy units. If the hunt was very strenuous, the predator may have required all 60 units, leaving nothing left for growth. This could result in a stunted animal or one that could not reproduce or would become ill from lack of resistance to disease. Perhaps the animal would hunt in a wider area, which would include more sources of food to supply a larger supply of energy units. Our predator is pretty healthy, so only 30 units of energy are consumed (the student eats 30 crackers) and the remaining are stored in the predator’s body.

Pyramid Power

Evaluate:

FOOD PYRAMID ASSIGNMENTS

Order	Students	Units Taken	Units Eaten	Units Surrendered
Producers	20	20	5	15
First-Order Herbivores	4	75	45	30
Second-Order Meat Eaters	2	60	30	30
Third-Order Top Predator	1	60	30	30

Who Eats What???

1. What is at the base of the ocean food web?
2. What do dolphins eat?
3. What animals do bowhead whales eat?
4. Name the organisms in the food chain that leads to the sperm whale.
5. What animals eat phytoplankton?
6. What eats the bowhead whale?
What animals eat small fish?
7. What is at the top of many food chains in the ocean?
Bonus: What's the difference between a food chain and a food web?

Stashing the Trash

1. Assemble the items to be “disposed of” in the miniature sanitary landfill. You will construct and list them in your science journal.
2. Place a mixture of the soil types in the bottom of the container (gallon jar with lid). On top of the soil mixture, place the fruit, plastic, paper and other items. Add more soil mixture on top of them. Put the container in a warm place, and keep the soil moist.
3. Estimate the extent to which each item will decompose in one week, one month, three months and six months, and record your estimates next to the items on your list. Some of these items will decompose (break down) and become part of the soil environment, while other will last a long time.
4. After one week, check to see what has happened to the items you buried in the soil. Which things look different than they did when you buried them? Record the changes you see in your science journal. How accurate were your estimates about the extent to which the items would decompose?
5. Check the materials again one month, three months and six months from the date you created the miniature landfill, and again note your observations in your science journal. How accurate were your estimates about decomposition over these time periods?

Menu Game

Engage:

Bring into class a take home menu from your favorite restaurant. Pick your favorite dish! List each item.

Explore:

Trace the energy of each food back to the sun.

Explain:

Which foods on your list were consumers?

How many were producers?

Elaborate:

Create a poster of a food chain showing your consumers and producers!

Evaluate:

Use a rubric to assess the poster.

Bread Molds Lab

Engage:

What does bread mold look like? What type of organism is it?

Bring into lab a loaf of bread.

Have the student research what does bread mold need in order to survive and grow!

Are there different types of mold depending on the type of bread?

Once you have set up a system that will promote mold growing on bread-- break off some of the bread mold and look at it with hand lens. Have the students draw and label what they see. This can also be done with fruit, too.

Remember this is to show decomposition using a fungi (mold).

Title: Making a Terrarium

Engage:

You have been asked to help make a terrarium for the kindergarten classroom. In the terrarium, they want to grow plants and may add a small organism or two. Your job will be to make suggestions for the type of soil(s) they will use and provide reasons for your choice(s).

Explore:

Draw a plan for the terrarium. Label all the soil(s) you will use in the terrarium.

Explain:

Explain the choices you made about soil(s). Tell what properties they must have. (Use what you learned about soil in the previous objective.)

Elaborate:

Make some recommendations for plants that might grow well in the terrarium. Use what you learned from your investigations on soil.

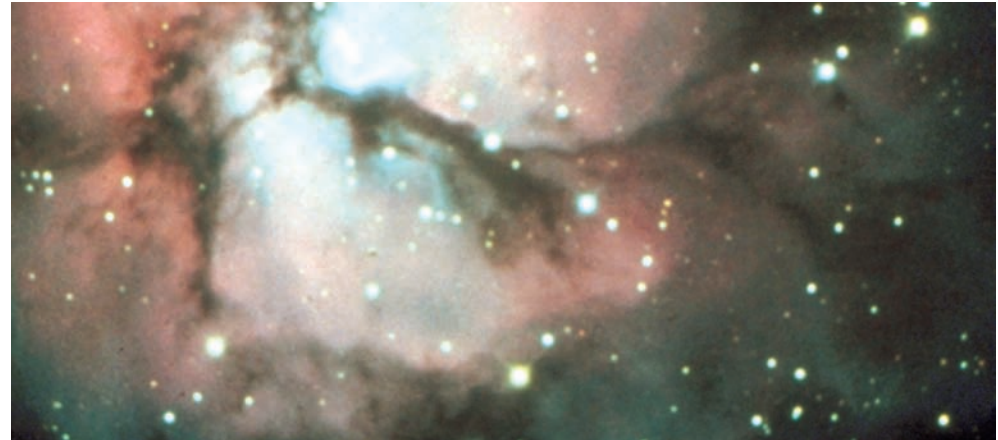
Evaluate:

Describe the soil horizon at the top of the terrarium, the need for humus in order for plants to grow and the characteristics of quality soil.

Middle Grades Science

6th Grade Support Document

Goals 1, 2, and the Solar System



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6th GRADE COMPETENCY GOAL 5

The learner will build an understanding of the Solar System.

BIG Ideas

Solar System

The Solar System consists of the Sun, planets, moons, asteroids, meteors, comets, dust, gases and primarily empty space. The Sun is the major source of heat and light for the solar system. Everything in the solar system is under the direct influence of the Sun's gravitational pull. Planets are the largest objects in the solar system and due to the Sun's gravitational pull, they revolve around the Sun with known frequencies.

Each planet is very different from the others and is known by its observable features and location in the solar system. The distance that a planet's orbit is from the Sun is an important variable in determining the physical and chemical make-up of the planet. Planets also vary in the number of moons within their gravitational pull from none to over twenty. Moons also vary greatly in their sizes and composition. The position of the Earth in our Solar System gives Earth its unique characteristics for supporting life.

The Earth's moon revolves around the Earth as both go through space and revolve around the Sun. From Earth, our moon appears in a series of phases that repeats in a regular cycle. Since the rotational period of the moon is the same as its period of revolution around the Earth, the same side of the moon is always viewed from Earth. The moon, along with the Sun, have a great effect on the ocean tides around the Earth. The alignment of the Sun, Earth and Moon can produce shadows periodically on the Earth or Moon resulting in Lunar or Solar Eclipses.

Solar System

The Earth's north-south axis is tilted at an angle, as compared with the plane of its revolution around the Sun. The rotation of the Earth causes all parts of the Earth to experience periods of daylight and darkness. The revolution of the Earth around the Sun on its tilted axis along with its daily rotation causes varying lengths of daylight on the Earth's surface as well as changes in the directness and intensity of sunlight. This results in a yearly cycle of seasons for much of the Earth's surface.

Space exploration has allowed humans to learn much about the workings of the solar system, the composition of planet and moons, and the effects of many types of solar radiation on the Earth and its inhabitants. In preparing for the challenges of space exploration, people have developed many tools and products that have become very important in enriching our lives. Humans have traveled to the moon, landed probes on Mars and Venus, and sent probes speeding past Jupiter, Saturn and Uranus. More recently we have built an International Space Station, through the joint effort of many countries, to allow space to be studied continually. Scientists have learned much about the uniqueness of Earth and its place in our solar system. They have also learned that there are millions of galaxies in space, each containing solar systems.

National Science Education Standards	AAAS Benchmarks
<p data-bbox="176 282 533 311">Earth in the Solar System</p> <ul data-bbox="226 318 1024 1269" style="list-style-type: none"><li data-bbox="226 318 1024 483">• The earth is the third planet from the sun in a system that includes the moon, the sun, eight other planets and their moons, and smaller objects, such as asteroids and comets. The sun, an average star, is the central and largest body in the solar system.<li data-bbox="226 522 1024 652">• Most objects in the solar system are in regular and predictable motion. Those motions explain such phenomena as the day, the year, phases of the moon, and eclipses.<li data-bbox="226 691 1024 821">• Gravity is the force that keeps planets in orbit around the sun and governs the rest of the motion in the solar system. Gravity alone holds us to the earth's surface and explains the phenomena of the tides.<li data-bbox="226 860 1024 958">• The sun is the major source of energy for phenomena on the earth's surface, such as growth of plants, winds, ocean currents, and the water cycle.<li data-bbox="226 997 1024 1094">• Seasons result from variations in the amount of the sun's energy hitting the surface, due to the tilt of the earth's rotation on its axis and the length of the day.<li data-bbox="226 1133 1024 1269">• Direct observation and satellite data allow students to conclude that earth is a moving, spherical planet, having unique features that distinguish it from other planets in the solar system.	<p data-bbox="1054 282 1369 311">The Universe: Gravity</p> <ul data-bbox="1104 318 1902 415" style="list-style-type: none"><li data-bbox="1104 318 1902 415">• The sun's gravitational pull holds the earth and other planets in their orbits, just as the planets' gravitational pull keeps their moons in orbit around them. <p data-bbox="1054 480 1453 509">The Universe: Solar System</p> <ul data-bbox="1104 516 1902 1286" style="list-style-type: none"><li data-bbox="1104 516 1902 652">• The moon's orbit around the earth once in about 28 days changes what part of the moon is lighted by the sun and how much of that part can be seen from the earth—the phases of the moon.<li data-bbox="1104 717 1902 919">• Nine planets of very different size, composition, and surface features move around the sun in nearly circular orbits. Some planets have a variety of moons and even flat rings of rock and ice particles orbiting around them. Some of these planets and moons show evidence of geologic activity.<li data-bbox="1104 984 1902 1055">• The earth is orbited by one moon, many artificial satellites, and debris.<li data-bbox="1104 1120 1902 1286">• Telescopes reveal that there are many more stars in the night sky than are evident to the unaided eye, the surface of the moon has many craters, and mountains, the sun has dark spots, and Jupiter and some other planets have their own moons.

National Science Education Standards	
<ul style="list-style-type: none">• From activities with trajectories and orbits and using the earth sun-moon system as an example, students can develop the understanding that gravity is a ubiquitous force that holds all parts of the solar system together.• Energy from the sun transferred by light and other radiation is the primary energy source for processes on earth's surface and in its hydrosphere, atmosphere, and biosphere.	

