Low Cost –High Interest Science Experiments for Adult Education

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As the 2014 high school equivalency test approaches, changes in curriculum are on the minds of adult educators in every field of study. Looking at the new requirement in the Depth of Knowledge in science, we have realized that students will be required to know more than merely how to read passages and interpret charts and graphs, a deeper understanding is necessary. Educators have long understood that the best way to approach the teaching of science includes a hands-on component; laboratory experimentation is universally accepted as a necessity to truly understand this field of study. However, within the confines of adult education, laboratory work is nearly impossible. Centers that are located within a high school may have access to laboratory equipment and supplies, but most adult learning centers do not have that luxury. How will the adult educators meet the more rigorous demands of the test while working with limited equipment and an even more limited budget?

This project provides a series of lessons that can be used in any classroom, and with supplies that are purchased from the local grocery store or home improvement center. Each experience includes a step-by-step set of lesson plans, along with supply lists. Also included are links to the websites where they were found for more information of similar experiments. Care has also be taken to include safety procedures, minimize risk, and limit set-up and clean-up time to fit within the bounds of the normal adult education environment.

Biology

1. Blood Compatibility Project

Use this project to illustrate blood type compatibility. If the color of the "blood" changes, it is incompatible. If the color of the "blood" stays the same, it is compatible.

Materials:

- 16 cups filled with water (four for each blood type)
- Red food coloring
- Blue food coloring
- Pen or pencil and paper to record data

Procedure:

1. Fill 16 cups with water.
2. Put red food coloring in four cups. They'll represent Type A blood.
3. Put blue food coloring in four cups. These will represent Type B blood.
4. Put blue *and* red food coloring in four more cups to make a purplish color; this will represent Type AB blood.
5. Leave only water in the last four cups; this will represent blood Type O.
6. Pour one of the red “A” blood type cups into another one of the “A” blood type cups. Since the color did not change, blood Type A is compatible for blood transfusions with blood Type A. Once you've recorded that data, discard the cup.
7. Next, pour another red “A” into a blue type “B” cup. Since the color changed to purple, Type A blood and Type B blood are not compatible. Make a note of this as well.
8. Then pour a different "A" cup into the purple AB blood type.
9. Finally, red type A will pour the last cup into type O.
10. Repeat the steps with type B, AB, and O and record the results.

What happened:

Blood Type A can only be given to Type A and AB patients. Blood Type B can only be given to Type B and AB patients. Blood Type AB individuals can receive blood from everyone, but can only donate to other AB blood type patients. Blood Type O individuals can only receive Type O blood, but they can donate blood to every other type.

(Blood Compatibility Project)

2. Nutritional Analysis

Good eating habits start at home, but it's difficult to keep track of your child's eating habits as she becomes older. Show her how to analyze the caloric and nutritional value of her favorite meals. She may be surprised to find out how healthy—or not—her favorite foods actually are. This activity's sure to increase her awareness of her diet and provide a gateway to a healthier future.

Materials:

- Favorite meal recipes
- Lined paper
- Pen or pencil

Procedure:

1. Have student list her favorite meals on a sheet of lined paper. They don't all have to be complete meals; she can also jot down her favorite side dishes and desserts.
2. Next, have her take another piece of lined paper and divide it into three sections, lengthwise. Ask her to write the word "Ingredients" at the top of the first column, "Number of Calories" at the top of the second column, and "Nutritional Value" at the top of the final column.
3. Now, invite her to choose one of her favorite meals and write it in the margin on the left hand side of her lined paper.
4. Encourage her to write each ingredient in a bulleted list if it's a recipe from scratch. If it's a prepared box meal, such as macaroni and cheese, have her write just the basic ingredients, cheese, pasta, milk, and butter.
5. Then, ask her to look up and record the number of calories in the second column across from each ingredient, based on serving size if made from scratch. Vegetables are extremely low in calories, so they don't need to be taken into account in this column. Fruits are a little higher in calories and amounts can be found via the internet. If it's a prepared meal, just have her write the total number of calories found on the back of the package. Remember: Most of the calories are based on small serving sizes, so try to take that into consideration.
6. Finally, have her write down the other important nutritional values or facts from the packaging from each ingredient, such as minerals, vitamins, fat, etc.
7. Invite her to repeat the above steps with all of her favorite foods and meals.
8. Now, have her add the total number of calories per meal. Have her analyze each meal paying attention to the amount of calories, fat, vitamins, minerals, etc.
9. Help your child come up with ideas to modify her meals if they are unhealthy in certain aspects, such as high in saturated fat. For example, packaged macaroni is high in calories and fat. Instead, you could use whole grain pasta, low-fat cheese, margarine, and add chopped zucchini and tomatoes. Another example is cheeseburgers; instead of beef burgers, you could substitute turkey (which has about half the fat and calories), low-fat cheese, a whole wheat bun, tomatoes, and romaine lettuce.

10. Finally, have her write her new modified recipes in each column. Encourage her to compare and contrast the old and new recipes for calories, fat content, and other nutritional values.
11. Try the new recipes together to promote a healthier lifestyle that will continue throughout adulthood!

(Dianda)

3. Autumn Leaves Science Projects

3a. PROJECT 1 - Separate Colors in a Green Leaf using Chromatography

Materials:

- leaves, small jars (baby food jars work well)
- covers for jars or aluminum foil or plastic wrap
- rubbing alcohol, paper coffee filters
- shallow pan, hot tap water, tape, pen
- plastic knife or spoon, clock or timer.

Procedure:

1. Collect 2-3 large leaves from several different trees. Tear or chop the leaves into very small pieces and put them into small jars labeled with the name or location of the tree.
2. Add enough rubbing alcohol to each jar to cover the leaves. Using a plastic knife or spoon, carefully chop and grind the leaves in the alcohol.
   SAFETY NOTE: Isopropyl rubbing alcohol can be harmful if mishandled or misused. Read and carefully follow all warnings on the alcohol bottle.
3. Cover the jars very loosely with lids or plastic wrap or aluminum foil. Place the jars carefully into a shallow tray containing 1 inch of hot tap water.
   SAFETY NOTE: Hot water above 150 F can quickly cause severe burns. Experts recommend setting your water heater thermostat no higher than 125 F.
4. Keep the jars in the water for at least a half-hour, longer if needed, until the alcohol has become colored (the darker the better). Twirl each jar gently about every five minutes. Replace the hot water if it cools off.
5. Cut a long thin strip of coffee filter paper for each of the jars and label it.
6. Remove jars from water and uncover. Place a strip of filter paper into each jar so that one end is in the alcohol. Bend the other end over the top of the jar and secure it with tape.
7. The alcohol will travel up the paper, bringing the colors with it. After 30-90 minutes (or longer), the colors will travel different distances up the paper as the alcohol evaporates. You should be able to see different shades of green, and possibly some yellow, orange or red, depending on the type of leaf.
8. Remove the strips of paper, let them dry and then tape them to a piece of plain paper. Save them for the next project.

