

Investigating

Investigating includes all the processes needed to ask and answer questions. These processes are called the *scientific method*. The processes are: *research* (the process of collecting information about a topic being studied), a *problem* (a science question to be solved), a *hypothesis* (an idea about the answer to a problem), an *experiment* (the process of testing in order to determine the accuracy of the hypothesis and/or to determine the answer to the problem), and a *conclusion* (a summary of the results of the investigation). Depending on what is being investigated, the order of the processes may change and some processes may not be used.

All experiments involve a *cause* and an *effect*. A *cause* is an action or act that makes something happen. An *effect* is something that happens because of an action or cause. Things in an experiment that can or do change are called *variables*. The variable that is manipulated is called the *input variable*. This results

in a change in a variable called the *output variable*. Variables that are controlled so they do not change are called *controlled variables*.

Young scientists can learn to identify and use the scientific method. As they master this tool, they will be more skilled at solving questions they have about things and events in the world around them.

TEACHING TIPS
1

The Scientific Method

Benchmarks

By the end of grade 2, students should be able to

- Develop the abilities necessary to do scientific inquiry.
- Develop an understanding of the scientific method.
- Understand what constitutes evidence.
- Be able to judge the merit or strength of data used to answer questions.

In this chapter, students are expected to

- Identify a reasonable question that can be answered through investigation.
- Identify reasonable hypotheses for specific problems.
- Plan and/or conduct simple investigations.
- Use simple equipment and tools to gather data.
- Use data to identify reasonable explanations.
- Communicate investigations and explanations.

Preparing the Materials

Activity 1: Research and Problems

- Make a copy of the Research and Problems activity instruction and answer sheets for each student.

Activity 2: Problems and Hypotheses

- Make a copy of the Problems and Hypotheses activity instruction and answer sheets for each student.
- Use Extension #2 for answers about butterflies.

Activity 3: Experiment

- Make a copy of the Experiment activity sheet for each student.

Activity 4: Conclusion

- Make a copy of the Conclusion activity sheets for each student.

Investigation 1: Elbows

- Make a copy of the Elbows investigation

instruction and answer sheets for each student.

- Make a flexible drinking straw available to each student.
- Students should work in pairs.

Activity 5: Investigation

- Make a copy of the Investigation activity sheet for each student.

Activity 6: Control

- Make a copy of the Control activity sheet for each student.

Investigation 2: Colored Leaves

- Make a copy of the Colored Leaves investigation instruction and data answer sheets for each student.
- On the instruction sheet, color the colored water in the glass red.
- Students should work in groups of four or more.
- Prepare identical plastic containers of red-colored water for each group. The containers should be sturdy enough so that they do not easily fall over. Tall plastic glasses or jars will work. Use the same amount of water, about 2 inches (5 cm), and drops of red food coloring for each group. Note: The water should be bright red. Use about 10 drops for each pint (500 ml) of water.
- Using the same kind of containers and amount of water, prepare a plastic container labeled “Control” for each group.
- Make two stalks of celery with leaves (preferably the pale innermost stalks) available for each group. Cut across the end of each stalk.
- FYI—For young children, a class investigation can be done. Students can make observations individually or in groups.

Presenting the Science Concepts

1. Introduce the new terms:
 - chart** A way to organize data for viewing.

TEACHING TIPS (continued)

conclusion A summary of information collected, including research and experiment results; a summary of the information that compares a hypothesis with experiment results.

control A test that other tests are compared to.

data Collected and recorded information.

experiment A test to answer a problem; a test to check the correctness of a hypothesis.

hypothesis An idea about what the answer to a problem is.

investigation The process involved in asking and answering questions about science.

problem A science question to be answered.

procedure The instructional steps of an experiment.

purpose The goal of an investigation.

research The process of collecting information about a topic being studied; the act of finding information.

result A summary of the data from an experiment.

scientific method The steps of an investigation used in asking and answering a science question.

table A type of chart with columns and rows.

2. Explore the new terms:

- Science investigations use all or part of the scientific method to ask and answer a science question. The scientific method is made up of five basic steps: research, problem, hypothesis, experiment, and conclusion.
- Types of investigations include describing objects, events, and organisms; classifying things; validating known facts; and doing an experiment.
- An experiment can be designed to answer a question and/or test the correctness of a hypothesis. This test does not necessarily prove that the hypothesis is right or wrong. Instead, it supports or doesn't support the hypothesis. A hypothesis may be wrong

after only one test. But the test may have been done incorrectly. Thus, to prove the correctness of a hypothesis, scientists perform the same test many times. Sometimes, if variables are changed, the results change too, which may support a hypothesis that was previously considered wrong.

- While the process is called the scientific method, it can be used to ask and answer questions about topics other than science.

EXTENSION

1. Fingers and elbows are not the only places on your body that have wrinkled skin and that bend. Where are other places (wrists, knees, toes, knuckles, ankles)?
2. A butterfly's long feeding tube is called a *proboscis*. When the butterfly isn't feeding, its proboscis is coiled up. When the butterfly wants to drink nectar from inside a flower, the proboscis uncoils like a party blower. Turn a party blower upside-down to show how a butterfly's proboscis coils and uncoils.

