

# Agriculture in the Classroom for the Secondary Classroom



A collection of lessons and activities for the secondary classroom with a strong emphasis on middle school science with cross-curricular applications for social studies and mathematics.



# Table of Contents

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- 11 Is Enough
- All About Cycles
- Biodegradable Plastic
- Bitter Water Blues
- Bread In A Bag
- Bread Winner
- Clean It Up
- Dirty Water
- DNA Extraction
- DNASTrands
- Do I Eat That
- Earth's Water Distribution
- Farmer's Web
- Farming Through Time
- Got Sun
- Growing Sneakers
- Habitat Hula
- Hexagon Hives
- High Rollers
- Home Made Chiapets
- Human Traits
- Inspecting Virginia Pines
- Interactions Among Predator And Prey
- Is It A Test
- Jr Family Tree2
- Making Plant Based Dye
- Making Waves
- Mummifying Apples
- Nitrogen Cycle
- Photosynthesis Book
- Plant Secrets
- Potato Obstacle Course
- Proof is in the Water
- Reading Trees
- Round And Round The Water Goes
- Striking A Balance
- Sweet Lesson in Econ
- Testing Darwin
- There's What in My Watershed?
- Us Agriculture And The World Market
- Visualizing Chlorophyll
- Water, Water, Everywhere
- What Do Farmers Do
- What's Really In The Bowl
- What's The Rule
- What's Wind Go To Do With It
- Why Buy Dirt
- Will It Last



# 11 Is Enough

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## **Standards of Learning**

Science 6.1, 6.4

## **Objective**

Students will:

- Recognize that 11 major elements make up the majority of living things

## **Materials**

- Periodic Table
- 11 elements written on puzzle pieces
- 8 x 11 ½ paper preferably different colors

## **Background Knowledge**

All living things are created from elements. There are currently 118 elements. 92 are natural and 26 man-made. Of those, 11 elements are considered major elements because they predominantly occur in the earth's crust, living matter, oceans, and the atmosphere. These elements are silicon, aluminum, iron, sodium, calcium, potassium, magnesium, hydrogen, oxygen, nitrogen, and carbon. Share information from the periodic table with the class. Highlighting elements found in the earth's crust.

Silicon is essential to biology and is very important to the metabolism of plants. Aluminum is remarkable for its ability to resist corrosion due to the phenomenon of passivation and the metal's low density. Structural components made from aluminum and its alloys are very important in other areas of transportation and building. Its reactive nature also makes it useful as an additive in chemical mixtures. Iron is a vital constituent of plant and animal life and works as an oxygen carrier in hemoglobin. Sodium is vital in the manufacture of esters and in the preparation of organic compounds. The metal may be used to improve the structure of certain alloys, descale metal, and purify molten metals. Calcium serves as a life form for bones and shells. Calcium is able to keep bones healthy and strong by eating a lot of dairy products. Potassium is necessary for the function of all living cells, and is thus present in all plant and animal tissues. It is found in especially high concentrations in plant cells, and in a mixed diet, it is most highly concentrated in fruits. Magnesium is used for flashlight photography, flares, and pyrotechnics. The metal improves the mechanical, fabrication, and welding characteristics of aluminum when used as an alloying agent. Magnesium is also used in some medicines. Great quantities of hydrogen are required commercially for nitrogen fixation using the Haber ammonia process, and for the hydrogenation of fats and oils. It is also used in large quantities in methanol production. Other uses include rocket fuel, welding, producing hydrochloric acid, reducing metallic ores, and filling balloons. Plants, animals, and humans rely on oxygen for respiration. Hospitals frequently prescribe oxygen for patients with respiratory ailments. The nitrogen cycle is one of the most important processes in nature for living organisms. Bacteria in the soil are capable of "fixing" the nitrogen into a usable form for plants. Nature has provided a method to produce nitrogen for plants to grow. Animals eat the plant material where the nitrogen has been incorporated into their system, primarily as protein. Carbon is used in power plants and in the iron industry to make steel. Carbon is also used for jewelry and is a great conductor and is used for pencils and sports equipment.

## **Procedure**



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1. Quickly review the periodic table. There are currently 118 elements. 92 are natural and 26 man-made. Of those, 11 elements are considered major elements because they predominantly occur in the earth's crust, living matter, oceans, and the atmosphere. These elements are silicon, aluminum, iron, sodium, calcium, potassium, magnesium, hydrogen, oxygen, nitrogen, and carbon.
2. Show each one of the puzzle pieces and ask students where they have heard of the elements before. Example: Oxygen – we breathe it. You could then say you are correct, in fact there is 21% oxygen in the atmosphere and oxygen's symbol is O.
3. Put on the front of the booklet – 11 is enough, 2<sup>nd</sup> page O – oxygen, we breathe it and there is 21% in the earth's atmosphere.
4. After all 11 have been discussed, go back through the 11 elements and specifically direct students as to the importance of each element to a farmer. Example: during the nitrogen cycle, nitrogen is re-deposited into the soil which causes it to act as a natural fertilizer.
5. Ask the following discussion questions:  
Are there other elements that were not mentioned that would be especially useful to a farmer?  
Why do you think these elements were chosen as the top eleven elements?

### **Extension**

Instead of asking for immediate responses in #3, you could put students in groups and let them come up with ideas for the elements and where they are found that need to go in the book.



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# All about Cycles

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## **Standards of Learning**

Science 6.3, 6.8, 6.9, LS.6, LS.7, LS.8, LS.11, LS.12

## **Objective**

Students will:

- Develop an understanding that many different cycles operate in the environment
- Develop an understanding that cycles are continuous and repetitive

## **Materials**

- Blank transparencies
- Scratch paper
- Water cycle transparency
- Clean white sock
- Overhead marker
- Mud/Soil

## **Background Knowledge**

On Earth, there is a finite amount of matter available which is used over and over again. Matter is needed to sustain life and is dependent on this recycling. Energy is a necessary input for some steps of a cycle and is an output of other steps in a cycle. For example, sunlight causes evaporation and the synthesis of sugars and starches in plants, wind causes evaporation and erosion, and the increase or decrease in temperature or movement. Remember, when discussing cycles, to mention the need for energy to make cycles operate.

## **Procedure**

1. Place a clean, white sock in the front of the classroom, preferable hanging where students will see it and question its presence.
2. Discuss methods of how to dirty the white sock such as rub on ground outside, rub along a dirty floor or pour mud on it.
3. Choose a student to dirty the sock.
4. Discuss and/or write the process to clean the sock.
5. As a class, list the steps/stages/procedure the sock could go through to become clean.
6. Create a class diagram/illustration of the clean/dirty sock cycle.
7. Using the sock as a model, discuss the following:
  - Energy must be added to the cycle in order for it to operate.
  - One cycle may affect other cycles.
  - Matter from other cycles is often added/removed from the cycle being analyzed. For example, soap and water were added and removed from the sock cycle. Dirt is removed from one part of the sock cycle and added at another part of the cycle.
8. Create cooperative learning groups of approximately 3-4 students. Each group must have scratch paper available.
9. Using scratch paper, instruct groups to brainstorm examples of cycles found in the environment. Discuss results of brainstorm.
10. Have each group choose a different (complete) cycle and create an illustration of the chosen cycle (on the transparency sheet) to be shared with the whole class.
11. Have each cooperative learning group present illustration to the class.



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### **Extension**

- Use large pieces of bulletin board paper instead of overhead transparency sheets.
- Display cycle illustrations on a bulletin board or in the hallway highlighting SOL involved in cycle.
- Invite a farmer, professional launderer, recycling manager or compost expert to the classroom to discuss how nutrients are recycled in his/her operation.
- Examine cycles that are affected by chosen cycle. These cycles may precede or follow the chosen cycle.
- Examine how energy flows through various cycles.



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# Biodegradable Plastics

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## **Standards of Learning**

Science 6.1, 6.6, 6.7, 6.9, LS.4, LS.12

Math 6.9

## **Objective**

The student will

- provide examples of the states of matter and explain that corn may be used as a renewable resource.

## **Materials**

Cornstarch  
Water  
Corn Oil  
Zip-lock baggies (quart size)  
Measuring spoons  
Dropper  
Food coloring

## **Background Knowledge**

Corn is a versatile crop. It is grown in every county in Virginia. It not only is used for food but also for manufacturing. Today corn has over 200 different uses in manufacturing. Corn is used in cosmetics, crayons, wallpaper, leather, firecrackers, paper manufacturing, paper board, and pharmaceuticals. Another way corn is used is in packaging-think of all those packing peanuts. Some packing peanuts are made up of a biodegradable starch-based material that is renewable and easily dissolves in water.

## **Procedure**

1. Place tablespoon of cornstarch in a plastic zip-lock bag.
2. Add 2 drops of corn oil to cornstarch.
3. Add 1 tablespoon of water to the mixture.
4. Mix cornstarch, corn oil, and water in plastic bag by rubbing the outside with your fingers.
5. Add 2 drops of food coloring and mix again.
6. Place the bag in a microwave oven on high for 20-25 seconds.
7. Do not completely seal the bag. Careful, it is hot!

## **Extension**

- Have students record their observations as the plastic is hardening (include the day it was made and the next day.) Has the consistency changed?
- Have students place their "homemade plastic in water." How long does it take to disintegrate?
- Have students research other products made with corn (ex; corn syrup used in Coke, ethanol used in gasohol.)
- Have student discuss the life cycle and the parts of a corn plant.
- Have students discuss natural resources. What are the advantages of using renewable resources?



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# Bitter Water Blues

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## **Standards of Learning**

Science 6.1, 6.5, 6.7, 6.9, LS.1, LS.11, LS.12

English 6.1, 7.1

Social Studies USII.2

## **Objective**

Students will

- observe how ground water transports pollutants, and simulate ground water testing to discover the source of contamination.

## **Materials**

- 1 cup per group filled with sand
- 1 clear pan
- Water
- Misting bottle
- Grape-flavored powdered drink mix
- Lemonade-flavored powdered drink mix

## **Background Knowledge**

People believe that groundwater is safe and protected by layers of soils which must be permeated for water to enter the water table. Agricultural best management practices are geared to further reduce risk of water contamination.

The cycle of the Earth's water is continuous, carrying and spreading pollutants introduced by human activity all around. Intensive farming uses chemical fertilizers responsible for various forms of air and water pollution. Animal dung introduces large quantities of nitrate into the soil; the nitrate then filters into the water table. Certain underground gas tanks leak, discharging hydrocarbons into the water table. Pesticide residue is found in the water table and in watercourses; it makes water unfit for consumption. Wastewater leakage from a dwelling's underground tank contaminates the water table. Vast expanse of underground water fed by rainwater filtering through the earth; it supplies springs and can be collected in wells. Burying household waste without taking any particular precautionary measures leads to contamination of the water table. Untreated, it contains organic matter and potentially pathogenic substances that cause infection and promote the growth of algae. Pollution causes by leaks from refineries and offshore drilling platforms, by ships emptying their fuel tanks at sea and by oil spills. Radioactive nuclear waste was once immersed at the bottom of the ocean; it has a life span of up to 1,000 years. Industrial waste is highly variable; its principal components are lead, mercury, cadmium, hydrocarbons and acid deposits.

Use this experiment to introduce your class to how little contaminant is needed to affect water quality. Lead the class to explore what practices our society uses to protect our water supply. Bring forth examples such as demolishing old gas stations, landfills, suburban runoff, and agricultural factors. Consider making a plan to test for water quality and remedy unacceptable results.

## **Procedure**



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1. Poke small holes in the bottom of the cups and pass them out to small groups of students that you have formed (2-3 students per group)
2. Take three cups and add to one cup sand mixed with the grape-flavored powder, to the second add sand with lemonade flavored powder, and to the third add plain sand.
3. Have students make predictions as to whether or not their sand is polluted, by looking at it. Record their predictions on the board.
4. Have one student pour water into the cup and allow the water to filter through it into another container. Have students hypothesize what has colored the water.
5. Write the results on the board and compare, (see discussion questions 1-4)

Second half of experiment:

1. Prepare a tray with sand and bury a small amount of grape powder close to the top. (Make sure that you know where you buried it.) This represents buried contaminate.
2. Ask students to predict what will happen to the substance buried underground when it rains.
3. Represent years of rainfall by gently spraying the pan with water for 5-10 minutes or until the sand is saturated.
4. Lift the pan and show the bottom. A streak of purple should originate from the source and follow the flow of water as it filters downhill. Discuss with the students.

### **Discussion Questions**

- Have you ever heard of a situation where water in the ground got contaminated? And how was it contaminated?
- What are some ways that we pollute our water?
- Was it easy to determine which cups had pollutants? Can pollutants always be easily seen?
- What are some ways other than sight, which we can identify to determine if our water is in danger of pollutants? (Are there factories, farms, parking lots near by, does the water smell, water testing strips)
- How can we have an affect on our water supply? (What do we do that helps/or adds to pollution)
- What if a community well field or homes with private wells were pumping water from a contaminated area?



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# Bread in a Bag

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## **Standards of Learning**

Science LS.1, LS.12, PS.2

English 6.1, 7.1

Social Studies CE.1

## **Objective**

Students will:

- Learn how processing adds value to agricultural products by making bread in a bag

## **Materials**

- 4 cups flour (try whole wheat for increased nutrition)
- Warm water
- 2 tablespoons sugar
- 1 package of yeast (try quick rise)
- 2 teaspoons of salt
- 1 tablespoon of vegetable oil

## **Background Knowledge**

Nearly all agriculture products must be processed in some way before we can use them. Pork is processed into sausage. Wool is processed into sweaters and its lanolin into hand lotions. Timber is processed into furniture and lumber for construction.

Wheat is processed into bread, rolls, muffins, buns, cereals, crackers, spaghetti, macaroni, cakes, and cookies. Rollers scrape off the outer bran layer and break the endosperm of wheat. It continues through a series of rollers and sifters until it is fine enough for flour, and the bran and germ have been separated. For whole-wheat flour, the bran, and sometimes the germ, remains with the ground endosperm.

After it has been ground into flour, it goes through another stage of processing where it is mixed with other ingredients and baked into bread, other baked goods, or shaped into pasta. Each step of processing adds more value to the final product. For that reason, a product that has been processed is called a value added product. Consumers are willing to pay more for wheat when it is sold as bread than they would if it was sold as wheat kernels.

## **Procedure**

1. In a one-gallon (heavy duty) Ziploc bag, mix:
  - ½ cup of all purpose flour
  - 1 pkg. or 2-1/4 teaspoons of yeast
  - ½ cup warm water
  - 2 tablespoons sugar
2. Close bag and knead with fingers until the ingredients are completely blended.
3. Leave bag closed, with contents in the corner, and let the dough rest 10 minutes.
4. Then add:
  - 2 cups whole wheat flour
  - ¾ cup warm water
  - 1 tablespoon vegetable oil
  - 2 teaspoons salt
5. Mix well. Add enough all-purpose flour to make a stiff dough, about 1 or 1 ½ cups.
6. Close the bag and knead it (you may need to remove some air in the bag).



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7. Add more flour until the dough no longer sticks to the bag.
8. Let the dough rest for 5 minutes.
9. Open the bag and allow the dough to fall out onto clean or gloved (food handlers gloves) hands.
10. Spray the hands or gloves with oil so there will be no sticking.
11. Form the dough into a loaf, place in a loaf pan or onto a cafeteria cookie sheet. The dough will grow 1-1/2 times larger, so leave space between loaves if baking on a cookie sheet.
12. Allow to rise 30 (quick rise yeast) to 45 minutes.
13. Bake 30-35 minutes in a 350 degree oven.

### **Extension**

- Research man's use of wheat. (Hint: Ancient Egyptians are believed to be the first to bake leavened bread, but anthropologists speculate that primitive people probably first chewed the raw wheat kernel before they learned to pound it into flour and mix it with water to make porridge.)
- Have students grind wheat kernels to make flour. Measure the amount of flour produced. Compare and contrast how Indians and settlers ground flour and how it is done today.
- Discuss with students the difference between yeast bread and unleavened bread. Can they name other types of bread made with yeast?
- Have students generate a list of products that use wheat.
- Discuss with students the geographic regions in Virginia where wheat is grown.
- Have students sequence the planting and harvesting of wheat.
- Review parts of the wheat plant.
- Have students develop a dictionary of new words (kernel, yeast, leavened, unleavened etc.).
- Discuss the nutrients necessary for plants to grow.

This lesson adapted from Utah AITC.



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# Bread Winner

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## **Standards of Learning**

Science 6.1, 6.9, LS.1, LS.12, LS.14

English 6.1, 6.5, 6.6, 7.1, 7.8

Social Studies CE.1

## **Objective**

Students will:

- Conduct a scientific experiment
- Identify the steps of the scientific method and complete an experiment to prove a hypothesis

## **Materials**

- worksheet
- 1 loaf of bread WITHOUT preservative
- 1 loaf of bread WITH preservatives
- Plastic baggies

## **Background Knowledge**

Molds can grow on wood, paper, carpet, and foods. But what conditions are most favorable for mold spores to reproduce? Usually wet conditions are favorable for mold to reproduce but the conditions really depend on the type of mold because there are molds that cannot reproduce if it is too hot or too cold. In this activity, students will grow bread mold under several different environmental conditions where the variables include temperature and moisture levels. Before the experiment, students will be asked to form a hypothesis about the best conditions for growing mold. After the mold-growing experiment, students will form their conclusions and present their results to the class.

## **Procedure**

1. Distribute the work sheet describing the use of the scientific method to prove a hypothesis.
2. Lead a discussion about hypotheses and the scientific method.
3. Have the students complete the experiment using the materials available.
4. Each day have them write descriptions of the different samples.
5. After the ten days are completed have the students record their conclusion and explanation.

## **Discussion Questions**

Can what is happening to your bread be defined as decomposing?

What is the job of a decomposer?

What will happen to this bread eventually?

What are preservatives? Are they always good, and what effect could they have, if any on the environment and people?

Preservatives being a form of biotechnology, how has it changed our lives, and how we see food?

## **Extension**

- Research the debate about preservatives and how they are affecting humans in the long run.



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- How was food production and consumption before we had preservatives? (Was it more limited?)
- What other things besides food use preservatives?
- Make a graph of deterioration for each piece of bread and compare the two.
- Talk about consumers and what consumers want, how has this affected our food production and processing?
- Make bread in a bag (without preservatives) using lesson plan included in curriculum.



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# Clean It Up!

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## **Standards of Learning**

Science 6.1, 6.5, 6.7, 6.9, LS.1, LS.7, LS.8, LS.12

## **Objective**

The student will

- explain reasons for water quality degradation, understand challenges in determining water quality standards, and provide examples of best management practices in water filtering.

## **Materials**

3 clear disposable plastic cups  
Kitty litter  
Food coloring  
Sand  
Aquarium charcoal  
Almond extract  
Gravel  
Coffee filter  
Water

## **Background Knowledge**

You are employed by the local water authority. Residents are complaining that their tap water looks cloudy and smells funny. Determine if the water is safe and how to provide the community with high quality water. Hypothesize regarding the causes of the problem and how best to handle the community complaints.

The cycle of the Earth's water is continuous, carrying and spreading pollutants introduced by human activity all around. Intensive farming uses chemical fertilizers responsible for various forms of air and water pollution. Animal dung introduces large quantities of nitrate into the soil; the nitrate then filters into the water table. Certain underground gas tanks leak, discharging hydrocarbons into the water table. Pesticide residue is found in the water table and in watercourses; it makes water unfit for consumption. Wastewater leakage from a dwelling's underground tank contaminates the water table. Vast expanse of underground water fed by rainwater filtering through the earth; it supplies springs and can be collected in wells. Burying household waste without taking any particular precautionary measures leads to contamination of the water table. Untreated, it contains organic matter and potentially pathogenic substances that cause infection and promote the growth of algae. Pollution causes by leaks from refineries and offshore drilling platforms, by ships emptying their fuel tanks at sea and by oil spills. Radioactive nuclear waste was once immersed at the bottom of the ocean; it has a life span of up to 1,000 years. Industrial waste is highly variable; its principal components are lead, mercury, cadmium, hydrocarbons and acid deposits.

## **Procedure**

1. Fill one plastic cup half full of water. Add food coloring and almond extract.
2. Poke a small hole in the bottom of the second cup. (a dissecting needle works well to make the holes)
3. Layer various materials in cup to serve as a filter. Record amounts and layering order.
4. Place the third cup under the second to collect water as it filters through the second cup.



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5. Pour the water from cup one (the water sample) into cup two (the filtering system), and analyze the results in cup three (the filtered water).
6. Record data regarding which materials were used to clean the water sample, in what combination, and to what extent. Was the filtering successful? Draw conclusions about your hypothesis.

#### **Extension Ideas**

- Discuss what criteria should be used in determining water safety?
- Suggest prevention practices which may increase clean water levels.
- How do you successfully encourage the community to participate in clean water practices?
- Conduct the experiment using one variable at a time. Record time which each variable takes to run as well as water quality.

Lesson plan adapted from ***Agriculture and the Environment Clean It Up!*** From American Farm Bureau Foundation for Agriculture in the Classroom copyright 2004.



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## ***Clean It Up!***



| <b><i>Filtering<br/>Devise</i></b> | <b><i>Time</i></b> | <b><i>Color<br/>Filtered</i></b> | <b><i>Amount</i></b> | <b><i>Independent<br/>Variable</i></b> | <b><i>Dependent<br/>Variable</i></b> |
|------------------------------------|--------------------|----------------------------------|----------------------|----------------------------------------|--------------------------------------|
|------------------------------------|--------------------|----------------------------------|----------------------|----------------------------------------|--------------------------------------|

***Control***

***Filter***

***Kitty Litter***

***Sand***

***Charcoal***

***Gravel***

***Combination  
#1***

***Combination  
#2***

***Combination  
#3***



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# Dirty Water

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## **Standard of Learning**

Science 6.5, 6.7

English 6.6, 6.7, 7.8, 7.9

## **Objective**

The student will:

- Identify best management practices dealing with water quality
- Write a persuasive essay encouraging best management practices to protect the water supply

## **Materials**

paper towel

scissors

paper funnel

clean sand

clear glasses or jars (plastic may be used)

spoon

water

soil

## **Background Knowledge**

Thousands of farmers have made the *Conservation Reserve Enhancement Program* (CREP) one of Virginia's most active water quality efforts. The program aims to improve Virginia's water quality and wildlife habitat by offering financial incentives, to farmers who voluntarily restore river bank buffers called riparian, filter strips and wetlands through the installation of approved conservation practices. CREP is part of a federal program established in 1985.

Virginia CREP is divided into two regions. The *Chesapeake Bay CREP* targets Virginia's entire bay watershed and calls for the planting of 22,000 acres of buffer and filter strips as well as 3,000 acres of wetland restoration along side riverbanks. The *Southern Rivers CREP* targets watersheds outside the bay drainage basin and will establish 13,500 acres of buffer and filter strip plantings and 1,500 acres of wetland restoration.

Farmers participating in CREP are protecting their own farm as well as the water system. This practice helps reduce sediment from eroding stream banks and improving water quality. Participants fence off a 100 foot wide strip alongside the creek and river banks on their farmland. Next hardwood and grasses are planted within the strip. The vegetation absorbs excess nutrients which may run off from nearby fields as well as provides a filter for water flowing into the waterway. This practice has significantly reduced excess nitrogen and phosphorus from the water flowing into the Chesapeake Bay. Participating farmers receive financial assistance to fence, plant, and even drill wells for livestock fenced out of creeks and rivers.

The Dirty Water experiment is designed to provide a literal view of water filtration through a simple one step method. Allowing students to expand upon filtration methods will produce a clean water sample and lead to interesting discussion how farmers and other groups can protect the water supply from the smallest creeks and ponds to the Chesapeake Bay and on the Atlantic Ocean.



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### **Procedure**

1. Cut a circle from the paper towel.
2. Fold it in half, then in half again.
3. Open the folded circle a little to make a paper cone.
4. Put the cone inside the funnel and set the funnel in one of the glasses or jars.
5. Fill the cone with clean sand. Fill the other jar with water.
6. Add  $\frac{1}{4}$  cup of soil to 2 cups of water and stir it. Slowly pour the muddy water into the funnel.
7. Record observations as water seeps through the funnel.
8. Discuss what happened to the soil and the water mixture traveled through the filter.
9. Does a phase filtering clean all particles from the water? Why or why not?

### **Extension**

- Have students revise a filtration system which will cleanse the water.
- Encourage students to develop a method to prevent soil and impurities from entering the water source at the creek and stream level.
- Assign students the task of writing a persuasive essay to use best management practices to keep streams and ponds free of soil run off.
- Explore how non-agricultural groups can take action to improve water quality.

### **References**

<http://www.dcr.virginia.gov>.



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# DNA Extraction

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## **Standards of Learning**

Science LS.1, LS.2, LS.3, LS.13

Math 6.9

English 6.1, 6.5, 7.1

## **Objective**

The student will

- follow a process and extract DNA from living tissue by using every day items.

## **Materials**

- DNA source (soybeans or other seeds, strawberry, banana, tuna juice, onion, celery)
- Water
- Salt
- Blender
- Coffee filter
- Detergent
- Test Tube
- Alcohol
- Wooden Stick

## **Background Knowledge**

Deoxyribonucleic acid is a nucleic acid that contains the genetic instructions used in the development and functioning of all known living organisms and some viruses. The main role of DNA molecules is the long-term storage of information. DNA is often compared to a set of blueprints since it contains the instructions needed to construct other components of cells, such as proteins and RNA molecules. The DNA segments that carry this genetic information are called genes, but other DNA sequences have structural purposes, or are involved in regulating the use of this genetic information. Chemically, DNA consists of two long polymers of simple units called nucleotides, with backbones made of sugars and phosphate groups joined by ester bonds. These two strands run in opposite directions to each other and are therefore anti-parallel. Attached to each sugar is one of four types of molecules called bases. It is the sequence of these four bases along the backbone that encodes information. This information is read using the genetic code, which specifies the sequence of the amino acids within proteins. The code is read by copying stretches of DNA into the related nucleic acid RNA, in a process called transcription.