3b. PROJECT 2 - Separate Colors in a Fall Leaf using Chromatography

Materials:

- leaves, small jars (baby food jars work well)
- covers for jars or aluminum foil or plastic wrap
- rubbing alcohol, paper coffee filters
- shallow pan, hot tap water, tape, pen
- plastic knife or spoon, clock or timer.

Procedure:
Repeat step (1)-(8) from Project 1, this time using leaves that have changed color. You may have to wait much longer in steps (4) and (7). There is normally much less of the other colors in the leaves compared to the green chlorophyll.

(Autumn Leaves and Fall Foliage)

4. Photosynthesis

Plants use Photosynthesis to create food from sunlight and carbon dioxide. This reaction occurs because of the chlorophyll within plants, and is what gives them their green color. This experiment will answer twos question: Why are plants green? Why do plants need sunlight to remain green?

Materials:

- Plant with broad leaves (may be inside or outside
- Black construction paper
- Transparent material (such as a plastic bag)
- Scissors
- Tape

Procedure:

1. Cut a piece of black construction paper large enough to cover a broad leaf.
2. Now, wrap the construction paper around the leaf and use the tape to secure it.
3. Wait at least a week before removing the construction paper from the leaf.
4. When the experiment is finished, compare your leaf to the other leaves on the plant.
5. You should be able to see a distinct difference between the leaves.

(Tucker)

5. Xylem in Plants

The following experiment is a fun and easy way to see how water and nutrients travel up the stem using xylem within the plant.

Materials:

- 6 white carnations
- 8 plastic cups
- Food coloring (red, blue, and green)
- Knife or scissors
- Water

Procedure:

1. Fill four of the cups one-half full with water.
2. Add about 20-30 drops of food coloring to three of the cups of water (red, blue, and green). In this case, more food coloring is better! The fourth cup should contain just plain water.
3. Before placing any of the flowers in the cups of water, trim the stem of each flower at an angle to create a fresh cut. For cut flowers, it is important for the stem tubes to be filled with water. If air gets in the tube no water can move up the stem. Many gardeners and florists cut stems under water so no air bubbles can get in to break the tube of water and make the flower wilt.
4. Place one freshly cut white carnation in the cup containing the uncolored water. Then place a freshly cut white carnation in each of the three cups of colored water. Save the remaining two carnations for the next step. As you wait to see the results, make some predictions: How will the carnation in the plain water compare to the carnations in the colored water? Which color will be soaked up first? How long will it take? Will one of the colors create a deeper colored flower or do the colors all absorb to the same degree?
5. The next step is a popular trick called "Split Ends." Use a sharp knife to slit the stem straight down the middle. Put each half of the stem into a cup of different colored water (try positioning the red and blue cups next to each other, for example). Make a few more predictions: Which color will be soaked up? Will the colors mix to make a new color or will the color of the flower be divided down the middle? Just remember to keep the ends of the stems wet at all times and to make fresh cuts on the ends.
6. You'll want to check back every few hours to see how things are progressing. It may take as long as 24 hours for the colored water to work its way up to the white petals. At the conclusion of your experiment, remember to examine the whole plant carefully including the stems, leaves, buds, and petals to find every trace of color.

What Happened?

1.
   As you probably noticed, most plants have a "drinking" problem. Okay, in this case it's a good problem. Most plants "drink" water from the ground through their roots. The water travels up the stem of the plant into the leaves and flowers where it makes food. When a flower is cut, it no longer has its roots, but the stem of the flower still "drinks" up the water and provides it to the leaves and flowers.
2. Okay, now it's time to get technical. There are two things that combine to move water through plants -- *transpiration* and *cohesion*. Water evaporating from the leaves, buds, and petals (transpiration) pulls water up the stem of the plant. This works in the same way as sucking on a straw. Water that evaporates from the leaves "pulls" other water behind it up to fill the space left by the evaporating water, but instead of your mouth providing the suction (as with a straw) the movement is due to evaporating water. This can happen because water sticks to itself (called water cohesion) and because the tubes in the plant stem are very small (in a part of the plant called the *xylem*). This process is called *capillary action*.
3. Coloring the water with food coloring does not harm the plant in any way, but it allows you to see the movement of water through the roots to the shoots. Splitting the stem simply proves that the tiny tubes in the stem run all the way from the stem to the petals of the flowers. Our unofficial tests indicated that the blue dye went up the carnations the fastest, followed by the red dye and then the green dye.
4. Like colored dyes in this experiment, some chemicals that pollute our waters can get into the soil and ground water and contaminate our vegetables and plants growing in the soil. Some chemicals and pollutants, just like the color dyes, may travel up into the plant and affect its health or growth.

(Steve Spangler Science)

Physics

6. Experiments with Magnets - Mapping A Magnetic Field

Draw A Magnetic Field | Map A Magnetic Field

Although you can't see magnetism, you can make a map of a magnetic field which will help you to see where and how magnetism works

Materials:

- A large piece of paper
- A pencil
- A bar magnet
- A small compass

Procedure:

1. Place the magnet in the middle of a large piece of paper and draw round it in pencil to mark its position.

2. Put the compass near the magnet. Draw a short arrow next to the compass, showing the direction the needle is pointing.

3. Move the compass to another position. Draw another arrow showing the direction of the needle. Mark the compass and draw short arrows in about 20 places around the magnet.

4. The arrows on your map show curved lines that run from the north pole of the magnet to the south pole. The lines are drawn close together near the poles, where the magnetism is strongest. Away from the poles, where the magnetism is weaker, the lines are drawn further apart.

(Squidoo)

7. Experiments with Magnets - Magnetism Passing Through

Which materials can magnetism pass through?

Try an experiment to find out which materials magnetism can pass through.

Materials:

- Some metal paperclips
- A piece of paper
- A piece of cloth
- Some aluminum foil
- A magnet
- A glass jar
- Several metal cans

Procedures:

1. Put some paperclips inside a glass jar. Using a magnet on the outside of the jar, can you slide the paperclips up the inside? Yes, you can! Your magnet will attract the paperclips inside the jar, because magnetism passes through glass.

2. Now try the same experiment with a small metal can. If the can is made with magnetic metal, such as iron or steel, the magnet will attract the can but not the paperclips. The magnet will stick to the can, but the magnetism doesn't pass through the metal to the paperclips.

3. Try the experiment again with a can made of non-magnetic metal, such as aluminum. Magnetism passes through aluminum, so you can use the magnet to move the paperclips inside the can.

4. Try wrapping your magnet in different materials, such as paper, cloth or aluminum foil. Can you pick up paperclips with the wrapped magnet?

