Typical Format for Informal Science Activities

For each activity, the following information is given. Each activity lists the grade level, estimated time, materials needed, education standards, safety concerns, adaptations for participants with disabilities, the educational objective, questions to ask participants as they do the activity, information on why it happens, links to web sites, software suggestions, recommended reading materials, and career connections. **The activity sheets included at the end of each activity contain the instructions for how to do the activity.**

- **Materials Needed:** This tells you what items you need for the activity.

- **Safety Concerns:** Although none of the activities are dangerous, this section informs you of common sense precautions to help you create a safe learning environment.

- **Adaptations for Participants with Disabilities:** These suggestions will help you do these activities with participants who have vision, hearing, or mobility impairments.

- **Educational Objective:** This tells the main ideas that are illustrated in the activity.

- **Questions to Ask Participants as They Do the Activity:** This section refers to questions throughout the student activity page and provides additional questions you can ask the participants as they do the activity.

- **Information on Why It Happens:** This section gives a more detailed explanation, written in understandable, everyday language, of the principles involved in the activity.

- **Recommended Reading Materials and Career Connections:** These are suggestions for other related activities and references to books that may be in your group's library, public library, or local bookstore, and how to find related career information.

The activities in this manual are adapted from other science and mathematics books and manuals. They were selected for use in this project because they foster problem-solving skills through the use of data collection and analysis. Most of the activities can be completed in 20 to 60 minutes; some activities can be used for science fair projects or as displays at community science days and events. Nearly all of the activities utilize inexpensive materials that are available from local grocery, hardware, and consumer-electronics stores, hobby shops, or museum gift-shops.

Probing Questions

It is important to let participants explore and try to figure it out on their own. This is hard to do because we all want them to feel success very quickly.

Resist the temptation to give them a quick answer. Instead, try using probing questions which encourage participants to explore further:

- What will happen if...?
- How does it work?
- How did you do that?
- Why do you think that happened?
- Why do you think that will happen?
- How can you find out? Why not try it?

An important part of your job as a workshop leader is to monitor the participants' *frustration* level. Suggest that participants who are having difficulty get help from participants who are having more success. Make sure that your last resort is to grab the materials and show them the right way to do it! This will ensure that your participants will end up with an experience that is all their own. Most of the activities in this manual are also set up so that participants can work in small groups. This is another important technique in leading science and mathematics activities. In general, it's just more fun to work in groups, and it also develops the sense of peer support for having fun doing science and mathematics.

SEE Science & Health Activities

In the TechLinks for CTCs: Science, Math, Health & Literacy Activities for Community Technology Centers
Edited by Yolanda S. George, Nathan E. Bell and Gaynelle Bowden.
Activities listed below are from the CTC book and other handouts.

Activities

I. 12 Spot

II. Inhale and Smell

III. Simple Electric Circuits

IV. Word Factory

V. Balancing Act

VI. Butterfly Color Explosion

VII. Round and Round

VIII. Building with Wonderful Junk

IX. Seeing is Deceiving

12 Spot

The Basics	The Toolbox	Education Standards	Life Science Content Standard: Understanding the human neuromuscular system and how environment and lifestyle can be beneficial or detrimental to that system.
 Grade Level: 4-12	• 12 spots, cut out (use the 12 spot master sheet on page 169) • A watch or clock with a second hand	Safety Concerns	None.
 Estimated Time: 30 min.		For Kids With Disabilities	Visually-impaired students will need to use spots with Braille as opposed to the 12 Spot master sheet.

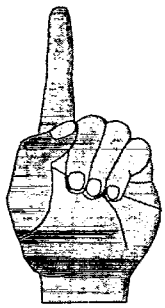
What To Do

Educational Objective:

To show that the proper function of the neuromuscular system and coordination depends on a healthy lifestyle, positive attitude, total focus on a goal, and avoiding drugs, alcohol, and prolonged stress.

What to Do:

- Make photocopies of the 12 Spot master sheet.
- Laminate the sheets on both sides using a laminating machine or 9 x 12-inch laminating sheets that can be found at any office supply store.
- Cut out the squares, and store each set in a separate plastic bag.



Questions to Ask Students As They Do This Activity:

- Try a round in which you and some students agree to praise some volunteers before they try 12 Spot. Choose a person who has tried but is not aware of the agreement. Smile at that person. Say, "You can do it. We know you are going to do really well this time."
- Try a negative approach. Say, "This is a test. You can quit at any time." Then say things like, "You might as well give up. This test is too difficult!" See how the times compare with the first round times.

- Did you feel stress during the activity?
- Could you handle the comments? Is it important for a person to feel able to handle a situation?
- Does alertness matter? What affects it?
- Did putting your finger on your belly button cause you to lose focus? What else might?
- How would drug use affect your ability?
- What if you were under stress?
- What if you used alcohol? Tobacco?
- What situations in life require people to perform well?

Why It Happens:

Task performance depends on **neurons** and **muscles**. Neurons carry signals in the **nerves**, **spinal cord**, and **brain**. Information goes to the brain, and signals make the muscles touch the correct number. Much can interfere with this process, like **drugs** and **stress**. Drugs interfere with the nervous system operation. Even **caffeine**, a legal stimulant, can cause problems and muscle tremors.

Alcohol depresses the part of the brain that controls impulsive behavior, so a person may feel talkative and stimulated. But the more you drink, the harder it is to make decisions. Nervousness and loss of coordination are part of regular drinking.

Smoking has harmful effects on the body. It slows down oxygen circulation. **Nicotine** stimulates nerve endings but then depresses them as the amount in the body increases. Smoking can cause muscle tremors.

Stress can cause the body to activate the sympathetic nervous system, which prepares the body for emergency situations. Short-term stress may have positive effects, but continued stress can hinder performance. Nicotine and caffeine can also activate the sympathetic nervous system. A positive attitude and focus on a task are factors in the successful completion of the task. Some people perform well despite criticism because they reject outside influences. Drugs and stress make positive attitudes and concentration difficult.

