About The Fun Guide

A scientifically literate public will be essential to society in the 21st Century. All areas of science and technology are progressing rapidly because of the revolution in information technology. Many predict that advances in biotechnology and nanotechnology will spur the same sort of dramatic changes in science, technology, and business. The 21st Century is also presenting us with the challenge of balancing economic development with stewardship of the environment at local and global scales. The more people know about the world around them, the more they understand science and the role it plays in their lives, the better equipped society will be to deal with these challenges.

Industry and academia should work together as partners in achieving excellence in scientific research and education. Indeed, industry supports academic and research efforts in science with many types of resources, and academia produces high-caliber research results and trains students who will create the new advances in industry. Of course, this could not be accomplished unless both partners spread enthusiasm and knowledge of science throughout their local communities.

This website, the *Austin Science Fun Guide,* represents just such a partnership. It is the outgrowth of the printed version of this gateway to intriguing science adventures, ranging from an entertaining and educational visit to a science center or an enjoyable stroll along a nature trail, to membership and a longer-term commitment to local science associations. All of these resources are generally accessible to the public and are located in the greater Austin area. All make science fun. The idea of the *Guide* itself grew along with a related program called Austin Science Fun Day. Austin Science Fun Day celebrates the joy of discovery by teaming school classes with groups of professional or serious amateur scientists to develop exhibit booths over the course of the winter for display on the first Saturday of every March at the Texas Memorial Museum.

The *Guide* and Austin Science Fun Day have always had corporate sponsorship. First AMD and later Motorola got the ball rolling on the *Guide*. National Instruments and AMD have been loyal funding sponsors of Austin Science Fun Day, and have recently been joined by Tokyo Electron America and KXAN-TV. Other corporations supply volunteers and judges for Austin Science Fun Day, like TyRex, the North Austin Rotary Club, National Instruments and AMD. And, of course, The College of Natural Sciences of the University of Texas at Austin was instrumental in creating and running both programs for several years, and remains a valuable partner in planning and organizing Austin Science Fun Day.

As with the previous editions of the *Austin Science Fun Guide*, many different types of science resources are included in the publication with the hope of stimulating interest in science for children as well as adults. We recognize that this guide is not comprehensive, thus, science groups not listed are encouraged to contact the Texas Memorial Museum for inclusion in the next edition of this guide.
As partners in this educational outreach mission, we hope that you will use the *Austin Science Fun Guide* as your companion while making scientific journeys in the greater Austin area.

Edward Theriot

Dr. Ed Theriot
Director, Texas Memorial Museum

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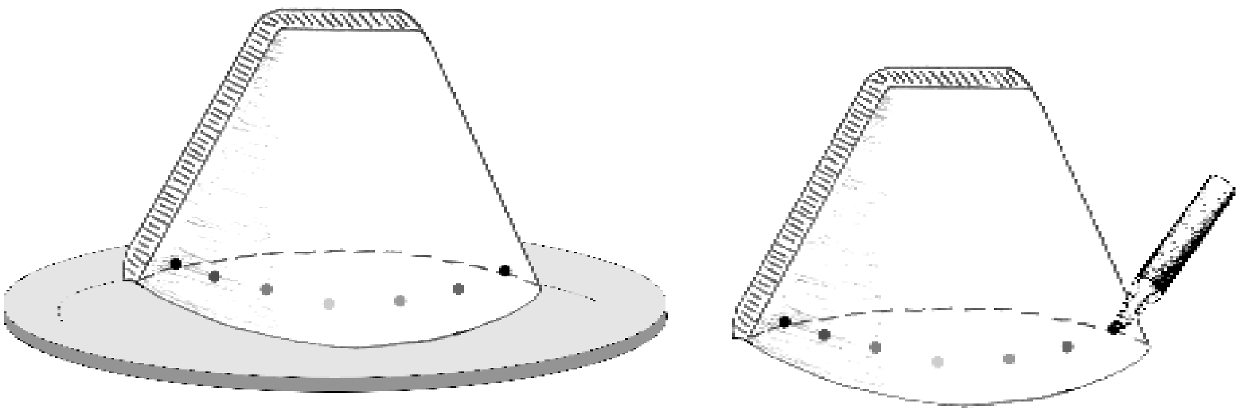
Science Activities To Do At Home!