(Squidoo)

8. Balloon Air Pressure Magic

Materials
- 2 plastic drink bottles, 1-2 liters in size, clean and dry
- Latex balloons
- Pin or tack

Procedure:
1. Behind the scenes, begin with one plastic drink bottle and the tack. Without showing anyone in your potential audience, press the tack into the plastic to make a small hole in the bottom of the bottle. Widen it so that your hole ends up about 1/8" across…if it's a little bigger, that's okay too.
2. Now you'll need two volunteers—preferably one who's a kid and one who's a big, burly teen or adult. Give the big guy the bottle without a hole, and give the kid the bottle with the hole. Now have each volunteer place a balloon inside the neck of the bottle and stretch the opening of the balloon over the top of the bottle, so that the opening is covered completely.
3. On the count of three, challenge the two volunteers to blow up their balloons. Get ready for some fun: the little kid's balloon should inflate just fine, making an attractive decoration inside the bottle. But the other one will just not inflate!
4. For a little extra fun, invite another volunteer to try, using a different balloon. You can also offer the bottle with the hole in it, but sneakily hold your finger over the hole…if you do that, the other balloon won't inflate either!

What Happened?

When we blow up balloons, we move air into a compressed space and inflate the latex. But when the balloon is placed inside the bottle, and there's no way for the bottle's air to escape, the pressure inside the bottle is greater than the pressure that occurs from blowing on the balloon…and the balloon just won't blow up. When there's a hole at the bottom, however, the compressed air can escape, and the balloon can expand. It's good science…and for an elementary school kid, it's also some magical fun.

(Williams)

9. Spinning Office Chair Science Project

Have you ever watched an Olympic diver or gymnast twisting through the air? Did you notice how they often bring their legs and arms in close to their bodies and tuck their chins to their chests? It's easy to observe the grace and beauty of their movements, but beyond the athletic ability and artistic expression, a more subtle element is at work—science.

Materials

- Rotating office chair on wheels
- Plenty of space
- 2 dumbbells, cans of soup or other heavy objects of equal weight
- A partner

Procedures:

1. Make sure you have plenty of space around and sit in the chair.
2. Arrange your feet so they're off the ground.
3. Stretch your arms out to your sides.
4. Have your partner give your chair a light spin then quickly step away.
5. Immediately pull your arms into your chest.
6. Try the experiment again holding a weight (like dumbbells or cans of soup) in each hand and see what happens.
7. **Be careful when you perform this experiment! If you get spinning too fast, the chair could tip over. And be extra cautious when you get up, since you'll probably be dizzy!**

What happened:

1. You should have noticed that once you brought your arms in close to your body, you started spinning faster. This phenomenon is called the conservation of angular momentum. According to Newton's first law of motion, also called the law of inertia, an object in motion will stay in motion until an outside force acts upon it. Conservation of angular momentum is the corresponding principle that applies to rotating or spinning objects.
2. When moving along a linear plane, momentum is determined by multiplying an object's velocity (meters-per-second) and its mass (how much space it takes up). Angular momentum is determined by multiplying angular velocity and moment of inertia. Angular velocity is measured in degrees, or radians-per-second. Moment of inertia refers to how much mass the object has and how the mass is distributed around the rotational axis.
3. That's why when you pulled your arms in, you were able to spin faster. You reduced your moment of inertia by redistributing your mass about the rotational axis. With your arms out, your mass was farther from the rotational axis and the moment of inertia was greater. With your arms in, your mass was closer to the rotational axis, and the moment of inertia was smaller. Because of conservation of angular

momentum, there was still as much energy involved but each rotation required less energy to execute, so your spinning sped up. This is most clearly displayed by ice skaters in the winter Olympic Games, but divers and gymnasts demonstrate it as well. Watch how they tuck their knees into their chests and drop their chins down during flips and notice how the angular velocity changes.

(Home Science Tools)

10. What Absorbs More Heat?

When you're out in the sun on a hot summer day, it pays to wear some light colored clothes, but why is that? Experiment with light, color, heat and some water to find out.

Materials:

- 2 identical drinking glasses or jars
- Water
- Thermometer
- 2 elastic bands or some tape
- White paper
- Black paper

Procedures:

1. Wrap the white paper around one of the glasses using an elastic band or sellotape to hold it on.
2. Do the same with the black paper and the other glass.
3. Fill the glasses with the exact same amount of water.
4. Leave the glasses out in the sun for a couple of hours before returning to measure the temperature of the water in each.

What's happening?
Dark surfaces such as the black paper absorb more light and heat than the lighter ones such as the white paper. After measuring the temperatures of the water, the glass with the black paper around it should be hotter than the other. Lighter surfaces reflect more light, that's why people where lighter colored clothes in the summer, it keeps them cooler.

(Science Kids)

Chemistry

11. Chemistry Fun with Pennies

You can explore chemical reactions and clean pennies at the same time.

Materials:

- 20-30 dull pennies
- 1/4 cup white vinegar (dilute acetic acid)
- 1 teaspoon salt (NaCl)
- 1 shallow, clear glass or plastic bowl (not metal)
- 1-2 clean steel screws or nails
- water
- measuring spoons
- paper towels

11a. Shiny Clean Pennies

Procedures:

1. Pour the salt and vinegar into the bowl.
2. Stir until the salt dissolves.
3. Dip a penny halfway into the liquid and hold it there for 10-20 seconds. Remove the penny from the liquid. What do you see?
4. Dump the rest of the pennies into the liquid. The cleaning action will be visible for several seconds. Leave the pennies in the liquid for 5 minutes.
5. Proceed to 'Instant Verdigris!'
6. Pennies get dull over time because the copper in the pennies slowly reacts with air to form copper oxide. Pure copper metal is bright and shiny, but the oxide is dull and greenish. When you place the pennies in the salt and vinegar solution, the acetic acid from the vinegar dissolves the copper oxide, leaving behind shiny clean pennies. The copper from the copper oxide stays in the liquid. You could use other acids instead of vinegar, like lemon juice.

11b. Instant Verdigris!

Procedure:

1. Note: You want to keep the liquid you used to clean the pennies, so don't dump it down the drain!
2. After the 5 minutes required for 'Shiny Clean Pennies', take half of the pennies out of the liquid and place them on a paper towel to dry.
3. Remove the rest of the pennies and rinse them well under running water. Place these pennies on a second paper towel to dry.
4. Allow about an hour to pass and take a look at the pennies you have placed on the paper towels. Write labels on your paper towels so you will know which towel has the rinsed pennies.

5. While you are waiting for the pennies to do their thing on the paper towels, use the salt and vinegar solution to make 'Copper Plated Nails'.
6. Rinsing the pennies with water stops the reaction between the salt/vinegar and the pennies. They will slowly turn dull again over time, but not quickly enough for you to watch! On the other hand, the salt/vinegar residue on the unrinsed pennies promotes a reaction between the copper and the oxygen in the air. The resulting blue-green copper oxide is commonly called 'verdigris'. It is a type of patina found on a metal, similar to tarnish on silver. The oxide forms in nature as well, producing minerals such as malachite and azurite.