Within cells, DNA is organized into X-shaped structures called chromosomes. These chromosomes are duplicated before cells divide, in a process called DNA replication. Eukaryotic organisms (animals, plants, fungi, and protists) store most of their DNA inside the cell nucleus and some of their DNA in the mitochondria (animals and plants) and chloroplasts (plants only)<sup>[1]</sup>. Prokaryotes (bacteria and archaea) however, store their DNA in the cell's cytoplasm. Within the chromosomes, chromatin proteins such as histones compact and organize DNA. These compact structures guide the interactions between DNA and other proteins, helping control which parts of the DNA are transcribed.

DNA is present in the cells of all living organisms. This procedure is designed to extract DNA from a food source in sufficient quantity to be seen and spooled.



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### **Procedure**

1. Place the following ingredients into a blender:  
100 ml or ½ cup of DNA source material  
200 ml or 1 cup of water  
1 gram or 1/8 tsp salt
2. Blend on high for 15 seconds
3. Strain the mixture through a sieve to remove the unblended material
4. Add 20 ml or 2 TBSP of detergent. Swirl to mix. Let sit for 5-10 minutes
5. Fill a test tube about 1/3 full with the mixture.
6. Add a pinch of enzymes (Meat tenderizer) to each test tube and stir carefully.
7. Tilt the test tube and slowly pour an equal amount of alcohol down the side of the tube so that it lies on top of the mixture.
8. Stringy DNA should appear at the boundary between the mixture and the alcohol.
9. Use a wooden stick or a hook to gently move the mixture up into the alcohol so that more DNA will precipitate out; you can also let the tube sit for 30 minutes or more.
10. You can keep the DNA indefinitely in a sealed container with alcohol or dry it on paper.

### **Extension**

- Try the same experiment with another DNA source such as spinach, chicken liver, onions and strawberries.
- Use a different type of detergent and/or enzyme and compare results.
- Observe DNA under a microscope.
- Try extracting DNA from things that you think might not have DNA.

Lesson adapted from ***Soybean Science Kit*** from Indiana Soybean Board.



For more resources to connect children to agriculture visit [AgInTheClass.org](http://AgInTheClass.org).

# DNA Strands

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## Standards of Learning

Science LS.1, LS.2, LS.3, LS.13

English 7.1, 7.6, 7.8

## Objective

The students will:

- provide exposure to the components of DNA codes of common living items

## Background Knowledge

Deoxyribonucleic acid is a nucleic acid that contains the genetic instructions used in the development and functioning of all known living organisms and some viruses. The main role of DNA molecules is the long-term storage of information. DNA is often compared to a set of blueprints since it contains the instructions needed to construct other components of cells, such as proteins and RNA molecules. The DNA segments that carry this genetic information are called genes, but other DNA sequences have structural purposes, or are involved in regulating the use of this genetic information. Chemically, DNA consists of two long polymers of simple units called nucleotides, with backbones made of sugars and phosphate groups joined by ester bonds. These two strands run in opposite directions to each other and are therefore anti-parallel. Attached to each sugar is one of four types of molecules called bases. It is the sequence of these four bases along the backbone that encodes information. This information is read using the genetic code, which specifies the sequence of the amino acids within proteins. The code is read by copying stretches of DNA into the related nucleic acid RNA, in a process called transcription.

Within cells, DNA is organized into X-shaped structures called chromosomes. These chromosomes are duplicated before cells divide, in a process called DNA replication. Eukaryotic organisms (animals, plants, fungi, and protists) store most of their DNA inside the cell nucleus and some of their DNA in the mitochondria (animals and plants) and chloroplasts (plants only)<sup>[1]</sup>. Prokaryotes (bacteria and archaea) however, store their DNA in the cell's cytoplasm. Within the chromosomes, chromatin proteins such as histones compact and organize DNA. These compact structures guide the interactions between DNA and other proteins, helping control which parts of the DNA are transcribed. DNA is present in the cells of all living organisms.

Each bracelet will contain two strands of beads to represent the double helix of specific DNA. The two strands will match up in the same way real DNA does. So every time a bead is placed on one strand a bead must be added to the second strand. With DNA “A” always pairs with “T” and “C” always pairs with “G.” The chart below will help keep track of the combinations.

“A” (gold beads) always pair with “T” (red beads)  
“T” (red beads) always pair with “A” (green beads)  
“C” (black beads) always pairs with “G” (green beads)  
“G” (green beads) always pair with “C” (black beads)

## Materials

- Something to string bead such as string, yarn, hemp or dental floss
- Pony beads – green, pink, yellow and purple are suggested but any bead combination would work



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- Scissors
- DNA code hand out

### **Procedure**

1. Place plenty of beads on paper plates for easy access and clean up.
2. Choose a DNA strand from the samples provided.
3. Cut two pieces of string about 12 inches long.
4. Tie at least one knot about two inches from one end of each string. Make the knot big enough that the beads don't slip off.
5. Thread a bead onto the first string. Then string the accompanying bead onto string 2. For example, if "C" goes on string 1, then "G" will go on string 2.
6. Keep threading beads until the DNA strand is long enough to slip over your hand. (This may not require all the letters represented in the DNA strand.)
7. Tie a knot around the last bead of each string.
8. Tie the ends of each string together to complete the bracelet.

### **Color Code:**

A- Gold  
T- Red  
C- Black  
G- Green



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### Sample DNA Codes

*Monarch butterfly (danaus plexippus)*

**gaggctaccaagtttccg**

*Grizzly bear (ursus arctos)*

**atgaccaacatccgaaaa**

*Sunflower (helianthus annuus)*

**tgagatgttagaaggtgc**

*Chimpanzee (pan troglodytes)*

**tgaccccgacacgaaaa**

*Human (homo sapiens)*

**tgacccaatacgcaaaa**

*African elephant (loxodonta Africana)*

**atgaccgacattcgaaaa**

*Apple tree (malus domestica)*

**gaattcggcagcagagaaga**

*Brown trout (salmo trutta)*

**ctttggctcactcttagg**

### Extension

- Research the family and genus of other species.
- Measure the length of the different DNA strands. Record the difference.
- Compare several DNA strands to Homo Sapien and discuss the differences/similarities.
- Compile informational reports on habits, life cycles and human interaction of selected species.
- Create a 3 dimensional cell including nucleus with DNA.
- Visit the following sites for other information (sites viable as of July 2003)
  - o <http://ology.amnh.org/genetics/>
  - o <http://sln.fi.edu/tfi/activity/bio/bio-3.html>
  - o <http://www.accessexcellence.org/AE/ATG/data/released/0307-TrumanHoltzclaw/description.html>
  - o <http://www.biologylessons.sdsu.edu/classes/index.html>

This lesson was adapted from [http://ology.amnh.org/genetics/stufftodo/bracelet\\_need.html](http://ology.amnh.org/genetics/stufftodo/bracelet_need.html)



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# Do I Eat That?

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## **Standards of Learning**

Science LS.7

## **Purpose**

Students will:

- Trace the energy flow in an ecosystem

## **Materials**

- Note cards
- Chart paper

## **Background Knowledge**

Review a food web with classes. You get energy from the food you eat. Similarly, all living things get energy from their food so that they can move and grow. As food passes through the body, some of it is digested. This process of digestion releases energy. A food chain shows how each living thing gets its food. Some animals eat plants and some animals eat other animals. For example, a simple food chain links the trees & shrubs, the giraffes (that eat trees & shrubs), and the lions (that eat the giraffes). Each link in this chain is food for the next link. A food chain always starts with plant life and ends with an animal. Plants are called producers because they are able to use light energy from the Sun to produce food (sugar) from carbon dioxide and water. Animals cannot make their own food so they must eat plants and/or other animals. They are called consumers. There are three groups of consumers. There are three groups of consumers. Animals that eat only plants are called herbivores (or primary consumers). Animals that eat other animals are called carnivores. Carnivores that eat herbivores are called secondary consumers. Carnivores that eat other carnivores are called tertiary consumers. Animals and people who eat both animals and plants are called omnivores. Then there are decomposers (bacteria and fungi) which feed on decaying matter. In a food chain, energy is passed from one link to another.

When a herbivore eats, only a fraction of the energy (that it gets from the plant food) becomes new body mass; the rest of the energy is lost as waste or used up by the herbivore to carry out its life processes (e.g., movement, digestion, reproduction). Therefore, when the herbivore is eaten by a carnivore, it passes only a small amount of total energy (that it has received) to the carnivore. Of the energy transferred from the herbivore to the carnivore, some energy will be "wasted" or "used up" by the carnivore. The carnivore then has to eat many herbivores to get enough energy to grow. Because of the large amount of energy that is lost at each link, the amount of energy that is transferred gets lesser and lesser. There cannot be too many links in a single food chain because the animals at the end of the chain would not get enough food (and hence energy) to stay alive. Most animals are part of more than one food chain and eat more than one kind of food in order to meet their food and energy requirements. These interconnected food chains form a food web. A change in the size of one population in a food chain will affect other populations. This interdependence of the populations within a food chain helps to maintain the balance of plant and animal populations within a community. For example, when there are too many giraffes; there will be insufficient trees and shrubs for all of them to eat. Many giraffes will starve and die. Fewer giraffes means more time for the trees and shrubs to grow to maturity and multiply. Fewer giraffes also means less food is available for the lions to eat and some lions will starve to death. When there are fewer lions, the giraffe population will increase. Discuss the sun as a primary energy source featuring how the sun energy translates



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into usable energy for humans. Trace the flow of energy from plants to animals and where humans fit into the equation.

### **Procedure**

1. On the note card, have the student list a typical dinner.
2. Share the dinners with the class, and group students with similar meals together.
3. Give each group a sheet of chart paper, and have them make columns labeled plant, animal, and other organisms. Then have students place their dinner foods under the appropriate column or columns.
4. Finally, have them count how many were plants, animals, other.
5. Ask discussion questions:
  - Where do these items come from (other than the grocery store)?
  - How many fell in the other category?
  - How many fell into more than one category?

### **Extension**

- In a food chain/food web, what part is missing? Why?
- Use a string line to create a web from one student to the next when acting out a food web.



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# Earth's Water Distribution

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## **Standards of Learning**

Science 6.5

## **Objective**

Students will:

- Describe the importance of protecting and maintaining earth's water resources

## **Materials**

- 1 one-liter bottle
- 1 50 ml graduated cylinder
- 1 10 or 25 ml graduated cylinder
- 5 clear plastic cups
- Blue Food coloring (optional)
- 1 packet of salt
- dropper

## **Background Knowledge**

Although the Earth's surface is about 75% water, only 3% of that is fresh, drinkable, water. Of that 3%, three-fourths is found in polar ice caps and glaciers. That means that less than 1% of the water on the earth is drinkable. Water is vital for humans, animals, and plants.

The purpose of this lesson is to show the value of the water as essential for life. In addition lead discussions of why 75% of the earth is covered with water but only a small portion is useable.

The cycle of the Earth's water is continuous, carrying and spreading pollutants introduced by human activity all around. Intensive farming uses chemical fertilizers responsible for various forms of air and water pollution. Animal dung introduces large quantities of nitrate into the soil; the nitrate then filters into the water table. Certain underground gas tanks leak, discharging hydrocarbons into the water table. Pesticide residue is found in the water table and in watercourses; it makes water unfit for consumption. Wastewater leakage from a dwelling's underground tank contaminates the water table. Vast expanse of underground water fed by rainwater filtering through the earth; it supplies springs and can be collected in wells. Burying household waste without taking any particular precautionary measures leads to contamination of the water table. Untreated, it contains organic matter and potentially pathogenic substances that cause infection and promote the growth of algae. Pollution causes by leaks from refineries and offshore drilling platforms, by ships emptying their fuel tanks at sea and by oil spills. Radioactive nuclear waste was once immersed at the bottom of the ocean; it has a life span of up to 1,000 years. Industrial waste is highly variable; its principal components are lead, mercury, cadmium, hydrocarbons and acid deposits.

## **Procedure**

1. Fill the one-liter bottle full of water or buy a one-liter bottle full of water and remove the label. This represents the earth's total water budget. Show this to the students and explain that for today this is the model for all of the water on earth.
2. Next, take the 50 ml graduated cylinder and either you or a student measure out 30 ml of water from the bottle. Do the percentages on the board.  $1000 - 30 = 970$ ,



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therefore the bottle now has 97% of the water and the cylinder has 3%. Take the salt and put it in the bottle. Ask the students why you did that? That's right, 97% of the earth's water supply is salt water. Now that is out of the way, let's focus on the main 3%.

3. Before you divvy it up, ask why it is important that we protect it? Let's see where it is.
4. Get cup one and label it ice (students may be thinking the ice you put in a glass, so clarify the ice like glaciers). Discuss whether or not this fresh water is directly beneficial to them here in Virginia. Then tell them that of the 3% of fresh water in the world, 76% of that is ice. Do the math  $30 \text{ ml} \times .76 = 22.8 \text{ ml}$  (round to 23 ml). You or a student can measure out 23 ml from the existing 30 ml place in the cut marked ice and set aside. (You should have 7 ml left)
5. Get cup two and label it shallow ground water. Discuss whether this is beneficial to them. Wells are made from shallow ground water. Then tell them that 12% of the earth's budget is from shallow ground water. Do the math  $30 \text{ ml} \times .12 = 3.6 \text{ ml}$  (round to 4). You or the student can measure out the 4 ml of water and place in the cup. Since this water is directly beneficial to them put a drop of food coloring in it (optional) before you set it aside.
6. Get cup three and label it deep ground water. Discuss whether this is beneficial to them. Deep ground water is not readily available for human use. Then tell them that 11% of the earth's budget is from shallow ground water. Do the math  $30 \text{ ml} \times .11 = 3.3 \text{ ml}$  (round to 3). You or the student can measure out the 3 ml of water and place in the cup. Set it aside.
7. Get cup four and label it lakes and rivers. Discuss whether this is beneficial to them. They can not drink from them, but they use them recreationally. Then tell them that .34% of the earth's budget is from shallow ground water. Do the math  $30 \text{ ml} \times .034 = .102 \text{ ml}$ . You or the student can try to get one or two drops of water from the cylinder to place in the cup. Since this water is beneficial to them put a drop of food coloring in it (optional) before you set it aside.
8. Get cup five and label it water vapor. Discuss whether this is beneficial to them. Water vapor is integral to the water cycle. Then tell them that .037% of the earth's budget is from shallow ground water. Do the math  $30 \text{ ml} \times .037 = .0111 \text{ ml}$ . You or the student can try to get one drop of water from the cylinder to place in the cup. Since this water is beneficial to them put a drop of food coloring in it (optional) before you set it aside.
9. Look at those that have been set aside as useful and those that have been set aside as not. How does this expedite your need for water conservation?
10. Discussion Questions:
  - What things can be done by individuals to conserve water?
  - What things can be done by industries to conserve water?
  - Why would conserving water be especially important to the agriculture industry?

### **Extension**

- Find out what things are being legislated in the name of conservation.



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# The Farmer's Web

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## **Standards of Learning**

Science LS.9

## **Purpose**

Students will:

- Learn that ecosystem means that all of life is interrelated in one way or another

## **Materials**

- Green yarn (food)
- Blue yarn (water)
- White yarn (air)
- Brown yarn (shelter)
- Note cards with the following assignments written on them: corn, cattail, bass, cow, human, oak tree, robin, topsoil, worm, and stream.
- Yarn should be cut into 5 foot lengths

## **Background Knowledge**

Review a food web with classes. You get energy from the food you eat. Similarly, all living things get energy from their food so that they can move and grow. As food passes through the body, some of it is digested. This process of digestion releases energy. A food chain shows how each living thing gets its food. Some animals eat plants and some animals eat other animals. For example, a simple food chain links the trees & shrubs, the giraffes (that eat trees & shrubs), and the lions (that eat the giraffes). Each link in this chain is food for the next link. A food chain always starts with plant life and ends with an animal. Plants are called producers because they are able to use light energy from the Sun to produce food (sugar) from carbon dioxide and water. Animals cannot make their own food so they must eat plants and/or other animals. They are called consumers. There are three groups of consumers. There are three groups of consumers. Animals that eat only plants are called herbivores (or primary consumers). Animals that eat other animals are called carnivores. Carnivores that eat herbivores are called secondary consumers. Carnivores that eat other carnivores are called tertiary consumers. Animals and people who eat both animals and plants are called omnivores. Then there are decomposers (bacteria and fungi) which feed on decaying matter. In a food chain, energy is passed from one link to another.

When a herbivore eats, only a fraction of the energy (that it gets from the plant food) becomes new body mass; the rest of the energy is lost as waste or used up by the herbivore to carry out its life processes (e.g., movement, digestion, reproduction). Therefore, when the herbivore is eaten by a carnivore, it passes only a small amount of total energy (that it has received) to the carnivore. Of the energy transferred from the herbivore to the carnivore, some energy will be "wasted" or "used up" by the carnivore. The carnivore then has to eat many herbivores to get enough energy to grow. Because of the large amount of energy that is lost at each link, the amount of energy that is transferred gets lesser and lesser. There cannot be too many links in a single food chain because the animals at the end of the chain would not get enough food (and hence energy) to stay alive. Most animals are part of more than one food chain and eat more than one kind of food in order to meet their food and energy requirements. These interconnected food chains form a food web. A change in the size of one population in a food chain will affect other populations. The interdependence of the populations within a food chain helps to maintain the balance of plant and animal populations within a community. For example,



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when there are too many field mice; there will be insufficient vegetation for all of them to eat. Many mice will starve and die. Fewer mice allows for more time in which the vegetation can grow. Fewer mice also means less food is available for the other animals who feed on mice. When there are fewer field mouse predators, the mice population will increase. Discuss the sun as a primary energy source featuring how the sun energy translates into usable energy for humans. Trace the flow of energy from plants to animals and where humans fit into the equation.

Discuss this scenario with students prior to engaging in this activity.

### **Procedure**

1. Ask students what John Muir, American naturalist, explorer and conservationist meant when he said, "When one tugs at a single thing in nature, he finds it attached to the rest of the world."?
2. Take a few minutes to discuss their thoughts.
3. Now explain what an ecosystem is (a group of organisms and their physical environment all of which interact through a flow of energy and a cycling of materials). "Eco" in greek means "home."
4. Divide the class into groups of 8 or 10. Give each student one color of each yarn and 1 note card.
5. Explain that each group represents an ecological farming community.
6. Choose one person in each community to start, and have them one by one satisfy the need of another community member by extending the appropriate colored yarn. (EX: topsoil may extend green to the corn because it provides corn food, and it may extend brown to worm because it provides worm with shelter). The students should verbalize why they are making the connections.
7. After several rounds, have the students place the web on the floor with their note card taking their place and stand up.
8. Have a few students from each group generalize the connections.
9. Discussion Questions:
  - What happens if you try to unravel the yarn?
  - Why do you think the web falls apart if the yarn is disturbed?
  - How does this symbolize what actually occurs in nature?

### **Extension**

- Have the students draw what they just made.
- Have the students write a poem about what they just experienced.
- Have a farmer come to the class to talk about farm life, or better yet visit a farm for a first hand look.



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# Farming Through Time

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## Standards of Learning

Science 6.2

## Objective

Students will

- analyze and describe how the United States farming energy use has changed over time.

## Materials

- hoe
- toy horse
- toy tractor

## Background Knowledge

Farmers have always gotten up before sunrise, but long ago, there was no electricity so farmers lit kerosene lamps so they could see. They did many chores by lamplight. In the past farm buildings were made of wood not metal like they are today. The barns were the biggest buildings on the farm and had two floors. The animals lived on the first floor and hay was kept upstairs to feed the animals. Food was also stored in the top of the barn or in silos to store grains. Most farm work was done by hand and most tools were made of wood. The tools were very heavy and were used for chopping wood, cooking, keeping weeds away from the crops, and cutting down tall crops. Water came from wells deep into the ground but was still important for the farmers. The water was carried through pumps and into buckets, and there was often no running water in farmhouses or buildings. If anyone wanted to cook or take a bath they had to carry water from the pump to the house. At harvest time, the whole farm family had to help. The crops were cut down or picked by hand and thrown on carts or wagons to carry off. Farmers kept large, heavy horses called draft horses. These animals could pull plows and heavy loads. All of the animals on the farm were largely used to feed the family and any leftovers might be sold to make money. Cows had to be milked by hand and the cream that rose to the top of the pail was used to make butter. Icehouses were used to keep the milk cold and early-morning trains would take the milk into cities to be sold. Farming was a lot harder than it is today because the weather played a big factor in the survival of the family. Crops could be eaten by insects or killed by plant diseases.

Imagine what the workforce will be like in 50 years. How will technology affect the way we work, live, and play? How will our society produce food and fiber?

## Procedure

1. Start a discussion on what farms were like in the United States in the 1700s. Students should mention farmers relied upon animal, family and possibly slavery (Turn this into human resources). Farming was done from sun up until sun down.
2. The 1800s scenario should look basically the same, but there were some tools that were introduced to make farming easier.
3. The 1900s scenario changed drastically with the introduction of the tractor and electricity made it to rural areas. Research into new and better crops, etc.



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4. No matter what the scenario or the time, the same amount of energy has existed. Energy is neither created nor destroyed only changed from one form to another.
5. So, whether it was a farmer in 1795 in his garden taking a hoe to hill his tomato plants which changes the chemical energy in his body to mechanical energy to move the hoe, or.. (demonstrate)
6. Whether it was a farmer in 1895 driving a team of horses across his field to clear it.
7. Chemical energy in the farmer's body to mechanical energy to move behind the horses who also have chemical energy being changed into mechanical energy.
8. Then in the 1900s you have the tractor which uses chemical energy of gasoline which is changed into mechanical energy that allows the tractor to moved and perform work.

### **Extension**

Build a classroom timeline from the 1700 to the present day involving food and fiber production.



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# Got Sun?

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## **Standards of Learning**

Science 6.2

## **Objective**

Students will:

- describe energy changes from one form to another recognizing that the sun can be traced to the origin of all things.

## **Materials**

- A large picture of the sun
- Pictures of various items found on a farm

## **Background Knowledge**

It always starts in the sun, where matter is changed into electromagnetic energy and zips out into space. The energy a person uses to jump always comes first from the sun. A tiny bit of the sun's energy falls onto earth. On earth some of the solar energy is changed by photosynthesis into chemical energy stored in the carbohydrate molecules in plant cells. A human eats a plant. Or a human eats an animal that ate a plant. The chemical energy stored in the plant (or animal) cells is moved into the cells of the human's body. All of the body processes, like digestion, pumping blood, breathing, are powered by cells converting the stored chemical energy into work and heat, in a process called respiration. Respiration takes place in every cell in your body. Inside the muscle cells of the human (or any animal), the chemical energy is transformed (changed) into mechanical work and heat. The muscle contracts, the legs push, and the body leaps into the air. Some of the chemical energy has now been changed into the kinetic energy of a body flying up into the air. The rest of the original chemical energy has been used to raise the temperature of your jumping body. If you keep jumping for long you'll get pretty hot.

The purpose of this lesson is to review the various forms of energy and the need for sunlight to charge up photosynthesis.

## **Procedure**

1. Discuss the various forms of energy (thermal, radiant, electrical, chemical)
2. Remind students that energy can neither be created, nor destroyed but only changed from one form to another.
3. Use the common example of the sun's radiant energy being changed into chemical energy by green plants. (PHOTOSYNTHESIS)
4. Pass out a picture to each student, and place the large picture of the sun at the front (or you can hold it if you wish). Have each student describe an energy change or changes as it relates to the sun.
5. Discussion Questions
  - What energy change occurs as a tractor is plowing a garden?
  - What energy change occurs as a farmer is tossing hay up onto a wagon?
  - What energy change occurs as a chicken scratches for feed?

## **Extension**

Trace all energy changes in discussion questions back to the sun.



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# Growing Sneakers

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## **Standards of Learning**

Science 6.1, LS.1, LS 12

## **Objective**

Students will:

- Conduct an experiment using the scientific method
- Gain an understanding of how seeds travel with the aide of ecosystem dynamics and population influences

## **Materials**

- Tennis shoes
- 1 large bag of birdseed
- 1 bag of grass seed
- An area with loose soil
- A large bag of soil
- Small containers for potting
- Gallon sized plastic bags

Ahead of time lay out an area (preferably outdoors) with loosened soil, bird seed, and grass seed. Moisten the mixture to provide a tacky substance which will adhere to the tennis shoes.

## **Background Knowledge**

We know that seeds travel in a variety of ways. Examples are the fact that the wind carries seeds through the air and animals carry seeds on there fur or in animal waste. What affect do humans have on the distribution and possible growth of seeds in our ecosystem? Do people threaten or enhance the survival of the vegetation around us? Humans can both threaten and enhance the growth of seeds in our ecosystem. They can carry them on their clothes and shoes to other pieces of land to grow. However, they may also destroy vegetation by building shopping malls and tearing down land where vegetation could grow.

Imagine you are walking through a nature path, or hiking in the woods, even taking a walk on a farm. When you complete the walk you find all sorts of seeds attached to your clothing and shoes. What happens to these seeds?

## **Procedure**

1. Divide class into groups of 3 or 4.
2. Instruct students to bring a pair of tennis shoes on lab day. Have student observe the soles of their tennis shoes. Each group should select the pair which has the greatest potential to trap seeds. Each group should explain the basis of their team selection.
3. Discuss as a class the similarities and differences of how each group formed the hypothesis. Explain how hypothesis's should be written.
4. To test each groups hypothesis have the owner of the tennis shoes selected walk through a soil preparation.
5. Immediately upon exiting the test site the student should remove their tennis shoes and place them in a plastic bag to prevent from loosing seeds.
6. In a lab setting remove the seeds and soil from the shoe. Count the number of seeds collected.



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7. Conclude if the group hypothesis was confirmed regarding number of seeds trapped in a tennis shoe compared with other teams in the class.
8. Record results of experiment and draw conclusions.
9. Put the soil and seeds collected into the potting container. Add additional soil to barely cover seeds. Mist with water.
10. Observe until seeds begin to sprout.
11. Discuss how walking through an environment can spread seeds. What affect does moving through the environment have on seeds? Include positive or harmful affects.

