get into energy

Get into STEM

Compiled by the Center for Energy Workforce Development

Donated by the WIN Chapter at Oak Ridge National Lab, Tennessee

Center For ENERGY Workforce Development

Dear Teachers:

Formed in March 2006, the Center for Energy Workforce Development (CEWD) is a non-profit consortium of electric, natural gas, and nuclear utilities, and their associations—Edison Electric Institute, American Gas Association, Nuclear Energy Institute, and National Rural Electric Cooperative Association. CEWD was formed to help utilities work together to develop solutions to the coming workforce shortage in the utility industry. It is the first partnership between utilities, their associations, contractors, and unions to focus on the need to build a skilled workforce pipeline that will meet future industry needs.

As technology continues to develop at a record pace, having strong skills in Science, Technology, Engineering, and Math (STEM) is becoming increasingly important in the workplace. While many think of engineers, scientists, and computer programmers when they think of STEM, all career pathways in the energy industry require STEM skills. In our industry, individuals are truly Putting STEM to Work™ by using STEM skills on an everyday basis. These touch on the Next Generation Science Standards, the Common Core in Mathematics, and other key standards used in grades K-12 education.

So we encourage you to engage children in using STEM skills in a variety of ways, and get them excited about and see the relevance of STEM. These lessons were developed by WIN Chapter at Oak Ridge National Lab, Tennessee.

CEWD has an energy curriculum website at www.cewd.org/curriculum if you are looking to expand on energy lessons, as well as a youth-friendly careers website at www.getintoenergy.com.

Thank you for your interest!

Ann Randazzo
Executive Director
Center for Energy Workforce Development

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Air Pressure

There is air surrounding us everywhere. You can't see it, but you can feel it when the wind blows. You can see it pushing the leaves around. The air is made of small particles called molecules that we can not see. Even though we cannot see them, they still take up space and have weight.

Try this: Take a deep breath and feel the air going into your nose. Did your chest move?

We don't think about it, but we are living at the bottom of a large pool of air that surrounds the entire earth. This large pool of air is called the atmosphere. The atmosphere is nearly 80 miles thick. Have you ever swum to the bottom of the swimming pool and felt the water push on your ears? The pool of air we live in is also pushing on us, but we are so used to it we don't even notice.

The weight of the air pushing on us is called air pressure and it is about 15 pounds on every square inch of us. The big turkey you had at Thanksgiving weighed about 15 pounds and a square inch is about the size of a stamp. That is a lot of weight pushing on us! Luckily the air inside us is also pushing out, so we aren't squashed.

Let's try some experiments to see what all that air pressure does and some ways we can change it.

Here are the activities we'll do as we investigate air pressure:

Air is all around us:	The Magic cup of water
	Water in a tube
More and less air pressure:	Marshmallow face
	The water fountain
Heating and cooling air:	The inflating balloon
	The collapsing bottle

Things in this kit:

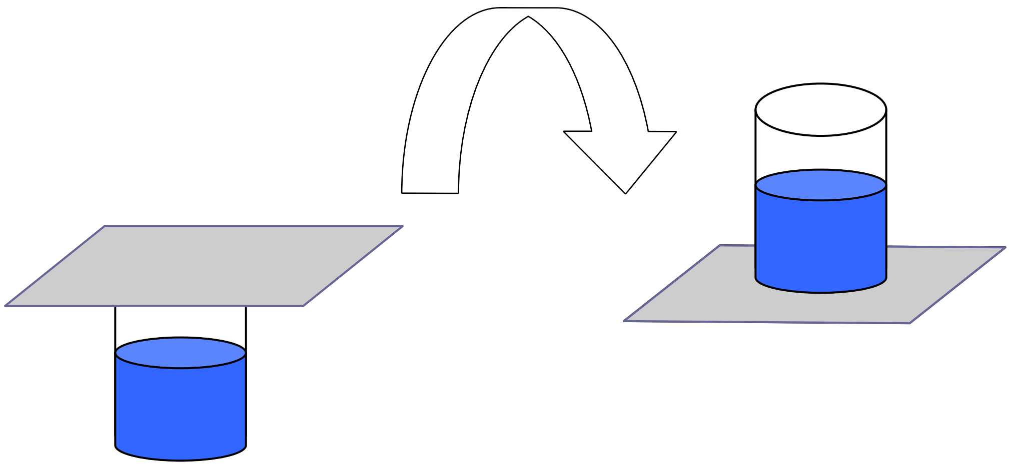
1. plastic cup
2. Index card
3. plastic tubing
4. tea bag
5. a canning jar
6. a marshmallow
7. a drinking straw
8. a piece of clay
9. a balloon

Other things you need:

1. water
2. a plastic bottle

Air is All Around Us

The Magic Glass of Water



You will need:

- A plastic cup
- An index card
- Water

What to Do:

1. Fill the glass 1/3 full of water. Cover the top of the cup with the index card.
2. Now go over to the sink.
3. Put your hand on the index card and hold it against the top of the glass and turn the glass and index card upside down.
4. Now here is the really cool part. What do you think will happen if you remove your hand from the index card (don't forget to hold onto the cup with your other hand)? Remove your hand from the index card and see what happens.

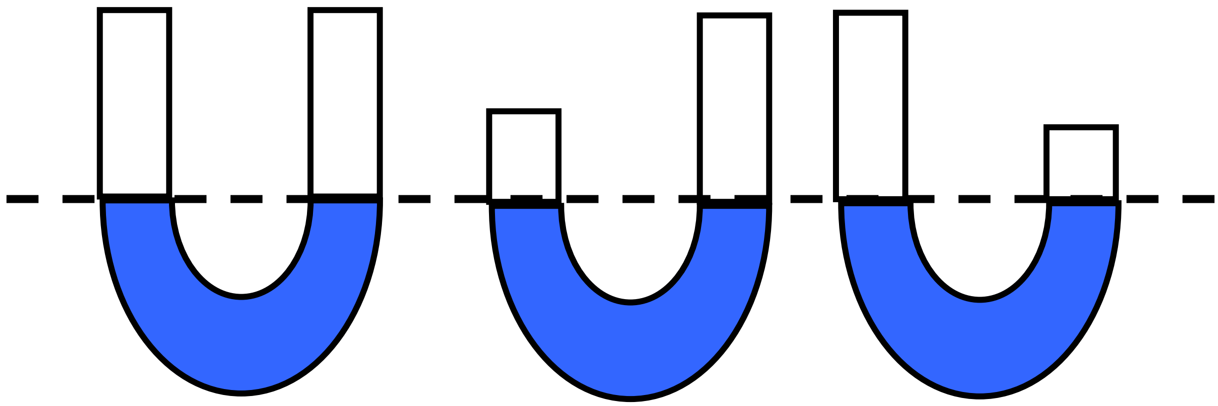
What happened:

Remember that ocean of air that we live in? Although we cannot see it, it is pushing on us and also on the index card. It is pushing so hard that the water can not push the index card away. The water weighs less than 1 pound, but the air is pushing with 15 pounds for every square inch of the index card. The air holds the index card in place and the water stays in the cup.

Water in a Tube

You will need:

- Plastic tubing
- Water
- Tea bag or food coloring (if you have it in your cupboard)



What to Do:

1. Place the tea bag into a glass of water, or color the water with food coloring.
2. Pour water in the plastic tube, but don't fill it up all the way. Hold both ends of the tube and see if the water is at the same height.
3. Now try moving the tubing to make one side of the water higher than the other. Could you do it?
4. Now put your finger over one end of the tubing and try again.

What happened:

The air was pushing on the water at both ends of the tube, so the water levels stay exactly the same. When you put your finger over one end of the tube, you blocked the air from getting to the water. Now the pressure on each side of the tube is different and you can change the level of the water.

You can use this principle when you are building a wall to make sure it is all at the same height. Just fill a garden hose with water and hold one end so the water level is at the top of the wall. Then stretch the hose to the other end of the wall. If your wall is level, the water level at that end should also be at the top of the wall.

More and Less Air Pressure

You can change the air pressure in a jar. Try the next two experiments to see how.

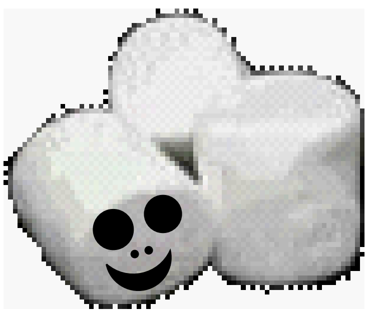
Marshmallow Face

You will need:

Marshmallow
A jar and lid (the lid has a hole in it)
A drinking straw
A Marker
A piece of clay

What to Do:

1. Draw a face on the flat end of the marshmallow with the magic marker. You can draw any face you like.



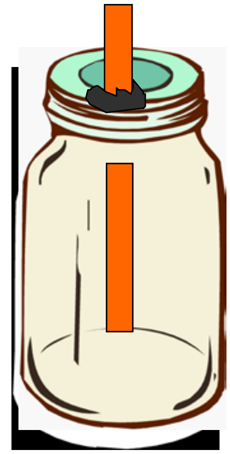
2. Now put the marshmallow in the jar and screw on the lid.
3. Put the straw through the hole in the lid until about an inch is inside the jar. Press the clay around the straw to make an air-tight seal. The clay will keep the straw from falling into the jar. **NOTE- The air-tight seal is important- it won't work without it!**
4. Now suck the air out of the jar. Suck really hard. If you do this in front of a mirror, you can see what is happening to your marshmallow face.
5. Now quit sucking and see what happens.

What happened:

Although the marshmallow looks solid, it is full of pockets of air. When you suck the air out of the bottle there is not as much air to push on the marshmallow. This means there is less air pressure. The pockets of air in the marshmallow are still full of air and are pushing out, but there is not much air in the jar to push back. The pockets of air push out and become bigger and the marshmallow puffs up.

When you quit sucking on the straw the air rushed back into the jar and pushed the marshmallow back to its original size.

The Water Fountain



You will need:

- A jar with lid
- A drinking straw
- A piece of clay
- Water
- A large bowl or a large sink

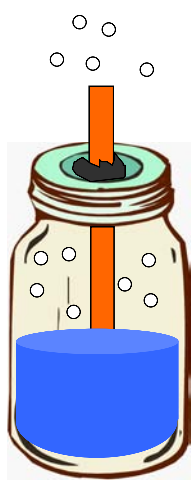
What to Do:

1. Use the jar, lid, straw, and clay from the last experiment.
2. Fill the jar 1/2 full of water. Push the straw through the lid until 1 inch of the straw is below water. Make sure the clay makes a seal with the straw and the jar lid.
3. Place the jar in a large bowl or the sink.
4. Now blow as hard as you can into the jar. Quickly let go of the straw.

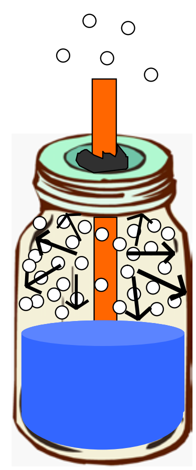
What happened:

Before you blew on the straw, the air pressure inside the jar and outside the jar were the same. Air is made of tiny particles that we can't see. These particles are called molecules. There is lots of empty space between these particles or molecules, so there is room for more air. When you blew on the straw, you pushed more air into the jar. Did you see the air bubble up through

Before you blew on the straw



After you blew on the straw

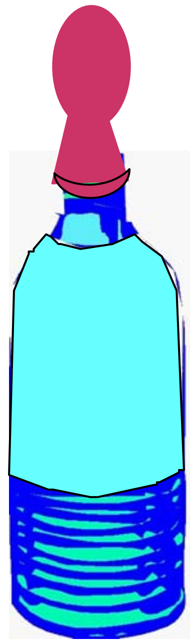


Where there is more air, there is more pressure. Now there is more air and pressure inside the jar than there is outside the jar. Look at the "after you blew" jar above. All that air is pushing hard. It can't get back out of the jar, because the water is in the way. The air pushes on the water so hard that it pushes the water up the straw and out of the jar and you have a water fountain.

Heating and cooling air

The Inflating Balloon

Heat changes air pressure in a closed container. The more heat the air the higher the air pressure in the container. Let's try an experiment and watch how heat changes air pressure.



You will need:

- A plastic bottle
- A balloon
- Some hot water
- Some ice cubes
- A bowl

What to Do:

1. Put a balloon over the end of the plastic bottle.
2. Pour some hot water in a bowl. Hot tap water will work, but hot water from the stove is even better. Hot water can burn, so have your parent help with this.
3. Place the bottle in the hot water. Watch what happens to the balloon (it may take a few minutes).
4. Let the air out of the balloon. If it breaks, get a new balloon.
5. Put the balloon back over the neck of the bottle.
6. Now place the plastic bottle in a bowl of ice water. Watch what happens to the balloon.

What Happened:

Bottle in hot water

Heat causes things to expand or get bigger. Cold causes things to contract or get smaller. When the bottle is put in the hot water, the air inside the bottle is heated. The air tries to expands and the air pressure increases. The air pushes out of the bottle and into the balloon. That is why the balloon inflates or gets bigger.

Bottle in cold water

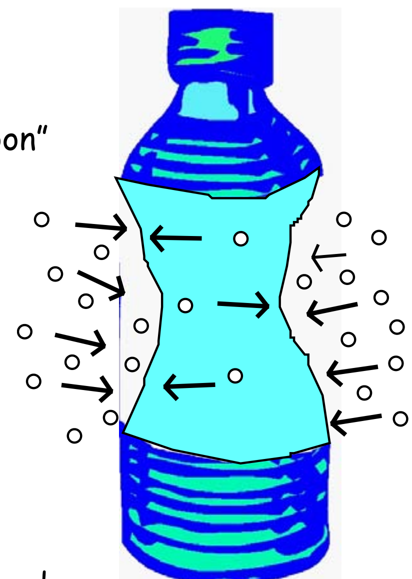
When the bottle is placed in the cold water, the air in the bottle cools and contracts (takes up less room). There is less air pressure in the bottle than outside in the room. Now the outside air is pushing harder (more air pressure) and it pushes the balloon into the bottle.

The Collapsing Bottle

You will need:

- A plastic bottle
- Some hot water
- Some ice cubes
- A bowl

Remember how we said that there are pounds and pounds of air pressure pushing on us all the time, but we are so used to it we don't even notice. The reason all that air pressure doesn't smash us is because we have air inside us also. The inside air is pushing out at the same pressure that the outside air is pushing in. What would happen if we took that inside air pressure away?



What to Do:

1. Take your plastic bottle from the "Inflating Balloon" experiment and take off the balloon.
2. Put the bottle back into the hot water.
3. Wait a few minutes and put the lid tightly on the bottle.
4. Now put the bottle into a bowl with ice cubes or you can put it in the freezer for 15 minutes instead. Did anything happen to the bottle?

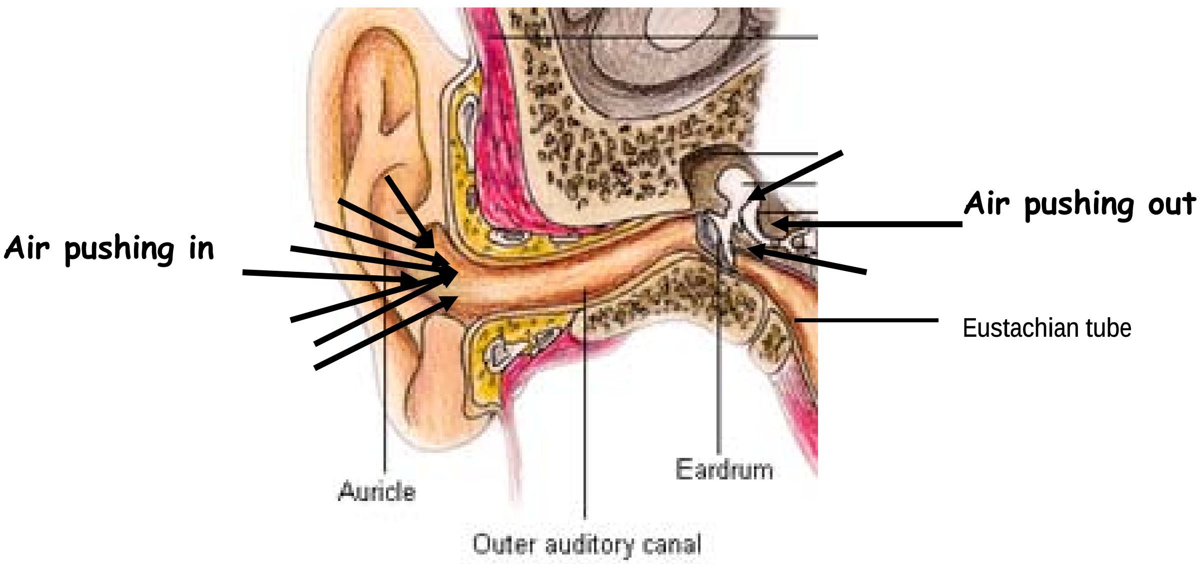
What Happened?

When the bottle was heated the air expanded and escaped from the bottle. When you put the lid on, the air could not return to the bottle. As the bottle cooled the air that was left in the bottle contracted or became smaller. The air pressure also became lower. The outside air was pushing in a lot harder than the inside air was pushing out. The outside air pushed hard enough to collapse the sides of the bottle.

An ear popping discovery:

Another interesting thing is that the higher we go in the atmosphere (the sea of air surrounding us), the thinner the air is and the lower the air pressure. That is why your ears hurt when you drive back down from the mountains. The air inside your ears is the still at the lower air pressure from the top of the hill, but now the outside pressure is getting higher. The outside pressure is pushing in harder than the inside pressure is pushing out.

Pretend the bottle on the top of the page is your ear drum. No wonder your ears hurt. When you yawn you open a passage (Eustachian tube) in your head that allows some more air to flow into your ears (that's when your ears pop). The pressure becomes the same inside and out and your ears quit hurting.



Sources

Http://www.spartechsoftware.com/reeko/Experiments

http://www.urbanet.uiuc.edu.weather/3.html

http://kids.earth.nasa.gov/archive/air_pressure

http://www.theteacherscorner.net/lesson-plan/science/experiments/pressure.htm

http://www.thehomeschoolmom.com/teacherslounge/articles/air_pressure_experiments.php

http://www.efluids.com/efluids/gallery_exp/exp_pages/manometer.jsp

Air Pressure Questionnaire

Were the materials provided appropriate? Yes _____ No _____
Please explain.____

____

1. Did you have enough materials for each experiment? Yes_____ No_____

Please explain.____

____

2. Did the experiments work? Yes_____ No_____

If not, please explain____

____

3. Please provide any suggestions for improvements or additional

   experiments/explanations.____

   ____

   ____

Atoms and Molecules

Have you ever built something from building blocks or Legos? You used small blocks of different shapes and sizes to make something bigger. Atoms and molecules are the same thing. They are the building blocks that make up all the things we see and feel around us.

The smallest drop of water you can get and still have it be water is called a molecule. If you break it up anymore, it won't be water anymore, just like if you break a cup of ice water into ice, water, and a cup, and then took away the ice and cup, it isn't a cup of ice water. Molecules must be very small, because all you can see is water, right? Right!

As small as molecules are, they can still be broken up into smaller pieces called atoms. There are lots of different kinds of atoms. Imagine having a large tub of building blocks. There are all different kinds of blocks- different sizes, colors, and shapes. These atoms go together in all kinds of different ways to make molecules. When you get enough molecules together, you have something you can see, like water.

TRY THIS QUICK EXAMPLE: Take the index card from your kit and cut it in half. Then cut one piece in half, then cut another piece in half, and so on and so on. If you could cut the paper into small enough pieces you would get down to a molecule and then if you could keep cutting you would get an atom.

Here are the activities we'll do as we investigate atoms and molecules:

1. A quick example (see above)
2. States of Matter
3. Let's Make a Molecule!
4. What A Change Cold Makes
5. What Is That Goop??
6. Molecules On The Move

The experiment kit contains:

1. An index card
2. A black sipper stick and 2 colors of modeling clay
3. 3 plastic bags and a glow-in-the-dark ball
4. 3 balloons
5. A cup, a craft stick and $\frac{1}{4}$ cup of cornstarch
6. 2 tea bags

States of Matter

Atoms and molecules make up something called matter. Matter is the stuff you see all around you- air, water, paper, just to name a few. They are all made of something.

So water is matter. Water can be made into ice by making it really cold in the freezer. You can turn it into steam when you get it really hot in the shower. What is different about water that is ice and water in your glass you can drink- they are both water, right? The difference is called the state of the matter. The ice is a solid, while the water you can drink is a liquid. The steam you get in the bathroom is a gas.

What you need:

1. An empty cup
2. 3 plastic bags
3. A pencil
4. A ball

What to do:

1. Put the ball in one of the plastic bags and close it. The ball is a "solid."
2. Put about $\frac{1}{4}$ cup of water into one of the plastic bags. Water is a "liquid".
3. Blow air into the third empty baggie and close the bag. Air is a "gas."
4. Look at each bag, and answer these questions:

Does what is inside the bag-

a. Take up space?
b. Can you see it?
c. Does it have weight? (Is it heavy?)

5. Now open the bags, one at a time, and pour what is inside into the cup. Does what is inside the bag it keep its shape if you pour it into the cup? (Be sure to empty the cup after you test each thing!)
6. Use your answers to fill out the chart.

Properties of Matter				
	Holds its shape when I pour it in a cup	Takes up space	I can feel its weight	I can see it
Solid				
Liquid				
Gas				

What is going on? So why are there different states of matter?

There are different states of matter because the atoms and molecules that make up the matter are actually moving around. When they got hot, they move around a lot faster and push each other around. When they cool down, they slow down, and they can get closer together because they aren't pushing so much. A gas has molecules that move around a lot and push each other around. A liquid has molecules that still move around a lot, but not as much as a gas. The molecules of a solid don't move around all that much.

Let's Make a Molecule!

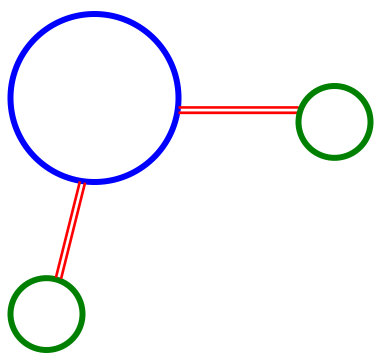
There are lots of different kinds of atoms. Just like building blocks, they join together to make different molecules. Let's make a molecule of our own.

What you need:

1. 2 colors of modeling clay
2. A brown sipper stick

What to do:

1. With one color of modeling clay, make two balls about the size of nickels.
2. With the second color of clay, make one larger ball- make sure it is bigger than the other two!
3. Now, cut your sipper stick into two pieces the same size. Put one on each side of the large ball of clay.
4. Now put a small clay ball on the end of each of the stick pieces coming out of the large ball. It should look something like this:



You just made a model of a water molecule! Your water molecule has two different kinds of atoms- called hydrogen and oxygen. A water molecule has 2 hydrogen atoms (the two small balls) and one oxygen atom (the larger ball). When you get enough of these molecules together, you have a glass of water!

Each type of atom has its own symbol, usually a letter or two from the atoms name. Scientists use the symbols for hydrogen (H) and oxygen(O) to write the recipe for water like this: H_2O

This means there are 2 hydrogen atoms and one oxygen atom (they just don't write the 1).

What a change cold makes!

What happens if you stop the molecules in a gas from moving around so much? How can you do that? Let's find out.

What you need:

1. Water
2. 3 balloons
3. One small empty bowl or cup

What to do:

1. Fill two balloons with water and have a grown-up tie them. Put one water-filled balloon in a small bowl or cup and put them into the refrigerator overnight. Put the other one in the freezer for at least one night.
2. Blow up the last balloon and have a grown-up tie it. Put this balloon in the fridge too. (This balloon is full of the gas you breathed out, and that gas has tiny bits of water in it.)
3. What do you think will happen to each balloon overnight?
   a. Balloon in the freezer:

   b. Balloon with water in the fridge:

   c. Balloon with air (gas) in the fridge:

4. After one night, take the balloons out of the fridge and freezer. What do they look like? How does each one feel?

   a. Balloon with water in the freezer:

   b. Balloon with water in the fridge:

   c. Balloon with air (gas) in the fridge:

5. Compare your predictions with your observations.

What is that goop??

Not all matter does what we think it should. It isn't always easy to tell if something is a liquid, a solid, or a gas. Have you ever turned a liquid into a solid just by tapping on it? In this experiment you make just such a liquid.

What you need:

- A plastic cup
- 1 craft stick
- $\frac{1}{4}$ cup of cornstarch
- Water
- Newspaper (a paper bag or a plastic bag are good substitutes)

LAB SAFETY: Do not wash the material you are about to make down the sink. Throw it in the trash!!

1. Place a sheet of newspaper flat on a table. Put the cup in the middle of the newspaper. Add $\frac{1}{4}$ cup of dry cornstarch to the cup. Add about 6 teaspoons (or just 6 spoonfuls) of water to the cornstarch and stir slowly. Add water slowly to the mixture, with stirring, until all of the powder is wet.
2. Your goal is to create a mixture that feels like a stiff liquid when you stir it *slowly*, but feels like a solid when you tap on it or squish it with your finger or the craft stick. If your mixture is too liquid, add more cornstarch. If it is powdery, add water.
3. Scoop or pour the cornstarch mixture into the palm of your hand, then slowly squeeze it into a ball. As long as you keep pressure on it by rubbing it between your hands, it stays solid. Stop rubbing, and it "melts" into a puddle in your palm. Can you think of other tests you can do with it?

What is happening?

Why does the cornstarch mixture behave like this? Think of a busy sidewalk. The easiest way to get through a crowd of people is to move slowly and find a path between people. If you just took a running start and headed straight for the crowd of people, you would slam into someone and you wouldn't get very far. This is similar to what happens in the cornstarch mixture. The solid cornstarch acts like a crowd of people. Pressing your finger slowly into the mixture allows the cornstarch to move out of the way, but tapping the mixture quickly doesn't allow the solid cornstarch particles to slide past each other and out of the way of your finger.

We use the term "viscosity" to describe how easily a liquid can flow. Water, which has a low viscosity, flows easily. Honey, at room temperature, has a higher viscosity and flows more slowly than water. But if you warm honey up, its viscosity drops, and it flows more easily. Most fluids behave like water and honey- their viscosity depends only on temperature. We call such fluids "Newtonian," since their behavior was first described by a very famous scientist called Isaac Newton. The cornstarch mixture you made is called "non-Newtonian" since its viscosity also depends on the force applied to the liquid (your tapping it) or how fast an object is moving through the liquid.

Other examples of non-Newtonian fluids include ketchup, silly putty, and quicksand. Quicksand is like the cornstarch mixture: if you struggle to escape quicksand, you apply pressure to it and it becomes hard, making it more difficult to escape. The recommended way to escape quicksand is to slowly move toward solid ground; you might also lie down on it, thus distributing your weight over a wider area and reducing the pressure. Ketchup is the opposite: its viscosity decreases under pressure. That's why shaking a bottle of ketchup makes it easier to pour.

NOTE: Isaac Newton was a member of a science club himself- The Royal Society of London for the Improvement of Natural Knowledge, or just the Royal Society. Look him up in your library or on the internet. You will find out how many neat things he discovered by being interested in math and science!

Molecules on the Move

Let's see what happens when molecules are heated up. We can actually see the movement of molecules by watching the way a tea bag colors water in a glass.

What you need:

- 1 clear glass
- 2 tea bags
- A cup of cold water
- A cup of hot water

Prediction: First, answer this question- do molecules move faster or slower when they are hot? What do you think happens to the movement of molecules in water when the water is heated?

____

____

Now test your prediction:

1. Fill a glass half way with cold water. Let it sit on the table a few minutes until the water seems still.
2. Add one tea bag by gently dropping it into the water. Do not touch the glass!
3. Time how long it takes for the tea to color the water in the glass. Do this by counting or by using a clock, watch, or timer.

   What happens to the water color- does the tea make a pattern or color the water all at once?

   ____

   ____

   How long did it take for the water to change color?

   ____

____

4. Do you think there would be any difference if the water was hot?

____

____

5. Try it. Rinse the glass then put some hot water in it. Let it sit on the table a few minutes until the water seems still.
6. Add the other tea bag. Do not stir or shake the glass.
7. Time how long it takes for the tea to color the water in the glass. Do this by counting or by using a clock, watch, or timer.

What happens to the water color- does the tea make a pattern or color the water all at once?

____

____

How long did it take for the water to change color?

____

____

CONCLUSION- compare your answers with your prediction

What happens to the movement of molecules in a substance (the water) when that substance is heated?

____

____

____

Credit where credit is due….

The experiments, discussions, and pictures in this handout were taken or adapted from the following websites and books:

1. The States of Matter activities were adapted from classroom activities developed by:

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2304 N. Cleveland	955 W. Garfield Blvd.
Chicago IL 60614	Chicago IL 60621
(312) 327-8671	(312) 535-9025

   Who used these references:

   Science on a Shoestring
   Scholastic's Big Science: Matter

   Here is the website: http://www.iit.edu/~smile/ph9516.html
2. What is that goop?? Was only slightly modified from the "lumpy liquids" experiment (http://scifun.chem.wisc.edu/homeexpts/lumpyliquids.htm) written by the master of chemical demonstrations, University of Wisconsin-Madison Chemistry Professor Bassam Z. Shakhashiri. He shares the fun of science through home science activities, demonstration shows, videos, and books. Information about these and other science fun stuff is available here: http://scifun.chem.wisc.edu/homeexpts. This is a great website!
3. The Molecules on the Move experiment was adapted from D. M. Candelora (Copyright 1996. All rights reserved. Reproduction for educational use is encouraged.) It was found at the following website: http://galaxy.net/~k12/matter/

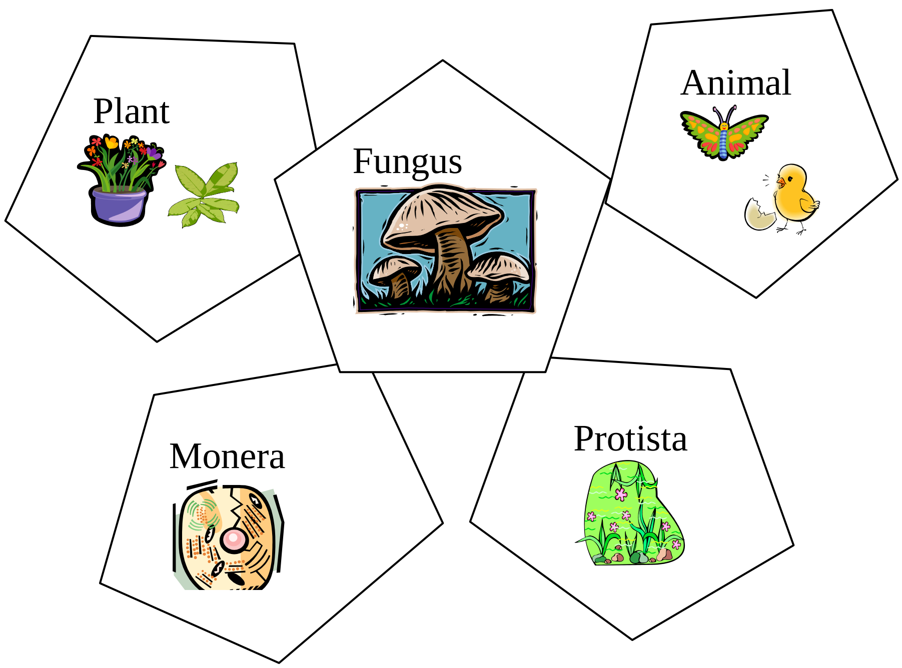
Special thanks to ORNL for contributing financial support to Science Club this year!

BIOLOGY

Biology is the study of life and living things. The scientists who study biology are called "biologists". Biologists look at everything from the very smallest living thing to very big things, and how all these living things work together. To make things easier for the biologist, they divide all living things into five groups called "kingdoms."

The five kingdoms are: Animal, Plant, Fungus, Protista, and Monera. Here are some examples from each kingdom:

Kingdoms



Monera = Bacteria (the plaque on your teeth has bacteria in it)

Protista = Plankton, algae (the green stuff growing in a lake)

Fungus = mushrooms

Plant = flowers, trees

Animal = butterfly, cat, bird, **you**

How do you know if something is alive?

Something that is alive can …

- Something that is alive can do work. No, not just going to work or school every day. Living things take in energy from the environment. This means a living thing takes the food, sunlight, or other types of energy and turns it into the energy it needs to survive. You do this every day when you eat breakfast. You eat the food then your body turns it into energy that allows you to run, play, and work.
- Something that is alive can grow. This means more than just getting larger in size. Living things can rebuild and repair themselves when injured. Your body is repairing itself and growing when you get a cut and it heals.
- Something that is alive can reproduce. Have you ever seen dirt have children? I don't think so. Life comes from other living things.
- Something that is alive can respond. Think about the last time you accidentally stubbed your toe. You probably said "ouch!" and grabbed your foot. That is a response to the pain in your foot. Something that is alive can respond to what is happening around it.
- Something that is alive can adapt. Think about a dog or horse in the winter time. The weather is colder, so the dog or horse grows a thicker coat. When the weather gets warmer, the dog or horse will shed this coat to stay cooler.

Here are the activities we'll do as we investigate Biology:

1. Where do Butterflies come from?
2. Grow and study seedlings-flower and tomato

The experiment kit contains:

1. 1 popsicle stick, 1 pipe cleaner, 2 eyes, and 1 sheet of heavy paper
2. 1 test tube with flower seeds, 1 with tomato seeds, and 1 with plant food
3. 1 small bag of Plant Gel and 1 extra test tube

****You will also need one toilet paper tube, scissors, glue, and something to color with.****

****We also recommend gathering some <u>clear</u> containers (mason jars, empty glass jars or cups) and some plants, such as weeds from your yard.****

Where do butterflies come from?

Ever wonder where a butterfly comes from? It comes from a chrysalis (KRIS-uh-liss) which is also called a pupa. A chrysalis looks like a tiny leathery pouch. You can find one underneath some leaves in the summer.

Some animals don't change much as they grow up. Think about it: someone your age looks a lot like a grown-up. Grown-ups have more wrinkles and gray hair. But they still have two arms, two legs and one head—just like you.

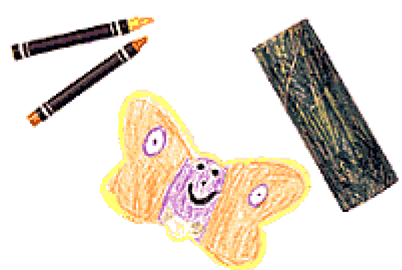
We're going to meet an animal that's very different—the butterfly. Butterflies go through four life stages, and they look very different at each stage.

Here's what you need:

- Toilet-paper tube
- popsicle stick
- Heavy paper
- A piece of pipe cleaner
- Markers or crayons
- Scissors and glue

Here's what you do:

1. Cut out and color a butterfly from the heavy paper. Use any colors, but make both halves look the same. Put a small hole at the top of the butterfly's head.



2. Color the toilet paper tube to look like a chrysalis. (A monarch butterfly's chrysalis is green, but you can use any color.)

3. Take a piece of pipe cleaner and shape it like the letter "V". Put one point through the little hole in the butterfly's head and then twist it to look like antennae. Butterflies use these "feelers" to learn about their environment.

4. Glue the butterfly to one end of the tongue depressor or ice-cream pop stick. Let the glue dry.

5. Curl the butterfly's wings and slide it into the chrysalis.

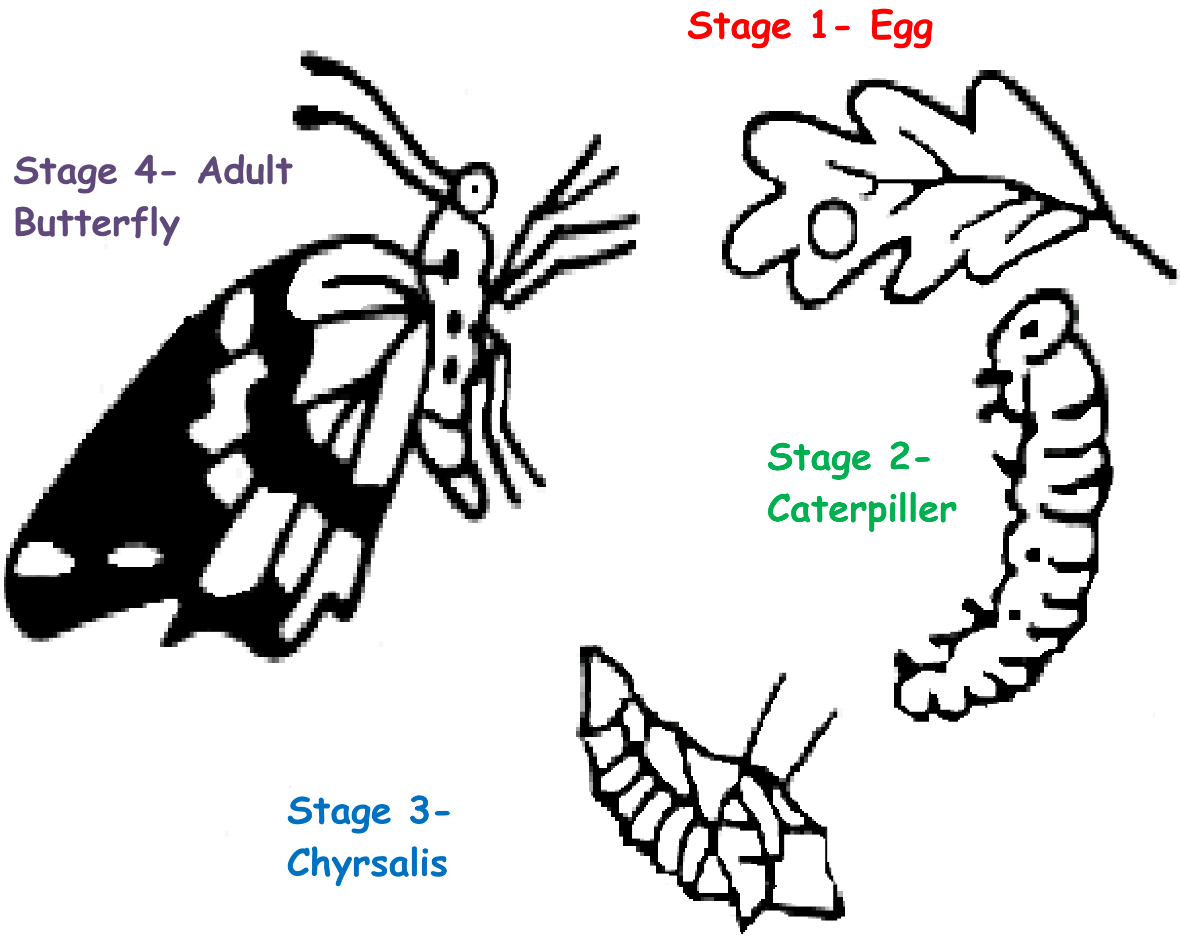
6. Pull the stick to make the beautiful butterfly come out of the chrysalis.

Fly your butterfly like a real one!

The butterfly's life cycle

Butterflies have four stages of life, but they only look like butterflies in the final stage. Birds, frogs, snakes and insects also change as they grow.

1. An adult butterfly lays an **egg.**
2. The egg hatches into a **caterpillar** or larva.
3. The caterpillar forms the **chrysalis** or pupa.
4. The chrysalis matures into a **butterfly**



Courtesy of the Scotia-Glenville Children's Museum, Scotia, New York
Scotia-Glenville Children's Museum developed the **butterfly and chrysalis project** with funding from Howard Hughes Medical Institute.

Seedlings-Flower and Tomato

Seedlings-Flower and Tomato

Let's plant some seeds and watch them grow. Using a clear PLANT GEL instead of soil, we can watch our seeds as they open and develop into flowers and tomatoes!