11c. Copper Plated Nails

Procedures:

1. Place a nail or screw so that it is half in and half out of the solution you used to clean the pennies. If you have a second nail/screw, you can let it sit completely immersed in the solution.
2. Do you see bubbles rising from the nail or the threads of the screw?
3. Allow 10 minutes to pass and then take a look at the nail/screw. Is it two different colors? If not, return the nail to its position and check it again after an hour.
4. The copper that coats the nail/screw comes from the pennies. However, it exists in the salt/vinegar solution as positively charged copper ions as opposed to neutral copper metal. Nails and screws are made of steel, an alloy primarily composed of iron. The salt/vinegar solution dissolves some of the iron and its oxides on the surface of the nail, leaving a negative charge on the surface of the nail. Opposite charges attract, but the copper ions are more strongly attracted to the nail than the iron ions, so a copper coating forms on the nail. At the same time, the reactions involving the hydrogen ions from the acid and the metal/oxides produce some hydrogen gas, which bubbles up from the site of the reaction - the surface of the nail or screw.

(Helmenstine)

12. Consumer Product Safety

As people become more Earth-conscious in their lifestyles –incorporating recycling into their daily routines, for example, or using less water for showers –children and teens are picking up on the message. And while you may try and shop for organic produce or carpool once in a while, chances are you have some very eco-unfriendly products lurking in your bathroom and kitchen cabinets.
In this activity, your teen will do some snooping to investigate just what's in those cleaning products, and learn how to use Material Safety Data Sheets to identify possible hazards in the home.

Materials:

- Household products (cleaning and bathing products are a great starting place)
- Computer with Internet connection
- Pen and paper

Procedure:

1. Pick out several household products you use every day. Possible items could include hair products, deodorant, cleaning products and laundry detergent.
2. Consult the list of ingredients. You have probably never paused to look at what goes into the materials that you use every day. Make a list of the different chemicals you find listed under each product name, particularly the "active ingredient."
3. There are many online sites which detail the Material Safety Data Sheets (MSDSs) for a given product or chemical. Depending on the database used, you will either find a sheet for the specific product or will need to search for individual chemicals in the product.
4. Read through the MSDS for each chemical. These papers tend to be cryptic and take a little bit of getting used to when reading. However, all MSDSs provide the same types of information including: Product name; name, address, and phone number of the company that manufactures the product; ingredients; acceptable exposure limits to the chemicals (usually listed as "OSHA PEL" or "ACGIH TLV" depending on governing agency limits used); hazard information; acute and chronic symptoms, carcinogenicity, and effects of overexposure; first aid measures; release measures; firefighting measures; handling and storage information; physical and chemical properties; stability and reactivity data; and disposal methods.
5. Things to consider while reading the MSDS: Is the product listed as a possible carcinogen (cancer-causing agent)? Do any of the chemicals listed in the product exceed maximum government recommended levels (OSHA PEL or ACGIH TLV)? What actions should be followed if you are overexposed to the product? Are there any risks of using the product that you were unaware of?
6. Although many chemicals listed in products may be noted as "hazardous" in the MSDS, keep in mind that these are designed for employees who are exposed to far higher quantities of the material in a work environment, and this does not

necessarily mean that they are dangerous for use in the home. However, there are usually more eco-friendly options out there.

7. After you have researched each chemical, write down any notes, especially the information on hazards, next to each item on the list.
8. To extend the activity, encourage your students to take a trip to the store and find more gentle, environmentally friendly products to replace the ones that they discovered to contain a high amount of chemicals. They can cross-reference with the MSDS a second time to make sure that the products billed as being "eco-friendly" really are any better!
9. If you students have a job (or gets one in the future) that works with chemicals (including cleaning products), their employers should have a folder on-site containing MSDSs for all products used at that location. Learning to understand MSDSs helps ensure worker safety, so encourage your class to locate and read the MSDSs for any chemical product they work with to ensure their safety as well!

(Stewart)

13. How To Make a Rainbow in a Glass Density Demonstration

This project forms nice layers. Try to avoid gel food colorings.

You don't have to use lots of different chemicals to make a colorful density column. This project uses colored sugar solutions made at different concentrations. The solutions will form layers, from least dense, on top, to most dense (concentrated) at the bottom of the glass.

Materials:

- Five clear glasses
- Sugar
- Water
- Spoon
- Food coloring (red, yellow, green, blue)

Procedure:

1. Line up five glasses. Add 1 tablespoon (15 g) of sugar to the first glass, 2 tablespoons (30 g) of sugar to the second glass, 3 tablespoons of sugar (45 g) to the third glass, and 4 tablespoons of sugar (60 g) to the fourth glass. The fifth glass remains empty.
2. Add 3 tablespoons (45 ml) of water to each of the first 4 glasses. Stir each solution. If the sugar does not dissolve in any of the four glasses, then add one more tablespoon (15 ml) of water to each of the four glasses.
3. Add 2-3 drops of red food coloring to the first glass, yellow food coloring to the second glass, green food coloring to the third glass, and blue food coloring to the fourth glass. Stir each solution.
4. Now let's make a rainbow using the different density solutions. Fill the last glass about one-fourth full of the blue sugar solution.
5. Carefully layer some green sugar solution above the blue liquid. Do this by putting a spoon in the glass, just above the blue layer, and pouring the green solution slowly over the back of the spoon. If you do this right, you won't disturb the blue solution much at all. Add green solution until the glass is about half full.
6. Now layer the yellow solution above the green liquid, using the back of the spoon. Fill the glass to three-quarters full.
7. Finally, layer the red solution above the yellow liquid. Fill the glass the rest of the way.

Tips:

1. The sugar solutions are miscible, or mixable, so the colors will bleed into each other and eventually mix.
2. If you stir the rainbow, what will happen? Because this density column is made with different concentrations of the same chemical (sugar or sucrose), stirring would mix the solution. It would not un-mix, like you would see with oil and water.
3. Try to avoid using gel food colorings. As you can see in my photo, it is difficult for young children to mix them into the solution.

4. If your sugar won't dissolve, an alternative to adding more water is to nuke the solutions for about 30 seconds in the microwave or to use warm water in the first place. If you heat the water, use care to avoid burns.
5. If you want to make layers you can drink, try substituting unsweetened soft drink mix for the food coloring, or four flavors of sweetened mix for the sugar plus coloring.

(Helmenstine, How to Make a Rainbow in a Glass Density Demonstration)

14. Hot Ice or Sodium Acetate

Make Hot Ice or Sodium Acetate from Vinegar and Baking Soda

You can supercool hot ice or sodium acetate so that it will remain a liquid below its melting point. You can trigger crystallization on command, forming sculptures as the liquid solidifies. The reaction is exothermic so heat is generated by the hot ice.