### **Extension**

- Use variables other than tennis shoes such as socks or gloves.
- Discuss where seeds land and travel other than the ground. (on the rug, sidewalk, in the car, in the laundry) Do these seeds survive? How far do they travel?
- Choose a more realistic environment such as a walk through the woods or a playground.



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# Habitat Hula

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## **Standards of Learning**

Science LS.4, LS.5, LS.7, LS.8, LS.10, LS.14

English 6.1, 7.1

## **Objective**

The student will:

- identify living organisms within a given environment.

## **Materials**

- 1 hula hoop per habitat
- Scratch paper

## **Background Knowledge**

What creates or changes an environment? Weather changes, climate, human population, competition among the population of plant and animal life all affect our environment. Change in the environment can also be caused by the manufacturing of buildings in an area so that trees and other plants have to be torn down. A microenvironment is an ecosystem with a relatively small, localized area, especially of a microhabitat. Within these microenvironments there are various animals and plants that live and thrive off the area around them. Different areas could be grassy, wooded, in or out of the sun, or contain water. Use the following activity to provide a concrete example of a microenvironment.

## **Procedure**

1. Place your hula hoops in various places throughout the outside of your school. Some suggested places are: parking lot (and to add to it, drop a piece of candy/ a cookie in it to show the ants etc...), grassy areas, wooded areas, under shrubs, if you have water near by in a stream or pond, do one there. Have them fairly close together so that you can see all your students to monitor how they are doing.
2. Split your class into groups, or pairs and assign them to the various hula hoops.
3. Students can draw what they see, or write it down. Have them pay close attention to detail. Recognizing spider webs, bugs, if there are flowers and what that would attract etc..
4. Return to the classroom and discuss the habitats, see the discussion questions for suggestions.
5. Discussion Questions
  - What was different in each of the areas, and how does that affect the types of life forms there?
  - What effect did the cookie on the concrete have? (Ants have been around long before concrete, how have they adjusted to this kind of environment)
  - How do we affect various habitats?
  - How do the things in this habitat interact with each other?

## **Extension**

Discuss integrated Pest Management and how that involves adjusting things in a habitat naturally, to control populations. (eg. ladybugs control aphids)

Have students look up a habitat and report on what lives there, and the special adaptations the living organisms have had to make to stay there.



For more resources to connect children to agriculture visit [AgInTheClass.org](http://AgInTheClass.org).

Watch a movie called “Champions of Wildlife” that discusses habitats, and protection of some of our greatest resources.  
Make connections with the food chain and how habitats play a role.



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# Hexagon Hives

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## **Standards of Learning**

Science LS.8, LS.12

Mathematics 6.9, 7.9

## **Objective**

Students will:

- Explain the advantage of the use of hexagon celled hives by honeybees
- Develop polygon models which demonstrate the strength and structural advantages of hexagon hive cells

## **Materials**

- Tape
- Paper clips
- 2" x 9" strips of construction paper
- Ruler
- Balloons

## **Background Knowledge**

Consider a bee hive. What does one look like? How does the structure provide a safe environment for the colony? Why do bees use a hexagon shape for the cells of the hive? Each question encourages the development of a hypothesis and proving a theory.

Whether naturally occurring or in manmade frames bees create cells within the honey comb in a hexagon shape. The hexagon shape provides a sturdy structure by using an irregular interlocking pattern with no space between cells. These cells are used as a place for bee larva to grow into adult productive members of the colony and to store food. One queen bee is in charge of the hive and lays up to 3000 eggs per day. The worker bees are responsible for collection of food, caring for the queen, tending a nursery full of larva, and keeping the hive.

Modern manmade beehives consist of wooden box-like sections stacked on top of each other. Each box (or super) holds 8-10 wooden frames, each containing a thin sheet of wax foundation. The bees build their combs on these foundations provided by the beekeepers, and therefore save time and effort in honey making. Honey is stored in the combs in the upper parts of the hive. When the bees have filled the combs in this upper section with honey and covered them with wax caps, the beekeeper takes them away to extract the honey and sell the wax for many products.

Bee facts:

Weight of average worker bee: 80 milligrams

Amount of nectar the honey sac can hold: 70 milligrams

Amount of pollen a worker can carry in the pollen baskets: 20 milligrams

Maximum number of eggs laid daily by the queen: 3,000

Average number of trips a worker bee makes outside the hive each day: 10 trips

Average speed of a worker bee in flight: 15 miles per hour

Average distance from hive a worker bee travels in one trip: 1-1/2 miles

Average life of a worker bee in the summer: 45 days

## **Procedure**

1. Ask students to define polygon.



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2. Provide examples of polygons including the number of sides for each.
3. For this example the length of all sides will total 9 inches.
4. Give each student at least 5 strips of construction paper.
5. Instruct the student to properly measure the dimensions listed on the chalkboard for each type of polygon and to fold each strip on the measurement lines in order to form the polygon. Students can use tape to connect the ends of the strip to complete the polygon.
6. Have the students construct their triangles as you demonstrate the measuring, folding, and taping of a triangle.
7. Have the students construct the four remaining polygons on their own. Have plenty of extra paper strips on hand for mistakes.
8. Once everyone has completed all the polygons, put students in groups of four to five to build structures of like polygons.
9. Give each group a few balloons to blow up to diameters of approximately 1", 1.5" and 2" to represent developing bees. Students should then see how balloons fit inside each polygon.
10. Have groups discuss the benefits or drawback of each structure in terms of how they fit together, strength of structure, if there is any wasted space between the polygons, if there is any wasted space within the polygon when the balloon is inserted, ect.
11. Come together as a class to discuss group findings.

### **Extension**

- Create a model of a manmade hive to include outer and inner covers, honey super, frame, brood chamber, and bottom board.

### **References**

This lesson was adapted from The Honey Files: A Bee's Life by Alyssa Boettcher  
[www.honey.com](http://www.honey.com)



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# The High Rollers Game

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## **Standards of Learning**

Science 6.2, 6.5, 6.9, LS.8, LS.12

Mathematics 6.4, 6.20, 7.14, 8.11

Civics CE.11, CE.12

## **Objective**

The student will

- work through a scenario of running a farm operation for profit
- demonstrate the risk and return of an enterprise
- use probability factors

## **Materials**

Play Money- \$360 per player (optional)

One die per player

Activity sheet

## **Background Knowledge**

This exercise is designed to demonstrate on a limited basis the risk and return on a given enterprise. It also will give students an opportunity to learn about the basic principles of probability. Each agricultural enterprise has its own risk and return potential with a number of variables. These variables can include pests, weeds, weather, and certain market forces. Variables can be either farm specific, regional or nationwide. Each variable on its own can turn an otherwise good year into a disaster.

This lesson can also help to teach your students the concepts behind U.S. economics and a free market. The opportunity cost of renting the land or saving the money is something that your students will need to know. What is the consequence of not renting the land? What are your students giving up if they do not rent the land? What are they giving up if they do rent the land? This could also be a great time to teach your students about supply and demand and what scarcity means in terms of economics. If the supply of land is small and a lot of consumers are demanding land then the suppliers may have a problem. It might be in their best interest to buy and cultivate more land for the consumers. If demand is low, then suppliers will be hurting financially because they do not have anybody to sell to and are not making any money. Scarcity means that available resources are insufficient to satisfy all wants and needs. If land is scarce, then not every consumer is getting what they want or need so it might benefit those who do have land to rent on it since the demand is so high.

The object of this game is to end with the most money.

## **Procedure**

1. Each student is given \$360.
2. Students are given the opportunity to rent one acre of land in Henrico County from May through September. The acre is covered with a highly productive soil- Pamunkey soil. In the best conditions, 200 bushels of corn can be produced on the acre.
3. Students can choose to not rent land and put their \$360 under their mattress for the summer.
4. Each student has two decisions to make:



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- a. Do they wish to rent an acre of land, or keep their \$360?
  - b. Do they want to grow an organic crop or a non-organic crop? An organic crop does not apply pesticides or man-made fertilizer. The yields are usually lower, but the market price is usually higher for organically grown produce. Also, the input costs (initial costs to plant a crop) are lower for an organic crop.
5. Use the production cost, yield factors, and calculations pages to determine profit or loss.

### **Extension**

Have students change locations, acreage, or crop depending on locality.

Repeat scenario several times recalling recent weather and economic variables that have occurred in Virginia such as hurricanes, flooding, drought, and fuel cost.

Discuss the feasibility of growing organic. Is this a niche operation?



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### ***High Rollers Game Production Cost***

| <b>Cost</b>                                          | <b>Per Acre</b> |
|------------------------------------------------------|-----------------|
| Land Rent (\$50 if planting a crop)                  | \$ _____        |
| Machinery (\$80 if planting a crop)                  | \$ _____        |
| Fertilizer (\$72 for non organic, \$54 for organic)  | \$ _____        |
| Pest Control (\$40 for non-organic, \$0 for organic) | \$ _____        |
| Seed (\$20 if planting a crop)                       | \$ _____        |
| Labor (\$14 if planting a crop)                      | \$ _____        |
| <br>Total Cost                                       | <br>\$ _____    |
| <br>Money left over from initial \$360               | <br>\$ _____    |



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### High Roller Game Yield Factors

Follow the directions for each factor to determine the affect on your crop.

You can control whether you produce an organic or non-organic crop, but you can't control the weather. Roll your die five times and record your results. Your **Rain Yield** factor will be determined by the sum of the five rolls, as follows:

#### Chart I

|       |   |      |       |   |     |
|-------|---|------|-------|---|-----|
| 5-6   | - | 0%   | 20-21 | - | 90% |
| 7-10  | - | 40%  | 22-25 | - | 80% |
| 11-13 | - | 80%  | 26-28 | - | 50% |
| 14-16 | - | 90%  | 29    | - | 30% |
| 17-19 | - | 100% | 30    | - | 0%  |

If you chose to produce an organic crop, your yields will usually be lower because you didn't apply pesticide. Roll your die five times. Your **Pest Control** yield factor will be determined by the sum of the five rolls, as follows:

| Chart II | Non-Organic | Organic |
|----------|-------------|---------|
| 5-6      | 0%          | 0%      |
| 7-10     | 60%         | 30%     |
| 11-13    | 80%         | 70%     |
| 14-16    | 90%         | 80%     |
| 17-19    | 100%        | 90%     |
| 20-21    | 90%         | 80%     |
| 22-25    | 80%         | 80%     |
| 26-28    | 50%         | 30%     |
| 29       | 50%         | 0%      |
| 30       | 0%          | 0%      |

If you produce a non-organic crop, your **Fertilizer** yield factor will be 100%. If you produced an organic crop, roll one die. Your yield factor will be determined as follows:

#### Chart III

|     |   |      |
|-----|---|------|
| 1   | - | 100% |
| 2-5 | - | 90%  |
| 6   | - | 75%  |

After you harvest your crop, you get to sell it. Roll one die. The price per bushel you will receive for your crop will be determined by the roll as follows:

#### Chart IV

|     | Non-Organic | Organic |
|-----|-------------|---------|
| 1   | \$2.60      | \$2.80  |
| 2-5 | \$2.80      | \$3.00  |
| 6   | \$3.00      | \$3.2   |



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### High Rollers Game Calculations

Roll one die five times to determine the rain levels for the five months:

May    June    July    August    September    Total

Rain:    \_\_\_\_ + \_\_\_\_ + \_\_\_\_ + \_\_\_\_ + \_\_\_\_ =    \_\_\_\_

Roll one die five times to determine the pest levels for the five months.

Pest:    \_\_\_\_ + \_\_\_\_ + \_\_\_\_ + \_\_\_\_ + \_\_\_\_ =    \_\_\_\_

If you chose to produce an organic crop, roll one die to determine your fertilizer yield %.

Roll one die to determine your market price per bushel.

Next, determine your yield factors based on your rolls of the die by using the “High Roller Game Yield Factors” sheet. Plug your yield factors into the below formula to determine your final yield. If you produced a non-organic crop, your fertilizer yield % is automatically 100%.

|                         |   |                                |   |                                 |   |                                      |   |             |
|-------------------------|---|--------------------------------|---|---------------------------------|---|--------------------------------------|---|-------------|
| Potential<br>Production | x | Rain<br>Yield % x<br>(chart I) | x | Pest<br>Yield % x<br>(chart II) | x | Fertilizer<br>Yield %<br>(chart III) | = | Total Yield |
|-------------------------|---|--------------------------------|---|---------------------------------|---|--------------------------------------|---|-------------|

200 bushels x    \_\_\_\_    x    \_\_\_\_    x    \_\_\_\_    =    \_\_\_\_ bushels

Multiply your total bushels by the market price determined by your roll of the die to determine the total price per bushel you will receive for your crop.

|                             |   |                |   |                         |
|-----------------------------|---|----------------|---|-------------------------|
| Total bushels<br>(chart IV) | x | Market Price   | = | Amount you will receive |
| ____ bushels                | x | ____ \$/bushel | = | ____                    |

Now, you need to determine how much money you have left. If you didn't plant a crop, you have \$360. If you planted a crop, you have the amount left over from your \$360 investment plus the amount you received for your crop.

|                                 |   |                          |           |
|---------------------------------|---|--------------------------|-----------|
| Left over from \$360 investment | + | amount received for crop | Total     |
| ____                            | + | ____                     | =    ____ |



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# Home-Made Chiapets

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## **Standards of Learning**

Science: LS.4, LS.5, LS.6

## **Objective**

The student will be able to:

- Learn what a plant needs to grow (light, water, gases, and nutrients)
- Distinguish between monocots and dicots
- Discuss energy than is transferred between sunlight and chlorophyll

## **Materials**

- Wheat seeds
- Large pine cones
- Water
- Medicine dropper

## **Background Knowledge**

Wheat is one of Virginia's top 20 commodities. Grown primarily in the piedmont region, this small grain is grown over 155,000 acres and yield cash receipts of 39.6 million dollars annually according to 2006 data. Wheat is a hardy crop and withstands winter temperatures. Generally it is planted in the fall following the harvest of corn and soybeans. Wheat grows throughout the winter especially as spring temperatures rise. As the plant matures the growth rate accelerates. Wheat can be used for fall or spring grazing, hay or silage. Wheat varieties range in height of maturity with the hay and silage varieties growing much taller for a greater yield. Wheat grown for grain should not be grazed. An acre of small-grain pasture can carry approximately 500 pounds of live weight per acre.

Watching the germination of a seed is interesting to observe, especially when it occurs on unusual surfaces. Grass germinating in the crack of a sidewalk and grains growing in the back of an empty wagon appear quite strange and fail to produce a full grown plant. The initial amount of growing medium, moisture, and warmth are present facilitating germination. Prompt a question to your class about where seeds choose to germinate. Can a small seed such as wheat grow on a hard undesirable surface such as a pine cone? What might happen if germination occurs? This experiment leads students to hypothesize about plant growth, phototropism, and even erosion.

## **Procedure**

1. Soak pine cone in water for 5 minutes.
2. Drop oat seeds in each rung of pine cone.
3. Set pine cone in a sunny window.
4. Water each seed daily with a medicine dropper. (Turn pine cone for a full pet, but if trying to show phototropism leave pine cone in one position)
5. Write down daily observations. (Especially note the root system)
6. Discussion questions:
  - How would this project work with other monocots?
  - Would this project work with a dicot plant? Why or why not?
  - How would this help to solve the food crisis if growing space was the issue? What about seasonality?



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### **Extension**

Note: This whole process takes about two weeks. After two weeks the roots will then destroy the pine cone and you can lead the students to discover the strength of the roots. The plants will also start to die because of lack of nutrients and being root bound.

- Have the students give the pine cone liquid nutrients to see how long the oats will grow.
- Have a farmer come to the class to talk about farm life, and what they think happened inside the pine cone. (Tell the farmer ahead of time about the project)

### **Credit**

Lesson created by Rebecca Gaulding

### **References**

<http://www.ext.vt.edu/pubs/cses/424-006/424-006.html>

<http://www.deq.state.va.us/vanaturally/guide/agriculture.html>

<http://teacher.scholastic.com/dirt/erosion/whateros.htm>



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# Human Traits

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## **Standards of Learning**

Science LS.1, LS.13, LS.14

Math 6.2, 6.4, 6.6, 6.18, 7.1, 7.4, 7.17, 7.18

English 6.1, 6.2, 6.6, 7.1, 7.8

History CE.1

## **Objective**

Students will:

- Attain a deeper understanding of genetic engineering as the newest form of agriculture
- Understand that genetic engineering is the perfect mix of biology and agriculture
- Demonstrate that when two plants, animals or humans cross paths they pass their traits onto new generations

## **Materials**

- PTC strips
- 1 worksheet per student
- Overhead with major categories written

## **Background Knowledge**

The genotype-phenotype distinction must be drawn when trying to understand the inheritance of traits and their evolution. The phenotype represents the appearance of an organism.

Phenotypes such as eye color, hair color, hair texture, hair curl, ear lobe attachment, hitching of the thumb, the ability to roll the tongue, the taste bud for bitterness, widow's peek, and arching of the sole of the foot, can be used to illustrate phenotype in humans. The genotype represents the genetic makeup of a living organism. The genotype is made up of two equal genetic materials from both parents. The dominant trait will be evident in the offspring. The dominant trait is characterized by a capital letter while the recessive is shown as a lower case.

## **Suggested Traits to Investigate:**

- |                         |                   |                                           |
|-------------------------|-------------------|-------------------------------------------|
| • Widow's Peak          | • Can roll tongue | • Allergies                               |
| • Eye color             | • Dimples         | • Top thumb when hands are clasp together |
| • Hair color            | • Right-handed    | • Colorblindness                          |
| • Hair texture or curl  | • Freckles        | • Arching of the sole of the foot         |
| • Hitching of the thumb | • Cleft chin      |                                           |
| • Ear lobe attachment   | • Taste buds      |                                           |

## **Procedure**

1. Enlist class participation to create a list of 10 physical traits to compare and record traits on the front of the data sheet. Students may choose items as simple as how many are wearing tennis shoes or true phenotypes (listed above).
2. Have students predict how many people in the class will have each trait and record on the front of their data sheets.
3. Create teams of 2-4 for the students. (This will take less time on data collection and ensure it is all collected)
4. Provide students an opportunity to collect data with their team on the chart on the back of their data sheet to determine the number of students with each character trait.



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5. At the end of the set time, the students must report the data that they collected. Select a spokesperson for each group to report.
6. Collect data on an overhead to provide a class record of the event.
7. Answer questions on the data sheet.
8. Have students construct a chart showing the prevalence in the classroom. Using the class data set find the ratio of the class possessing each phenotype. Convert each ratio to a percent. (Review dominance and recessive and see if they hold true in the classroom)
9. Discussion Questions:
  - What are some of the problems we have with plants and animals (ie.. disease, deformities etc..)?
  - What genetic traits would humans look for in plants and animals (e.g. Disease resistant, strong muscles, high milk producer etc.)?
  - How can genetic engineering help with those problems?
  - What are the controversies and debates about genetic engineering?

### **Extension**

- Have students make a graph of matching traits.
- Get information from the parents, or extend the testing group by having the students get the said traits from at least 5 other people....does having more people change the validity of the information? How large should a testing group be?
- Have students come up with a list of traits that they are said to have inherited from their relatives.
- Complete a Punnet Square of each trait.
- Have a debate on biotechnology and cloning.
- Have students come up with ways that we have contact with biotechnology everyday.

### **Reference**

<http://learn.genetics.utah.edu>



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Name: \_\_\_\_\_

## Investigating Human Traits

### ***Traits and Predictions***

As a class, develop a list of 10 traits to compare with the students in your class. Do you have the trait? Make predictions on how many students in your class will have each trait.

| Trait | Description / Phenotype | I have this trait.<br>YES/NO | PREDICTION:<br># of Classmates with Trait |
|-------|-------------------------|------------------------------|-------------------------------------------|
| 1     |                         |                              |                                           |
| 2     |                         |                              |                                           |
| 3     |                         |                              |                                           |
| 4     |                         |                              |                                           |
| 5     |                         |                              |                                           |
| 6     |                         |                              |                                           |
| 7     |                         |                              |                                           |
| 8     |                         |                              |                                           |
| 9     |                         |                              |                                           |

### ***After the lesson:***

1. How did your predictions compare with the actual results?
2. Which traits had the highest percentage or ratio of students with the trait?
3. Which traits had the lowest percentage or ratio of students with the trait?
4. Which traits do you have in common with most of your class?

### ***Investigations***



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Meet with your group to see how many students in your class have each trait. Put a tally mark for YES or NO for each trait. What are the ratios and percentages for each trait? What traits do you have in common with other students in your class?

| Trait | Tally<br>YES | Tally<br>NO | Ratio with trait:                                 | Ratio without trait:                             | Percent<br>Who<br>Match Me |
|-------|--------------|-------------|---------------------------------------------------|--------------------------------------------------|----------------------------|
|       |              |             | $\frac{\# \text{ Yes}}{\text{Total \# Students}}$ | $\frac{\# \text{ No}}{\text{Total \# Students}}$ |                            |
| 1     |              |             |                                                   |                                                  |                            |
| 2     |              |             |                                                   |                                                  |                            |
| 3     |              |             |                                                   |                                                  |                            |
| 4     |              |             |                                                   |                                                  |                            |
| 5     |              |             |                                                   |                                                  |                            |
| 6     |              |             |                                                   |                                                  |                            |
| 7     |              |             |                                                   |                                                  |                            |
| 8     |              |             |                                                   |                                                  |                            |
| 9     |              |             |                                                   |                                                  |                            |
| 10    |              |             |                                                   |                                                  |                            |



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# Inspecting Virginia Pines

## Standards of Learning

Science 6.1, LS.1, LS.4, LS.5, LS.11

## Objective

Students will:

- Make observations of plants, trees, and leaves around the school
- Apply know of microscope use
- Make slides with Virginia pines using the wet mount method
- Observe leaf sample slides under a microscope
- Record and compare observations
- Identify plants and trees in the area
- Recognize the importance of trees to Virginia agriculture

## Materials

- Various leaves (including conifers [evergreen])
  - Use at least 1 type of Virginia grown pine
- Slides and covers
- Water
- Eye dropper
- Microscope

## Background Knowledge

Virginia's soil and climate are ideal growth conditions for certain varieties of conifers. These evergreens are used as cut Christmas trees as well as planted for planting in yards or forming wind breaks.

The Christmas tree industry is becoming a major aspect of Virginia Agriculture. These evergreens can be found throughout the state, as well as in your region. Some popular species grown in Virginia include:

| <u>Costal Plain</u> | <u>Piedmont</u> | <u>Mountains</u> |
|---------------------|-----------------|------------------|
| White Pine          | White Pine      | White Pine       |
| Scotch Pine         | Scotch Pine     | Scotch Pine      |
| Virginia Pine       | Virginia Pine   | Virginia Pine    |
|                     | Norway Spruce   | Norway Spruce    |
|                     |                 | Fraser Fir       |

\*information found at [www.ext.vt.edu/pubs/forestry/420-082/table1.html](http://www.ext.vt.edu/pubs/forestry/420-082/table1.html)

The Virginia pine's needles occur in pairs. They are twisted and range from 1.5 to 3" in length. They are relatively short when compared to those of other pines. Loblolly needles, by comparison, are from 4 to 9" long. Individual needle clusters can remain for 3 or 4 years. They are then shed and replaced with new needles as the branches grow in length. The branches are stout and woody. The bark is typical for most pines. It forms plates that are reddish brown in color with shallow fissures or furrows. The bark has a coarse appearance. Cones begin forming in about the fifth year. They are about 2 inches long and are protected by quite prickly scales. Pollination occurs in early June and cones mature in late September to early November of the



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following year. Open pollination is used in most Virginia pine seed production. Virginia pine responds well to trimming. And, on Christmas tree plantations their foliage can become extremely dense. As with other pines, these show a tendency to self pruning when grown with competition from other trees. This characteristic becomes apparent after about the sixth year as the lower limbs begin to wither. Virginia pine has been the staple for the Christmas tree industry in the south since its inception.

### **Procedure**

1. Take a nature walk with students and make observations about the trees and plants around the school.
2. Record observations and make sketches in their science journals about the type of trees and plants, leaves, size, etc.
3. Students should collect samples of leaves from the ground around the plants.
4. In the classroom, make slides with the leaf/needle samples.
  - a. Place leaf/needle sample on slide.
  - b. Cover sample with a drop of water.
  - c. Place a slide cover over the sample.
5. Use microscopes to view the leaf sample slides.
6. Record observations in science journals and compare microscope observations with “naked eye” observations from outside.
7. Have students rotate around the room to different microscopes to compare a variety of leaves.
8. Discuss how trees are important to Virginia agriculture – forestry, Christmas trees, plant products, etc.

### **Extension**

- Discuss the structure of the trees, plants, and leaves.
- Observe the plant cells.
- Research the types of trees grown in Virginia and locally in the region.
- Research the use of trees in Agriculture, including the products created from trees and plants.

### **References**

<http://www.ext.vt.edu/pubs/forestry/420-082/table2.html>  
[www.evergreen.ca](http://www.evergreen.ca)



*For more resources to connect children to agriculture visit [AgInTheClass.org](http://AgInTheClass.org).*

# Interactions among Predator and Prey

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## **Standards of Learning**

Science LS.1, LS.9

## **Objective**

Students will:

- interpret, analyze and evaluate data from an experiment on predator-prey interactions.

## **Materials**

- 200 small squares of card stock paper for each group (represents prey)
- 50 large squares of card stock paper for each group (represents predator)
- data table for each group
- blank graph paper for each group
- set of lab directions for each group

## **Background Knowledge**

In a community, populations interact with other populations by exhibiting a variety of behaviors that aid in the survival of the population. Organisms may coexist, form symbiotic relationships, and be dependent on one another. On the other hand organisms may also compete with one another for food or survival. The battle between organism on the various levels of the food chain is about survival of the species as a whole not just one animal or plant.