NC Science SCS	Content Elaboration	Ideas for exploration	Web Resources
<p>5.01 Analyze the components and cycles of the solar system including:</p> <ul style="list-style-type: none"> • Sun. • Planets and moons. • Asteroids and meteors. • Comets. • Phases. • Seasons. • Day/year. • Eclipses. 	<p>The Solar System consists of:</p> <p>Sun Planets Moons Asteroids Meteors Comets Dust Gases Empty space</p> <p>Analyze the lifecycle of stars by studying and working with the Hertzsprung-Russell diagram.</p> <p>Investigate the relationship between revolution and rotation and how seasons occur.</p>	<p>Use <u>Solar System Trivia</u> to access prior knowledge</p> <p><u>Solar System Mnemonic Phrases</u></p> <p>Watch: The Magic School Bus Gets Lost in Space</p> <p><u>Travel Through the Solar System (Tri-fold brochure)</u></p>	<p>www.nasa.gov/vision/universe/solar_system/newplanet-072905.html</p> <p>http://www.windows.ucar.edu/tour/cool_stuff/tourstars_1.html</p> <p>Great site for star life cycle.</p> <p>http://hyperphysics.phy-astr.gsu.edu/hbase/hph.html Background information for teachers with concept maps of light, sound and astrophysics</p> <p>http://www.spacegrant.hawaii.edu/class_activities—good site for teachers and students as well</p> <p>http://www.solarviews.com/eng/homepage.htm Fantastic site for students to research about planets, meteors, asteroids, history of space, astronomers, data bases, etc.</p> <p>http://www.smv.org/jims/unit.htm</p> <p>Wonderful site about stars.</p> <p>http://library.thinkquest.org/3645/page2.html</p>

NC Science SCS	Content Elaboration	Ideas for exploration	Web Resources
<p>5.02 Compare and contrast the Earth to other planets in terms of:</p> <ul style="list-style-type: none"> • Size. • Composition. • Relative distance from the sun. • Ability to support life. 	<p>Using Earth as the standard for comparison, have students compare and contrast each planet to Earth. Use criteria such as:</p> <ul style="list-style-type: none"> Revolution Rotation Distance from sun Distance from Earth Angle of inclination Composition Mass Circumference Diameter Satellites <p>Evaluate the effects of these criteria on each planet.</p>	<p><u>Solar System Scale Model</u></p> <p>Project Astro— see website</p>	<p>This site is comprehensive for this goal. Good for both students and teachers.</p> <p>www.comics.com/shortcuts</p> <p>Great for creating accurate comics about the solar system.</p> <p>http://www.enchantedlearning.com/subjects/astronomy/</p> <p>Great site to obtain basic to complex data on astronomy and activities too.</p> <p>http://pds.jpl.nasa.gov/planet/welcome.htm A good site to find some good general information on planets. A really good site to find out about some of the satellites we have released for exploration purposes.</p> <p>http://www.jpl.nasa.gov/ NASA Jet Propulsion Lab site great for current happenings and how things work in space.</p>

NC Science SCS	Content Elaboration	Ideas for exploration	Web Resources
<p>5.03 Relate the influence of the sun and the moon's orbit to the gravitational effects produced on Earth.</p> <ul style="list-style-type: none"> • Solar storms. • Tides. 	<p>The Earth's moon revolves around the Earth as both go through space and revolve around the Sun. From Earth, our moon appears in a series of phases that repeats in a regular cycle. Since the rotational period of the moon is the same as its period of revolution around the Earth, the same side of the moon is always viewed from Earth. The moon, along with the Sun, has a great effect on the ocean tides around the Earth. The alignment of the Sun, Earth and Moon can produce shadows periodically on the Earth</p>	<p><u>Why study the Sun?</u></p>	<p>http://www.astrosociety.org/education/activities/activities.html</p> <p>Link to Project Astro-great workshop.</p> <p>http://www.ncsu.edu/sciencejunction/station/gameroom/leclipse/index.html lunar eclipse site</p> <p>www.comics.com/shortcuts Great for creating accurate comics about the solar system.</p> <p>http://images.jsc.nasa.gov Images from Yohkoh Mission to the sun</p> <p>http://earth.jsc.nasa.gov/ Astronauts' Views of the Earth</p> <p>http://stardate.utexas.edu</p> <p>http://www.osf.hq.nasa.gov/welcome.html</p> <p>Visit often! This site thrives on current events and is constantly</p>

NC Science SCS	Content Elaboration	Ideas for exploration	Web Resources
	<p>or Moon resulting in Lunar or Solar Eclipses.</p> <p>The Earth's north-south axis is tilted at an angle, as compared with the plane of its revolution around the Sun. The rotation of the Earth causes all parts of the Earth to experience periods of daylight and darkness. The revolution of the Earth around the Sun on its tilted axis along with its daily rotation causes varying lengths of daylight on the Earth's surface as well as changes in the directness and intensity of sunlight. This results in a yearly cycle of seasons for much of the Earth's surface.</p>		<p>updated. If you are looking for the latest information on both human and unmanned space flights-this is the place to go!</p> <p>http://nssdc.gsfc.nasa.gov/planetary/planetary_home.html</p> <p>do not be fooled by its name! While "space date" implies dry, technical stuff, this site is packed with easy – to-find and easy-to-read facts on all of NASA's planetary and lunar information. If you need a space fact or photo, this is the place to start!</p> <p>http://seds.lpl.arizona.edu/nineplanets/nineplanets.html http://128.165.1.1/solarsys/homepage.html</p> <p>These sites are SO GOOD! Every teacher needs a handy Solar System reference, and here are two. Wonderfully organized and loaded with exactly the type of information students and teachers need!</p>

NC Science SCS	Content Elaboration	Ideas for exploration	Web Resources
<p>5.04 Describe space explorations and the understandings gained from them including:</p> <ul style="list-style-type: none"> • N.A.S.A. • Technologies used to explore space. • Historic timeline. • Apollo mission to the moon. • Space Shuttle. • International Space Station. • Future goals. 	<p>Investigate and develop a timeline that links space exploration to technologies created.</p> <p>Predict what may be explored in the future. What would we hope to learn?</p> <p>Learn about space junk- where does it come from? Is it a problem?</p> <p>Investigate how satellites work? Who is the primary user of satellites? What kind of data do we get from satellites?</p>	<p>Conduct the electronically available activity Why Do We Explore? at http://ares.jsc.nasa.gov/Education/activities/destmars/destmarsLes6.pdf</p> <p><u>Design a lunar city or an International Space Station.</u></p>	<p>http://spacelink.msfc.nasa.gov</p> <p>The primary NASA education website offers educational materials, software, and images on aerospace topics.</p> <p>http://mpfwww.jpl.nasa.gov</p> <p>Mars Pathfinder</p> <p>http://oposite.stsci.edu/pubinfo/edugroup/educational-activities.html</p> <p>Hobnob with the Hubble team. This site is packed with picture galleries, background information, and lots of educational opportunities, including Amazing Space, the Hubble team's set of web-based activities. Some sections even have pop quizzes.</p> <p>http://jpl.nasa.gov/missions/</p> <p>JPL Mission Home Page Directory</p>

NC Science SCS	Content Elaboration	Ideas for exploration	Web Resources
<p>5.05 Describe the setting of the solar system in the universe including:</p> <ul style="list-style-type: none"> • Galaxy. • Size. • The uniqueness of Earth. <p>5.06 Analyze the spin-off benefits generated by space exploration technology including:</p> <ul style="list-style-type: none"> • Medical. • Materials. • Transportation. • Processes. • Future research. 	<p>Scientists have learned much about the uniqueness of Earth and its place in our solar system. They have also learned that there are millions of galaxies in space, each containing solar systems.</p> <p>Investigate the products, industries, and technologies that evolved out of space exploration.</p> <p>Have students decide which spin-off is most important. Have students generate advertising campaigns to “sell” the significance of the chosen technology, service, or product.</p>	 <p>Choose two spinoffs and describe how your life would be without them! Write this in your science journal.</p> <p>Video: <u>October Sky</u></p>	 <p>http://nctn.hq.nasa.gov/success/index.html</p> <p>Spinoffs from the Space Shuttle Program</p> <p>http://www.challenger.org</p> <p>In addition to links to the sites below, this website has downloadable worksheet – quality classroom activities, called Lesson Launchers, as well as great links, space clipart, news and information about our educational simulation programs.</p>

6th Grade
Middle School Support Document
Solar System

NC Science SCS	Content Elaboration	Ideas for exploration	Web Resources
			<p data-bbox="1459 272 1801 305">http://www.spaceday.com</p> <p data-bbox="1459 342 1923 477">On the official Embrace Space web site, you will find snazzy graphics, fun space facts, and electronic postcards to send friends.</p>

Solar System Trivia

1. Why is Mars red?
2. What causes a solar eclipse?
3. Which planet rotates on its side?
4. How many large groups of rings does Saturn have?
5. Name the 5 planets located beyond the asteroid belt?
6. How much of the Earth is covered with water?
7. Is the sun a planet, a star or comet?
8. Where is the Oort Cloud?
9. Where would the biosphere be found?
10. Why does Mercury have craters?
11. Which planet was once thought to be two planets?
12. Which planet is closest to the sun?
13. Which planets have rings?
14. Which planet is big in total size but has a small core?
15. What keeps the planets in orbit around the sun?

Solar System Trivia

16. Why is Pluto different from the other planets?
17. What planet is the hottest in our solar system?
18. How many planets are made of gas?
19. Name the inner planets.
20. What is the largest star in our solar system?

Solar System Trivia Answers

1. The reddish color is from the rocks that contain iron.
2. The moon casts a shadow on the Earth.
3. It is Uranus.
4. There are 7 large groups.
5. Jupiter, Saturn, Uranus, Neptune, and Pluto are the 5 outer planets.
6. Three quarters of the Earth is covered with water.
7. It's a star.
8. It is found beyond Pluto.
9. It is found in the lower part of the atmosphere, all of the hydrosphere, and the upper part of the lithosphere.
10. It has a thin atmosphere that can't burn up meteors.
11. It is Mercury.
12. It is Mercury.
13. Jupiter, Saturn, Uranus, and Neptune have rings.
14. Jupiter has a small core and has a thick layer of gas around it.
15. It is gravity that hold the planets in place.
16. It is made of rock and the others are gas planets.
17. Venus is the hottest planet.
18. There are 4 planets made of gas.
19. Mars, Earth, Venus and Mercury are the inner planets.
20. The largest star in our solar system is the sun.

How did you do? Rate yourself—

20 right..... "Solar System Super Star"

15-19 "You've Got Solar Power"

10-14 "Rising Rocket"

5-9 "WATCH OUT, an asteroid is in the way!"

1-4 " You are flying into the Sun"

0 right..... " Improvement Scientist"

Solar System Mnemonic Devices

Engage:

What is the correct order of the planets from the Sun?