You can explore science in and around Austin, or you can have a science adventure at home! The following activities have been collected from some of the groups listed in this guide. They are designed to be fun, instructive and simple to do with materials you have around your house or can easily and inexpensively purchase. We suggest that parents supervise children on all of these activities, but have specially noted the experiments that absolutely require parental supervision. So have fun and learn a little something in the process!

Chromatography



Grade level: Elementary through high school

What you need: White paper cone coffee filters
Plate or saucer with 1/8" of water
Water soluble marking pens in different colors

What to do: With one marker, make dots of color along the open end of the filter, as shown in the drawing. Open the filter and stand it in the sauce of water, with the dots of color at the bottom. As the water is absorbed by the filter, it will move up toward the dots. What happens when the water reaches and passes the dots?

Now try with other colors. You may be surprised at what you see. Be sure to try using a black marker. You may want to make some with many colors.

What is happening: In chemistry laboratories, liquids other than water are usually used to separate mixtures (like the ink in a marker) into its parts, or components. But chemists often see the same kinds of pattern you saw, with streaks of color that reach different heights and spread differently throughout the filter. Chemists use this method to identify the different chemicals in a mixture.

Submitted by:

Dr. J.M. White
University of Texas at Austin

Still Waters

Grade level: Elementary through high school

What you need: Large mixing bowl; Plastic wrap; Table salt; Plastic cup that is not as deep as the bowl; Clean marbles; A sunny window ledge

What to do: Fill the mixing bowl with two to three inches of water. Pour in several tablespoons of salt and mix the two together. Don't worry if all the salt doesn't dissolve. Place several marbles in the plastic cup (enough so that it won't float), and place the cup in the center of the bowl of salt water. Cover the bowl with the plastic wrap so that no air can get in or out, but not too tightly (you'll see why in a minute). Now, place several marbles in the center of the plastic wrap, so that the weight of the marbles makes the plastic wrap sag down over the top of the cup inside the bowl. Place the bowl in a warm, sunny window and wait.

When the water gets warm, some of it will evaporate. Evaporation means that some of the water in the bowl will go from being a liquid (which is one phase of matter) to a gas (another phase of matter). When the water becomes a gas we call it water vapor. There is always some water vapor in the air around us; the exact amount is called the humidity. What is the third phase of water?

Check on your still after it has been in the sun for a few hours. What do you see? Or maybe the better question is what dew you see? The evaporated water cannot escape from the bowl because it is covered with the plastic wrap. Therefore, it condenses (turns back into water) on the plastic. The water runs down the sagging plastic (weighted down by the marbles) and drips down into the cup.

Every morning and evening check on the level of water in the plastic cup. When you have collected enough water in your cup, you can try a taste. Is it salty? Compare it to the taste of the water in the mixing bowl. Is there a big difference? Based on what you taste, do you think that the salt evaporates with the water? The water in the cup may not taste very pleasant, but could you drink it if you had to? How about the salt water? Do you see how this science experiment could be used as a life-saving device?

What is happening: The objective of this experiment is to construct a water still and make pure, clean water out of salt water.

Submitted by: Dr. J.M. White, The University of Texas at Austin

The Fantastic Plastic Film Experiment

The goal of this experiment is to test the interactions that occur between water, shampoo and polystyrene.

Grade level: Middle school through high school

What you need: A piece of polystyrene clear plastic *(One source is a plastic sheet protector for 3-hole notebook paper. You can get them at the bookstore)*.
A soda straw to use as a dropper; A little shampoo; A centimeter ruler
A toothpick, wire or some other small diameter "stick-like tool" that you can coat with shampoo

What to do: Place your polystyrene sheet on a flat level surface where you can observe easily from the side and from the top.

Place some drops of water on the sheet using your straw. You can do this by sticking your straw into a glass of water, placing your index finger over the hole and pulling out the straw. When you loosen your index finger slightly, you can control the amount of water that you drop out. Make some big drops and some small ones.

Measure the diameters of the drops and looking from the side, sighting with your ruler, estimate their height. Finally, and again looking from the side, estimate the angle at which the water contacts the poly-styrene. Why are these drops all circular? Make a plot of the height versus the diameter? What do you conclude? Make a plot of the contact angle versus the diameter. Again, what do you conclude?

Take your “tool” (no shampoo yet), and push it across and through a water drop (i.e. move it parallel to the polystyrene). Describe what happens. You may want to try it several times to check what things happen every time.

Dip your “tool” in your shampoo and shake off the excess (we do not want any big drops). Now push your “tool” into the edge of one of the water drops. What happens? Now push it across and through a drop. What happens? How is this different from what happened before you dipped it into the shampoo?