## **Procedure**

1. Please clear your lab space as this represents your ecosystem. (Lab tables work best for this activity).
2. Place three prey (small squares) on your table.
3. Toss one predator onto the table (evenly dispersed) and attempt to make the card touch as many "Prey" as possible. In order to survive, the predator must capture at least 3 prey. It will be impossible to survive at this point.
4. Remove any prey capture and record your data for the first generation.
5. The prey population doubles each generation. Count how many prey you have left on your table, double that number and add prey cards to the table. Record the number in the data table under the second generation "number of prey". (It should be twice the number you have under the "prey remaining" for generation 1).
6. Your predator died in round 1, but that's okay, a new predator moves in for the second round. If your predator died, put 1 in "number of predators" for generation 2 to represent the new arrival. Repeat the tossing procedure and record your data for the second generation.
7. Again, number of prey doubles, if your predator didn't capture 3 prey, it died. But a new one moves in for the next round. Keep going, adding to the number of prey each round.
8. Eventually your predator will be able to capture enough prey to survive. Guess what happens? The number of predators will double. Add to your



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predator population by adding predator cards. Now when you toss your predators, you will be tossing more than one. Don't forget to move "captured" prey.

9. Continue to record the data through 20 generations.
10. Once your data table is complete, construct a graph of your results. On the x-axis, put generations 1 through 20. On the y-axis, you will have the population numbers for each generation (number of predators, number of prey). Use one line for the predator and one line for the prey to graph the data.
11. Write your conclusion about the relationship of predators and preys based on the data that you have gathered.
12. Discussion Questions:
  - What animals could be inserted for the pieces of paper?
  - Do you think the simulation is close to what happens in the wild? Why? Why not?

| Generations | 1st | 2nd | 3rd | 4th | 5th | 6th | 7th | 8th | 9th | 10th | 11th | 12th | 13th |
|-------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
|-------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|

Number of  
Predators

Number of Prey

Remaining Predators

Remaining Prey



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# Is It A Test?

---

## **Standards of Learning**

Science 6.9

## **Objective**

Students will:

- prove that all soils are not the same.

## **Materials**

- Various soils (either brought in by teacher or students)
- Stopwatch per group
- Water
- 3 large clear cups per group
- 3 small clear cups per group
- 1 large beaker per group

## **Background Knowledge**

There are three main types of soil—sand, silt and clay. When all three are mixed together they create loam. Humus, anything in the process of decaying, is the organic matter found in soil. In this activity, the students will take soil samples, place them in a jar with water, then shake. The soil will settle out in different layers. Sand, being the largest and heaviest soil particle, will settle at the bottom of the container first. Silt, a fine textured soil that feels like talcum powder, settles out next. The final soil, clay, will settle out last. Clay is the smallest and lightest particle of soil. The material floating on top of the water will be organic matter in the process of decaying.

This lesson will review the layers of soil as they are in the ground. On the bottom is bedrock, which is the parent material for the soil that will not be shown until erosion or an earthquake exposes it to the world. Next is subsoil, which is mostly sand/silt and clay. This is where most of the nutrients are found and deep plant roots will come here for water. Next is topsoil, which is where plant roots grow and animals live. This is sometimes called the organic layer where decomposers recycle dead plants and animals into the top layer. On top is humus, which includes more decomposing organic material.

Pamunkey soil is the state soil of Virginia. The James River crosses the entire state and carries soil from all areas, which it deposits on what are called flood plains. These soils are made up of sediments from all over the state. The soil is called Pamunkey soil after the Pamunkey River, which was named after an Indian tribe that lives along the river today. Pamunkey soils were first identified on a farm near Jamestown, VA, which is known as the oldest tilled farm in the United States. Pamunkey soils are prime agriculture soils in Virginia and occur on about 30,000 acres. Extensive areas of Pamunkey soils have been mapped in the counties of Charles City, Chesterfield, Essex, Goochland, Hanover, Henrico, James City, New Kent, Prince George, Richmond, Westmoreland, and York. Pamunkey soil is the most fertile because it contains a little bit of sand, silt, and clay to make for an abundant crop. The surface is dark brown fine, sandy loam, the upper and lower subsoils are yellowish red clay loam and yellowish red sandy loam. Lastly, the substratum is a yellowish and reddish brown with stratified sand and gravel.

Review the types of soil available in Virginia. Where are sand, silt, and clay located in the state? Discuss which soil type is most prevalent in your area.



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### **Procedure**

1. Label large cups A, B, and C and poke small hole in the bottom of the cup.
2. Get three different types of soil from your teacher, and place in cups labeled A, B, and C.
3. Fill beaker with 100 ml of water
4. Place larger cup A into small cup, and slowly pour 100 ml of water into cup A. When water starts coming out of the bottom start the stop watch keep timing until the water stops.
5. Repeat Steps 3 and 4 with cups B and C.
6. Record times for all cups.

| Material | Observation | Time |
|----------|-------------|------|
| Cup A    |             |      |
| Cup B    |             |      |
| Cup C    |             |      |

### 7. Discussion Questions:

- Which soil had the fastest time?
- Which soil had the slowest time?
- Why do you think the times were different?
- What occupations do you think would care about these results?

### **Extension**

1. Invite a hydrologist in the day that you do this lab.
2. Test for things other than permeability, such as acidity, nitrogen level, etc.



# Junior's Family Tree

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## **Standards of Learning**

Science 4.5, 4.8, 5.5, LS.13

Math 4.19, 5.17, 6.20, 7.14, 7.15, 7.17, 7.18

English 4.1, 4.3, 4.6, 4.7, 4.8, 5.1, 5.2, 5.4, 5.7, 5.8, 5.9, 6.1, 6.4, 6.5, 6.6, 6.7, 7.6, 7.7, 7.8, 7.9

## **Objective**

Students will:

- Show that traits are passed on from one generation to the next

## **Materials**

### ***For Teacher:***

Meet Junior: A Quart of Paint, An Interview With a Horse Breeder (handout provided)

Junior's Relative Fact Sheet – Teacher's Copy (handout provided)

### ***For each Student:***

Meet Junior: A Quart of Paint, An Interview With a Horse Breeder (handout provided)

Junior: A Quart of Paint Activity sheet (handout provided)

### ***For Each Team:***

- Junior's Family Tree Team Project (handout provided)
- Junior's Relatives Fact Sheet (handout provided)
- Color Junior (handout provided)
- Family Tree Horse Templates (handout provided)
- Chart paper
- Glue
- Markers/crayons/colored pencils
- Rulers

## **Background Knowledge**

Throughout history, many animals and plants have been bred to perpetuate certain traits. Horses, cows, tomatoes, corn and strawberries are just a few examples of living things that have been selectively bred by humans. Breeders of horses are very aware of horse family traits. The horse traits they breed can be visual, such as hair coloring and muscularity, or intangible, such as temperament and health characteristics.

Traits are passed down through genes in cell. Genes are made of DNA molecules. Each parent contributes one half of the genetic makeup of offspring. Your students will learn more about cells, chromosomes, and the details of heredity as they learn about the cell.

This lesson includes an interview with a horse breeder and shows students that certain traits are passed on from one generation to the next. The students will trace the family history of a horse named Junior and learn why he has the characteristics he does. Feel free to extend this activity, and have students observe and review their own family traits.

## **Procedure**

1. Explain to the students that they are about to read an interview with a horse breeder. Read aloud and discuss Meet Junior: A Quart of Paint with the class.
2. Distribute the Junior: A Quart of Paint activity sheet to each student. Individually, have the students review the interview and then complete the worksheet. Share and discuss the student worksheets.



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3. Divide the students into groups of three or four. Review the Junior's Family Tree Team Project with your students and set guidelines for group work. The more organizational structure you provide at the onset, the more successful the students will be. Have the students complete the Junior's Family Tree Team Project.
4. At the completion of the activity, have student groups display Junior's Family Tree. Discuss the similarities and differences between the family tree diagrams. Keep in mind that the students should not be graded on "right" or "wrong" answers in this activity. They should be assessed on how well they thought out the "blue-eyed" question and how well they worked in their groups.
5. Discuss that Junior obtained half of his genes from each parent and that his parents obtained half of their genes from their parents. Since blue eyes are a recessive trait, blue-eyed genes had to come from both sides of Junior's family. Discuss as much or as little of this as you feel appropriate.
6. Have the students complete a paragraph that starts with a sentence similar to the one written below:

"I learned quite a bit about traits and heredity while charting Junior's family tree".

- Choose a different animal (steer, dog) and discuss its family tree.
- Have students do the activity individually rather than in groups.

### **Extension**

- Invite a horse trainer to class to discuss how certain characteristics affect a horse's ability to perform certain functions.
- Have students research the characteristics needed to be a good cutting horse, racehorse, riding horse, or a horse that is part of a transport team.
- Discuss that human traits are passed on from one generation to the next. Have students give examples of traits they have inherited from their ancestors. Remember that inherited traits are not always visual but may include traits such as health and temperament. Discuss how family members feel about the traits changed over time.
- Have students make a personal family tree by interviewing an older family member.
- Have students research how certain plants and animals have been selectively bred for certain characteristics. Good examples include corn (maize), cows, figs, grapes and cotton.
- Invite a seed-manufacturing representative to class or take a field trip to a seed company. Discuss the processes used to produce seeds that have desirable traits.
- Collect seed packets of different varieties of the same item such as corn, beans, or radishes. In groups, have students read the packets and analyze what characteristics they think were selectively bred for home gardeners (for example, long beans, sweet corn, mild tasting radishes, etc.).
- Have the students read the story *Corn is Maize* by Alikei (see page 67). Discuss how corn was selectively bred over time to produce the corn we have in the marketplace today.



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## MEET JUNIOR: A QUART OF PAINT

### An Interview with a Horse Breeder

- Narrator:** *Horses are used in a variety of ways-for working on cattle ranches, for racing, for show, for strength, etc. In this interview, you will learn about a horse named Junior: A Quart of Paint! He is part quarter horse and part paint horse. Can you figure out how he got his name? You will have another little mystery to solve as soon as this interview is over.*
- Owner:** Welcome to my family's ranch. My name is Karen.
- Interviewer:** How long have you lived here?
- Owner:** I have been breeding paint and quarter horses since 1988. However, my family has been breeding horses since the early 1950's. We have owned this property since 1961.
- Interviewer:** Who is this interesting horse? *(Interviewer points to a horse)*
- Owner:** He is part paint horse and part quarter horse. Meet Junior: A Quart of Paint.
- Interviewer:** What beautiful eyes he has!
- Owner:** I know! It was a real surprise when he opened his eyes for the first time. Both of his parents have brown eyes!
- Interviewer:** Tell me a little bit about paint horses and quarter horses.
- Owner:** Well, quarter horses have a special build *(She points to Junior as she talks)*. They generally have big hips, a short back, a nice long neck, and a small head. Quarter horses are bred for these characteristics. Junior is also part paint horse. A paint horse is a special kind of quarter horse. Paint horses are known for their coloring. Junior's base coloring is bay *(a brownish color)*, but he has lots of white hair. It looks as though he has been painted with white paint. When I breed for offspring, I want horses with "painted" coloring and the nice build of an attractive quarter horse.
- Interviewer:** Tell me what quarter horses and paint horses are used for.



**Owner:** There are many breeds of horses. Quarter horses are generally used for riding and cutting cattle. Cutting cattle means to remove a particular steer or cow from a herd of cattle and make it go where you want it to. Paint horses are also often used for pleasure riding and showing. Junior, here, would be a good horse for a young person to own. He could be a real good show horse some day. He has a real sparkle in his eye and has a lot of personality. He also has great lines.

**Interviewer:** Tell me a little about his coloring.

**Owner:** He has brown markings on his head up to his ears. We call this a “medicine hat”. Since his face is all white, we call it a “bald face”. See here (*she points toward the mane and tail*)... he has black markings on the tip of his tail and on the part of his mane that hangs down on his forehead. All of these things are markings that an owner may or may not want on a paint horse.

**Interviewer:** Tell me about his parents.

**Owner:** Junior’s mother is a mare named Heart’s Delight. She is bay colored (brownish) and has a white tail with a black tip. Her legs are white and her neck and back are somewhat short. She has brown eyes. She is a very gentle horse but is very lively. In fact, I think she is more lively than Junior. By the way, she is called a dam because she is a mom.

**Interviewer:** What about Junior’s father?

**Owner:** Well, we call the father of a horse a sire. His name is Triple Feature. He is a sorrel colored (*a light reddish brown*) quarter horse. His hair, mane and tail are all sorrel colored. His is a beautiful horse. I especially like his blaze face. A blaze face is one like this horse has here. (*She points to a horse that has a white strip that runs between his eyes and down to his nose.*) Junior’s father is not quite as big as Heart’s Delight. He’s very calm and pleasant with good athletic ability. Junior has great athletic ability, too.

**Interviewer:** What color are Triple Feature’s eyes?

**Owner:** His eyes are brown! That is why I was quite surprised to see that Junior’s eyes are blue.

**Interviewer:** Where did he get his blue eyes then?

**Owner:** Well, I can tell you a little about Junior’s grandparents. That may help!



**Interviewer:** Great! But I only have a few minutes before I have to head back to the office. Let's go for it! This is getting interesting.

**Owner:** Junior's mother's mother, known as a second dam, was named Pretty Papoose. She was a paint horse with brown and white body hair. She had four white legs and a blaze face. She was owned by some children. Junior's grandfather on his mother's side (known as a "dam sire") is named Dixie Wardrum. He is part paint and part quarter horse and lives on our ranch. He is very gentle and docile. He is bay and white with four white socks, which are white markings on his lower legs-like socks! He has sparking brown eyes.

**Interviewer:** Wow! You certainly know a lot about Junior's relatives. Can you quickly tell me about his other two grandparents?

**Owner:** Certainly. I know all of this information because in the horse breeding industry it's very important to know the history of your horse. We register our horses. Junior's father's mother, I guess I can call her the sire's dam, is named Welcome Home. She has an elegant long neck and is bay colored with a black mane and tail. She has four white socks. Welcome Home is a very gentle horse.

**Interviewer:** I am enjoying hearing the horse's names. Someday you will have to tell me how horse breeders name their horses. Anyway....I think you have to tell me about one more grandfather.

**Owner:** Yes! Junior's father's father, known as a sire's sire, is called Triple Tough and is a quarter horse. He has two white socks on his hind legs and brown eyes. He was one of my first horses. He's a bit wild and difficult to work with, but he certainly is a beautiful horse!

**Narrator:** *As the owner and interviewer walk back to the ranch entrance, they stop and look at Junior one more time. He is eating grass in the pasture. He looks up at the two.*

**Owner:** Junior likes to eat hay and grain with rice bran in it. But he also loves spending his days in the pasture. I hope Junior will make a good show horse or good working cattle horse. We'll just have to wait and see how well he does as he grows and gets trained.

**Interviewer:** Look! Junior's looking right at me. His eyes are so sparkling! Well, you never did tell me how Junior got those beautiful blue eyes! I guess I will have to figure that out on my own!

**Owner:** Thank you for stopping by. Come back anytime to see Junior.

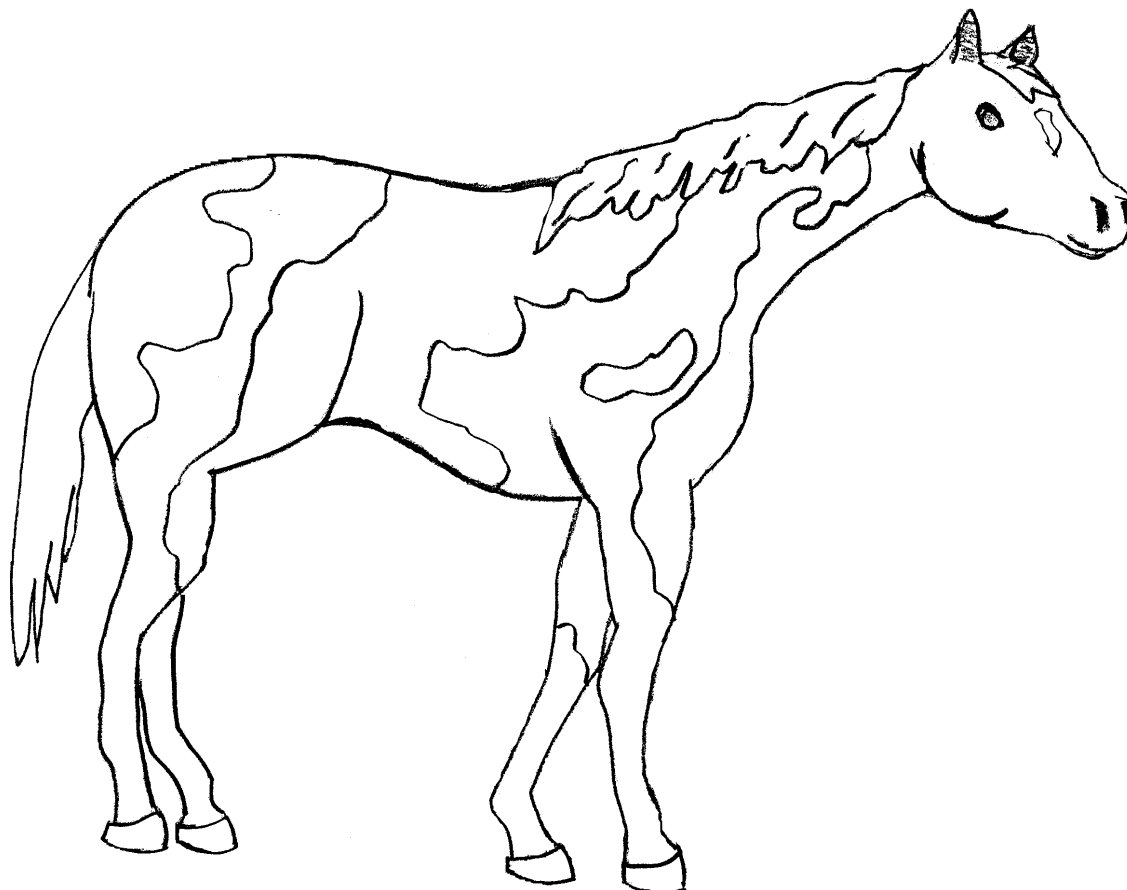
**Narrator:** *So, how did Junior get those blue eyes!*



Name: \_\_\_\_\_ Date: \_\_\_\_\_

## Junior: A Quart of Paint Activity Sheet

After listening to the interview about Junior, color the picture as realistically as possible.



1. What are some characteristics of Junior that you were unable to show by coloring?

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2. After discussing your drawing with your classmates, are there any changes you would make to the picture you colored of Junior? If so, what would they be?

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---

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Name: \_\_\_\_\_ Date: \_\_\_\_\_



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# Junior's Family Tree Team Project

Horses are necessary on many farms in the United States today. Cattle ranchers use horses to round-up cattle. Certain horses are preferred for this job because they require particular characteristics. Can you imagine a rancher riding a horse that was not fast enough to help rope a calf, or a horse whose legs were too wobbly to climb a rocky mountain? Horse owners not only choose their horses for strength and agility, but they also choose horses for their temperament and appearance. As you complete this activity, you will see that horse breeding is a very complex science.

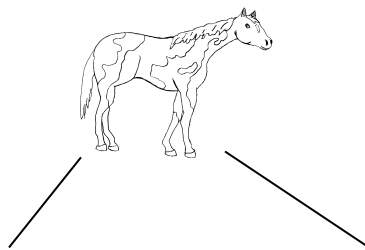
Your team will create a model of Junior's family tree using facts that you obtained from his breeder during the interview and by making assumptions of your own. Junior has a combination of his mother's and father's genes. Junior's mother and father got their genes from each of their parents. Complete the following procedure to make Junior's family tree and determine how Junior got his blue eyes!

## Materials

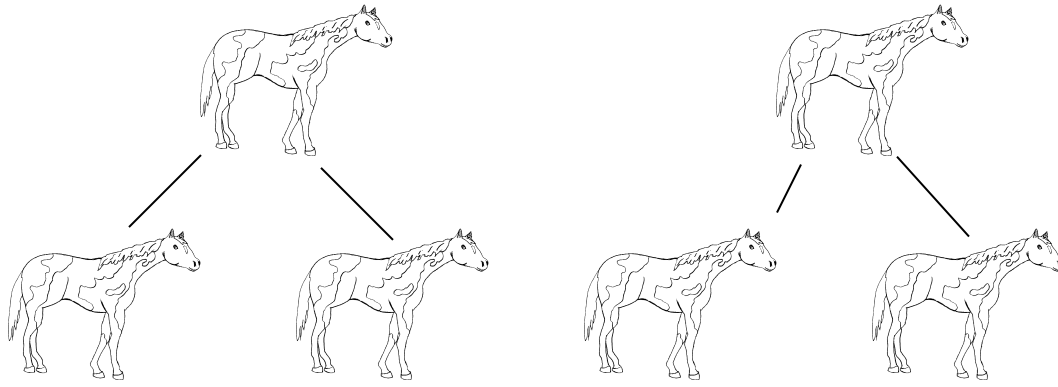
- *Meet Junior: A Quart of Paint*, An Interview with a Horse Breeder
- *Junior's Relatives Fact Sheet*
- *Color Journey* handout
- *Six Family Tree Horse Templates*
- Large sheet of chart paper
- Markers, crayons or colored pencils
- Black marker
- Ruler
- Glue

## Procedure

1. Establish a neat and organized work place for your team.
2. Organize the material provided by your teacher.
3. Fill in the facts you learned from the interview about Junior and his relatives on the *Juniors Relatives Fact Sheet*.
4. As a group, review what Junior really must look like. Have someone in the group color Junior's picture on the *Color Junior* handout.
5. Make a rough sketch of Junior's family tree using the following diagram as a guide.



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Your rough sketch should include descriptions of each relative in the family tree. The descriptions should include appearance as well as characteristics you cannot see. Have your teacher approve your rough sketch.

6. Make your final display of Junior's family tree on the large sheet of chart paper. Your family tree must include the following items.
  - The names of your group members
  - Accurately colored pictures of each relative
  - Written descriptions of characteristics one cannot see for each relative
  - Lines that accurately connect one horse to the next
  - A written explanation describing where Junior got his blue eyes
  - Any facts or details your group would like to add

## Junior's Relatives Fact Sheet

Teacher's Copy

### Junior

Quarterhorse/paint horse  
Bay colored (brownish)  
Lots of white hair  
Medicine hat (Brown markings on his head)

### Pretty Papoose

Paint horse  
Bay colored  
White legs  
Blaze Face



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Up to his ears)  
 Bald fact (white face)  
 Black markings on tail tip and on forehead mane  
 Blue eyes  
 Big hips  
 Short back  
 Long neck  
 Small head  
 Good, lively personality  
 Great athletic ability

### Heart's Delight

#### Junior's Mother (dam)

Brown eyes  
 Bay colored (brownish)  
 White tail with black tip  
 White legs  
 Short neck and back  
 Lively

### Triple Feature

#### Junior's Father (sire)

Quarterhorse  
 Brown eyes  
 Hair, mane and tail are sorrel (light reddish Brown)  
 Blaze face  
 Calm and pleasant  
 Good athletic ability

Gentle

### Dixie Wardrum

#### Junior's Mother's Father (dam's sire)

Quarterhorse/Paint horse  
 Bay colored  
 White socks  
 Brown eyes  
 Gentle and docile

### Welcome Home

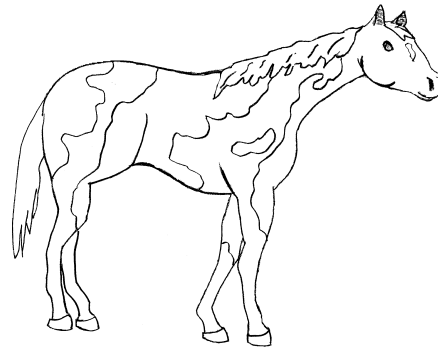
#### Junior's Father's Mother (sire's dam)

Bay colored  
 Black mane and tail  
 White socks  
 Long neck  
 Gentle

### Triple Tough

#### Junior's Father's Father (sire's sire)

Quarterhorse  
 Two white socks  
 Brown eyes  
 Wild



Name: \_\_\_\_\_ Date: \_\_\_\_\_

## Junior's Relatives Fact Sheet

Fill in the chart below with as many facts as you can about Junior and his relatives. Use this chart to help create Junior's family tree display. You may choose to make some hypotheses about some traits – if you do this, somehow mark that these are guesses and not actually proven facts.

| Junior | Pretty Papoose |
|--------|----------------|
|--------|----------------|



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|                                 |                                                 |
|---------------------------------|-------------------------------------------------|
|                                 | Junior's Mother's Mother ( <i>second dam</i> )  |
|                                 |                                                 |
|                                 |                                                 |
|                                 |                                                 |
|                                 |                                                 |
|                                 |                                                 |
|                                 |                                                 |
|                                 |                                                 |
|                                 |                                                 |
|                                 | <b>Dixie Wardrum</b>                            |
|                                 | Junior's Mother's Father ( <i>dam's sire</i> )  |
|                                 |                                                 |
|                                 |                                                 |
|                                 |                                                 |
|                                 |                                                 |
|                                 |                                                 |
| <b>Heart's Delight</b>          | <b>Welcome Home</b>                             |
| Junior's Mother ( <i>dam</i> )  | Junior's Father's Mother ( <i>sire's dam</i> )  |
|                                 |                                                 |
|                                 |                                                 |
|                                 |                                                 |
|                                 |                                                 |
|                                 |                                                 |
|                                 |                                                 |
|                                 |                                                 |
|                                 |                                                 |
| <b>Triple Feature</b>           | <b>Triple Tough</b>                             |
| Junior's Father ( <i>sire</i> ) | Junior's Father's Father ( <i>sire's sire</i> ) |
|                                 |                                                 |
|                                 |                                                 |
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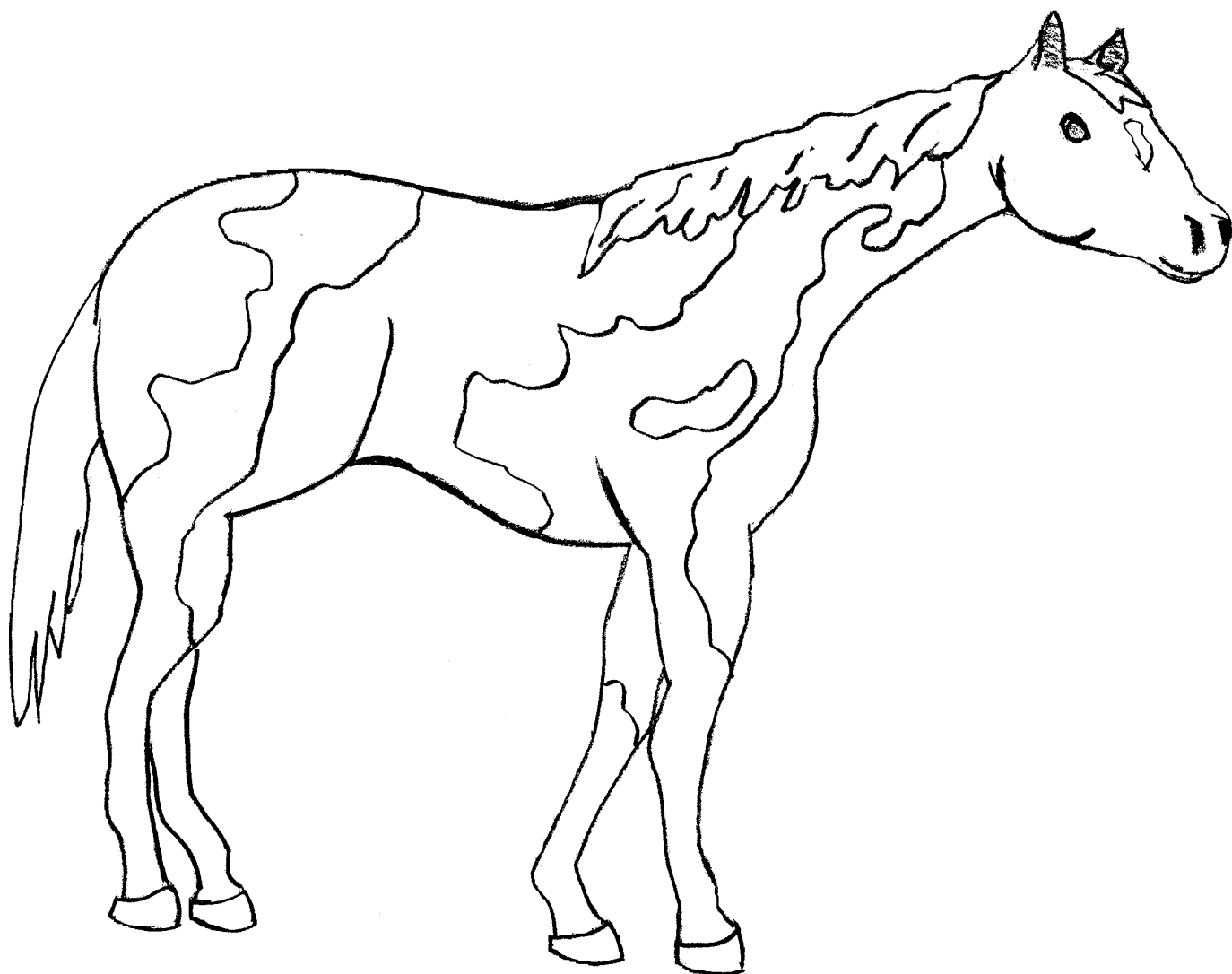
Name: \_\_\_\_\_ Date: \_\_\_\_\_

## Color Junior

After discussing what Junior looked like with your team members, color this picture accurately and use it to begin your family tree project.