Sodium acetate or hot ice is an amazing chemical you can prepare yourself from baking soda and vinegar. You can cool a solution of sodium acetate below its melting point and then cause the liquid to crystallize. The crystallization is an exothermic process, so the resulting ice is hot. Solidification occurs so quickly you can form sculptures as you pour the hot ice.

Materials:
1 liter clear vinegar (weak acetic acid)
4 tablespoons baking soda (sodium bicarbonate)

Procedure:

1. In a saucepan or large beaker, add baking soda to the vinegar, a little at a time and stirring between additions. The baking soda and vinegar react to form sodium acetate and carbon dioxide gas. **Note:** If you don't add the baking soda slowly, you'll essentially get a baking soda and vinegar volcano, which would overflow your container. You've made the sodium acetate, but it is too dilute to be very useful, so you need to remove most of the water.
2. Here is the reaction between the baking soda and vinegar to produce the sodium acetate:
3. $Na^+[HCO_3]^- + CH_3–COOH \rightarrow CH_3–COO^- Na^+ + H_2O + CO_2$
4. Boil the solution to concentrate the sodium acetate. You could just remove the solution from heat once you have 100-150 ml of solution remaining, but the easiest way to get good results is to simply boil the solution until a crystal skin or film starts to form on the surface. This took me about an hour on the stove over medium heat. If you use lower heat you are less likely to get yellow or brown liquid, but it will take longer. If discoloration occurs, it's okay.
5. Once you remove the sodium acetate solution from heat, immediately cover it to prevent any further evaporation. I poured my solution into a separate container and covered it with plastic wrap. You should not have any crystals in your solution. If you do have crystals, stir a very small amount of water or vinegar into the solution, just sufficient to dissolve the crystals.
6. Place the covered container of sodium acetate solution in the refrigerator to chill.

Activities Involving Hot Ice

1. The sodium acetate in the solution in the refrigerator is an example of a super-cooled liquid. That is, the sodium acetate exists in liquid form below its usual

melting point. You can initiate crystallization by adding a small crystal of sodium acetate or possibly even by touching the surface of the sodium acetate solution with a spoon or finger. The crystallization is an example of an exothermic process. Heat is released as the 'ice' forms. To demonstrate super-cooling, crystallization, and heat release you could:

2. Drop a crystal into the container of cooled sodium acetate solution. The sodium acetate will crystallize within seconds, working outward from where you added the crystal. The crystal acts as a nucleation site or seed for rapid crystal growth. Although the solution just came out of the refrigerator, if you touch the container you will find it is now warm or hot.
3. Pour the solution onto a shallow dish. If the hot ice does not spontaneously begin crystallization, you can touch it with a crystal of sodium acetate (you can usually scrape a small amount of sodium acetate from the side of the container you used earlier). The crystallization will progress from the dish up toward where you are pouring the liquid. You can construct towers of hot ice. The towers will be warm to the touch.
4. You can re-melt sodium acetate and re-use it for demonstrations.

Hot Ice Safety

As you would expect, sodium acetate is a safe chemical for use in demonstrations. It is used as a food additive to enhance flavor and is the active chemical in many hot packs. The heat generated by the crystallization of a refrigerated sodium acetate solution should not present a burn hazard.

(Helmenstine, Hot Ice or Sodium Acetat)

15. Rock Candy - How to Make Rock Candy

15a. Colored & Flavored Rock Candy to Eat

Making your own rock candy is a fun and tasty way to grow crystals and see the structure of sugar on a big scale. Sugar crystals in granulated sugar display a monoclinic form, but you can see the shape much better in homegrown large crystals. This recipe is for rock candy that you can eat. You can color and flavor the candy, too.

Materials:
Basically all you need to make rock candy is sugar and hot water. The color of your crystals will depend on the type of sugar you use (raw sugar is more golden and refined granulated sugar) and whether or not you add coloring. Any food-grade colorant will work.

- 3 cups sugar (sucrose)
- 1 cup water
- clean glass jar
- cotton string
- pencil or knife
- food coloring (optional)
- 1/2 tsp to 1 tsp flavoring oil or extract (optional)
- Lifesaver candy (optional)
- pan
- stove or microwave

Procedure:

1. Pour the sugar and water into the pan.
2. Heat the mixture to a boil, stirring constantly. You want the sugar solution to hit boiling, but not get hotter or cook too long. If you overheat the sugar solution, you'll make hard candy, which is nice, but not what we're going for here.
3. Stir the solution until all the sugar has dissolved. The liquid will be clear or straw-colored, without any sparkly sugar. If you can get even more sugar to dissolve, that's good, too.
4. If desired, you can add food coloring and flavoring to the solution. Mint, cinnamon, or lemon extract are good flavorings to try. Squeezing the juice from a lemon, orange, or lime is a way to give the crystals natural flavor, but the acid and other sugars in the juice may slow your crystal formation.
5. Set the pot of sugar syrup in the refrigerator to cool. You want the liquid to be about 50°F (slightly cooler than room temperature). Sugar becomes less soluble as it cools, so chilling the mixture will make it so there is less chance of accidentally dissolving sugar you are about to coat on your string.
6. While the sugar solution is cooling, prepare your string. You are using cotton string because it is rough and non-toxic. Tie the string to a pencil, knife, or other object

that can rest across the top of the jar. You want the string to hang into the jar, but not touch the sides or bottom.

7. You don't want to weight your string with anything toxic, so rather than use a metal object, you can tie a Lifesaver to the bottom of the string.
8. Whether you are using the Lifesaver or not, you want to 'seed' the string with crystals so that the rock candy will form on the string rather than on the sides and bottom of the jar. There are two easy ways to do this. One is to dampen the string with a little of the syrup you just made and dip the string in sugar. Another option is to soak the string in the syrup and then hang it to dry, which will cause crystals to form naturally (this method produces 'chunkier' rock candy crystals).
9. Once your solution has cooled, pour it into the clean jar. Suspend the seeded string in the liquid. Set the jar somewhere quiet. You can cover the jar with a paper towel or coffee filter to keep the solution clean.
10. Check on your crystals, but don't disturb them. You can remove them to dry and eat when you are satisfied with the size of your rock candy. Ideally you want to allow the crystals to grow for 3-7 days.
11. You can help your crystals grow by removing (and eating) any sugar 'crust' that forms on top of the liquid. If you notice a lot of crystals forming on the sides and bottom of the container and not on your string, remove your string and set it aside. Pour the crystallized solution into a saucepan and boil/cool it (just like when you make the solution). Add it to a clean jar and suspend your growing rock candy crystals.

(Helmenstine, Rock Candy - How to Make Rock Candy)

15b. Help for Trouble with Sugar Crystals

Sugar crystals or rock candy are among the safest crystals to grow (you can eat them!), but they aren't always the easiest crystals to grow. If you live in a humid or warm climate, you may need a little extra advice to get things going.