What is happening: Scientists describe this using the language of surface tension. Water molecules on polystyrene find themselves more strongly attracted to each other than to the polystyrene so they want to pile up where they can stick to themselves. When you put shampoo molecules into the system, you have a different situation. One end of a shampoo molecule is attracted to plastic (or grease/oil on your hair) while the other end of the molecule is attracted to water. By bringing the water and polystyrene into mutual contact with these shampoo molecules, we say the shampoo “wets” the plastic and the water “wets” the shampoo. As a result, the water droplets spread out all over the plastic sheet.

Now to finish off, do/think about the following:

Wash your hair with shampoo. What is the function of shampoo?

Draw a model which illustrates the polystyrene, shampoo, water system, paying particular attention to the properties you would like the shampoo molecule to have if you were called on to make one. Don’t worry about the atomic composition of your model shampoo molecule – just say what molecular level properties you want it to have.

Now make a model for your hair washing experiment, showing what function the shampoo serves in a water, shampoo, dirty hair system.

Submitted by:

Dr. J.M. White,
University of Texas at Austin

Concentration: the great salt tasting experiment

Grade level: Middle and high school

What you need: Empty soda pop can (empty and rinsed thoroughly)
Table salt | Teaspoon | Salt detector (your tongue!)
Dry, clean jar (large enough to hold at least two pop cans of water)

What to do: A common soda pop can has a volume of 355 ml. A teaspoon of common table salt (NaCl) weighs about 10.7 gm.

Put a teaspoon of salt into the bottom of the jar. Fill your pop can with water and pour it into the jar. Make a mark on the outside of the jar so you can tell the level reached with one can of water. After dissolving the salt with vigorous stirring, taste the solution. Is it salty? This solution has about 10 molecules of salt for every 1000 molecules of water.

Add another can of water and stir. The concentration (number of salt molecules per unit volume) is now cut in half. This solution will have roughly 5 molecules of salt per 1000 molecules of water. Does this solution taste salty?

Pour out half the jar of water (i.e. down to the mark you made). Does this change the concentration? No! It just changes the volume of solution. So what you have left still has 5 molecules of salt per 1000 molecules of water.

Add another pop can of water. How many molecules of salt per 1000 molecules of water now? Is it salty?

Now repeat the above process (pour out half, add another can of water, get the new concentration, check for saltiness) until you can no longer taste the salt. How many molecules of salt per 1000 grams of water is your threshold detection level? Get a couple of friends to check you – maybe they have a worse or better sense of taste. The point is that taste is a rough detector – and a fairly sensitive one but we can do better with optical and mass detection machinery.

What is happening: When two compounds can be mixed uniformly together, like table salt and water, we say that a homogeneous solution has formed. Since we can dissolve a lot or a little salt in water, the idea of concentration is used to describe just how much salt there is in the water. This is really important. For example, saline solutions are used in medicine. To make them, just the right amounts of various things must be mixed together. Once mixed together, how do we measure concentration? In this experiment, we used a detection method we all have, taste!

It may not be too accurate, but we can all do it!

Submitted by:

Dr. J.M. White,
University of Texas at Austin

The Great Colored-Sugar-Cube-in-Water Experiment

Suggestion: Read through this experiment before you set out to do it. The goal of this experiment is to observe what happens when a highly colored cube of sugar is dropped into a glass of water. There are some short time and some long time processes.

Grade level: Middle and high school

What you need: Sugar cubes Food coloring Clear drinking glass Tap water
Watch with seconds, to measure elapsed time
Ruler, with cm on one side and inches on the other

What to do: To prepare for this experiment, take a sugar cube and put about six drops of dark (green is fine) food coloring onto one face. The idea is to get about half of the cube colored. Set the cube aside to dry briefly.

Fill the clear drinking glass with ordinary tap water (cold) and set it in a position where you can do the following – look down from the top, look through from the side, measure along the height of the glass with your ruler, and where you can leave it to sit undisturbed for several days.

Gently get hold of the sugar cube with the colored side up. Place it over the center and just above the top of the water, then drop it gently when your watch hits a convenient time. Some things are going to happen in seconds, others in minutes, and others in days, so be prepared!

How long does it take for the cube to get to the bottom?

Where are all the bubbles from? Are some colored? What happens when they hit the top of the water?

How long does it take for the bubbles to stop? What shape is the sugar cube in by then?

Does the color or do the sugar grains move faster? Why?