What you need:

1. Small bag of Plant Gel
2. Four small paper cups
3. tomato seeds and flower seeds
4. a sunny place to keep your seedlings
5. four clear test tubes
6. plant food (we are using SuperThrive)
7. Distilled water

NOTE TO PARENTS: You will have about 1 gallon of Plant Gel, which is a lot more than will be needed to fill the test tubes for this experiment. We recommend gathering a few clear jars or cups from around the house, and some seeds and weeds from the yard to add to your experiment! This clear gel will allow you to watch the roots in action (so weeds should be perfect for this!!). Directions for plants are provided at the end of the experiment.

DIRECTIONS TO CREATE PLANT GEL:

1. Pour 1 gallon of d*istilled* water into a large bowl or container (**Use distilled water only**).
2. Add plant food (from the test tube) to the water and stir to mix.
3. Add 1 packet of PLANT GEL Crystals (2 Tablespoons) to the water and let stand for 5-6 hours *(Note: May let stand longer).*
   One packet (2 Tablespoons) makes 1 gallon of PLANT GEL.
4. Pour wet PLANT GEL into a strainer to remove excess water and let stand for at least 2 hours to remove extra water.
5. Place clear PLANT GEL into the test tubes. You can also use any clean, clear container that you might have around.

NOTE TO PARENTS: Because the test tubes have screw-on caps, we suggest you do not fill the tubes all the way to the top, so when your seed begins to develop, you will see it more clearly.

6. Now plant your tomato seeds: For two of the test tubes, use your little finger to poke a hole in the middle of the gel. Make the hole about ¼ inch deep- just the tip of your finger. Put one tomato seed in each hole and cover them lightly with gel. Use your pencil to mark where the level of the PLANT GEL in the tube.
7. Turn you paper cups upside down, and poke one test tube through each- these will hold the tubes upright.
8. Now plant your flower seeds just like you did the tomato seeds.
9. Put all of the tubes near a window so the seeds can get sunlight.
10. **REMEMBER!!** Your seeds need sun and water to grow! You must remember to check you plants every day. Check your seedlings every morning. You should see little plants growing in 7-10 days.

DIRECTIONS FOR WATERING PLANT GEL :

When the PLANT GEL settles approximately 1" to 1½" from original level, it's time to add some water.

1. Add water until PLANT GEL reaches just below the original level. If all the water is not absorbed after 3 hours, pour out excess water. (*Note: If you do not drain excess water, a faint odor may develop. If this occurs, simply rinse PLANT GEL in a strainer with fresh tap water. Let dry 1-2 hours and replace as previously directed.)*

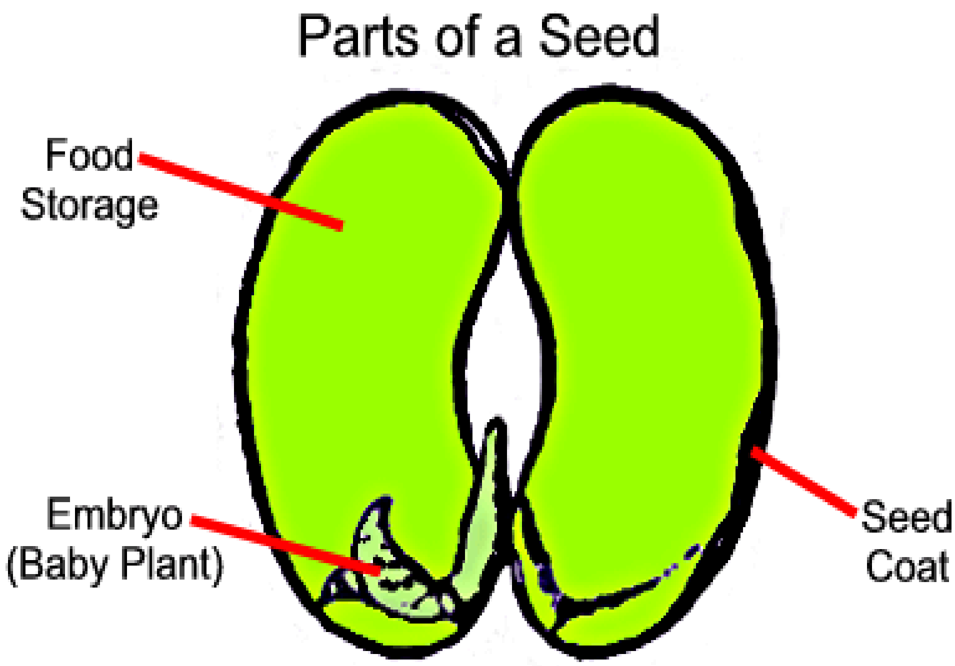
   NOTE: Plant Gel recommends adding more plant food (such as SuperThrive of Shultz) when you water.

To use with plants (instead of seeds):

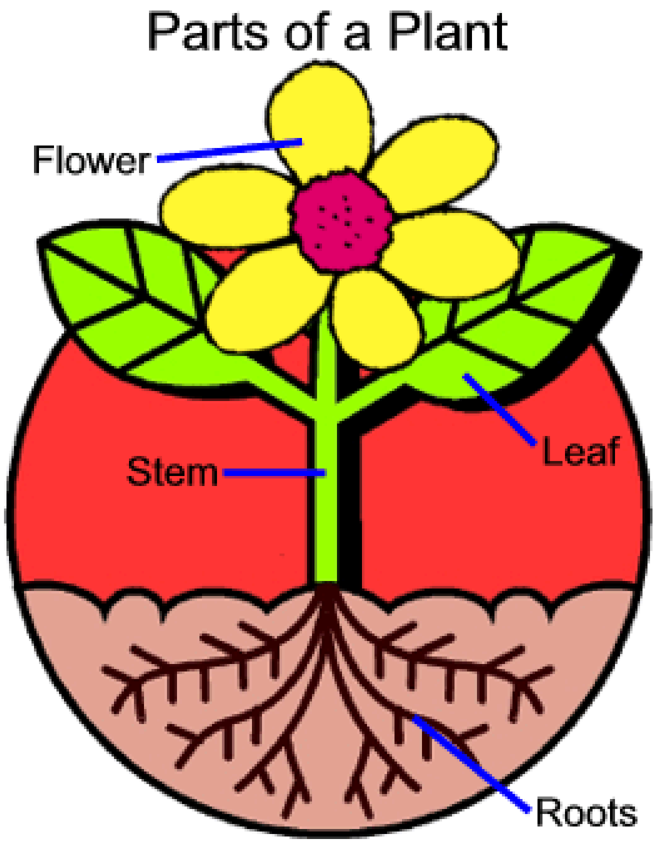
1. Carefully rinse soil from plant roots and gently trim long stringy roots to about 2". Plants will no longer need, or grow, a large root ball because they are surrounded in PLANT GEL, which provides direct access to water at all times.
2. Gently insert plant into PLANT GEL.
3. Do not place plant in direct sunlight for long periods of time, as sunlight promotes algae growth.

What is happening to the seeds???

Plant & Flower Facts



Plants grow from seeds. Inside each seed is an embryo, or baby plant. The embryo is surrounded by a food storage area. Seeds have a protective outer layer called the seed coat.



Plant roots grow underground and are not seen. Roots help to hold the plant up and bring in food and water from the soil. Food travels up the roots through the stem of the plant. The stem holds up the leaves and flowers on the plant. The leaf is the food-making factory of a plant. Leaves are usually green and contain a substance called chlorophyll. Some plants, but not all, have flowers. Flowers are important in making seeds.

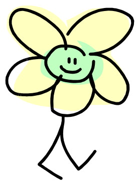
PLANT GEL by DNB Designs ➡ Look for us at www.plantgel.

PLANT GEL is an excellent growing medium for plants due to its water absorbing ability. PLANT GEL can be used alone or with soil. Over 90% of the water and plant food are directly available to the plant's root system. No other component used in growing mixes allows this much absorption by plants. For example, clay soils retain a great amount of water, but less than 50% of the water is released to the root systems. In addition, PLANT GEL, being a gelatin, allows for excellent aeration.

Another advantage to using PLANT GEL is that the vitamins and minerals contained in the PLANT FOOD is time-released to the root systems, thereby continually providing these essential elements to your plants over a long period of time.

PLANT GEL is a 100% Non-Toxic, biodegradable, and odorless super absorbent polymer that absorbs up to 300 times its weight in water, and has a lifespan of approximately 5 years.

Neat words to remember:
Seed Root Stem Leaf Flower
Fruit Vegetable



Grow your mind!

Check out these neat books on plants:.

- ☐ *Stems*, by Gail Sunders-Smith
- ☐ *How do Apples Grow?* By Giulio and Betsy Maestro
- ☐ *From Seed to Plant*, by Allan Fowler
- ☐ *How Plants Grow*, by Angela Royston
- ☐ *Plants Without Seeds*, Helen J. Challand
- ☐ *Strange Plants*, Angela Royston
- ☐ *Wetland Plants*, by Ernestine Giesecke and Eileen Mueller Neill
- ☐ *Plants and Us*, by Angela Royston
- ☐ *Plants of the Rain Forest*, by Lynn M. Stone
- ☐ *Trees are Terrific*, by Lisa Trumbauer
- ☐ *Seed Surprises*, by Andrew Willett
- ☐ *Seeds (Growing Flowers)*, by Gail Saunders-Smith
- ☐ *Plant Experiments*, by Vera Webster

Credit where credit is due….

The experiments, discussions, and pictures in this handout were taken or adapted from the following websites and books:

1. **www.hhmi.org/coolscience/scotia.htm**
2. **http://www.primarygames.com/science/flowers/facts.htm**
3. **http://biology.about.com/od/apforstudents/a/aa082105a.htm**
4. **http://www.emc.maricopa.edu/faculty/farabee/BIOBK/BioBookintro.html**
5. **www.plantgel.com**

Biology Questionnaire

Were the materials provided appropriate? Yes _____ No _____
Please explain.____

1. Did you have enough materials for each experiment? Yes_____ No_____

   Please explain.____

2. Did the experiments work? Yes_____ No_____

   If not, please explain____

3. Please provide any suggestions for improvements or additional

   experiments/explanations.____

   ____

Bugs

Insects or bugs are everywhere in nature. They come in all shapes, sizes and colors. Many scientists called **entomologists** study insects, but everyone should learn about insects. Some insects are very helpful to people, but others are harmful. For example, bees eat pollen and nectar and help pollinate plants which produce food for humans, but they also may sting you. Other insects such as crickets destroy plants, while ladybugs eat bugs that harm plants or carry disease.

The purpose of this unit is to help students learn about insects by finding them in their yards or other places and observing their behavior.
Some questions to answer as you observe bugs are:

1. Where do bugs live? What do they eat?
2. How do they move?
3. What colors are they? For example, are all butterflies the same color?
4. Are any insects social? That is, do they work together to find food or take care of their homes?

Here are the activities we'll do as we investigate bugs:

1. Exp. 1: Insect Art: Clothes Pin Butterflies
2. Exp. 2: Butterfly Pavilion
3. Bug Tongs and Bug Boxes
4. Color the bug

The experiment kit contains:

- clothes pin
- piece of 2 different colors of tissue paper
- pipe cleaner
- 4 magnets
- photo of a 'not so icky bug'
- stickers
- butterfly pavilion
- bug tongs
- bug box

****You will also need glue and colored pencils ****

Insect Art: Clothespin Butterflies

Things you will need:

- Clothes pins
- Colored tissue paper
- Pipe cleaner
- Pencil or black crayon
- Magnets
- Glue

1. Cut tissue paper into six inch squares. Take two squares of tissue paper, (different colors), and gather them along the center to make the wings of the butterfly. Glue the gathered center into the clothespin.
2. Fan out the edges of the paper.

3. Cut the pipe cleaner into two equal pieces. Take one half of the pipe cleaner and fold it in half. Glue the middle of the pipe cleaner to the top of the clothespin to make the antennae. Make small hooks at the ends of the antennae.

4. Use pencil or crayon to draw eyes onto the clothes pin.

5. Glue magnets on to the underside of the clothespin to make refrigerator art.

Photographs courtesy of Lana Unger, University of Kentucky Department of Entomology

Butterfly Pavilions

Butterfly wings have different patterns and colors. If you try to hold one, a fine colored powder rubs off on your hands. The powder is actually small scales. Try to catch a butterfly and put it in the pavilion and observe it.

The following instructions are adapted from the Children's Butterfly Website (http://bsi.montana.edu/web/kidsbutterfly/faq/catching)

How can I catch a butterfly or moth?

The best way to *"catch"* a butterfly or moth is to raise it from the caterpillar stage. Then when the butterfly or moth hatches out you can observe it and then let it go. Since most moths are attracted to lights, you can find moths at porch lights (if you use a white bulb--not yellow) or other lights.

How can I raise a caterpillar?

To raise a caterpillar through the chrysalis or pupa to the adult moth or butterfly is an excellent lesson about insect metamorphosis. All you need is a caterpillar, some of its favored food, and a suitable container (like your butterfly pavilion). You can find caterpillars on most plants during the spring and early summer.

1. Put the caterpillar and a few fresh leaves in your butterfly pavilion.
2. Every day change the leaves.
3. You can put in pencil-size twigs upon which the caterpillar can attach its chrysalis or silken cocoon (with the pupa inside).
4. The insect should hatch in 10-14 days, or maybe longer.
5. Before releasing it you can photograph your prize. Don't be disappointed if small wasps or flies--natural parasites--hatch out instead. These insects keep the butterfly and moth populations under natural control.

You can also order a butterfly caterpillar kit over the Internet from a site such as www.insectlore.com and put the caterpillar in the pavilion with the special food that comes with the kit. In about 3 weeks the caterpillar will hatch into a beautiful butterfly.

Here are some fascinating facts about butterflies & moths...from

MilkweedCafe.com
Unique Nature Gifts & Merchandise

When you think of butterflies, the first thing that comes to mind is probably the colorful flutter of wings...but there is so much more than initially meets the eye!

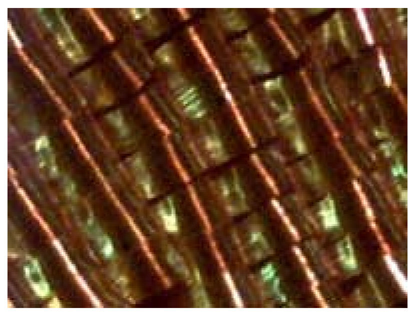
Take a look below at some of the fascinating things about butterflies.

Did you know...

...that the wings of butterflies and moths are actually transparent?

The iridescent scales, which overlap like shingles on a roof, give the wings the colors that we see. Contrary to popular belief, many butterflies can be held gently by the wings without harming the butterfly. Of course, some are more fragile than others, and are easily damaged if not handled very gently.

Both butterflies and moths belong to the order lepidoptera. In Greek, this means *scale wing.*



200x magnification of Sunset Moth Wing, showing individual scales

Take a closer look at butterfly scales!

Go to http://www.milkweedcafe.com/microscope.htm to visit MilkweedCafe.com's page of microscope photos.

Photo courtesy of and copyrighted by Tina Carvalho.

Did you know...

...that butterflies taste with their feet?

Their taste sensors are located in the feet, and by standing on their food, they can taste it!

All butterflies have six legs and feet. In some species such as the monarch, the front pair of legs remains tucked up under the body most of the time, and are difficult to see.

Did you know...

...that butterflies don't have mouths that allow them to bite or chew?

They, along with most moths have a long straw like structure called a proboscis which they use to drink nectar and juices. When not in use, the proboscis remains coiled like a garden hose.

Some moths, like the Luna moth don't have a proboscis. Their adult lifespan is very short, and they do not eat. They simply seek a mate, reproduce, then die.

The Asian Vampire moth pierces the skin with its strong, sharp proboscis and drinks the blood of animals.

In the photo above, you can see the proboscis of the recently emerged monarch butterfly. Notice that it is in two pieces and has a forked appearance. As soon as it emerges, the butterfly begins working on the proboscis with two palpi (found on each side of the proboscis), forming it into one tube. It must do this successfully in order to be able to nectar.

Did you know...

...that a caterpillar grows to about 27,000 times the size it was when it first emerged from its egg?

If a human baby weighed 9 pounds at birth and grew at the same rate as a caterpillar, it would weigh *243,000 pounds* when fully grown.

Shown: Eggs of Painted Ladies butterflies on hollyhock leaf. Standard size paper clip shows relative size of eggs.

Shown above: 5th instar monarch caterpillar on milkweed

Because the caterpillar's skin doesn't grow along with it as ours does, it must periodically shed the skin as it becomes too tight. Most caterpillars molt five times before entering the pupa stage.

Did you know...

...that the butterfly doesn't spin a cocoon?

You will often erroneously hear and read that the adult butterfly emerges from its cocoon. Moths spin cocoons of silken threads, often using leaves to help surround themselves.

Caterpillars shed their final skin to reveal a pupa. The outer skin of this pupa hardens to form a chrysalis which protects and hides the amazing transformation that is occurring inside.

Pupae take on a wide variety of appearances, depending on the species of butterfly. Some hang from beneath leaves or twigs. Others are girdled to the side of a stem much like a worker on a telephone pole. Some are smooth and shiny while others are rough and even spiky. Some are beautifully colored with dots and lines of gold while others are drab and barely noticeable. No matter what the design, the function is the same - to lessen the chances of being eaten by a predator and to increase the likelihood of producing an adult butterfly or moth.

You can also order a butterfly caterpillar kit over the Internet from a site such as www.insectlore.com and put the caterpillar in the pavilion with the special food that comes with the kit. In about 3 weeks the caterpillar will hatch into a beautiful butterfly.

Bug Tongs and Bug Boxes

The best way to discover insects is to watch them!

What you need:

- Bug tongs
- Bug box
- Colored pencils

What to do:

1. Go outside with a grownup to find a bug. You want to be careful, because some bugs can bite or sting.
2. Use your bug tongs to catch your bug.
3. Carefully transfer the bug into your bug box, and put on the lid. WARNING: DO NOT TAKE THE BUG INTO YOUR HOUSE UNLESS YOUR GROWN UP SAYS IT IS OK!!
4. Look at your bug. The bug box has a magnifying lid for better insect viewing. Can you see the different parts of its body?
5. Use your colored pencils to draw a picture of your bug below.

Color the Bug

Unlike a bug, the skeleton of a person is on the inside of the body. A bug has a different kind of skeleton – an exoskeleton. This skeleton is on the outside of the body. Your skeleton grows as you grow up; but an insect can only grow as big as its exoskeleton. When an insect outgrows its exoskeleton, it molts (sheds its outer skin) to reveal a larger skeleton in which to live.

The picture of a bug at the end of this handout shows an insect's body parts. Color the bug and then look at other bugs that you see and try to identify their body parts.

Can you identify these body parts on the picture of the bug you drew on page 8?

Have some more fun with BUGS!

Try out these related Web sites:

http://pests.ifas.ufl.edu/bestbugs has a list of many other websites on insects
www.uky.edu/ag/entomology
www.ipm.iastate.edu/ipm/iiin
www.easttennesseewildflowers.com has many pictures of butterflies.
www.insectlore.com
www.surfnetkids.com/creepy.htm

Questionnaire

Were the materials provided appropriate? Yes _____ No _____
Please explain.____

1. Did you have enough materials for each experiment? Yes_____ No_____

Please explain.____

2. Did the experiments work? Yes_____ No_____

If not, please

explain____

3. Please provide any suggestions for improvements or additional

experiments/explanations.____

____

____

Chemistry

Discuss, review atoms and molecules, and how they connect.

Here are the activities we'll do as we investigate Chemistry:

1. Mentos Geyser- watch the reaction.
2. Bouncy Ball- crazy polymers
3. Hot and Cold- cool exothermic and endothermic chemical reactions
4. Baby Diaper Secret- amazing absorbers- how much can they hold??

The experiment kit contains:

1. A full 12 oz. can of carbonated beverage (cola, diet cola, root beer, sprite, all have been tested).
2. Mentos candies
3. 2 plastic cups
4. 2 craft sticks
5. ½ tsp. Borax
6. 1 T. of cornstarch
7. 2 sandwich size sealable plastic bags
8. 1 T. of quick rising dry yeast (or 1 pkg.)
9. 1 T. of Epsom salts
10. 2 Disposable baby diapers ,
11. zipper-lock bag

****You will also need newspaper and ¼ cup of hydrogen peroxide, this is not in your kit****

Mentos™ Geyser

What you need:

1. A full 12 oz. can of carbonated beverage (cola, diet cola, root beer, sprite, all have been tested). The soda can be cold or warm.
2. 1 to 2 Mentos candies
3. A large open area outside that can be hosed off or your bathtub!

NOTE: This will make a MESS. Be prepared for a fountain.

What to do:

1. Open the beverage can and place on the ground.
2. Drop 1 or 2 Mentos into the open can quickly. If you are doing this in your tub, use only 1 Mento.
3. Jump back as the volcano action begins.
4. The more Mentos, the faster & bigger the reaction!
5. Other things to try on your own:
   a. Taste the soda after the volcano dies down. Does it taste flat?
   b. Put the mentos & carbonated beverage into an open cup. You won't get a volcano, but you will see the rolling bubbles.
   c. Pour salt into the bubbling mentos/soda mixture. Do you see more bubbles?
   d. Pour salt into another can of carbonated beverage. Do you see bubbles escaping?
   e. For the true rocket fans, try to slide a whole roll of mentos into a 2 liter bottle of coke at one time. It is supposed to be quite spectacular! There is a video of this on the reference website.

What is going on?

The bubbles that you saw were caused by the release of all the $CO2$ that was trapped inside the soda. The $CO2$ is forced into the liquid soda at the bottling plant by using a lot of external pressure. The $CO2$ doesn't want to remain inside the soda, so it wants to escape. The addition of mentos to the soda cause a change in chemistry that makes the $CO2$ escape very quickly and completely. There is debate about the actual reaction that leads to the release of the $CO2$ from the carbonated beverage. In the case of table salt, it is easier for bubbles to form around each grain of salt that it is for bubbles to form in the middle of a liquid. So each grain of salt provides a bubble formation site and the $CO2$ has a way to escape. In the case of mentos, some scientists suspect that the surface of the candies is pitted enough to create thousands of bubble formation sites and therefore the bubble formation and escape can happen very quickly.

Reference: http://www.stevespanglerscience.com/experiment/00000109
This is a great website for more experiments too!

Bouncy Ball

What you need:

12. 2 plastic cups
13. 2 craft sticks
14. ½ tsp. Borax
15. 2 T. warm water
16. 1 T. of white glue (in your basic kit)
17. 1 T. of cornstarch

What to do:

1. Pour the 2 T. of warm water and the ½ tsp. of Borax into one of the plastic cups.
2. Stir to dissolve the Borax.
3. Pour 1 T. of white glue into the other (empty) cup.
4. Add 1 T. of cornstarch and ½ tsp of the Borax/water mixture into the cup with the white glue.
5. Let the cornstarch/Borax/water/glue mixture sit for about 10 seconds. Then stir.
6. When you can't stir it any more, grab the mixture with your hands and start molding it into a ball. This can make your hands pretty messy!
7. As you keep squishing the ball, it should become less sticky, until you can try to bounce it.
8. When you are done bouncing your ball, you can store it in a sealed plastic bag.
9. You can dispose of the excess Borax mixture and clean your hands in the sink.
10. Other things to try on your own:
    a. Make another ball using more cornstarch. This should make it more strechy.
    b. Make another ball using less borax. This should make it more sticky.
    c. Make another ball using more glue. This should make it more slimy.

What is going on

The very earliest balls were made of stones or wood. They were used for games that involved throwing or kicking. These balls didn't really bounce at all. The first bouncing balls were made after the discovery of natural rubber which comes from a special type of tree sap. Now rubber is mostly made from petroleum and bouncing balls can be made from a variety of materials. The bouncing ball in this activity is made from a type of material called a polymer. Polymers are very long chain-like molecules that are made up of smaller repeating chemical units or molecules. Glue contains the polymer polyvinyl acetate (PVA), which can cross-link or connect to itself when reacted with borax. The resulting substance is made up of a spider's web of polymers.

References:

http://chemistry.about.com/od/demonstrationsexperiments/ss/bounceball.htm

http://chemistry.about.com/gi/dynamic/offsite.htm?zi=1/XJ&sdn=chemistry&zu=http%3A%2F%2Facswebcontent.acs.org%2Fcelebrate_chemistry%2Fcc_bouncing_ball.pdf

Hot & Cold

What you need:

1. 2 sandwich size sealable plastic bags
2. 1 T. of quick rising dry yeast (or 1 pkg.)
3. $\frac{1}{4}$ cup of hydrogen peroxide (not included)
4. 1 T. of Epsom salts
5. 1 T. or so of tap water, neither hot nor cold (also not included)

What to do:

Note: Exact quantities are not important in these 2 experiments, just get close!

1. Part 1: The Hot Spot!
    a. Place the yeast into one of the sandwich bags. Do not seal the bag shut!
    b. Pour the hydrogen peroxide into the bag.
    c. The mixture will start to foam immediately and you should feel something on the outside of the bag.
2. Part 2: The Cold Spot!
    a. This reaction is more subtle than Part 1, so pay close attention to the temperature of your water before you start!
    b. Place the Epsom salts into the other (empty) plastic bag.
    c. Feel the water temperature before you add it.
    d. Add the water, seal the bag, and shake a little bit.
    e. Feel the outside of the bag. You won't see anything, but you should feel a change.

What is going on?

In Part 1, the bubbles you saw was oxygen being released from the hydrogen peroxide by a reaction with the yeast. The yeast encourages the molecules in the hydrogen peroxide to break down into oxygen and water. The resulting reactions produce heat, and reactions that produce heat are called exothermic reactions. Exothermic reactions are used in places where there is a lot of snow and ice in the winter. Road salt is thrown out on the roads and sidewalks and the heat created by the reaction of the road salt with the water melts the ice and snow. In Part 2, the water encourages the Epsom salts, also known as magnesium sulfate, to break down into molecules of sulfate and magnesium. This reaction won't occur without the addition of heat and the heat is being drawn out of the water making the water colder. This is called an endothermic reaction.

References: http://www.sandiegozoo.org/education/science_hot_cold.html
http://www.sciencecenterct.org/education/monthly-science/dec05.htm

Baby Diaper Secret

If you've ever changed a diaper and noticed what looked like tiny crystals on the baby's skin, you've uncovered the secret of superabsorbent, disposable diapers. Those tiny crystals actually come from the lining of the diaper and are made out of a safe, non-toxic polymer that absorbs moisture away from the baby's skin.

Materials:

2 Disposable baby diapers (several brands), zipper-lock bag, scissors, water, newspaper.

Experiment:

1. Place a new (unused is your first choice) diaper on the piece of newspaper. Carefully cut through the inside lining and remove all the cotton-like material. Put all the stuffing material into a clean, zipper- lock bag.
2. Scoop up any of the polymer that may have spilled onto the paper and pour it into the bag with the stuffing. Blow a little air into the bag to make it puff up like a pillow, then seal the bag.
3. Shake the bag for a few minutes to remove the powdery polymer from the stuffing. Notice how much (or how little) powder falls to the bottom of the bag.
4. Carefully remove the stuffing from the bag and check out the dry polymer you just extracted from the diaper. Amazing stuff!
5. Grab a new diaper and slowly pour about one-fourth cup warm tap water into the center. Hold the diaper over a large pan or sink and continue to add water, a little at a time, until it will hold no more. Keep track of how much water the diaper can absorb before it reaches its limit.
6.
7. ADD SALT... Gather the pieces of gel into a cup and smoosh it down with your fingers. Add a teaspoon of salt, stir it with a spoon, and watch what happens. Salt messes up the gel's water-holding abilities! When you're finished, pour the salt water goo down the drain.

How Does It Work?

The secret, water-absorbing chemical in a diaper is a superabsorbent polymer called sodium polyacrylate. A polymer is simply a long chain of repeating molecules (monomers). If the prefix poly means many, then a polymer is a large molecule made up of many smaller units, called molecules, that are joined together. Some polymers are made up of millions of monomers. Superabsorbent polymers expand tremendously when they come in contact with water because water is drawn into and held by the molecules of the polymer. They act like giant sponges. Some can soak up as much as 800 times their weight in water!

The cotton-like fibers you removed help to spread out both the polymer and the, uh, "water" so that baby doesn't have to sit on a gooshy lump of water-filled gel. It's easy to see that even a little bit of powder will hold a huge quantity of water, but it does have its limits. At some point, baby will certainly let you know when the gel is full and it's time for new undies!

Credit where credit is due….

The experiments, discussions, and pictures in this handout were taken or adapted from the following websites and books:

Some of the explanatory material was taken from:

- http://www.chem4kids.com/files/react_intro.html

The Mentos Geyser came from Reference:

- http://www.stevespanglerscience.com/experiment/00000109

The Bouncy Ball experiment was adapted from the following websites:

- http://chemistry.about.com/od/demonstrationsexperiments/ss/bounceball.htm
- http://chemistry.about.com/gi/dynamic/offsite.htm?zi=1/XJ&sdn=chemistry&zu=http%3A%2F%2Facswebcontent.acs.org%2Fcelebrate_chemistry%2Fcc_bouncing_ball.pdf

The Hot and Cold experiments were taken from the following websites:

- http://www.sandiegozoo.org/education/science_hot_cold.html
- http://www.sciencecenterct.org/education/monthly-science/dec05.htm

The Baby Diaper experiment was taken from:

- http://www.stevespanglerscience.com/experiment/64

Parents- We loved the Steve Spangler Science website- it is a great website for more experiments too! The chem4kids website is also very good and has links to other branches of science for kids.

Questionnaire

Were the materials provided appropriate? Yes _____ No _____
Please explain.____

1. Did you have enough materials for each experiment? Yes_____ No_____

   Please explain.____

2. Did the experiments work? Yes_____ No_____

   If not, please explain____

3. Please provide any suggestions for improvements or additional

   experiments/explanations.____

   ____

Crystals

What's a crystal?

Crystals are solids that are made up of molecules that have smooth sides and fit together in a neat, ordered package. All crystals of the same material have the same shape, no matter what their size is. Crystals are formed when certain liquids and gases cool and lose water. Most minerals, such as salt, are crystals. Some crystals can be polished into gems (like diamonds or rubies).

Here are the activities we'll do as we investigate crystals:

1. Crystals in everyday life.
2. Geodes- crystals hidden inside rocks.
3. Experiment 1- Growing crystals that you can eat!
4. Experiment 2- Epsom salt- dissolving one crystal to grow a different one.
5. Experiment 3- Crystals in food- making ice cream!

The experiment kit contains:

1. Two geodes
2. A magnifying glass
3. Two popsicle sticks
4. Three piece of thread
5. Epsom salt
6. Black construction paper
7. A metal pie tin
8. Rock salt in a plastic bag
9. Two different bags of sugar

****You will also need a hammer, a pair of scissors, ½ cup milk, and vanilla- these are not in your kit****

Let's investigate where you see crystals everyday!

What you need:

1. a pinch of rock salt
2. a pinch of table salt
3. a pinch of Epsom salt
4. a pinch of sugar
5. wall of freezer (if has frost on it)
6. magnifying glass

What to do:

1. Look at each of the five items with the magnifying glass. Notice the different sizes and shapes of the crystals.
2. Use the spaces on the next page to draw what you see in the magnifying glass:

Don't throw the Epsom salt, sugar, or rock salt out as you'll need these for other experiments!

everyday crystals		
Rock Salt	Table Salt	Epsom Salt

Sugar	Frost from the freezer

Geodes

What you need:

1. Geode,
2. a plastic bag,
3. a hammer,
4. and anadult to use the hammer

What to do:

1. **Get an adults permission to do this first!!**
2. Place the geode inside the plastic bag and seal.
3. Use the hammer tap the rock until it cracks open.
4. Look at the pieces of the geode.
5. Compare the crystals that you see on the geode to those you saw when you looked at the salt, sugar, and freezer wall in the last experiment.
6. If one geode doesn't have crystals in, place the second geode in the bag and carefully tap it with the hammer until it cracks open.

What is a Geode?

Crystals can form when a molten rock (a rock so hot that it melts!) cools off. This is what happens with a geode, a hollow rock lined on the inside with crystals. Geodes form when the minerals inside a molten rock (like limestone) cool and crystallize. Take the geode and look at the outside. Right now it just looks like a rock, right? That's because the crystals are INSIDE the geode! The crystals remain hidden until someone or something breaks the rock.

Epsom Salt Crystals

Sometimes you can dissolve one crystal and make another one that looks totally different!

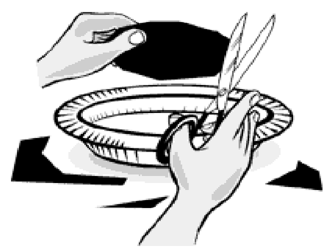
What you need:

1. Black construction paper
2. Scissors
3. Metal pie pan
4. $\frac{1}{4}$ cup of warm water
5. Epsom salt
6. a cup

What to do:

NOTE: This works best on a sunny day

1. Use your scissors to cut the black paper so it will fit in the bottom of your pie pan.



2. Add 1 tablespoon of Epsom salt to 1/4 cup of warm water. Stir until the salt is dissolved.
3. Pour the salty water onto the black paper in the pie pan.

4. Put the pie pan out into the sun. When the water evaporates, you'll see lots of crystal spikes on the black paper!
5. Look at the crystals under a magnifying glass.

Why does Epsom salt make crystal spikes?

When you add Epsom salt to water, the salt dissolves. When you leave the pan in the sun, the water evaporates and the salt forms crystals shaped like long needles.

Growing Crystals … That You Can Eat (yum)!

Why are some crystals bigger than other crystals? Our next experiment will look at how time and temperature help to decide how large the crystals grow.

What you need:

1. Hot water
2. 2 pieces of string (about 12 inches long)
3. 2 popsicle sticks
4. 1 cup sugar
5. 2 heat-resistant glasses
6. Magnifying glass
7. A spoon
8. Food coloring (optional)
9. A ruler

What to do:

1. Fill (not all the way!) each glass with very hot water.
2. Slowly mix half the sugar into one glass, and the rest of the sugar into the other glass. The sugar will dissolve. If you want, add a few drops of food coloring to the syrup to grow colored crystals.
3. Tie a piece of string around the center of each popsicle stick.
4. Place one popsicle stick across the top of each glass, so that the string hangs in the sugar water.
5. Use your ruler to measure the distance from the top of the glass to the top of the water (do this on the outside of the glass). Write your answer on the results table on the next page.
6. Have a grown-up help you place one of the glasses in a warm spot (near a sunny window, or a heat vent) and place the second glass in a cool spot (the basement, a closet).
7. Every day, check the glasses and measure where the top of the sugar water is. Record the results in the results table on the next page.
8. After a few days, crystals will begin growing around the string. In about 7 days, pull the strings (and your new crystals) out of the glass. Use your magnifying glass to examine the crystals' shapes.
9. **ASK PERMISSION BEFORE YOU EAT YOUR CYSTALS!**

Why do crystals form?

When sugar dissolves in hot water, it breaks up into smaller and smaller pieces until you can no longer see it. As the sugar water (called a solution) cools and the water evaporates (goes into the air), the sugar becomes concentrated and begins settling out and forming crystals.

GROWING CRYSTALS YOU CAN EAT

RESULTS TABLE

	Glass in Warm Spot		Glass in Cold Spot	
	Measure liquid level	**Change from day before**	**Measure liquid level**	**Change from day before**
Day 1				
Day 2				
Day 3				
Day 4				
Day 5				
Day 6				
Day 7				

When your crystals are done, use your finished results table to ask yourself…Do you see any difference in the crystal sizes?

What is happening?

The crystals that grew in the cold place may be larger than the crystals you grew in the hot place. Cooler places have a slower evaporation rate. The slower the water evaporates, the larger the crystals that grow. Crystals that grow slowly through evaporation or cooling (such as the geode) have more time to form, and thus are larger.

Using Crystals- Let's Make Ice Cream!

Crystals are used everyday to make and flavor our food. In this experiment, you will use salt crystals and water crystals (ice) to make ice cream!!

What you need:

1. 1/2 cup milk
2. 1/2 teaspoon vanilla
3. The plastic bag with 1 tablespoon sugar from your kit
4. 4 cups crushed ice
5. The plastic bag with 3 tablespoons rock salt from your kit
6. 1 or 2 hand towels to keep fingers from freezing as well!

NOTE: Parents, this will get a little messy as water condenses on the outside of the bag. The towels are important!

What to do:

1. Add the milk and vanilla to the plastic bag with 1 tablespoon of sugar from your kit. Get a grownup to help you seal the bag tightly, allowing as little air to remain in the bag as possible. Too much air left inside may force the bag open during shaking.
2. Add crushed iced to the bag with the rock salt in it.
3. Put the smaller bag with the milk, vanilla, and sugar inside the large bag. Get a grown-up to help you seal the bag (try to get as much of the extra air out as you can).
4. Wrap the bag in the towel or put your gloves on, and shake and roll the bag, making sure the ice surrounds the milk mixture. Five to eight minutes is adequate time for the mixture to freeze into ice cream.
5. When your ice cream is done, open the bags and enjoy!!

Who invented ice cream?

Legend has it that the Roman emperor, Nero, discovered ice cream. Runners brought snow from the mountains to make the first ice cream. In 1846, Nancy Johnson invented the hand-cranked ice cream churn and ice cream surged in popularity. Then, in 1904, ice cream cones were invented at the St. Louis World Exposition. An ice cream vendor ran out of dishes and improvised by rolling up some waffles to make cones.

So what does the salt do?
Salt mixed with ice causes the ice to melt. This is why we use salt on icy roads and sidewalks in the winter. When salt comes into contact with ice, the freezing point of the ice is lowered. Water will normally freeze at 32 degrees F. A 10% salt solution freezes at 20 degrees F, and a 20% solution freezes at 2 degrees F. By lowering the temperature at which ice is frozen, we are able to create an environment in which the milk mixture can freeze at a temperature below 32 degrees F into ice cream.

Here's another experiment to demonstrate:

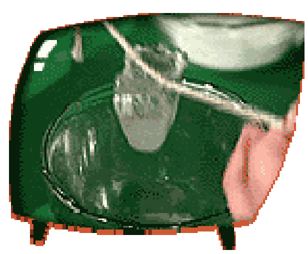
Rising Ice

What you need:

1. large glass of water
2. the short piece of string from your kit
3. ice cubes
4. salt

What to do:

Do you think you can get an ice cube out of a glass of water using a piece of string?



1. Drop an ice cube into a glass of water.
2. Put a pinch of salt on the ice cube.
3. Drag the string over the ice cube.
4. Now put a little more salt on top of the string.
5. Wait a little while. In about three minutes try lifting the ice out of the water with the string. The string becomes attached to the ice.

What is happening?

This works because the salt melts the ice and makes a small puddle of water on top of the ice cube. The puddle then re-freezes a little bit around the string and you have "rising ice."

Interested in Learning More About Crystals??

Credit where credit is due….

The experiments, discussions, and pictures in this handout were taken or adapted from the following websites and books:

1. PBS Kids http://pbskids.org/zoom
2. Teachnet science lesson plans http://www.teachnet.com/lesson/science/
3. Exploratorium, The museum of science, art and human perception http://www.exploratorium.edu
4. Snowflakes http://www.its.caltech.edu/~atomic/snowcrystals/photos/photos.htm
5. http://www.shermanisd.net/Curriculum/matter/ice_cream.htm
6. http://sln.fi.edu/tfi/activity/physics/mat-2.html
7. Magic School Bus **http://www.microsoft.com/education/MSBEarth.mspx#EALAC**

PARENT FEEDBACK- Please help us improve! Just fill this out, and have your child take it to the library.