There are two techniques for growing sugar crystals. The most common one involves making a saturated sugar solution, hanging a rough string in the liquid, and waiting for evaporation to concentrate the solution to the point where crystals start to form on the string. The saturated solution could be made by adding sugar to hot water until it starts to accumulate in the bottom of the container and then using the liquid (not the sugar at the bottom) as your crystal growing solution. This method tends to produce crystals over the course of a week or two. It fails if you live someplace where the air is so humid that evaporation is very slow or if you place the container in a location where the temperature fluctuates (like a sunny window sill) so that the sugar stays in solution.

If you have had problems with the simple method, here's what you need to do.

Grow a seed crystal.
The other way to get a seed crystal is to break one off from a piece of rock candy or other sugar crystal. Use a simple knot to tie the seed crystal onto some nylon line (don't use rough thread if you have a seed crystal). When you suspend the crystal in the solution you want it to be completely covered, yet not touching the sides or bottom of the container.

Supersaturate your crystal solution.
You need as much sugar as possible to dissolve into solution. Increasing the temperature dramatically increases the amount of sugar that will dissolve, so you can get a lot more sugar into boiling water than in hot tap water, for example. Boil the water and stir in more sugar than will dissolve. It's a good idea to pour the solution through a coffee filter to make sure no undissolved sugar remains in the crystal growing solution. You can use this solution as-is or you can let it evaporate for a day or so, until you see crystals start to form on the container. If you choose to evaporate off some of the liquid, reheat it and filter it before introducing the seed crystal.

Cool the solution slowly.
Sugar becomes much less soluble as the temperature falls from boiling to room temperature or refrigerator temperature. You can use this characteristic to stimulate quick crystal growth. The 'trick' is to allow the solution to cool slowly because if a sugar solution cools very quickly it tends to become supersaturated. This means solutions that cool quickly will become highly concentrated rather than grow crystals. You can slow the cooling of your solution by setting the whole crystal growing container inside a pot of near-boiling water. Either seal the crystal growing container so that no water gets in or else make sure the sides of the crystal container are tall enough that water won't get inside. Let the whole setup slowly drop down to room temperature. Sugar crystals grow slowly so while you might see growth within a couple of hours, it could take a couple of days to be visible. Once the solution has slowly dropped to room temperature, you could continue to take it down to the temperature of the refrigerator (if the container will fit inside).
If you suspend a seed crystal in a sufficiently saturated solution, you may get crystal growth over a few hours by controlling the cooling of the solution. Therefore, even if you live someplace where you can use the evaporation method for growing sugar crystals, you may want to give this method a go.

(Helmenstine, Sugar Crystal Growing Problems)

Geology

16. Make Your Own Quick Sand

Materials:

- 1 cup of maize cornflour
- Half a cup of water
- A large plastic container
- A spoon

Procedure:

1. This one is simple, just mix the cornflour and water thoroughly in the container to make your own instant quick sand.
2. When showing other people how it works, stir slowly and drip the quick sand to show it is a liquid.
3. Stirring it quickly will make it hard and allow you to punch or poke it quickly (this works better if you do it fast rather than hard).
4. Remember that quick sand is messy, try to play with it outside and don't forget to stir just before you use it.
5. Always stir instant quicksand just before you use it!

What happened?

1. If you add just the right amount of water to cornflour it becomes very thick when you stir it quickly. This happens because the cornflour grains are mixed up and can't slide over each other due to the lack of water between them. Stirring slowly allows more water between the cornflour grains, letting them slide over each other much easier.
2. Poking it quickly has the same effect, making the substance very hard. If you poke it slowly it doesn't mix up the mixture in the same way, leaving it runny. It works in much the same way as real quick sand.

(Science Kids)

17. Grow Stalactites and Stalagmites

Stalactites and stalagmites are large crystals which grow in caves. Stalactites grow down from the ceiling, while stalagmites grow up from the ground. The world's largest stalagmite is 32.6 meters long, located in a cave in Slovakia. Make your own stalagmites and stalactites using baking soda. It's an easy, non-toxic crystal project. Your crystals won't be as big as the Slovak stalagmite, but they will only take a week to form, instead of thousands of years!

Materials:

- 2 glasses or jars
- 1 plate or saucer
- 1 Spoon
- 2 Paper Clips
- Hot Tap Water
- Piece of Yarn, about a meter long
- Baking Soda (Sodium Bicarbonate)
- Food Coloring (optional)
- If you don't have baking soda, but you can substitute a different crystal-growing ingredient, such as sugar or salt. If you want your crystals to be colored, add some food coloring to your solutions. You might even try adding two different colors to the different containers, just to see what you get.

Procedure:

1. Fold your yarn in half. Fold it in half again and twist it together tightly. My yarn is colored acrylic yarn, but ideally you want a more porous natural material, such as cotton or wool. Uncolored yarn would be preferable if you are coloring your crystals, since many types of yarn bleed their colors when wet.
2. Attach a paper clip to either end of your twisted yarn. The paper clip will be used to hold the ends of the yarn in your liquid while the crystals are growing.
3. Set a glass or jar on either side of a small plate.
4. Insert the ends of the yarn, with the paper clips, in the glasses. Position the glasses so that there is a slight dip (catenary) in the yarn over the plate.
5. Make a saturated baking soda solution (or sugar or whatever). Do this by stirring baking soda into hot tap water until you get so much added that it stops dissolving. Add food coloring, if desired. Pour some of this saturated solution into each jar. You may wish to wet the string to start the stalagmite/stalactite formation process. If you have leftover solution, keep it in a closed container and add it to the jars when needed.
6. At first, you may need to keep an eye on your saucer and dump liquid back into one jar or another. If your solution is really concentrated, this will be less of a problem. Crystals will start to appear on the string in a couple of days, with stalactites growing down from the yarn toward the saucer in about a week and stalagmites growing up from the saucer toward the string somewhat later. If you need to add

more solution to your jars, be sure that it is saturated, or else you will risk dissolving some of your present crystals.

7. The crystals in the photos are my baking soda crystals after three days. As you can see, crystals will grow from the sides of the yarn before they develop stalactites. After this point, I started to get good downward growth, which eventually connected to the plate and grew up. Depending on the temperature and rate of evaporation, your crystals will take more or less time to develop.