Web Sites

- **KidsHealth**
  http://www.kidshealth.org/ (Grades 3-12)
- **PREVLINE: Prevention Online**
  http://www.health.org/ (Grades K-12)
- **Dole 5 A Day**
  http://www.dole5aday.com/ (Grades 3-5)

Software

- **Body Works**
  The Learning Company, 1997
  (Grades 6-12)
- **My Amazing Human Body**
  DK Interactive Learning, 1997
  (Grades 3-6)

Reading Room

- Parramon Editorial Team. **The Human Body: Understanding and Taking Care of Your Body.** Parramon, 1998. (Grades 7 and up.)
- Sanders, Pete, and Steve Myers. **Drugs.** Copper Beech Books, 1996. (Grades 5-8)
- Williams, Frances. **Human Body.** DK Publishing, 1997. (Grades 5-8)

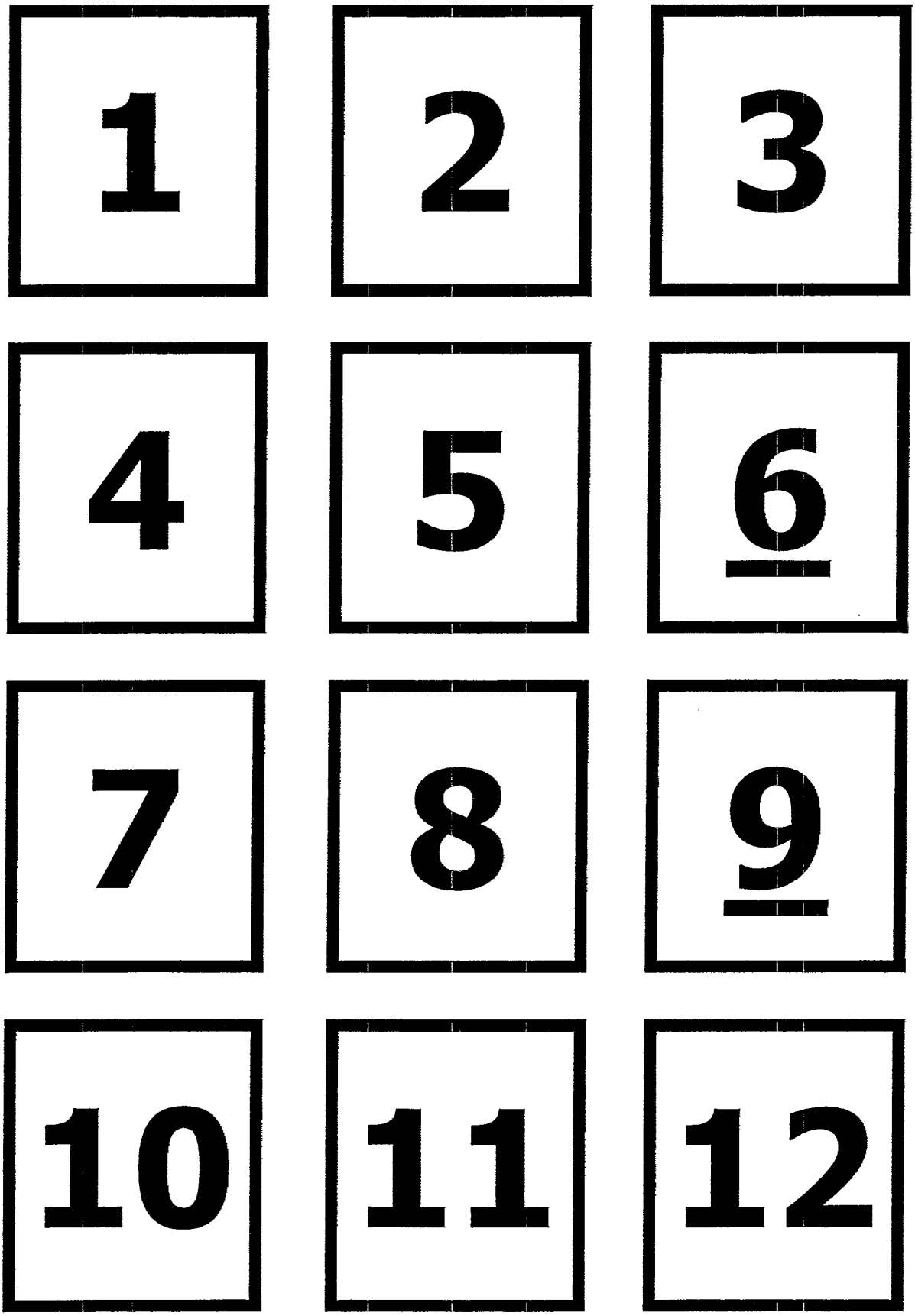
Career Connections

Neurology is the study of the nervous system in respect to its structure, functions, and abnormalities. Neurologists treat patients and also do research on such diseases as Cerebral Palsy, Muscular Dystrophy, Parkinson's Disease, and Alzheimer's.

12 SPOT ACTIVITY SHEET

- Your leader will give you 12 spots, numbered from 1 to 12.
- Appoint a person as a timekeeper.
- Appoint a person as a checker. The checker must make sure the volunteer touches each of the 12 numbered spots.
- Place the numbered disks on the table in random order in front of the volunteer.
- The object of 12 Spot is to touch each of the disks in order as fast as you can. The timekeeper will begin timing at the word "Go!" and stop when the volunteer touches #12.
- Record the results of these trials on a separate piece of paper.
- Try the same pattern three times, and record the best time. Give each student a chance to try being the volunteer, the timer, and the checker.
- Now try it while placing a finger of one hand on your belly button, while using the other hand to touch the 12 spots. Is this more difficult? Did this cause you to lose focus on the object of the test?
- Make up your own 12 Spot rules and variations. Try them and record your times!

Rule	Time


1
2
3
4
5
6
7
8
9
10
11
12

Inhale and Smell

THE BASICS	THE TOOLBOX
 Grade Level: 4-12  Estimated Time: 35 min.	• 7-8 food extracts such as vanilla, root beer, lemon, orange, almond, pineapple, or peppermint. • Masking tape • Pencils and paper

EDUCATION STANDARDS	**Life Science Content Standard:** Understanding that every organism has structures that serve different functions, and can also work together for growth and survival.
SAFETY CONCERNS	Don't inhale too deeply, or you could get a noseful of extract!
FOR KIDS WITH DISABILITIES	This is an excellent activity for visually-impaired students.

What To Do

Educational Objective:

To identify various smells, and demonstrate that the sense of taste is related to the sense of smell.

What to Do:

- Make copies of the activity sheet and data chart.
- Cover the labels on the food extract bottles with masking tape so the participants cannot identify the substances by sight.
- Number each bottle, and write the number and the name of the corresponding extract on a master sheet so you know the answers.
- You may want to make 2 or 3 identical sets for large groups of students.

Questions to Ask Students As They Do This Activity:

- Did you identify the smells?
- Which scents were easy to identify?
- Which were difficult?
- Name some situations in which you would encounter some of these scents.