1. Provide students with a brief overview of the Solar System including the Sun, planets, moon, asteroids, and comets. Use audio/visual materials or text materials for this overview.
2. Describe the meaning of the word, "Mnemonic". It is a method used to help a person memorize a list of information in a particular order. For example, one common mnemonic for remembering the order of the planets from the Sun is My Very Educated Mother Just Served Us Nine Pizzas whereby the first letter of each word represents the first letter of the names of the planets in order from the Sun. another example of a mnemonic is CAMPS, which represents the main objects in the solar systems. (Comets, Asteroids, Moons, Planets, Stars)
3. Have students brainstorm other examples of mnemonics that could help them remember facts or things.

Explore:

What is a mnemonic that can help to remember the order of all objects in the Solar System including the Sun, each of the planets, asteroids and comets?

1. Establish teams of three to five students. Each team is to design a chart that would help them create a mnemonic of the objects in the Solar System in order. Assign a recorder, reporter, and a mediator for each team.
2. Student teams should use available texts, websites or computer software to help with the activity.
3. Make sure that each student team completes their chart with the proper order of the objects.
Note: Asteroids are typically found between the orbits of Earth and Mars. Comets are typically found beyond the orbit of Pluto.
4. Have the reporter for each team shares their favorite mnemonic with the class.

Evaluate:

How well did the team of students work together.

Was every one involved in the activity?

Could the team explain why they used certain words?

Travel through the Solar System

Engage:

How would you go about promoting a tour to a location within the Solar System?

In cooperative groups or individually, have students design a travel brochure or booklet for one of the nine planets, the Sun, or the asteroid/meteoroid belt.

Brochure/booklet should include:

- Travel brochure talk, to make it sound like an ideal vacation spot
- Brief history of the exploration of the location by astronomers and/or satellites/probes
- Description of attractions and lodging
- Drawing or portrait of a “creature” tourists may see and a written description of this creature
- The kinds of activities or sports tourists can participate in
- Details about the planet including distance from Earth, length of day and year, temperatures, atmosphere, terrain, size comparison to Earth’s a person’s weight at the location compared to it on Earth, etc
- Method of travel to location and itinerary of a typical tour
- How travel agency will ensure safety of tourists
- Limitations/restrictions that tourists should know about
- Websites or other resources to find out more about the location
- A special theme or gimmick to get people to want to come

If students are placed in cooperative groups, assign “experts” in the professions of Astronomer, Meteorologist, Geologist, Biologist, and Historian. See table for information each “professional” should collect. Add or delete topics as you see necessary and combine “professions” as needed.

Variations on this “travel” theme can be used to suit the teacher and student needs. One variation could be to let the teams select three objects in the Solar System and create a “tour package” for potential vacationers. For example, the tour could go from Earth to the ISS, to Mars, to Jupiter, Saturn, back to the ISS, and back to Earth. The “tour package” would include similar items in the example above but could be modified to include more details such as the types of space suits needed, the activities on board the space craft, the speed and time of flight between the stops, type of shopping or store on the planets, etc.

Travel through the Solar System

Explain/Elaborate

1. Bring examples of travel brochures and booklets to class and allow the students time to look through them and discover some of the major points of a good brochure/booklet.
2. List ideas of students on the board or overhead.
3. Discuss with the students an example of a location in the Solar System that could be described in a brochure. Use Earth as an example. List major "topics" that they identify on the board/overhead.
4. If students are to be placed in groups, describe the different "professions".
5. Discuss the "limitation" of a Solar System tour...time to get to the locations, hazardous atmospheric conditions, providing food and shelter, etc
6. Allow the students to create their brochure using computer software or any other means they select.
7. Student/cooperative teams should develop a "presentation" to be given to the class regarding their work.

Evaluate

1. Evaluate the data collected by each "professional".
2. Evaluate each student's work within the team.
3. Evaluate the work of the team with regards to their brochure/booklet.
4. Evaluate oral presentations.

Could set up a rubric for the student or cooperative teams to follow! Use the Strategies booklet page _____.

See Planet Data Table—Student Travel Brochure!

Travel through the Solar System

Planet Data Table Student Travel Brochure

Astronomer

Category	Earth	Planet _____
Diameter		
Distance from Sun		
Rotation Period		
Revolution Period		
Number of Moons		

Meteorologist

Category	Earth	Planet _____
Atmospheric Gases		
Wind		
Temperature		
Precipitation		
Unique Features		

Travel through the Solar System

Geologist

Category	Earth	Planet _____
Surface Features		
Materials		
Processes that shape the planet/object		
Wind		
Water flows		
Impacts		
Volcanoes		
Landslides		
Tectonics (quakes)		

Historian

Category	Earth	Planet _____
Discovery		
Reconnaissance satellites		
Probes		

Biologist

Category	Earth	Planet _____
Evidence of water		
Evidence of oxygen		
Evidence of carbon		
Evidence of possible life locations		

Adapted from NASA

Solar System Scale Model

Engage

Ask this essential question—How does the Earth compare in size and distance from the Sun with other planets of the Solar System?

1. Briefly provide an overview to students regarding the Solar System and its components. You may wish to preview the mnemonic phrases from the previous activity. Use whatever you have to give the students an idea of the relative sizes of the planets.
2. Discuss with the students the fact that the sizes and distances of many of the objects in the Solar System are so large as to be inconceivable. For example, if a spacecraft traveled from Earth to Mars at the speed of a jetliner (600mph), it would take more than 12 YEARS just to get there! For a similar trip to Saturn it would take nearly 15 YEARS. Most spacecraft actually travel through space at a speed of about 25,000 mph and, even then, a trip to Mars would take nearly a year. The Moon is about 250,000 miles from Earth. How long (hours and days) does it take a spacecraft to reach the Moon? You may wish to show students how these times are determined and let them practice making their own calculations. Time=distance divided by speed.
3. Have students research the actual distance and sizes of the Sun and planets and record their data in the student data table provided. You may have them record the information in metrics or English units of measure. It is not necessary to find “exact” numbers. Many sources do not have the same numbers for the values and it is not important in this particular activity. A completed data table is provided for teacher reference. At this point, students only need to complete the size and distance parts of the data table. Using the data collected, a meter stick, string, and markers, students (groups of 3 to 5) will begin to create their scale model of the Solar System based on distances from the Sun. **The scale being used in this activity is 1:1,000,000,000.** This scale means that every **inch** along the string represents 10 billion **miles**. Or every **meter** along the string represents 10 billion **kilometers**. You may wish to review the use of “scale” on road maps during discussion.
4. Have the students calculate the scaled distance to each of the planets. For example, the distance to Mercury is about 58 million kilometers (58 billion meters). Using the scale of 1:10,000,000,000, the distance represented on the scale model for Mercury would be 5.8 meters from the sun. You may wish to round off to 6 meters.
5. Once the students have completed the scaled distances, take them to a football field or a large area to have them measure off the distances for each planet. Mark the place that would represent each planet. You can have the students practice “pacing” to get an idea of how far a meter is and use pacing to get the measurements needed on the scale model. Don’t worry, you are going to run out of room in creating your scale model. Students are going to discover that the distance to the outer planets, especially Pluto is a challenge to see even with a scale model. **What about the new 10th planet just discovered?**

Solar System Scale Model

- Using the same scale (1:10,000,000,000), students will complete the data table to find the measurement to represent the diameter of the Sun and the planets. You may wish to use millimeters, centimeters or inches for this scale. For example, the actual diameter of Earth is about 12,756 km. Using a 1:10,000,000,000 scale, the scale size of Earth would be 12,756 km. Using a 1:10,000,000,000 scales, the scale size of the Earth would be 1.27 millimeters or, rounded off to about 1.3 mm. Remember, 12, 756 km is 12,756,000,000 millimeters.
- Have student construct models that would represent each of the planets and the Sun that is based on the scale used. They can draw circles of the correct size on a note and then add some interesting facts about the planet. Students can place the cards in the proper position along the string. Again, remember that, even using this scale, you may not have the room to represent all planets.

Explain/Elaborate:

Questions and answers are given

- Where and what size would the Moon be on your Solar System model?
It would be about 38 mm from Earth and about .3mm in diameter.
- The nearest star from us other than the Sun is 4.3 light years away and 1 light year is about 9.5 trillion km or 6 trillion miles. Using the scale you used for your model, how far would this star (Alpha Centauri Proxima) be from the Earth?
About 4,000,000 meters
- How do the distances between planets in the real Solar System change as they orbit the sun?
The planets have an almost circular orbit around the Sun. The planets closer to the sun move faster than the planets farther away. Therefore the distance between the planets is constantly changing. However, the distance to the Sun is almost the same. Pluto and Mercury have an "eccentric" (elliptical orbit around the Sun and their distance between the other planets and Sun varies more than all of the other planets.
- What are some reasons we did not include asteroids and comets on our scale model?
Asteroids and comets are much, much smaller than any of the planets or their moons. Had we tried to represent them on the scale model, they would have appeared smaller than the dots from a pencil. Also, there are thousands, if not more, asteroids and comets and the exact distances could not be determined or easily represented.
- A unit of measure that is often used to describe the vast distances between the planets and the sun is the **Astronomical Unit**. This is the distance between the Earth and the Sun. Its value is 93,000,000 miles or 150 km. How much space should be needed to make a scale model of the Solar System using a scale of 1: Astronomical Unit?

Solar System Scale Model

You would use the same process to calculate as with any of the other scales. Divide 3.6 billion miles (distance to Pluto) by 93 million and the result is about 39. Therefore, if the scale model is using 1inch=1 A.U., then the distance to Pluto would be represented by 39 meters from the Sun.

- Some comets originate in the Oort Cloud, a region beyond Pluto that is made up of very icy debris. This region is between 6 and 15 Trillion miles from the Sun. Using the 1:10,000,000,000 scale, approximately where on your scale model of the Solar System would you place the Oort Cloud? Explain.
Depending on the scale used (metrics or English), the answer will be a phenomenal distance. The answer should be in the order of 600,000 meters from the Sun on the scale model.

Evaluate:

1. Evaluate the Students' data tables and their group work. Find these at this website:
http://tes.asu.edu/Education/activities/93_94guide/cg93_94_solar_syst_scale.html
2. Answers to the Explain/Elaborate questions.
3. As a homework assignment, have students develop a scale model of the distances of the planet from the Sun that could be demonstrated in the classroom. This is an "open-ended" assignment that should allow students the opportunity to demonstrate their understanding of a scale model. They should provide the scale used on their model and be able to explain how they developed their model.
4. Have the students research the use of scale models in other areas such as automobiles, planes, buildings, boats, maps, etc. have them bring in examples.
5. Have the students create a scale model of Saturn, including its major rings.