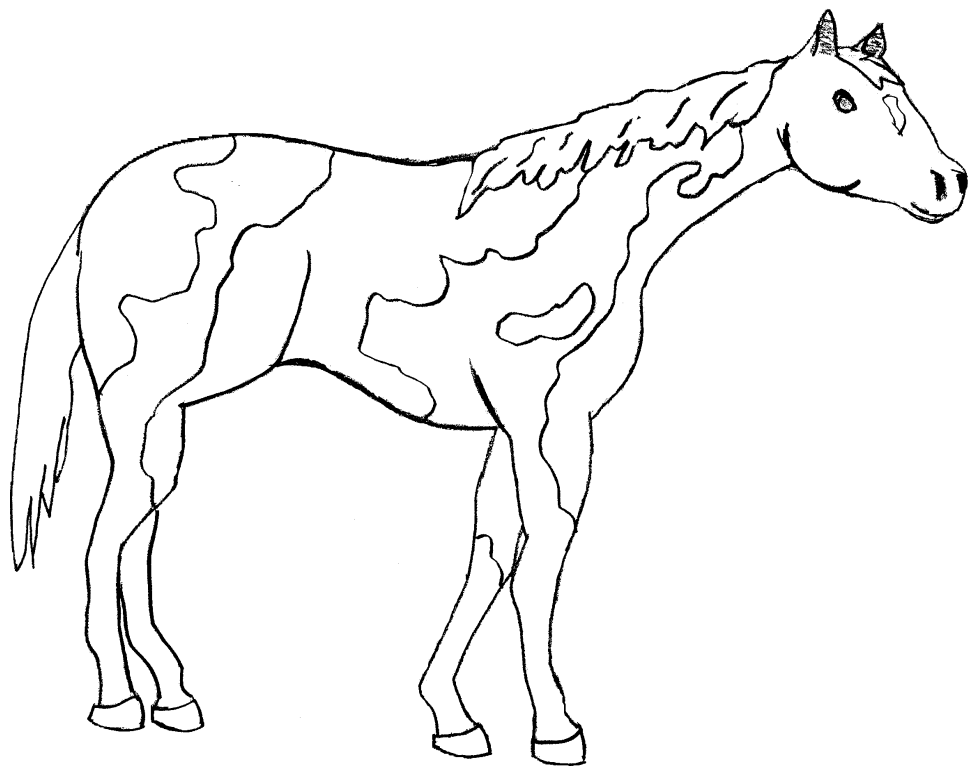
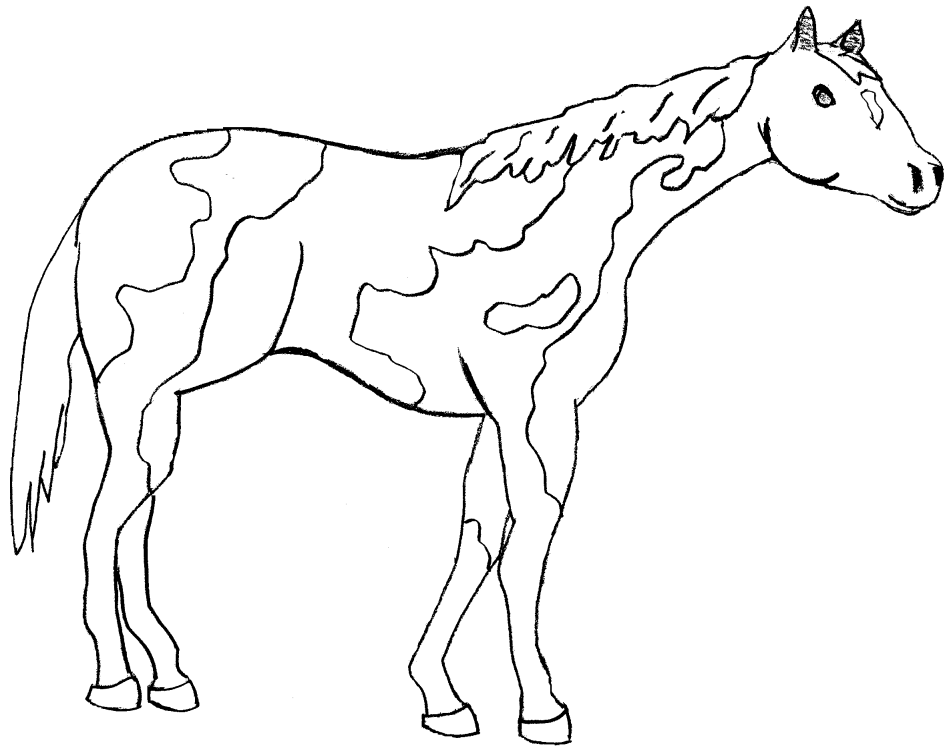
For more resources to connect children to agriculture visit [AgInTheClass.org](http://AgInTheClass.org).



## Family Tree Horse Templates



For more resources to connect children to agriculture visit [AgInTheClass.org](http://AgInTheClass.org).



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## Junior's Eyes

**Given: Blue eyes are recessive**    **Directions: Use the handout to determine the phenotype and possible genotypes for EYE COLOR.**

JUNIOR  
Phenotype \_\_\_\_\_  
Genotype(s) \_\_\_\_\_  
Possible \_\_\_\_\_

On the back, answer the following:  
1) Could all six of Junior's relatives have brown eyes? 2) Summarize your data by describing how Junior could end up with blue eyes. Include Punnett Square(s) to support your explanation.

Triple Feature  
Sire  
Phenotype \_\_\_\_\_  
Genotype(s) \_\_\_\_\_  
Possible \_\_\_\_\_

Heart's Delight  
Dam  
Phenotype \_\_\_\_\_  
Genotype(s) \_\_\_\_\_  
Possible \_\_\_\_\_

Triple Tough  
Sire's sire  
Phenotype \_\_\_\_\_  
Genotype(s) possible \_\_\_\_\_

Welcome Home  
sire's dam  
Phenotype \_\_\_\_\_  
Genotype(s) possible \_\_\_\_\_

Dixie Wardrum  
dam's sire  
Phenotype \_\_\_\_\_  
Genotype(s) possible \_\_\_\_\_

Pretty Papoose  
dam's dam  
Phenotype \_\_\_\_\_  
Genotype(s) possible \_\_\_\_\_

**Junior's Eyes – KEY B<sub>1</sub> = brown, bb = blue**



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**Given: Blue eyes are recessive    Directions: Use the handout to determine the phenotype and possible genotypes for EYE COLOR.**

Triple Feature  
Sire  
Phenotype \_\_\_\_\_  
Genotype(s) \_\_\_\_\_  
Possible \_\_\_\_ Bb \_\_\_\_

Triple Tough  
Sire's sire  
Phenotype \_\_brown\_\_\_\_\_  
Genotype(s) possible \_\_ BB or Bb  
{NOTE: Both Triple Tough &  
Welcome can NOT be BB\*  
Welcome Home  
sire's dam  
Phenotype \_\_\_\_? brown or blue  
Genotype(s) possible: BB, Bb, bb

## JUNIOR

Phenotype \_\_blue\_\_\_\_\_  
Genotype(s) \_\_\_\_\_  
Possible \_\_\_\_bb\_\_\_\_

On the back, answer the following:  
1) Could all six of Junior's relatives have brown eyes? 2) Summarize your data by describing how Junior could end up with blue eyes. Include Punnett Square(s) to support your explanation.

Heart's Delight  
Dam  
Phenotype \_\_\_\_\_  
Genotype(s) \_\_\_\_\_  
Possible \_\_Bb\_\_

Dixie Wardrum  
dam's sire  
Phenotype \_\_\_\_\_  
Genotype(s) possible \_\_BB or Bb  
{NOTE: Both Dixie & Pretty  
{can NOT be BB\*  
Pretty Papoose  
dam's dam  
Phenotype? Brown or blue  
Genotype(s) possible BB,Bb,bb

\*If one parent is homozygous (BB) then the other must be either Bb or bb.



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# Making Plant Based Dyes

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## **Standards of Learning**

Science 6.1, LS.1, PS.1, PS.5

Social Studies USI.4, USI.5

## **Objective**

Students will:

- Conduct a scientific investigation to validate a hypothesis using controls, independent, and dependent variables.
- Conduct an experiment identifying chemical and physical changes of the dependent variable.
- Identify practices of colonial life in the Mid-Atlantic region.
- Explore the dyeing qualities of different plant materials which are mixed with hot water.

## **Materials**

- Vegetation samples for dyes (Red cabbage, carrot tops, beets, berries, birch leaves, parsley, mint, tea leaves)
- Water
- Vinegar
- Heat source such as a stove, hotplate, or microwave
- Hot water
- Heat-resistant containers
- Spoons or stir sticks
- White fabrics: cotton fabric or roping, cotton balls, wool yarn, wool athletic socks
- Trays lined with paper toweling
- Knife, scissors, or other safe cutting instrument
- Hammer (or mortar and pestle) for grinding the samples into tiny bits
- Tweezers
- Rubber gloves

## **Background Knowledge**

Throughout history mankind has used natural dyes to adorn clothing. In colonial times the color of clothing signified class and noted occasions. Roots, nuts and flowers are just a few common natural ways to get many colors. Early American colonists used (among other things) salt, vinegar, urine, and oak galls, which are the lumpy growths found on oak branches where insect larvae distort the normal growth. The ashes of burned juniper branches were used by Native Americans as well as used wood ash, rusty water and clay.

A number of methods can be used to dye fabric from plants. Plants are generally ground up and added to water then boiled. Cloth, yarn, or wool was then added to the boiling pot. Muslin, silk, cotton and wool work best for natural dyes and the lighter the fabric in color, the better. White or pastel colors work the best. Time and temperature played a factor in the intensity of color absorbed by the fabric. Metal pots themselves released metals into the dye baths, so copper, iron and other pots would sometimes yield different colors in the dyed product. Some colors permanently affixed to the fabric while others needed a mordant. A mordant was sometimes used to “fix” the dye color into a fabric. Vinegar and alum were often used for this purpose. Fabrics were treated pre and post dye.

Using a variety of fabrics and plants students can develop hypothesis regarding which fabrics take on color the best. In addition students will have the opportunity to analyze which plant materials yield the most intense dye. It's best to use an old large pot as your dye vessel. Wear rubber gloves



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to handle the fabric that has been dyed, the dye can stain your hands. It's also important to note, some plant dyes may be toxic. Practice lab safety throughout this or any experiment.

### Plants to Grow and Collect\* for Dyeing

| Color             | Plant                                               |
|-------------------|-----------------------------------------------------|
| <b>Blue</b>       | Leaves: red cabbage                                 |
|                   | Fruit: elderberries                                 |
|                   | Leaves & stems: tomato plants                       |
| <b>Yellow</b>     | Leaves: mint, parsley, birch, onion skin            |
|                   | Flowers: chamomile, dandelion, marigolds, zinnias   |
|                   | Other: Paprika                                      |
| <b>Green</b>      | Leaves: carrots, red onion                          |
|                   | Flowers: black-eyed Susan                           |
|                   | Leaves & stems: spinach                             |
| <b>Orange</b>     | Flowers: dyer's coreopsis                           |
|                   | Other: turmeric                                     |
| <b>Gold/Brass</b> | Flowers: sunflower                                  |
|                   | Leaves & stems: cocklebur, dock, goldenrod          |
|                   | Seeds: sunflower                                    |
| <b>Tan/Brown</b>  | Leaves: birch                                       |
|                   | Nuts: acorns                                        |
|                   | Other: Coffee grounds, tea bags                     |
| <b>Magenta</b>    | Roots: dandelion                                    |
| <b>Pink</b>       | Leaves: red cabbage, strawberries, cherries, roses  |
| <b>Purple</b>     | Fruit: wild grapes, mulberries, beets, blackberries |
| <b>Red</b>        | Roots: madder                                       |
| <b>Black</b>      | Black walnut hulls                                  |

### Procedure

1. Each student will create a hypothesis regarding dying medium and dye. "If (independent variable) then (dependent variable)."
2. Students will choose a plant material and grind or cut the material into small pieces.
3. Add plant material and  $\frac{1}{2}$  cup of hot water to a container.
4. Add fabric material to container with plant material and hot water.
5. Soak material for 5 minutes.
6. Remove material with tweezers and spread on paper towel to dry.
7. Repeat adding 1 tablespoon of vinegar as a mordant.
8. Once dry test each fabric sample for colorfastness by adding water drops to fabric and observing changes in dyed fabric.
9. Additional trials may be conducted using various plant materials.
10. Record data including chart noting which planted were tested as dye to which fabrics, and whether a mordant was used.
11. Write a conclusion paragraph including whether the hypothesis was confirmed.



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| <b>Trial</b> | <b>Material Used</b> | <b>Independent Variable (plant dye)</b> | <b>Dependent Variable (dye result)</b> | <b>Colorfast test Results</b> | <b>Mordant</b> |
|--------------|----------------------|-----------------------------------------|----------------------------------------|-------------------------------|----------------|
| #1           | Ex: Cotton           | Beet                                    | Light Red                              | Color bleeds                  | Without        |
| #2           | Cotton               | Beet                                    | Light Red                              | Holds Color                   | With           |
|              |                      |                                         |                                        |                               |                |
|              |                      |                                         |                                        |                               |                |

### **Extension**

Increase the amount of time fabric is soaked in dye, water temperature, amount of mordant.

Use a copper pot for dying fabric. The copper reacts causing a chemical reaction and impacting dye color.

Attempt to remove stain from fabric. Discuss what seems to make some stains harder to remove, and how people may have learned in history what plants make good dyes.

### **References**

<http://www.nationalgardenmonth.org/index.php?page=dye>

<http://www.pioneerthinking.com/naturaldyes.html>

<http://www.kidsgardening.com/growingideas/PROJECTS/may03/pg2.html>



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# Making Waves

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## **Standards of Learning**

Science 6.1, 6.5, 6.7, LS.1, LS.7, LS.10, LS.12

## **Objective**

Students will:

- Explain how a wetland helps to control shoreline erosion, reduced flood damage, and provides a place for aquatic life to reproduce

## **Materials**

- 2 rectangular cake pans
- 2-3 lbs of clay
- Thin plastic strips (could be cut from plastic bottles)
- 1 carpet scrap
- Water
- Tape
- 2 popsicle sticks
- Topsoil
- Sand

## **Background Knowledge**

Wetlands serve an important function in the environment. Functions of wetlands include water quality improvement, erosion prevention, and flood control. They are critical to the survival of a wide variety of plants and animals, including many on the endangered species list. In the United States nearly 45% of the plants and animals on the endangered species list and watch list live in the wetlands. Wetlands also serve as a shelter for a great deal of wildlife during the cold weather months in the north. This environment is also an important fishing ground for U.S. fish and shellfish harvesting. Preservation and protection of our nation's wetlands is crucial to our environment and agricultural production.

## **Procedure**

1. Put topsoil in the center of pan 1. Form soil in a mound sloping upwards one end of the pan while leaving the other end bare.
2. Sink a piece of carpet into the top of the mound. This will serve as our simulated wetland "vegetation." Sprinkle topsoil over the carpet.
3. Cover the soil with clay to create an elevation to the mound and form a lagoon behind the mound.
4. Put sand in the center of pan 2. Form sand into a mound sloping upwards on one end of the pan while leaving the other end bare.
5. Cover the sand with clay creating an elevation to the mound and form a lagoon behind the mound.
6. Cut 2 pieces of plastic large enough to fit securely into the pans. Attach a Popsicle stick to the center of each piece of plastic. The plastic piece will be used to create waves.
7. Slowly fill each pan with water being careful to saturate the mound of soil, carpet, and filling the lagoon.
8. Use the plastic "wave generator" to create waves washing up on shore every 5 seconds.
9. Record observations for each pan.
10. Simulate a storm and create waves rapidly and strongly. Record observations.



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11. Summary questions:

- Which pan showed the most erosion?
- What function does the wetland serve?
- What protection did the lagoon have?
- Why do lagoons serve as good places for sea life to reproduce?
- How can preserving wetland benefit landowners, wildlife, and the community?

**Extension**

- Discuss causes of wetland loss.
- How can those involved with agriculture preserve wetlands?
- Describe how prosperity affects wetlands.

**References**

Lesson adapted from ***Agriculture and the Environment*** from American Farm Bureau Foundation for Agriculture copyright 2004.



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# Mummifying Apples

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## **Standards of Learning**

Math 6.10, 6.18

Science 6.1, 6.5, PS.1, PS.2

## **Objective**

Students will:

- conduct a scientific investigation to validate a hypothesis using a control and variables.

## **Materials**

- 2 fresh apples, each cut into quarters (per group)
- large box of table salt
- large box of Epsom salts
- large box of baking soda
- knife (for the teacher)
- eight 12-oz. disposable plastic cups (per group)
- measuring cup (one per group)
- large mixing bowl
- permanent marker
- masking tape
- scale
- graph paper

## **Background Knowledge**

Throughout history, countries have used mummification as a way to preserve their family members who have passed on. In order for mummification to occur, all the water must be removed from the body. Although the mummification process evolved over time, body preparers used a natural salt, natron (now called baking soda), to help dry out the body. This investigation will allow students to experiment with different minerals to determine which best dries out an apple. This lesson focuses on conducting an experiment using different salt compounds to determine which will best mummify an apple.

## **Procedure**

1. Pass out the apple slices (eight slices), eight cups, and pieces of tape to each group of students.
2. Ask the students to copy the table below into their science notebooks.
3. Write "starting weight" on eight pieces of tape, leaving room to write the weight of the apple slices on the tape. Tape one of these pieces to each cup.
4. Select one apple slice, weigh it, and record the slice's weight on the piece of tape on the front of cup 1. Place this apple slice in cup 1.
5. Select the other apple slices, one at a time, and weigh them. As each apple is weighed, place it in a cup and write its corresponding weight on the front of the cup. Have the students record the data on their data tables.
6. After all the apple slices have been weighed and the cups labeled appropriately, get out the measuring cup, table salt, Epsom salt, and baking soda.
7. Add  $\frac{1}{2}$  cup of baking soda to cup 1, completely covering the apple slice. Label this cup as "baking soda only."



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8. Add  $\frac{1}{2}$  cup of Epsom salt to cup 2, completely covering the apple slice. Label this cup as "Epsom salt only."
9. Add  $\frac{1}{2}$  cup of table salt to cup 3, completely covering the apple slice. Label this cup as "table salt only."
10. Add  $\frac{1}{4}$  cup of table salt and  $\frac{1}{4}$  cup of Epsom salt to cup 4, completely covering the apple slice. Label this cup as "table and Epsom salt."
11. Add  $\frac{1}{4}$  cup of table salt and  $\frac{1}{4}$  cup of baking soda to cup 5, completely covering the apple slice. Label this cup as "table salt and baking soda."
12. Add  $\frac{1}{4}$  cup of baking soda and  $\frac{1}{4}$  cup of Epsom salt to cup 6, completely covering the apple slice. Label this cup as "baking soda and Epsom salt."
13. Add  $\frac{1}{3}$  cup baking soda,  $\frac{1}{3}$  cup table salt, and  $\frac{1}{3}$  cup Epsom salt to cup 7, completely covering the apple slice. Label this cup as "baking soda, table, and Epsom salts."
14. Leave cup 8 with only the apple slice and label this cup as the control.
15. Place all eight cups on a shelf out in direct sunlight and let them sit for seven days.
16. Ask the students to make a hypothesis about which mineral mixture will work best to dry out (or mummify) the apple slice. Have the students write down their hypothesis in their science notebooks.
17. At the end of the seven days, take down the cups from the shelf. Take each apple slice out of the cup, one at a time, and try to brush off as much salt and baking soda as possible. Do not rinse off the slices, as they will become rehydrated.
18. Weigh each apple slice and record the data on their data tables.
19. Have the students compare the starting weight of each apple slice with its ending weight.
20. Have the students record their conclusions in their science notebook and create a graph comparing the different weights of the apple slices.

### **Extension**

Put the dried apple slices under a microscope to allow the students to observe the appearance.

Try this experiment with other types of fruit!

### **References**

- <http://www.newtonsapple.tv/TeacherGuide.php?id=1422>
- <http://www.virginiaapples.org/>

| Cup Number | Starting Weight | Mineral Used | Ending Weight |
|------------|-----------------|--------------|---------------|
| 1          |                 |              |               |
| 2          |                 |              |               |
| 3          |                 |              |               |
| 4          |                 |              |               |
| 5          |                 |              |               |
| 6          |                 |              |               |
| 7          |                 |              |               |
| 8          |                 |              |               |



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# Cycling Nitrogen

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## **Standards of Learning**

Science 6.9, LS.7

## **Objective**

Students will:

- Investigate how living and nonliving components are dependent upon one another during the nitrogen cycle

## **Materials**

- 1 poster or overhead with the nitrogen cycle diagram (Prentice Hall pp.726 is a good example)
- 1 pack of white note cards
- 1 copy of "The Nitrogen Cycle" at <http://soil.gsfc.nasa.gov/NFTG/nitrocyc.htm>

## **Background Knowledge**

Nitrogen is an essential component of DNA, RNA and proteins. All living things require nitrogen to live and grow. Most nitrogen in the atmosphere is unavailable for use by organisms. Five main processes cycle nitrogen through the earth's atmosphere are nitrogen fixation, nitrogen uptake, nitrogen mineralization, nitrification, and denitrification. Nitrogen is 80% of the air we breathe, needed for plant growth, and a component in photosynthesis. Farmers rely on nitrogen in the form of fertilizer (organic or non organic) and nitrogen producing crops to keep the soil rich and balance to produce the best plant growth.

## **Procedure**

1. Start at any point in the diagram by explaining the steps to the nitrogen cycle. It is a cycle so it does not matter where you begin.
2. On the back of a note card have the students write down the first word that you say that they are unfamiliar with. (Different students will have different words.)
3. Verbally get a few students to go through the cycle.
4. Get all students to briefly summarize the cycle on the front of the note card, and then cycle the note cards for classmate's approval.
5. Correct any misconceptions and students will have a nice little study tool.
6. Discussion questions:
  - How is nitrogen fixation a necessary part of the nitrogen cycle?
  - Where do nitrogen-fixing bacteria live?
  - What percentage of the Earth's air is nitrogen?

## **Extension**

- <http://soil.gfc.nasa.gov/NFTG/nigrocyc.htm> Use page 2 of the NASA document to describe what is happening with the cycle. It is more detailed and an excellent real life application scenario.
- <http://www.neuse.ncsu.edu/nitrogen/index.htm>
- *Understanding Nitrogen in Our World* by International Plant Nutrition Institute



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# Photosynthesis Booklet

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## **Standards of Learning**

Science: 4.4, LS.6

English: 4.7, 5.7

## **Objective**

The student will be able to:

- Illustrate the process of photosynthesis
- Summarize the steps in the process of photosynthesis

## **Materials**

- 11 x 17 paper
- Markers

## **Background Knowledge**

Photosynthesis is essential for plant growth and development as well as providing oxygen to the earth. It is the process in which green plants use carbon dioxide and water to create energy. The process of photosynthesis takes place in chloroplast within the cells where chlorophyll is concentrated.