Why It Happens:

Your nose is the organ for smell. There are nerve endings in your nose that distinguish the odors of different substances. When you have a cold and your nose is congested, your odor detectors do not function properly. This makes it difficult for you to taste your food, because most of "taste" is really smell. When they are functioning properly, the nerve endings in your nose detect a smell and send nerve impulses to your brain. The brain then determines what the smell is, allowing you to identify it. Over time, smoking can diminish your sense of smell.

Web Sites

- **Yucky Gross & Cool Body**
  http://yucky.kids.discovery.com/flash/body/ (Grades 3-8)
- **The Senses**
  http://faculty.washington.edu/chudler/chsense.html (Grades K-12)

Software

- **My Amazing Human Body**
  DK Interactive Learning, 1997
  (Grades 3-6)
- **A.D.A.M. The Inside Story**
  ADAM Software, Inc., 1996
  (Grades 5-8)

Reading Room

- Ballard, Carol. **How Do We Taste and Smell?** Raintree Steck-Vaughn. 1998. (Grades 1-4)
- Wright, Lillian. **Smelling and Tasting.** Raintree Steck-Vaughn, 1995. (Grades 3-4)
- Pluckrose, Henry. **Smelling.** Gareth Stevens, 1995. (Grades K-4)

Career Connections

An otolaryngologist is a doctor who focuses on the treatment of ailments that primarily affect the ear, nose, and throat.

INHALE AND SMELL ACTIVITY SHEET

Your nose is the organ for smell. Today, we're going to use our noses to identify several kitchen extracts used in cooking. None of these extracts are harmful, but be careful not to sniff too deeply or you might get a noseful of extract!

1. Your leader will provide you with 7-8 different kitchen extracts with the labels covered up.
2. Smell the first extract. What does the smell remind you of? What kind of extract do you think it is? Record your observations and your guess on the chart below.
3. Repeat step 2 for all the remaining extracts.
4. When everyone is done, your teacher will reveal what the extracts really are. How many did you get correct?

Inhale and Smell Data Chart

	Observations/Notes	Guess
1		
2		
3		
4		
5		
6		
7		
8		

Simple Electric Circuits

THE BASICS	THE TOOLBOX
 Grade Level: K-12  Estimated Time: 25 min.	• Large bulb and battery drawing • 2 D-cell batteries per person • 2 flashlight bulbs (about 3-volt) per person • 2 strips of aluminum foil ½" wide by 5-6" long per person.

EDUCATION STANDARDS	**Physical Science Content Standard:** Understanding the properties of electricity and how electricity travels within a simple circuit.
SAFETY CONCERNS	The voltage of 1, 2, or 3 D-cell batteries will not hurt you. Do not store batteries and aluminum foil together in plastic bags or the bag may melt.
FOR KIDS WITH DISABILITIES	For students with vision impairments, instead of a lightbulb, use a device that makes a sound. For students with limited dexterity, use battery and bulb holders.

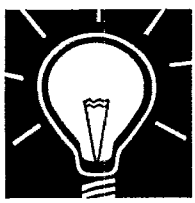
What To Do

Educational Objective:

To demonstrate that a battery is a source of energy (electricity) that can make a lightbulb turn on. To demonstrate that the electricity has to follow a particular type of path (complete circuit) in order for the bulb to light. To demonstrate that there is more than one way to make a complete circuit.

What to Do:

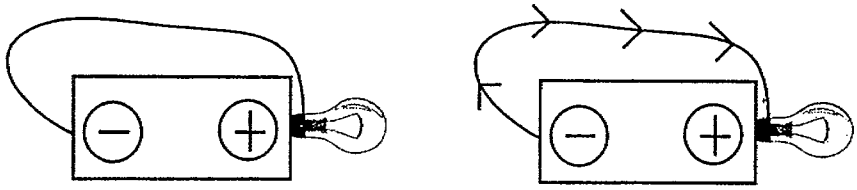
- Make a simple circuit yourself with a fresh battery and a fresh bulb in order to see how brightly the bulb will light up. Later, you can use this as a comparison to see if the batteries have gotten low and need to be replaced, or use the tester included in the packaging of some batteries.
- Cut pieces of aluminum foil to the appropriate sizes.
- Arrange for a place to work where participants can sit at tables with their materials.



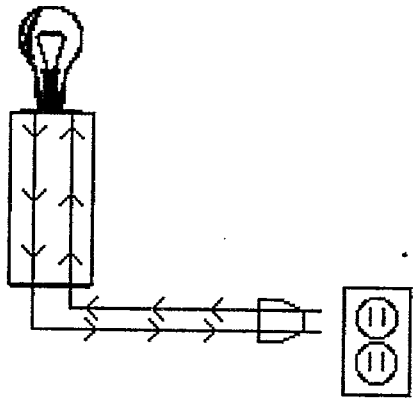
Questions to Ask Students As They Do This Activity: (Also see the questions throughout the activity sheet.)

- Does it matter whether the bulb touches the positive end or negative end of the battery?

- What happens to the aluminum foil when you create a **short circuit** (by connecting the positive terminal of the battery directly to the negative terminal without the bulb in the path)?
- If the electricity is running through the foil, why don't you get a shock when holding the foil?
- What happens to the brightness of the bulb if you use two batteries? Three batteries? What would happen if you kept stacking up more and more batteries? Try it on one bulb.
- Why do you think there are two wires in an extension cord or electrical appliance cord? Why are there two prongs on the electrical plug at the end of the cord?
- Can you draw arrows on the diagram to show how the electricity flows in a simple circuit? (The diagram is shown below on the left, and the answer on the right.)



- Can you draw a diagram to show how electricity flows through a lamp in your house?



- How do you think the switch works on your lamp? Open one up and see! **Be sure to get an adult's permission first, and be sure the lamp is unplugged.**

Why It Happens:

Inside the battery, there are chemical reactions going on that cause negatively charged particles to accumulate on the bottom (-) end of the battery and positively charged particles to be more abundant on the top (+) end. This sets up a difference in electrical potential (**pressure**) between the two ends, since the negative charges are attracted toward the

positive terminal of the battery. But because of the construction of the battery, the negative charges cannot just flow toward the positive charges on the inside of the battery. There needs to be some kind of connection made on the outside of the battery that links the two ends so that the negative charges can flow and produce a current. When the positive and negative ends are connected by a complete, uninterrupted path, the difference in electrical potential (pressure) between the two ends causes the current to flow through the path. This path is called a **circuit**. When the circuit is complete and is allowing current to flow through it, it is described as a **closed circuit**. If the path is interrupted in any way, such as a disconnected wire, then the current will not flow. That is called an **open circuit**.