1. Were the materials provided appropriate? Yes _____ No _____
Please explain.____

2. Did you have enough materials for each experiment? Yes_____ No_____

Please explain.____

3. Did the experiments work? Yes_____ No_____

If not, please explain____

4. Please provide any suggestions for improvements or additional

experiments/explanations.____

____

ECOLOGY

Water Water Everywhere

In this packet we'll learn more about
the **amount of fresh water available** on Earth -
how water is treated to make it drinkable, -
and what we can do to **conserve** our precious resource.

Here are the activities we'll do as we investigate:

1. Water World: The water available on the Earth's surface and the amount available as freshwater.
2. Surface tension, parts 1 and 2
3. Building an aquifer.
4. Nature's water cycle.
5. Cleaning up Your Act – Water Conservation

The experiment kit contains:

1. (3) 9oz.plastic cups
2. (1) paper cup for "rainmaker"
3. (2) 1 gallon self sealing plastic bags
4. medicine cup
5. coloring sheet for water world demo
6. 1 piece modeling clay (enough for 2" pancake)
7. 1/4 cup white play sand
8. 1/3 cup aquarium gravel
9. paper clip
10. plastic pipette

****You will also need these things, they are not in your kit****

1. Sunny window
2. blue, red and green coloring pencil
3. red and blue food coloring
4. empty washed 1 gallon milk jug and a 1-cup measuring cup
5. small amount of cooking oil
6. dish washing liquid
7. ceramic mug to fit inside large bowl inside plastic bag
8. permanent marker
9. yard or garden dirt (several teaspoonfuls)

Water World

The surface of our planet, Earth, is seventy-five percent water. All life on Earth from the largest whales to the tiniest insect depends on water to survive. Every living organism is composed of more than sixty-percent water. We use water to drink, cook, manufacture good, grow crops, produce energy, transport items, and for recreation. Ninety-seven percent of all the water on Earth is salt water. Salt water cannot be used to maintain terrestrial (land) plants, including food crops. It is also not a suitable source of water for most animals. Only 3% of the Earth's surface is fresh water. Two thirds of the fresh water is in frozen form as glaciers, ice caps and snow. This leaves only about 1% of all the water on Earth to meet our needs for fresh water.

The amount of water available on Earth is **finite** and essentially the same water has been moving through the water (also called the **hydrologic cycle**) cycle since the beginning of time. We are using the same water that was used by dinosaurs and our great-great grandparents!

What you need: the coloring sheet on the next page your handout

What to do:

1. The sheet is divided up into 10 x 10 rows of blocks.
2. **Color 97 of the blocks all blue.** This represents the amount of salt water on the Earth's surface.
3. **Color 2 of the remaining blocks red.** This represents the amount of freshwater in glaciers, polar ice caps, rivers, lakes, ponds, plants and clouds.
4. Now **color the last remaining block green.** This represents the amount of freshwater available to us as drinking water.

Bathtub Demo

You can **conserve** water by doing this experiment at bath time and using warm water. (Don't forget to close the drain!)

What you need:

1. Clean 1 gallon container, like a milk jug (which is not in your kit).
2. Bath tub or container which can hold 10 gallons of water easily.
3. 1 cup measuring cup
4. 1 gallon plastic bag or large bowl
5. Small plastic cup
6. Plastic pipette

What to do:

1. Measure out **10 gallons of water**, one at a time and pour into the bathtub. This represents all the water on earth, about 77 trillion gallons per person. That's 77,000,000,000,000 gallons a person!
2. Open your plastic bag or bowl and while holding one side open take **4 and one half cups** of water from the tub and place in the bag. This represents the amount of **freshwater** available. All the rest of the water in the tub is the volume of **salt water** on the earth.
3. Take your measuring cup and fill it to the brim from your freshwater bag or bowl. All the rest of the water in your bag or bowl represents the amount of water that is frozen in glaciers and ice caps. Only the **cup of water** in your hand is what is available as fresh water from all the water on earth. But guess what? Not all of it is drinkable.
4. Using your pipette, remove **10 drops** from your one cup of freshwater and place it in the small plastic cup. This represents the only clean drinking water we have available. All the rest of the water in the cup is water that is trapped beneath the earth, is too contaminated too drink, or is in some other use like in lakes and ponds, rivers, soil, plants, and clouds. It may look like a small amount but it actually represents about 232 thousand gallons per person.

What is happening?

We see water everywhere around us.

Name some of the places you see water everyday.

Did you include puddles and clouds, plants and lakes?
We can get water from our faucet at home and water fountain at school. Some water we use to drink and some we use for other purposes like bathing, washing clothes and dishes…

Have you been to the beach or ocean?

What was the water like? Could you drink the water if it was salty?

Try this one…

Can plants use salty water? Set up an experiment using two flowers. Place one flower in fresh water and the other is water that contains a teaspoon of salt. Record the daily changes. Is salty water good for growing plants?

Surface Tension - part 1

A drop of water is small, but it is made of even smaller parts called molecules. Water molecules have bonds that hold them together. At the surface of the water, the molecules hold on to each other even more tightly because there are no molecules pulling on them from the air above. As the molecules on the surface stick together, they form an invisible "skin" called surface tension.

Water striders and other insects can walk on water without sinking. The surface tension is strong enough to hold them. The insects' feet make dents in the surface tension, but it doesn't break. Here are some experiments to show that surface tension is there, even if you can't see it.

What you need:

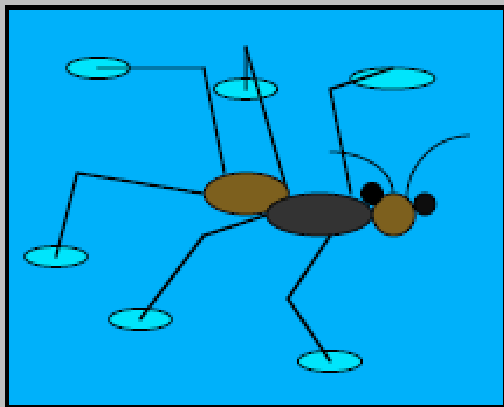
- cooking oil
- water

What to do:

1. Rub a few drops of cooking oil on your hand.
2. Let water from a faucet (tap) run over your hand then turn off the faucet. What happens?

3. Wash your hands with soap. Does this make the oil go away?

WATER STRIDERS



Water strider on the water.

Water striders are insects that glide on the water's surface. Their legs stay on top of the water through surface tension. Air is trapped on hairs at the ends of the legs of the water striders, keeping their legs from falling into the water. If you look at one floating on the water, it looks like the ends of its legs are resting on little floating pads. These are actually small dents in the surface of the water made by the weight of the insect pushing down. Water bugs help the ecosystem. Some eat algae, which helps keep the amount of algae from becoming too high. They also provide food for other creatures .

by Andrew McCreight

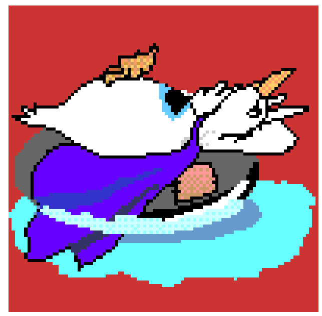
How it Works:

The water molecules stick together tightly and will not mix with the oil on your hand. Since water molecules are attracted to each other so strongly, they formed small balls or drops which rolled over your oil coated hand. There is an invisible "skin" of surface tension around each drop.

Soap molecules are attracted to both water and oil. One end of the soap molecule sticks to oil, the other end sticks to water. The soap breaks up the surface tension and keeps the oil drops mixed in with the water so that the oil can wash off your hand.

Surface Tension - part 2

Sometimes detergents (soaps) get into creeks or lakes. This could happen if people use too much soap to wash their cars. The water washes down the street, into street drains, and into a creek or lake. Once in the creek or lake, detergent could destroy the surface habitat.



What you need:

- a plastic cup (free of detergent)
- paper clip
- fork or tweezers
- liquid dish detergent

What to do:

1. Fill the bowl with water.
2. Put a paper clip on the times of the fork, or hold it with the tweezers. Gently place the paper clip on the surface of the water. Be patient and careful. You will be able to get the clip to sit on top of the water! Can you see the surface tension bend under the paper clip?

3. Add one or two drops of detergent to the water near (not on top of) the paper clip. What happens?

What is happening?
The paper clip was resting on top of the surface tension. This "skin" supported the clip and kept it from sinking. When you added detergent, the soap weakened the attraction the water molecules had for each other. This caused the surface film to disappear. Then the paper clip sank.

Building an Aquifer

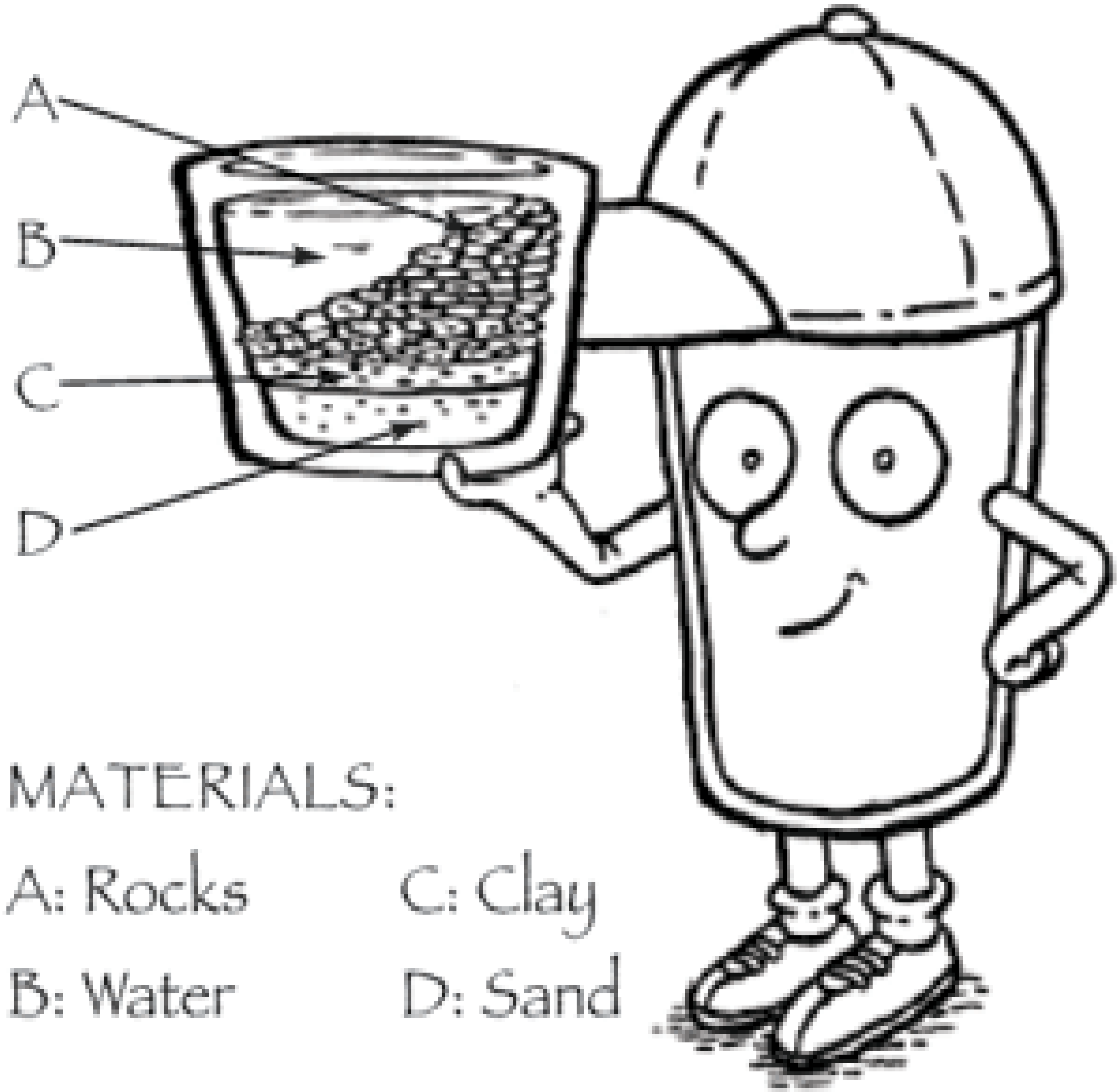
When rain falls, it is collected below the earth's surface and forms the lakes and water tables we need for drinking water. Many people get their drinking water from underground sources called aquifers.

Water suppliers or utility companies often drill wells through soil and rock into aquifers for the ground water contained therein to supply the public with drinking water. Sometimes people have their own private wells drilled on their property.

Unfortunately, ground water can become contaminated by harmful chemicals, such as lawn care products and household cleaners that were used or disposed of improperly, and any number of other pollutants, that can enter the soil and rock, polluting the aquifer and eventually the well. Such contamination can pose a significant threat to human health. The measures that must be taken by well owners and water plant operators to either protect or clean up contaminated aquifers are quite often costly.

What you need:

1. clear plastic cup
2. 1 piece of modeling clay or floral clay that will allow a 2" flat pancake to be made for their cup
3. White play sand
4. Aquarium gravel
5. Red food coloring
6. small paper cup w/ holes – a "rainmaker"



What to do:

1. Pour the white sand in the bottom of each cup completely covering the bottom of the container. Using your rainmaker, pour a small amount of water into the sand, wetting it completely (there should be no standing water on top of sand). Watch how the water is absorbed in the sand, but remains around the sand particles as it is stored in the ground and ultimately forming part of the aquifer.

2. Flatten the modeling clay (like a pancake) and cover 1/2 of the sand with the clay (press the clay to one side of the container to seal off that side). The clay represents a "confining layer" that keeps water from passing through it. Pour a small amount of water onto the clay. Watch how the water remains on top of the clay, only flowing into the sand below in areas not covered by the clay.

3. Use the aquarium rocks to form the next layer of earth. Place the rocks over the sand and clay, covering the entire container. To one side of the cup, slope the rocks, forming a high hill and a valley (**see illustration**). These layers represent some of the many layers contained in the earth's surface. Now pour water into your aquifer until the water in the valley is even with your hill. See the water stored around the rocks? The rocks are porous, allowing storage of water within the pours and openings between them. You might also notice a "surface" supply of water (a small lake) has formed. This shows a view of both the ground and surface water supplies which can be used for drinking water purposes.

4. Use the food coloring and put a few drops on top of the rock hill as close to the inside wall of the cup as possible. Sometimes people use old wells to dispose of farm chemicals, trash, and used motor oil. These chemicals can show up in the ground water and the drinking water. The color spreads not only through the rocks, but also to the surface water and into the white sand at the bottom of the cup. This is one way pollution can spread throughout the aquifer over time.

What is happening?

The food coloring represented a potential source of pollution to drinking water supplies. Now that you see how water is stored in an aquifer, and how ground water can become contaminated, you can see how this contamination ends up in a drinking water well. Careless use and disposal of harmful contaminants above the ground can potentially end up in the drinking water below the ground.

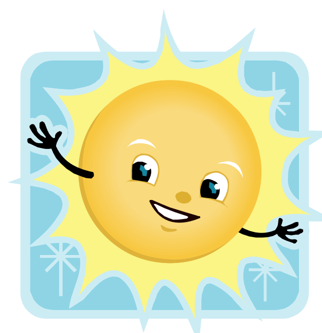
Nature Recycles

The three basic parts of the hydrologic cycle are evaporation, condensation and precipitation. **Evaporation** is the process in which the heat energy of the sun causes the water to change from a liquid to a vapor (gas). **Condensation** is the process of changing from a vapor (gas) back into liquid form. Condensation is what forms clouds. **Precipitation** occurs when water droplets or ice particles from vapor increase in size and fall to the Earth's surface.

What you need:

1. clear plastic cup
2. ruler
3. self sealing bags
4. small container (medicine cup) to fit inside self sealing bag

Evaporation

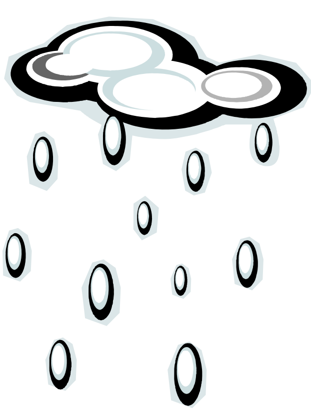


What to do:

1. Fill your cup one-half full of water.
2. Mark the level with a permanent marker.
3. Place the cup on a sunny windowsill.
4. Look at your cup every day. Measure how much water is in the cup, staring from the bottom, and record your data on the data sheet.

What is happening?

The water level in the cup should be less than where it was marked from day one. Why? Where did the water go? The water ***evaporated*** by changing from a liquid to a gas. Have you ever noticed how after a rain shower puddles disappear or get smaller on a sunny day? That is evaporation taking place.



Condensation

What to do:

1. Fill the medicine cup to about one half full with water.
2. Carefully place the cup in the corner of a self sealing bag. Do not spill the water in the cup. Tape the bag at an angle (which allows the cup to be level) to a sunny window.

3. Look at your cup every day. Measure how much water is in the cup, staring from the bottom, and record your data on the data sheet.

What is happening?
The plastic bag should have water droplets formed on the inside of the bag. Where did they come from? The process of ***condensation*** is how clouds are formed.

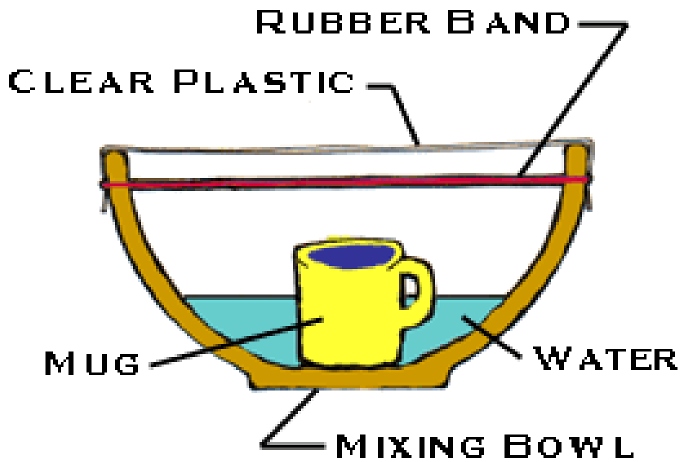
Evaporation and Condensation Data Sheet		
	Evaporation	Condensation
Day 1 water level		
Day 2 water level		
Day 3 water level		
Day 4 water level		
Day 5 water level		
Day 6 water level		
Day 7 water level		

Making your own Water Cycle

Many children in the world today do not have clean water to drink. Some school children in Africa are learning how to clean water with the help of the sun. The sun can also help you to make water cleaner in this demonstration.

What you will need:

1. A small amount of dirt (just a couple of teaspoons) mixed into 3 cups water.
2. Bowl large enough to hold mug and water.
3. Ceramic mug that will fit inside a bowl.
4. Self sealing plastic bag.
5. Small pebbles
6. Sunny location

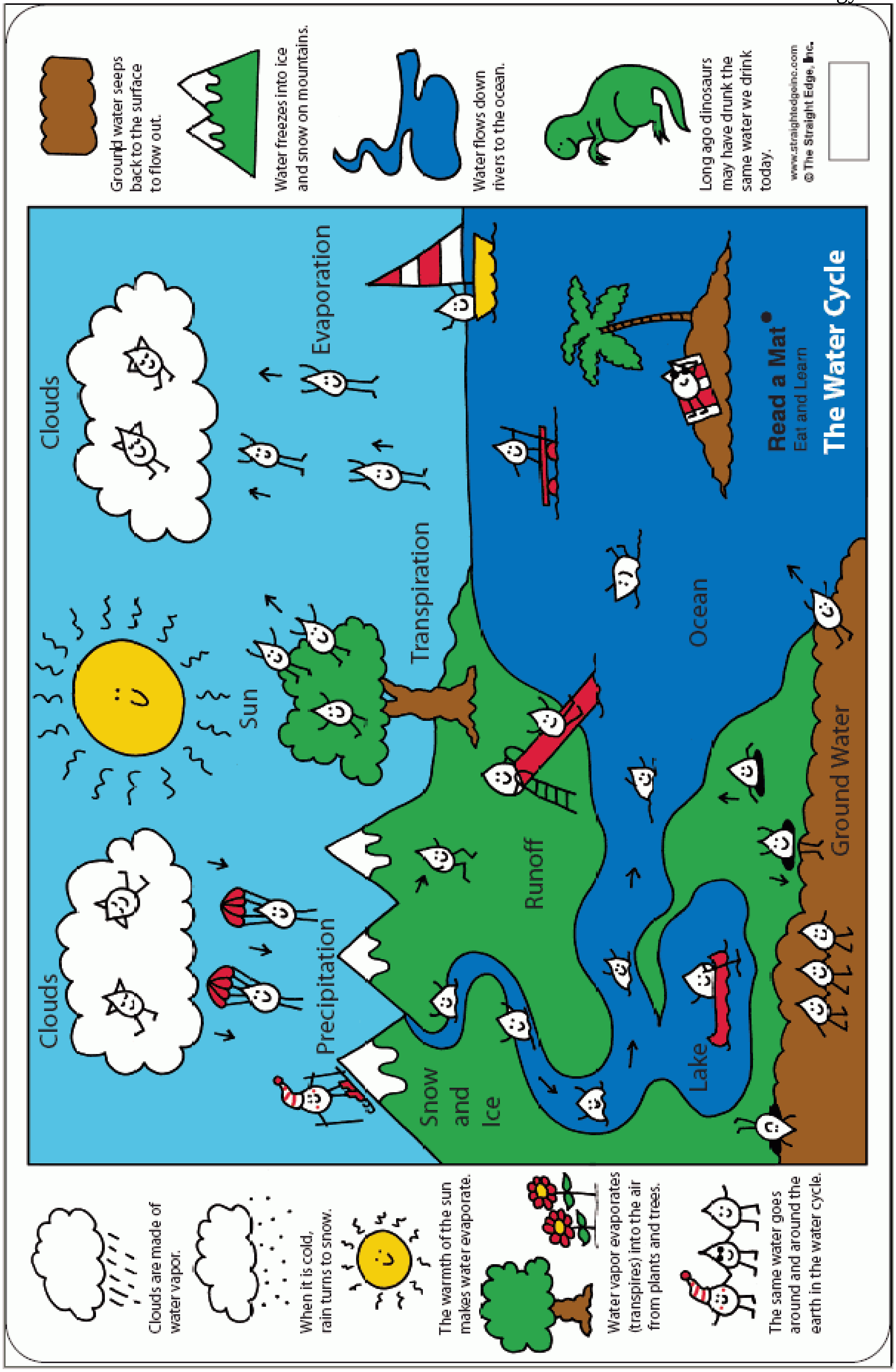


What you need to do:

1. Carefully pour the dirty water into the bowl.
2. Set the collection cup (mug) into the muddy water without getting any water inside.
3. Place the bowl into the plastic bag or cover with plastic wrap and seal shut.
4. Set in sunny location.
5. Place a few small pebbles on top of the bag directly over the mug.
6. Watch for clean water to collect at the top surface of the plastic bag and drip into the collection mug below.

What is happening?

The sun warms the dirty water. As the water evaporates and forms a gas it rises to the upper surface of the plastic bag. The water forms droplets when it condenses as it touches the bag. The droplets fall as precipitation from the lowest point on the bag surface and collect in the small cup below.


Clouds are made of water vapor.
When it is cold, rain turns to snow.
The warmth of the sun makes water evaporate.
Water vapor evaporates (transpires) into the air from plants and trees.
The same water goes around and around the earth in the water cycle.
Clouds
Precipitation
Snow and Ice
Runoff
Lake
Ground Water
Clouds
Sun
Transpiration
Evaporation
Ocean
Read a Mat
Eat and Learn
The Water Cycle
Ground water seeps back to the surface to flow out.
Water freezes into ice and snow on mountains.
Water flows down rivers to the ocean.
Long ago dinosaurs may have drunk the same water we drink today.
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Conservation-Cleaning up your act!

We use about 50 gallons of water in our homes each day, but only 1% (approximately two quarts) is used for drinking. Because people usually think water is plentiful and renewable, many of our uses of water are wasteful. Seventy five percent of home water use occurs in the bathroom. There are many ways to change our water use behaviors to use less water.

Conservation

What you need:

1. one plastic cup
2. sink with plug to hold water
3. toothbrush and tooth paste.
4. running water for tooth brushing exercise.
5. large plastic bag to measure tooth brushing water from demo

What to do:

1. Fill the cup with water. This is the water you will use for brushing your teeth. Do not turn the faucet back on while you are doing your experiment.
2. Close the sink drain.
3. Wet your toothbrush by dipping into the cup of water.
4. Apply toothpaste and brush your teeth.
5. Use the water in the cup for rinsing your mouth and toothbrush.
6. Look at the amount of water collected in the sink.
7. Empty the sink by opening the drain.
8. **Close** the sink drain again.
9. This time brush your teeth the way you normally would with the faucet running.
10. **Careful not to overfill the sink!!!**
11. Place your collection bowl on the counter. Use your cup from the earlier demonstration to scoop out water from the sink into the bowl.
12. Empty the sink basin by scooping out the water one cup at a time and counting as you fill up the collection bowl.
13. You may not be able to get every drop out of the sink. It is not important to count every drop.
14. How many cups did it take to empty the sink?

What is happening?

Which method used less water? Keeping something from being wasted is called ***conservation***. There are lots of ways we can use less water around our homes.

List some of the ways you can think of.

How much water do **you** use?

HOW MUCH WATER DOES IT TAKE TO...

- Brush your teeth? - 2 to 5 gallons
- Wash the car? - 50 gallons
- Use the dishwasher? - 8 to 15 gallons
- Flush the toilet? - 1.5 to 4 gallons (each flush)
- Take a shower or bath? - 17 to 24 gallons
- Run the washing machine? - 35 to 50 gallons (each load)

Interested in learning more about Water Ecology and Conservation???

Credit where credit is due….
The experiments, discussions, and pictures in this handout were taken or adapted from the following websites and books:

1. Environmental Conditions Online for the DFW Metro PLEX (ECOPLEX) (**http://www.ecoplex.com**)

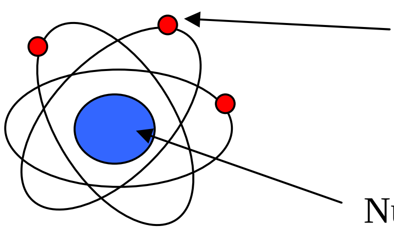
2. EPA's Water Foundation for Kids: **http://www.water-ed.org/kids.asp**
   Thirstin's Water Activity Book for Kids. K-3
   Drinking Water & Ground Water Kids' Stuff 2/7/2007
   http://www.epa.gov/safewater/kids/grades

3. Monroe County Water Authority – Kids Water Fun **(http://www.mcwa.com/kids.htm)**

Electricity

Ever wonder why when you flip a switch the light comes on? It's not magic, its electricity! So what is electricity?

Just like atoms and molecules are the building blocks that make up all the stuff around us, electrons are one of the building blocks that make up atoms. Atoms are really made up of three kinds of building blocks- neutrons, protons, and electrons. Neutrons and protons are in the middle of the atom, and the electrons move around them. Neutrons do not have a charge, but protons have a positive charge and electrons have a negative charge. Opposite charges attract each other, while the same charges push each other away (just like magnets). The protons in the atom are attracted to the electrons in the atom because they have opposite charges.



Sometimes electrons move from one atom to another atom. If electrons collect and stay on something, they make a negative charge. Electrons can move and keep moving. When they do, it's sort of like water flowing down hill. Water will move from a high place to a low place (like a water fall). Electrons will do the same thing. They will move from a place with what we call a high potential to a low potential. When electrons move, we say there is an electrical current, just like we say there is a current in the river – a direction the water is moving. Electricity is what you get when the electrons move around (called an electric current) or collect in one place (called a static charge).

We can make electrons move by making a path for them to move along. We make a path for the electrons to move along with metal wires. We use metal because it is easy for electrons to move around in. We also have to make the electrons move by making a difference in potential. We make a difference in potential by putting a positive charge on one end of the wire and a negative charge on the other. We have to do one other thing to make the electrons flow- we must make a complete circle, or circuit. Otherwise the electrons would get to the end and just stop.

When you flip on a light switch, you complete the circuit- you connect the wires that make a path for the electrons to flow. The electrons flow through the light bulb, and it makes the light glow. Presto! **Light**!

Here are the activities we'll do as we investigate electricity:

1. Exp. 1: See a static charge- make an electroscope
2. Exp. 2: Make a test circuit and see how well different objects conduct electricity!
3. Exp. 3: Put your knowledge to use- make a flashlight

The experiment kit contains:

1. A clear plastic cup, a large paper clip, 1 sheet of colored stickers, a balloon, and a sheet of tin foil
2. two AA batteries and a battery holder
3. Two wires with alligator clips on the ends
4. a plain piece of wire
5. A flash light bulb and a base for the flashlight bulb
6. and electricity test kit (small baggies of items)
7. Sheet of white stickers
8. a white plastic cup
9. 1 sheet of white card stock, 1 sheet of blue card stock

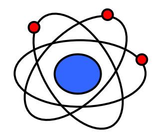
****You will also need an empty toilet paper tube or paper towel tube, and a sheet of newspaper (or some scrap paper), these are not in your kit****

Parents, please note that your child will probably need a little more help putting these experiments together. They are not difficult, but they are just a bit longer than our usual experiments.

See a static charge- make an electroscope

Have you ever rubbed a balloon on your head to make your hair stand up? When you do this, you are making a static charge. You can't see a static charge, but you can see what it can do. This project makes something called an electroscope that shows you a static charge.

What is a static charge? All materials are made up of billions of atoms. Each atom has a center, or nucleus, with electrons swimming around it.



Rubbing can make the electrons move. When electrons move from one material to another, it gives one material a positive charge, and one a negative charge. The charges stay, or remain static, on the surface of the material until they have a path to move on or discharge. Static charge can pull things together or push them apart because (like magnets) opposite charges attract and like charges repel (push apart).

What you need:

- Clear plastic cup
- Aluminum foil
- Metal paperclip
- Sheet of colored stickers
- Balloon
- Scissors and ruler

What to do:
Make the electroscope (use the picture to help you):

1. Unfold the paperclip so that it looks like a long **J.**
2. Cut two strips of foil that measure roughly ¼ inch by 1 ½ inch.
   Use your fingers to gently smooth out the foil strips and get out any wrinkles.
3. Use the end of the paper clip to punch small holes in the one end of each foil strip. Wad the rest of the aluminum foil into a little ball.
4. Use the paperclip to make a small hole in the bottom of the clear plastic cup.
5. Hang the foil strips, called leaves, on the curved end of the **J**.
6. Holding the cup upside-down, put the straight part of the **J** paper clip through the hole in the cup, so the leaves hang inside the upside down cup <u>without</u> touching the table or desk top.
7. Fix the paperclip in place with the colored stickers.

8. Put the aluminum foil ball on the top of the paperclip that is sticking out from the cup. **The electroscope is complete and ready for use!**

Now use your electroscope:

9. Blow up the balloon and tie it off.
10. Charge the balloon by rubbing it in your hair.
11. ***Slowly*** bring the charged balloon **near** the foil ball on the electroscope and watch how the leaves react. DON'T touch the balloon to the foil ball, or you will remove the static charge. (if you do, just charge the balloon again!)
12. Move the balloon away and watch the leaves of the electroscope.

What is happening?

When you rub a balloon on your head, the energy of rubbing or friction gives the electrons in your hair and the balloon extra energy. Some of the electrons break away from their atoms and wander off on their own. Some of them collected on the balloon and it became negatively charged. When the negatively charged balloon comes near the foil ball, it repels (pushes away) some of the electrons in the foil. Those electrons travel down the paper clip to the leaves, giving each of them extra electrons- a negative charge. Since like charges repel, the leaves moved away from each other. The leaves of the electroscope move away from each other because they both have a negative charge and repel each other.

A Basic Circuit

Batteries can store an electric charge. When they are put together with the right things, the stored charge can flow and produce electricity. The things you put together to release the charge in the batteries is called a circuit. A circuit gives the electrons a path to move along.

Some materials let electrons travel through them better than others. These are called conductors. Let's look at some different materials and see if they conduct electricity.

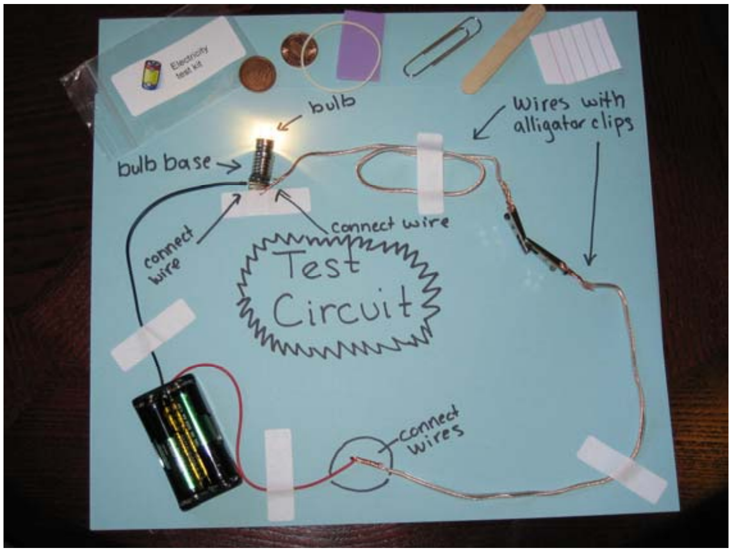
What you need:

1. two AA batteries and a battery holder
2. two wires with alligator clips on one end
3. a flashlight bulb and a base for the bulb
4. an electricity test kit
5. ~5 stickers (white or colored)- these will help hold things in place
6. Sheet of blue card stock

NOTE: you will be using most of these materials for the next project, so be careful with them (try not to mess up the wires!). **Try not to use all of the white stickers, because you will use them for the flashlight project.**

What to do:

Make a test circuit (use this picture to help you):



How to make your test circuit:

1. Find the wires from your test kit and carefully unwrap and straighten them. Find the two wires with alligator clips on the ends, and set these aside.
2. Find the light bulb and the light bulb base. Carefully screw the light bulb into the base. Use a sticker to tape the base to the blue paper- the base has a flat metal piece that sticks off the bottom for this.
3. Look at the batteries. One end of each will have a flat end, and one end will have a bump. Look at the battery holder, and you will see a picture of how the batteries should go into the holder. Put the batteries into the holder.
4. Attach one wire from the battery holder to one side of the bulb base. Use a sticker to hold the wire down to the paper and keep it from moving. **NOTE**: the wire from the battery holder just needs to go through the little hole and be bent over- it just needs to stay in touch with the lamp base for this to work.
5. Attach the other wire from the battery holder to one of the wires with an alligator clip on one end. Attach the wire to the end without the alligator clip. Use a sticker to hold these in place. **Again**, the two ends of wire just need to stay touching each other for this to work.
6. Attach the other wire with an alligator clip to the free side of the lamp base. Use the end without the alligator clip. Use a sticker to hold the wire down on the sheet- you may need to bend the wire so it will fit on the paper.
7. Clip the two alligator clips together. If your circuit is all connected, the bulb should light up, just like the picture. Did it work?
8. If your light is not working, you need to check all the wire connections to make sure the wires are all touching and that the batteries are in the holder correctly. Once your light is working, your test circuit is ready to use!

Neat Fact: In 1800 **Alessandro Volta** made the first battery by layering copper, zinc, and pasteboard soaked in saltwater. When these things touched each other in the order Volta put them together, they created the first steady supply of electricity. These days, the steady supply of electricity from batteries is used to power all sorts of electrical devices such as toys, light bulbs, radios, calculators and cars.

Test materials to see if they conduct electricity:

9. Now test different materials to see if they will conduct electricity. Unclip the alligator clips on your test circuit.
10. Pick an item from you electricity test kit- let's start with the paperclip. Clip one alligator clip to one side of the paperclip, and the second clip to the other. MAKE sure the alligator clips are not touching each other!!
11. Did the bulb light up when you completed the circuit? Write what happened in the chart below.
12. Test each thing in the bag, and fill in the chart. If the bulb lights up, it is a good conductor. Which items from your test kits are good conductors?

Electricity Test Chart		
What I tested	**Did the bulb light up?**	**Good or bad conductor?**
Paper clip		
Wood stick		
Plastic penny		
Real penny		
Paper		
Rubber band		
Foam sheet		

Let's make a flashlight!

A flashlight is the same type of basic circuit you made to test how well materials conduct electricity. It is made from batteries connected to a light bulb. When flashlight is turned on, all the wires are touching each other and the circuit is closed, allowing the electrons to flow. When the flashlight is off, two of the wires are pulled apart so electrons cannot flow, and the bulb does not light up.

What you need: (you will need to dismantle your basic circuit to make this flashlight.)

1. two AA batteries and a battery holder
2. two wires with alligator clips on one end and maybe one plain wire
3. one white plastic cup
4. a flashlight bulb and a base for the bulb
5. an empty toilet paper tube or paper towel tube
6. white stickers to help hold things in place
7. sheet of white card stock
8. scissors and colored pencils

What to do:

Making the inside of the flashlight:

1. Find the light bulb and the light bulb base. Carefully screw the light bulb into the base.
2. Look at the batteries. One end of each will have a flat end, and one end will have a bump. Look at the battery holder, and you will see a picture of how the batteries should go into the holder. Put the batteries into the holder.
3. Attach one wire from the battery holder to one side of the bulb base. Use a sticker to hold the wire in place and keep it from moving. **NOTE**: the wire from the battery holder just needs to go through the little hole and be bent over- it just needs to stay in touch with the lamp base for this to work.
4. Attach the other wire from the battery holder to one of the wires with an alligator clip on one end. Attach the wire to the end without the alligator clip. Use a sticker to hold this in place. **Again**, the two ends of wire just need to stay touching each other for this to work.
5. Attach the other wire with an alligator clip to the free side of the lamp base. Use the end without the alligator clip. Use a sticker to hold the wire in place.
6. Touch the two alligator clips together. If your circuit is all connected, the bulb should light up. Did it work?

7. **If your light is not working, you need to check all the wire connections to make sure the wires are all touching and that the batteries are in the holder correctly. Once your light is working, you can assemble the flashlight**.

NOTE: The wire with the alligator clip coming from the light bulb will need to be long enough to go down through the paper tube and stick out of the bottom of the tube. If it is not long enough to do this, use the extra piece of wire (that doesn't have any alligator clips on it) to make it longer. **Remember, test your light before you go any further.**

Assembling the flashlight-

8. If you are using a paper towel tube, cut this to the same length as a toilet paper tube. Cut out the shapes shown on the white card stock.
9. Fold a sheet of newspaper or scrap paper until it is as wide as your paper tube is long. Wrap it around the battery holder and the wires so that the bulb is at the top, and the alligator clips come out of the bottom. This will keep you from squishing your flashlight when you hold it. Make sure the roll will fit inside the paper tube- you may need to remove some of the newspaper. When it will fit, use a sticker or two to hold the newspaper in place.
10. Now push the newspaper and guts of your flashlight into the empty paper tube. The light will stick out one end and the alligator clips will stick out the other.
11. Clip the alligator clips to the side of the paper tube for now. Put one of the cardstock circles over the bottom of the tube- the alligator clips and wires will stick out a little on one side. Fold the tabs down and hold the paper circle in place with some stickers.
12. Poke a hole in the other circle you cut out with a pencil. Put this over the light bulb to cover the top of the flashlight. Fold the tabs down and use two stickers to hold it to the paper tube.
13. Now wrap the large rectangle you cut out around the paper tub. Use stickers to hold it in place.
14. Cut out or poke a large hole in the bottom of the white plastic cup (get a grownup to help). Put the small end of the cup with the hole over the bulb end of the paper tube. Fix it in place to the paper tub with stickers.
15. Decorate your flashlight!