Plants absorb water through roots. The fluid travels through the xylem into the leaves of the plant. Carbon dioxide, which is a compound in the air that mammals exhale, is absorbed through tiny openings in the plant leaves called stomata. Sunlight energy is also absorbed through the leaves. The water and carbon dioxide are converted to oxygen and glucose within a green pigment called chlorophyll located in the chloroplast of plant leaf cells. With the assistance of sunlight; compounds of carbon dioxide and water are decomposed and transformed to glucose with oxygen.

Glucose is used to provide energy to the entire plant as a basic building block of carbohydrates. Glucose may form into sugars such as sucrose to be used to energize the plant. Starches take the form of tiny granules and stored in leaves, roots, and fruits also have a base of glucose. The cell wall also requires glucose in the form of cellulose.

The byproduct of photosynthesis is oxygen which is eliminated from the cell through a process called transpiration. It is similar to the plant exhaling. Plants have a vital role to provide oxygen for animals which in turn provide plants with an ample supply of carbon dioxide.

## **Procedure**

1. Take a 11x 17 piece of paper. Fold the paper in half vertically (hot dog fold). Crease.
2. Open to original size and fold in half horizontally (hamburger fold). Crease.
3. With the hamburger fold, fold each side up from the opening to the middle. Crease.  
Page should be folded to show impressions for 8 identical pages.
4. Cut or tear center crease line from middle fold to first crease.
5. Open and accordion to make a continuous book.
6. Write 6 statements which summarize the process of photosynthesis on the book.
7. Illustrate each statement with a picture.
8. Pair up students with the task of reading and explaining booklets.

## **Extension**



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This booklet design can be used for any three to six step processes, writing a story, song or even creating math word problems for solving.

Have students search photosynthesis on the internet. Google images results for photosynthesis provide good visual tools. You Tube or Teacher Tube also have photosynthesis short videos and songs.

### References

<http://www.encyclopedia.com/topic/photosynthesis.aspx>

[http://www.youtube.com/watch?v=R\\_17euLU\\_EM&feature=related](http://www.youtube.com/watch?v=R_17euLU_EM&feature=related)

<http://www.youtube.com/watch?v=CXbhdBzx1Ag&feature=related>

<http://www.youtube.com/watch?v=IV-E68rh18>

<http://www.educationalrap.com/62/photosynthesis.html>



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# Plant Secrets

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## **Standards of Learning**

Science 6.1, 6.2, 6.8, 6.9, LS.1, LS.3, LS.4, LS.6, LS.7, LS.9, PS.5

## **Objective**

The student will:

- determine what factors are necessary for plant growth and measure and compare plant growth under different environmental conditions.

## **Materials**

- 50 pea, bean, or alfalfa seeds
- Paper towels
- Potting soil
- Large jar
- 15 to 20 planting containers
- Tape/Permanent markers

NOTE: Approximately 3 weeks before beginning the activity, place about 50 bean, pea or alfalfa seeds in a clear jar on a layer of damp paper towels and put the jar near a window. Monitor the seeds daily and keep the paper towels moist.

## **Background Knowledge**

Farmers produce plant crops that are suited to the climate and soil for their area. This is to insure maximum yields of the food and fiber products, while conserving natural resources and helping to protect the environment. Well suited plants need less added chemicals and do a better job of holding soil in place. Using the scientific method, students will set up an experiment to determine what factors are necessary for plant growth and measure and compare plant growth under different environmental conditions.

Germination is when the seed sprouts and begins to grow. It is important for your students to know that it starts right when there is a bud present from the seed. Explain to your students that their sprout will need a while to grow and that every plant is different in the amount it takes for them to get to maturity. Ask them what their plant will need to grow. All plants need water, light, temperature, time, soil (nutrients), oxygen, and space to grow to full maturity, which is something you can show your students as they are creating their own dirt baby. The process that their plant is going to go through is also something that should be talked about and monitored for a few weeks. All plants go through about the same cycle of sprout, growth, flower, and fruit. However, it is important to also point out to your students what their plant parts are since they will not have flowers or fruits. The basic parts of the plant to point out are roots, leaves, stem, flower, seeds, and fruit. Make sure to point out that not all plants have every part.

## **Procedure**

1. Discuss with students what seeds need to sprout and develop. Seedlings will be ready for experimentation when they have developed leaves and roots. (Germination rates vary by seed type.)
2. Introduce or review the concept of the scientific method.
3. Divide the students into five research teams and have students name their groups. Ask what factors they think are necessary for plants to grow. Have each team develop a hypothesis to test. Invite the teams to devise experiments to test whether or not plants really need specific elements to grow. Help teams to think through each step of their



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experiment and to predict what might happen. Then, help them construct and conduct their experiment. Here are two sample experiments.

- A. **Hypothesis-** Plants need direct sunlight for healthy growth.  
**Control-** Plant three seedlings in three separate containers of potting soil. Label these containers “control.” Place them near a window or other light source. Water as needed.  
**Test for Light-** Plant three seedlings in three separate containers of potting soil. Label the containers: “No Light,” “Low Light,” “Bright Light,” Place them in appropriate places. Water as needed.
- B. **Hypothesis-** Plants need adequate water for healthy growth.  
**Control-** Plant three seedlings in three separate containers of potting soil. Label the containers “Control.” Place them near a window or other light source. Discuss the amount of water that is necessary for optimum plant growth. Water these plants accordingly.  
**Test for water-** Plant three seedlings in three separate containers of potting soil. Label the containers “No Water,” “Low water,” “Too Much Water.” Discuss exact amounts to water each container. Water accordingly. Place them near a window or other light source.
4. Have the groups set up their experiments as designed and test their hypothesis. Direct them to select seedlings that are all nearly the same size before planting their control and test subjects. This will insure that the results are not skewed by starting with seedlings of different sizes.
5. As the plants begin to grow, graph their heights. Students can measure the plants’ heights with rulers and transfer the measurement to graph paper. Graph the plants daily or weekly.
6. Discussion questions:
- Which plants grew the most? Which grew the least?
  - What other differences did you observe among the plants?
  - What happens if a plant doesn’t get enough sunlight? Water? Soil?
  - Which parts of the plants seemed most affected by lack of sunlight? Water? Soil?
  - If you were going to plant a tree on the school grounds, where might you plant it? Why? (Look for a place with the right conditions: sunlight, air, water, soil, room to grow.)
  - If you were to plant a tree on the school grounds, how might you benefit from it? (aesthetics, attracts animals, fruit, blocks winds, provides shade, and provides oxygen)

### **Extension**

Arrange a visit to a nursery or orchard to see the trees in various stages of growth and to find out how they control the various needs of plants to grow what they want at what ever time.

Have students try propagating from a plant cutting or tree seed they find.

Talk about biotechnology and the role it plays in plant production. (Corn can grow closer together, disease resistant, drought resistant etc.)

Talk about the different varieties of plants, fruits, and vegetables. What are their different needs, where do we produce them in this country and why.

Talk about the green belt and how it applies to the United States and world trade.

This lesson adapted from Tennessee AITC.



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# Potato Obstacle Course

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## **Standards of Learning**

Science: LS.1, LS.4

## **Objective**

The student will be able to:

- Conduct scientific investigations
- Investigate basic plant needs to complete life processes

## **Materials**

- shoebox with lid
- seed potatoes
- cardboard
- tape
- knife
- scissors

## **Background Knowledge**

The part of the potato plant we eat is called the tuber, which is an underground stem. Each plant produces multiple tubers. Most potato tubers are white or red however newer varieties include blue, purple, and speckled. Potatoes have buds or small node like indentions called eyes. When placed in a warm location sprouts will develop. The sprouts seek light and are the beginnings of a new plant.

Potatoes are grown predominantly in the tidewater region of Virginia. Varieties of white and red skinned potatoes are popular including Kennebec and Cherry Red. The crop begins with seed potatoes being cut into sections with at least one eye in each section. Small potatoes the size of an egg or less may be left whole. The stem emerges from the eye. Ideal planting times for potatoes in the Commonwealth are from mid March to early April. Virginia potatoes are sold fresh, bagged, or chipped.

Phototropism is the growth of a plant toward a light source. Plants are uniquely equipped to bend toward the direction of the light. A hormone in the plant stem causes it to seek out light which is generally upwards. Plant stems seek out light in order to start the process of photosynthesis.

## **Procedure**

1. Cut a ½ inch hole in one end of a shoebox.
2. Create an obstacle course by cutting pieces of cardboard to create a maze within the box for the tuber to move through.
3. Put a sprouting potato on the opposite end of the box from the hole.
4. Securely attach the box lid eliminating light from any source other than the hole.
5. Place shoebox in well lit area of the room.
6. Keep a record of observations outside of the box. How many days until you see a sprout growing out of the hole in the box?
7. Discuss findings.

## **Extension**



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- Have students follow the scientific method creating a hypothesis, lab write up, observation charts, written summary and conclusion.
- Change one variable in the experiment such as potato variety, box size, or light amount.

### **References**

<http://www.hort.purdue.edu/ext/senior/vegetabl/potato1.htm>

<http://www.scienceclarified.com/Oi-Ph/Phototropism.html>

<http://www.ipmcenters.org/CropProfiles/docs/VApotato.html>

<http://www.gardencityseeds.net/growers10.php>



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# The Proof is in The Water

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## **Standards of Learning**

Science 6.5

## **Objective**

Students will:

- investigate which plant material contains the most water.

## **Materials**

- Triple beam balance or digital balance
- Grass clippings
- Pears
- Celery stalks
- Carrots
- Newspaper
- Data Table

## **Background Knowledge**

The rate of water loss (transpiration) depends on evaporation. Therefore anything that affects the rate of evaporation would also affect the rate of water lost. Some of the factors that affect this in plants are as follows:

**Humidity in Air:** The inner cellular spaces within the leaf are usually over filled with water vapor. If the air outside is dry, water vapor from the leaf will spread out at a faster rate. Thus the rate of transpiration would be greater. If the air outside is humid evaporation will be hindered and the leaf will transpire less. Assuming, the other factors are constant, the rate of transpiration decrease with increasing humidity.

**Temperature of the Air:** Leaves transpire more in hot weather conditions.

**Strong Wind:** As leaves lose water due to transpiration, the air outside gets damp. If a wind is blowing, this water vapor gets blown away, making the air around the leaf less damp. A leaf loses more water in high winds. However, if the wind is blowing too fast the stomata may shut down to prevent too much loss of water.

**Light:** Since light affects the size of the stomata of the leaf. It therefore also has an affect on the rate at which a leaf loses water. During the day, the stomata get wider. This increases the rate of transpiration. At night, the stoma closes down.

Review plant part definitions with students.

- Roots – usually the underground part of a plant that absorbs water and nutrients and can also store food; means of anchorage and support for plants
- Stems – the main trunk of a plant that supports and carries water and nutrients to the rest of the plant
- Leaves – the outgrowth from the stems whose main function is to produce food for the plant through photosynthesis
- Flowers – the parts of the plant that hold the reproductive organs
- Fruits – the fleshy part of the plant that holds the seeds
- Seeds - the fertilized ripened ovule of a flowering plant containing an embryo and capable normally of germination to produce a new plant

Review edible plant parts with students, show fresh, artificial or illustrations.

- Roots – carrot, radish, beet, turnip, parsnip, sweet potato
- Stems – celery, asparagus, potato (fleshy underground stem called a tuber), rhubarb, cinnamon
- Leaves – lettuce, cabbage, spinach, onion (bulb), garlic (bulb), parsley, dill, rosemary, thyme,



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sage, collards, brussel sprouts

- Fruit – tomato, cucumber, squash, apple, peppers, eggplant, pears, avocado, peach, green beans
- Flowers – broccoli, cauliflower, artichoke, capers
- Seeds – corn, peas, peanuts, black-eyed peas, kidney beans, pinto beans, black beans

### **Procedure**

1. Divide class into groups of 3 or 4.
2. Give each group a handful a grass clippings, a pear, a celery stalk, a carrot, a newspaper and a data table.
3. Have each group put their names on the newspaper.
4. Have each group weigh the grass clippings and place on the newspaper. Record on data table.
5. Have each group weigh the pear, then you cut it into four pieces (or you can designate a student to cut it) and place it on the newspaper. Record on data table.
6. Have each group weigh celery stalk, then you cut it into strips (or you can designate a student to cut it) and place it on the newspaper. Record on data table.
7. Have each group weigh carrot, then you cut it into strips (or you can designate a student to cut it) and place it on the newspaper. Record on data table.
8. Answer discussion questions 1 & 2 and explain that question 3 will be answered tomorrow. DAY #2. Repeat steps 4-7, but you do not have to cut anything all you have to do is weigh, record and calculate total water loss and percent water.
9. Once calculations are done, answer discussion question #3.
10. Also discuss what part of the plant that each part belongs to grass is a leaf, pear is a fruit, celery is a stem, and carrot is a root. Does the part have any affect on the amount of water it contains?
11. Discussion questions:
  - Why was it necessary to cut the items into strips?
  - Which material do you think contains the most water?
  - Which material contained the most water?

### **Extension**

1. Based on this lab, do different parts of the plant contain more water than others? Why might this be so?
2. Have students design another lab using other plant parts to prove water content.

|        | Fresh (g) | Dried (g) | Total Water Loss (g) | Percent Water |
|--------|-----------|-----------|----------------------|---------------|
| Grass  |           |           |                      |               |
| Pear   |           |           |                      |               |
| Celery |           |           |                      |               |
| Carrot |           |           |                      |               |

To do Percent Water: **Total grams of water lost X 100**  
**Weight of Fresh**



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# Reading Trees

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## **Standards of Learning**

Science 5.1, 6.5, LS.4, LS.12, LS.14

Mathematics 6.4, 6.5, 6.7, 6.9

## **Purpose**

Students will:

- Explain how the environmental conditions affect tree growth

## **Materials**

- Yellow construction paper
- Brown crayons/markers
- Compass
- Scissors
- Rain fall spinner

## **Background Knowledge**

Research at Jamestown has shown that early settlers struggled with environmental challenges beyond their control. The study of tree rings has shown that the settlers and Native Americans survived one of the worst droughts in history. Archaeologist Dennis Blanton of the College of William and Mary has shared his research on tree rings with the archaeologists at Jamestown Rediscovery. His research shows tree rings with the archaeologists at Jamestown Rediscovery. His research shows that the limited fresh water resources caused great hardship for the people of Jamestown. Many of the settlers died from starvation and disease which were caused by a lack of useable water. Dendrochronology is “tree-ring dating”. Climate changes create patterns in tree rings, which grow annually.

Discuss how lack of water caused stress on the settlers. How might this affect the relationships and trade systems between the Powhatans and the English?

## **Procedure**

1. Divide class into groups of 5 or 6 students.
2. Instruct students to draw a circle in the center of the paper between 1 – 4 inches in diameter. Use a brown crayon to make a thin band of color to represent the tree rings.
3. Have each group spin the spinner to determine the next diameter ring to be added. Color each band with a brown line. Repeat until you are instructed to cut your tree.
4. Have each student cut a 1 inch wide sample through the center of the tree rings. Collect and mix samples. Randomly redistribute and have the class arrange the samples in chronological order.
5. Discuss the reasoning used to arrange samples.
6. Divide class into groups of 5 or 6 students.
7. Instruct students to draw a circle in the center of the paper between 1 – 4 inches in diameter. Use a brown crayon to make a thin band of color to represent the tree rings.
8. Have each group spin the spinner to determine the next diameter ring to be added. Color each band with a brown line. Repeat until you are instructed to cut your tree.
9. Have each student cut a 1 inch wide sample through the center of the tree rings. Collect and mix samples. Randomly redistribute and have the class arrange the samples in chronological order.
10. Discuss the reasoning used to arrange samples.



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### **Extension**

- Create graphs for rainfall based on 1" ring + 10" rainfall.
- Discuss what environmental factors contribute to growth rates of lumber.

Lesson from: Historic Jamestown America's Birthplace

[Historicjamestowne.org/learn/pdf/elementary\\_school/4-5\\_reading\\_trees.pdf](http://Historicjamestowne.org/learn/pdf/elementary_school/4-5_reading_trees.pdf)



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# Round and Round the Water Goes

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## **Standards of Learning**

Science 6.1, 6.9, LS.4, LS.8, LS.9, LS.12, LS.14

English 6.1, 6.2, 6.5, 7.1, 7.7

History USII.1, USII.2, USII.3, USII.5, USII.8, CE.1

## **Objective**

The student will:

- illustrate how multiple users of water resources can affect water quality and quantity.
- examine the complexities of providing water for all water users.

## **Materials**

- A large bucket to hold several gallons
- 1 container per student ( can use a milk carton)
- 17 large household sponges
- Various colors of food coloring colors of food coloring (put several drops of food coloring of any color on all the sponges and sponge pieces)
- Markers
- Poster board

## **Background Knowledge**

The journey water takes as it circulates from land to sky and back down is called the water cycle. Another name for the cycle is the hydrologic cycle.

Heat from the sun provides energy to evaporate water from the Earth's surface (pond, streams, lake, and oceans). The water vapor eventually condenses, forming tiny droplets in clouds. When the clouds meet cool air over land (condensation), precipitation is triggered, and water returns to the land. Precipitation comes in solid or liquid form. Precipitation soaks into the ground. Some of the underground water is trapped between rock or clay layers; this is called groundwater. Most precipitation which lands on the ground forms runoff whether it stays on the surface or sinks underground. The runoff flows underground or above into streams, rivers, ponds, and eventually the ocean. Then the cycle continues all over again.

## **Procedure**

1. Cut the sponges in the following fashion:
  - cut 3 of the sponges into fourths
  - cut 5 of the sponges into thirds
  - cut 5 of the sponges in half
  - leave the last 4 whole(You can increase or decrease these numbers to fit the number of students that you have.)
2. Fill a large bucket to the brim with water. (This represents water stored in a reservoir, pond, or lake. Some communities depend on ground water. If this is the case, the bucket represents water underground and the sponges symbolize wells.)
3. Tell the students that they are going to simulate changes in a watershed over several time periods. (Each 30 second round represents a time period)
4. For each round the students should be equal distance from the water source, when the round starts, students fill their sponges with water from the reservoir to represent consumption. They squeeze the water out of the sponges into their containers. They can refill as often as they like per round.
5. At the end of each round, note how much water is still in the bucket. Tell students to empty half of the water from their container back into the bucket. (This represents the water that comes back to the reservoir (i.e. When it percolates through the solid, when it is discharged from a factory,



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after it runs off the surface) Students will notice that it is colored, this represents sewage and runoff from urban and rural areas.

6. Record the student's comments about the amount of water used and the amount of waste materials generated. Compare after each round.

After each round refill the bucket with clean water to represent the water source eventually cleaning and replenishing itself over time.

**Round 1:** It is 200 years ago. A few homesteaders operating small farms inhabit the watershed. (Three students represent the homesteaders. Give each of them one-fourth of a sponge and a container.)

**Round 2:** One hundred years have passed. A large farm and a small town are now located in the watershed. Distribute sponges cut in fourths to 6 students (town dwellers) and a half sponge to a student representing the farm. Provide each student with a container.

**Round 3:** It is now just after WWII. The size of the town has increased. Many of the town residents are employed in an industry that makes typewriters. Half a sponge represents the factory. Two farming areas supply milk and some food, like meat grains and vegetables for the town. They get one sponge each. Give one sponge to a student who represents a power company. Several community services, such as hospitals, schools, and stores, are now a part of the town; watch student representing such, a service agency gets half a sponge. Provide each family, about 10 students with a third of a sponge. Provide each student with a container.

**Round 4:** It is now the present. The town has continued to grow. A new industry that makes household cleaning products has moved in (1 Sponge). Represent residential expansion by giving sponge pieces and a container to any remaining students. Complete a round.

### **Discussion Questions**

How do we use water in our town?

How does the water in our area replenish itself?

How can adjustments be made in this activity to ensure enough clean water for everyone?

What are some ways that we can conserve water?

What has the growing population and businesses done to other parts of the environment, how does it affect plants and animals?

How has the use of water changed from time period to time period, and what effect has that had on water quality?

### **Extension**

- Find out what your community does to conserve water
- Tour or have someone come in from the local water district.
- Make a graph to depict the water users in each of the four rounds.
- Create a different scenario based on the occurrence of a drought. (Full bucket for a normal year, half bucket for a drought year.)
- [www.kidzone.ws/water](http://www.kidzone.ws/water)
- [www.ga.water.usgs.gov/edu/watercycle](http://www.ga.water.usgs.gov/edu/watercycle)



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# Striking a Balance

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## **Standards of Learning**

Science 6.2, 6.7, LS.4, LS.6, LS.7, LS.9, LS.11, LS.12

## **Objective**

Students will:

- Demonstrate an understanding that energy is lost through breathing, heating and moving and that energy is transferred when it passes from one organism to another

## **Materials**

- 2-3 gallons of popped popcorn
- Marking pen
- Timer
- Plastic baggies, marked
- 3 colors crepe paper
- Lawn or outdoor area
- Rulers

## **Background Knowledge**

Feeding relationships are often difficult to observe. In this activity, students gain some understanding of these relationships by assuming the roles of animals, playing tag, and simulating feeding relationships. Popcorn is spread over a lawn, park or play ground area. The kernels of popcorn represent plants, which are the food sources for the plant eaters. Some students play grasshoppers (plant eaters or herbivores), some students play frogs (grasshopper eaters or carnivores), and some students play hawks (frog eaters or carnivores).

The object of the game is for each animal to eat without being eaten before the “day” (five minutes) is over. In nature, the populations of plants and animals are usually large enough to insure continuation of the species if some are lost. In this game, populations (popcorn “plants,” grasshoppers, frogs and hawks) are so small that the survival of one of each kind will be considered an indication of a “balanced” ongoing community. The game may be repeated many times in one activity session, but encourage the students to change the rules of behavior and the numbers of each kind of animal until a balance is achieved in the plant-grasshopper-frog-hawk food chain. In nature’s balance, there are more plants than plant eaters, and more plant eaters than animal eaters.

## **Procedure**

1. Using rulers, have students make marks on the sandwich bags. These bags represent the animal’s stomachs, so mark as follows:
  - 60% of the class will be grasshoppers. Grasshopper stomach bags need to be marked 1.5” from the bottom of the bag.
  - 25% of the class will be frogs. Frog stomachs need to be marked 2.5” from the bottom of the bag.
  - 15% of the class will be hawks. Hawk stomachs need to be marked 2.5” from the bottom of the bag (just like the frog).
2. Cut crepe paper in the same fashion. This paper is a form of identification and can be tied around the student’s waist to indicate animal type.
  - 60% light green crepe paper for the grasshoppers
  - 25% dark green crepe paper for frogs



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- 15% gold crepe paper for hawks
3. Divide class into three groups according to the percentages above.
  4. Begin classroom discussion about food chains. Create a class diagram of a simple chain.
  5. Discuss the energy transfer found in food chains. Using the class diagram, indicate energy transfer with an arrow. For example:  
     sun → grass → beef → humans
  6. Hand out grasshopper stomach baggies and identification sashes to first group. (60%)
  7. Hand out frog stomach baggies and identification sashes to second group. (25%)
  8. Hand out hawk stomach baggies and identification sashes to third group. (15%)
  9. Designate a “safety” area at game area.

### **Rules of the Game**

- a. The grasshoppers pick up (eat) the popcorn and place the pieces in the stomach baggies.
- b. Frogs try to tag (eat) the grasshoppers. When a frog “eats” a grasshopper, the grasshopper’s stomach contents are transferred to the frog’s stomach baggie. While this exchange is taking place, the grasshopper and frog are safe from other players.
- c. Hawks try to tag (eat) the frogs. When a hawk “eats” a frog, the frog’s stomach contents are transferred to the hawk’s stomach baggie. Again, while this transfer is taking place, the frog is safe from other hawks.
- d. Note – in this game, hawks do not eat grasshoppers.
- e. Animals that are eaten can rejoin the game to simulate reproduction and continue to gather food.
- f. Once a grasshopper and/or a frog have filled its stomach baggie to the marked line, it has survived. A hawk must have at least one frog to survive. Once the stomach is filled these animals may travel and stay at the designated safety area.

### **Playing the Game**

1. Set a timer for 5 minutes and start the game.
2. Analyze the results by asking questions such as
  - How many animals survived?
  - Is the food chain still complete?
  - Can the game be continued?
  - Did any specie die out?
  - Is this a balanced cycle?
3. Return the popcorn to the activity area for another round.
4. Change one rule of the game. For example:
  - the number of grasshoppers, frogs and/or hawks
  - time releases: allow grasshoppers to forage for 30 seconds before frogs are introduced and wait 30 seconds before hawks are then released
  - use more activity area
  - spread out more/less popcorn
 (*Only one change should be made during each round.*)
5. Analyze results of each game. Keep information in data format.
6. Return indoors and discuss/write about the results. Discussion questions may include:
  - What would happen if there were 50% less popcorn plants?
  - What would happen to the animals that depend on those plants?



- If there were no frogs, what would happen to the plant population, the grasshopper population and the hawk population?
- Do hawks need plants to survive?

### **Extension**

- Research other food chains.
- Create a similar game using other food chains.
- Research whether there are any plants/animals that are not part of any food chain.
- Research, discuss and illustrate the energy transfer within various food chains.

Adapted from USDA Agriculture in the Classroom – [www.agclassroom.org](http://www.agclassroom.org)



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# A “Sweet” Lesson in Economics

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## **Standard of Learning**

Science 6.1, LS.1, LS.12

English 6.6, 6.7, 7.7, 7.8, 7.9, 8.6, 8.7, 8.8

Civics CE.1, CE.11, CE.12

## **Objective**

Students will:

- Develop an understanding of economic concepts as they apply to the interdependence and decision making of individuals, households, businesses, and governments
- Locate specific areas of Virginia on map where agricultural products are produced
- Discuss aspects of Virginia agriculture
- Explain the economic impact of agricultural production on Virginia
- Explore a jellybean to determine its flavor without tasting it
- Make predictions
- Invent a new jellybean flavor
- Write an essay about the concepts used to create the Virginia jellybean flavor

## **Materials**

- Sweet Surprises Prediction sheet
- Sweet Surprises Flavor Key
- Sweet Surprises Task Sheet
- One bag of a single flavor jellybean
- Bags with 10 assorted jellybeans (per student)
- Virginia Map
- Virginia Commodity Map (located on CD)

## **Background Knowledge**

The student will gain background information on different commodities grown in Virginia. The students will learn about the agricultural industry and how the various commodities produced are of value to the state economy. The student will use inquiry skills and prior knowledge to determine specific flavors of Jelly Belly jellybeans. The students will create a new Virginia flavor jelly bean for the Jelly Belly Company.