When the light bulb is connected as part of the circuit, it has to be connected so that the current still has a complete, uninterrupted pathway between the two terminals of the battery. When this happens, the light bulb will light (if it's not burned out). In order for the light bulb to be connected to form a closed circuit, the metal parts of the bulb have to be part of the circuit. The electrons will not flow through the light bulb's glass or plastic parts.

By the way, the light bulb works because it contains a tiny filament of wire that has a very high **resistance** to electricity flowing through it. This resistance in the filament is similar to friction that occurs when you rub your hands together briskly. When you do this, the friction produces heat. Since the atoms in the filament resist, or oppose, the flow of electrons through them, some of the electrical energy gets converted to heat, and the filament gets so hot that it begins to glow. Other devices that purposefully waste electrical energy like this to produce heat and/or light include toasters, irons, and space heaters or the heating elements (burners) on an electric stove. If the ends of the battery are connected by a conducting path without any device in the circuit to use the circuit (such as the bulb in this activity), then a larger amount of current will flow. This situation is called a short circuit. In the case of this activity, that means that the battery will die out more quickly, and the foil may get warm.

Most larger circuits are designed so that a certain amount of resistance is supposed to be part of the circuit. When this resistance is present, the right amount of current will flow in the circuit and not too much heat will be produced. If the resistance in the current is low, then too much heat can be produced. This is why a short circuit in a home electrical system can be very dangerous. If the wires get too hot, they can cause a fire. Again, this is not a danger with this activity because the source of electricity we are using (batteries) does not have enough voltage to produce a dangerously high current.

A note about materials: While both alkaline and regular batteries work in this activity, most of them contain mercury. Recently developed mercury-free batteries are now available; these are safer for the environment.

Many kinds of flashlight bulbs will work with a D-cell battery in this activity. We recommend #47 and #48. They are not very bright when used with one battery, but they will burn brightly when used with two or more. The advantage is that it will take a stack of 8 or 9 batteries to make these bulbs burn out. While bulbs are available at local electronic stores, it is more cost-effective to make a bulk purchase from a supplier listed in Appendix B.

Web Sites

- **A Spark...of Brilliance**
  http://sln.fi.edu/qa98/attic12/index.html (Grades 4-12)
- **Thomas A. Edison Papers**
  http://edison.rutgers.edu/ (Grades 9-12)
- **Battery Life – A Science Experiment**
  http://www.energy.ca.gov/education/projects/projects-html/battery.html (Grades 2-12)

Software

- **Physics Explorer: AC/DC Circuits**
  LOGAL Software, Inc., 1999.
  (Grades 9-12)
- **School House Rock: Science Rock**
  Creative Wonders, 1995.
  (Grades 2-6)

Reading Room

- Houghton, Janaye & Robert. **Circuit Sense for Elementary Teachers and Students**. Teacher Ideas Press, 1994. (Grades 2-6)
- Robson, Pam. **Electricity**. Gloucester Press, 1993. (Grades 2-6)
- Schafer, Larry. **Taking Charge: An Introduction to Electricity**. NSTA, 1992. (Grades 7 and up.)

Career Connections

Scientists who study space depend on instruments containing many circuits. For more information on careers in space, contact your local planetarium or science museum.

SIMPLE ELECTRIC CIRCUITS ACTIVITY SHEET

What To Do:

1. Look at your battery. What differences are there between the two ends? If you've used batteries before, in flashlights for example, then you may be familiar with this difference. Look at the labeling on the battery to determine which end is positive (+) and which end is negative (-).

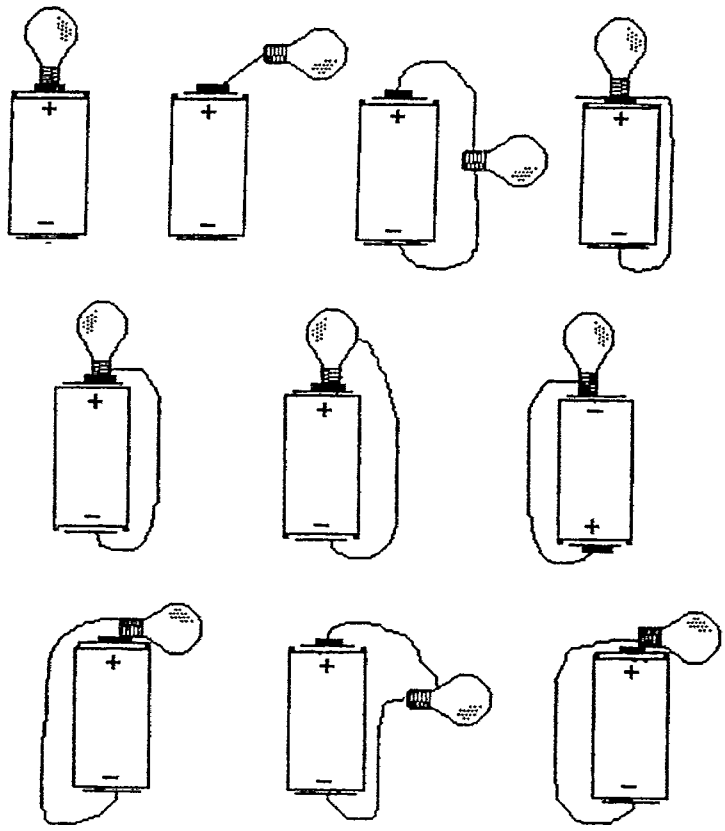
2. Look at your light bulb. What kinds of materials are put together to make the light bulb? How do you suppose the materials and the way they are put together are related to making the bulb work?

3. Take your battery, light bulb, and 1 strip of aluminum foil and try to connect them so that the bulb will light. Try as many different ways of connecting them as you can. When the bulb lights, the path that you have made with your connections is called a circuit. Some possible circuits to try are shown below. Before you try them, predict whether each one will cause the bulb to light. Then, see whether or not you are right.