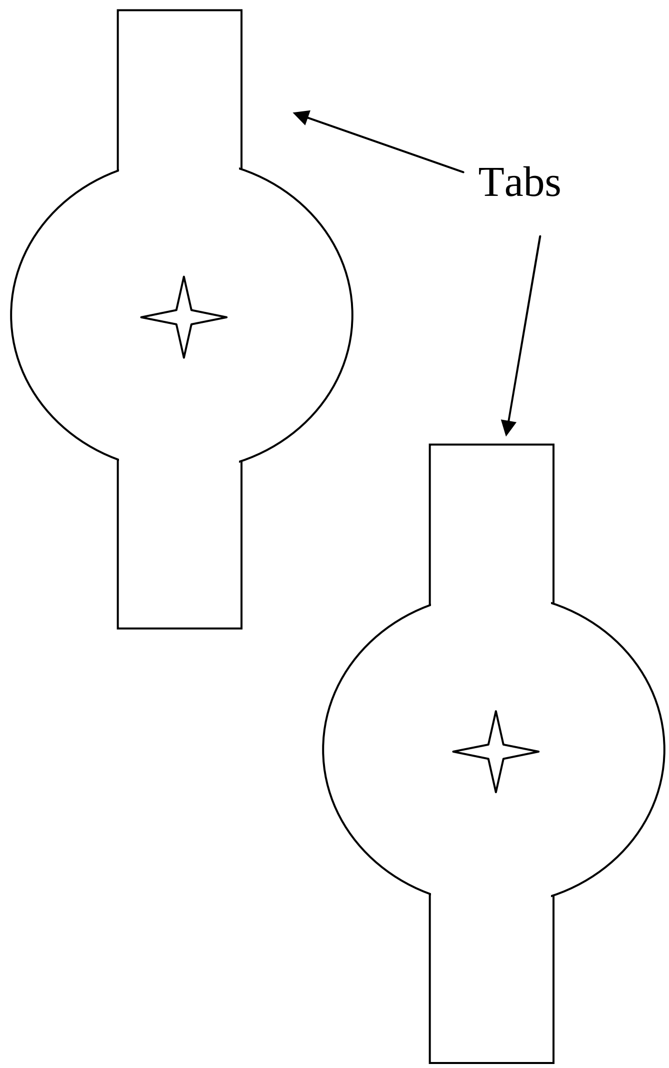
Turn on the flashlight: Now you should have a working flashlight! Turn it on by clipping one alligator clip to the paper tube and the other alligator clip to the one attached to the paper tube. Presto! Light!

Credit where credit is due….

1. The electroscope project was taken from the website:
http://wow.osu.edu/experiments/electricity/electroscope.html
"Awesome Experiments in Electricity and Magnetism." Michael DiSpezio, Sterling Publishing Co.: New York, 1998, p. 62-63.

2. Portions of the explanations provided in this handout were adapted from the book ***The World of Science***, Parragon Publishing, Copyright 1999.

Circles to cover the top and bottom of the flashlight. Cut along the black lines. On the circle for the top, use your pencil to poke a hole through the star. When you put on the top and bottom, fold the tabs down and use stickers to hold the circle in place.



Rectangle to wrap around the outside of the flashlight. Cut along the black line.

Electromagnetism

Electricity is closely related to an invisible force called magnetism. In fact, electricity and magnetism are two aspects of the same force, which modern science views as one of the four fundamental forces in the universe- electromagnetism.

When electricity flows through a conductor, like an insulated wire, it produces an invisible magnetic field around the wire. This is known as the electromagnetic effect. Magnets made in this way, by flowing electricity, are called electromagnets.

Here are the activities we'll do as we investigate electromagnets:

Activity #1: Make an electromagnet that will attract a metal object.
Activity #2: Compare the properties of magnets and electromagnets.
Activity #3: How can you increase the strength of an electromagnet?
Activity #4: Electromagnets have lines of force.

The experiment kit contains:

- 20 inch strip of insulated copper wire, 1/2 exposed on each end
- 40 inch strip of insulated copper wire, 1/2 exposed on each end
- 2 size "AA" batteries
- 2 iron nails, 4" long
- a bunch of paper clips
- small compass
- 1 roll of electrical tape
- 1 bar magnet

Make an electromagnet that will attract a metal object

A typical electromagnet is made from a coil of plastic-covered wire wrapped around an iron bar, called a core. A coil of wire, or solenoid, produces a stronger magnetic field than a straight length of wire. The wire is connected to a source of electricity like a battery. As soon as the electrical circuit is completed, the iron bar becomes a magnet. When the electricity is switched off, the magnetism disappears. Let's make an electromagnet from an ordinary nail, some wire, and batteries.

What you need:
20 inch strip of insulated copper wire, 1/2 exposed on each end
1 "AA" battery
iron nail, 4" long
a bunch of paper clips
electrical tape
scissors to cut the electrical tape

What to do:

1. Using only the nail, try to pick up as many paper clips as possible. How many did you get?
2. Now wrap the copper wire around the nail about ten times leaving 5-6 inches of wire free on each end of the nail.
3. Attach one end of the wire to the negative pole of the battery using the electrical tape
4. Touch the other end of the wire to the positive pole of the battery. Use electrical tape to hold it in place.
5. Now use the nail to pick up paper clips.
6. How many nails did you pick up?

Compare the properties of magnets and electromagnets.

Electromagnets have poles which can be reversed when the path of electricity is reversed. **This is not a characteristic of regular magnets.**

What you need:

- 20 inch strips of insulated copper wire, 1/2 exposed on each end
- 1 "AA" battery
- compass
- iron nail
- Electrical tape
- scissors

What to do:

1. Wrap the wire around the nail about ten times leaving 5-6 inches of wire free on each end of the nail.
2. Attach one end of the wire to the **negative** pole (the flat end) of the battery using the electrical tape.
3. Hold the nail over the compass.
4. Touch the other end of the wire to the positive pole of the battery. What happens to the compass needle when the other end of the wire makes contact with the positive pole of the battery?
5. Repeat this process, but with a slight variation: attach the wire to the **positive** pole of the battery first, then, holding the nail over the compass, complete the circuit by touching the other end of the wire to the negative pole of the battery.

What happens?

How can you increase the strength of an electromagnet?

Do you think you can increase the strength of your electromagnet? Let's try a few combinations and see! The strength of an electromagnet can be increased by using more batteries and/or more wires. Using more nails will increase the electromagnet's capacity to hold more paper clips, without necessarily increasing the magnetic force.

What you need:

- 20 inch strip of insulated copper wire, 1/2 exposed on each end
- 40 inch strip of insulated copper wire, 1/2 exposed on each end
- 2 size "AA" batteries
- 2 iron nails, 4" long
- a bunch of paper clips
- Electrical tape
- Scissors to cut the electrical tape

What to do:

1. How do you think you could increase the strength of an electromagnet? Possible ideas are to:
   1) use more wire;
   2) use more batteries;
   3) use more nails.
2. Start with the electromagnet you put together for the first activity. Write home many paperclips you picked up with the magnet in the table on the next page.
3. Now, disconnect your electromagnet. Replace the short wire with the longer wire, wrapping it around the nail as many times as you can (but still leave a few inches on each end). Connect the ends of the wire to the battery, one to each end and use electrical tape to hold the wires in place. Now how many paperclips can you pick up?
4. Try the different combinations show in the table, and any others you can think of. When you use two batteries, make sure you connect them end to end, making the positive end of one touch the negative end of the other. When you try 2 nails, you can try them end to end or side by side. What happens?

Electromagnetism Table of Results						
1 battery	2 batteries	Short wire	Long wire	1 nail	2 nails	# paper clips
X		X		X		
X			X	X		
X		X			X	
X			X		X	
	X	X		X		
	X		X	X		
	X	X			X	
	X		X		X	

Challenge! The strength of an electromagnet depends on how many loops of wire are packed into certain length. For example, an electromagnet made from wire wrapped 10 times over the length of one nail is not as strong as one with 20 times. Try the combinations below and see if this is true. Remember, you need to cover the same amount of the nails no matter how many loops you use-you are adjusting the number of loops per unit length. Use 2 batteries, the long wire, and 1 nail. Test the strength of the electromagnets by seeing how many paper clips you can pick up.

Number times wire was wrapped around the nail	# paper clips
6	
8	
10	
20	

Electromagnets have lines of force.

A magnetic field is an area around a magnet where it pulls iron containing objects towards itself. The pull spreads out all around the magnet. In this experiment you will draw a picture of a magnetic field.

What you need:

- 20 inch strip of insulated copper wire, ½" exposed on each end
- 2 size "AA" batteries
- iron nail, 4" long
- compass
- electrical tape
- scissors
- pencil

What to do:

1. Make the electromagnet described in the first experiment (or one of the other experiments).
2. Place the electromagnet on the middle of the next page.
3. Place the compass in one of the boxes near the magnet. Draw an arrow in the direction the compass is pointing. Repeat this for each box.
4. When you are done, you will have a picture of your electromagnet's magnetic field!

Magnetic Field Picture

Put the
electromagnet
here

Interested in learning more about electromagnets?

Credit where credit is due….
The experiments, discussions, and pictures in this handout were adapted from two sources. The discussions and the experiment mapping the magnetic field lines were taken from The World of Science, Paragon Publishing, 2005 Edition.

The remaining experiments were adapted from:

SMILE PROGRAM PHYSICS INDEX at http://www.iit.edu/~smile/index.html.

The SMILE website is hosted by the Illinois Institute of Technology

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The SMILE website is a collection of almost 200 single concept lessons. These lessons may be freely copied and used in a classroom but they remain the copyright property of the author(s) and the directors of the SMILE program.

The Physics lessons are divided into the following categories: Matter, Mechanics, Fluids, Electricity & Magnetism, Waves, Sound and Optics, and Miscellaneous.

&

Questionnaire

Were the materials provided appropriate? Yes _____ No _____
Please

explain.____

1. Did you have enough materials for each experiment? Yes_____ No_____

Please

explain.____

2. Did the experiments work? Yes_____ No_____

If not, please

explain____

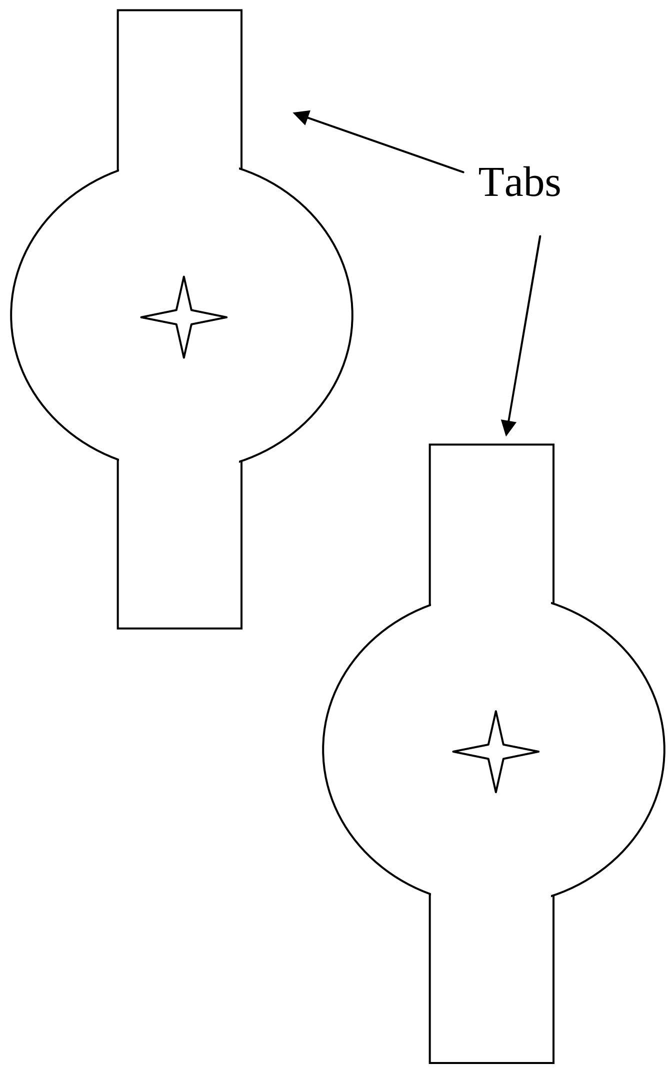
3. Please provide any suggestions for improvements or additional

experiments/explanations.____________________________________

____

____

Circles to cover the top and bottom of the flashlight. Cut along the black lines. On the circle for the top, use your pencil to poke a hole through the star. When you put on the top and bottom, fold the tabs down and use stickers to hold the circle in place.



Rectangle to wrap around the outside of the flashlight. Cut along the black line.

FOOD SCIENCE:

MOLD and YEAST

I'm sure you've heard this before from either your mom or dad. "Quick, throw that bread away right now; it has **yucky MOLD** growing on it!" Or, maybe it's the cheese that's gone bad this time. At the time anyone in your family is asked to do this, you may hear the shrieking sound " EEEUUUWWW GROSS ….. MOLD "

Maybe you've been driving around town and have seen the number of signs along the road: "Breathe Mold Free Today," or "Clear Your Home of Mold and Rid Yourself of Allergies Forever."

> What is Mold? Is it bad for you? How does mold grow, and how do you keep mold from growing on the food you eat?

As you will learn in this set of experiments, MOLD is a type of fungus. YEAST is another type of fungus. Unlike MOLD, YEAST is used in the everyday baking of bread, and we do eat it all the time.

> What is different about YEAST? What does YEAST do? How does it eat and what does it produce as it eats?

FOOD SCIENCE is the study of understanding the food we eat. By understanding what is good for you and what is not, we make sure our bodies remain healthy. FOOD SAFETY AND TOY SAFETY is in the news everyday. You may remember the recent recall of some toys made in China that were found painted with lead paint. The good news is that in the United States we have lots of scientists evaluating everything we eat or use in our homes and schools. These scientists work around the clock to make sure that the products we use and the food we eat is safe for us – this is FOOD SCIENCE at work in our communities.

Here are the activities we'll do as we investigate FOOD SCIENCE:

MOLD
- You will grow mold under controlled conditions
- You will determine how mold grows the best
- You will see what mold looks like

YEAST
- You will use yeast to observe how it eats.
- You will watch the yeast eat and produce gas.

The experiment kit contains:
- One Ziploc bag
- Three paper bags
- Q-tips
- One log book-for taking notes
- One yeast packet
- One balloon
- One rubber band
- $\frac{1}{4}$ Cup sugar (in a labeled baggie)

****You will also need one empty plastic water or soda bottle, this is not in your kit****
You will also need the magnifying glass from your basic kit.

We know what you're thinking. You're thinking "how will I watch yeast eat?" "If I grow mold, is it harmful to me?" The answer it, no you'll be just fine, and you won't believe how much fun you will have watching science at work.

WHAT IS MOLD?

The fuzzy, kind of dark stuff growing on bread is mold. There are thousands of different kinds of molds. The mold that grows on bread looks like white fuzz at first. If you watch the mold for a few more days, it will turn black. Mold is a tiny living organism…yes, it's alive just like a plant is alive or an animal is alive. It grows. It eats. It converts whatever it eats into energy to live …. just like you!

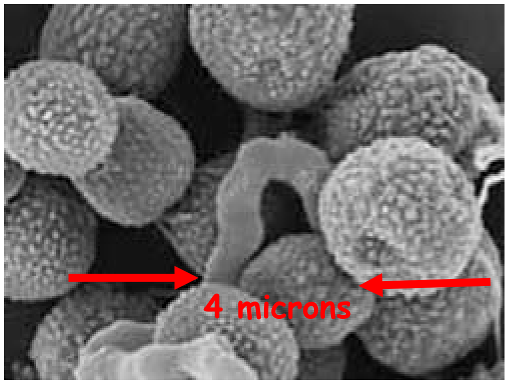
Mold is one type of FUNGUS. Mushrooms are another kind of fungus, and we love the taste of mushrooms on pizza and salad. Some fungi we eat and love; other fungi are allergens. An allergen is word we use to describe anything that may cause an allergic reaction to someone who comes in contact with it. For instance, you may have heard of kids who are allergic to peanuts. But, not all kids are allergic. So, an allergen (or allergic reaction) is very specific to the person.

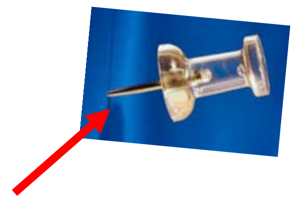
Unlike plants, molds don't grow from seeds. They grow from tiny spores that float through the air. When "floating spores" fall onto a food that is slightly wet or moist, mold will grow. The tiny black spots that appear on the bread after awhile are in turn the mold's spores, which are again released into the air.
Green living plants are green because they contain a special chemical compound called chlorophyll. This chemical is "the blood of the plant." It makes it possible for the green plant to convert sunlight, oxygen in the air, and water to food – sugars and starches.

Unlike green living plants, molds do not have chlorophyll and cannot convert sun, air, and water into digested sugars and starches. So how does mold feed itself? What does it eat to survive? Mold eats bread! As the mold eats the bread, the bread starts to rot. As the bread rots, mold grows and grows. By the way, this decomposing process (rotting) is actually a benefit to nature----for example when we throw away our left-over food; it enriches the soil in which it is placed. This is the concept of a composting in your garden.

How small is small?

A MOLD spore is very, very small! The distance across a single spore is about 4 microns. This is so small that 250,000 spores could fit on the tiny point of a push pin (like below)! Imagine all of the people in Knoxville living on one spot the size of the pin!!





250,000 spores could live here, at the top of the pin.

To get an idea of how small spores are, take your sharpened pencil and make one dot in the middle of the circle below:

This one dot is about 250,000 times larger than a mold spore!!!

Now, pretend like your pencil tip is the size of a mold spore, and see how many dots you can place in the circle below.

If you put 100 dots in the circle, this would be like 100 spores living on the end of one single strand of hair!!

MOLD spores are very small and can only be seen under a microscope.

Once spores deposit on bread that is kept in a damp (wet), dark place, mold will start to grow. After awhile, you can see the mold with your own eye. If you use a magnifying glass, you'll see even more interesting features

Mold Factory

What you need:

- bread (4 slices)
- water
- Plastic bag (1)
- Paper bags (3)
- Q-tips
- 1 to 2 weeks of experiment time
- Notebook to record results
- Magnifying glass-from your Forensics Kit

Parents: Please read through these instructions first. There are a total of eight variations to this experiment. For younger children, we suggest that you choose fewer variations to make this less complicated. This experiment uses a scientific notebook, so encourage them to write or draw in it everyday!

What you do:

BREAD SLICE 1 – Wrap/No Wrap: Take a piece of bread and slice it in half (it can be a few days old, but make sure it isn't too stale---hard and crusty). Using your Q-tips, swipe a window sill to collect any spores then wipe the Q-tip onto each half. Seal one half in the zip-lock bag and expose the other half to air. Leave both halves out on the table or counter.

BREAD SLICE 2 – Dark/Sunlight: Take another piece of bread and slice it in half. Using your Q-tips, swipe a window sill to collect any spores then wipe the Q-tip onto each half. Leave one half in the dark by placing it in a paper bag and the other half in strong light (sunlight works the best!).

BREAD SLICE 3 – Dry/Wet: Take a third piece of bread and slice it in half. Using your Q-tips, swipe a window sill to collect any spores then wipe the Q-tip onto each half. Keep one half very dry and put about 1 tablespoon of water on the other half. (Each day, take the wet piece of bread and add a little water to it. This can be done using a common spray bottle or use your fingers to sprinkle the water.)

BREAD SLICE 4 – Warm/Cold: Take a fourth piece of bread and put half of it someplace warm, in the dark (on top of the fridge in a paper bag) and the other half someplace cold in the dark (in the refrigerator in a paper bag).

Examine the samples each day with your eye and magnifying glass and record any changes in appearance. Record your observations and drawings in your notebook using the lined side for notes and the blank side for a picture. It may take up to 14 days to really see the mold grow. Using your notes, fill out the following summary sheets, so you can see over time how what happened and answer the following questions.

1. What experimental conditions created the best environment for mold to eat and grow?

2. What experimental conditions created the worst environment for mold to eat and grow?

3. What did mold look like under a magnifying glass?

4. Does mold change colors as it grows? Describe how the mold changed over time?

5. Is mold gross?

How Does Mold Grow? SUMMARY – SLICE 1

WRAPPED in Ziploc	IN AIR – (not in Ziploc)
Day1	
Day2	
Day3	
Day4	
Day5	
Day6	
Day7	
Day8	
Day9	
Day10	
Day11	
Day12	
Day13	
Day14	

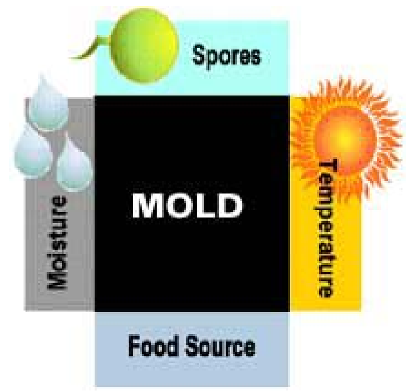
How Does Mold Grow? SUMMARY – SLICE 2	
IN DARK	IN SUNLIGHT
Day1	
Day2	
Day3	
Day4	
Day5	
Day6	
Day7	
Day8	
Day9	
Day10	
Day11	
Day12	
Day13	
Day14	

How Does Mold Grow? SUMMARY – SLICE 3	
DRY	WET
Day1	
Day2	
Day3	
Day4	
Day5	
Day6	
Day7	
Day8	
Day9	
Day10	
Day11	
Day12	
Day13	
Day14	

How Does Mold Grow? SUMMARY – SLICE 4

WARM	COLD
Day1	
Day2	
Day3	
Day4	
Day5	
Day6	
Day7	
Day8	
Day9	
Day10	
Day11	
Day12	
Day13	
Day14	

Here is what you should have observed:
Molds will develop on some of the samples.



Molds grow best in warm, dark and moist conditions.

In the first slice, the sealed bread should develop mold more slowly than the unsealed bread.

In the second slice, the bread kept in darkness should develop mold more quickly than the bread kept in light.

In the third slice, the moist bread will develop mold more quickly than the dry.

In the fourth slice, the mold in the warm place should develop mold more quickly than the bread in the cold place.

Mold loves dark, wet, warm places!

Keep your bread in a dry, cool place first. If you keep it in a sunlit area, mold will first appear between slices, where it is dark. That's why when you open up a stale loaf of bread and thumb through the slices, mold "may" be present between slices and not on the outer crust.

What other foods will grow mold?

- Cheese, oranges, tomatoes, lemons, onions, used coffee grounds, potatoes

What are common ways to preserve our food?

- Refrigerators, artificial preservatives, natural preservatives (like vinegar and salt), Air tight containers (Tupperware, Rubbermaid, etc)
- Many foods are now treated with **x-rays** to keep it from spoiling, or getting moldy.

What happens if I eat mold on my bread or cheese?

- If you happen to eat a bit of mold, don't worry, you'll be fine. Most everyone is bound to eat a small amount of mold throughout the year.
- Some cheese is specifically grown to be moldy – a certain kind of "good" mold. It is called BLUE CHEESE. You will commonly see it on salads.
- Most allergenic reactions with mold occur, not through your stomach, but through breathing. (Breathing and not eating).

YEAST

YEAST is another type of FUNGUS, a little different from MOLD.

YEAST has been used in baking and the fermenting of beverages for thousands of years. It is also extremely important in the study of biology. Most yeast is "good" for humans. There are a few however that can cause infection in humans. Some new research on yeast has shown that they can generate electricity in specific biofuels.

Yeast does not need sunlight to grow (similar to mold). What yeast eats is sugar. It converts the sugar into energy it needs to survive and at the same time produces carbon dioxide (CO_2). Humans also produce CO_2! With each breath we breathe, we inhale oxygen. The oxygen is absorbed into the body so that we live. And we exhale carbon dioxide.

We'll have fun with YEAST! How? Well, it turns out that yeast is very efficient at eating sugar and producing CO_2 gas! Yes, gas! If you have ever been able to watch your mom or dad make bread from sugar and flour, you may have noticed that they add yeast. The yeast will eat the sugar, produce CO_2 gas. The gas causes the bread to magically rise before it is placed in the oven.

Magic Balloon

In this experiment you will "watch" CO_2 gas generated by the yeast eating the sugar. Yeast is used in baking as a leavening agent, where it converts the sugars present in the dough into carbon dioxide (CO_2). This causes the dough to expand or rise as the carbon dioxide forms pockets or bubbles. When the dough is baked it "sets" and the pockets remain, giving the baked product a soft and spongy texture.

What you need:

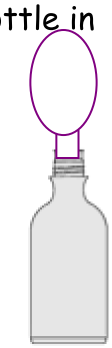
- One balloon
- One packet of yeast
- 1/4 cup sugar
- 1 cup very warm water, (plus extra for filling a mixing bowl)
- Mixing bowl or pot
- 1 plastic bottle
- 1 rubber band

What you do:
Stretch the balloon by blowing it up several times and letting the air out.

Pour the yeast into the plastic bottle. With your parent's help, pour the very warm water into the bottom. Take a moment and watch what happens. Do you see any bubbles? This is the yeast giving off CO_2.

Now add the sugar to the plastic bottle. Put the balloon over the top of the plastic bottle and secure it to the neck of the bottle with the rubber band.

Fill a mixing bowl or pot halfway with warm water and place the plastic bottle in the pot or bowl.



Watch what happens.

Use your notebook and record what you see in the first 15 minutes. Wait a couple of hours and check your balloon. Write down in your notebook what it looks like.

Interested in learning more about FOOD SCIENCE?

Credit where credit is due….

The experiments, discussions, and pictures in this handout were taken or adapted from the following websites and books:

http://www.kidzone.ws/science/mold.htm

http://en.wikipedia.org/

http://www.aiha.org/Content/AccessInfo/consumer/factsaboutmold.htm

Questionnaire

Were the materials provided appropriate? Yes _____ No _____
Please

explain.____

1. Did you have enough materials for each experiment? Yes_____ No_____

Please

explain.____

2. Did the experiments work? Yes_____ No_____

If not, please

explain____

3. Please provide any suggestions for improvements or additional

experiments/explanations.____________________________________

____

____

Crime Solvers: Forensic Science 

When there are crimes to be solved, the police use science to help them look at the clues. This is called **forensic science**. Forensic science actually involves many areas of science, such as anatomy, biology, and chemistry.

Many different kinds of scientists help the police as they gather and analyze the evidence from crime scenes. In this unit, we will look at just a few techniques scientists use. We will learn about crime scene investigation with four hands-on activities.

Here are the activities we'll do as we investigate forensic science:

- Crime scene investigation- collecting evidence
- Dactylography - the art of fingerprints
- What is that stuff?? Perform chemical experiments to identify unknown substances
- Determine the height of a person using their footprint

The experiment kit contains:

- Four test tubes with different white powders, with **red**, **green**, **blue**, and **yellow** tops
- One test tube with a black top, filled with red litmus paper strips (~8 strips)
- Two plastic pipettes
- One magnifying glass
- One inkless fingerprint kit in an envelope

****You will also need white vinegar, this is not in your kit****
You will also need the colored pencils , string, scissors, and ruler from your basic kit.

IMPORTANT NOTES TO PARENTS:

This kit contains a DNA and fingerprint kit provided by the FBI office in Knoxville, Tennessee. While the kit is to enable your science club member to examine their own fingerprints, we hope that you will also find the kit helpful in recording this information about your child should you ever need it in the future.

Also, you might find the "crime scene investigation" experiment a lot more fun if you "stage" a crime scene for your member! This is also true of "what is that stuff?" Read through the experiments (look for the red print!) first to see what you would need to set up.

Study a Crime Scene of Your Own

When a crime has been committed, the police look carefully at where it happened to gather clues, or **evidence**. Even the smallest little pieces of dirt and hair can be important clues and can be the key to solving a crime. So what do the police look for? Fingerprints, hair, dirt, footprints, things that may be out of place, like things that may not belong. Let's take a look and see how many clues you can identify in your own "crime scene."

Choose a room in your house or part of a room, or maybe the garage or outside, and go over it carefully, looking for ***evidence*** such as hair, footprints, clothing fibers, and chips of paint. You can even collect these with a pair of tweezers and place them in envelopes or Ziplock bags to identify later. Are there any prints or scuff marks on the floor from shoes? Are there any bits of soil or rock that might have been tracked in? Record all your clues and make a sketch on an investigation sheet using the next page.

HINT TO PARENTS:

It may be helpful to set up your crime scene for your child so they will be sure to find some clues. For a footprint that won't mess up a clean house, try using a paper cut out instead. To help them see where fingerprints could be found, you might use some paper dots or sticky notes. Try including a few out of place things that they normally do not see in the room, like oven mitts in the bathroom.

What you need:

- Colored pencils and a pencil from your basic kit
- A magnifying glass
- Ruler from your basic kit

What to do:

1. Pick out a room in your home as your crime scene.
2. Draw a map of your room on the "Crime scene map." It does not need to be very detailed!
3. On your map, put a red **X** on places where you think someone may have touched with their hands.
4. Slowly walk through the room. On your map, mark all the places you can walk in the room with green **O**'s.
5. Now look around the room again. Do you see anywhere to sit? Mark these places on your map with a blue **S**.

Crime scene map

Key: X = places touched; O = places walked; S = places to sit

Now….Analyze your crime scene-

What area did you choose?

____

How many red Xs are on your map? Did you get all the places someone may have touched?

____

Look closely at where you marked the Os on your map. Do you see any traces of dirt or footprints? Use your magnifying glass the help you!

____

Did you find a footprint? If you do, use your ruler from your basic kit to measure how long it is from toe to heel. Write down how long the footprint is.

____

Look closely at the areas where you marked Ss on your map. Can you find any hairs? Can you find any hairs anywhere in the area? Use your magnifying glass to help you.

Try to collect at least two hairs at your crime scene.

Is it long? ________________________________

What color is it? ________________________________

Is it curly or straight? ________________________________

Make a list of the people who could have gotten into the room. Be sure to include any pets!

____

____

____

____

When the police find evidence, they try and match it to people who have been at the crime scene. If you found any evidence, such as hair or footprints, try and match the evidence to the person.

Compare any hair you found to the people on your list. Who do you think the hair belonged to?

____

Compare any footprints you found to the people on your list. Who do you think the footprint belonged to? You may have to measure the foot of the people on your list!

____

Did you find anything unusual in your room? What was it?

____

Dactylography: The Art of Fingerprints

Look closely at the tip of your finger. Do you see lots of little lines? These lines make something called a **pattern**. Now, put your fingertips on a clear glass, mirror or window. Do you see a pattern left behind when you take your finger away? This is called a **fingerprint**.

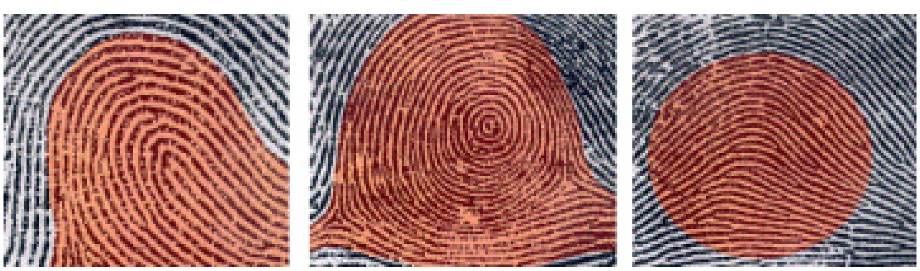
We have all seen fingerprints, on windows, drinking glasses, and shiny surfaces. Fingerprints are made when the oil and dirt on your hand gets on the lines of your hand, and when you touch something, the oil and dirt is left behind on what you touched. Have you ever played with an ink stamp or marker stamp? Fingerprints are just like that. The ink on the lines of the stamp's picture is left on the paper (or whatever you decide to stamp) when you press the stamp down.

Fingerprints are **unique**! Unique means that no two fingerprints are alike. Each of us has unique patterns on our fingers. Fingerprints do not change with age, but what you do with your hands can change your fingerprint. Sometimes if you get a sore or get sick, this can change your fingerprint too. Have you ever played on the monkey bars at school? Did you get sores on your hands? Or have you ever gotten a bad cut on a finger? These can leave scars that will change your fingerprints.

No two prints have ever been found that were exactly alike-even fingerprints of identical twins are different!

Fingerprints can help us with hints as to a person's size, if the person is a boy or girl, and what the person may do with their hands. A taller person might leave higher prints on a wall and a construction worker's prints may be show calluses' and so on. The palms of your hands and your bare feet also have ridges, just like your fingertips.

Experts divide these patterns into three basic types:



Loops (left), Whorls (middle), and Arches (right).

So let's look at your fingerprints!

What you need:
One inkless fingerprint kit
Magnifying glass

What to do:

1. Your inkless fingerprint kit has some different things in it. One of these is a special piece of paper with places to record your fingerprints. It also has a small pack with an inkless fingerprint towel in it.
2. **Have the grown-up helping you carefully read the directions on the fingerprint kit.**
3. You will see places to put prints of all your fingers.

NOTE: the inkless fingerprint kit does not work on regular paper- it is meant to show only on the special paper provide with the kit. HOWEVER….this does not mean the ink won't show up where it should not, on say, a white couch. **Each kit has a small box for you to try out fingerprinting before you make your record!**

4. With the help of a grown-up, complete your fingerprint record. You may also want to add fingerprints from your grown-up and any brothers or sisters, so you can look at them too. If you do, you will want to label everyone's fingerprints.

NOTE: You can also use the edges of the paper for extra prints- the entire sheet is special paper, not just the blocks for the prints.

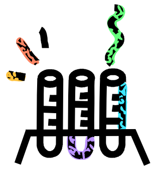
5. When you have your fingerprints done, use you magnifying glass to look at the patterns of your fingerprints.
6. Using the pictures from this experiment, try to identify what type of fingerprint you have. Write it here:

____

Did you get fingerprints from anyone else in you family? _____________

Do they look exactly like yours? ____________________________

What kind of print do they have? ___________________________



What is that stuff??

Sometimes the police find things at a crime scene, and they aren't sure what it is. When they find this sort of clue, they take it to a scientist in a laboratory who can perform tests on it. Some of these are very simple- does it smell? What color is it? What does it look like? Some of tests use chemicals to try and find out what the clue is. A scientist will add different chemicals to the clue to see how it reacts, or what happens. Let's try a few of these tests to see how different clues will react.

What you need:

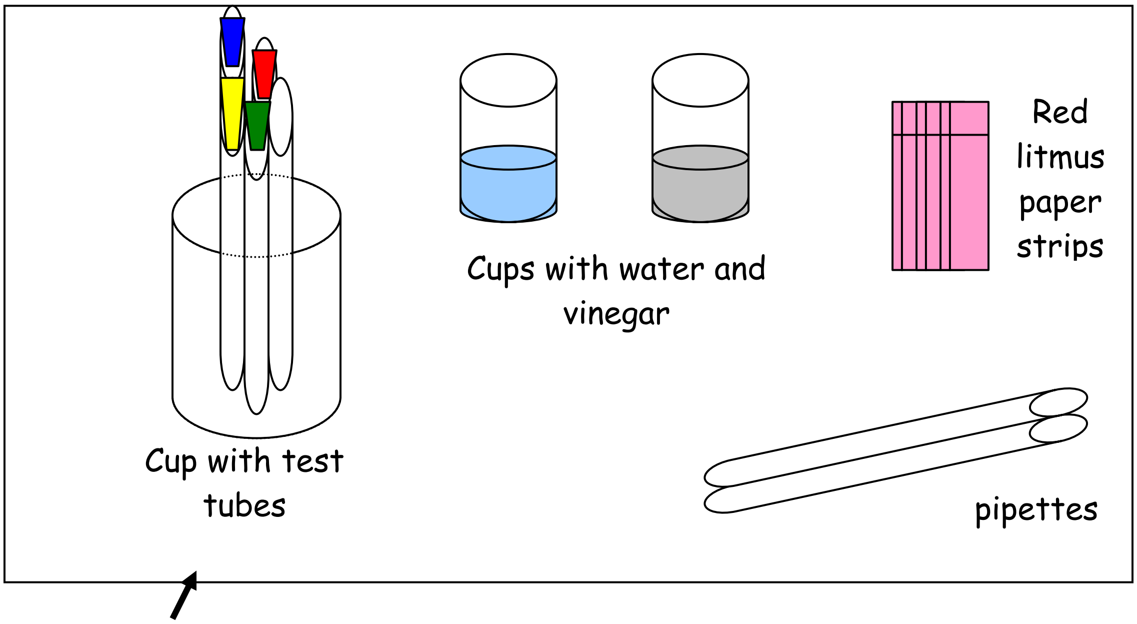
- Four test tubes with different white powders, with **red**, **green**, **blue**, and **yellow** tops
- One test tube with a black top, filled with red litmus paper strips (~8 strips)
- Two plastic pipettes
- Some paper towels, newspapers, or a kitchen towel to put on the kitchen table (so you don't make a mess!)
- A glass you can put to test tubes in to hold them up. A coffee cup will work.
- A glass of water
- A little glass or dish of white vinegar (you really don't need much!)
- A pencil to record your results
- A small piece of paper to hold powder

What to do:

- Each tube with a colored top has a different white powder in it. This is what they are:
  - **Blue**: Epsom salt, or magnesium sulfate.
  - **Red**: Baking soda, or sodium bicarbonate
  - **Yellow**: This is calcium carbonate, or regular crushed white chalk
  - **Green**: sodium carbonate or washing soda
- You also have a tube with a black top, with strips of pink paper (called red litmus paper) in it. Open this tube and remove the litmus paper, and set the papers to the side. Make sure to put them in a place where they will not get wet when you do your other experiments! **This clear, empty test tube with the round bottom is what you will use to perform your experiments.**

- Set up your experiment station on your kitchen table (or some place else you can make a mess) like the picture.

Set up your experiments something like



Paper or
kitchen towel

NOTE!!

If you would like to challenge your science club member, remove a small amount of powder from each tube, label them, and set them aside. You can give one or two of these back to the experimenter ***after*** they have completed their results table so they will have unknown powders to identify.

We have included a blank results table for your member to analyze their mystery sample, and to test any other white powders (like sugar, salt, or flour) you may have in the kitchen.

Here is what you will do for each white powder sample. You will repeat these instructions for each white powder:

- Choose one of the tubes with white powder. Put half of the powder in the **clear** test tube. Save the rest of your powder in its original tube, you will use this later.
- Look at you powder and try to describe it. Does it have really small pieces? Does it have chunks? Is it all white? Record your answer in the results table.
- Using one of the pipettes, add some water to the powder in the test tube, until it is about half full. Put the black top on, and shake it gently. Does the powder dissolve in water? **Dissolve** means you cannot see the powder floating in the water anymore or on the bottom of the test tube. Keep this mixture for the next test!
- Now take one strip of the red litmus paper and dip it into the mixture in the test tube. You may need to tip the tube a little (be careful not to spill!) to get the paper to touch the mixture. Does it change color? Record the result in the table.
- Empty and rinse the test tube.
- Put the rest of the saved powder in the clear tube. Using your clean pipette, add some white vinegar to the test tube. What happens? Does it fizz? Record your results in the table. **Set the pipette you used for the white vinegar to the side, so that you do not use it for the water experiments!**
- When you are done with all four powders, if your grown-up helper has saved some powder for you, repeat these tests to find out which powder they saved for you. Ask for some other white powders (like sugar, table salt, or flour) that you may have in the kitchen to see how they react to these chemical tests!

What is that stuff??
Results Table

Powder	Does it dissolve in water?	Does it make the litmus paper change color?	Does it fizz when you add water?	Does it fizz when you add vinegar?
Washing Soda: Sodium carbonate				
What does washing soda look like?				
Baking Soda: Sodium bicarbonate				
What does baking soda look like?				
Chalk: Calcium carbonate				
What does chalk look like?				
Epsom salt: magnesium sulfate				
What does Epsom salt look like?				