(Helmenstine, Baking Soda Stalactites and Stalagmites)

18. How Do the Seasons Change in Each Hemisphere?

Materials:

- Computer with internet
- Globe or world map
- Pencil and paper for recording data

Procedure:
The first step of this project is to find at least 2 major cities from each hemisphere quadrant. Use a globe or the online World Atlas to search for cities. Remember to use your own city as one of the locations for your study! For each city you find, write down the name of the city and the country it is in. You can make a data table like the one below, and write two major cities in each quadrant:

	Western Hemisphere	Eastern Hemisphere
Northern Hemisphere	(city 1, country 1) (city 2, country 2)	(city 1, country 1) (city 2, country 2)
Southern Hemisphere	(city 1, country 1) (city 2, country 2)	(city 1, country 1) (city 2, country 2)

Now you are ready to look up weather information for each city. You will be using the internet to look up historical temperature data, so grab a pencil and paper to write down your data. For each city, you will be recording monthly temperature data from the last 3 years. Make a data table like this in your notebook to write down your data for each city:

Average Monthly Temperatures for:
(city) ___________________________________
(country) ________________________________
(circle the hemispheres) NW NE SW SE

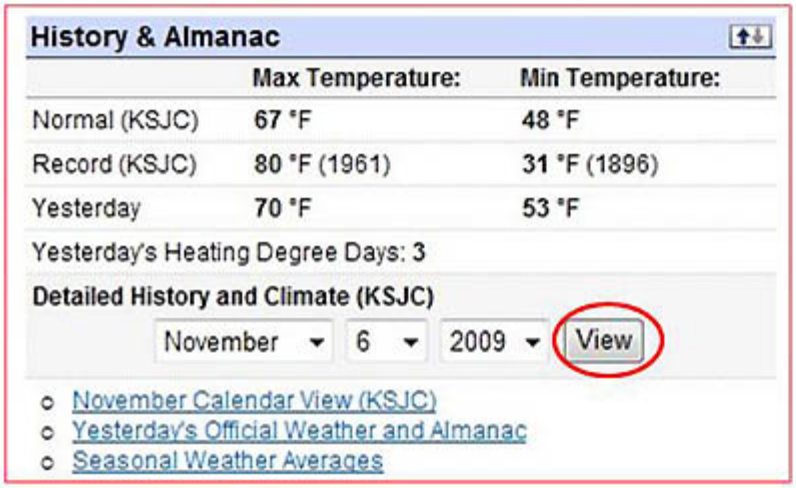
	2005	2004	2003	Average
January				

February				
March				
April				
May				
June				
July				
August				
September				
October				
November				
December				

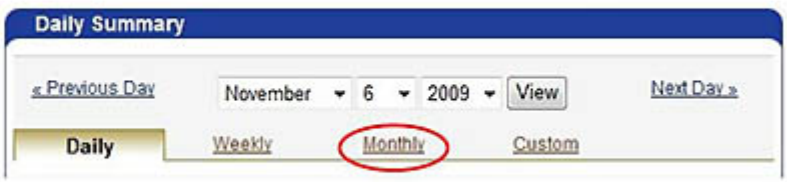
Now, get on your computer, connect to the internet, and open up your web browser. Type the URL, or web address, for "The Weather Underground" web site into the navigation bar: http://www.wunderground.com/

At the top, left-hand corner of the page there will be a box where you can type in your city and state to find your local weather. Type in your city and state, or your zip code, and then hit "Enter" or click on "Go."

About halfway down the page, you will see a box that says, "History and Almanac." In this box you will see the "Detailed History & Climate" option with today's date. Click on the "View" button.



A detailed history for your local weather station will appear on your screen, followed by a daily summary table. Just above the "Daily Summary" will be a series of output options: Daily, Weekly, Monthly, etc. Click on Monthly.

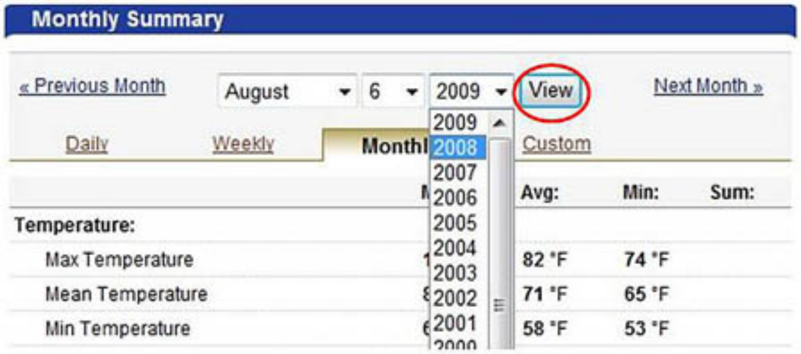


Now, using the drop down menu, choose the month and year you want to collect data for, then click "View."

When the new window appears, you will see "Summary," a table full of data for weather during that month in your city. Look for the box that tells you the "Average Mean Temperature." Use this example to help you find it:

	Max:	Avg:	Min:
Temperature:			
Max Temperature	100 °F	81 °F	73 °F
Mean Temperature	84 °F	71 °F	67 °F
Min Temperature	69 °F	61 °F	57 °F

Write down the data on your data sheet, and continue to collect data for each of the other months and years on your data sheet. You can do this by changing the month or year in the drop down menu above your "Summary" table and clicking on "View." You do not need to change the day of the month.



When you are done collecting data for your city from the last 3 years, you will need to average the data from each month. Calculate the average by adding together the three data points from each year, and then dividing the answer by three. Write this number in the data table. Repeat this calculation for each month in your data table.

After you collect data from each month and year, you are ready to collect the data for the other cities in your study. Just repeat steps 5 - 11 for each city on your list.

Last, you will need to make graphs and compare your results for each hemisphere. Make a line graph of Average Monthly Temperature vs. Month by making a separate line for each major city. On the left side of the graph (y-axis) make a scale of temperature and on the bottom side of the graph (x-axis) make a series of months. For each city, plot the point of intersection of each month with the matching average temperature and connect the dots. Give each city its own color, and make a color key for your graph to make it easy to interpret.

Which cities seasonal weather cycles matched on the graph? Are they in the same or different hemisphere? Which hemispheres match up and which ones don't?

(Agee)

19. Sponge Rock

You may be wondering how water gets in rocks in the first place. Aren't rocks solid? Actually, they have tiny pores or pockets that can be filled with water or air (or sometimes oil and natural gas) like a sponge. No rock can soak up as much water as a sponge, but some rocks absorb more water than others - these are called *porous* rocks.
This experiment will show you how a piece of chalk can absorb a great deal of water in a short time. Chalk is composed of the mineral calcium carbonate. (Different types of rocks are made of different pure minerals; rocks such as limestone have lots of calcium carbonate.) Have older students try this with various types of porous rock, such as pumice - they may need to wait up to a day for the rock to absorb the total amount of water it can hold.