How long does it take for the color to become uniform across the bottom when viewed from the top? What is the color distribution when viewed from the side at this time? Why does the color tend to stay near the bottom?

Now the slow part. Measure with your ruler and keep track of the time for the movement of the color up through the water. From measurements over the first several hours you should be able to guess how long it will take to become uniformly green. Make your guess and then test your ideas by continuing to follow the green color.

Now go back through all these observations and see if you can give them a molecular level (microscopic) description. Use the language of water molecules, sugar molecules and dye molecules.

Now suppose you repeated the experiment with a shorter glass and used a plain white sugar cube. Would it take longer or shorter for some sugar to make its way to the top of the glass (compared to the taller glass)? Can you think of a simple way to detect when the sugar gets to the top?

What is happening: Diffusion is the chemical word that is used to describe the kind of motion being followed in this experiment. Do not worry too much about the quantitative time details, just do the experiment and get a sense of how long things take.

Submitted by:

Dr. J.M. White,
University of Texas at Austin

Collecting And Pressing Wildflowers

Collecting Wildflowers

*Never collect wildflowers from public lands, preserves, or protected natural areas. If you're collecting on private land, be sure to get permission from the landowner first. Don't stop along busy highways and roads – by doing so you create potential hazards for both yourself and others.

*Always identify wildflowers before picking them. Most areas have comprehensive wildflower field guides that will help you learn the local flora.

*Never collect endangered species; to find out which species area endangered in your state, contact your state Natural Heritage Program.

*Beware of any poisonous plants that may occur in your area – such as poison ivy, poison oak, and stinging nettles – and avoid them! Many poisonous plants have harmless look-alikes. Be sure you can determine the differences, or avoid both of them altogether.

*Do not pick a flower if it is the only one in a particular spot! Find a large population and only pick a few flowers.

*Try not to trample other plants or otherwise disturb the area as you collect.

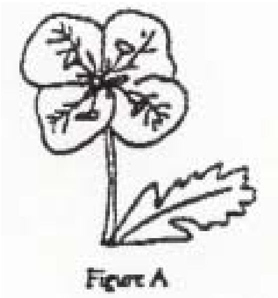
*Place cut flowers in buckets of water or an ice chest to transport them home, or press them in the field as you collect (see directions following).

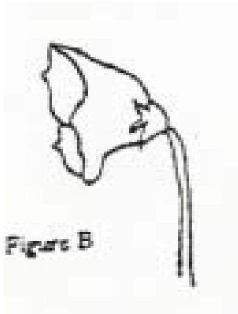
*Bring a notebook to record the location, collection date, habitat description, and any other details you may need for later records.

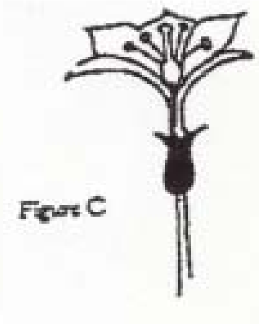
Pressing And Mounting Wildflowers And Native Plants

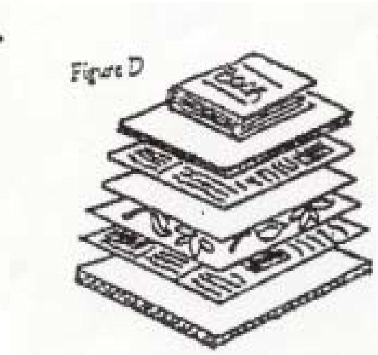
Materials Needed:

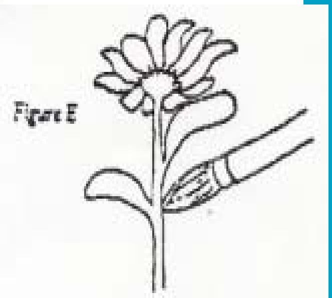
*White Paper (typing paper or computer paper)
*Newspaper
*Corrugated cardboard (channels should run the width of the piece to aid ventilation)
*Wooden plant press, or heavy boxes, or books, or bricks
*Elmer's glue
*Clear tape
*Paper towel (untextured)
*Toothpicks
*Needle and cotton quilting thread
*Artist's natural bristle brush (size 505)