What is that stuff?? Extra Results Table				
Powder	Does it dissolve in water?	Does it make the litmus paper change color?	Does it fizz when you add water?	Does it fizz when you add vinegar?
Name:				
What does the powder look like?				
Name:				
What does the powder look like?				
Name:				
What does the powder look like?				
Name:				
What does the powder look like?				

Determine the height of a person …using their footprints!

The police find footprints at crime scenes all the time. A footprint is the mark your foot or shoe makes on the ground when you walk. We leave footprints when we walk. Sometimes they are easy to see, sometimes difficult. For example, they are easy to see of you walk with muddy shoes on a clean floor. They are hard to see if you walk with bare feet across a carpet!

The police can use a person's footprints to guess how tall the person who made them is. They can do this because the size of a person's foot is proportional to (or related to) how tall the person is. If a person is very tall, they will have larger feet, so they can balance themselves and stand up straight. If a person is shorter, they will have smaller feet, because they can balance themselves with shorter feet.

Try this: stand up straight on your flat feet. Pretty easy, right? Now try to stand up straight while you stand on your tippy toes. Hard isn't it? This is the same thing! When your feet are flat on the ground, you can use your whole feet to balance yourself. When you stand on your toes, you don't have as much foot to balance with!

Because people are usually wearing shoes, and the footprints we leave behind are never perfect, the guess that the police make is never exact, but it can be pretty close!

NOTE TO PARENTS: This experiment works better on an adult, whose foot is fully grown. You will need to help your child with the math in this section!!

What you need:

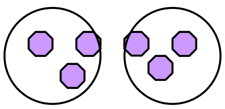
- A blank sheet of paper
- The ruler, pencil, string, and scissors from your basic kit

What to do:

1. First, write the name of the person in the results table. Is this person a grown-up or a kid? Mark your answer in the table.
2. Now, have the person helping you stand on the piece of paper with bare feet. One bare foot will do. Make sure the entire foot is on the paper.
3. Mark on the piece of paper where your helper's toes are with a pencil. Then mark where their heel is.
4. Use your ruler to measure, in inches, how long your helper's foot is. Record this answer on the results table.
5. Now, using the string from your basic kit, measure how tall your helper is. Do this by having the helper hold the string even with the top of their head, while you pull the string down all the way to the bottom of their feet. Cut the string so that it is as tall as your helper.
6. Measure the length of the cut string, in inches using your ruler. This is easiest if you lay the string out in a straight line on the floor. Record this answer on your results table.
7. Now you can estimate the height of your "suspect" (your helper) using the length of their foot. You can get your grown up helper to help you do the math.
    a. First you need to MULTIPLY the length of the person's foot by 100. For example, if your person's foot is 12 inches tall, when you multiply by 100, you are saying you are taking the number 100 12 times, or that you have 12 groups of 100: $12 \times 100 = 1200$.

    A simpler example of multiplication (or times) is shown below:

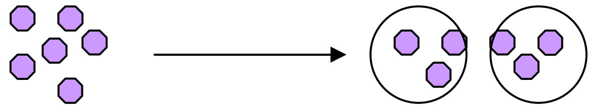
    $2 \times 3 =$ 2 groups of 3=

    How many colored balls are there? ______________________________

    You should count 6 colored balls.

    b. Now, you need to take your answer from part a and DIVIDE it by 15. Division is just the opposite of multiplication. So looking at the simple example of 2×3 above, if you divide the answer (6) by 2, you will get 3. This is saying that if you divide the group of 6 balls into 2 smaller EQUAL groups, you will have 3 balls in each new group.

Your answer from part b is an estimate of your helper's height in inches. Compare your result with the height you measured with your string. How close did you get?

8. Now, repeat steps 1-7 using your footprint and height.
9. Look at the difference between the heights you measured with the string, and what you guess from the footprints. Did you get pretty close? Was your guess closer for the adult or the child?

Determine the Height of a Person Results Table					
Person's name	Is the person a grown-up or a kid?	How long is the person's foot in inches?	Multiply by 100	Divide by 15- this is your guess of how tall the person is in inches	How tall is the person, using the string to measure, in inches?

Interested in learning more about forensic science?

Credit where credit is due….

The experiments, discussions, and pictures in this handout were taken or adapted from the following websites and books:

1. Study a crime scene was adapted from: http://www.hometrainingtools.com/articles/forensic-science-projects.html
2. The fingerprint pictures were taken from: http://www.sciencenewsforkids.org/articles/20060503/Feature1.asp
3. The "What is that stuff??" and "Determining the height of a suspect" experiments were adapted from The Think Box "Learn about Forensic Science" activity kit. The kit has more detail and activities related to forensic science.

Special thanks to the following organizations:

The FBI in Knoxville, TN

for donating the fingerprint kits!!!!

And to the

- American Nuclear Society Oak Ridge/Knoxville Local Section
- American Nuclear Society National NEED Committee
- University of Tennessee Physics Department
- Oak Ridge Associated Universities Volunteers in Education Committee

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- Women in Nuclear, Oak Ridge Chapter
- Oak Ridge National Laboratory
- BWXT-Y-12
- American Nuclear Society, University of Tennessee student section
- Society of Women Engineers, University of Tennessee student section
- Parent volunteers at our participating schools

For assembling all the science kits, performing science experiments at schools, and delivering kits to kids at schools participating in Science Club. You guys are terrific!!

Questionnaire

Were the materials provided appropriate? Yes _____ No _____
Please

explain.____

1. Did you have enough materials for each experiment? Yes_____ No_____

Please

explain.____

2. Did the experiments work? Yes_____ No_____

If not, please

explain____

3. Please provide any suggestions for improvements or additional

experiments/explanations.____________________________________

____

____

Geology

There was a time when our solar system had nine planets and a sun. All the planets move around the Sun, which is at the center of the solar system. The planets are Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, Neptune, and finally **Pluto**. Pluto has an interesting story and unfortunately the ending is our solar system only has eight planets, not nine based on the following:

> *"Is Pluto a planet? Does it qualify? For an object to be a planet, it needs to meet these three requirements defined by the IAU:*
> 1. *It needs to be in orbit around the Sun - Yes, so maybe Pluto is a planet.*
> 2. *It needs to have enough gravity to pull itself into a spherical shape - Pluto…check*
> 3. *It needs to have "cleared the neighborhood" of its orbit - **Uh oh. Here's the rule breaker. According to this, Pluto is not a planet."***
>
> *Why Pluto is No Longer a Planet Written by Fraser Cain*

Earth is the planet that we live on. It is part of our solar system. It has a moon that moves around it, just like the Earth moves around the Sun. You see parts of our solar system every day- the moon and the Sun. Scientists study our planet to learn more about how it was made and about the other planets in the solar system.

Scientists study how rocks form and change to learn about our planet Earth. Scientists study our planet Earth to help them learn about other planets in our solar system. Rocks are one of the things scientists study. Rocks are always changing. Wind and water wear rocks down and turn them into smaller rocks and dirt. These small rocks and dirt get washed away by the water and into lakes and oceans. Then the dirt and rocks settle at the bottom of a lake or ocean and harden into rock again.

A geologist is a scientist that studies rocks. Geologists classify rocks in three groups, according to the major Earth processes that formed them. The three rock groups are:

- Igneous,
- Sedimentary, and
- Metamorphic.

To learn about our planet Earth, we will start a rock collection and learn about the three types of rocks.

Here are the activities we'll do as we investigate our Earth and solar system:	**The experiment kit contains:**
Start a rock collection and learn about the three basic types of rock	A DVD called The Sun and Space Weather from NASA
Learn about the Solar Eclipse	Three rock samples- a fossil limestone rock, a white marble rock, and a gray granite
Learn about the Mars rovers	Two small round rocks (geodes).

Igneous Rocks

Believe it or not, you can make a rock melt just like a piece of chocolate left in the sun. Igneous rocks are made from rock that has been melted, cooled, and solidified (gotten hard). When rocks are buried deep underground (REALLY deep), they melt. This is because it is **very hot** far underground.

Igneous rocks come from volcanic eruptions. They can form from either magma, that has cooled and hardened beneath the earth's surface, or from lava that cooled and hardened once it oozed or exploded (volcano) on the earth's surface or into the ocean. Igneous rocks will have a texture determined by the speed with which the melted rock cooled. If it cooled quickly, the igneous rock will be smooth. If it cooled slowly, the igneous rock will be coarse. There are hundreds of named igneous rocks. Granite is a light colored igneous rock. Basalt, Earth's most common rock is dark in color.

Look for the rock labeled "grey granite" in your science kit. If it is not labeled, find the rock with the most colors of black, white and gray and that is it. This is an example of an igneous rock. It is from a state where there are lots of mountains, named Colorado.

What you'll need:

1. The map of the United States at the end of your handout.
2. The "grey granite" sample from your science kit.
3. Your ruler and colored pencils.

What to do:

Find the state of Colorado on the map of the United States. Write a number 1 on the state, and make a circle around it, like this: 1

Wash and dry your rock with regular water. Now, look at your rock, and answer the questions listed below. These are the same basic question geologists ask themselves when they study a new rock.

Neat words to remember

Igneous rocks
Solidified
Molten
Magma
Lava
Volcano

Rock Sample #1: Grey Granite

1. Trace the outline of your rock here, and next to it or over it, trace your hand:
How big is your rock? Use your ruler to measure your rock. Draw a line on the picture below to show where you measured.

My rock **my hand**

2. Where is the rock from?

____

3. What kind of rock is it?

____

4. What color is the rock? Use your colored pencils to color in the outline you made.

____

5. Look closely at the rock. Do you see crystals? Does it all look the same, or do you see different things in the rock?

____

6. How hard is your rock? Go outside to your front step. Hit the rock on the front step (get permission first).
Did the rock break? ______________________________

Did it leave a mark on the step? ______________________________

Sedimentary Rocks

Sedimentary rocks are formed at the surface of the Earth, either in water or land. They are made from layers of sediment –little bits of rocks, minerals, and animal or plant material that settle down to the bottom of a lake, stream, river, or ocean. If you were to scoop up a glass of water from a puddle, stream or ocean you could watch the sediment in the water slowly sink to the bottom of the glass. Sedimentary rocks take many years to form. As layers settle on top of layer, the bottom layers are compressed. Eventually, they are compacted into rock. They are often recognizable by distinctive stripes or spots. When an animal or plant material becomes part of the rock, they become fossils.

Sedimentary rocks are forming around us all the time. Sand and gravel on beaches or in river bars look like the sandstone they will become. Dry mud hardens into a type of rock called shale.

The small gray rock with some irregular shaped marks on it is the fossil limestone. Fossil limestone rocks can be found many places in the United States and are common in Middle Tennessee, around Nashville and the surrounding area.

The two small round gray rocks in your kit are called geodes. Geodes can be sedimentary rock or igneous rock. Sometimes when an igneous rock is being made, it has a bubble of gas in the middle. In a sedimentary rock, sometimes a hollow space can be made from an animal burrow, tree root or mud ball. Water gets inside the rock and over time the water evaporated, leaving a hollow space in the rock that is filled with different types of crystals. It may take up to 240 million years to form a geode! Geodes can be found in Tennessee in Loretto and in Pegrum, near Nashville.

What you will need:

1. The map of the United States at the end of your handout.
2. Your ruler and colored pencils.
3. The fossil limestone from your experiment kit.
4. The two round rocks (geodes).
5. An old sock or piece of thick cloth you can throw away when you are done
6. A hammer
7. A grown-up to use the hammer!!!!

What to do:

1. Wrap one of the geodes in the old sock.

2. Ask your parents where you can break open your geode with the hammer. Get your parent to help you crack open the geode!

3. Find the state of Tennessee on the map of the United States. Write a number 2 on the state, and make a circle around it, like this: 2

4. Wash and dry your geode with regular water. Now, look at your rock, and answer the questions on the following page.

5. Find the state of Tennessee on the map of the United States. Write a number 3 on the state, and make a circle around it, like this: 3

6. Wash and dry your fossil limestone with regular water. Now, look at you rock, and answer the questions listed below. These are the same basic question geologists ask themselves when they study a new rock.

Neat words to remember

Sedimentary rocks
Sediment
Fossil

Rock Sample #2: Geode

1. Trace the outline of your rock here, and next to it or over it, trace your hand:
How big is your rock? Use your ruler to measure your rock. Draw a line on the picture below to show where you measured.

My rock **my hand**

2. What does the rock look like on the outside?

____

3. Did your rock have fossils you could identify as plant or animal?

____

4. What color is the outside? What color are the fossils?

____

5. Look closely at the rock. How does it look compared to the granite sample?

____

6. How hard is your rock? Is it harder or softer than the granite?

____

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Rock Sample #3: Fossil Limestone

1. Trace the outline of your rock here, and next to it or over it, trace your hand:
How big is your rock? Use your ruler to measure your rock. Draw a line on the picture below to show where you measured.

My rock **my hand**

2. What does the rock look like on the outside?

____

3. Did your rock have fossils you could identify as plant or animal?

____

4. What color is the outside? What color are the fossils?

____

5. Look closely at the rock. How does it look compared to the granite sample?

____

6. How hard is your rock? Is it harder or softer than the granite?

____

Geology: 8

Metamorphic Rocks

Sometimes sedimentary and igneous rocks are subjected to pressure so intense or heat so high that they are completely changes. They become metamorphic rocks, which form while deeply buried within the Earth's crust. The process of metamorphism does not melt the rocks, but instead turns them into different rocks.

A sample of white marble.
Photo taken from:
http://volcano.und.nodak.edu/vwdocs/vwlessons/lessons/Metrocks/Metrocks15.html

Marble is metamorphosed limestone or dolomite. Limestone and dolomite are types of sedimentary rocks. Marble has many different sizes of crystals. Marble comes in many colors. This is because of the different materials that the rocks can be made of. Some of the different colors of marble are white, red, black, mottled and banded, gray, pink, and green.

Marble is much harder than the rock it was made from. For example, marble is much harder than limestone. Because it is very hard, it can be cut and polished. This makes it a good material for use as a building material, making sink tops, bathtubs, and a carving stone for artists. Today, kitchen and bathroom tiles and countertops are made from marble and granite because both of these rocks weather very slowly and carve well with sharp edges.

Marble is quarried in Vermont, Tennessee, Missouri, Georgia, and Alabama.

What to do:
1. Find Vermont, Tennessee, Missouri, Georgia, and Alabama on the map.
2. Mark these states with a letter "M" to show they have metamorphic rocks.
3. Look at your sample of white marble and answer the questions on the following page. It is the one that is lighter in color and shinier than the others.

Rock Sample #3: White Marble

1. Trace the outline of your rock here, and next to it or over it, trace your hand:
How big is your rock? Use your ruler to measure your rock. Draw a line on the picture below to show where you measured.

My rock **my hand**

2. Where is the rock from?

____

3. What kind of rock is it?

____

4. What color is the rock? Use your colored pencils to color in the outline you made.

____

5. Look closely at the rock. Do you see crystals? Does it all look the same, or do you see different things in the rock?

____

6. How hard is your rock? Go outside to your front step. Hit the rock on the front step (get permission first).
Did the rock break? _______________________________

Did it leave a mark on the step? ______________________

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Rock Collecting- Keep up the good work!

A good rock collection starts with rocks that you like to look at- any color or shape. You have just started a collection with the three types of rocks in your kit. You can keep adding to your collection with rocks that you find around your home or buy at a rock shop. **Take a look at the rock collection in the school library to get some ideas.**

- It is important to label each rock and ask yourself the same questions about your rocks. How big is it?
- What does it look like?
- How hard is it?
- Where did you find it?
- What did the land where you found it look like- was there water nearby? Was it on a mountain?
- Look at your rock under the magnifying glass. Can you see any particular crystals or spots on the surface? The colors you see usually represent different types of minerals that make up the rock.
- Does the rock have any fossils in it?
- Which of the three major rock types is it?

Hints for rock collectors-

- A general book on geology will help you identify rocks that you put in your collection. It is also a good idea to get a plastic case with dividers, like a craft case or fishing lure case, with a top, to put you rocks in.
- Label your rocks as soon as you collect them so they will not get mixed up.
- Ask for **permission** to collect rocks on private property.
- **Do not** collect rocks in national parks, monuments or in State parks; it is **illegal**.
- Collect small rocks so your collection can be easily stored and transported.
- Fossils can also be an exciting part of your rock collection.

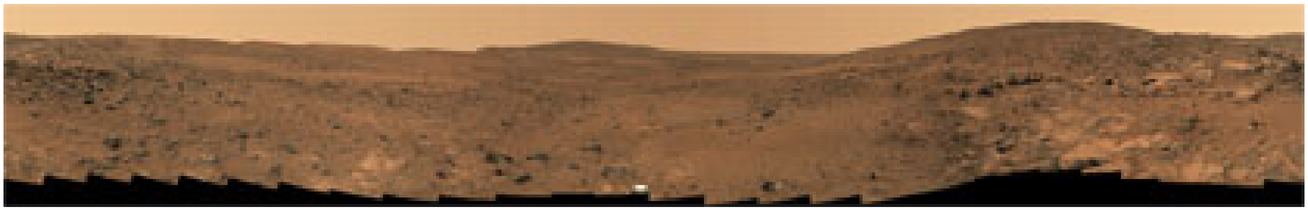
THE MARS MISSION

Mars, known as the Red Planet, is being explored by two robots sent up there by NASA. The robots are called Opportunity and Spirit. They are moving around on the planet's surface and collecting samples of rocks (just like you!). In 2004, Opportunity and Spirit landed on opposite sides of the planet and began their mission. Scientists thought they would only last three months, but it is several years later and they are still working! What a nice surprise. Scientists are looking for signs of life on Mars.

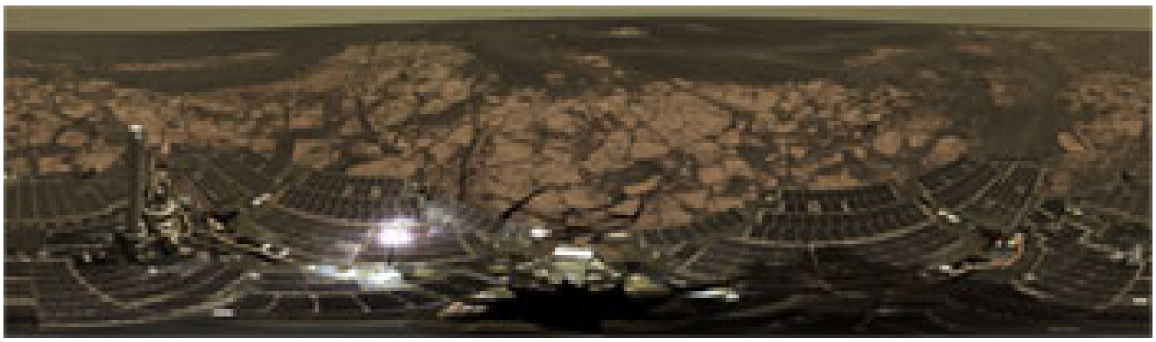
Spirit and Opportunity have been working very hard to help scientists better understand what it was like a very long time ago on Mars. The rovers are finding new kinds of rock in the areas they are exploring on opposite sides of Mars. By studying the information the robots have collected about rocks on Mars and comparing them to rocks here on Earth, scientists think there may have been water on the now dry planet.

Places on Earth that can help us understand Mars include:

- Death Valley, California, where Ubehebe crater and "Mars Hill" have geologic features similar to those on Mars
- Mono Lake, California, which is a 700,000-year-old evaporative lake that compares to Gusev Crater, a basin on Mars where water once was likely
- Channeled Scabland in Washington, where catastrophic floods swept through the land much like what happened long ago in the Ares Vallis flood plain where Mars Pathfinder landed
- Permafrost in Siberia, Alaska and Antarctica, where subsurface water-ice and small life forms exist
- Volcanoes in Hawaii, which are like those on Mars, though much smaller



In late November 2005 while descending "Husband Hill," Spirit took the most detailed panorama to date of the "Inner Basin."
Image credit: NASA/JPL/Cornell



This is the Opportunity rover's panorama of "Erebus Rim," acquired as the rover was exploring sand dunes and outcrop rocks in Meridiani Planum.
Image credit: NASA/JPL/Cornell

For information about NASA and other agency exploration programs on the Web, visit:
http://www.nasa.gov/home/

For images and information about the rovers and their discoveries on the Web, visit:
http://www.nasa.gov/mars/

Geology: 13

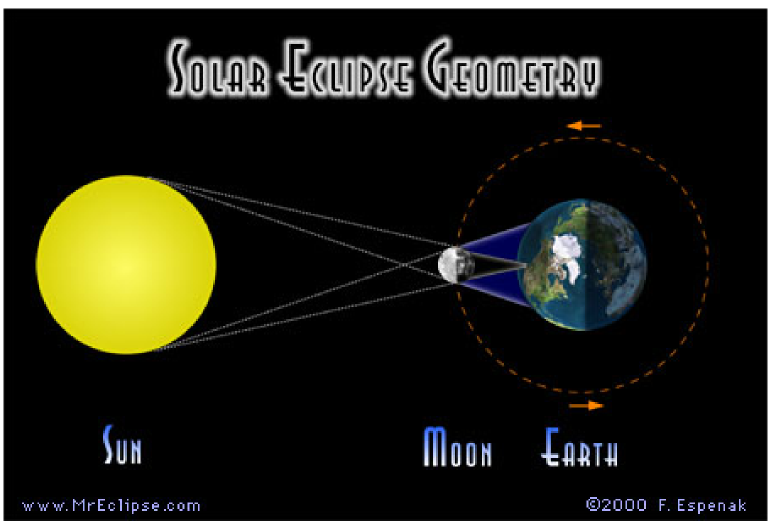
SPECIAL EVENT!

TOTAL SOLAR ECLIPSE

The Sun is the largest body in our solar system. The planets rotate around the Sun. A solar eclipse happens when the Moon passes between Earth and Sun. If the Moon's shadow happens to fall upon Earth's surface at that time, we see most of the Sun covered or 'eclipsed' by the Moon. Most of the time the Moon's shadow usually misses Earth as it passes above or below our planet at Full Moon. At least twice a year, the Moon and the Sun line up just right so that some part of the Moon's shadow falls on Earth's surface and an eclipse of the Sun is seen from that region.

On July 22, 2009, there will be a total solar eclipse. For more information see the website at:

http://eclipse.gsfe.nasa.gov/SEmono/TSE2009/TSE2009



Basic Geometry of the Sun, Moon and Earth During an Eclipse of the Sun

Eclipse figure courtesy of Fred Espenak, NASA/Goddard Space Flight Center.

For more information on solar and lunar eclipses, see Fred Espenak's Eclipse Home Page: http://eclipse.gsfc.nasa.gov/eclipse.html.

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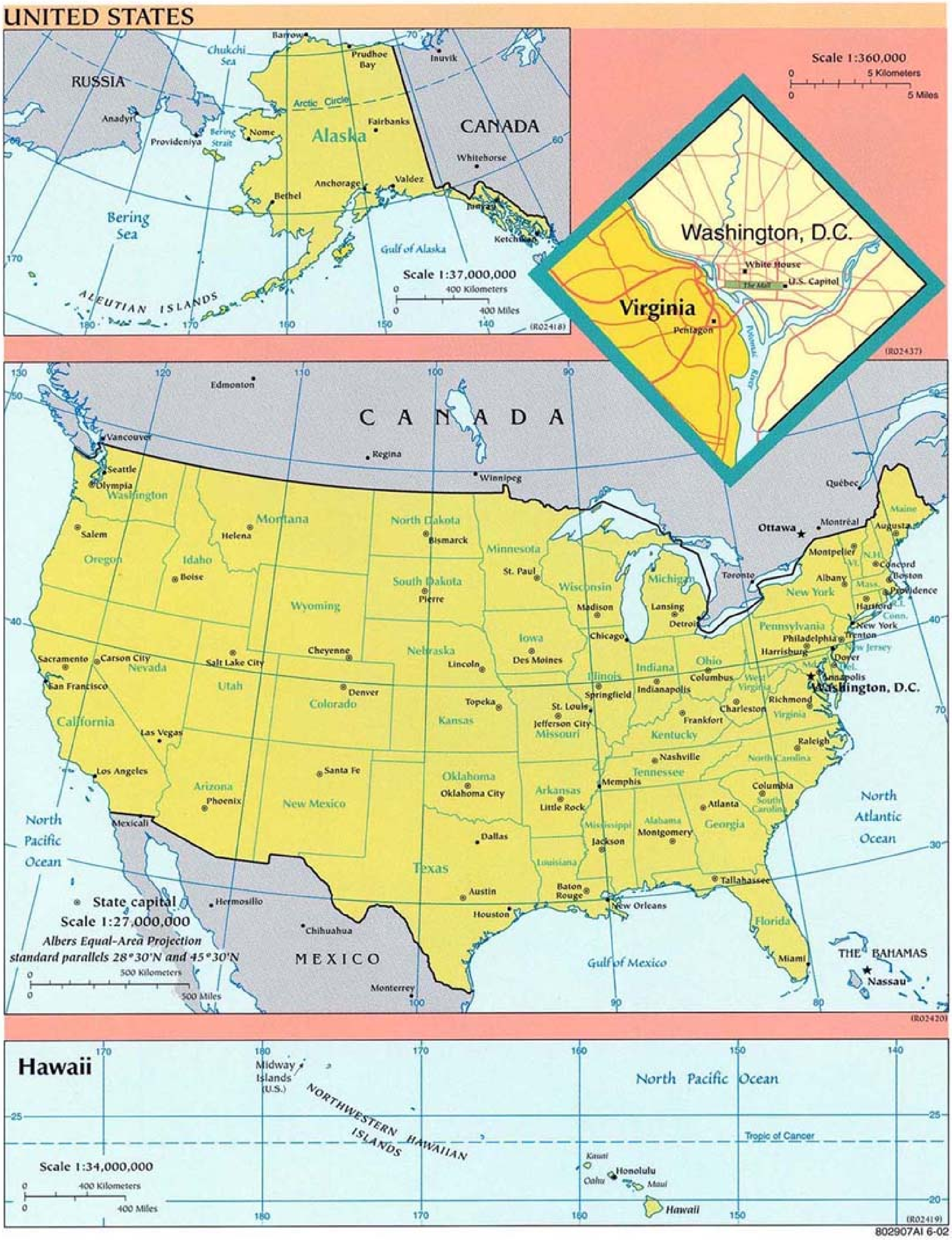

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The map of the United States of America was taken from:
http://www.lib.utexas.edu/maps/united_states/united_states_pol02.pdf

Interested in learning more about geology and the solar system?

Check out the library science section. Ask for books about rocks, the solar system, and eclipses.

Credit where credit is due….

The experiments, discussions, and pictures in this handout were taken or adapted from the following websites and books:

http://www.nasa.gov
http://pubs.usgs.gov/gip/collect1/collectgip.html
http://nasa.gov/mars
http://www.lib.utexas.edu/maps/united _states_po102.pdf
http://eclipse.gsfc.nasa.gov/eclipse.html
http://eclipse.gsfc.nasa.gov/SEmono/TSE2009/TSE2009.html
http://volcan.und/nodak.edu/vwdocs/vwlessons/lessons/Metrocks/Metrocks15.html
http://www.universetoday.com/2008/04/10/why-pluto-is-no-longer-a-planet/

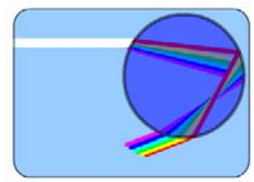
Extra Special Thanks to:

Radiation Safety Information Computational Center of Oak Ridge National Laboratory for copying the DVD's (with NASA's permission of course!)

The Nuclear Science and Technology Division of Oak Ridge National Laboratory for buying the materials

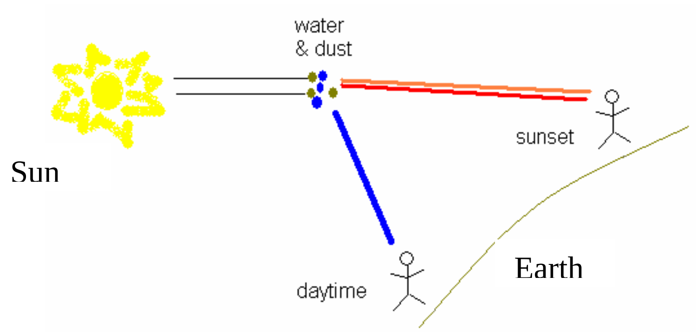
Light and Color

Light is a kind of energy that can travel through space. Light from the sun or a light bulb looks white, but it is really a mixture of many colors. The colors in white light are red, orange, yellow, green, blue and violet. You can see these colors when you look at a rainbow in the sky.



The sky is filled with air. Air is a mixture of gas, tiny drops of water, and small bits of solid stuff, like dust. As sunlight goes through the air, it bumps into the gas, water, and dust. When this happens, different colors of the light will bounce off in a different direction.

Some colors of light, like red and orange, pass almost straight through the air. Most of the blue light bounces off in all directions- it gets scattered all around the sky. When you look up, some of this blue light reaches your eyes from all over the sky. Since you see blue light from everywhere overhead, the sky looks blue. At sunset, you see the last bit of sunshine before the sun goes down- those colors of light that didn’t get bounced around as much. That’s why the sunset is red and orange – those are the colors of light you can see because of the position of the sun relative to the earth.



In outer space, there is no air. Because there is nothing for the light to bounce off, it just goes straight. None of the light gets scattered, and the "sky" looks dark and black.

Here are the activities we’ll do as we investigate light and color:

1. Bend a stick – just add water
2. Chasing rainbows - split white light into a spectrum
3. Mixing colors- blend colors back into white
4. Let the light shine in- a look at the iris
5. Chromatography- split the ink from Sharpie markers into different colors

The experiment kit contains:

1. A square of foamcore
2. A small bag with two eyelets (small metal tubes) and a piece of string
3. A compact disc (these are blank)
4. A sheet of plastic with color paddles to cut out
5. Several index cards marked with ink

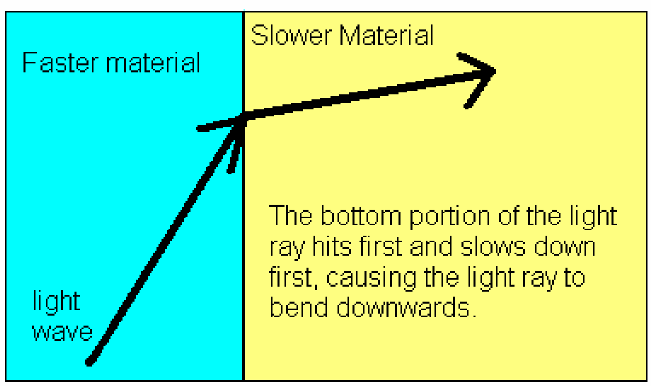
****You will also need rubbing alcohol, this is not in your kit****

Bend A Stick

What you need:
1. A plain clear glass (without etching or patterns)
2. Water
3. A marker, pencil, or similar object that is taller than the glass

What to do:
1. Put the stick into the glass, and let the top rest against the side of the glass.
2. Look at the stick from the side of the glass and from the top of the glass. What do you see?
3. Add water to the glass. The glass should be about 2/3 full.
4. Look at the stick from the side and through the top of the water. The stick should look different in both cases - from the side it looks bigger, from the top it looks like it has a bend in it near the waterline.

What is happening:
When light passes from one material to another, for example from air to water, its speed and direction change. This is called refraction. The light reflected (or bounced back) to your eye from the stick above the water is moving faster than the light reflected from the stick below the water. This makes the image of the stick appear "bent" at the waterline.



Refraction can also happen in a single material if the material has areas of different temperature. For example, in the desert, the air near the ground is hotter than the air above the ground. Light travels faster through the hotter air near the ground and it can appear that the ground is shimmering, or like there is a lake up ahead. This is called a mirage.

Neat words to remember

Reflection
Refraction
Mirage

Chasing Rainbows

Splitting Light Into the Spectrum

What you need:

1. A sheet of white paper
2. Colored pencils or crayons (yellow, orange, red, pink, violet, blue & green)
3. A compact disc (CD)
4. Water
5. Dish soap
6. A small dish for soap bubbles

What to do:

1. Look at the back of the compact disc (the side with no writing on it). You'll see different colors. Move the CD back and forth and the colors will shift and change.
2. Look at the colors you see. As you move the CD around, you will be able to find rainbows. Write down the colors you see. What order are the colors in?

   Did you know rainbows have another name? ROY G. BIV. The letters in this name are from the colors that make up the rainbow (the first letter of each color):

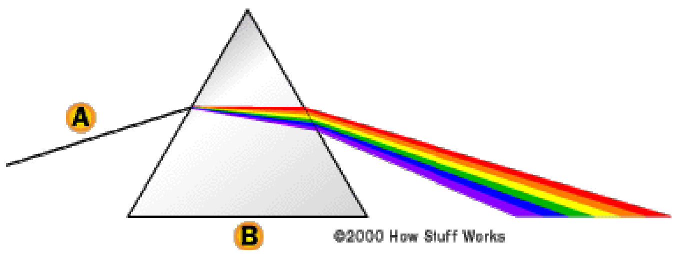
   Red Orange Yellow Green Blue Indigo Violet

   Is this what your rainbow looks like? Draw one of the rainbows you see with your colored pencils.

3. Put a small amount of water and dish soap on a small plate and mix them together. Try and make a few bubbles. (You can also try this in the bathtub). Look at the bubbles and the soapy water. Can you find little rainbows and different colors?

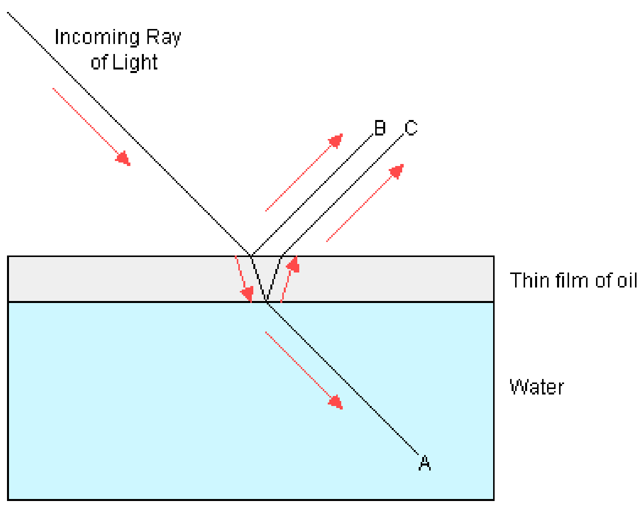
What is happening?

When light passes from one material or medium to another, for example from air to water, its speed and direction change. This is called refraction. A prism is a piece of glass or plastic shaped like a triangle that uses simple refraction to split white light into the colors of the spectrum or rainbow. As the white light (**A** in the picture below) moves through the two sides of the prism, the different colors bend different amounts and spread out into a rainbow. Violet light slows the most and bends the most. Red light slows and bends the least. When the different colors of light that make up white light are spread out and separated, we can see the spectrum, or the different colors of light.

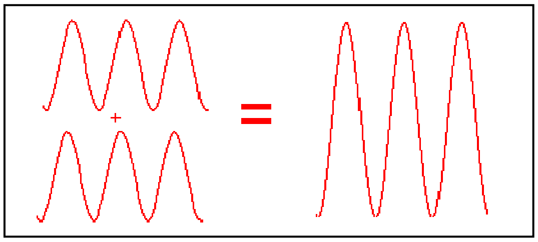


In a rainbow in the sky, raindrops in the air act as tiny prisms. Light enters the raindrop, and the white light is broken into a spectrum just like in a prism. The next time you spot a rainbow, you will see it in a whole new light!

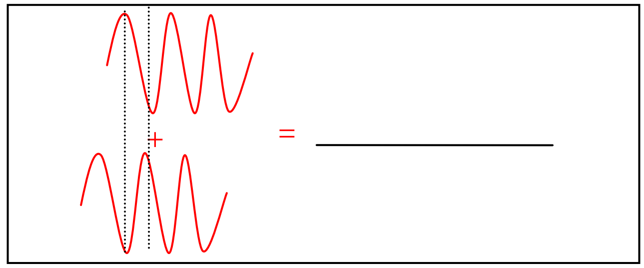
Rainbow patterns can also be made by the reflection of light. When you stand in front of a window in your house, you can see a reflected image in the window. Most of the light is passing through the window and out of the house, but some is reflected back at you, and this is how you see yourself in the window. Now think about a very thin film of oil (or soap) floating on water. As shown in the picture below, when white light strikes the film, most of the light passes through (A), but some is reflected off of the top (B) and bottom (C) layers of the film.



Now, you can think of light as being made up of waves - like the waves in the ocean. Sometimes the waves add together, making certain colors brighter, and sometimes they cancel each other, taking certain colors away.



Two waves added together that make a bigger wave- the stronger wave is easier to see



Two waves added together that cancel each other- the weaker wave is very hard to see

In the case of the thin film of oil or soap on the water, the light that reflects off the top layer (B in the picture on the previous page) travels a slightly shorter distance than the light reflecting off the bottom layer (C). If the film is just the right thickness, a colored light wave, like red, will bounce off the top and bottom layers in perfect alignment, and the two resulting waves will combine to double the amount of red light seen (just like you see in the picture above). Or, they may be exactly opposite (or out of phase), and red will be eliminated. This is called interference.

Take a close look at your CD. It's made of aluminum with lots of tiny ridges that is coated with plastic. The colors that you see on the CD are created by white light reflecting from very small ridges in the aluminum. When light waves reflect off the ridges on your CD, they overlap and interfere with each other. The colors you see reflecting from a CD are interference colors, like the shifting colors you see on a soap bubble or an oil slick.

Neat words to remember:

Prism, Medium, Reflection, Refraction, Spectrum

Mixing colors

What you need:

1. A pencil
2. Scissors
3. White paper
4. Crayons or markers in yellow, orange, red, pink, violet, blue & green
5. A ruler
6. A CD
7. String
8. A piece of white foamcore
9. Color paddles (colored circles on transparencies)
10. A grown-up with grown-up scissors

What to do:

First, let mix just a few colors-

1. Cut out the color paddles provided in your kit.
2. Hold the color paddles up to the light in different combinations to see what colors they make when added together. Fill out the chart below:

Red + **Yellow** = ______________

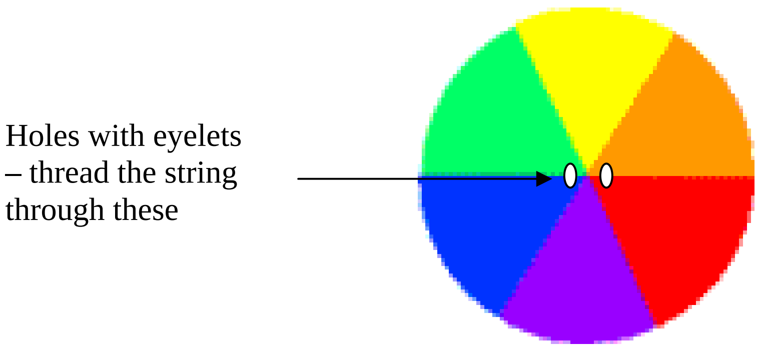
Yellow + **Blue** = _____________

Blue + **Red** = ________________

3. Now, hold the red and yellow paddles together in one hand. In the other hand, hold up the orange paddle. Hold your color paddles up to the light. Do the red and yellow paddles look almost the same as the orange paddle?
4. Based on the chart you made above, hold up the yellow and blue paddles together and compare them to the ___________ paddle. Do they look the same? What about for blue and red together?