Adapted from NASA, JPL and California Institute of Technology

Why Study the Sun?

Another possible source of climate change is our star—the Sun itself. The Sun's energy varies and could be modifying the chemistry and makeup of Earth's atmosphere.

The power of the Sun's energy is particularly visible when there are prominences, huge bright loops or arches of gas that are evidence of violent solar storms. Solar flares are another kind of storm, but they are much briefer. Although short, they are accompanied by increases in X-ray, gamma ray, and UV emissions by the Sun. Variations in the strength of the solar wind also reflect changes in the Sun's output of energy. The solar wind is a stream of high-energy particles released into space from the outermost layer of the Sun's atmosphere, the corona. The solar wind is capable of interfering with radio and telephone communications on Earth. Sunspots, which can be larger in area than Earth itself, are huge storms in the Sun's lower atmosphere, the photosphere. The Sun's atmosphere above sunspots emits strong streams of x-rays, but the Sun's total brightness decreases when large groups of sunspots appear on its surface.

All of these solar activities may affect Earth's climate, but we cannot know unless we study the Sun's energy over a long period of time. The best place to student the energy beaming from the Sun is in space, beyond the absorbing and reflecting effects of Earth's atmosphere. Scientists made some of their major discoveries about the Sun while occupying America's first space station, Skylab, in the 1970s. Researchers have continued this important work over the years and now pursue it with ATLAS 2 and the Upper Atmosphere Research Satellite, measuring the Sun's total energy output and comparing it with past measurements and future calculations. ATLAS 2 scientists also evaluate changes in the intensity of individual parts of the solar spectrum— particularly infrared, visible, and UV radiation—during this mission and others. (The solar spectrum is the range of energy emitted by the Sun).

Investigation A: Here, Spot.

While it is never safe to look directly at the Sun, sunspots can be viewed indirectly. Consult an almanac or other science reference books or websites to find out when sunspots are most likely to occur. During times of sunspots activity, try this experiment.

Materials needed:

- Paper plate
- Straight pin
- Sheet of white computer paper

Why Study the Sun?

Procedure:

Use the straight pin to make a hole in the center of the paper plate.

With your back to the Sun, hold the plate so that the sunlight can travel through the center hole.

Focus the light onto the white paper, creating a small image of the Sun.

It may be necessary to slowly move the plate toward and then away from the white paper until you obtain a clear image.

The spots on the Sun should be visible as small, dark areas on the focused image.

Evaluate:

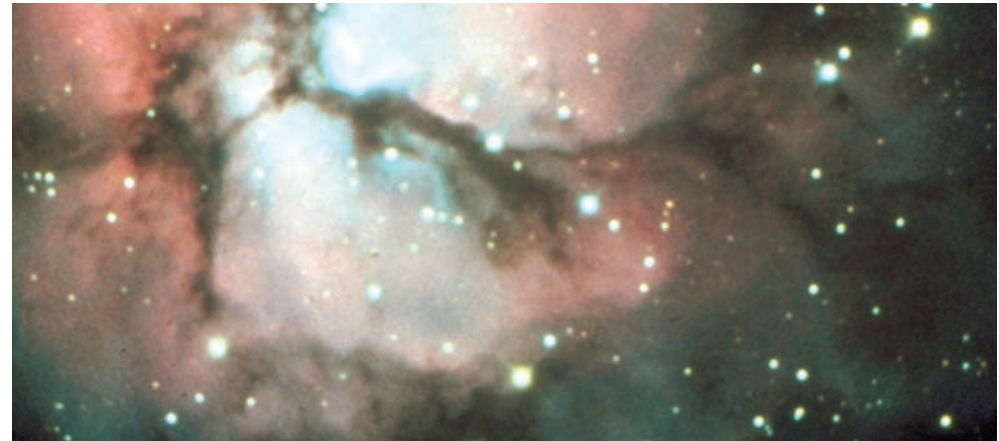
What other solar event might be visible using this method?

Adapted from NASA-- Atmospheric Detectives

Middle Grades Science

6th Grade Support Document

Goals 1, 2, and Energy Transfer/Transformation



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PUBLIC SCHOOLS OF
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Instruction

6th GRADE COMPETENCY GOAL 6

The learner will conduct investigations and examine models and devices to build an understanding of the characteristics of energy transfer and/or transformation.

BIG Ideas

**Energy Transfer/
Energy Transformation**

Heat flows through materials or across space from warm objects to cooler objects, until both objects are at equilibrium. Heat travels through solids, primarily by conduction. Heat is circulated in fluids, both liquids and gases, through the process of convection. Most fluids expand when heated, causing the volume of the fluid to increase but without changing the mass of the material in the fluid. Similarly, the cooling of fluids increases the density of a portion of a fluid causing it to contract and sink. This motion sets up circular convection cells in fluids due to these changes in density. These cells rotate and help change the temperature of the entire fluid.

Light is a form of energy emitted by the Sun as well as light-producing objects on Earth. Light can be absorbed or reflected by objects depending upon the properties of the object and the type and angle of light when it hits the object. Some materials scatter light and others allow light rays to pass through, but refract the light by changing its speed. The structure of the human eye can detect many colors in visible light that are reflected by objects.

Sound is a form of energy that is caused when vibrating materials produce waves that move through matter. These waves have different characteristics such as frequency and amplitude, which will determine the properties of sound such as pitch and loudness. The form of the human ear can receive sound waves as vibrations and convert them to signals that are processed by the brain.

**Energy Transfer/
Energy Transformation**

There are many forms of energy such as thermal, mechanical, light, sound, electrical, solar, chemical, and electromagnetic. Energy can not be created or destroyed, but only changed from one form into another. This means that the total amount of energy in a system stays the same. Energy conversion is never perfect and usually heat is released in the process.

Humans have learned to use these forms of energy in many ways to meet our basic needs and enrich our lives. Humans have developed many tools and instruments that detect the many forms of energy. These instruments help us understand the properties of materials which determine their suitability for technological design.

National Science Education Standards	AAAS Benchmarks
<ul style="list-style-type: none">• Energy is a property of many substances and is associated with heat, light, electricity, mechanical motion, sound, nuclei, and the nature of a chemical. Energy is transferred in many ways.• Heat moves in predictable ways, flowing from warmer objects to cooler ones, until both reach the same temperature.• Light interacts with matter by transmission (including refraction), absorption, or scattering (including reflection). To see an object, light from that object—emitted by or scattered from it—must enter the eye.• Electrical circuits provide a means of transferring electrical energy when heat, light, sound, and chemical changes are produced.• In most chemical and nuclear reactions, energy is transferred into or out of a system. Heat, light, mechanical motion, or electricity might all be involved in such transfers• The sun is a major source of energy for changes on the earth's surface. The sun loses energy by emitting light. A tiny fraction of that light reaches the earth, transferring energy from the sun to the earth. The sun's energy arrives as light with a range of wavelengths, consisting of visible light, infrared, and ultraviolet radiation.	<p>Structure of Matter: States of Matter</p> <ul style="list-style-type: none">• Atoms and molecules are perpetually in motion. In creases temperature means greater average energy of motion, so most substances expand when heated.• Energy appears in different forms. Heat energy is in the disorderly motion of molecules.• Energy appears in different forms.....Arrangements of atoms have chemical energy. <p>Motion: Waves</p> <ul style="list-style-type: none">• Light from the sun is made up of a mixture of many different colors of light; even though to the eye the light looks almost white. Other things that give off or reflect light have a different mix of colors.• Human eyes respond to only a narrow range of wavelengths of electromagnetic waves—visible light. Differences of wavelength within that range are perceived as differences of color.• Something can be “seen” when light waves emitted or reflected by it enter the eye—just as something can be “heard” when sound waves from it enter the ear.• Light acts like a wave in many ways. And waves can explain how light behaves.

AAAS Benchmarks

- Vibrations in materials set up wavelike disturbances that spread away from the source. Sound and earthquake waves are examples. These and other waves move at different speeds in different materials.
- Wave behavior can be described in terms of how fast the disturbance spreads, and in terms of the distance between successive peaks of the disturbance (the wavelength).

Flow of Matter and Energy: Flow of Energy in Ecosystems

- Most of what goes on in the universe...involves some form of energy being transformed into another. Energy in the form of heat is almost always one of the products of energy transformations.
- An important kind of reaction between substances involves the combination of oxygen with something else...as in burning or resting.

Design and Systems: Designed Systems

- Thinking about things as systems means looking for how every part relates to others.
- The output from one part from a system (which can include material, energy, or information) can become the input to other parts.

The Universe: Galaxies and the Universe

- Human eyes respond to only a narrow range of wavelengths of electromagnetic waves—visible light.
- Something can be “seen” when light waves emitted or reflected by it enter the eye.

NC Science SCS	Content Elaboration	Ideas for exploration	Web Resources
<p>6.01 Determine how convection and radiation transfer energy.</p>	<p>Convection is the transfer of thermal energy by the circulation or movement of liquid or gas. Radiation is the transfer of energy as electromagnetic waves.</p>	<p><u>Solar Cooker</u></p> <p><u>Lunch Box Test</u></p> <p>Use a convection tank to demonstrate. Link this concept with Goal 3 -- plate tectonics.</p>	<p>http://www.solarviews.com/eng/edu/convect.htm</p> <p>Nice site for teacher background.</p>
<p>6.02 Analyze heat flow through materials or across space from warm objects to cooler objects until both objects are at equilibrium.</p>	<p>Investigate how different materials conduct or insulate heat.</p> <ul style="list-style-type: none"> • Metals • Rubber • Glass <p>Relate phase change of matter to heating or cooling.</p>	<p>Melt Ice Heat water so it become a vapor Create a graph to show phase change.</p> <p><u>Smoke Rings</u></p>	<p>http://www.pbs.org/wgbh/nova/teachers/activities/2913_volcano.html</p> <p>This site isn't active but it does provide links to other NOVA websites.</p> <p>http://www.simplyscience.com/physicalslinks.html</p> <p>Wide variety of physical science concepts such as heat, light and sound.</p>