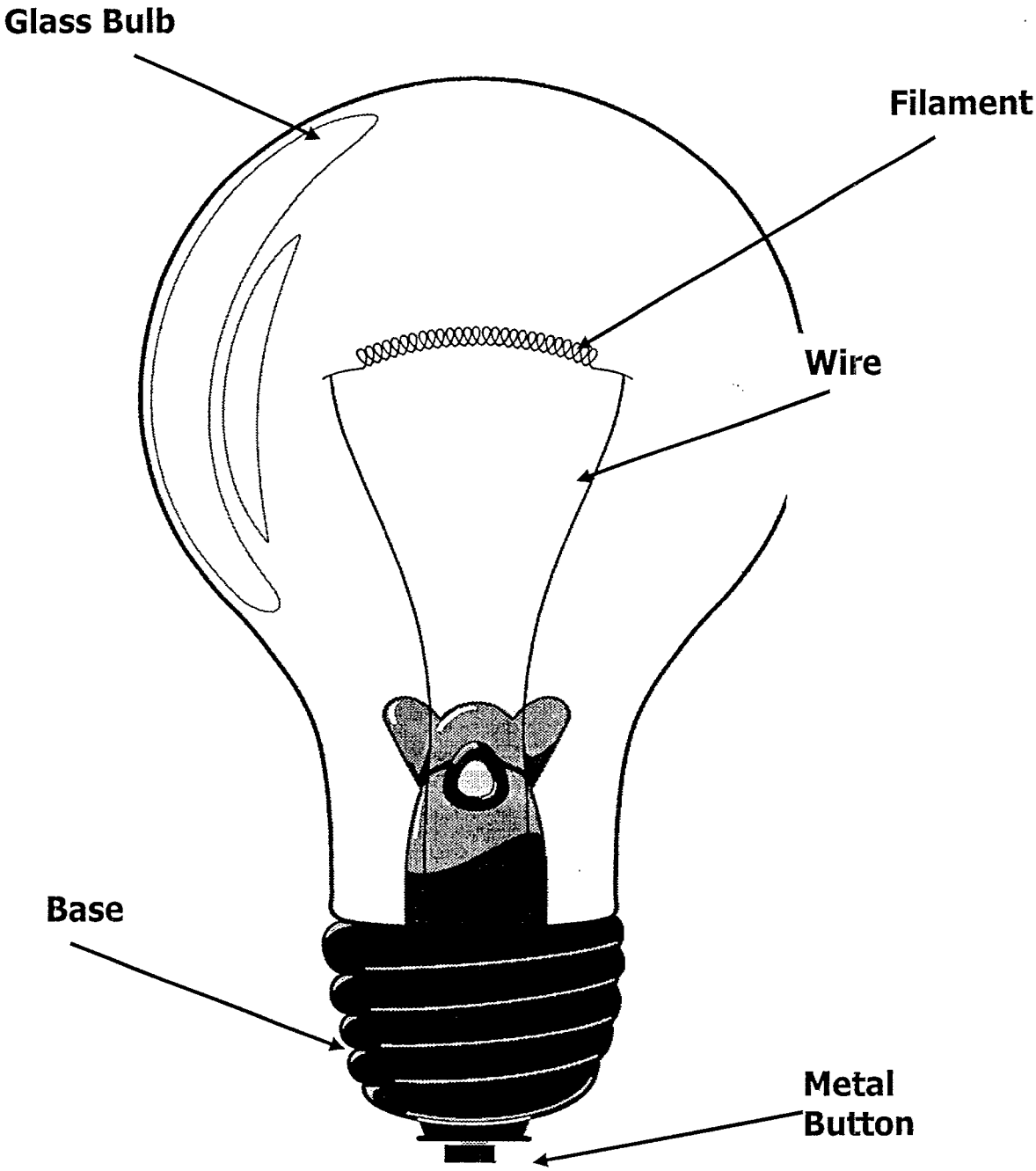
4. After you have made one or more successful circuits with just one piece of foil, try to make some circuits with two pieces of foil and/or two batteries and/or two bulbs. Again, make predictions first and then try it out. Use scrap paper to draw the circuits that you try.

5. Now, try to make:

- A circuit in which the bulb does not directly touch the battery;
- A circuit that lights two bulbs; and
- A flashlight that uses two batteries.



Electric Light Bulb



Word Factory

THE BASICS	THE TOOLBOX	EDUCATION STANDARDS	Grammar English/Language Arts Performance Standard Students should demonstrate a basic understanding and control of sentence construction, spelling, and usage.
 Grade Level: K-12  Estimated Time: 40 min.	• Sentence strips or paper to write on • A set of Word Factory cards for each group of 2-4 students	SAFETY CONCERNS	None.
		FOR KIDS WITH DISABILITIES	Students with dexterity impairments may work with a partner. Students with vision impairments may participate orally.

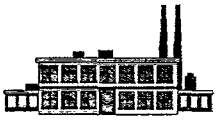
What To Do

Educational Objective:

To become more familiar with word beginnings and endings commonly used for science vocabulary words, and identify their meaning.

Directions:

1. Duplicate the attached masters and cut them out. There are four masters, with eight cards per page. The pages are also labeled Sets A and B. Set A is a little easier. You may choose to use them one at a time or together.
2. Divide into groups of 2-4 people and give each group a set of cards.
3. Choose a beginning part of a word and an ending. Put them together. Decide what your word might mean. **Note: In this exercise, the words made by students do not necessarily have to be found in the dictionary.** The emphasis is on recognizing common word beginnings and endings, and becoming familiar with their meanings.
4. Rearrange the parts to make a new/different word. Play around for awhile making different words and deciding what they mean.



5. Pick a favorite word or design a new one to share with the entire group, and make a sentence using that word. Have the group determine what the meaning for your word might be based on how it is used in the sentence.

For example:

The word might be **hemomaniac**
The definition would be - **one who craves blood**
A sentence could be - **We often wondered if our teacher was a vampire because, she seemed to be a hemomaniac.**

6. Post your sentences and definitions for all to see! Don't forget to practice pronouncing the words!

Web Sites

- **Vocabulary Charade Game**
  http://wings.avkids.com/Curriculums/History/vocab_charade_game_howto.html
  (Grades K-6)
- **Brain Freeze Tag**
  http://faculty.washington.edu/chudler/letag.html (Grades 3-8)

Software

- **CornerStone Language Arts**
  SkillsBank Corporation, 1995
  (Grades 3-8)
- **Reader Rabbit, Reading 2**
  The Learning Company, 1997
  (Grades K-3)

Reading Room

- Steig, William. **CDB!** Simon & Schuster, 2000. (Grades K-3)
- Nye, Bill. **Bill Nye the Science Guy's Big Blast of Science.** Perseus Publishing, 1993. (Grades 6 and up)

Career Connections

An editor refines and checks documents for accuracy before printing. Editors can work for magazines, newspapers, and even scientific journals.

WORD FACTORY ACTIVITY SHEET

Working with your group, list the words that you come up with and their definitions below.

Word	Definition

Any others? Use another sheet of paper if necessary.

Select your favorite word, and construct a sentence using that word to share with your group. Ideally, others should be able to determine the definition of your word based on its use in the sentence.