Now, let's make a color spinner to see what all the colors mixed together look like-

5. Use the CD to trace a circle onto a piece of white foamcore (from your kit).
6. Use the CD to trace a circle on a regular piece of paper.
7. Cut out both circles. Get your parents to cut the foamcore, it is tough!
8. With the ruler, divide the circle on the piece of paper into six equal pie-shaped sections. Color the six sections with the colors of the spectrum as shown (look at the picture on next page)
9. Glue the paper circle onto the foamcore circle.
10. Poke two small holes, about 1 inch apart, through the middle of the circle. Push the eyelets through these holes so the string (see the next step) won't tear your foamcore wheel.
11. Thread the string through the holes, and tie the ends together.



12. Now your color spinner is ready to use. Hold one end of the string loop in each hand. Gently swing the spinner in circles until the entire loop is twisted, then gently pull the ends apart. As the spinner unwinds, it will wind back up in the opposite direction. Keep doing this, and you will get the spinner to spin fast enough to see the colors on the wheel blend into white. ****This may take a little practice to get right, so be patient!**
13. Try the experiment again, going back to step 5. Try to use different patterns and colors- just glue the paper circles over your first one. What colors do you see when you mix yellow and red only? What happens if you use red and blue only?
14. What is your favorite color? Using your color wheel and paddles, can you find what colors make your favorite color?

What is happening:

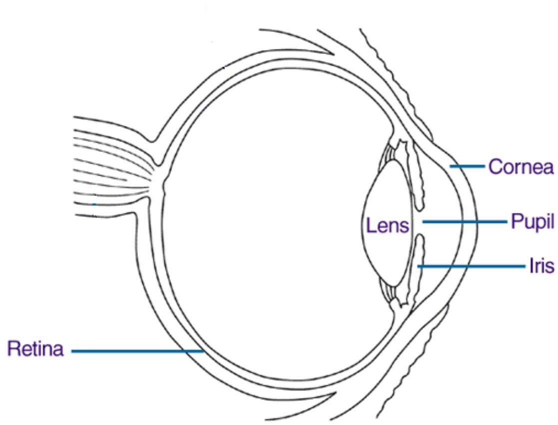
The colors on the wheel are the main colors in white light. When the wheel spins fast enough, the colors blend together, and the wheel looks white. The color spinner is also known as a Newton's wheel, named for a very famous scientist (Sir Isaac Newton) who studied light and color with a similar wheel.

Red, yellow, and blue are known as primary colors. Mixtures of these three colors result in the remaining colors on the wheel, as shown by your experiment with the color paddles. Purple, orange, and green are known as secondary colors. Try experimenting with different color combinations to see which ones you like the most.

Let The Light Shine In

A Look At The Iris

The eye is made up of several parts: the cornea, pupil, iris, lens, and retina. Each has an important function.



Have you ever seen a picture of yourself where your eyes are red? This happens when the camera's flash reflects off the retina - or back wall - of your eye.
Look closely at your eye in the mirror. The iris is the colored part of your eye. The iris is the muscle that lets the proper amount of light through the pupil and into the eye. The pupil is the black dot in the middle of the iris. The iris opens to make the pupil big when there is only a little light and closes to make the pupil smaller when there is a lot of light.

What to do:

1. Get someone to help you- Mom, Dad, or a brother or sister.
2. Go outside on a sunny day, or go to a brightly lit room.
3. Tell your helper to close their eyes and count to ten.
4. Tell your helper to open their eyes. What happens to their eyes?

What is happening:
The pupil will start out large then become smaller. When the eye was shut, the iris relaxed and made the pupil large, trying to get more light into the pupil. When the eye opened, there was a flood of light - the iris shut and made the pupil smaller, trying to limit the light coming in.

Neat words to remember:
Pupil, Iris, Cornea, Retina

Chromatography

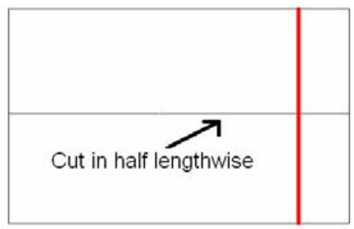
Breaking up colors

What you need:

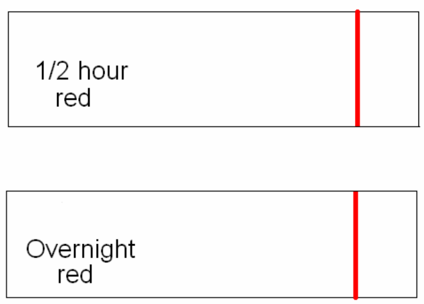
1. The marked index cards from your experiment kit
2. Several cups, maybe two for each card (see step 5 below)
3. Rubbing alcohol **(not provided with your kit)
4. Paper towels

What to do:

1. Cut each index card in half lengthwise as shown, so that you get two strips of paper with an ink line on one end.



2. Label your test strips on the end opposite the ink line. Mark one with a "1/2 hour" and the other "overnight." Below this write the color of the ink.



3. Set out the cups in a row on the paper towels.
4. Put 2-3 tablespoons of rubbing alcohol in each cup, enough to cover the bottom of the cup.
5. Place one of the paper strips inside each cup, putting the edge with the colored ink line down. <u>Make sure the mark does not sit in the alcohol.</u>

**You can put more than one strip in a cup, just make sure they do not touch.

6. Wait about 30 minutes. Look at the strips. Take the ones marked "1/2 hour" out of the cups and lay them on the paper towels to dry a little.
7. Using your ruler, measure how far the ink moved on the paper. Write down your results in the chart on the next page.
8. In the morning, take out the strips marked "overnight" and place them on the paper towels to dry a little. Again, using your ruler, measure how far the ink moved on the paper, and write your results in the chart on the next page.
9. Look at your completed chart. What do you see? Did the ink on the strips left overnight move more than the ink for the strips left only for 30 minutes? Did the original color of the ink change? Do you see different colors?

Chromatography Chart

Time: ½ hour	Starting Color:	Starting Color:	Starting Color:	Starting Color:
How far did the ink move?				
What colors of ink do you see?				
Time: Overnight				
How far did the ink move?				
What colors of ink do you see?				

What is happening:
Chromatography is a technique for separating mixtures. Each color of ink, just like white light, is made up of several different colors or pigments. This experiment uses chromatography to separate out the different pigments used in the ink. The paper placed in the cup serves as a wick to slowly draw the alcohol upwards. As the alcohol moves up the paper, the alcohol dissolves the ink and allows the pigments to separate. The different pigments move up the paper with the alcohol at different speeds. The speed depends upon the type of ink (analyte), the solvent (such as alcohol or water), and the absorbing medium (paper in this case).

The ink line on each index card was made with a Sharpie permanent marker. You can try more ink colors and different types of markers with different solvents at home.

Neat words to remember:
Analyte, Chromatography, Pigment, Solvent

Interested in learning more about light and color?

Check out the library science section. Ask for books about light, rainbows, and colors.
Here are a few examples:
1. Switch On, Switch Off by Melvin Berger (*Advanced Reader book*)
2. All About Light by Lisa Trumbauer (*Advanced Reader book*)
3. What Makes a Rainbow? by Betty Ann Swartz
4. Lets Find Out About Color by Ann Campbell
5. Colors by Pamela Schroeder and Jean Donisch
6. What Makes a Shadow? by Clyde Bulla
7. Raindrops and Rainbows by Rose Wyler and Steven Petruccio (*Advanced Reader book*)
8. All the Colors of the Rainbow by Allan Fowler (*Advanced Reader book*)

Credit where credit is due….
The experiments, discussions, and pictures in this handout were taken or adapted from the following websites and books:

1. Science Made Simple (http://www.sciencemadesimple.com/)
2. Franklin Institute Online (http://fi.edu/tfi/)
3. How Stuff Works (http://science.howstuffworks.com/question41.htm)
4. NASA (http://whyfiles.larc.nasa.gov/treehouse.html)
5. HyperPhysics website, Georgia State University, R. Nave, (http://hyperphysics.phy-astr.gsu.edu/hbase/hph.html)
6. “My Big Science Book,” Simon Mugford, St. Martin’s Press, New York, New York

Coming soon: Science Club website

As soon as we are up and running, we will post the web address in the school newsletter.

The next experiment packets will available from the school library on the following days:

Second Grade: Feb 27
First Grade: Feb 28
Kindergarten (and pre-K): March 2

NOTE TO PARENTS

Dear Parents-

We have had several questions regarding whether or not kids are required to turn back in their work. The answer is NO. These experiments and handouts are intended not as homework to be turned in, but rather fun activities for the kids to do when the family has time. Some may want to do the entire kit in one day. Others may do one activity every couple of weeks. That is up to your family schedule.

The basic kit did come with a folder. If your child makes a picture, adds to the experiment, finds a neat website, or does some other form of work that they want to share with ANS and the rest of the club, then they will print their first name and last initial and their grade on the work, put it on their folder, and return it to the library cart. The information on the label of the front of the folder ensures that you will get your child's work back. The folders will be returned to the children via the library cart- when they pick up the next kit, the folders should be there. (Since this is the first time we have done this, there may be some snags in this process, but having the child's information on the folder means that you will eventually get their work back.)

ANS/WIN would like to post results the kids provide on the website. However, if this is not possible (because of the volume of material), the ANS/WIN members (who do not have children at FPS) will look at the returned work and pick out several to post on the website. When we return the folders, we'll stick a note in the folder letting you know to look for their work on the web. Any information, such as recommended websites, books, etc., will be incorporated into the website, it just may not be possible to post all the pictures.

Regardless, your feedback is crucial to the success of the club. Even if your child doesn't want to send anything back, to help us improve, please fill out and return the questionnaire on the back of this note. The questionnaires do not need to be returned in the folders. We appreciate it!!

Light and Color Questionnaire

Were the materials provided appropriate? Yes _____ No _____
Please explain.____

1. Did you have enough materials for each experiment? Yes_____ No_____

Please explain.____

2. Did the experiments work? Yes_____ No_____

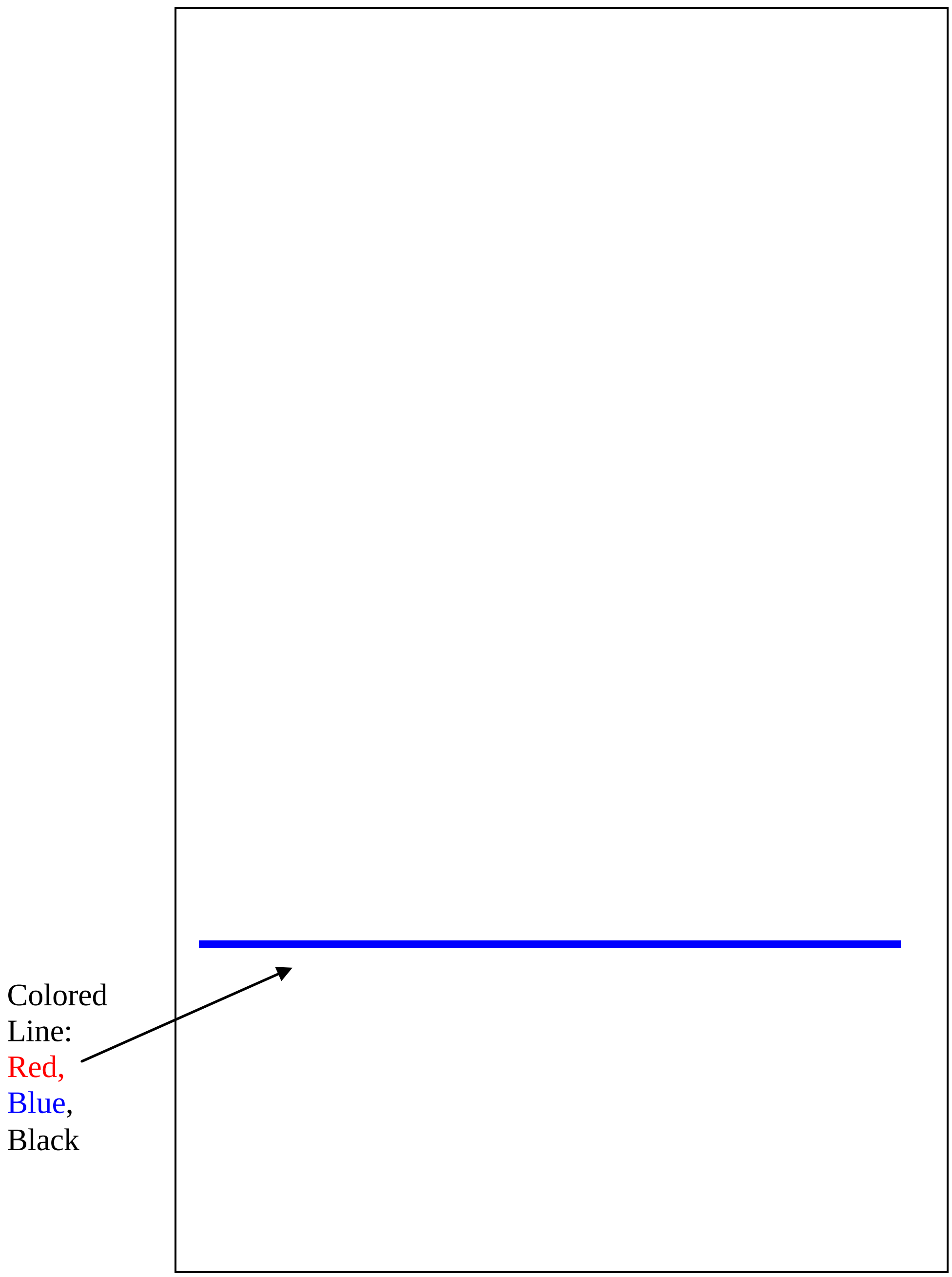
If not, please explain____

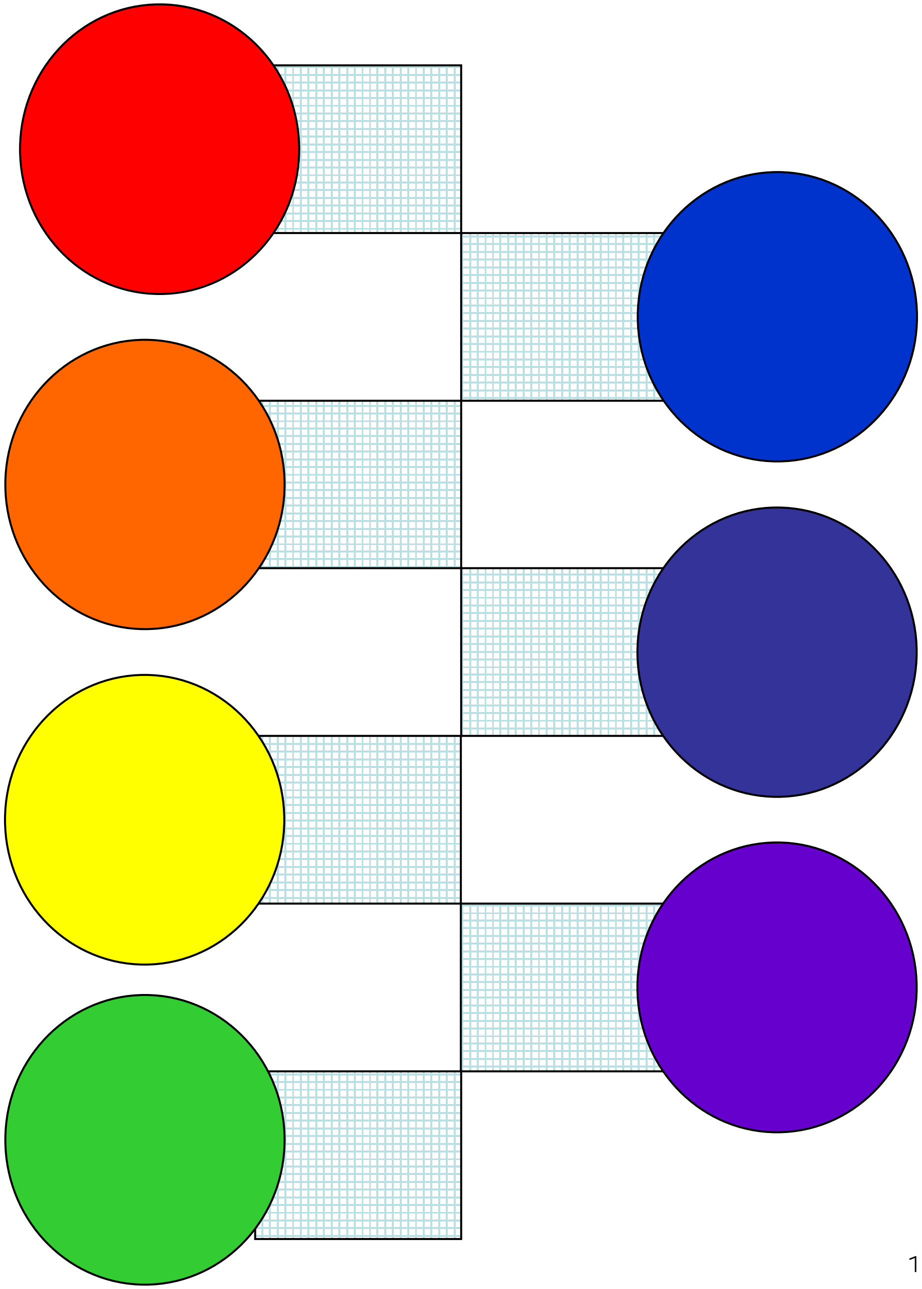
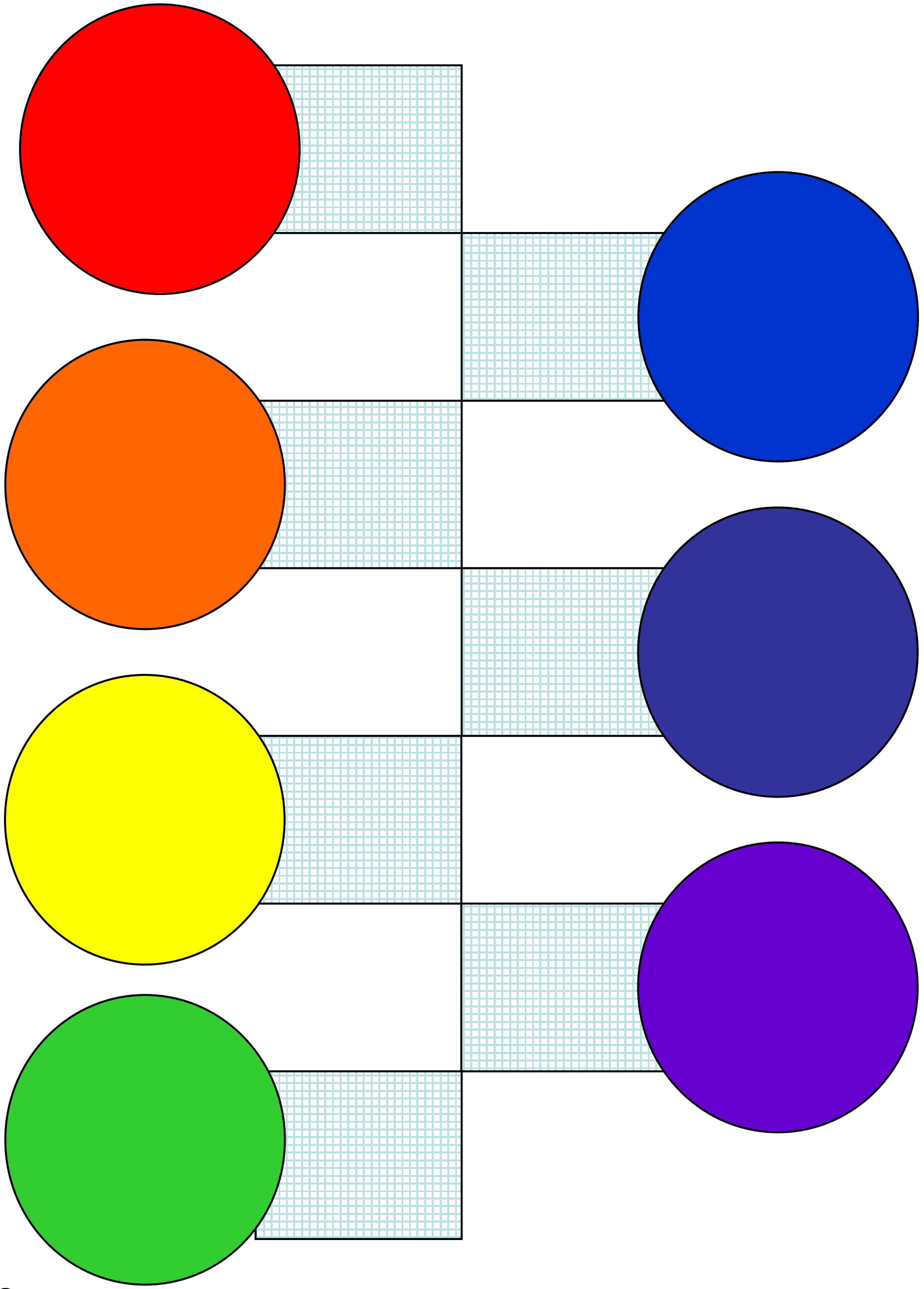
3. Please provide any suggestions for improvements or additional

experiments/explanations.____

____

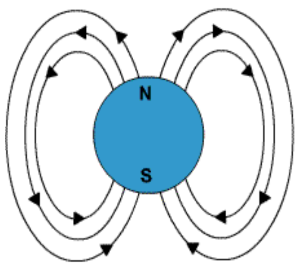
3 X 5 Card
One colored line per card



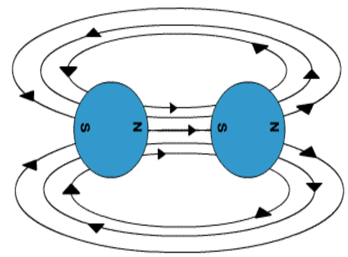



MAGNETISM

Magnetism is a force that acts at a distance and creates an invisible field called a **magnetic field**. A magnetic field strongly attracts special materials like iron, nickel, and cobalt. What a magnetic field actually consists of is somewhat of a mystery, but we do know it is a special property of space.



Magnetic Field

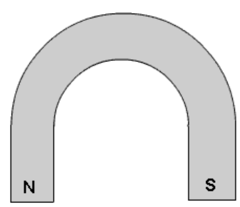


Force attracts N to S

Properties of magnets

A magnet is an object or material that attracts certain metals.

- Magnets attract certain metals, such as iron, nickel, and cobalt.
- A magnet can also attract or repel another magnet. When placed near each other, opposite poles attract and like poles repel each other.
- Magnets come in various shapes.



Here are the activities we'll do as we investigate Magnetism:

1. A Different Kind of Compass
2. The Dancing Cobra
3. Exploring Magnetism

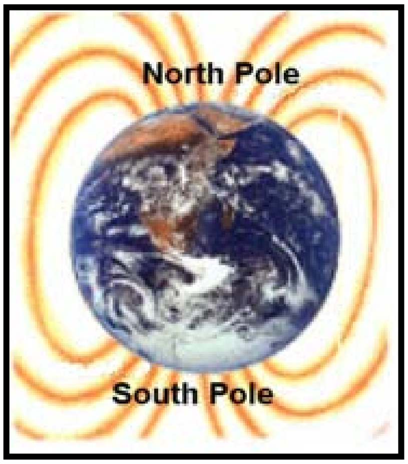
The experiment kit contains:

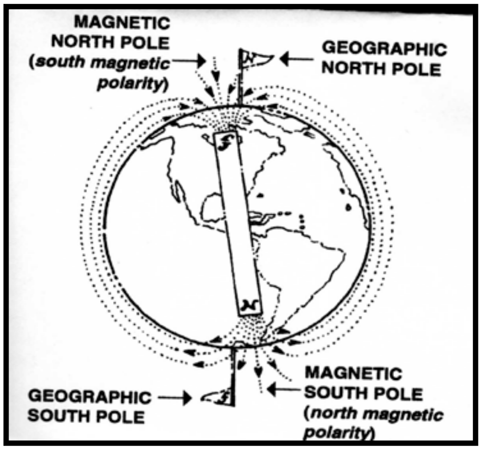
1. Horseshoe Magnet
2. Adhesive Magnet (1 inch)
3. Popsickle stick
4. Cotton Thread (8 inches)
5. Modeling Clay
6. Lead Pencil with Eraser
7. Test Bag (Chips, Buttons, Paper clips, etc)

****You will also need a small bowl of water and a straight pin, these are not in your kit****

First Experiment: A Different Kind of Compass

In a compass, the side marked **(N)** will point toward the Earth's North magnetic pole. Thus, it is called the **"North-seeking pole."** The first true application of a magnet was the compass, which not only helps in navigation by pointing toward the North magnetic pole, but it is also useful in detecting small magnetic fields. A compass is simply a thin magnet or magnetized iron needle balanced on a pivot. The needle will rotate to point toward the opposite pole of a magnet. It can be very sensitive to small magnetic fields.

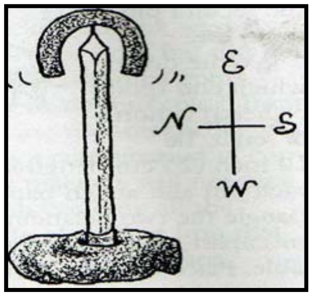




You Will Need:
Modeling Clay (for stand)
Sharp Pencil with an Eraser
Horseshoe Magnet

What to Do:

1. Find the plastic bag containing the clay, open the bag and remove the clay. Sharpen the pencil.
2. Roll the piece of clay into a ball and flatten it to make a sturdy stand.
3. Push the eraser end of the pencil into the clay stand.
4. Carefully balance the magnet on the pencil lead.



What Happens:
The magnet gradually positions itself into a north – south direction.

Why:
The earth is a magnetic ball with north and south magnetic poles. The magnet positioned itself in a north-south direction because magnetic metals and liquids buried within the earth's core have turned it into a giant magnet that naturally attracts all compasses and magnets. These great magnetic forces are concentrated at its north and south magnetic poles.

Second Experiment: The Dancing Cobra

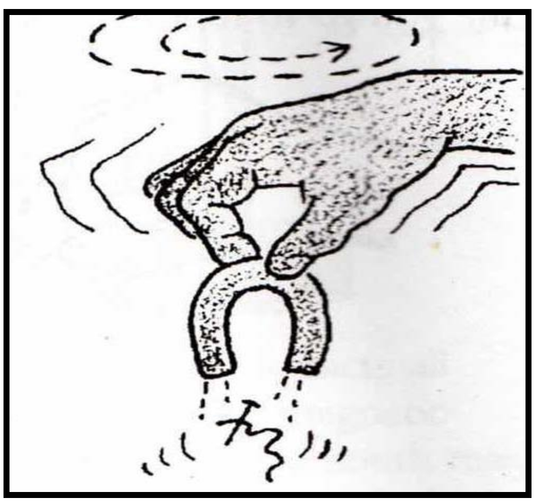
You Will Need:
Cotton Thread (8 inches)
Straight Pin
Horseshoe Magnet

What to Do:

1. Have an adult make a loop in the thread and tie it around the head of the pin.
2. Hold the end of the thread with the pin attached
3. With the other hand, lift it with the magnet
4. When you get the pin to an upright position, carefully lift the magnet from the pin so it is slightly suspended in midair.
5. Move the magnet slowly in circles and watch the pin and thread, or cobra, follow the movements.

What Happens:
The pin and thread float suspended in the air slightly below the magnet and follows its path as you move it around.

Why:
Gravity is the force that pulls everything downward toward the middle of our planet. The pin seems to be slightly overcoming gravity, floating below the magnet while not touching it. This is proof that the magnet's attraction can pass through air and, over a short distance, can "balance" the force of gravity.



Third Experiment: Exploring Magnetism

You will need:
Popsicle Stick
Adhesive Magnet
Magnetic Pickup Data Sheet
Test Materials Bag

What to Do:

1. Make your **prediction** (what you think will happen)
    - Place all your test materials on the table
    - Write the name of each item on your *Magnetic Pickup Data Sheet* in the ITEM - "What are we testing?" column.
    - Which ones do you think will be attracted to the magnet?
    - Make two piles. Place all the items you think **will** be attracted to the magnet in one pile. Place all the items you think **will not** be attracted to the magnet into another.
    - Write your **will** and **will not** predictions on the data sheet in the PREDICTION – "What will happen column?"

2. Test your prediction
    - Make a Magnet Wand
        - i. remove adhesive backing from magnet
        - ii. stick magnet on one end of the popsicle stick
    - Bring your magnet wand close to one of the items. What happens? Is the item attracted to the magnet? How can you tell?
    - Test each item by bringing your magnet close to it.
    - Do you see something special about all the items that are attracted to the magnet? How are they all the same? How are they different?
    - Record your RESULTS on the data sheet.

What Happens:
Some of the items you test will be attracted to the magnet and **will** stick to it, some of the items you test **will not** be attracted to the magnet.

Why:
We call items that are attracted to the magnet **MAGNETIC.** These items are always made of iron, steel, nickel or cobalt. All the items that **will** stick to the magnet are metals or they contain metals.

Neat Thing to Do:
Drop the metal items in a small bowl of water, use your horseshoe magnetic to see if it will pick them up in water. Do magnetic forces work in water?

Magnetic Pickups Data Sheet		
ITEM **What are we testing?**	**PREDICTION** **What will happen?**	**Result** **What really did happen?**

Interested in learning more about MAGNETISM?

Check out the **following resources that provided information on this subject:**

1. **365 Simple Science Experiments, Churchill, Loesching, & Mandell, 1997.**
2. **Physical Science Resources :**

http://www.school-for-champions.com/science/resources.htm

3. **Exploration of Magnetism : http://www-istp.gsfc.nasa.gov/Education/Imagnet.html**
4. SEE science and everyday experiences **: http://www.deltasee.org**

Science Club website:

www.discoveret.org/scienceclub

Come and see what our members have done!

Even though school is about to end for the year, we'd still like see the kid's results! Until school is out, we'll keep checking the science club cart at the library. If you would like to share some work over the summer, you can e-mail them to the science club (scienceclub@discoveret.org) or send them by regular mail to :

Science Club
American Nuclear Society, Oak Ridge/Knoxville section
P.O. Box 5075
Oak Ridge, TN 37831-5075

NOTE TO PARENTS

Dear Parents-

This science club pack is designed for the basic education standards in physical science. The content will enhance your student's understanding of the properties of magnets, magnetic fields, and the properties of the objects magnets attract and repel.

Questions to ask your child as they do this activity may include:

- What is a magnet?
- Describe how you know if something is a magnet.
- How did you decide whether something was magnetic or not?
- Can you see magnetism?
- Can you feel magnetism?

For safety, please do all activities with your child and;

- Be sure that any materials you give to the younger children do not have sharp edges.
- Be sure students do not put objects in their mouths.

Magnetism Questionnaire

1. Were the materials provided appropriate? Yes _____ No _____
Please explain.____

2. Did you have enough materials for each experiment? Yes_____ No_____

Please explain.____

3. Did the experiments work? Yes_____ No_____

If not, please explain____

4. Please provide any suggestions for improvements or additional

   experiments/explanations.____

   ____

Ornithology: The Study of Birds

Bird watching (or birding) is the observation and study of wild birds. The behavior of wild birds is what makes them so fascinating to watch. The best place to **try bird watching** is in your own backyard. With this science kit, you will make a few bird feeders and watch the reactions as birds begin to come to your feeders.

Ask yourself these questions as you watch your birds-
Where do birds live?
What do birds eat?
How do birds fly?
Why do birds sing?
What kind of bird is that?
A great place for more information (and a source of information and discussions used in this science kit) is the website:
http://www.a-home-for-wild-birds.com/bird-watching-for-kids.html

Here is what we'll do as we get started with bird watching!
1. Learn about different types of common birdseeds
2. Talk about different bird feeders and what birds like to eat
3. Make a bird house and some different types of bird feeders to put in your back yard!

This kit includes:
1 wooden bird house kit
2 pipe cleaners
1 popsicle stick
1 bag cereal
1 bag of thistle seeds (tiny black seeds)
1 bag of sunflower seeds
1 portion of suet (CAUTION- may contain peanuts!)

Other things you will need:
String and scissors from your basic kit, a plate or container for bird seed, a pine cone, and a small hammer to put your wooden bird house together with, crayons or colored pencils to decorate your bird house with. If you use paint, you may want to spray your finished house with an acrylic spray to protect it from rain.

Types of Wild Bird Seed,
Taken from the website:
http://www.a-home-for-wild-birds.com/wild-bird-seed.html

Black Oil Sunflower Seed

This bird seed really delivers. If you are having trouble attracting wild birds or are putting out a wild bird feeder for the first time then this is the wild bird seed for you.

Most seed eating birds love black-oil sunflower seed. You can **attract many species of wild birds** with black-oil sunflower seed including: woodpeckers, finches, goldfinches, northern cardinals, evening grosbeaks, pine grosbeaks, chickadees, titmice, nuthatches, and grackles.
You can purchase black-oil sunflower seed with or without the shells. The birds will crack open the seeds and eat the inside but leave the hull. Using **hulled seeds will produce less mess**.

Nyjer Seed (Thistle)

Nyjer seed is a specialized type of wild bird seed. It requires a specific type of bird feeder called a finch feeder or thistle feeder. It will have smaller openings for the **tiny seed** to flow through.

It can be used to attact American Goldfinches, Lesser Goldfinches, House Finches, and Common Redpolls.

Suet Bird Food

Suet bird food attracts many species of **tree clinging birds**, such as: woodpeckers, nuthatches and chickadees.

You can purchase commercial **suet cakes**. They are available in many varieties, and can attract wild birds that like seeds, nuts, fruits or insects.

DINNER? IT'S FOR THE BIRDS!

Taken from the website: http://www.osweb.com/kidzkorner/feeder.htm

What we can do to help provide the birds with food? Bird feeding isn't just a winter activity; it might surprise you to learn that even in spring, food is still scarce for our feathered friends.

The temperatures are usually cool enough that many insect populations haven't emerged, and that's sad news for those birds who eat insects. Also, the fruit eating birds won't see their favorite foods naturally appearing until harvest!

Plus, everyone is always so eager to get outdoors as soon as spring arrives, that it is the perfect time to get yourself involved with bird feeding and bird watching. Then, by the time winter arrives, those birds who over-winter in your area will know where the food is.

Of course, it will be up to YOU to keep their dinner table supplied!

TIP: Remember to check out the bird books at your local LIBRARY for specific details on birds, their favorite foods, and favorite styles of dining table.

You don't need to buy fancy bird feeders to feed your backyard friends!

You can:

- Set a pie tin on a stool or flat topped tree trunk or hang it in a hanging plant hanger; dump it out after a rain, or punch drainage holes in it, and elevate it a little by placing small rocks or twigs beneath it. (All birds, specially Juncos, Cardinals, Jays, Sparrows)
- Punch holes on either side of a plastic pop bottle, stick a twig all the way through with its ends sticking out for perches and poking more holes nearby for the birds to pull the seeds out. Then hang the bottle by tying a string around its neck. (Finches really like these!)
- Coat a pine cone with **peanut butter**, roll it in **birdseed**, and hang it from a tree branch;

- Stick a piece of **bread**, a doughnut, or half of an **orange**, on a twiggy branch of the tree (the Orioles will LOVE the **orange**!)
- Tie a string around the neck of a baby food jar and fill with **orange juice**. Hang it from a tree. (It will hang tilted, but Orioles will perch on the rim and take dainty sips).
- Scatter **bread** crumbs on the ground.

WHICH BIRDS EAT WHICH FOOD?

BIRDS	Ground Feeders	Raised Feeders	Hanging (Suet)	Hanging (Seed)
Blue Jay		X		
Chickadee	X	X		X
Cardinal		X	X **(if seed is in it)**	X
Finches		X		X
Grackle	X	X		
Junco	X	X		
Dove	X			
Mockingbird		X		
Sparrow	X	X		
Woodpecker	X	X	X	
Wren		X		
Yellow Bellied Sapsucker		X	X	

Photos of Common Feeder Birds:


Chickadee


Nuthatch


Cardinal


Sparrow


Junco


Mourning Dove


Tufted Titmouse


Woodpecker

Bird feeder #1: Suet Pine Cone Feeder

Photo taken from the Illinois Department of Natural Resources:
http://www.dnr.state.il.us/lands/Education/birdfeeder.htm

What you need:

- 1 portion of suet
- 1 pine cone, collected from your yard
- String

What to do:

CAUTION! The suet contains nuts, so ask your parents if you can handle it!

Do not open the bag with the suet. Use your hands to very gently knead the suet, until it becomes soft like peanut butter.

When the suet is nice and sift, squish it onto the pine cone, like in the photo. You will not have enough to cover the whole pine cone, so try pressing small blobs onto the "leaves" of the cone to spread it out.

Tie a string around the top of the pine cone.

Take your suet pine cone feeder outside and hang it in a tree or from another object where the birds can find it.

You can also make a suet pine cone feeder by spreading cold lard on the pine cone and rolling the cone in bird food.

You can also try this variation from the Illinois Department of Natural Resources (but these materials are not included in your kit):

Put several layers of newspaper or some aluminum foil on a flat surface where it won't hurt to get messy. Pour some bird seed on the newspaper or aluminum foil. Obtain some suet or lard. You may find that lard is easier to work with. Place the suet or lard in a saucepan on a burner on your stove. Set the burner temperature to low. Melt the suet or lard. Watch it carefully as it melts. Once the suet or lard has melted, turn the burner off. Remove the pan from the burner. Dip a pine cone in the suet or lard, using a spoon to help you completely cover it. Now roll the pine cone in bird seed. Tie a string around the top of the pine cone. Take your suet pine cone feeder outside and hang it in a tree or from another object where the birds can find it.

Bird Feeder #2: String Treats

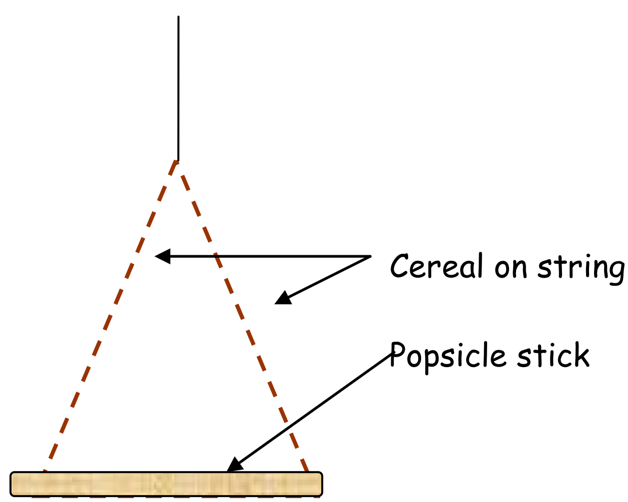
Adapted from: http://ezinearticles.com/?Crafts-for-Kids:-Homemade-Bird-Feeders&id=120210

What you need:

- A small amount of Cheerios, Fruit Loops, or other similar cereal
- A popsicle stick
- String from your basic kit

What to do:

1. Cut two lengths of string, about one and a half feet each.
2. Tie the strings to each end of the popsicle stick. This will provide a base, for threading the cereal on to the strings.
3. Thread the cheerios onto the strings- try to use the same amount on each side.
4. Tie the two strings together at the top, making a triangle with the stick and strings.
5. Tie another string to the two strings, so you can tie the bird feeder to a tree branch.
6. Hang your feeder outside, and wait to see who comes for dinner!



Bird Feeder #3: A Simple Ground Feeder

This is the simplest feeder of all!

Ask your parents for a small dish, cup, or container you can place outside. If you use something very light, like a paper plate, weigh it down with some rocks (nothing too tiny a bird might try to eat!) so it will not blow away. Place the sunflower seeds from your kit on the feeder, and put it outside, on the ground or on your patio. Watch to see who comes to dinner!