## **Procedure**

1. Introduce class to Virginia agricultural commodities by using the Virginia map and the Virginia Commodity map to discuss which products are grown in the state and in what areas of the state. Point out that soybeans are Virginia's number one cash crop. Highlight horticulture and vineyards as rising agricultural industries in the state.
2. Provide each student with 1 jelly bean. Instruct class to predict the flavor of the bean without tasting. Record predictions on board. Discuss the various class predictions. Allow class to taste the jellybean.
3. Handout the sweet surprise prediction sheet and a bag of 10 jellybeans. Students should predict the flavor of each jellybean without tasting and record predictions on the form.
4. Hand out the sweet surprise color key and have students use the key to determine the flavor of each bean. Model the use of the chart for the class.
5. Students should record the flavor on the predictor sheet.



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6. Allow students to eat jellybeans after step 5 has been completed.
7. Discuss how the chart helped in determining the flavors.
8. Tell the class that the Jelly Belly Company has asked them to create a Virginia flavor Jelly Belly.
9. The student will write an essay explaining how they chose the flavor they did and the process they followed to market their new flavor.
10. Provide each student with a sweet surprise task sheet as a guide.

### **Extension**

- Create a poster advertising the Virginia Jelly Belly.
- Create a TV commercial to advertise the new Virginia Jelly Belly.

Lesson developed by Louisiana Agriculture in the Classroom by Robin Dugas.

## **SWEET SURPRISES PREDICTIONS**

NAME: \_\_\_\_\_ DATE: \_\_\_\_\_

Directions: Begin by predicting the flavor of each of your jelly beans. Next, using your



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“Sweet Surprises Flavor Key” to decide what the flavor might be. Then, gobble up to see if you were correct.

|                |                |
|----------------|----------------|
| Prediction: #1 | Prediction #2  |
| Actual Flavor  | Actual Flavor  |
| Prediction #3  | Prediction #4  |
| Actual Flavor  | Actual Flavor  |
| Prediction #5  | Prediction #6  |
| Actual Flavor  | Actual Flavor  |
| Prediction #7  | Prediction #8  |
| Actual Flavor  | Actual Flavor  |
| Prediction #9  | Prediction #10 |
| Actual Flavor  | Actual Flavor  |



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# SWEET SURPRISES COLOR KEY TO DETERMINE FLAVORS

## COLOR KEY:

1. Yellow, Orange, Red, Pink.... go to 2  
Purple, Green Blue ..... go to 22  
Black, Brown, Tan, White .... go to 29
2. Yellow or Orange ..... 3  
Red or Pink ..... 13
3. Yellow ..... 4  
Orange ..... 8
4. Solid Yellow..... 5  
Yellow w/Spots ..... 7
5. Bright yellow ..... Lemon  
Light or pale yellow ..... 6
6. Light yellow ..... Pina colada  
Pale yellow ..... Crushed pineapple
7. Yellow w/Brown Spots ..... Top Banana  
Bright Yellow w/White Spots... Lemon Drop  
Bright Yellow w/Green Spots.. Mango
8. Solid Shades of Orange..... 9  
Orange with Spots ..... 12
9. Bright Orange ..... 10  
Light or Pale Orange ..... 11
10. Orange ..... Orange Juice
11. Pale Orange ..... Tangerine  
Light Orange ..... Cantaloupe  
Neon Orange ..... Orange Sherbet  
Pinkish Orange ..... Pink Grapefruit
12. Orange w/red spots ..... Peach
13. Red ..... 14  
Pink ..... 19
14. Solid Red ..... 15  
Spotted Red ..... 18



|     |                               |                       |
|-----|-------------------------------|-----------------------|
| 15. | Bright Red .....              | 16                    |
|     | Dark Red .....                | 17                    |
| 16. | Red .....                     | Very Cherry           |
|     | Red w/White Center .....      | Red Apple             |
|     | Cinnamon Red .....            | Cinnamon              |
| 17. | Dark red .....                | Raspberry             |
|     | Really Dark red .....         | Dr. Pepper            |
| 18. | Red w/Yellow spots.....       | Sizzling Cinnamon     |
|     | Red w/Dark Red spots .....    | Strawberry Jam        |
| 19. | Solid Pink .....              | 20                    |
|     | Pink w/spots .....            | 21                    |
| 20. | Bright Pink .....             | Cotton Candy          |
|     | Pale Pink .....               | Bubble Gum            |
| 21. | Pale Pink w/Red Spots .....   | Strawberry Cheesecake |
|     | Dark Pink w/Red Spots .....   | Strawberry Daiquiri   |
|     | Dark Pink w/White Spots ..... | Champagne Pink        |
| 22. | Purple or Blue .....          | 23                    |
|     | Green .....                   | 26                    |
| 23. | Purple .....                  | 24                    |
|     | Blue .....                    | 25                    |
| 24. | Purple .....                  | Grape Jelly           |
|     | Dark Purple .....             | Wild Blackberry       |
|     | Lavender .....                | Island Punch          |
| 25. | Blue .....                    | Blue Berry            |
|     | Bright Blue .....             | Berry Blue            |
|     | Dark Blue w/Red Center.....   | Plum                  |
| 26. | Solid Green .....             | 27                    |
|     | Green w/spots.....            | 28                    |
| 27. | Bright Green .....            | Kiwi                  |
|     | Green Green .....             | Green Apple           |
|     | Light Green .....             | Lemon Lime            |
|     | Deep Dark Green .....         | Jalapeno              |
| 28. | Dark Green w/Red Spots .....  | Watermelon            |
|     | Light Green w/ Dark Spots ... | Juicy Pears           |
|     | Green w/Dark Spots .....      | Margarita             |
| 29. | Brown or Tan .....            | 30                    |
|     | Black or White .....          | 37                    |



|     |                              |                      |
|-----|------------------------------|----------------------|
| 30. | Brown .....                  | 31                   |
|     | Tan .....                    | 34                   |
| 31. | Solid Brown .....            | 32                   |
|     | Brown w/spots.....           | 33                   |
| 32. | Brown .....                  | Chocolate Pudding    |
|     | Light Brown .....            | A&W Root Beer        |
| 33. | Dark Brown w/White spots.... | Cappuccino           |
| 34. | Tan .....                    | 35                   |
|     | Tan w/spots.....             | 36                   |
| 35. | Light Creamy Tan .....       | Café' Latte          |
|     | Tan.....                     | Peanut Butter        |
|     | Light Tan w/Green Center...  | Carmel Apple         |
| 36. | Tan w/Brown Spots .....      | Toasted marshmallows |
|     | Tan w/Tan spots .....        | Carmel Corn          |
| 37. | White .....                  | 38                   |
|     | Black .....                  | Licorice             |
| 38. | Solid White.....             | 39                   |
|     | White w/Spots.....           | 40                   |
| 39. | Bright White.....            | Coconut              |
|     | Pale White.....              | A&W Cream Soda       |
| 40. | White w/Yellow Spots.....    | Buttered Popcorn     |

## SWEET SURPRISES TASK

Your next task is to write an essay using the following information as a guide. You should include a separate paragraph for each section.



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- a. **Process you went through to decide on your flavor and color**
  - i. Choice
  - ii. Opportunity cost
  - iii. Opportunity benefits
  - iv. Consumers (who are you trying to get to but this)
- b. **What you need to produce your jelly beans**
  - i. Producer
  - ii. Ingredients
  - iii. Resources: natural, capital, human
- c. **How will you market it**
  - i. Consumers (who are you trying to target)
  - ii. Where will you sell your new jelly bean
  - iii. Interdependence
- d. **Advertisements**
  - i. Type of advertisements
  - ii. Who will be involved
  - iii. Logo, slogan
  - iv. Target audience

\*Sample advertisements: Poster, commercial, radio jingle, etc.

*Be creative and have fun!!!!*



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# Testing Darwin

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## **Standards of Learning**

Science LS.1, LS.8, LS.9, LS.11, LS.14

## **Purpose**

Students will:

- Determine if adaptation to environment is correlated to survival

## **Materials**

- 3 bags of beans
- 10 trays
- 10 clothespins
- 10 spoons (metal or plastic)
- 10 forks (metal or plastic)
- 10 tweezers

## **Background Knowledge**

Charles Darwin, British naturalist states, "I have called this principle, by which each slight variation, if useful, is preserved, by the term Natural Selection." Darwin's theory of natural selection (evolution) states that variation within species occurs randomly and that the survival or extinction of each organism is determined by that organism.

Animals must make adaptation to survive gradual changes within their environment. Adaptations need to be made so that animals are able to catch food and fight off their predators. Plants need to make adaptations in order to survive in drastic climate changes and varying populations. All organisms need to make changes and adapt to their habitat so that they can live comfortably in shelter and eat food.

The simulation below is geared to have students experience how adaptations affect the ability to obtain food.

## **Procedure**

1. Background – if this is a review of natural selection you could just review. If it is an introduction, you could set it up with a little story. On a distant farm, there exist 5 species of a creature called "AGIN". Each "AGIN" is similar except their mouth has variations. All "AGIN" eat beans. Some "AGIN"s have clothespin mouths, some have spoon mouths, some have tweezer mouths, and some have fork mouths. Each of you will play the part of **an** "AGIN" on this farm.
2. Pass out the materials and assign each student a specialized mouth. Demonstrate that they must hold the utensil in their mouth and try to get the beans from the tray.
3. Students will take turns trying to get 20 beans on the first trial in 60 seconds. If not their "AGIN" dies.
4. Students will try to get 20 beans on the second trial in 45 seconds. If not their "AGIN" dies, then 30 seconds, 15 seconds.



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5. When an “AGIN” dies, the student can play the offspring of the surviving “AGIN”. Give them a new utensil.
6. At the end, the most likely survivors will be the spoon mouth “AGIN”s.
7. Discussion Questions:
  - What happens to animals that cannot compete with other animals in the wild?
  - Was Darwin correct when he said the fittest survive?
  - Can you think of any real-life examples of AGINs, where one species has a definite advantage over the other? What about on the farm?
  - Sometimes animals that are introduced into an area that they never lived in before, out compete and endanger resident species, why do you think this happens?
  - How do you think diseases can affect natural selection?

### **Extension**

- How does genetically engineering animals make them the fittest?



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# There's *What* in My Watershed?

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## **Standards of Learning**

Science: 3.6, 3.9, 3.10, 4.5, 4.9, 6.5, 6.7, LS.12

## **Objective**

The students will:

- ◆ define “watershed” and identify the effect of runoff on watersheds.
- ◆ identify ways to prevent pollution.

## **Materials**

- ◆ white computer paper
- ◆ washable markers
- ◆ spray bottles with water

## **Background Knowledge**

Sometimes the ground is too wet to soak up more water. So when it rains or snow melts, the water moves until it meets or creates a stream. The area of land that drains the water into the stream is called a watershed. The Chesapeake Bay watershed covers approximately half of Virginia's land area.

Watershed pollution is caused by point source as well as non-point source pollution. Point source pollution is when you know exactly where the pollution entered the water system, such as when motor oil goes down a storm drain. Non-point source pollution is when the pollutant enters the water system over a large area, such as when heavy rains wash grass fertilizer, soil, and trash from a neighborhood into the river.

Farmers work to reduce water pollution several ways, as good management of natural resources increases the value and productivity of their land. Conservation tillage allows the farmer to dramatically reduce soil erosion as well as the amount of pesticides used. Additionally, farmers may leave buffer zones around their crops and use cover crops to reduce the movement of pollutants. Finally, farmers avoid spraying their crops before a heavy rain.

## **Procedure**

1. Ask students to describe what happens when we get a lot of rain. Point out that the water must go somewhere, and when the ground has absorbed all that it can, the water then runs into drains and or streams.
2. Define the term “watershed.” Point out that they just because they might not live alongside a river does not mean that they are not part of a watershed.
3. Take a piece of white computer paper and draw several medium sized dots on it using a washable marker. Tell students that the dots represent pollution
4. Have students brainstorm and give examples of pollution as well as its different sources. Define point source and non-point source pollution and give examples of each.
5. Tightly crumple the paper into a ball.
6. Unfold the paper and lay on a table or desk. Point out that the paper now resembles the Earth's terrain, with hills, ridges, and valleys.
7. Use a water spray bottle to spray the paper to simulate rain.
8. Ask students to describe their observations.
9. Debrief by discussing how watersheds were created where the water ran together and eventually pooled. Additionally, discuss how the ink bled into the water. Explain that this is similar to what happens when rain washes away soil, trash, and chemicals.
10. Divide students into small groups; assign each group a different topic, such as farms, factories, and homes. Have each group research ways that their segment of the population can reduce water pollution. Have them present their findings in the form of a public service announcement.

## **References**

Lesson adapted from Illinois Agriculture in the Classroom.



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# US Agriculture and the World Market

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## **Standard of Learning**

Math 6.1, 6.4, 6.7, 6.9, 6.18

Science 6.1

Social Studies CE.1, CE.11

## **Objective**

Students will:

- Analyze agricultural import and export data from tables and charts
- Determine percentages
- Convert values between measurement systems and graph tables
- Identify and extract information regarding US trade of goods

## **Materials**

- US Agricultural exports chart
- Graph paper
- Calculator
- Response sheet

## **Background Knowledge**

More than likely you are wearing something that was not made in the United States. Your shoes may have been made in Thailand or your shirt in Indonesia. Perhaps you have eaten bananas from Costa Rica or grapes from Chile. Because of world trade, countries can buy goods from, or sell goods to, other countries of the world. There are rules to be followed regarding trade, and an international organization, the World Trade Organization, works to keep world trade as fair and equal as possible for all countries.

Creating goods for export to other countries stimulates a country's economy. New jobs are created, and living standards are raised. There is less reliance on foreign aid. Because of trade, consumers get a larger selection of products, and the competition can help keep quality up and prices down. Manufacturers also have more markets in which to sell their product.

Some people are wary of global trade, however. Imported goods that are similar to what is produced domestically may increase competition and cause citizens to lose their jobs. To help prevent this and alleviate such fears, some countries add tariffs to imported goods to bring the price up so they are more expensive than domestically-produced goods. Unfortunately, tariffs make it harder for poor countries to sell their goods.

Agricultural subsidies are payments made to farmers by the government. Farmers who get subsidy payments can sell their goods for less money and still have enough income to support their families. Subsidies help keep food prices low for consumers, but farmers from countries without subsidies cannot sell their goods for as little as the subsidized farmers and so find it difficult to find markets for their products. World trade is a complicated matter; it is not always easy to make it fair for all involved.

## **Procedure**

1. Provide copies of the import and export charts included in this lesson along with the questions.
2. Instruct students to work with a partner to discuss and justify answers to the questions.
3. Have each pair choose five products from the US imports and exports to analyze.
4. Students select a graphing method to compare the values and volumes of products selected over four time periods listed from the table. (December 2006 through January 2007)



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5. Using either the export or import values, the students must select the most appropriate graphing method and graph the percent change for either time period listed for all products.

### **Key Vocabulary**

**Export-** to ship goods out of a country

**Import-** to bring goods into a country

**Subsidy-** financial aid that encourages the production of a product

**Tariff-**tax on imported goods

### **Extensions**

- Students create a word problem, using the measurements listed below. Work out the problem and write/justify how it is solved.
- Share word problems with other class groups.
  - 1 metric ton = 1,000; 1 kg = 2.2 pounds
  - 1 American short tone = 2,000; 1 pound = 16 ounces; 1 dram = 1.77 g
  - 1 stone = 14 pounds; 1 scruple = 6.48 carats; 1 carat = 0.2 grams
  - 1 ounce= 16 drams

### **Background Sources**

The World Bank, Us Department of Agriculture Economic Research Service



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# US Agricultural Exports

## Year-to-date and Current Months

|                                    | Dec.                     | Jan.                     | Change         |                          | Oct.-Jan.                | Change         |
|------------------------------------|--------------------------|--------------------------|----------------|--------------------------|--------------------------|----------------|
| Item                               | 2006                     | 2007                     | Dec.-Jan.      | 2006                     | 2007                     | '06-'07        |
| <b>Ag export values</b>            | <b>million dollars</b>   | <b>million dollars</b>   | <b>percent</b> | <b>million dollars</b>   | <b>million dollars</b>   | <b>percent</b> |
| Live animals                       | 105                      | 28                       | -73            | 365                      | 423                      | 16             |
| Red meats & products               | 466                      | 448                      | -4             | 1590                     | 1873                     | 18             |
| Poultry meats & products           | 241                      | 237                      | -2             | 1055                     | 1034                     | -2             |
| Dairy products                     | 146                      | 153                      | 4              | 521                      | 622                      | 19             |
| Hides & skins                      | 161                      | 177                      | 10             | 570                      | 666                      | 17             |
| Grains and feeds                   | 1860                     | 1917                     | 3              | 5972                     | 7248                     | 21             |
| Wheat                              | 398                      | 464                      | 17             | 1581                     | 1560                     | -1             |
| Rice                               | 128                      | 122                      | -5             | 445                      | 415                      | -7             |
| Corn                               | 796                      | 677                      | -15            | 1845                     | 2897                     | 57             |
| Animal feeds & oil meal            | 410                      | 429                      | 5              | 1574                     | 1709                     | 9              |
| Soybeans                           | 821                      | 1003                     | 22             | 3125                     | 3896                     | 25             |
| Vegetable oils                     | 204                      | 175                      | -15            | 583                      | 730                      | 25             |
| Fruits & products                  | 305                      | 309                      | 1              | 1217                     | 1330                     | 9              |
| Fruits, fresh                      | 222                      | 232                      | 4              | 943                      | 1001                     | 6              |
| Fruits, prepared                   | 83                       | 77                       | -7             | 274                      | 329                      | 20             |
| Fruit juices                       | 82                       | 80                       | -3             | 271                      | 309                      | 14             |
| Vegetables & products              | 358                      | 336                      | -6             | 1253                     | 1377                     | 10             |
| Vegetables, fresh                  | 158                      | 156                      | -1             | 514                      | 597                      | 16             |
| Vegetables, processed              | 200                      | 180                      | -10            | 739                      | 780                      | 6              |
| Tree nuts and preparations         | 296                      | 250                      | -15            | 1372                     | 1346                     | -2             |
| Cotton & linters                   | 239                      | 240                      | 0              | 1142                     | 834                      | -27            |
| Sugar & tropical products          | 217                      | 213                      | -2             | 785                      | 925                      | 18             |
| <b>Volumes</b>                     | <b>1,000 metric tons</b> | <b>1,000 metric tons</b> | <b>percent</b> | <b>1,000 metric tons</b> | <b>1,000 metric tons</b> | <b>percent</b> |
| Red meats & products               | 197                      | 196                      | 0              | 688                      | 784                      | 14             |
| Poultry meats                      | 221                      | 207                      | -7             | 903                      | 946                      | 5              |
| Nonfat dry milk                    | 17                       | 17                       | 0              | 66                       | 78                       | 18             |
| Wheat                              | 1,918                    | 2274                     | 19             | 57                       | 54                       | -6             |
| Rice                               | 323                      | 296                      | -8             | 1409                     | 1112                     | -21            |
| Coarse grains                      | 5140                     | 4513                     | -12            | 19328                    | 20410                    | 6              |
| Corn                               | 4,785                    | 4024                     | -16            | 17529                    | 18838                    | 7              |
| Sorghum                            | 315                      | 408                      | 29             | 1634                     | 1310                     | -20            |
| Soybeans                           | 3060                     | 3676                     | 20             | 13027                    | 15146                    | 16             |
| Oil meal                           | 733                      | 695                      | -5             | 2594                     | 2834                     | 9              |
| Vegetable oils                     | 253                      | 208                      | -18            | 687                      | 899                      | 31             |
| Fruits, fresh                      | 222                      | 252                      | 13             | 991                      | 952                      | -4             |
| Fruits, prepared or preserved      | 44                       | 42                       | -4             | 162                      | 173                      | 7              |
| Fruit juices                       | 81                       | 81                       | 0              | 376                      | 306                      | -19            |
| Vegetables, fresh                  | 174                      | 151                      | -13            | 666                      | 649                      | -3             |
| Vegetables, preserved or processed | 169                      | 153                      | -9             | 689                      | 689                      | 0              |
| Nuts & preparations                | 76                       | 64                       | -16            | 351                      | 368                      | 5              |
| Cotton & linters                   | 176                      | 170                      | -3             | 922                      | 610                      | -34            |

Source: Economic Research Service compiled from Census bureau data, US Department of Commerce.



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## US Agricultural Imports Year-to-Date and Current Months

|                              | Dec.                     | Jan.                     | Change         |                          | Oct.-Jan.                | Change         |
|------------------------------|--------------------------|--------------------------|----------------|--------------------------|--------------------------|----------------|
| Item                         | 2006                     | 2007                     | Dec.-Jan.      | 2006                     | 2007                     | '06-'07        |
| <b>Ag import values</b>      | <b>Million dollars</b>   | <b>Million dollars</b>   | <b>Percent</b> | <b>Million dollars</b>   | <b>Million dollars</b>   | <b>Percent</b> |
| Live animals                 | 222                      | 232                      | 5              | 1023                     | 975                      | -5             |
| Red meats & products         | 431                      | 430                      | 0              | 1796                     | 1717                     | -4             |
| Beef & veal                  | 273                      | 288                      | 5              | 1133                     | 1090                     | -4             |
| Pork                         | 96                       | 85                       | -11            | 436                      | 390                      | -11            |
| Dairy products               | 228                      | 221                      | -3             | 1007                     | 949                      | -6             |
| cheese                       | 101                      | 71                       | -30            | 360                      | 392                      | 9              |
| Grains & feeds               | 467                      | 474                      | 1              | 1660                     | 2008                     | 21             |
| Grain products               | 309                      | 316                      | 2              | 1205                     | 1376                     | 14             |
| Oilseeds & products          | 317                      | 298                      | -6             | 1013                     | 1177                     | 16             |
| Vegetable oils               | 272                      | 247                      | -9             | 862                      | 990                      | 15             |
| Fruits & preparations        | 611                      | 787                      | 29             | 2025                     | 2316                     | 14             |
| Fruits, fresh or frozen      | 501                      | 653                      | 30             | 1598                     | 1837                     | 15             |
| Fruits, prepared             | 110                      | 133                      | 22             | 427                      | 478                      | 12             |
| Fruit juices                 | 104                      | 132                      | 26             | 326                      | 446                      | 37             |
| Vegetables & preparations    | 620                      | 760                      | 23             | 2497                     | 2533                     | 1              |
| Vegetables, fresh or frozen  | 441                      | 577                      | 31             | 1864                     | 1810                     | -3             |
| Vegetables, prepared         | 168                      | 172                      | 2              | 597                      | 681                      | 14             |
| Tree nuts & preparations     | 97                       | 90                       | -8             | 404                      | 392                      | -3             |
| Cotton & linters             | 0                        | 1                        | 448            | 4                        | 3                        | -39            |
| wine                         | 347                      | 340                      | -2             | 1369                     | 1570                     | 15             |
| Malt beverages               | 297                      | 291                      | -2             | 975                      | 1223                     | 25             |
| Essential oils               | 184                      | 179                      | -3             | 730                      | 700                      | -4             |
| Cut flowers & nursery stock  | 105                      | 143                      | 36             | 463                      | 509                      | 10             |
| Sugar & related products     | 230                      | 204                      | -11            | 961                      | 882                      | -8             |
| confections                  | 94                       | 92                       | -1             | 389                      | 411                      | 5              |
| Cocoa & products             | 264                      | 230                      | -13            | 942                      | 931                      | -1             |
| Coffee & products            | 267                      | 318                      | 19             | 942                      | 1128                     | 20             |
| Rubber, natural              | 119                      | 159                      | 34             | 609                      | 659                      | 8              |
| <b>Volume</b>                | <b>1,000 metric tons</b> | <b>1,000 metric tons</b> | <b>percent</b> | <b>1,000 metric tons</b> | <b>1,000 metric tons</b> | <b>percent</b> |
| Wine l/                      | 70                       | 71                       | 0              | 269                      | 303                      | 13             |
| Malt beverages l/            | 288                      | 275                      | -4             | 920                      | 1171                     | 27             |
| Cattle & calves              | 196                      | 150                      | -24            | 988                      | 841                      | -15            |
| Beef & veal                  | 80                       | 88                       | 9              | 351                      | 323                      | -8             |
| Dairy products               | 31                       | 24                       | -21            | 122                      | 117                      | -4             |
| Processed grains, e.g., feed | 85                       | 89                       | 5              | 350                      | 376                      | 7              |
| Fruits, fresh or frozen      | 681                      | 859                      | 26             | 2508                     | 2769                     | 10             |
| Fruits, prepared             | 94                       | 117                      | 24             | 387                      | 409                      | 6              |
| Vegetables, fresh or frozen  | 483                      | 606                      | 26             | 1964                     | 1949                     | -1             |
| Vegetable oils               | 288                      | 253                      | -12            | 861                      | 969                      | 13             |
| Sugar & related products     | 280                      | 239                      | -15            | 1335                     | 1018                     | -24            |
| Cocoa & products             | 124                      | 111                      | -10            | 443                      | 416                      | -6             |
| Coffee & products            | 110                      | 130                      | 18             | 424                      | 463                      | 9              |

Source: Economic Research Service compiled from Census bureau data, US Department of Commerce.



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## US Agriculture and the World Market

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Use the January 2007 columns in the import and export tables to fill in the blanks below. Notice that the items are listed under values and volumes.