Materials:

- A piece of chalk
- Cup of water
- Spring scale

Procedure:

1. Weigh the chalk with the spring scale to determine how heavy it is when dry. To do this, hang a small plastic bag from the hook and place the chalk in the bag. Record how much it weighs.
2. Place the chalk in a cup of water. In five minutes take the chalk out of the water, shake it off and weigh it again. Record the weight. Repeat at five-minute intervals until the chalk no longer increases in weight.
3. The chalk got heavier because it was absorbing water. After about 10-15 minutes, it absorbed all that it could hold. You can figure out how much water it absorbed, because 1 gram of water = 1 ml of water = 1 cubic centimeter (cc). If the chalk gained 2 grams in water, that means it soaked up 2 ml or 2 cc.
4. More advanced students can figure out what percentage of its volume the chalk absorbed. If the piece of chalk is a cylinder, they can find out its volume using the formula Volume = $\Pi r^2(h)$ where r is the radius and h is the height. (For example, if you have a piece of chalk 2 cm in diameter and 5 cm long, the formula would be $3.14 \times 1^2(5) = 15.7$ cc.) If it is a different shape, or they're trying this with other rocks, they can use the displacement method: pour 100 ml of water into a graduated cylinder and add the rock. The water level will rise, and the amount it rises is the rock's volume. If the water level rises to 125 ml, for example, then the volume of the rock is 25 ml, or 25 cc. Once you know the volume of the water absorbed and the volume of the rock, you can find what percentage of its volume the rock absorbed. Just divided the volume of water by the volume of the rock (e.g. 2cc/25cc = .08 = 8%).
5. Try this experiment with several different kinds of rock. Calculate the percentage of its volume that each rock can absorb. Which absorbs the most? Based on what you learned in the previous experiment, how do you think this affects the erosion of that type of rock?

6. Bubbling Rock
7. Certain rocks with *carbonate compounds* erode or dissolve when they come in contact with acidic chemicals. Carbon dioxide in the atmosphere sometimes can produce rain that is slightly acidic. Over time, this acid rain erodes rocks. You can see it happen quickly if you use vinegar, which is a *much* stronger acid than acid rain.
8. Use a piece of limestone, which is made of calcium carbonate. Put the limestone in a bowl, pour a little vinegar on top of it and watch what happens. It will fizz and form bubbles, because the vinegar reacts with the carbonate ions. As it reacts, it dissolves the limestone. When you're done watching it fizz, take the limestone out and look in the bottom of the bowl. You should see a layer of sediment made of small particles of calcium acetate, a chemical made when the acid and carbonates react.
9. Try it again, but this time use chalk, which is also made of calcium carbonate. Set one piece of chalk in a cup of vinegar and one in water. The chalk will immediately start reacting with the vinegar, making quite a show! Pour off the liquid after about an hour and compare the chalk that was in the water to the chalk in the vinegar. Is there sediment in the bottom of the vinegar cup? Is there any sediment in the water cup?
10. You can try this experiment again with different strengths of acid. Try lemon juice, diluted lemon juice, coke, or anything else you can think of!

(Home Science Tools)

20. Build a Solar Oven

You can use the sun's energy to heat up a tasty treat with this simple solar oven! (Get an adult to help you with the cutting.)

Download our Solar Oven Recipes to get ideas for what to make with your solar oven (http://www.hometrainingtools.com/images/art/SolarOvenRecipes.pdf)

Materials:

- Cardboard pizza box (the kind delivered pizza comes in)
- Box knife or scissors
- Aluminum foil
- Clear tape
- Plastic wrap (a heavy-duty or freezer zip lock bag will also work)
- Black construction paper
- Newspapers
- Ruler, or wooden spoon

Procedure:

1. Use a box knife or sharp scissors to cut a flap in the lid of the pizza box. Cut along three sides, leaving about an inch between the sides of the flap and the edges of the lid. Fold this flap out so that it stands up when the box lid is closed.
2. Cover the inner side of the flap with aluminum foil so that it will reflect rays from the sun. To do this, tightly wrap foil around the flap, then tape it to the back, or outer side of the flap.
3. Use clear plastic wrap to create an airtight window for sunlight to enter into the box. Do this by opening the box and taping a double layer of plastic wrap over the opening you made when you cut the flap in the lid. Leave about an inch of plastic overlap around the sides and tape each side down securely, sealing out air. If you use a plastic bag, cut out a square big enough to cover the opening, and tape one layer over the opening.
4. Line the bottom of the box with black construction paper - black absorbs heat. The black surface is where your food will be set to cook.
5. To insulate your oven so it holds in more heat, roll up sheets of newspaper and place them on the bottom of the box. Tape them down so that they form a border around the cooking area. The newspaper rolls should make it so that the lid can still close, but there is a seal inside of the box, so air cannot escape.
6. The best hours to set up your solar oven are when the sun is high overhead - from 11 am to 3 pm. Take it outside to a sunny spot and adjust the flap until the most sunlight possible is reflecting off the aluminum foil and onto the plastic-covered window. Use a ruler to prop the flap at the right angle. You may want to angle the entire box by using a rolled up towel.

7. You can make toast by buttering a slice of bread, or sprinkling cheese on it, then letting the sun do the rest. Cooking a hot dog or making nachos with chips and cheese are also fun treats to make in your solar oven! It would also work great to heat up leftovers. So the paper at the bottom doesn't get dirty, put what you would like to cook on a clear plastic or glass plate. A pie plate would work well.
8. To take food out of the oven, open up the lid of the pizza box, and using oven mitts or potholders, lift the glass dish out of the oven.
9.

What happened?

The heat from the sun is trapped inside of your pizza box solar oven, and it starts getting very hot. Ovens like this one are called collector boxes, because they collect the sunlight inside. As it sits out in the sun, your oven eventually heats up enough to melt cheese, or cook a hot dog! How does it happen? Rays of light are coming to the earth at an angle. The foil reflects the ray, and bounces it directly into the opening of the box. Once it has gone through the plastic wrap, it heats up the air that is trapped inside. The black paper absorbs the heat at the bottom of the oven, and the newspaper make sure that the heat stays where it is, instead of escaping out the sides of the oven.

Your solar oven will reach about 200° F on a sunny day, and will take longer to heat things than a conventional oven. Although this method will take longer, it is very easy to use, and it is safe to leave alone while the energy from the sun cooks your food. If you do not want to wait long to have a solar-cooked dish, try heating up something that has already been cooked, like leftovers, or a can of soup. Putting solid food in a glass dish and liquids in a heavy plastic zip lock bag works well. You can also pre-heat your oven by setting it in direct sun for up to an hour.

Other recipes you may want to try are making baked potatoes, rice with vegetables, chocolate fondue, s'mores, and roasted apples with cinnamon and sugar. Even on partly cloudy days there may be enough heat and light from the sun to slow cook a special dish. Here are a few tips for having success with your solar oven:

10. Stir liquids (if you're cooking something like fondue, rice, or soup) every 10 minutes. You can rotate solid food every 10-15 minutes as well, so it cooks evenly.
11. Reposition your solar oven when needed, so that it faces direct sunlight. You should be checking periodically on your oven, to make sure it is in the sun.
12. Make sure that the foil-covered flap is reflecting light into the pizza box, through the plastic-covered window.

(Home Science Tools)

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