6th Grade
Middle School Support Document
Energy Transfer/Transformation

NC Science SCS	Content Elaboration	Ideas for exploration	Web Resources
<p>6.03 Analyze sound as an example that vibrating materials generate waves that transfer energy,</p> <ul style="list-style-type: none"> • Frequency. • Amplitude. • Loudness. • How sound travels through different material. • Form and function of the human ear. 	<p>Compare sound waves (longitudinal waves) to light waves (transverse waves).</p> <p>Energy will cause material to vibrate. These vibrations are carried as “waves” and transfer energy.</p> <p>Investigate how musical instruments work to control pitch and loudness.</p> <p>A sound wave is made up of compressions (place where matter is pushed together) and rarefactions (places where matter is spread out).</p> <p>Investigate the Doppler Effect.</p> <p>Investigate how sound travels through different solid materials.</p> <p>Compare and contrast how sound travels</p>	<p><u>Bump</u></p> <p><u>Waves</u></p> <p>Extension: Fill a large beaker with water. Set the beaker in the middle of a table. Ask the students to predict what will happen if you strike a tuning fork and put it into the water.</p> <p>Once students have contributed their ideas, strike the tuning fork to your heel and place the tines of the tuning fork just below the surface of the water. (Water will spray out-evidence that sound is energy and is capable of causing change).</p> <p>Challenge students to think of alternate ways to test how sound waves travel.</p> <p>Color and label the parts of the human ear! Textbook should have this in their transparencies.</p>	<p>http://physicsclassroom.com/Class/sound/U11L2a.html</p> <p>This is a great site for teachers. Food background information about the physics of sound.</p> <p>http://www.grc.nasa.gov/WWW/K-12/airplane/sndwave.html</p> <p>Great interactive site for studying the Doppler Effect.</p> <p>http://www.frontiernet.net/~imaginq/play_a_piano.html</p> <p>An interactive site for sound!</p>

6th Grade
 Middle School Support Document
 Energy Transfer/Transformation

NC Science SCS	Content Elaboration	Ideas for exploration	Web Resources
<p>6.04 Evaluate data for qualitative and quantitative relationships associated with energy transfer and /or transformation.</p>	<p>through different states of matter.</p> <p>Investigate how the ear works:</p> <ul style="list-style-type: none"> • Structure within the ear • Functions of those structures • Conditions that affect hearing <p>Energy is the ability to cause change.</p> <p>Change can be measured qualitatively by pitch, loudness, hot, cold, bright, dim etc quantitatively by speed, frequency, amplitude</p>	<p>Food web, chain or pyramid Refer back to Goal 4 Cycling of Matter</p> <p>Earthquake waves are a great way to study this concept</p>	

NC Science SCS	Content Elaboration	Ideas for exploration	Web Resources
<p>6.07 Analyze the Law of Conservation of energy:</p> <ul style="list-style-type: none"> • Conclude that energy cannot be created or destroyed, but only changed from one form into another. • Conclude that the amount of energy stays the same, although within the process some energy is always converted to heat. • Some systems transform energy with less loss of heat than others. 	<p>matter.</p> <p>Energy Conservation in a light bulb—some electrical energy is converted into light energy, some energy is converted into thermal energy, which makes the bulb feel warm and as electrical energy is carried through the wire, some of it is converted into thermal energy. This is a closed system so energy can change from one form to another but all of the different forms of energy in a system always add up to the same total amount of energy. It does not matter how many energy conversions take place.</p>	<p>science journal.</p> <p>Use the labs from this web site to help with the Law of Conservation of Energy</p> <p>Rube Goldberg devices</p>	<p>www.scilinks.org</p> <p>Click on Law of Conservation of Energy</p> <p>Developed and maintained by the National Science Teachers Association</p>

Solar Cooker

Engage

How would you cook a hot dog with radiant energy?

Explore

Gather these materials and create a design for the solar cooker!

2 sealed sandwich bags (3/4 full of rice, beans, or sand)

large, round oatmeal box with lid

white glue

cereal box top

2 paint stirrers

small saw

aluminum foil

scissors

stapler

hole punch

Teachers make these for safety sake!!

Procedure:

1. Make two cuts, just over halfway around the oatmeal box, about two centimeters from the bottom. Make sure the top and bottom cuts are parallel.
2. Slit the box from the middle of the top cut to the middle of the bottom cut. The sides of the box should open like the bay doors on the space shuttle.
3. Using the saw, cut the paint stirrers to 14 cm and staple them outside the "doors" to flatten and expose the doors to the sun. Start the staples from the inside.
4. Cover the inside of the box with aluminum foil, shiny side up. Avoid crinkling the foil as much as possible.
5. Cut two cardboard strips (3 cm x 10 cm) from the cereal box top. Punch three holes in the strips about 1.5 cm apart.
6. Glue the cardboard strips to the outside of the lid and bottom of the cooker. (See illustration for proper alignment).
7. Rest the cooker on two bags of rice, beans, or sand so it faces the sun.
8. Use the solar cooker.

Solar Cooker

Question: How does a solar cooker maximize sun rays to cook food?

Hypothesis:

Materials:

Solar cooker from previous page

Skewer (wood or metal)

4 hot dogs

plate

clock or timer

Caution: Use care when inserting skewer into hot dog.

Procedure:

1. Run the skewer through a hot dog. Insert the skewer into the lowest set of holes. Keep the cooker pointed toward the sun to efficiently use the solar rays.
2. Place another hot dog on a plate. Set the plate in the sun next to the cooker. This hot dog serves as the control (source of comparison, and helps determine if a hot dog left in the sun will cook without the aid of a cooker.
3. Time the experiment. When the experimental hot dog in the cooker is done, it will have beads of moisture on its surface.
4. Place another hot dog in the cooker using the middle holes. Time the experiment to see if the second hot dog cooks slower or faster than the first experimental hot dog.

Results and Conclusion:

- How long did it take the first hot dog to cook? _____ the second hot dog? _____ the third hot dog? _____ Which position was most effective? Why?
- Describe the condition of the control hot dog at the end of the same amount of time it took the experimental hot dogs to cook.
- Describe the role of the foil in harnessing the sun's solar energy.
- What part do you think air currents may have played in cooling the second hot dog? Why do you think commercially-sold solar ovens have glass covers?

Solar Cooker

- How did the results of the experiment compare with your hypothesis?
- Explain in some detail how you would improve/change the solar cooker if you were to rebuild it. Be sure to include a description of the materials and their effectiveness in harnessing solar rays

Adapted from Creative Teaching Press

Lunch Box Test--

Engage

Lucia brought her lunch to school each day. She wanted to see which lunch box was the best insulator. She wants to keep her cold food cold and her hot food hot. Heat transfer!

Explore

Design a controlled experiment to help Lucia pick the best lunch box.

Experiment

Determine and describe a procedure to find out whether lunch box A, B, or C, is the best insulator. Present your results clearly and completely. Leave the station as you found it.

Item Logistics

A. Materials

- 3 lunch box/bag samples: A, B, or C
- 6 thermometers
- 3 identical ice chests containing the same amount of frozen ice packs or covered dry ice
- hot plate or means to heat water
- ice cubes
- small zip bags
- timer
- lamp with 60 watt bulb
- ruler
- construction paper
- masking tape
- scissors
- graph paper

B. Projected student completion time: 45-60 minutes

C. Preparation: (including diagram and maintenance)—set up-collect materials, freeze ice packs

D. Space: a large table

Lunch Box Test

Elaboration

Students upon completion of this activity will be able to:

- State hypothesis
- List materials
- Clearly explain procedures
- Control variables
- Read and interpret temperature
- Organize and record information
- State conclusions based on results

Evaluation

Activity 1—Design an Insulated Lunch Boxes Student Record Sheet with graph. This can be done with Cooperative Learning Teams with a contest at the end for choosing the best one. This "chosen one" will be used as the class model for data collecting.

Adapted from Deborah Scherr-Freedman

SMOKE RINGS

Purpose: To observe the downward flow of cold colored water through warmer clear water.

Problem: How will the rings be observed?
What makes the rings?

Hypothesis: Student thoughts or team thoughts written down and discussed before the experiment.

Materials:

- 1 large-mouthed, clear, glass, quart jar
- red food coloring
- small baby food jar
- 6 – inch square of aluminum foil
- rubber band
- pencil
- 1 ice cube

Procedure:

- Place the ice cube in the baby food jar. Fill the jar with cold water.
- Fill the quart jar to within an inch of the top with hot water from the faucet.
- Remove the ice cube from the baby food jar. Add and stir in six to seven drops of food coloring.
- Cover the mouth of the baby food jar with aluminum foil. Use the rubber band to secure the foil around the mouth of the jar.
- Use the point of the pencil to make a small hole in the aluminum foil.
- Quickly turn the baby food jar upside down and hold it so that the hole is just beneath the surface of the hot water.
- Slowly and gently tap the bottom of the baby food jar with the eraser of the pencil or use your finger.

Results:

The cold colored water flows downward. The tapping causes the colored water to come out in spurts, producing smoke-like rings of color in the warm clear water.

Smoke Rings

Why?

Cold water weighs more than warm water because the cold water molecules are closer together. The molecules of water, like all matter, are spaced closer together when cold and farther apart when heated. The food coloring has little or no effect on the weight. Since the cold water is heavier, it sinks down through the lighter warmer water.

BUMP!

Purpose: To demonstrate the forward movement of wave energy.

Problem: How does a wave of energy move?

Hypothesis: Give time for the individual or team to discuss the problem and write down their thoughts.

Materials:

Book
6 marbles

Procedure:

- Lay the book on a flat surface such as a table or floor.
- Open the book and place 5 of the marbles in the book's groove. Push the marbles tightly together and position the group in the center of the book.
- Place the free marble about 1 inch (3cm) from the group of marbles, and thump it with your finger so that it moves forward and bumps into the end marble of the group.

Conclusion:

The thumped marble stops when it strikes the end marble, and the marble on the opposite end of the group moves away from the group.

Why? The thumped marble has kinetic energy (energy of motion). Upon contact, this energy was transferred to the stationary marble, which transferred it to the marble next to it. Each marble transfers the energy to the next marble until the end marble receives it and moves forward. Any one of the marbles would have moved forward had it not been blocked by another marble. Water waves appear to move forward, but actually only the energy is transferred from one water molecule to the next, and each water molecule remains in relatively the same place. Like the end marble, the water near the beach moves forward, there is nothing to hold it back.

WAVES

Purpose: To demonstrate the motion of water waves.