Set A Beginnings

cyano- blue, bluish	crypto- hidden
hydro- water	tele- far, distant
hemo- blood	micro- small
thermo- heat	chrono- time

Set A Endings

-kinesis movement	-phobia fear of
-graph something that writes -gram something written	-mania craving -maniac someone who craves
-scope device for viewing	-logy study of -sophy science of
-meter device for measuring	-philia love of

Set B Beginnings

pedi- foot	bio- life
ortho- straight	tachy- fast, swift
pachy- thick	stereo- solid (also as in 3-D)
phono- sound, voice	geo- earth

Set B Endings

-pod foot	-pterous having wings
-phage eater -phagous eating	-morph shaped like -morphic being shaped like
-derm skin	-genous -genic producing, making
-lith stone	-phone device for listening

Activity: Balancing Act

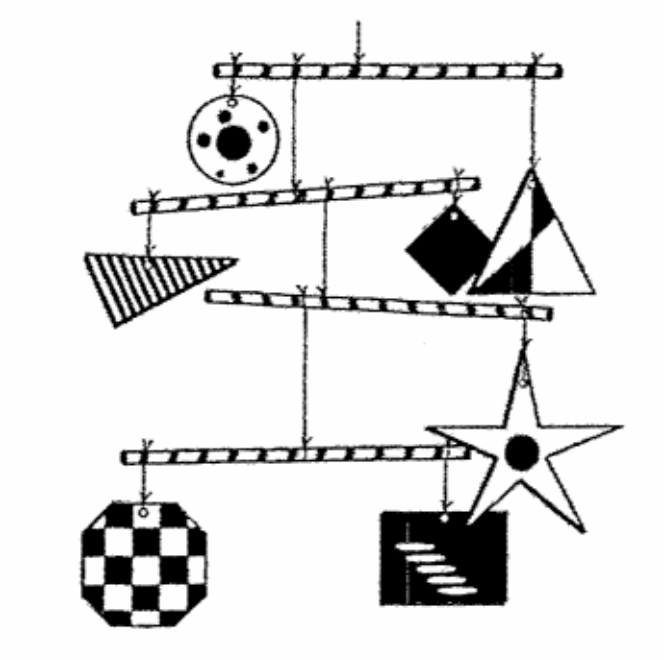
Objective: To explore the concept of balance by making a mobile.

Materials Needed and Preparation:

- 1 package plastic drinking straws
- cardboard scissors
- string
- scotch tape
- crayons or color markers
- white paper

Procedure:

- Refer to the diagram below for assistance.
- Tie a piece of string about one foot long tightly around the center of a straw. Tape it securely. This is the base for your mobile.
- Tape the other end of the string to a table edge so that the straw hangs down.
- Cut out pieces of cardboard in the shapes of stars, triangles, squares, circles, and any other shapes you can think of. Use the shapes on page 82 to help you get started.
- Cut out pieces of white paper that fit the shapes. Decorate the paper, and decorate both sides of your cardboard cut-outs by taping the pieces of paper to them.
- Cut another piece of string of any length up to one foot.
- Tape one end of the string to a decorated piece of cardboard.
- Tie the other end of the string to one of the ends of the straw. Observe what happens
- Cut another piece of string of a different length, and tape it to another decorated piece of cardboard. Tie the other end of the string to the free end of the straw.
- Move the pieces of cardboard until they balance.
- Repeat the above steps so that you have two mini-mobiles.
- Tie the free ends of the mini-mobiles to the ends of a third straw.
- Tie a piece of string to the middle of the third straw, and hang up your mobile.
- Observe what happens.



Questions to Ask Students about This Activity:

- What happens to a straw that only has one piece of cardboard hanging from it?
- Why does this happen?
- How does moving the pieces of cardboard around on the straw help this situation?
- What happens when you lose your balance?
- When you are walking a straight line, what do you do to keep your balance?

Background Information

A mobile is a good example of balance in action. When only one piece of cardboard hangs from a straw, the mobile is unbalanced, and the piece of cardboard weighs down one side of the straw. Adding a piece of cardboard to the other side helps to restore the mobile's balance. Then it will have as much weight on one side of it as on the other.

If you have ever ridden a bike or tried to walk a very straight line, you have used your sense of balance to keep your weight evenly distributed. If too much of your weight moves to one side of you, you lose your balance and fall down!

Activity C: Butterfly Color Explosion

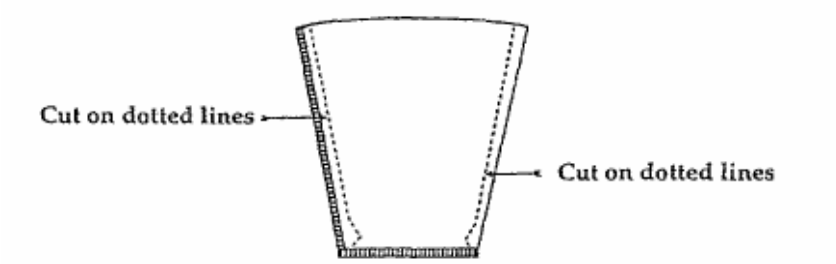
Objectives: To demonstrate the process of paper chromatography. To determine how colors can be separated by chromatography. To determine the components of black ink.

Materials Needed and Preparation:

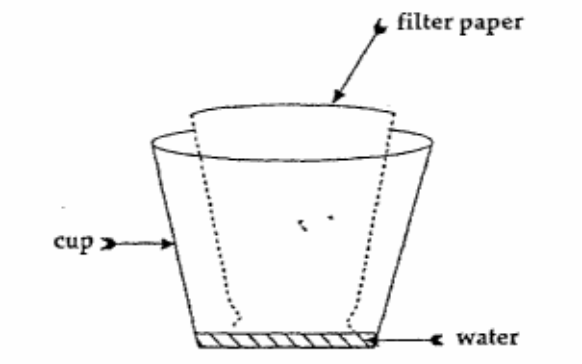
- 18-ounce wide-mouth plastic tumbler with ½-inch of water
- Melitta® coffee filters (no. 6), or comparable brand and size
- black water-soluble marker (overhead nonpermanent markers work best)
- scissors
- pencil
- 2-3 paper towels
- coleus leaf or other brightly colored leaf (optional)

Procedure:

- With the pencil, draw the butterfly outline shown below on a coffee filter.



- Cut only on the dotted lines. Your filter should still be in one piece.
- Using the black marker, decorate both sides of the filter with dots, lines, or other markings. **Be sure not to mark the ribbed bottom edge.**
- Place your filter in the cup of water as shown. Only the ribbed edge should touch the water.
- Allow the filter to Sit undisturbed for 10-15 minutes.
- Once the water level has risen to the top of the paper, remove the filter from the cup, and gently open the filter. What do you see?
- What do you think will happen to the black ink?