Bird Feeder #4: Build a Bird House

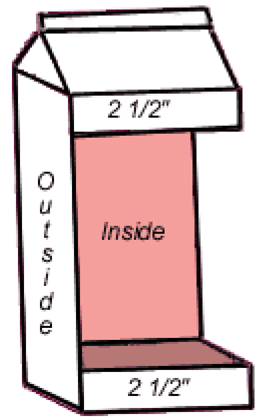
Your kit contains the parts and instructions you need to build a small bird house (the instruction sheet is with the parts for the bird house). In addition to this kit, you will need a small hammer, and some crayons, colored pencils, and maybe paint or stickers to decorate your house- whatever you have! If you use paint or stickers to decorate your house, you may want to ask your parents to spray it with an acrylic spray to protect it from the rain when you put it outside. If you use crayons and colored pencils, you won't need to worry about this.

When you are finished building the house and are ready to hang it, put the thistle seed included in your kit on the ledge outside the house and on the inside of the house to attract a bird. Place your new house somewhere you will be able to check on it. Hopefully you will get a bird to build a nest!

Recycle! Other bird feeders to try

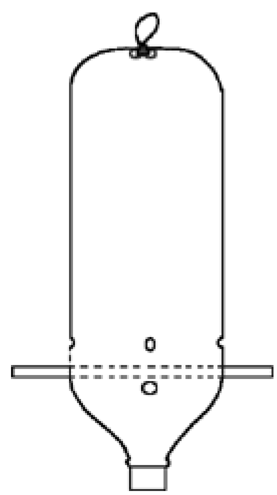
From the website:
http://birding.about.com/od/buildfeeders/How_to_Build_Bird_Feeders_Free_Plans.htm

Milk Carton Birdfeeder



Wash and dry a half gallon cardboard milk carton.
Using a ruler, measure and mark a line 2½" up from the bottom of the carton on two adjoining sides. *(See illustration)*
Using a ruler, measure and mark a line 2½" down from the top edge of the carton on two adjoining sides. *(See illustration)*
Cut the sides off between the marked lines on the two adjoining sides.
Using a small hole punch, make two small holes in the very top edge of the carton.
Put string through the holes.
Hang the feeder from a branch or post. Fill it with seed, suet or mealworms. Watch the birds enjoy the feast!

2 Liter Soda Bottle Birdfeeder



Remove all the labels and stickers from the soda bottle.
Wash and dry the bottle.
The bottom of the bottle will be top of the feeder.
Drill two small holes in the bottom of the bottle. Thread wire through one hole and out the other. Twist the ends of the wire together to make a loop for hanging the feeder. Use a small piece of duct tape or caulk to seal the holes so rain can not get into the feeder.
Using a drill, make 5/16" holes that are on opposite sides of the bottle. Insert 8" - 9" by 5/16" dowels into the pairs of holes.
Repeat the above step to make several more perches.
If you want a thistle (niger) seed feeder, make 1/4" by 1/8" slots 1 ½" above the perches.
If you want a sunflower seed feeder, make 5/15" holes 1 ½" - 2" above the perches. http://www.homeschoolzone.com/pp/crafts/birds-eggcarton.htm

Other Useful Sources of Information on Bird Watching

1. Birds of North America:
http://whatbird.wildbird.com/mwg/_/0/attrs.aspx

2. National Birdfeeding Society
http://www.birdfeeding.org/

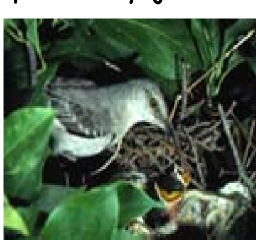
3. Cornell Lab of Ornithology (http://birds.cornell.edu/): favorite site for backyard birding, and home of Project Feederwatch. When you join Feederwatch, you become a citizen scientist with opportunities to contribute real data about the birds you see at your birdfeeder. They also send you a full-color poster to help you identify birds and other cool stuff.

Bird Watching Especially Sites for Kids

Here are bird sites written especially for kids - your kids will love to look at these sites alone or with a parent or friend.
Enchanted Learning - for younger kids who can read a little:
http://www.enchantedlearning.com/subjects/birds/
Bird biology and observation for older kids and families:
http://www.tpwd.state.tx.us/adv/birding/beginbird/kidbird.htm
An online book about birds and how they fly:
http://wings.avkids.com/Book/Animals/beginner/birds-01.html
Read about common species: http://aviary.owls.com/

Tennessee Ornithological Societyhttp://www.tnbirds.org/

This site is designed to be the internet source for information on birds and birdwatching in Tennessee. Use it to learn about recent bird sightings, plan your next birding trip, or plan your attendance at the next TOS event. The Tennessee Orntithological Society was founded in 1915 to promote the enjoyment, scientific study, and conservation of birds. The TOS publishes a quarterly journal, *The Migrant*, and a newsletter, *The Tennessee Warbler*, and holds statewide meetings. It is also a federation of local chapters which hold regular meetings and field trips.



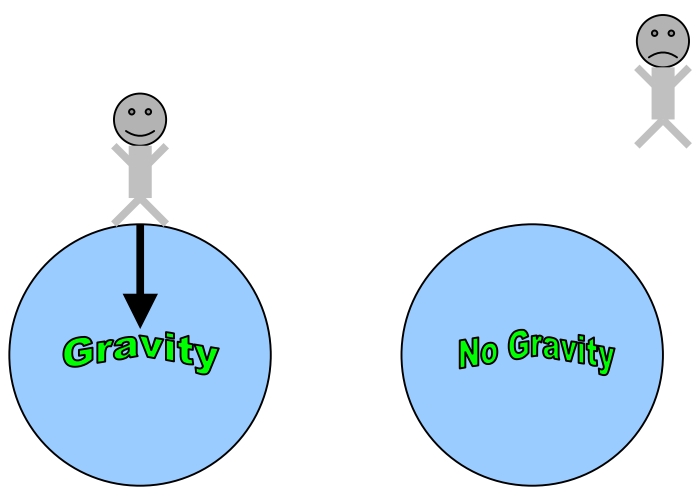
Northern Mockingbird- State Bird of Tennessee

PHYSICS:

FRICTION, GRAVITY AND ENERGY

Physics is an area of science that is all about motion. Physics is the study of all the rules that explain how things move. This set of experiments will cover just a few small pieces of the science of physics – friction, gravity and energy.

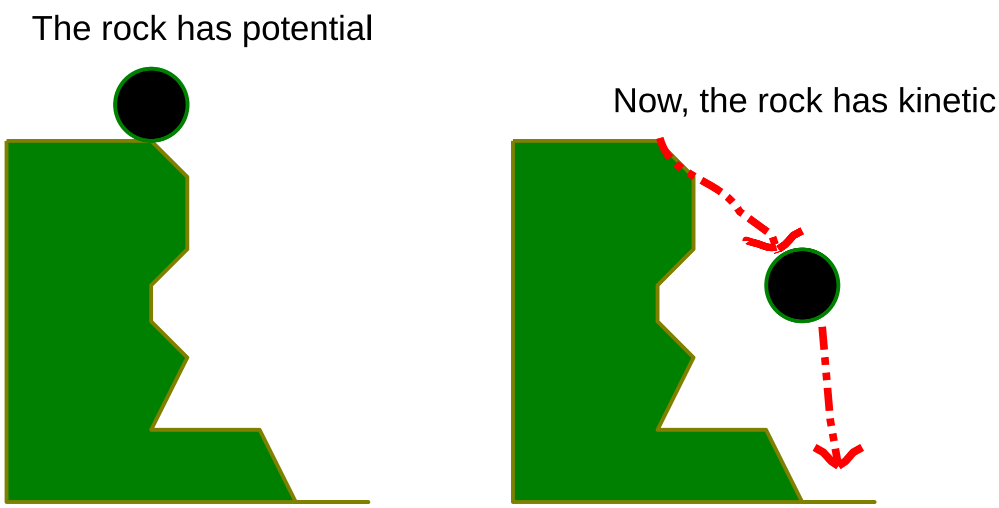
- Friction is a force that resists motion. Friction is created when two objects rub against each other like wheels rolling on the road.
- Gravity is the force that exists between two objects that have mass (or take up space), like two planets or a person and the Earth. Gravity is the force that holds us onto the Earth so we don't float off into space and gravity is the force that keeps the moon in orbit around the Earth.



- What is energy? Energy is the ability to do work, or cause change. Energy is literally what makes the world and everything in it ***go***. Energy is the stuff stored in the battery that makes the flashlight work. Energy is also stored in the gasoline in a car's gas tank. The car's engine converts the gasoline's stored energy into a usable form by burning it. While energy is found in many forms and places, there are only two types: kinetic and potential.

Merriam-Webster's Dictionary defines *kinetic energy* as the "energy associated with motion." A train racing down the track, a car speeding down the road and a rock falling downhill all have kinetic energy. When talking about kinetic energy, remember that the weight of an object and how fast an object is moving controls how much kinetic energy it has.

Wikipedia defines *potential energy* as "the energy stored in a physical system." For example, a spring can be stretched and held, or a weight can be lifted up and suspended. The spring and the weight both have the potential, or opportunity, to do work. This means a rock on the edge of a cliff has gravitational potential energy because it can fall, while a wind-up toy has elastic potential energy once you wind it up because it can unwind. We will be investigating the potential energy caused by the force of gravity.



The activities in this kit examine friction, gravity, energy and how they are related.

Here are the activities we'll do as we investigate PHYSICS:

1. Roll It! – How do surfaces affect friction?
2. Drop It! – Gravity and friction at work in 3 parts!
3. Bounce It! - Gravitational potential energy
4. Race It! - Energy at work

The experiment kit contains:

1. A large rubber band and a paper clip
2. Two pieces of paper
3. A rubber ball and a ping pong ball
4. One balloon race car kit

You will also need the clay, colored pencils, scissors & ruler from your Basic Kit. You will also need a couple of hardback books, VHS tapes, or food boxes (cake mix).

Roll It!

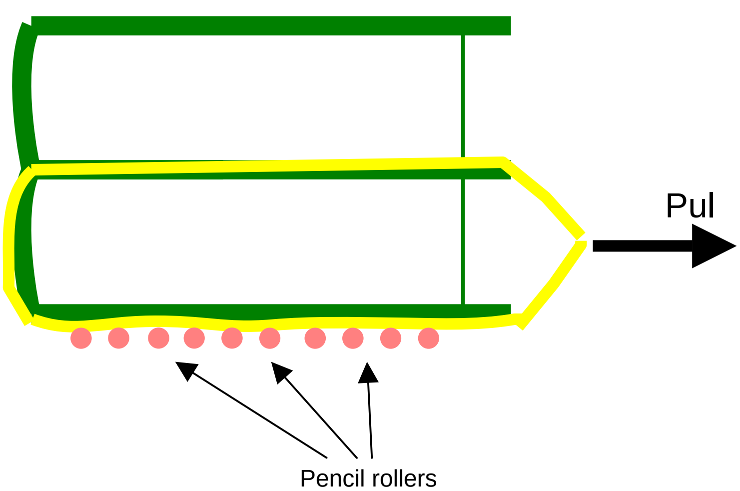
Friction is a force caused by two objects rubbing together. Let's see how different surfaces and wheels (or rollers) affect friction. What surfaces (smooth or rough) will require less force? Why?

What you need:

- 2 large books or VHS tapes or heavy boxed food (like a cake mix)
- A rubber band large enough to go around the book, tape or box
- A paper clip
- 10 round pencils or markers
- Ruler

What to do:

1. Stack the books, tapes or boxes on a piece of carpet or a towel stretched out on a flat surface.
2. Wrap a rubber band around the bottom item.
3. Attach the paper clip to the rubber band so you can use the paper clip to pull the rubber band.
4. Set down the ruler next to the stack or put a piece of tape or some other mark on the surface so you can measure how far the rubber band stretches.
5. Move the stack of items by pulling on the paper clip. Keep your pulling motion level with the items.
6. Measure how far the rubber band stretches using the ruler.
7. Record your measurement in the table.
8. Place the 10 pencils or markers under the stack of books.



9. Move the books by pulling the paper clip level with the books.
10. Measure how far the rubber band stretches.
11. Record your results in the table.
12. Repeat steps 1-11 using a smooth surface like a table or countertop.
13. Compare your results.

Did the rubber band stretch more with or without the rollers? Why? Friction is a force that tries to stop motion. The flat surface of the book slides across the rough carpet or the smooth table and the round pencils roll across. Things that roll cause less friction between the pens and the table than between the book and the table. What would happen with more rollers or fewer rollers? Try it!

Table 1
Rolling Friction Results

	Stretched length of rubber band
Rough surface	
Rough surface & 10 pencils	
Smooth surface	
Smooth surface & 10 pencils	

Drop It!

This experiment has three parts. Part 1 is about friction, part 2 is about gravity and part 3 is about kinetic energy.

What you need for all three parts:

- A blob of modeling clay
- Two pieces of paper that are the same size
- A ruler

PART 1: FRICTION

Friction is another force that has an effect on falling objects. When an object falls, the air around it pushes on it and slows it down. This is a type of friction called wind resistance. In a vacuum (a place with no air like outer space), a piece of paper will fall straight to the ground. In air, it will flutter and float to the ground. What difference do you think the shape of an object makes on how it falls?

What to do:

1. Take the 2 flat pieces of paper and hold them over your head. Drop them to the floor.
2. Which took longer to fall? Did they both fall straight down? Record your observations in Table 2.
3. Take one piece of paper and wad it up into a tight ball. You may want to wad it up a few times so that it will be a nice tight ball.
4. Hold your paper ball and the flat piece of paper over your head and drop it to the floor.
5. Which took longer to fall? Did they both fall straight down? Record your observations in Table 2.
6. Keep your flat paper and your paper ball for part 2!

Table 2 How Does It Fall?		
	Flat paper	Flat paper
Fastest? (Y or N)		
Falls straight? (Y or N)		
	Flat paper	Paper ball
Fastest? (Y or N)		
Falls straight? (Y or N)		

Why doesn't a flat piece of paper fall at the same speed as the paper ball? They would if it wasn't for a type of friction called air resistance. The flat paper catches a lot of air during its fall, which slows it down. The flat paper will fall slower because it has more surface area for the air resistance to work on. This means that the flat piece of paper is slowed down by more friction than the wadded up ball of paper.

PART 2: GRAVITY

Gravity is the force between two objects due to their mass or size. Gravity keeps us "stuck" to the Earth and is the force that makes things fall by pulling them down to Earth. Aristotle is a famous Greek philosopher and part-time scientist who lived from 384 to 322 BC. Many of his writings are still studied today. He believed that the heavier something is, the faster it will fall to Earth. Do you believe this? Let's find out!

What to do:

1. Hold the clay in your hands for a minute and then divide the clay into 3 equal pieces and roll them into equal sized balls.
2. Hold two of the small clay balls about 2 feet from the ground. Drop them at the same time onto a hard surface and see if they fall at the same speed. It would be best to have one person drop the clay balls and one person watch them.
3. Record your observations in Table 3. Did they fall at the same speed?
4. Combine two of the three balls to make one larger ball. This one should be twice the weight of the remaining small ball.
5. Hold the large ball and the remaining small ball about 2 feet from the ground. Drop them at the same time. Record your observations in Table 3.
6. Take the wadded up paper ball from Part 1. Wad it up again into a tight ball.
7. Hold your paper ball and the small clay ball over your head and drop them to the floor. Which took longer to fall? Record your observations in Table 3.
8. Keep your 2 clay balls for Part 3!

Table 3 Is It Faster?		
	Small clay ball	Second small clay ball
Fastest? (Y or N)		
	Small clay ball	Large clay ball
Fastest? (Y or N)		
	Small clay ball	Paper Ball
Fastest? (Y or N)		
Pick something else!		
Fastest? (Y or N)		

Look at your finished table. Was Aristotle right? Do the different sized clay balls reach the ground at the same time? If not, which one reaches the ground first? What about the paper ball and the clay ball?

Aristotle had a lot of great ideas, but this time he was wrong! Galileo, an Italian physicist who lived from 1564 to 1642, showed that all things of roughly the same shape fall at the same rate no matter how much they weigh. The two balls, although different in weight, fall at the same speed.

PART 3: KINETIC ENERGY

There is yet another piece of the physics puzzle to explore with this experiment – the kinetic energy of a falling object. You may have already noticed that the clay balls from Part 2 changed shape when you dropped them. This happens because the kinetic energy the ball has when falling has to go somewhere when the ball can't fall any more. The kinetic energy is used up by making the ball flatten out when it hits the ground. The change in shape is called "deformation."

What to do:

1. Hold the 2 clay balls from Part 2 in your hands for a minute and then roll them back into balls.
2. Look at each ball carefully to make sure it is as round as you can make it. No flat spots!
3. Hold the two balls about 2 feet above a hard surface. Drop them at the same time onto a hard surface and see what happens. It would be best to have one person drop the clay balls and one person watch them.
4. Do the balls bounce? Do they change shape? Measure the width or diameter of any flat spots using your ruler.
5. Record your observations in Table 4.
6. Reshape both clay balls and repeat dropping the balls from different heights. Record your observations in Table 4. Reshape the balls after each drop.

Table 4 Deformation Table		
	Small Clay Ball	Large Clay Ball
Dropped from 24 inches (2 feet)	Did it bounce? Did it change shape? How big is the flat spot?	Did it bounce? Did it change shape? How big is the flat spot?
Dropped from 36 inches (3 feet)	Did it bounce? Did it change shape? How big is the flat spot?	Did it bounce? Did it change shape? How big is the flat spot?
Dropped from 48 inches (4 feet)	Did it bounce? Did it change shape? How big is the flat spot?	Did it bounce? Did it change shape? How big is the flat spot?

Look at your finished Deformation Table. What do you notice about how much the ball deforms (the size of the flat spot) and how far it dropped?

Bounce It!

Gravitational Potential Energy:
Measuring how height affects potential energy

In this experiment you get to bounce balls around and observe the effects of gravitational potential energy. Gravitational potential energy (GPE) depends on the height of an object. If an object is positioned in a way that allows the force of gravity to set the object in motion, then the object has GPE. For example, imagine a bowling ball teetering on the very ledge of a building (don't try this). If the ball rolls over the edge, the force of gravity will set it in motion. Look out below!

Amusement park "sky coaster" rides are an excellent example of GPE. Thrill seekers are strapped into a swing harness and raised three stories or more into the air. While perched precariously in pre-launch position, the riders have GPE. The moment they pull the "ripcord", they swing free, and the potential energy becomes kinetic energy.

We've seen how clay balls squish or deform when they are dropped from a height in the Drop It! experiment. The energy in the clay balls is used up when they are squished. Now you will drop two different balls that aren't as squishy and count how many times they bounce when dropped from different heights. The two different balls in this experiment do deform, but not enough to use up all the energy. Instead the energy is put into the bouncing.

What you need:

A ping pong ball and a rubber ball

What to do:

1. Stand on a hard floor (wood, linoleum, tile, concrete but NOT carpet). Hold your first ball about 12 inches (1 foot) above the floor.
2. Now, let the ball go and count how many times it bounces before it stops. (You may have to repeat this step several times if the ball tends to bounce off…).
3. Now hold the ball at about 2 feet, let it go, and count how many times it bounces. Record your answer in the Table.
4. Repeat this for 3 feet and 4 feet and record your answers in Table 5.
5. Repeat steps 1-4 using the ping pong ball.

Look at your finished results table. Squeeze each ball in your hand. Which ball is easier to deform or squish? Which ball bounced more, the one that was easier to squish or the other one? What do you notice about how high it was and how many times it bounced? The higher the ball is the more potential energy it has, so you will see more bounces as the ball falls farther.

Table 5 Count The Bounces		
	Rubber Ball	Ping Pong Ball
	How many times did it bounce?	How many times did it bounce?
12 inches (1 foot)		
24 inches (2 feet)		
36 inches (3 feet)		
48 inches (4 feet)		

Roll It!

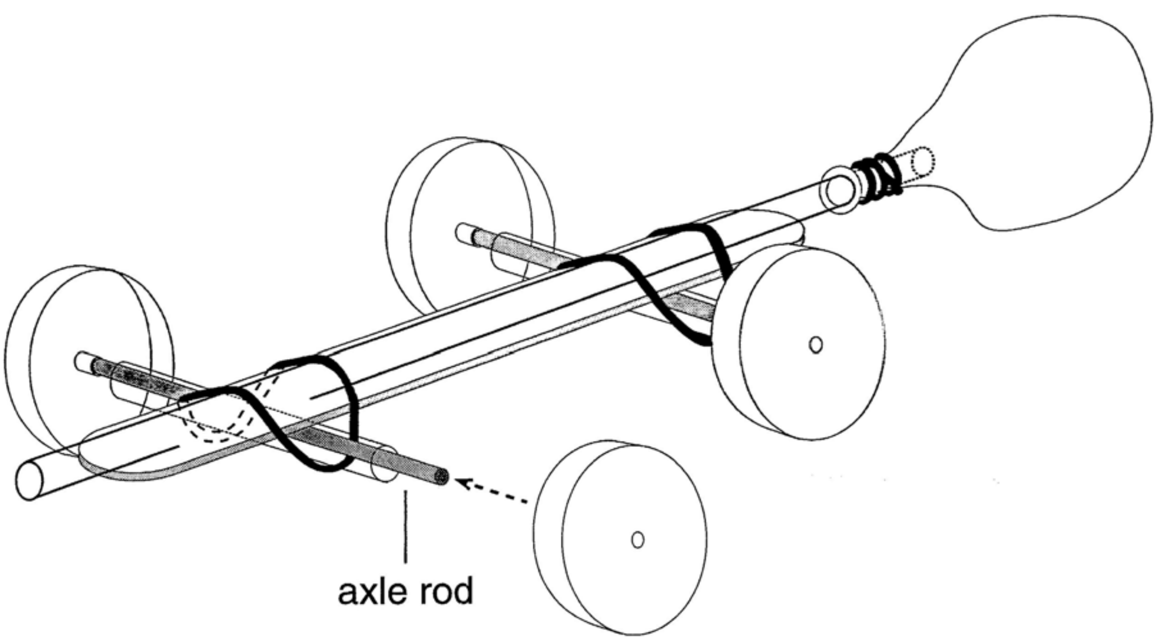
Here is a fun way to watch energy change from potential to kinetic. This is not an experiment, but a project. You (and an adult helper) will build your own balloon powered car. The air you blow into the balloon becomes the energy that makes the car go.

What you need:

- 1 balloon
- 4 plastic wheels
- 2 long straws
- 2 short straws (green)
- 2 tongue depressors
- 3 rubber bands (2 large and 1 small)
- scissors

What to do:

We've given you some instructions for building a car. You can follow these or try out your own ideas. Several of the steps are hard to explain with words, so make sure to keep looking at the picture for help.



1. Cut one of the long straws into 2 pieces that are each about 1.3 cm (1/2 inch) shorter than each axle (short green) straw.
2. Insert an axle into each straw piece.
3. Push plastic wheels onto both ends of the axle/straw assemblies. This is hard to do, so you may need some help.
4. Take one of your wheel assemblies and put one wheel through a rubber band.
5. Take a tongue depressor and place it on top of the wheel assembly.
6. Pull the rubber band over the tongue depressor and go over the other wheel. The rubber band will be loose so you will have to either twist the rubber band several times or wrap it around the end of the tongue depressor. Don't make it too tight, just tight enough to hold things together. The wrapping is not shown in the picture.
7. Take the other wheel assembly and put one wheel through another rubber band.
8. Put the wheel assembly on the other end of the tongue depressor.
9. Just like in step 8, take this rubber band and pull loose end of the rubber band over the tongue depressor and go over the other wheel on the wheel assembly.
10. Adjust the wheel assemblies and the tongue depressor so that the tongue depressor is centered between the wheels on each axle and that the tongue depressor sticks out about 2.5 cm (1 inch) at each end. Again, check the picture for help. Set this aside for a minute.
11. Insert about 2 cm (0.75 inch) of the straw into the neck of a balloon.
12. Secure the balloon in place by looping a rubber band around the neck of the balloon several times. This will be your "engine."
13. Now get the rest of your car and slide the long straw along the top of the tongue depressor and underneath the rubber bands. Each end of the straw should stick out beyond the length of the tongue depressor.
14. To "energize" the balloon car, blow into the free end of the straw until the balloon is the desired size. Place a finger over the open end of the straw to keep the air (or potential energy) from escaping.
15. Place the car on a smooth surface like a wood floor or tile floor and let it go! The air is released from the balloon, the potential energy becomes kinetic energy and the car moves.
16. You can experiment with your car by changing how much air you blow into the balloon or adding more weight to it by taping coins on the tongue depressor. Then see if the extra air or extra weight makes a difference in how it far or fast it moves.

Interested in learning more about physics?

Credit where credit is due….
The experiments, discussions, and pictures in this handout were taken or adapted from the following websites and books:

The introductory discussion was adapted from:
http://www.legoeducation.com/content/item.aspx?CategoryID=130&ap=1&art=24)

The Gravitational Potential Energy discussion and parts of the experiment were adapted from the same at:
http://www.legoeducation.com/content/item.aspx?CategoryID=130&ap=5&art=24)

Portions of the remaining experiments were adapted from the site: Skateboard Science http://www.promotega.org/ksu30001/intro.htm

The balloon cars are from the "Great American Balloon Car Race" from S&K Science Kit & Boreal Laboratories (**www.sciencekit.com**). They have a lot of great experimental supplies for classrooms and teachers.

For information on more challenging experiments, please visit the following websites:

1. Nova Online – The great robot race (**http://www.pbs.org/wgbh/nova/teachers/activities/3308_darpa.html**)
2. Mousetrap vehicle (**http://www.mousetrap-vehicles.com/article.cfm?article_id=14**)
3. Rubber band car (**http://www.webs.uidaho.edu/epscor/Outreach/Ed_Res/Rubber_Band_Car_Instructions_Oct06.pdf**)
4. Roll back toy (**http://www.uwsp.edu/cnr/wcee/keep/Mod1/Whatis/experiments.htm**)

Questionnaire

Were the materials provided appropriate? Yes _____ No _____
Please

explain.____

1. Did you have enough materials for each experiment? Yes_____ No_____

Please

explain.____

2. Did the experiments work? Yes_____ No_____

If not, please

explain____

3. Please provide any suggestions for improvements or additional

experiments/explanations.____________________________________

____

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Our Earth and the Solar System

Our solar system has nine planets and a sun. All the planets move around the Sun, which is at the center of the solar system. The planets are Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, Neptune, and finally Pluto. Earth is the planet that we live on. It is part of our solar system. It has a moon that moves around it, just like the Earth moves around the Sun. You see parts of our solar system every day- the moon and the Sun. Scientists study our planet to learn more about how it was made and about the other planets in the solar system.

Scientists study how rocks form and change to learn about our planet Earth. Scientists study our planet Earth to help them learn about other planets in our solar system. Rocks are one of the things scientists study. Rocks are always changing. Wind and water wear rocks down and turn them into smaller rocks and dirt. These small rocks and dirt get washed away by the water and into lakes and oceans. Then the dirt and rocks settle at the bottom of a lake or ocean and harden into rock again.

A geologist is a scientist that studies rocks. Geologists classify rocks in three groups, according to the major Earth processes that formed them. The three rock groups are:

- Igneous,
- Sedimentary, and
- Metamorphic.

To learn about our planet Earth, we will start a rock collection and learn about the three types of rocks. Then, we will help out a fellow scientist studying the nearby planet Mars by sending him a few rock samples of our own. Finally, we'll take a look at the solar eclipse that will happen at the end of March and learn about the Sun.

Here are the activities we'll do as we investigate our Earth and solar system:

1. Star a rock collection and learn about the three basic types of rock
2. Collect a new rock and help a fellow scientist study Mars
3. Learn about the Mars rovers
4. Watch a DVD and learn about solar eclipses

The experiment kit contains:

1. A DVD called Total Eclipse: Solar Eclipses and the Mysteries of the Corona
2. A small bag with two round gray rocks
3. A NASA bookmark
4. A small bag with one small light brown rock

Igneous Rocks

Believe it or not, you can make a rock melt just like a piece of chocolate left in the sun. Igneous rocks are made from rock that has been melted, cooled, and solidified (gotten hard). When rocks are buried deep underground (REALLY deep), they melt. This is because it is **very hot** far underground.

Melted rock is also called molten rock or magma. Magma can be pushed up from underground until it explodes or oozes out through the ground. This is called a volcano.

Look for the rock labeled “Yucca Mountain Tuff” in your science kit. This is an example of an igneous rock. It is from a place called Yucca Mountain in the state of Nevada. It is a special type of igneous rock called tuff. The tuff was made by many explosive eruptions of volcanoes a very long time ago.

Yucca Mountain was made when volcanoes exploded and blew out many layers of ashes and rock. The ash and rock cooled into many think layers of tuff. One of the layers is called the Topopah Spring. It is very hard rock. Your rock is from Topopah Spring.

What you’ll need:

1. The map of the United States at the end of your handout.
2. The tuff sample from your science kit.
3. your ruler and colored pencils.

What to do:

Find the state of Nevada on the map of the United States. Write a number 1 on the state, and make a circle around it, like this: 1

Wash and dry your rock with regular water. Now, look at you rock, and answer these questions. These are the same basic question geologists ask themselves when they study a new rock.

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Rock Sample #1

1. Trace the outline of your rock here, and next to it or over it, trace your hand:
How big is your rock? Use your ruler to measure your rock. Draw a line on the picture above to show where you measured.

My rock **my hand**

3. Where is the rock from?

____

4. What kind of rock is it?

____

5. What color is the rock? Use your colored pencils to color in the outline you made.

____

6. Look closely at the rock. Do you see crystals? Does it all look the same, or do you see different things in the rock?

____

7. How hard is your rock? Go outside to your front step. Hit the rock on the front step (get permission first).
Did the rock break? ______________________________________

Did it leave a mark on the step? ______________________________

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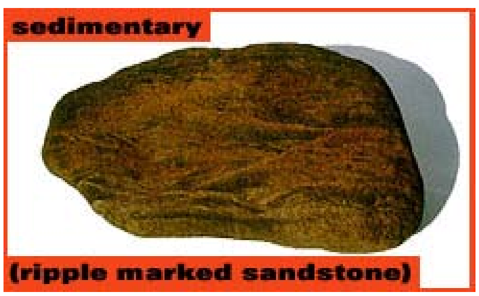
Sedimentary Rocks

Sedimentary rocks are formed at the surface of the Earth, either in water or land. They are layered accumulations of sediment-fragments or rocks, minerals, or animal or plant material. Temperatures and pressures are low at the Earth's surface, and sedimentary rocks show this fact by their appearance and the minerals they contain.

Most sedimentary rocks become cemented together by minerals and chemicals or are held together by electrical attraction; some however remain loose and unconsolidated. The layers are normally parallel to the Earth's surface or if they are at an angle, twisted or broken, some type of movement of the Earth's surface has occurred since the rock was formed.

Sedimentary rocks are forming around us all the time. Sand and gravel on beaches or in river bars look like the sandstone and conglomerate they will become. Compacted and dry mud flats harden into shale. Scuba divers who have seen mud and shells settling on the floors of lagoons find it easy to understand how sedimentary rocks form.



This picture was taken from:
http://www.bbc.co.uk/education/rocks/primer.shtml
BBC's "The Essential Guide to Rocks"

Metamorphic Rocks

Sometimes sedimentary and igneous rocks are subjected to pressure so intense or heat so high that they are completely changes. They become metamorphic rocks, which form while deeply buried within the Earth's crust. The process of metamorphism does not melt the rocks, but instead turns them into different rocks.

The other rock in your kit is called a geode. It can be sedimentary rock or an igneous rock. Sometimes when an igneous rock is being made, it has a bubble of gas in the middle. In a sedimentary rock, sometimes a hollow space can be made from an animal burrow, tree root or mud ball. Water gets inside the rock and over time the water evaporated, leaving a hollow space in the rock that is filled with different types of crystals. It may take up to 240 million years to form a geode! Geodes can be found in Tennessee in Loretto and in Pegrum, near Nashville.

What you will need:

1. The geodes from your experiment kit- the two rocks that look like little gray balls.
2. An old sock or piece of thick cloth you can throw away when you are done
3. A hammer
4. A grown-up to use the hammer!!!!

What to do:

1. Wrap one of the geodes in the old sock
2. Ask your parents if break open your geode with the hammer.

Answer the following questions about your geodes.

Did you find any crystals in your geode?
Compare your geode with the Yucca Mountain Tuff.
How are the two rocks similar?

How are the two rocks different?

Keep the open geode for your rock collection. You now have three rocks for your collection.

Rock Collecting- Keep up the good work!

A good rock collection starts with rocks that you like to look at- any color or shape. You have just started a collection with the Yucca Mountain tuff and the geodes you broke open. You can keep adding to your collection with rocks that you find around your home or buy at a rock shop. It is important to label each rock and ask yourself the same questions about your rocks. How big is it? What does it look like? How hard is it? You will also need a plastic case with dividers, like a craft case or fishing lure case, with a top, to put you rocks in.

"Rock Around the World"

The next rock you are going to collect is going to be sent to NASA to a scientist who is collecting rocks from all over the world. This program is called "Rock around the World."

Mars scientists are asking students from around the world to help them understand the red planet. Send in a rock from your neighborhood or yard and they will use a special tool, like the one on the Mars rover, to tell you what your rock is made of. They will post a picture of your rock on their website, Http://www.marsprogram.jpl.nasa.gov/rockworld/ and also send you a certificate. They will take its fingerprint, otherwise known as its spectrum. Every rock has a unique fingerprint. Your rock will be kept in a special collection where scientists from around the world will come to study it. It is very important that you take a rock from its natural setting and not one that has been used for decoration purposes and comes from another area. Also, be sure and save a rock just like it for your collection. Now you will have three rocks!

Here's how you can participate:

Find 4 inches on your ruler. Pick out a rock that is about 4 inches in size (can be from 2inches but no greater than 6 inches). Wash and dry your rock and put it in a paper or plastic bag. On a piece of paper, write down the following information:
Your name
Your age
Your Address, complete with name of city, state, country and zipcode

Optional:
Latitude and longitude of sample site
Name of Geographic feature (if it has one) where the rock was collected
Copy of map with location where rock was collected
Picture of rock in person's hand for size
Picture of location where rock was collected (with no people)
Short paragraph describing area where rock was collected
Phone number

Put your piece of paper in the bag with the rock so they will stay together and close the bag (tape, folding, staples, whatever). Then bring your rock sample to the collection box in front of the school library BY MARCH 30. We will collect and send our rocks too:

Dr. Phil Christensen at the Mars Space Flight Facility, Arizona State University.

The Mars Mission

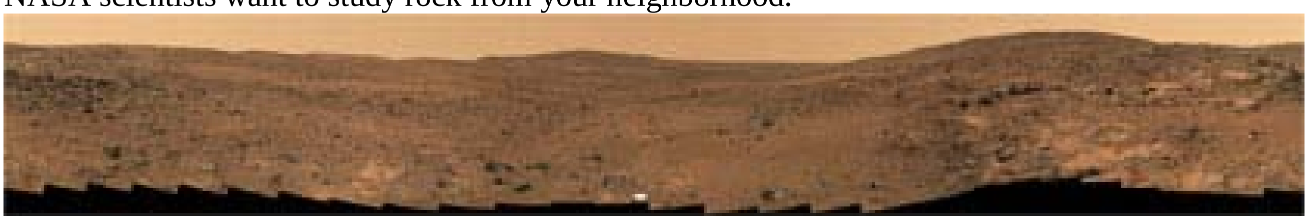
Mars, known as the Red Planet, is being explored by two robots sent up there by NASA. The robots are called Opportunity and Spirit. They are moving around on the planet's surface and collecting samples of rocks (just like you!). In 2004, Opportunity and Spirit landed on opposite sides of the planet and began their mission. Scientists thought they would only last three months, but it is two years later and they are still working! What a nice surprise. Scientists are looking for signs of life on Mars.

Spirit and Opportunity have been working very hard to help scientists better understand what it was like a very long time ago on Mars. The rovers are finding new kinds of rock in the areas they are exploring on opposite sides of Mars. By studying the information the robots have collected about rocks on Mars and comparing them to rocks here on Earth, scientists now think there may have been water on the now dry planet.

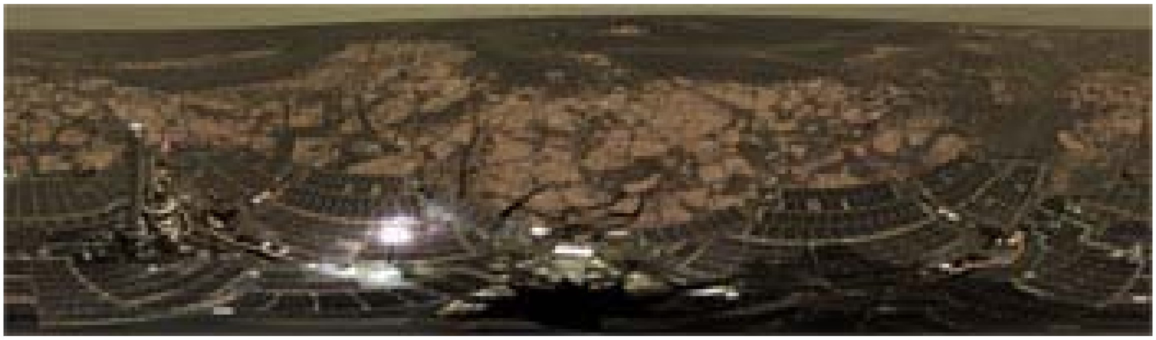
Places on Earth that can help us understand Mars include:

- Death Valley, California, where Ubehebe crater and "Mars Hill" have geologic features similar to those on Mars
- Mono Lake, California, which is a 700,000-year-old evaporative lake that compares to Gusev Crater, a basin on Mars where water once was likely
- Channeled Scabland in Washington, where catastrophic floods swept through the land much like what happened long ago in the Ares Vallis flood plain where Mars Pathfinder landed
- Permafrost in Siberia, Alaska and Antarctica, where subsurface water-ice and small life forms exist
- Volcanoes in Hawaii, which are like those on Mars, though much smaller

SO now that you know the similarities between Mars and Earth you can see why the NASA scientists want to study rock from your neighborhood.



In late November 2005 while descending "Husband Hill," Spirit took the most detailed panorama to date of the "Inner Basin." Image credit: NASA/JPL/Cornell



This is the Opportunity rover's panorama of "Erebus Rim," acquired as the rover was exploring sand dunes and outcrop rocks in Meridiani Planum. Image credit: NASA/JPL/Cornell

For information about NASA and other agency exploration programs on the Web, visit: http://www.nasa.gov/home/

For images and information about the rovers and their discoveries on the Web, visit: http://www.nasa.gov/mars/

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NASA Headquarters, Washington

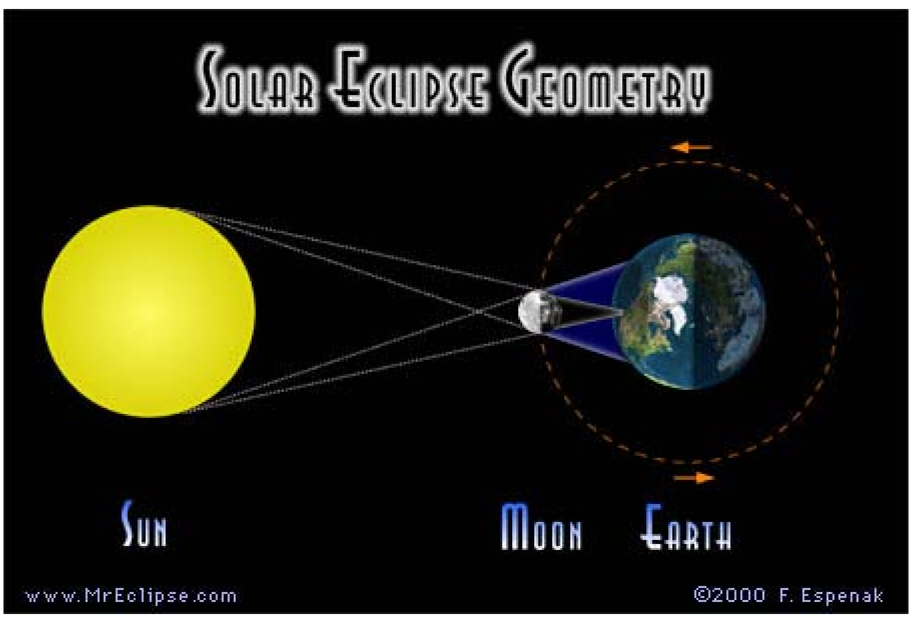
The Sun

The Sun is the largest body in our solar system. We live in the atmosphere of a dynamic, magnetic star that interacts with Earth and the other planets. The planets rotate around the Sun. On March 29, 2006, there will be a total solar eclipse. For more information see the website at:

http://sunearthday.gsfc.nasa.gov/whatis.php

You have received a CD of called “Total Eclipse” to watch and learn more before the March 29, 2006 Total Solar Eclipse.