Materials: Slinky spring toy
Helper

Procedure:

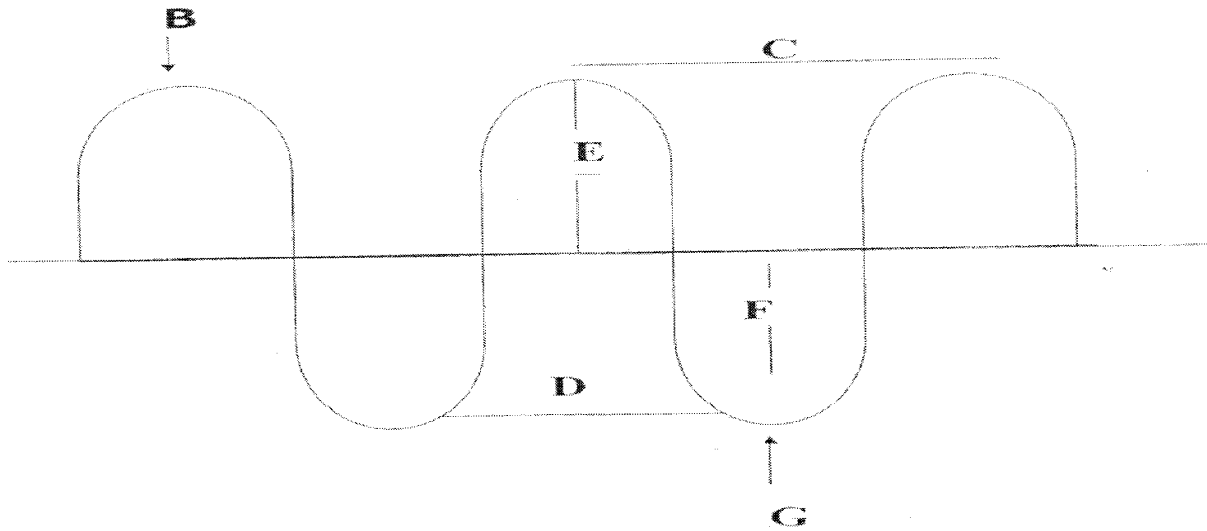
- Lay the Slinky on the floor.
- Stretch the slinky between you and your helper.
- Gently move one end of the Slinky back and forth several times.
- Change the speed of your back and forth movement by increasing and decreasing the distance that the end is moved.

Explain:

Up-and-down waves of motion move from one end of the Slinky to the other. The wave height increases with an increase in the distance that the end is moved. WHY? Waves that move up and down are called transverse waves. The high part of each wave is called the crest and the lowest part is called the trough. The movement of the Slinky is a flat version of how water waves look and move from one point to another. Waves move from one end of the Slinky to the other, but the material in the Slinky stays in relatively the same place. Water molecules, like the rings in the Slinky, move up and down, but they do not move forward. Only the energy of each wave moves forward.

EVALUATE:
Label the wave below:

- Crest
- Trough
- Wave length
- Frequency of the wave



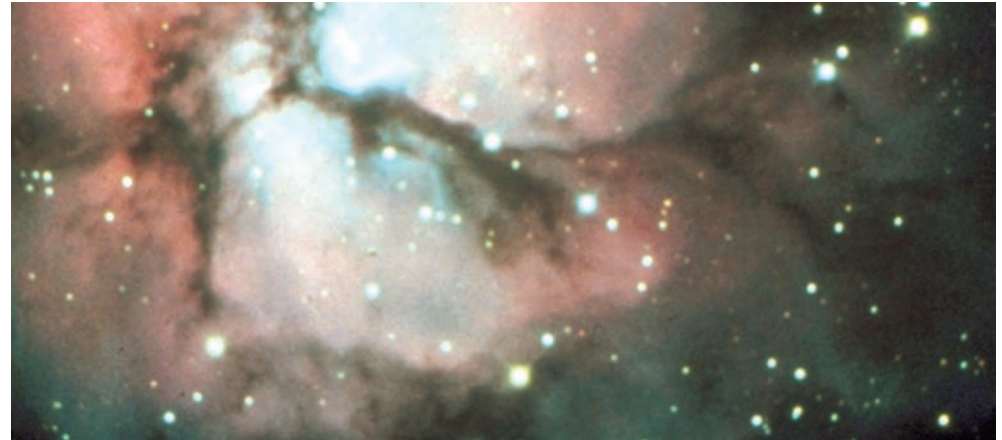
Colored Filters

1. Obtain four plastic filters—red, blue, yellow, and green.
2. Look through one filter at an object across the room. Describe the object's color.
3. Repeat step 2 with each of the filters.
4. Repeat step 2 with two or three filters together.
5. Why do you think the colors change when you use more than one filter?
6. Write your observations and answers in your science journal.

Middle Grades Science

6th Grade Support Document

Goals 1, 2, and Population Dynamics



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PUBLIC SCHOOLS OF
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6th GRADE COMPETENCY GOAL 7

The learner will conduct investigations and use technologies and information systems to build an understanding of population dynamics.

BIG Ideas

Population Dynamics

The earth is home to many different life forms, including plants, animals, humans, and other organisms. There is a high degree of interdependence among populations of organisms and the non-living components of their environments. These interactions may support a stable population, but often result in wide fluctuation of population numbers over time in natural environments. Many environmental factors such as varying amounts of heat, light, water, minerals, shelter, and food influence the growth and survival of individuals within a population.

Populations of various species co-exist within an ecosystem, often having to compete for limited resources of food, water, space, and shelter. Some species, however, have symbiotic relationships in which interactions benefit long-term survival of one or both species. The interconnectedness of populations means that change in one population within a community of living things often results in a change in others. Over population by any species has an impact on the environment.

Any change in living or non-living parts of a habitat has the potential to impact population numbers. Organisms within a species must be able to find sufficient resources to survive. As environmental conditions change due to natural events or human activities, it may be more difficult for organisms to maintain health and the ability to reproduce and sustain population numbers. Variation within species allows for those individuals with characteristics best suited to the new conditions to survive and reproduce and, over time, permits the survival of the species. A species that is not able to adapt to changing conditions will, over time, become extinct.

Organisms have survived and continue to live in a wide variety of conditions on the

earth. Physical and behavioral adaptations have enabled organisms to meet basic needs, even in environments with extremes of heat, light, moisture, soil type, and energy.

Human population has grown at a constantly increasing rate over the last two centuries. This booming population growth has resulted in changes in landscapes, oceans, and atmosphere that interfere with life-sustaining natural systems. These systems when out of balance endanger the survival of many plant and animal populations.

Growth in human population, especially in some parts of the world, has been a challenge to science and technology as the search for ways to keep up with the demand for basic needs of food, clean air, and water and the safe disposal of waste products continues. Depletion of limited natural resources used in manufacturing and transportation as well as the pollution and land degradation that occurs due to the removal of these resources is accelerated as human population and individual consumption of resources increase.

Over population by any species has an impact on the environment. Over population results when the long term ability to sustain quality of life is negatively impacted by the current population.

National Science Education Standards	AAAS Benchmarks
<p data-bbox="170 259 588 292">Populations and Ecosystems</p> <ul data-bbox="210 292 1029 1201" style="list-style-type: none"><li data-bbox="210 292 1029 422">• A population consists of all individuals of a species that occur together at a given place and time. All populations living together and the physical factors with which they interact compose an ecosystem.<li data-bbox="210 454 1029 730">• Populations of organisms can be categorized by the function they serve in an ecosystem. Plants and some micro-organisms are producers—they make their own food. All animals, including humans, are consumers, which obtain food by eating other organisms. Decomposers, primarily bacteria and fungi, are consumers that use waste materials and dead organisms for food.<li data-bbox="210 763 1029 828">• Food webs identify the relationships among producers, consumers, and decomposers in an ecosystem.<li data-bbox="210 860 1029 1023">• For ecosystems, the major source of energy is sunlight. Energy entering ecosystems as sunlight is transferred by producers into chemical energy through photosynthesis. That energy then passes from organism to organism in food webs.<li data-bbox="210 1055 1029 1201">• The number of organisms an ecosystem can support depends on the resources available and abiotic factors, such as quantity of light and water, range of temperatures, and soil composition.	<p data-bbox="1041 284 1470 316">Flow of Matter in Ecosystems</p> <ul data-bbox="1092 316 1911 1234" style="list-style-type: none"><li data-bbox="1092 316 1911 519">• All organisms, including the human species, are part of and depend on two main interconnected global food webs. One includes microscopic ocean plants, the animals that feed on them, and finally the animals that feed on those animals. The other web includes land plants, the animals that feed on them, and so forth.<li data-bbox="1092 552 1911 584">• One organism may scavenge or decompose another.<li data-bbox="1092 649 1911 747">• The cycles continue indefinitely because organisms are decomposed after death to return food materials to the environment.<li data-bbox="1092 779 1911 876">• Organisms that eat plants break down the plant structures to produce the materials and energy they need to survive. Then they are consumed by other organisms.<li data-bbox="1092 909 1911 1088">• Over a long time, matter is transferred from one organism to another repeatedly and between organisms and their physical environment. As in all material systems, the total amount matter remains constant, even though its form and location change.<li data-bbox="1092 1120 1911 1234">• Organisms get energy from oxidizing their food, releasing some of its energy as heat. Almost all food energy comes originally from sunlight.

National Science Education Standards	AAAS Benchmarks
<ul style="list-style-type: none">Given adequate biotic and abiotic resources and no disease or predators, populations (including humans) increase at rapid rates. Lack of resources and other factors, such as predation and climate, limit the growth of populations in specific niches in the ecosystem. <p>Diversity and Adaptation of Organisms</p> <ul style="list-style-type: none">Millions of species of animals, plants, and microorganisms are alive today. Although different species might look dissimilar, the unity among organisms becomes apparent from an analysis of internal structures, the similarity of their chemical processes, and the evidence of common ancestry.Biological evolution accounts for the diversity of species developed through gradual processes over many generations. Species acquire many of their unique characteristics through biological adaptation, which involves the selection of naturally occurring variations in populations. Biological adaptations include changes in structures, behaviors, or physiology that enhance survival and reproductive success in a particular environment.Extinction of a species occurs when the environment changes and the adaptive characteristics of a species are insufficient to allow its survival. Fossils indicate that many organisms that lived long ago are extinct. Extinction of species is common; most of the species that have lived on the earth no longer exist.	<ul style="list-style-type: none">One of the most general distinctions among organisms is between plants, which use sunlight to make their own food, and animals, which consume energy-rich foods. <p>Evolution of Life: Natural Selection</p> <ul style="list-style-type: none">Changes in environmental conditions can affect the survival of individual organisms and entire species.In all environments...organisms with similar needs may compete with one another for resources, including food, space, water, air, and shelter.In any particular environment, the growth and survival of organisms depend on physical conditions.