Questions to Ask Students about This Activity:

- What happened to the black ink?
- What happened in this activity that you didn't expect or was different from what you expected?
- What did you learn about the black ink?
- Do you think the same thing would happen if you used red ink? Green ink? Purple ink? Try it!
- What do you think would happen if you ground up a coleus or other brightly colored leaf, placed a dot of the leaf's pigment on a filter, and immersed the end of the paper in water? Try it!

Background Information

This activity uses a technique called *paper chromatography*. The water is absorbed by the coffee filter and rises up the filter. When the water reaches a spot of black ink, it carries the spot up the filter. As the water continues to rise, some of the ink components are deposited at various distances from the original spot. In effect, the ink separates into the colors that comprise it. Black markers are made of many different dyes. Some of these dyes dissolve easily in water. They travel far up the paper.Some are more like oil and don't dissolve well in water. They only move a short distance up the paper. Substances that can cause other substances to dissolve, like water can, are called solvents.

Water is the simplest solvent to use in paper chromatography. Not all components in a sample may dissolve in water. Other liquids that can be used as solvents include alcohol and ammonia, but these should not be used with young children. They give off unpleasant fumes.

Scientists use chromatography frequently to determine the component parts of mixtures, solutions, and molecules. It is a valuable tool for helping us understand what makes up various solutions in our environment.

Activity: Round and Round

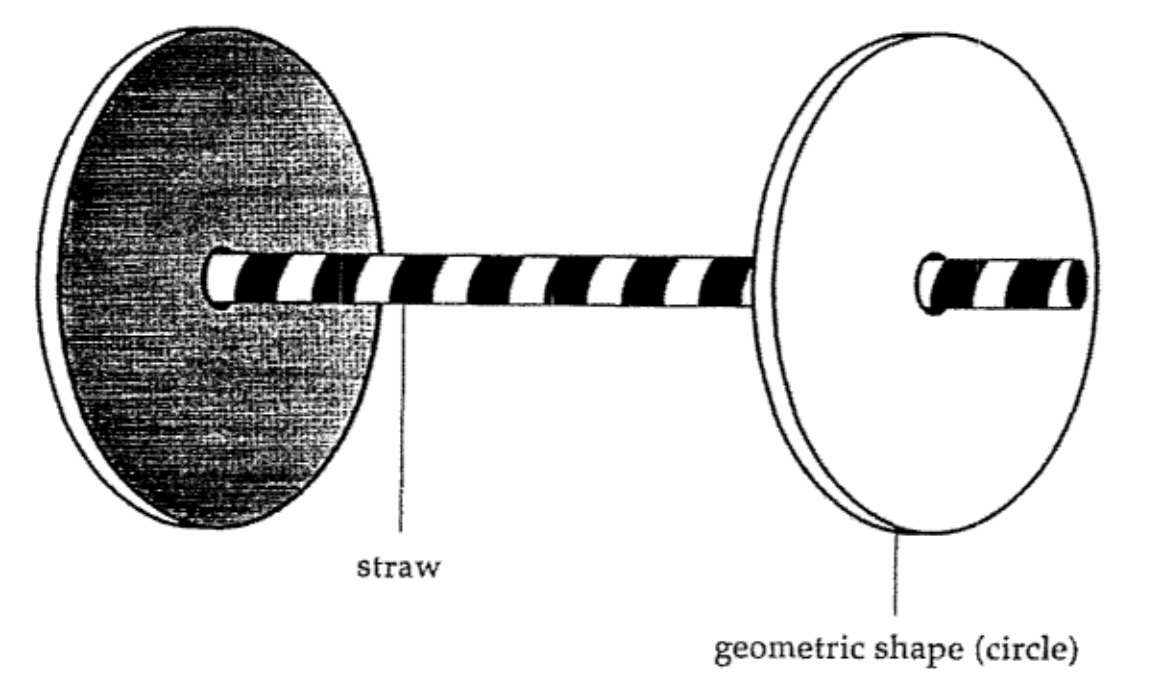
Objective: To learn about the function of the wheel and axle.

Materials Needed and Preparation:

- Paris of geometric shapes cut out of thin cardboard (triangles, circles, squares, ovals, pentagons), some with holes cut precisely in the middle, and some with holes closer to a side. Use the shape on page 82 to help you get started.
- Straws or pencils
- Modeling clay (optional)

Procedure:

- Place the holes of a pair of geometric figures over the ends of the pencil or straw. Refer to the diagram below.
- If you like, attach the figures to the straw with modeling clay.
- Try to get the figures to move.



Questions to Ask Students about This Activity:

- Which geometric figures move the best? Why?
- Which hole placement works the best? Why?
- Why do you need the straw?
- Name some uses for the wheel and axle.

Background Information

Have you ever heard anyone use the expression "reinvent the wheel?" The *wheel* is one of the most useful inventions ever created. But it is not as useful on its own as it is when used with an *axle*. When an axle attaches two wheels together, the resulting mechanism can be attached to another pair of wheels and another axle to create a space on which things could be pushed or pulled. Using wheels makes it much easier to push or pull a load. This is because the roundness of the wheel cuts down on the ***friction***, or drag, that makes it difficult to push or pull things. Say, for example, that you tried to push your brother and sister down the street while they were sitting on the ground. You wouldn't get very far. But if they got into your wagon, which is made with two sets of wheels and axles, you would have no trouble at all getting them to your destination!

BUILDING WITH WONDERFUL JUNK

MATERIALS

- **Trashables — lots of them! Try:**
  - **-empty boxes of all sizes (cereal boxes, shoe boxes, large cartons, gift boxes, egg cartons, etc.)**
  - **-Cups (paper, plastic, cardboard)**
  - **-Tennis ball cylinders and other sports packaging**
  - **-Paper, (tissue, crepe, gift)**
  - **-Tubes (paper towel rollers, toilet paper rollers, poster tubes, gift paper rollers)**
  - **- Foil (pie plates, cake pans, etc.)**
  - **-Whatever else your imagination comes up with**
- **Masking Tape**
- **Glue**
- **Scissors**

TIME 30 MINUTES FOR EACH GROUP OF CHILDREN

GETTING READY!
Designate a large space in the room, where the structures can be built and stored. Put your "wonderful junk" on a table, or somewhere on the floor. Have the tape, glue, and scissors conveniently at hand. You'll be working with small groups of children, three or four at a time.