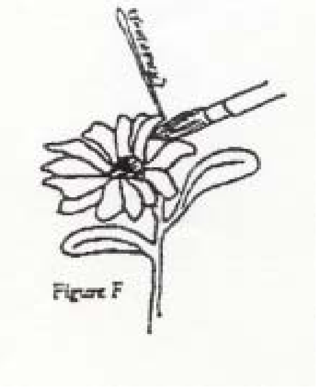






Pressing Plants

1. Pick a flower that is dry. Make sure you have the plant's roots as well.
2. Place the plant on white paper (do not use newspaper because ink will come off on the plant) and lay the leaves and petals flat.
3. If you are collecting flowers for the herbarium, always press extra flowers, in case of errors or accidents! Also in this case try to gather many of the same type of flower in different poses. (Figure A,B, and C)
4. Place a second sheet of white paper on top of your plant, and then sandwich it between two pieces of cardboard. (Figure D)
5. Weigh the specimens down with heavy boxes or books if you don't have a wooden plant press.
6. Place the specimens in a well-ventilated area to dry. DO NOT put plants in an oven, even at low temperatures! Plants that dry too quickly can turn brown or become brittle.
7. The plants should dry in four to five days.



To Mount Plants

1. When the plant is dry, gently remove it from the press. Place it on a strong piece of paper or cardboard on which you want to display it.
2. Indicate on your page the top and the bottom of your flower.
3. Lay the plant face down on the paper, and squeeze out a bit of glue (about the size of a penny) onto a piece of scrap or wax paper.
4. Dip an artists brush into the glue and paint the specimen on all flat surfaces. Do NOT paint the petals, just the leaves and stems. Too much glue is more of a problem than too little - coat lightly! (Figure E)
5. Carefully place your flower onto the sheet. Wipe off any extra glue.
6. Carefully lift each petal with a toothpick and apply glue to the paper directly under the petal. (Figure F)
7. Cover the plant with a sheet of wax paper to prevent it from sticking to the overlaying paper. Add a layer of folded newspaper for padding, then a sheet of cardboard forming a stack. Add some books to hold it down. Allow a few hours for drying.

Submitted by: The Lady Bird Johnson Wildflower Center

Water Quality: mini-groundwater models

The purpose of this experiment is to demonstrate the concepts of groundwater, aquifer, infiltration, leaching, percolation, water table and soil profile.

Grade level: Elementary school with adult supervision

What you need:
- clear plastic cups, about 10 oz in size
- paper coffee filters, cut into 2 in diameter rounds
- 1/4" clear tubing- cut in 6" lengths
- squirt bottles, misters, etc. filled with water
- tape
- 10 cc capacity syringes
- gravel, sand, topsoil
- food coloring (optional)

What to do: Take one length of clear tubing and tape to inside of cup so that the end of the tube rests on the bottom of the cup. The cup represents a "cut-out" of your backyard and the tubing is the "well".

Add a layer of gravel to the bottom of the cup. This represents the water holding material which makes up the aquifer.

Place a paper filter on top of the gravel. This is a "semi-permeable membrane". Water passes through but not the soil and sand above it. Many soils act as semi-permeable membranes.

Add layers of sand and soil, compacting as you go. This is the soil profile of your backyard!

Spray water on top of soil - this simulates rain.

Watch the water percolate through the soil and collect in the gravel (aquifer). This is a good way to demonstrate infiltration.

Use syringe as the pump and withdraw water from the "aquifer". (The syringe acts as a vacuum pump.)

Optional: add food coloring to the soil top near the well to act as pollution. See food coloring in withdrawn water.

Extensions: Add all of one soil and compare infiltration rates (time it takes for the water on top of the soil to get to the gravel or cut holes in bottom of cup).

Add food coloring to top of soil and ask students how much water will need to be added to the system before all the coloring is gone. Is the food coloring still there? Let the water evaporate to see if pigment remains.

Find out what a typical soil profile is in your area and simulate that profile in the cup. Measure how long it takes water to reach the "aquifer". Draw conclusions of how long it would take for a pollutant to pollute your community aquifer.

What pollutants from the activities in your community might the food coloring represent? Discuss nonpoint source pollution.

What is happening: Groundwater is defined as the water that seeps or percolates into the soil and is stored in an aquifer (water bearing material like gravel) where it can be pumped out for use.

Groundwater accumulates chiefly from rain that filters through the soil (also known as infiltration, percolation and leaching). It also forms from water that seeps into the ground from lakes and ponds. The water settles into the pores and cracks of rocks and into the spaces between grains of sand and pieces of gravel. A layer or bed of such porous material that yields useful amounts of groundwater is called an aquifer. Wells are drilled to an aquifer to draw the water to the surface.