NC Science SCS	Content Elaboration	Ideas for exploration	Web Resources
<p>7.01 Describe ways in which organisms interact with each other and with non-living parts of the environment:</p> <ul style="list-style-type: none"> • Coexistence/Cooperation/Competition • Symbiosis. • Mutual dependence. 	<p>Investigate, compare and contrast, and then describe a variety of symbiotic relationships in different ecosystems both globally and locally.</p> <p>Students will be able to explain how non-living components in an ecosystem contribute to the various interdependent relationships</p> <p>Plant and animal communities exhibit an intricate web of interdependence with one another and with the non-living parts of an ecosystem.</p>	<p>NC Wildlife Resources</p> <ul style="list-style-type: none"> • NC Wild Places • NC Wildlife Profiles • Project Wild Activities “Good Buddies” <p>Research blending such as when a chameleon changes color to match its surroundings.</p> <p><u>Balanced Systems and their Disruptions</u></p>	<p>www.mbgnet.mobot.org</p> <p>www.ncwildlife.org/pg07_WildlifeSpeciesCon/pg7b2.htm</p> <p>http://www.mbgnet.mobot.org/</p> <p>www.ncwildlife.org/pg07_WildlifeSpeciesCon/pg7b2.html</p> <p>http://www.nhptv.org/natureworks/nwep12.htm</p> <p>Population dynamics lesson and links</p> <p>http://www.estuaries.gov/pdf/habitat.pdf</p> <p>This is a pen and pencil reading for information exercise. Good discussion questions.</p>
<p>7.02 Investigate factors that determine the growth and survival of organisms including:</p>	<p>Investigate the limiting factors that determine the health and viability of an ecosystem</p> <ul style="list-style-type: none"> • Climate-this is 	<p><u>Neighborhood Lab</u></p> <p>Build terrariums that simulate different conditions. Collect, compare, and</p>	<p>http://www.dnr.state.nd.us/education/growfromhere/LESSON4/LESSON4.htm</p>

NC Science SCS	Content Elaboration	Ideas for exploration	Web Resources
<ul style="list-style-type: none"> • Light. • Temperature range. • Mineral availability. • Soil/rock type. • Water. • Energy. <p>7.03 Explain how changes in habitat may affect organisms.</p>	<p>important as biomes are defined by climate</p> <ul style="list-style-type: none"> • Minerals and soils, Parent rock • Topography • Availability of shelter • Availability of food and water <p>All species are dependent on the resources within an ecosystem for survival and well-being. Humans have a greater capacity to shape and adapt to the physical environment than other species. This is one of the major causes of plant and animal species extinction.</p> <p>Compare and contrast how humans and nonnative invasive plants and animals can cause change in an ecosystem.</p> <p>Investigate and prepare</p>	<p>analyze data to determine which limiting factor has the most influence on the ecosystem.</p> <p>Discuss and document how terrariums and aquaria are models of ecosystems.</p> <p>Parts of the Whole List all the components of the ecosystem. Determine the impact of each component by asking the question, 'What would happen to the ecosystem if _____ were removed from the whole ecosystem? Have students make a matrix to track their thought and ideas. Student-designed experiments would provide an opportunity to investigate the Parts of the Whole ideas.</p> <p>Read <u>Silent Spring</u> by Rachel Carson <u>Lab: Literature, Science, Technology, and Society Connections of an Environmental Issue.</u></p> <p>Research the Rachel Carson</p>	<p>ON4/htm</p> <p>Nice model lesson. Produced by Maryland Department of Education.</p> <p>http://www.ncsu.edu/science/study/site/oldwebpages/oldindex.html</p> <p>This can implement this investigation and study virtually all of the objectives for Goal 7 and some of the objectives for Goal 4 and Goal 3.</p> <p>www.Rachelcarson.org</p> <p>www.achelcarsconcouncil.org</p> <p>http://www.epa.gov/bioindicators/aquatic/river-r.html</p>

NC Science SCS	Content Elaboration	Ideas for exploration	Web Resources
<p>7.05 Examine evidence that overpopulation by any species impacts the environment.</p>	<p>social and environmental effects of population growth in those countries are larger than many fast growing nations because of the individual consumption of resources.</p> <p>Over population by any species has an impact on the environment. Over population results when the long term ability to sustain quality of life is negatively impacted by the current population.</p> <p>Compare and contrast the effects of overpopulation of humans on the earth and plants and animals on an ecosystem. Are there any ecosystems that tolerate overpopulation? Explain your findings.</p>	<p><u>Sixty Billion People on Spaceship Earth...So What? Use Carton for lab!</u></p> <p><u>Kaibab Plateau Lab</u></p> <p>Engagement: What happens to the resources available to schools when schools become overcrowded?</p> <p>Brainstorm ideas and then link these ideas to our earth and individual ecosystems.</p>	<p>Great resource for teachers. It is suggested that teachers preview materials before assigning to students. Some publications are heavy with science language.</p> <p>www.populationconnection.org</p> <p>Excellent activities to help students gain perspective on this important milestone that occurred on Oct. 12, 1999 when world population reached six billion.</p> <p>www.worldpop.org/prbdata.html</p> <p>Great publications on population demographics</p> <p>www.dayof6billion.org/home.html</p> <p>What does a "world of 6 billion" really mean? Site includes maps and videos.</p> <p>http://www.ekcsk12.org/science/lelab/kaibablesson.htm</p>

NC Science SCS	Content Elaboration	Ideas for exploration	Web Resources
<p>7.06 Investigate processes which, operating over long periods of time, have resulted in the diversity of plant and animal life present today:</p> <ul style="list-style-type: none"> • Natural selection. • Adaptation 	<p>The degree of impact of a human population on finite resources depends on these equally important factors:</p> <ul style="list-style-type: none"> • Number of people and where they live • Methods of manufacturing goods, designing communities, and using technology • Actual amount of resources consumed per person. <p>Populations often grow exponentially, doubling over and over until a very small population becomes a very large one. As the time required for a population to double decreases population growth accelerates. Doubling time is a key indicator of population growth.</p>	<p>Have students design an organism with adaptations that would allow it to survive in conditions present on one of the other planets in our solar system or a lunar city.</p> <p><u>Learning for the Lorax</u></p>	

Balanced Systems and Their Disruption

Essential Questions:

How do organisms interact with one another and with the non-living parts of their environment?

Engage:

As a class examine a balanced system of living things. Students construct a collage using pictures of habitats, ecosystems, or biomes. Good sources include pictures from calendars, magazines, textbooks or trade books. Books like NC Wild Places provides pictures of NC habitats. They also provide pictures of biomes and ecosystems of the world. Research the web too.

Have student groups make lists of living and non-living parts of the systems they put in their collages. Access prior knowledge by having student groups brainstorm possible connections and interactions between the non-living and living things in a balanced and healthy system. Identify the following kinds of relationships: coexistence, cooperation, competition in the system. Look for and describe any symbiotic relationships. Classify them as mutualistic, parasitic, or commensal. Draw and describe special adaptation of organisms for survival in these systems.

Explore:

Prepare a ziplock bag for each group with 12 large nails and one larger nail driven into a small piece of wood. Ask each group to work on a flat surface and create a balanced system of the 12 nails that balances on the head of the nail in the wood. As students work offer hints to guide thinking if needed. Remind students that all parts of a system must work together and therefore nails cannot be placed one at a time on the head of the nail. Suggest that a system of the 12 nails be created first on the table and then lifted up and placed on the head of the nail in the block. Once groups have been successful in building a balanced system compare this balanced system to the earth's natural system. In both this system of nails and in natural systems of the earth various components or parts must interact and work together to achieve and maintain balance. Just as the nails form the balanced system on the head of the upright nail, systems in nature must demonstrate a similar balanced relationship between all of their components in order to thrive. This includes complex biological, chemical, and physical conditions and organisms, all interacting and dependent on each other for a balanced ecosystem.

Explain:

How does the system of nails balance?

Describe how all nails are "connected" and depend on other members of the system.

Balanced Systems and Their Disruption

Balanced Systems

Why are some nails more important to the system than others?
How could additional nails be added to this system?
What are some natural ecosystems?
What parts of an ecosystem might the nails represent?
What relationships exist between these parts of an ecosystem?
How might natural ecosystem become "unbalanced"?

Elaborate:

Have student groups research and prepare presentation for classmates on the balance of physical conditions and interactions of living things in selected habitats, ecosystems, or biomes.

Students work together to learn about the physical conditions, interesting plant and animal adaptations and interactions, and any looming threats to the existence or natural balance of living and nonliving components of this system.

The group designs visuals such as concept maps, illustrated poster using left over pictures from their collage, chart, etc. to record the conditions of temperature, moisture, soil quality and type, light, and other conditions that define the habitat, ecosystem, or biome being studied. Labeled drawings can be used to show examples of different types of relationships between organisms in the biome such as coexistence, cooperation and competition.

Each group member should select a different plant or animal from the habitat or ecosystem to research using the web or library resources to answer these questions:

- What makes this organism interesting and unique?
- What adaptations does this organisms have to survive in this environment?
- How is the organism connected to others in this environment?
- What advantages and disadvantages does the organism provide others?
- How would scientists classify this relationship?
- What might happen if the population of this organism increased or decreased dramatically?
- What factors might produce such a change in population numbers of this organism?
- What might happen if this organism were to become extinct?

Balanced Systems

Evaluate:

Groups share visuals which describe the defining characteristics of each environment studied. Individuals share visuals highlighting interesting plants and animals in the environment.

Summarize sharing by having class compare and contrast each of the environments studied. How were they all alike? How was each different from the others? What are some examples of interesting adaptations for low levels of heat, light, energy, moisture, or poor soil quality? What are some interesting adaptations for high levels of heat, light, energy, moisture, or poor soil quality? What are some common threats to populations of plants and animals in all these environments?

Neighborhood Meeting

1. Explore two or three blocks of your neighborhood. Could be a subdivision or farm. A **safety precaution** would be to take along an adult and explain why you are doing this research as you walk.
2. Draw a map of the area's biotic and abiotic features. For example, map the location of large trees, large shrubs, sidewalks, curb and gutter, and any animals you see, etc. **Remember--** to approach all plants and animals with caution. Plants could be poisonous and animals may not be friendly.
3. How are the biotic factors affected by the abiotic factors?
4. How are the abiotic factors affected by the biotic factors?

Literature, Science, Technology, and Society Connections of an Environmental Issue

Engage

Read Chapter 1 of *Silent Spring*

List some phrases that describe a Spring that is “not silent”.

List some phrases that describe a “Silent Spring”.

What does the author believe has brought on the “Silent Spring”?

Discuss content of this book which was very controversial when it was published but is now credited with bring the effects of pollution on all organisms to the general public.