ACTIVITY

1. **Explain to children that they'll be constructing something out of the "wonderful junk" they see nearby. The rules are that they…….**
   - **must plan and work together**
   - **must build something as tall as it can be and still stand on its own**

2. **Ask children to choose some junk to begin with. Suggest that they use at least one large carton in their structure. Explain that they are free to come back to the pile to select more junk as needed.**

3. **Encourage children to see that everyone participates in the building process. If you observe that someone is not involved, try suggesting that he or she select something special to add to the structure.**

4. **As children work, facilitate by suggesting ways they can balance their buildings, but guide them to discovering solutions of their own-don't simply walk up and say: "You need to enlarge the base."**

5. **When the building is finished, have each group take turns telling the other children in the room what they've made and how they made it.**

CONCEPTUAL BACKGROUND

Construction activities will keep children busy for hours on end! Not only are they fun, they'll develop children's problem — solving, mathematical, and physical science skills, and when children work cooperatively together, they'll be developing social skills, as well.

Children can explore problems involving shape, size, scale and stability, in this activity. They'll also be dealing with the concepts of balance, weight, gravity and symmetry. Trail and error, a valuable way of learning, plays an important role in this project.

The physical properties of the materials being used will influence the kind of structure that's built. Children will discover that

- **seemingly flimsy materials can be strengthened by folding**
- **triangular shapes are rigid**
- **tubes have bending strength**
- **towers need a stable base**
- **symmetry is important in the overall strength of a tower**
- **if the weight of the whole structure leans out, beyond the base, the structure will topple.**

As a side effect of this activity, children may become aware of how much waste there is in our environment. "Wonderful Junk" is one way to recycle some of that waste.

GLOSSARY

Balance: A stable state, characterized by cancellation of all forces by equal, opposing forces. A state of bodily equilibrium.
Gravity: The Force that pulls one object toward another.
Symmetry: A balanced correspondence of size, form, and arrangement of parts.
Weight: The force with which gravity pulls a body towards earth.

Extensions

No Tape? No Glue?

1. Gather the "trashables" as described in the activity. Leave out items that you think will not stay without tape or glue, e.g. tissue paper.
2. Choose small groups (4-8) to work together. Try to choose an equal number of girls and boys.
3. Tell the children that their job is to build something that will stay together without tape or glue.
4. Suggest that they make a plan together before they start to build. Older children can write down their plan. Have some paper and pencils handy for this task.

Choose Your Junk

1. Gather a large of supply of "trashables." Glue and/or tape are optional.
2. Form small groups and ask each group to choose a pile of junk.
3. Tell the children that they can build whatever they want but:

- they must use up every piece of junk.
- it must be able to stand on its own.

Small Junk

1. Gather a supply of small "trashables," tape, and glue.
2. Form small groups.
3. Explain to the children that:

- first, each child will make her/his own construction.
- next, they should make one big construction out of all the small ones.

4. Children also can make individual constructions to take home.

Activity D: Seeing Is Deceiving!

Objective: To demonstrate persistent vision, which was one of the principles Thomas Edison used in developing moving pictures.

Materials Needed and Preparation:

- white or light colored construction paper or other heavy paper
- scissors
- pencils or long sticks
- tape
- crayons or colored markers

Procedure:

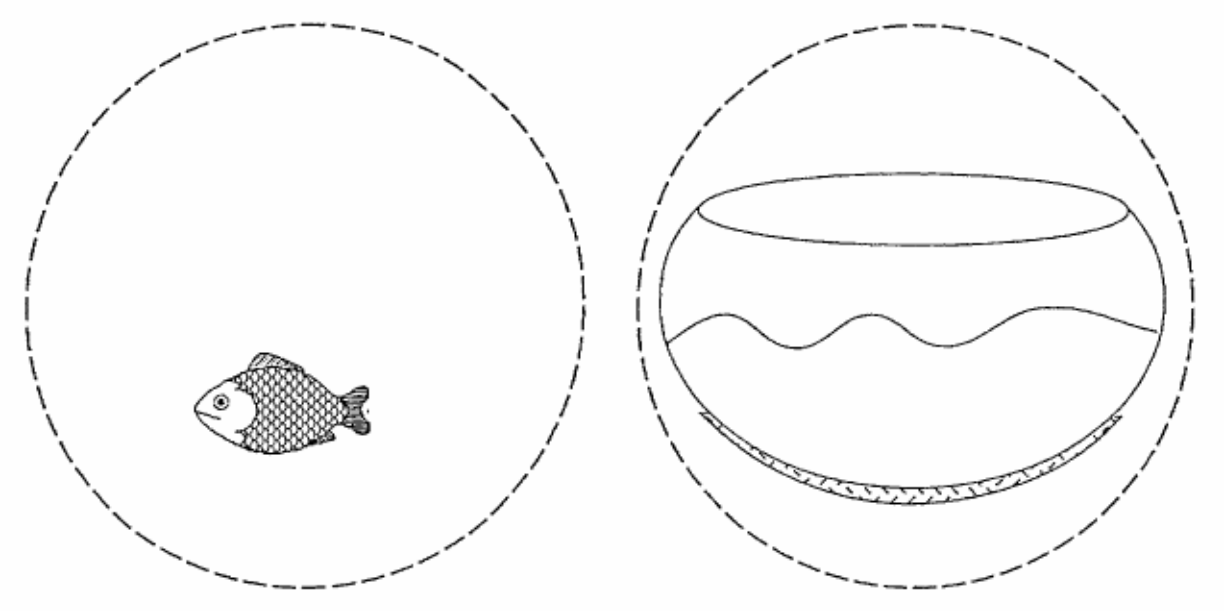
- Photocopy the drawings on the following pages onto two sheets of construction paper or other heavy paper.
- Cut out each drawing from the construction paper along the dotted lines. Tape the spider and the web, the bird and the cage, the fish and the bowl, and the face and the pumpkin back-to-back.
- Slide the pencil or stick between the back-to-back circles and tape the circles securely to the pencil or stick.
- Hold the pencil or stick between your hands and twirl it rapidly. Observe what happens.
- Try creating your own drawings.

Questions to Ask Students about This Activity:

- What do you see when you twirl the pencil or stick?
- Why can you see both images "at once?"
- Which designs work best?
- Does color play a role in how well you see both images?

Background Information

When you spin the circles quickly, you should be able to see the images on both sides at once. The spider looks like it is on the web, the bird looks like it is in the cage, the fish looks like it is in the bowl, and the face looks like it is on the pumpkin. This occurrence is known as ***persistent vision***. It is the tendency of the brain to "see" an object for about ten seconds after the object disappears. The pictures in this activity are moving so fast that the brain doesn't have time to process them as separate images. This is the basis for moving pictures, or ***movies***. A movie is actually a series of still pictures shown in rapid succession. Persistent vision makes the things in the pictures appear to move.



Seeing is Deceiving! Materials Page
Cut out each of these circles along the dotted lines.