"For more information on solar and lunar eclipses, see Fred Espenak's Eclipse Home Page: sunearth.gsfc.nasa.gov/eclipse/eclipse.html"



Basic Geometry of the Sun, Moon and Earth During an Eclipse of the Sun

A solar eclipse happens when the Moon passes between Earth and Sun. If the Moon's shadow happens to fall upon Earth's surface at that time, we see most of the Sun covered or 'eclipsed' by the Moon. Since New Moon occurs every 29 1/2 days, you might think that we should have a solar eclipse about once a month. Unfortunately, this doesn't happen because the Moon's orbit around Earth is tilted 5 degrees to Earth's orbit around the Sun. As a result, the Moon's shadow usually misses Earth as it passes above or below our planet at New Moon. At least twice a year, the geometry lines up just right so that some part of the Moon's shadow falls on Earth's surface and an eclipse of the Sun is seen from that region.

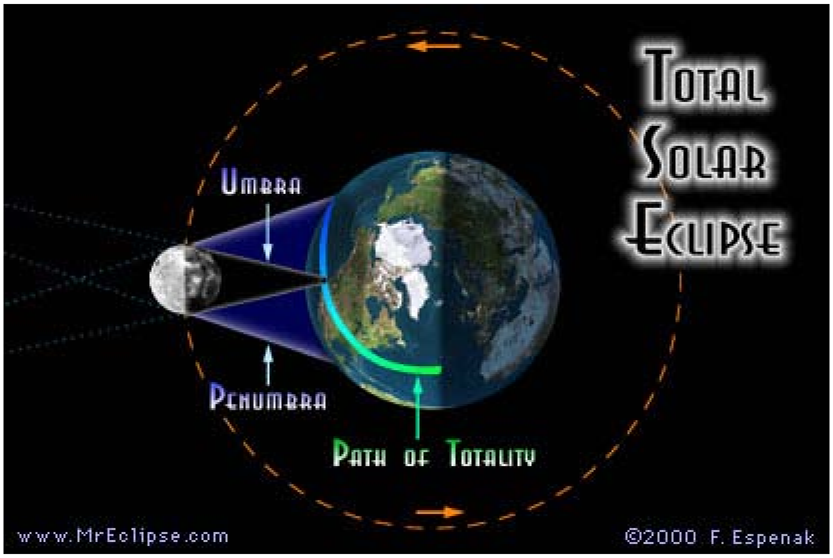
The Moon's shadow actually has two parts:

Penumbra - Faint outer shadow; partial eclipses are seen from within this shadow.

Umbra- Dark inner shadow; total eclipses are seen from within this shadow.

When only the Moon's penumbral shadow strikes Earth, we see a partial eclipse of the Sun from that region. Partial eclipses are dangerous to look at because the un-eclipsed part of the Sun is still very bright. You must use special filters or a home-made pinhole projector to safely watch a partial eclipse of the Sun (see: Eclipses & Eye Safety).

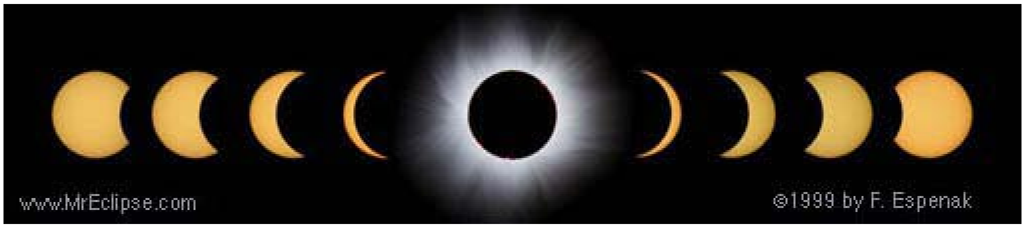
However, if the Moon's dark umbral shadow sweeps across Earth's surface, then a total eclipse of the Sun is seen (see figure below). The track of the Moon's shadow across Earth's surface is called the Path of Totality. It is typically 10,000 miles long but only 100 miles or so wide. In order to see the Sun totally eclipsed by the Moon, you must be in the path of totality.



Total Solar Eclipse and the Path of Totality

The total phase of a solar eclipse is very brief. It rarely lasts more than several minutes. Nevertheless, it is considered to be one of the most awe inspiring spectacles in all of nature. The sky takes on an eerie twilight as the Sun's bright face is replaced by the black disk of the Moon. Surrounding the Moon is a beautiful gossamer halo. This is the Sun's spectacular solar corona, a super heated plasma two million degrees in temperature. The corona can only be seen during the few brief minutes of totality. To witness such an event is a singularly memorable experience which cannot be conveyed adequately through words or photographs. Nevertheless, you can read more about the Experience of Totality in the first chapter of Totality - Eclipses of the Sun.

The most recent total solar eclipse occurred on August 11, 1999 and was visible from Europe and the Middle East. Fred Espenak traveled to Turkey to witness the event. You can see a collection of his photographs at 1999 Eclipse in Turkey. An earlier total eclipse occurred on February 26, 1998 and was visible from the Caribbean. A Brief Report on the 1998 Eclipse describes the eclipse experience with words and photos.

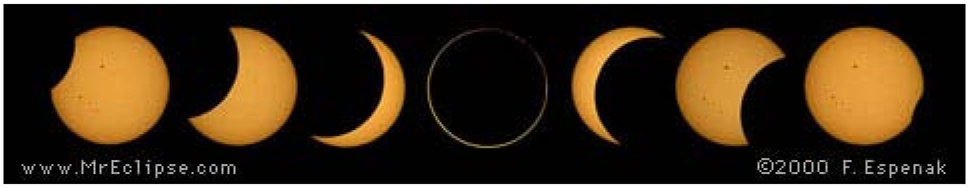


1999 eclipse sequence
This nine image sequence captures the essence of the last total solar eclipse of the Millennium.
The central image of totality is a composite from 22 separate negatives which were combined via computer to closely resemble the naked eye appearance of the solar corona.
Total Solar Eclipse of 1999 Aug 11 (Lake Hazar, Turkey)
Photo (c)1999 by Fred Espenak

Unfortunately, not every eclipse of the Sun is a total eclipse. Sometimes, the Moon is too small to cover the entire Sun's disk. To understand why, we need to talk about the Moon's orbit around Earth. That orbit is not perfectly round but is rather oval or elliptical in shape. As the Moon orbits our planet, it's distance varies from 221,000 to 252,000 miles. This 13% variation in the Moon's distance makes the Moon's apparent size in our sky vary by the same amount. When the Moon is on the near side of its orbit, the Moon appears larger than the Sun. If an eclipse occurs at that time, it will be a total eclipse. However, if an eclipse occurs while the Moon is on the far side of its orbit, the Moon appears smaller than the Sun and can't completely cover it. Looking down from space, we would see that the Moon's umbral shadow is not long enough to reach Earth. Instead, the 'antumbral' or negative shadow reaches Earth. The track of the antumbra is called the path of annularity. If you are within this path, you will see an eclipse where a ring or 'annulus' of bright sunlight surrounds the Moon at the maximum phase. Annular eclipses are also dangerous to look directly with the naked eye. You must use the same precautions needed for safely viewing a partial eclipse of the Sun (see: Eclipses & Eye Safety).

Annular Solar Eclipse and the Path of Annularity

Annularity can last as long as a dozen minutes, but is more typically about half that length. Since the annular phase is so bright, the Sun's gorgeous corona remains hidden from view. But annular eclipses are still quite interesting to watch. You can read all about the recent annular eclipse of February 16, 1999 which was visible from western Australia. More annular eclipse photos are posted at Solar Eclipse Photo Gallery.



1999 annular eclipse sequence
This seven image sequence covers the entire 2.5 hour long annular eclipse of Feb 16, 1999.
Annular Solar Eclipse of 1999 Feb 16 (Greenough, Australia)
Photo (c)1999 by Fred Espenak

Eclipse Frequency and Future Eclipses

During the six Millennium period 2000 BC to AD 4000, Earth will experience 14,263 solar eclipses as follows:

All Eclipses = 14263 = 100.0%

Partial (P) = 5029 = 35.3%
Annular (A) = 4699 = 32.9%
Total (T) = 3797 = 26.6%

Hybrid[1](H) = 738 = 5.2%

[2]Hybrid eclipses are also known as annular/total eclipses. Such an eclipse is both total and annular along different sections of its umbral path.

The table below lists every solar eclipse from 2001 through 2008.

The Eclipse Magnitude is the fraction on the Sun's diameter covered by the Moon at greatest eclipse. For magnitudes greater than 1.0, it is a total eclipse. The Central Duration is the duration of either the total or annular phase of the eclipse.

The last total solar eclipse visible from the continental United States occured on Feb. 26, 1979. A total solar eclipse was visible from Hawaii and Mexico on July 11, 1991. The next two total solar eclipses visible from the United States occur on Aug. 21, 2017 and Apr. 8, 2024.

Specific Copyright Information

The use of eclipse maps, figures, tables and eclipse predictions in other publications is freely permitted when accompanied by the following credit line:

"Eclipse map/figure/table/predictions courtesy of Fred Espenak, NASA/Goddard Space Flight Center."

A copy of the finished publication (book, article, poster, etc.) should be mailed to:

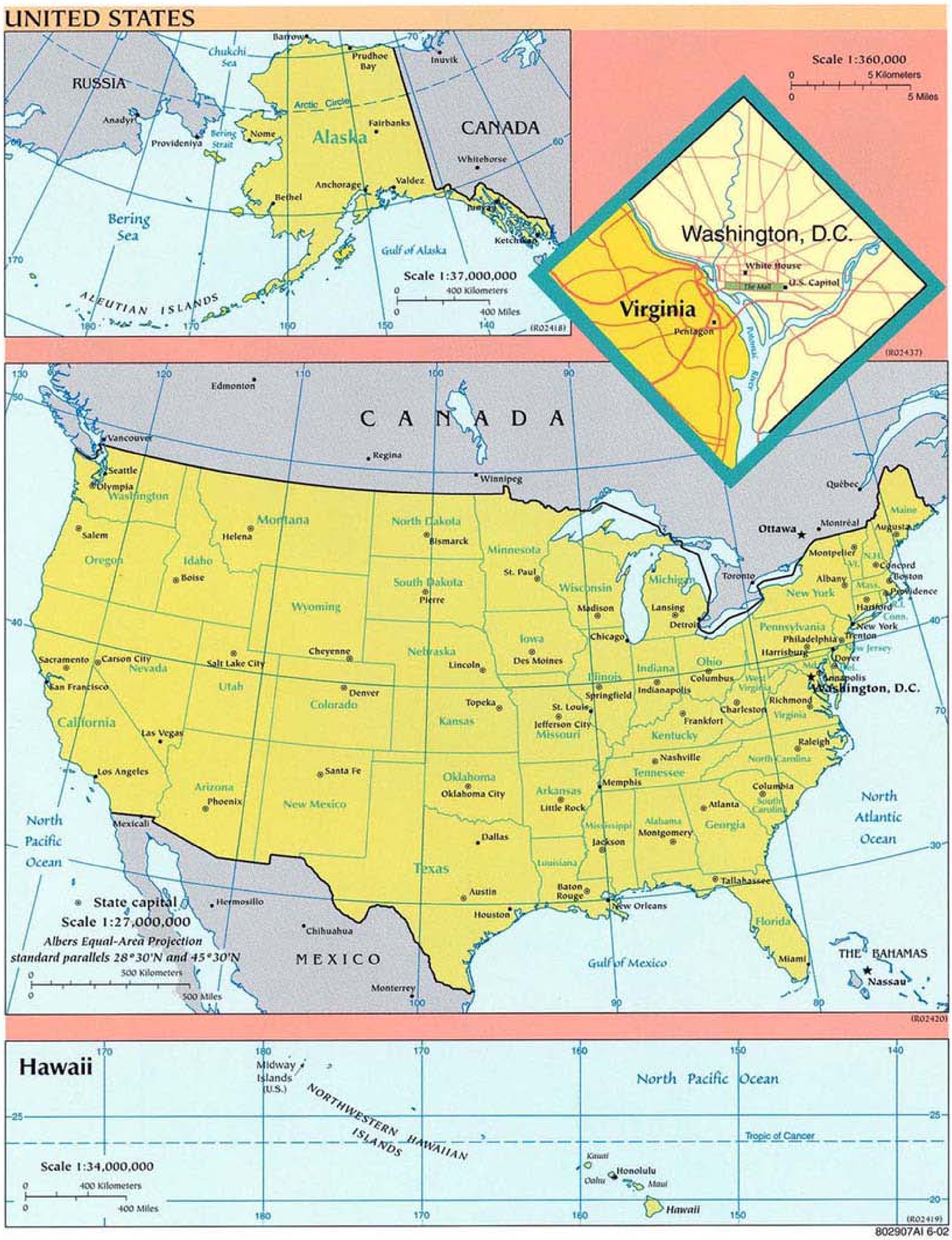
Fred Espenak
NASA/Goddard Space Flight Center
Code 693.0
Greenbelt, MD 20754
USA

A reference to the Eclipse Home Page should also be included somewhere in the publication. For example:

"For more information on solar and lunar eclipses, see Fred Espenak's Eclipse Home Page: sunearth.gsfc.nasa.gov/eclipse/eclipse.html"

The use of eclipse maps, figures, tables and eclipse predictions on other web sites is also permitted using the above guidelines. The web usage should also include a link to the Eclipse Home Page along with the credit line. Use the following example as a guide:

Eclipse map courtesy of Fred Espenak - NASA/Goddard Space Flight Center.
For more information on solar and lunar eclipses, see Fred Espenak's Eclipse Home Page:



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This map was taken from:
http://www.lib.utexas.edu/maps/united_states/united_states_pol02.pdf

Interested in learning more about geology and the solar system?

Check out the library science section. Ask for books about rocks, the solar system, and eclipses.

Here are a few examples:

Credit where credit is due….

The experiments, discussions, and pictures in this handout were taken or adapted from the following websites and books:

STRUCTURES:

SAM - SHAPE, ANCHORS, and MATERIALS

Houses and bridges can all be called "structures" and this science kit is all about exploring why some structures are stronger than others. Making strong structures requires choosing the right materials, choosing the best shapes and connecting all the pieces together with the right anchors.

Engineers and scientists work together to figure out how to build structures that keep people safe from natural disasters like tornados, hurricanes and earthquakes. Scientists study how tornados, hurricanes and earthquakes behave – how fast the wind is, how much the ground moves, how much rain can come down in a short time. Engineers learn what building materials are the strongest and most flexible, what shapes are the strongest, and what anchors hold the pieces together the best. All of this information helps the engineers design structures like bridges and buildings that can survive the forces of nature, or at least stay intact long enough to keep people safe.

Have you heard the story of the "Three Little Pigs"? The three little pigs are all afraid of the Big Bad Wolf, so they each decide to build a house to keep them safe. Each little pig builds his house out of different materials. The first little pig uses straw, the second little pig uses sticks, and the third little pig uses bricks. Can you guess which house the Big Bad Wolf can't blow down? Well, with this science kit, you will build your own houses and find out for yourself how hard (or how easy) they are to blow down! You will also build your own bridges and try different ways to make them stronger.

The activities in this kit give you a chance to be the engineer and build a better structure. Be sure to keep "SAM"- Shapes, Anchors and Materials -in mind as you do these experiments!

Here are the activities we'll do as we investigate STRUCTURES:

1. Who's afraid of the Big Bad Wolf? – Build the best house.
2. Who ever heard of a paper bridge? - Build the strongest bridge.

The experiment kit contains:

1. Paper (4 sheets)
2. Mini-marshmallows
3. Pretzels
4. Toothpicks (6)
5. 2 small rectangular boxes – They are flattened and need to be folded into shape.
6. 1 container of powdered sugar

You will also need from home:

1. Pennies (at least 40) or dry beans or other coins to use as weights
2. A small amount of water (in a spray bottle, if you have one)
3. Some tape – masking tape or clear scotch tape or electrical tape will do

You will also need the scissors & ruler from your Basic Kit.

REMEMBER SAM – Shapes, Anchors and Materials

Who's Afraid of the Big Bad Wolf?

The Three Little Pigs decided to build houses to protect themselves from the Big Bad Wolf. Each little pig built his own house and hid inside. The Big Bad Wolf blew down 2 of the houses, but not the third. What made one house better than the others? (Hint: What was different for each house?)

The first little piggy chose to build using the material straw. This house would look a lot like an American Indian hut like this one!

The only problem with this nice little house was that when the Big Bad Wolf came around, he huffed and puffed and blew that house down! The little piggy had to run like crazy to get away!

The second little pig chose to build using sticks as his material. Once again, when the Big Bad Wolf came around, he huffed and puffed and blew that house down, too! This little piggy also had to run like crazy to get away! Whew! How close was THAT!

Now, the third little piggy had been watching the other two and learning some great lessons about structures! She used what she learned to design her house. Her design used materials like brick, and she used mortar to anchor the bricks. Her house looked great…and it was very strong!

Imagine how surprised that Big Bad Wolf was when he came calling! He huffed…and he puffed…and he huffed…and he puffed some more, but this sturdy little house just was ***not*** falling down!

Each of the three little pigs used different materials and anchors to build their houses. Now it's your turn! Let's build some houses and find out which "structures" work the best. Remember to be creative! Each house you build can be a different shape – a traditional block house, a teepee, a tent, an igloo. It will also be different because of the materials and the anchors used.

Your goal is to design and build a house that the Big Bad Wolf can't blow down! Remember…shape, anchors, and materials…these three things matter.

What you need:

- A sheet of paper
- A handful of pretzel sticks (about 24)
- A handful of mini-marshmallows (about 24)
- Toothpicks (6)
- 1 container of powdered sugar
- Ruler
- Scissors
- Some water and a spray bottle (if you have one)

What to do:

First we are going to experiment with different materials and different shapes of houses.

1. Take your scissors and cut one piece of paper into skinny strips (kind of like straw!).
2. Build a small "straw" house that will fit into a 3 inch x 3 inch square. It doesn't need to have a roof. (HINT: Are you having trouble with making a certain shape of house? We did. Our test house looked a lot like a bird nest without a floor as you can see in the picture.)

3. Now take your pretzel sticks and build a "stick" house of some shape that is close to the same size as the "straw" house. It doesn't have to be the same style as the paper house. (HINT: Our test house ended up being a small square made from overlapping pretzel sticks. There were gaps between the stick walls. It reminded me of Lincoln Log toys or a log house from the 1800's.) Make sure to place this house close to your first house, but not too close. You want to be able to blow on one house at a time.
4. Now take your marshmallows and build a house of a similar size by just stacking the marshmallows like bricks. (HINT: Just make a pile of them if you can't build a house. It will get easier in the next part!!)
5. Now play the Big Bad Wolf and see if you can blow each house down. Be sure to count the number of times you blow on each house!
6. Record your results in the "Material Only" section of Chart 1.
7. Don't eat your houses yet!

I bet you could blow most of these houses down. In fact, they may have been pretty hard to build because they kept falling apart!

Let's make all of these houses better. Think about the house you live in and the buildings at school. Are those materials just stacked together? NO! People used things like nails and mortar (that's the stuff between the bricks) to keep the pieces tied or anchored together. Do you think our houses would stand longer if we connected the pieces together? Let's try it!

1. Put your "straw" house back together and then sprinkle (or even better, spray) a little bit of water on it. Don't use too much, just enough to get the paper to stick together.
2. Now you need to mix up some "mortar". Open the container of powdered sugar (very carefully) and add just a few drops of water. It only takes a teeny bit of water. DON'T add too much or your mortar will be too runny to work. Stir the water and powdered sugar. If the mixture isn't sticking together yet, add drops of water and mix until you get a stiff mixture that is like frosting.
3. Now go back to your pretzel house. Dip the ends of the pretzel sticks in the mortar, then rebuild your house, making sure to have the sticky pieces connecting pieces together.
4. Now for the marshmallow house. You can try two different things for this house. Pick one (or try both):
   - You can stick the marshmallows together by licking them or dipping them in water as you stack them together.
   - You can use toothpicks to attach marshmallows together. Have an adult help you with the toothpicks. (HINT: A triangle or pyramid type shape works well for this.)
5. It's Big Bad Wolf time again! Blow on each house and see if you can blow it down! Be sure to count the number of times you blow on each house.
6. Record your results for each house in the "Material plus Anchor" section of Chart 1.

Chart 1 - Can You Blow Your Houses Down?

Material Only	How many times did you blow on the house before it fell down?	Which material was best for wind?
"Straw" (Shredded paper) house		
"Stick" (pretzel) house		
"Brick" (marshmallow) house		
Material plus anchor	**How many times did you blow?**	**Which material plus anchor was best for wind?**
Wet "straw" house		
"Stick" house		
"Brick" house		

Questions to ask yourself:

- What difference did the materials for your house make?
- Which material stood up best to the wind – "straw," "stick," or "brick"?
- When you added something to hold the pieces of material together, did the anchors make the house stronger? Were they easier to build?
- Did the same house still last best under the "material plus anchor" tests?

Wrap-up:

Now all we did for this experiment was try to blow the houses down. What if it was raining? Or snowing? Or if there was an earthquake? If any or all of those things happened in your area, deciding which materials were best for your house would depend on more than just the wind.

Houses in deserts (like Las Vegas, Nevada have to protect against the heat. Houses near the ocean (like New Orleans, Louisiana) have to withstand hurricanes with strong winds and lots of rain. Houses in the prairies (like Kansas City, Kansas) don't have as much rain, but they can get heavy snow. Houses in Alaska have to protect against the snow and cold…and Eskimos use blocks of snow to do it!

Now you know some of the reasons why you see different types of houses in different places!

Who Ever Heard of a Paper Bridge?

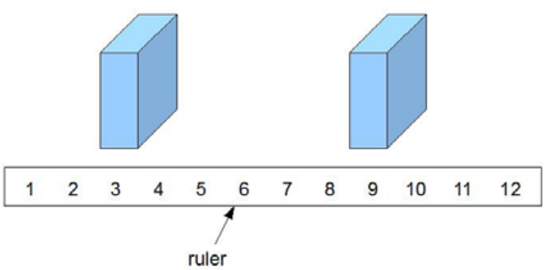
In this experiment, you will build a bridge using only paper. The first time through, you will see how changing the shape of the paper changes the strength of the bridge. The second time through, you will also see how anchoring the bridge ends changes its strength.

What you need:

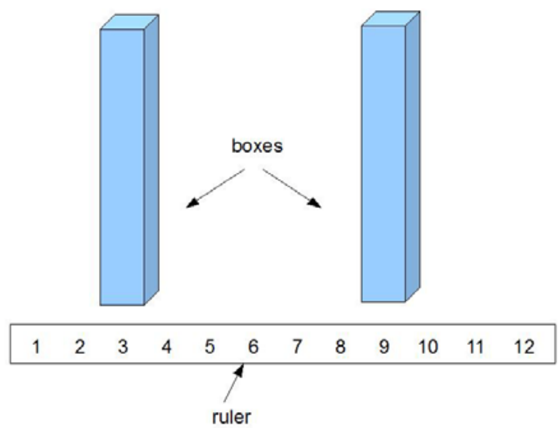
- 2 small rectangular boxes that have been folded into shape
- Three pieces of paper (One piece is a spare piece.)
- A ruler
- Some weights like pennies or dry beans – anything small that you can use for weights. You'll need at least 40 pennies.
- Some tape

What to do:

1. Place your ruler down on a flat surface like a table, a wood floor (not a carpeted one!) or a counter top.
2. Place your 2 boxes on the same surface next to the ruler. Place the middle of the first box on the 3″ mark on the ruler and place the middle of the second box on the 9″ mark. The longest side of the box should be on top and the short side facing the ruler. (See the pictures below.). The boxes are going to be the supports for your bridge.

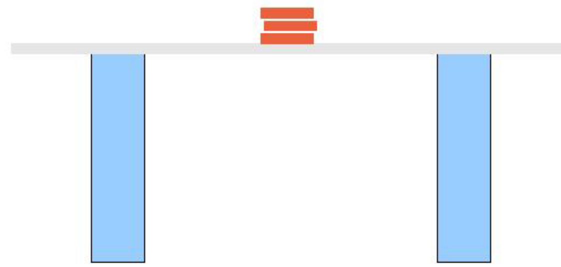


View from the SIDE



View from the TOP

3. Take your piece of paper and lay it flat on top of your 2 boxes so that it makes a bridge.
4. Place a weight like a penny (or whatever you found to use) on top of the paper in the middle of the bridge.
5. Did the bridge hold up? If so, keep putting weights on the bridge, as close to the center as you can, until the bridge falls down.



6. Count the number of weights you added before it fell and record it on the "Flat Paper" line of Chart 2 under "Without Anchors" (first time).
7. Now take the piece of paper and fold it in half along the long edge so that your paper is about 4 inches wide and 11 inches long. Place the folded piece of paper on top of your supports (the boxes).
8. Place weights on the center of the bridge, one at a time, until the bridge falls down.
9. Count the number of weights you added before it fell and record it on the "Paper with 1 fold" line of Chart 2 under "Without Anchors" (first time).
10. Then fold the paper in half again, so that your paper is about 2 inches wide and 11 inches long. Place the folded piece of paper on top of your supports (the boxes).
11. Place weights on the center of the bridge, one at a time, until the bridge falls down.
12. Count the number of weights you added before it fell and record it on the "Paper with 2 folds" line of Chart 2 under "Without Anchors" (first time).
13. Then fold it in half one more time. Now open up the piece of paper and re-fold it like a fan. This means to open up the piece of paper and then fold along each crease line in a back and forth fashion to make an accordion type fold or a fan. The paper will look like this:

14. Place this on top of the boxes so that the fold peaks are on the top and bottom and you see the triangle shapes along the long edge of the box.

15. Add a small piece of paper to the top of the bridge so that your weights don't fall into the valleys made by the folds, then place weights on the center of the bridge, one at a time, until the bridge falls down. The paper may end up falling into the valleys, but that will be OK.
16. Count the number of weights you added before it fell and record it on the "Paper folded like a fan" line of Chart 2 under "Without Anchors" (first time) .

    Questions to ask yourself:

    - When you folded the paper each time, it was narrower, but do you think it is stronger? _____ Why or Why not?
    - What was different about the paper folded like a fan? Look at the sides of the bridge, what shape do you see?
    - When a bridge fell down, how did it fall – did the paper break or did the ends of the paper just slide off the boxes?

If the ends slid off the boxes, what do you think would happen if you put something to hold down (or anchor) the ends of the bridge? Let's try it!

1. Build a new "flat paper" bridge with a new piece of paper, but hold down the ends of the bridge with tape (tape it to the boxes) or with several of your weights. You can use a rolled piece of tape underneath the paper or tape the edges of the paper to the boxes.
2. Place weights on the center of the bridge, one at a time, until the bridge falls down.

3. Count the number of weights you added before it fell and record it on the "Flat Paper" line of Chart 2 under "With Anchors" (second time).
4. Build a new "1 Fold" bridge (fold the new paper once like you did before), but hold down your bridge to the boxes with tape or weights.
5. Place weights on the center of the bridge, one at a time, until the bridge falls down.
6. Count the number of weights you added before it fell and record it on the "Paper with 1 fold" line of Chart 2 under "With Anchors" (second time).
7. Build a new "2 Fold" bridge (fold the new paper once more like you did before), but hold down your bridge to the boxes with tape or weights.
8. Place weights on the center of the bridge, one at a time, until the bridge falls down.
9. Count the number of weights you added before it fell and record it on the "Paper with 2 fold2" line of Chart 2 under "With Anchors" (second time).
10. Now build a new "fan" bridge, but hold down the ends of your bridge with some tape or weights. (You have an extra piece of paper if you need to use a new piece for this.) Add a small piece of paper to the top of the bridge and tape it to the boxes so your weights don't fall into the valleys made by the folds.
11. Place weights on the center of the bridge, one at a time, until the bridge falls down.
12. Count the number of weights you added before it fell and record it on the "Paper folded like a fan" line of Chart 2 under "With Anchors" (second time).

Chart 2: How Much Weight Can the Bridge Hold?

	Number of Weights On Bridge Before Collapse	
Bridge style	**Without anchors (first time)**	**With anchors (second time)**
Flat paper		
Paper with 1 fold		
Paper with 2 folds		
Paper folded like a fan		

Wrap-up:

During the first experiment, for each new style of bridge, we changed the shape of the bridge and how the material was used in the bridge (number of paper layers). During the second experiment, we built the same three styles of bridges but also anchored each bridge.

Questions to ask yourself:

- Which bridge was the strongest without being anchored at the ends? Which
- bridge was strongest with anchors?
- Did the anchors matter? _______ Why or why not?

Interested in learning more about structures?

Credit where credit is due….
The experiments, discussions, and pictures in this handout were taken or adapted from the following websites and books:

1. The story of the "Three Little Pigs" was first published in the 18th century, but the story itself is thought to be much older. Many versions of the tale exist. We chose to stay with a more cheerful version where no one gets eaten. See Wikipedia for more notes on the story and its history.
2. The bridges experiment came from the following website: http://www.tryscience.org/experiments/experiments_paperbridge_athome.html

For information on more challenging experiments, please visit the following websites:

- http://www.tryscience.org
- http://www.tryscience.org/experiments/experiments_spaghettibridge_athome.html

Questionnaire

1. Were the materials provided appropriate? Yes _____ No _____

   If not, please explain. ________________________________

   ____

2. Did you have enough materials for each experiment? Yes___ No___

   If not, please explain. ________________________________

   ____

3. Did these experiments work? Yes_____ No_____

   If not, please explain. ________________________________

   ____

4. Please provide any suggestions for improvements or additional

   experiments/explanations.

   ____

   ____

   ____

Your feedback is very valuable to us! Thanks!

Tangrams

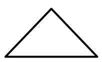
Here are the activities we'll do as we investigate Shapes using Tangrams:

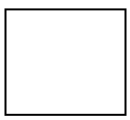
1. Tangram Exploration Chart
2. Tangram Puzzle

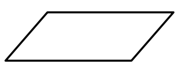
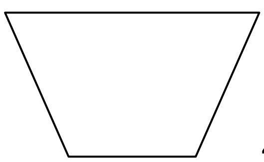
The activity kit contains:

1. Tangram Cutouts
2. Tangram Shape Puzzle

Tangrams help develop your understanding of shapes.

- **Triangle**  **3 equal sides**

  Square  **4 sides with all sides equal**

- **Rectangle**  **4 sides with opposite sides equal**
- **Parallelogram**  **4 sides with one pair of sides slanted the same direction**
- **Trapezoid**  **4 sides**

What to Do:

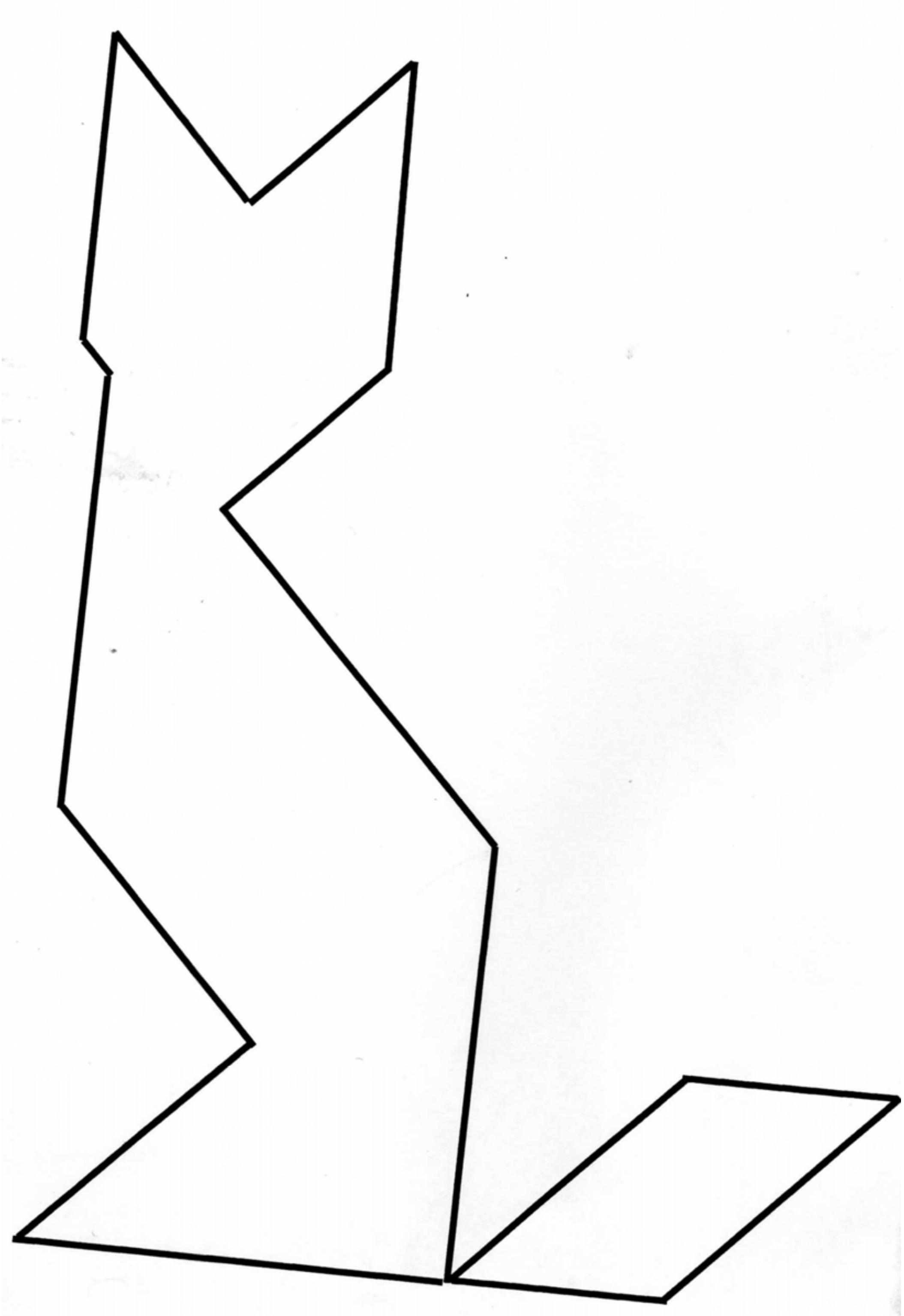
1. **Use the seven Tangram cutouts to see how many cutout pieces it takes to make each shape listed on your Tangram activity sheet.**
2. **Mark your results on the Tangram Exploration Chart for each shape.**
3. **Answer these questions:**
   - **What did you discover about triangles?**
   - **What process did you use to figure out the shapes?**
   - **Are you able to make all the shapes?**

Complete the Tangram Chart by placing an X in the box for the numbers of pieces it takes for you to make each shape.

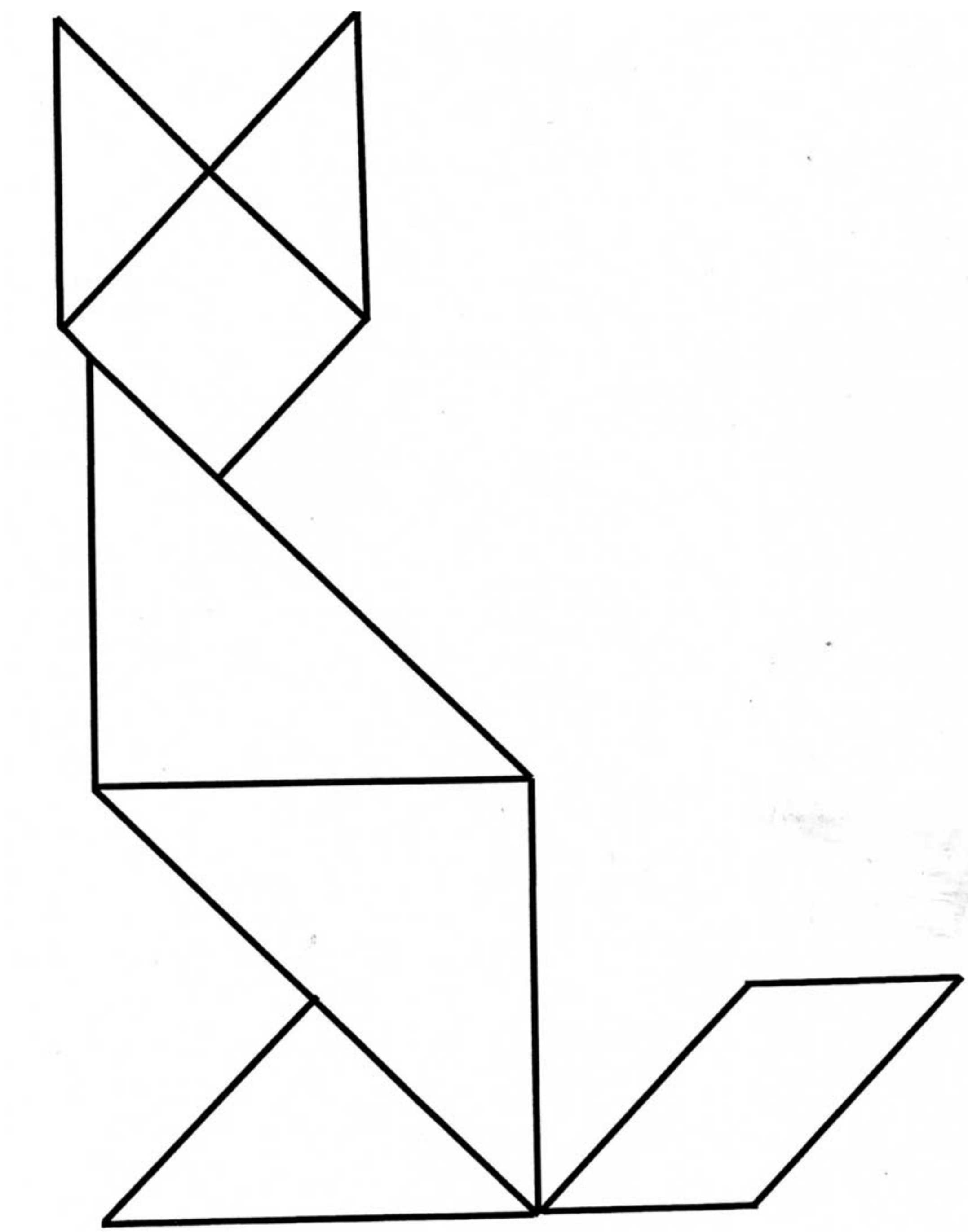
Tangram Exploration Chart					
	Shapes to Make				
Number of Tangram Pieces	Triangle	Rectangle	Square	Parallelogram	Trapezoid
1					
2					
3					
4					
5					
6					
7					

BONUS:

Just for fun try to use your 7 cutouts to fill in the Tangram shape puzzle.



PUZZLE ANSWER KEY:



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