Explore

Prepare materials:

- Large clear are (outdoors is ideal)

- Small paper squares (about 30 per student)

 - Two thirds should be white

 - The other one third another color or white with a colored marking.

- Plastic or paper bags (about 20 or enough for each grasshopper)

Begin by reviewing the concept of food webs, chains by playing the “Symphony of Nature”

- Select one student to be the sun and the conductor of this symphony!

- Divide rest of class into three groups.

 - Half should be “producers”

 - Quarter should be “consumers”

 - Quarter should be “decomposers”

- At a signal from their director, the sun, members of the symphony do their thing with each group shouting their name while making a suitable motion to represent their role as a producer, consumer, or decomposer. Discuss flow of energy through a food chain.

Regroup students. This time everyone will be a consumer in a food chain. Plan for 3 times as many shrews as hawks and 3 times as many grasshoppers as shrews. You might have 2 hawks, 6 shrews, and 18 grasshoppers. Each grasshopper gets a “stomach” (plastic or paper bag) in which to collect food (paper squares which are spread over the clear area).

As the simulation begins, grasshoppers are allowed to “feed” (collect paper squares) for 30 seconds. The hawks and shrews stand on the side and watch as the grasshoppers fill their stomachs (bags) with food (paper squares).

Literature, Science, Technology

The simulation continues as the shrews are allowed to hunt grasshoppers for 30 seconds. Any grasshopper caught by a shrew surrenders its food to the shrew and goes to the sideline.

The simulation continues for another 30 seconds as the hawks enter the area to feed on the shrews. Any shrew caught by the hawk must surrender all food bags to the hawk. Any surviving shrews may continue to hunt for grasshoppers during this 30 seconds.

Record data on a chart, List names of students, what organism each represented and whether it got eaten or not. Just as the survivors are celebrating their success, have them empty the food bags and count the number of white and multicolored food pieces collected. Add this information to the data chart.

At this point tell students that a farmer sprayed a chemical on the crop that the grasshoppers were eating. This pesticide was used to protect the crop from grasshoppers. This pesticide is poisonous and collects in the food chain. The multicolored food squares are tainted with this pesticide. Any surviving grasshopper with even one piece of multicolored food in the bag is poisoned by it even though it may have survived the shrews. Any shrews with half or more multicolored food squares is also poisoned by the pesticide. The hawk with the highest number of multicolored pieces will not die at this time. However, it has likely accumulated enough of the pesticide so that eggs produced by it and its mate may have shells so thin that the eggs will not hatch.

Explain

Draw and label a diagram to illustrate the food chain simulated in this activity.

Discuss how this activity shows how toxic substances can enter the food chain with unexpected and unintended results.

Why was it important for the farmer to use the pesticide?

What could happen to the populations of grasshoppers, shrews, and hawks over time if the farmer continued to use this pesticide?

Research the use of DDT and other pesticides and their effects on animal populations over time

Research and graph data on bald eagle populations in the US and NC over the last fifty years.

Research and write a new article summarizing the effect that Rachel Carson's book, Silent Spring, had on science, farming, and the politics of the environment.

Evaluate

A toxic pollutant is carried by runoff into a lake or stream in such small amounts that it is safe to drink the water. However, it may not be safe to eat the fish living in the lake or stream because the fish may have a greater concentration of the pollutant than the water does. Explain how this could occur and how it may affect humans. Draw and label a diagram to illustrate your answer.

Six Billion People on Spaceship Earth...So What?

Engage

Show cartoon "Table of 6 Billion, Please" (Copy of carton attached)

Ask student groups to

1. Describe what they see in the carton.
2. Is the cartoon "funny"? Why or why not?
3. List and describe any symbols used to get the cartoonist message across.
4. Explain what the cartoonist is trying to say to us.
5. How do you feel when you think about the issue the cartoon addresses?

Explore

Brainstorm a list of possible environmental, social, political, and economic effects associated with increasing world population. (Such as environmental diseases, contagious diseases, loss of forests, loss of farmland, sedimentation of streams, crowded living spaces, war, road rage, over fishing of seas, loss of wild places, pollution, inflation, endangered species, energy crisis, garbage, lack of health care, insecure urban life, loss of soils, traffic congestion, decreasing respect for human life, manufacturing and mining waste, etc)

How might increasing population be a "positive"?
(more creative "brain" power for problem solving)

Each student selects five effects (positive or negative) of increasing population that they feel would affect them directly and explains reasoning used in making each choice.

Explain

Student groups use information from brainstorming to create a web illustrating some effects (positive and/or negative) of increasing world population. (Adapted from "Everything is Connected", from People and the Planet)

Elaborate

Cooperative learning groups select and research the five effects (positive or negative) of increasing population that they feel will have the greatest impact on planet Earth in the future. Research each effect and justify choices with information related to environmental, social, political, and economic well being of the people of planet Earth.

Six Billion People

Find news and magazine articles that relate to issues of population growth. Compile summaries of articles. Include title, source, and date of article. Identify locale of article (industrialized or developing country), causes (population number, resource consumption, technology), effects (social, environmental, economic) possible solutions (population, resource consumption, technology) population connection (has an activity—"Six Billion Reasons", and graphic organizer for this type of media research.

Evaluate

Each student selects one effect of increasing world population with potential to have the greatest future impact on planet Earth. Share your most important research findings to support your choice in a one-page paper. Include these parts in your paper: definition of problem, causes, effects, and possible solutions. Use one of these formats to illustrate this effect:

- Editorial Cartoon, Billboard, or Bumper Sticker
- Radio Spot Announcement
- Song or Rap

Adapted from Population Connection



Kiabab Plateau—Story of Man’s efforts to “Help” the Deer Population

Essential Questions:

What are limiting factors in a system of living things?

How can changes in population affect the carrying capacity of an environmental system?

Background Information

An area’s carrying capacity is the number of a given species that an area can support without impairing its ability to continue supporting that population. Any resources that is finite and limits the size of a population is a limiting factor. Limiting factors affect the ability of living things to remain healthy and successfully reproduce to maintain stable populations over time. Things such as disease, predator-prey relationships, varying weather conditions form season to season, accidents, environmental pollution, and habitat destruction can be limiting factors.

Nature provides many examples of a population first exploding and then crashing when the carrying capacity is exceeded. There are also many examples of the actions of humans intentionally or unintentionally introducing changes in a habitat that affects the stability of species population.

An area is overpopulated when its long-term carrying capacity is being negatively impacted by its current population (human or otherwise)

Engage

Study limiting factors on changes in a deer population by taking students outside or to a large commons area. Assign students a number 1, 2, 3, or 4. One of these numbers will represent deer in the opening round of play. The others will represent either food, water, or shelter that deer need to survive.

Food is simulated by placing both hands over stomach.

Water is simulated by placing hands over chin.

Shelter is simulated by placing both hands on top of head.

Students representing food, water, and shelter begin play on the left side of the designated area. Each uses hands to simulate limiting factor of food, water, or shelter. Students should face away from the line of deer.

Deer begin play at the other side of the designated area. Each “deer” uses the symbol for food, water, or shelter to indicate the limiting factor for which they will search. These students should face away from the students representing food, water or shelter.

Kaibab Plateau

On signal, both lines turn to face each other. Limiting factors stand still. Deer run toward them and finds someone whose symbol matches what they have signaled a need for, takes the hand of that person and moves back to the “deer line”. Any limiting factor not needed or chosen by a deer as well as any deer not finding what it needs (it therefore dies) returns to the limiting factor line and becomes food, water or shelter for the next round of play.

It is important to record number of students who represent deer and the number who represent a limiting factor in the deer habitat at the beginning of the game and the beginning of each new round. After about 10 rounds of play, it is interesting to graph data using two different colored lines one representing the number of deer at the beginning of each round and the other the number of students representing limiting factors of food, water, and shelter. Analysis of data and patterns on the graph will build understanding of the relationship of limiting factors and changes in them to the growth or decline of a population in the wild.

Explain

Research man’s attempt to “help” deer population on the Kaibab Plateau in early 1900’s by killing off predators. Graph exploding deer population, followed by the resulting crash. Show carrying capacity of area for deer before and after the population swings! What limiting factors played a role in this drastic fluctuation in population of deer and reduction of carrying capacity for the area?

Evaluate

Research and report on other attempts by man to “improve” natural systems such as introducing kudzu and other non-native plant and animal species into an environment that produced unexpected results. Research other efforts that have successfully impacted or restored population numbers for endangered or threatened species such as the bald eagle, peregrine falcon, alligator, etc.

Adapted from Population Connection

Learning from the Lorax

Background Information

Technological progress, economic necessities, and population growth are sometimes at odds with preserving, protecting, and conserving environmental resources. Thoughtful reading and study of Dr. Seuss' book about the conflict between the Onceler and the Lorax as the Truffula forest is destroyed can spur student thinking about important choices we make in our daily lives!

Use these resources: Population Connection activity "The Lorax" or "The Continuing Adventures of the Truffula Tree Company" Science Scope, May 1995 for other excellent student activities to develop meaning and build concepts related to use, availability, and management of natural resources.

Essential Question

How can we balance quality of life with quality of the environment?

Engage

Read the Lorax (or view a video) by Dr. Seuss. Discuss issues of the use, availability, and management of resources from the perspective of the Lorax and the Onceler. Story is set in a beautiful woodland area. We witness its' destruction as economic demands lead to excessive use of natural resources and rapid population growth adds to environmental stress. This is, as many of Dr. Seuss' works are, a children's story with an important message to people of all ages if we read and ponder it's meaning and application closely!!!

Explore

Have one group of students consider how the Lorax feels, how it acts, and what it wants. Another group does the same thing for the Onceler. List issues related to technology, population, economics, and environment that ultimately destroyed the Truffula forest. Brainstorm what might be done differently in order to address these issues or needs yet produce a different and happier scenario.

Discuss all possibilities of outcome for the story from best to worst case scenarios. Challenge the Onceler and the Lorax groups to negotiate and work out the best outcome which they can agree on.

Explain

Share the best case scenario that each group of Oncelers and Loraxs come up with. What compromises, concessions, and mutual understandings were needed to balance the needs of the Onceler and the Lorax?

Learning from The Lorax

Have students or student pairs or groups use information from discussion and brainstorming to write a sequel to The Lorax that leaves both the Onceler and the Lorax happy because needs and dreams of both are satisfied.

Evaluate

Share sequels, thesaurus, and/or concept maps of ideas related to this book with emphasis on connections to environmental issues we face today.

Adapted from Science Scope and Population Connection