1. The value of US exports of live animal values is what percentage of imports? \_\_\_\_\_
2. The value of US exports of red meats and products is \_\_\_\_\_% more/less (circle one) than that of imports.
3. US dairy product export values equal \_\_\_\_\_% of US import values.
4. The value of US grain and feed exports is \_\_\_\_\_ times that of grain and feed imports.
5. What percent less is US vegetable oil imports than the value of vegetable oil exports?  
\_\_\_\_\_
6. What percent less is US fruit juice imports than the value of fruit juice exports?  
\_\_\_\_\_
7. The US exports \_\_\_\_\_ times as many tree nuts as it imports.
8. The US exports \_\_\_\_\_ % of the VOLUME of the prepared fruits it imports.
9. The US is only \_\_\_\_\_ % short of having equal VOLUMES of vegetable oil entering and leaving the U.S.

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Illustrate a line graph comparing grain imports verses exports.

This lesson was provided by Oklahoma Ag in the Classroom, a program of the Oklahoma Cooperative Extension Service, the Oklahoma Department of Agriculture, Food and Oklahoma State Department of Education, 2008.



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# Visualizing Chlorophyll

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## **Standards of Learning**

Science 6.1, LS.3, LS.4, LS.6

## **Objective**

Students will:

- Show and understand that plants contain many pigments necessary for photosynthesis

## **Materials**

- Fresh spinach leaves
- Rubbing alcohol
- Popsicle sticks
- Paper coffee filters cut into 3x5 cm strips
- Baby food jars
- Coins

## **Background Knowledge**

Not all of the light from the Sun makes it to the surface of the Earth. Even the light that does make it here is reflected and spread out. The little light that does make it here is enough for the plants of the world to survive and go through the process of photosynthesis. Light is actually energy, electromagnetic energy to be exact. When that energy gets to a green plant, all sorts of reactions can take place to store energy in the form of sugar molecules. We already spoke about the structure of chloroplasts in the cells tutorials. We want to reinforce that photosynthesis happens in the chloroplast. Within this cell organelle is the chlorophyll that captures the light from the Sun. Chlorophyll is the magic compound that can grab that sunlight and start the whole process. Chlorophyll is actually quite a varied compound. There are four (4) types: a, b, c, and d. Chlorophyll can also be found in many microorganisms and even some prokaryotic cells. However, as far as plants are concerned, the chlorophyll is found in the chloroplasts. The other big molecules are water ( $H_2O$ ), carbon dioxide ( $CO_2$ ), oxygen ( $O_2$ ) and glucose ( $C_6H_{12}O_6$ ). Carbon dioxide and water combine with light to create oxygen and glucose. That glucose is used in various forms by every creature on the planet. Animal cells require oxygen to survive. Animal cells need an aerobic environment (one with oxygen). The whole process doesn't happen all at one time. The process of photosynthesis is divided into two main parts. The first part is called the light dependent reaction. This reaction happens when the light energy is captured and pushed into a chemical called ATP. The second part of the process happens when the ATP is used to make glucose (the Calvin Cycle). That second part is called the light independent reaction.

Green leaves contain more than one pigment used in photosynthesis. Photosynthetic pigments can be separated in alcohol (or Acetone) because of different molecular weights and other molecular characteristics. These characteristics determine the speed at which the molecule can travel along the surface of the filter paper.

## **Procedure**

1. Take your filter paper and draw a line across it in the middle.
2. Place the spinach leaf on top of the filter paper so that it is overlapping the line you drew.
3. Take your coin and rub it over the spinach leaf that is laying on the filter paper until you have something like a leaf rubbing on top of the line that you drew.



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4. Take your jar and stick and place the stick across the top of the jar so that it rests on the rim.
5. Attach the filter paper strip to the stick with tape but make sure that the line and leaf rubbing are not touching the bottom of the jar. The bottom of the filter paper should be barely touching the bottom of the jar.
6. Slowly add rubbing alcohol to the container. The bottom edge of the filter should be submerged in the alcohol and the alcohol line should be below the line and leaf rubbing you made.
7. Wait 10-15 minutes while the filter is sitting in the alcohol. Remove the filter paper when liquid has traveled  $\frac{3}{4}$  of the way up the strip.
8. You should see bands of different colors where the alcohol has reached the leaf rubbing and line. This is called a Chromatogram.

### **Extension**

- Complete chromatogram using different types of leaves.
- Measure the distances traveled by the pigments.
- Research plants used by Indians to produce natural dyes.
- Discuss the process of leaves changing color in the fall and fruit changing color in the fall and fruit changing color when it ripens.



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# Water, Water...Everywhere?

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## **Standards of Learning**

Science: 1.8, 3.9, 4.9, 6.5, 6.7, 6.9

## **Objective**

The student will

- identify the major uses of water and understand the limited amount of water available. Discuss the importance of water conservation.

## **Materials**

- 1 gallon jug of water (can recycle an old milk jug)
- measuring cup
- tablespoon
- eye dropper
- clear plastic cup

## **Background Knowledge**

Water travels in a cycle. It comes down as precipitation; the sun causes evaporation; and then forms clouds through condensation. In this cycle, water is neither gained nor lost, it simply continues through the cycle.

Although the Earth's surface is about 75% water, only 3% of that is fresh, drinkable, water. Of that 3%, three-fourths is found in polar ice caps and glaciers. That means that less than 1% of the water on the earth is drinkable. Water is vital for humans, animals, and plants.

## **Procedure**

1. Begin the lesson by asking students how they use water each day. Discuss answers and record on the board.
2. Brainstorm other uses of water, industrial and agricultural. Record on the board as well.
3. Ask students where fresh water comes from. (rain/snow, rivers, lakes)
4. Hold up a gallon jug filled with water. Tell students that this represents all of the water on the Earth.
5. Use the measuring cup and pour out  $\frac{1}{4}$  cup of water from the jug.
6. The water in the measuring cup represents the Earth's supply of fresh water. The water remaining in the jug represents ocean/salt water.
7. Take 3 tablespoons of water out of the measuring cup and dump into a clear plastic cup. The 3 tablespoons represents the water locked away in glaciers and polar ice caps.
8. Ask for a volunteer. Take the eyedropper and place 2 drops (taken out of the measuring cup) into his/her hand. These 2 drops represent all of the fresh water available for use on Earth.
9. Revisit the list of water uses on the board. Why is it important to conserve water? Why is water pollution and contamination so harmful? Discuss.

## **Extension**

Break students into groups of 3-4. Have groups brainstorm ways to conserve water. Next, each group should create a Public Service Announcement skit or poster advertisement encouraging people to conserve water. Skits/posters should include conservation tips as well as explain the importance of doing so.

## **References**

Lesson adapted from Space Agriculture in the Classroom, [www.spaceag.org](http://www.spaceag.org).



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# What Do Farmers Do?

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## **Standards of Learning**

Science 6.9

English 6.1, 7.1

## **Objective**

Student will:

- learn how seasons affect what farmer's do.

## **Materials**

- Pictures of farms during different seasons
- 4 sheets of chart paper

## **Background Knowledge**

Discuss seasonal changes and the terms vernal equinox, summer and winter solstice. Review the terms global warming and how it affects the US and Virginia weather.

The seasons that our world goes through affect everything around us especially our farms and gardens. During the spring is when most people plant their farm full of flowers or vegetables. Then during the summer they have beautiful flowers or vegetables with the sun shining down on them or they pick them for their family to eat. Farmers will harvest their crops if they need to in the summer, and they will also have their livestock out on the farm so they can enjoy the fresh air. In the fall the leaves start to fall from the trees and most vegetables that are left are harvested. Lastly, in the winter, the farm is empty except for snow that has fallen on the ground. Livestock are put up in the barn so they can stay warm. There are many objects that represent our different seasons, such as a sun or vegetable for summer, leaves or pumpkins in the fall, sleds or snow hats in the winter, and flowers or bees for the spring. However, the changes in the seasons are also much more complicated than just what we see on earth. There is a popular misconception that the seasons on the Earth are caused by varying distances of the Earth from the Sun on its elliptical orbit. This is not correct. The primary cause of the seasons is the 23.5 degree of the Earth's rotation axis with respect to the plane of the ecliptic, as illustrated in the adjacent image. This means that as the Earth goes around its orbit the Northern hemisphere is at various times oriented more toward and more away from the Sun, and likewise for the Southern hemisphere. Thus, we experience Summer in the Northern Hemisphere when the Earth is on that part of its orbit where the N. Hemisphere is oriented more toward the Sun and therefore the Sun rises higher in the sky and is above the horizon longer, and the rays of the Sun strike the ground more directly. Likewise, in the N. Hemisphere Winter the hemisphere is oriented away from the Sun, the Sun only rises low in the sky, is above the horizon for a shorter period, and the rays of the Sun strike the ground more obliquely.

An equinox occurs twice a year, when the tilt of the Earth's axis is inclined neither away from nor towards the Sun, the Sun being vertically above a point on the Equator. At an equinox, the Sun is at one of two opposite points on the celestial sphere where the celestial equator and ecliptic intersect. These points of intersection are called equinoctial points: the vernal (spring) point and the autumnal (autumn) point.

A solstice is an astronomical event that happens twice each year, when the tilt of the Earth's axis is most inclined toward or away from the Sun, causing the Sun's apparent position in the



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sky to reach its northernmost or southernmost extreme. The solstices, together with the equinoxes, are connected with the seasons. In some cultures they are considered to start or separate the seasons while in others they fall in the middle. The English expressions "midwinter" (winter solstice) and "midsummer" (summer solstice) may derive.

### **Procedure**

1. Hold up the picture of the farm during the summer time, ask the students what happens on the farm during the summer?
2. Make a list on the chart paper.
3. Repeat the process for each season
4. After all seasons are done, compare the list. Is one list longer than the others? Is there a reason for this?
5. Discussion Questions:
  - How would global warming affect this list?
  - Would this list look the same for crop farmers as opposed to animal farmers?
  - How would this list compare if students completed it in South America as opposed to North America?
  - What actually causes the seasons?

### **Extension**

1. Have the students draw a farm in each of the seasons as it may look.
2. Have a farmer come to the class to talk about farm life, and how it changes with the seasons.



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# What's Really in the Bowl?

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## **Standards of Learning**

Science: 6.1

Health: 6.2, 7.2

## **Objective**

The student will be able to:

- identify critical information on food labels
- correlate suggested serving sizes to nutritional information
- collect and analyze data of food products

## **Materials**

- 6 cereal boxes (one box with cereal still in it)
- cereal bowls
- dry measure (measuring cups)
- metric scale

## **Background Knowledge**

Breakfast is essential to a balanced diet. What we eat as well as how much can start the day with energy for the morning or a burst of instant energy.

Eating a regular, healthy breakfast does make a difference. Studies show it improves your overall health and well-being. School children who skip breakfast have greater hyperactivity, irritability, and anxiety; more disruptive classroom behavior; more tardiness; and a decreased ability to concentrate and solve problems. Eating breakfast reduces fatigue and sleepiness in the mid-morning hours; helps banish away the blues; improves concentration, increases alertness, and helps one function more efficiently. Academic performance is generally better when breakfast is eaten. Children who eat breakfast perform better on standardized achievement tests and have fewer behavior problems in school.

Cereals are a popular breakfast choice in many households. Just what is in breakfast bowl? Does it fill you with whole grains, vitamins, minerals, and perhaps even a little protein or just a sugary start to the day?

## **Procedure**

1. Provide a sampling of cereal boxes for the class to examine.
2. Have a student come up and pour a bowl of cereal. The bowl should represent the amount the student would serve themselves for breakfast.
3. Read the serving size listed on the box. Measure how much the student has poured and write the number of servings on the board. Most likely, the student will have poured significantly more than one serving.
4. Determine and record the amount of calories, fat, carbohydrates, fiber, and sugars that would be consumed if they were to eat the amount of servings written on the board.
5. Record all data on the What's Really in the Bowl? Worksheet.
6. Measure this amount of refined white sugar into a different bowl using the metric scale. Compare the total amount of cereal to the amount of sugar.



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7. Read the label to determine the calories, fat, carbohydrates, fiber, and sugars in a recommended serving.
8. Record all data on the What's Really in the Bowl? Worksheet.
9. Divide the class into groups and provide a sample box for each group.
10. Provide students time to analyze each box and record the findings. Rotate boxes until students have recorded information for each sample box.
11. Lastly, have each group try and put the cereals in order from most healthy (1) to least healthy (5). Record in the health ranking column and discuss results.

### **Extension**

Analyze other breakfast items using labels. How does cereal compare to breakfast options such as toast (be sure to subtract the fiber), orange juice, biscuits, soft drinks or any other breakfast items that the students in the class mention?

### **References**

<http://www.elook.org/nutrition/cereals>



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# What's Really in the Bowl?

| Breakfast Cereal | Serving Size (cups) | Calories | Total Fat (g) | Saturated Fat (g) | Carbs (g) | Fiber (g) | Sugar (g) | Carbs - Sugars= | Health Ranking |
|------------------|---------------------|----------|---------------|-------------------|-----------|-----------|-----------|-----------------|----------------|
| EX: Froot Loops  | 1                   | 120      | 1             | 0.5               | 26        | 1         | 13        | 13              |                |
|                  |                     |          |               |                   |           |           |           |                 |                |
|                  |                     |          |               |                   |           |           |           |                 |                |
|                  |                     |          |               |                   |           |           |           |                 |                |
|                  |                     |          |               |                   |           |           |           |                 |                |
|                  |                     |          |               |                   |           |           |           |                 |                |



| Nutrition Facts                   |                      |
|-----------------------------------|----------------------|
| Serving Size: 1-1/4 cup (32g)     |                      |
| Amount Per Serving                |                      |
| <b>Calories</b> 126               | Calories from Fat 10 |
| % Daily Value*                    |                      |
| <b>Total Fat</b> 1.09 g           | <b>2%</b>            |
| Saturated Fat 0.45 g              | <b>2%</b>            |
| Trans Fat                         |                      |
| <b>Cholesterol</b> 0 mg           | <b>0%</b>            |
| <b>Sodium</b> 179.52 mg           | <b>7%</b>            |
| <b>Potassium</b> 43.84 mg         | <b>1%</b>            |
| <b>Total Carbohydrate</b> 27.52 g | <b>9%</b>            |
| Dietary Fiber 1.02 g              | <b>4%</b>            |
| Sugars 10.08 g                    |                      |
| Sugar Alcohols                    |                      |
| <b>Protein</b> 1.98 g             |                      |
| <b>Vitamin A</b> 515.52 IU        | 10%                  |
| <b>Vitamin C</b> 15.04 mg         | 25%                  |
| <b>Calcium</b> 5.44 mg            | 1%                   |
| <b>Iron</b> 6.08 mg               | 34%                  |



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# What's My Rule? – Produce Version

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## **Standards of Learning**

Science 6.1, LS.5

Mathematics 8.2, 8.14

## **Objective**

The student will

- generate MANY ways to categorize the produce and to justify/articulate the characteristics used to create those groupings

## **Materials**

Produce with variations – gourds, apples, citrus fruits, seeds (important to use a variety) – at least 6-8 pieces per group

Venn Diagram or physical rings

## **Background Knowledge**

Using the wonderful variation found in nature, teachers can use produce to teach sorting, observation, logical thinking, the study skill of using Venn diagrams, the making of a dichotomous key, or set theory (intersections and unions).

## **Procedure**

1. Give each small group as many pieces of produce as possible (at least 6 – 8). Have the group work together to divide the produce into two groups. They should then articulate the characteristic they used to categorize the produce.
2. Now have one student split the produce differently into two piles and then ask the other members of the group to figure out “What’s My Rule?” – what characteristic was used to divide the produce.
3. Other students in the group should get a chance to divide the produce into multiple groups using multiple criteria. Each time the other members of the group are to determine “What’s My Rule?”
4. Now use the Venn diagram. Model the concept of intersection and union using an overhead diagram or two hula hoops on a table.
5. Let the student groups come up with their own way of using their produce to illustrate a 2 ring Venn diagram.

## **Extension**

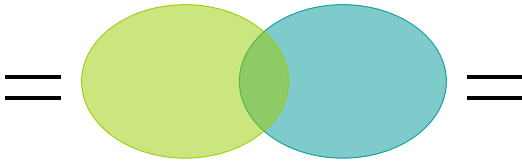
1. Instead of the above procedure, the teacher can begin the lesson by making up a list of traits which can be written on cards and drawn out of a box by the groups. The students can organize the produce using these traits first. Example of traits include: red, yellow, green, multi-colored, round, oblong, irregular shape, edible skin, smooth skin, rough skin. An interesting example would be to use “yellow” and “red” as the traits. See if students would interpret the intersection of those traits as “orange”.



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2. Increase the complexity to three rings.
3. Physically manipulate Venn diagrams using hula hoops, embroidery hoops or metal wreath rings.
4. For a biology or life science class have the students create their own dichotomous key using the produce. Start with the whole group of produce and name it. Then break it into smaller groups. Each time a subdivision is made, have the students Name the Rule. Eventually there will be a large number of groups and the students will have developed a list of rules. From this list, students should develop a list of “yes/no” questions which will become their own dichotomous key. Have groups exchange bags of produce/keys and follow the keys to sort other students’ produce. Did the dichotomous keys work?

What's the Rule



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# Why Buy Dirt?

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## **Standards of Learning**

Science LS.1, LS.7, LS.12

## **Objective**

The student will be able to:

- create and test hypothesis
- test soil pH
- diagnose nitrogen, phosphorus, and potash levels
- analyze data and make recommendations to amend soil levels

## **Materials**

- 1 cup potting mix
- 1 cup potting soil
- 1 cup Soil sample from home
- 1 gallon distilled water
- 3 clear plastic cups
- 3 plastic spoons
- dropper
- Rapitest Soil Test Kit
- Periodic Table

## **Background Knowledge**

Why do we purchase soil for planting trees, vegetables, and flowers when it is plentiful all around our yards? Is there an increasing value in this dirt? Why do some bags of soil feel light and fluffy while others are heavy and dark? The dirt in my yard doesn't look anything like what is in the bag, why? Asked your class these questions and many answers and hypotheses will surface.

Soil is a loose mixture of rock fragments and organic material. The fragments are formed from many years of weathering, water, and the influence of other living organisms. Topsoil is the upper layer and is the richest part of the soil for plant growth. It contains humus or decaying matter which adds nutrients. Three tiny particle varieties are present in the topsoil including sand, silt, and clay. Topsoil is essential for plant growth and provides support and nutrients for plants. Subsoil and bedrock are the other two layers beneath the topsoil. These layers lack the essential nutrients and minerals needed for plant growth.

Plants absorb nutrients from the soil. Soil composition and acidity determines the extent to which nutrients are available to plants. The primary nutrients needed by plants are nitrogen (N), phosphorus (P), and potassium also referred to as potash (K). Plants require large amounts of these nutrients for growth and survival.

pH levels significantly affect the presence of nutrients in the soil. Primary nutrients are less available in soil with a low pH. Ideally soil will be at a neutral level of pH 7. Lime is often used to raise the pH level of soil with high acidity.

Nitrogen is essential for the production of proteins, enzymes, and metabolic processes involving energy transfer. Nitrogen is required for photosynthesis and is a part of chlorophyll. The nitrogen cycle further explains how nitrogen is replaced in the soil.



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Phosphorus is important for agriculture because it improves water retention, yield, nutrient value, color, texture, and disease resistance in crops. It is a necessary element for the process of photosynthesis. Phosphorus is found in organic materials and is known for stimulating plant growth from roots to blooms.

Potash, also known as potassium (K), is absorbed by plants in large amounts. It helps in building protein, photosynthesis, and reduces the chances of disease. Potassium may be found in soil naturally, in organic material, or in chemical fertilizer.

Basic soil samples from yards, fields, and wooded areas will vary in levels of pH, elements, and nutrients needed to grow healthy plants. Top soil and potting mixes are a combination of ingredients to provide balanced pH and rich growing medium for plants. For this reason many people add purchased topsoil, mulch, fertilizers, and peat moss to new garden spots or even when planting trees and shrubs.

“Why Buy Dirt?” allows a student to investigate the value of a rich balanced soil.

### **Procedure**

1. Create a hypothesis regarding why people often buy soil rather than use what is in the yard to plant flowers, garden plants, and shrubs.
2. Using the back side of the periodic table poster discuss appropriate pH levels for soil along with key indicators of balanced quality soil.
3. Measure 2 tablespoons of potting mix in one plastic cup and add 10 tablespoons of water. Stir mixture thoroughly. Allow mixture to settle for 30 minutes or more.
4. Set up nitrogen comparative cylinder on flat surface. Open comparators capsule and empty the contents for nitrogen into the small side of the nitrogen cylinder. Using a dropper add liquid from the potting mix sample to the small side of the cylinder. Place the cap securely on the nitrogen cylinder and shake thoroughly until comparative powder is dissolved into the liquid.
5. Wait 15 minutes for solution to settle to a color. Match solution color to cylinder color chart to determine amount of nitrogen present in potting mix.
6. Discuss results with students and possible solutions to situations of deficit or surplus samples.
7. Repeat process using phosphorus and potash test using potting mix sample.
8. Record results from each test.
9. Conduct a pH test as a final soil analysis. Use the pH test cylinder.
10. Add potting mix granules to the small side of the cylinder. Add contents from the comparator capsule. Using the dropper add distilled water to the fill line.
11. Secure cap on cylinder and shake vigorously for 30 seconds or until sample is mixed well.
12. Wait 5 minutes and record results.
13. Repeat steps 1-10 with each remaining soil sample.
14. Discuss if hypothesis was correct and why.
15. Answer the question, “Why buy dirt?”

### **Charts**



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| Soil Sample       | pH | Nitrogen<br>(N) | Phosphorus<br>(P) | Potash<br>(K) | Recommended<br>Amendment |
|-------------------|----|-----------------|-------------------|---------------|--------------------------|
| Potting mix       |    |                 |                   |               |                          |
| Potting Soil      |    |                 |                   |               |                          |
| Soil Yard Sample  |    |                 |                   |               |                          |
| Soil Field Sample |    |                 |                   |               |                          |

### **Extension**

- Investigate how to amend soil. Use Rapitest Soil Test Kit charts to determine the best fertilizer mix for each sample.
- Use Rapitest Soil Test Kit pH Preference List to determine the best plants and crops for the soil samples.

### **Resources**

- Rapitest Soil Test Kit from Luster Leaf Products at <http://www.lusterleaf.com>
- <http://www.soiltest.vt.edu>
- <http://www.lowes.com/lowes/lkn?action=howTo&p=LawnGarden/soiltest.html>
- <http://www.humeseeds.com/soiltest.htm>
- <http://www.humeseeds.com/soilph.htm>
- <http://www.ncagr.gov/cyber/kidswrld/plant/nutrient.htm>



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# Will It Last

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## **Standards of Learning**

Science 6.2, 6.9, LS.9, LS.11, LS.12

English 6.1, 6.2, 6.5, 7.1

Social Studies USII.1e, USII.2b, CE.1, CE.9

## **Objective**

The student will:

- be able to identify ways to conserve our natural resources
- identify the difference between renewable and nonrenewable resources
- explain consumption
- state the importance of their role in conserving natural resources

## **Materials**

- Measuring cup
- Sponges (cut 1 piece per student)
- Marker or Masking Tape
- 2 Large clear glass container
- Towel
- Tint/food coloring

## **Background Knowledge**

Data for graphs:

### **Earth's Total Water Supply**

97.2%            Salt Water (oceans, seas, and salt lakes)

2.8%            Fresh water

### **Earth's Total Freshwater Supply = total of 2.8% (as listed above)**

2.38%           Icecaps, glaciers

0.397%        groundwater – available

0.022%        Surface water – available

0.001%        Air and Soil

People use water daily in many ways, often-unrealized amounts. A single family home that has no water conservation fixtures may use as much as 64.6 gallons per person per day (gpd) or 244.5 liters per day. Some of the major water uses include 18.3 gpd for toilet flushing, 14 gpd for clothes washers, 12.2 gpd, for showers, and 10.3 gpd for faucets used such as hand washing, drinking, and cooking water and washing dishes. We also use water in many indirect ways such as in the production of manufactured items and food, irrigation of lawns and food crops, preparation of food, cooling, and heating.

Even though there is an abundance of water on earth much of it is unusable for consumption by people or animals in its present form. (See the above information)



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## **Procedure**

1. Have students take the information provided concerning water supply on earth, and graph it using a pie graph or bar graph to illustrate how little available fresh water we have and to reinforce its value.
2. Measure 8 cups of tinted water into the container. The container represents the earth, and the tinted water represents the available fresh water supply on earth.
3. Mark with tape or marker where the level of the water is to begin with.
4. Have students brainstorm ways in which we use water, and write them on the board. (Drinking, irrigation, watering plants, recreation, bathing, cleaning, cooking, processing)
5. Drop a piece of sponge into the container as you state one demand you made on water yesterday. Then remove the sponge **WITHOUT SQUEEZING WATER OUT!** (Place in another container)
6. Have the students examine the water level (there should be very little difference)
7. Ask students one at a time to state a demand they made on water yesterday; as they do they put their sponge into the water. Leave sponges in the water until the last student.
8. Remove sponges **WITHOUT SQUEEZING THEM OUT** set them aside in a bowl.
9. Mark the new level of water on the container. (There should be a large difference.)
10. In the same way that you demonstrated the demand on resources, demonstrate the need for conservation. Take one sponge that was set aside, and state one way that you conserved water and squeeze it back into the original container. (The students will notice very little difference.)
11. Have each student come up with ways to conserve and squeeze the water back into the container.
12. The level will not go all the way back up to the top, some will stay in the sponge this is the water that is used and enters into the water cycle and is recycled and comes back to us.
13. Discussion questions:
  - What happens to the water level as we remove all the sponges?
  - What will happen to our water supply if we continue to use water at this rate?
  - What are some things that we can do to control the situation?
  - What happens to the water left in the sponge after it is squeezed out (can launch into water cycle)?
  - How can the water represent other resources that we use? (Other renewable resources)
  - Water is renewable, what does that mean and how is that represented in our experiment?
  - What are some resources that are not renewable? What will happen if we overuse these?

## **Extension**

Use different color sponges, with each color representing a different natural resource (blue= water, green= plants, yellow= minerals, and so on.)

Overturn container to simulate natural disasters limits on water availability.

Adapted from Tennessee ATIC and Project Food Land and People



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