The surface of groundwater, called the water table, drops when more water is withdrawn than can be replaced naturally. In some areas that have large populations or little rainfall, the groundwater supply may have to be recharged artificially. However, many regions of the world are using up the groundwater faster than aquifers are being recharged.

Pollution of groundwater is a serious problem. Pollutants that seep into the ground can come from contaminated surface water, leaks from sewer pipes and septic tanks and gasoline and chemical spills. Groundwater may also be polluted by chemical fertilizers and buried radioactive wastes.

Submitted by:

Austin Nature and Science Center

Modeling Petrified Wood

Grade Level: Upper elementary, middle school and high school

What you need:
Small pieces of wood, such as 4 cm long sections of small dowels, or similarly sized fresh twigs
5-10 lbs of playground sand
Food coloring (at least two colors)
Plastic wrap
6 small clear plastic cups
6 rubber bands
1 stirring rod or 1 Popsicle stick
Water (at room temperature)

What is happening: Certain conditions are necessary for wood to become petrified in Nature, but it is not as uncommon as we might think. First, a tree must be sealed from oxygen to prevent decay. If it is not sealed, bacteria will usually decompose the wood.

This seal may be created in a variety of ways. A flood which deposits sand and silt may suddenly bury a tree that has fallen to the forest floor. It may also be buried by volcanic ash from a nearby volcanic explosion or a lava flow. Next, there must be minerals present that will cause petrification. Examples include calcite, pyrite or “fool’s gold,” marcasite, and silica, which is the most common. These minerals dissolve in groundwater, seep through the sediment covering the wood, and replace the organic material in the wood. Through chemical processes, the minerals move from the water and into the individual plant cells. In good examples of petrification, you can still see the cell walls if you look closely enough.

This experiment will model the process of petrification. While performing the experiment, try to think of the natural processes that the experiment imitates. Before performing the experiment, read the “what to do” and predict what you think your results will be. Record your thoughts before and after the experiment in a ***Scientist Notebook***.

What to do:

1. If necessary, cut the wood into small enough pieces to fit into the small cups.
2. Fill one cup 1/4 full with sand.
3. Place one or two pieces of wood in the cup on top of the sand.
4. Pour sand over the wood until it is completely covered. Your cup will probably be about 1/2 full (maybe even more).
5. In another cup, fill it 1/2 full with water. Choose a color from the food coloring. Put 6 drops of food coloring in the water and stir with the stirring rod. Add drops of food coloring until the desired shade is reached. 10 drops are recommended. (Remember, the food coloring represents silica, or any of the other replacement minerals mentioned above. It can only be carried in water.)
6. Slowly pour the colored water into the cup with the sand and wood pieces. Pour just a little at a time, and watch it seep to the bottom each time.
7. Continue to add colored water until the sand is completely and evenly saturated and a little water covers the sand. It is best to have only about 1/2 cm of water on the surface of the sand. You do not have to use all of the colored water. Only use what you need.
8. Be sure that the wood is still buried after you pour the water in the cup. If not, push the wood under the surface of the sand with the stirring rod or a Popsicle stick.
9. Cover the cup with plastic wrap and place a rubber band around the outside. The rubber band and plastic wrap should fit tightly around the cup.
10. Repeat the above steps with a different color of food coloring, in a different cup.
11. Lastly, repeat the above steps without using food coloring, in a different cup. This will be the control of the experiment.
12. After 1 week, uncover the experiment and observe changes that have taken place in the various pieces of wood.

Your *Scientist Notebook*

Before the experiment

Write down your hypothesis, or what you think will happen.

After the experiment

What physical characteristics of the wood have changed?
How did these changes occur?
What part of natural petrification does the food coloring represent in this experiment?
Why were the cups covered with plastic wrap and a rubber band?
How would real petrified wood be different from the petrified wood that you created in the experiment? Why?
Explain the importance of the presence of water for petrification to occur.

What else? What happens if you try it again, and you change the some of the materials or the "to do" in the experiment? These are called variables. Try introducing new variables into the experiment and observe the changes, if any. Here are some examples of variables you could change for a new try at the experiment:

- time of burial
- clay instead of sand
- temperature of water
- old chicken bone instead of wood
- salinity of water
- piece of plastic instead of wood

For example, try using a different kind of sand or dirt. Does this change your results? If so, what might this tell you about the best environments for petrification?

Submitted by:
Texas Memorial Museum Education Department