ANSWERS

Activity 1: Research and Problems

1. C
2. B
3. A
4. C

Activity 2: Problems and Hypotheses

1. C
2. B

Activity 3: Experiment

1. A

Activity 4: Conclusion

1. B
2. A

Investigation 1: Elbows

1. Stretched out

TEACHING TIPS (continued)

2. Squeezed together
3. Squeezed together
4. Stretched out
5. B and C

Activity 5: Investigation

1. B
2. B
3. A
4. B
5. B

Activity 6: Control

1. B
2. C
3. A

Investigation 2: Colored Leaves

The expected answers are listed here, but student answers may vary depending on the results of their experiment.

Hypothesis: Student answers may vary.

Colored Leaves Data Table

Start The color of the leaves on both the experiment and control celery stalks should be pale green.

Finish The color of the leaves on the experiment celery stalk should be reddish-green. The color of the leaves on the control celery stalk should not have changed. They should still be pale green.

Results:

1. T
2. F
3. F
4. T

Conclusion:

5. Student answers may vary.
6. T

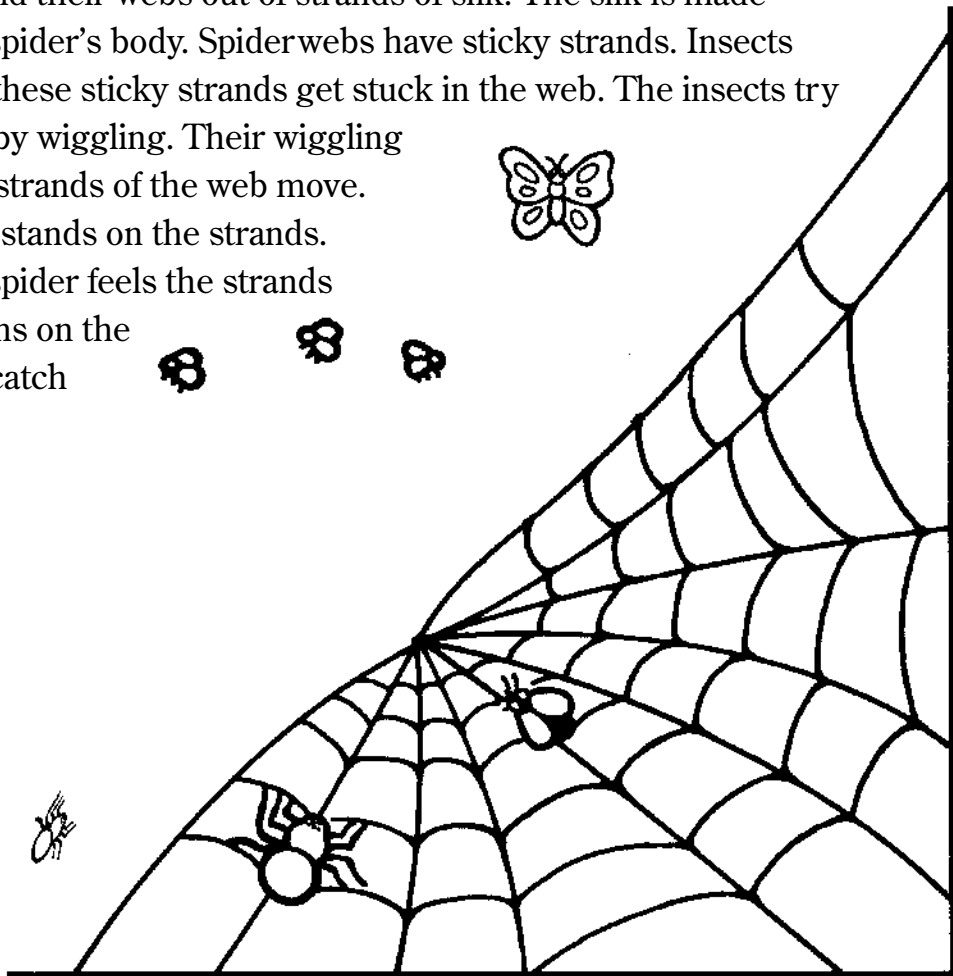
ACTIVITY 1
1
Instruction Sheet

Research and Problems

The **scientific method** includes the steps of an investigation used in asking and answering a science question. Research and problems are two of the steps. **Research** is the act of finding information. One way to do research is to read. A **problem** is a science question to be answered. Doing research can answer some problems.

Directions: Read the story below. Then follow the instructions on the answer sheet.

Spiders build their webs out of strands of silk. The silk is made inside the spider's body. Spiderwebs have sticky strands. Insects that touch these sticky strands get stuck in the web. The insects try to get free by wiggling. Their wiggling makes the strands of the web move. The spider stands on the strands. When the spider feels the strands move, it runs on the strands to catch the insect.





Research and Problems

Directions: Read each question. Fill in the circle beside the correct answer.

1. What are spiderwebs made of?
 - A. wire
 - B. sewing thread
 - C. silk strands

2. Where does the spider make the silk for its web?
 - A. in a mixing bowl
 - B. inside its body
 - C. in the kitchen

3. What do insects do when they get stuck in a spiderweb?
 - A. wiggle to get unstuck
 - B. call 911
 - C. take a nap

4. How do spiders know an insect is stuck in their web?
 - A. They hear it calling 911
 - B. They hear it snoring
 - C. They feel the strands of the web moving

ACTIVITY 2
1
Instruction Sheet

Problems and Hypotheses

Problems and hypotheses are steps in the scientific method. A problem is a science question and a **hypothesis** is an idea about what the answer to the problem is.

Directions: Read the problem. Then circle the letter for the hypothesis you think is most correct. This example is done for you.

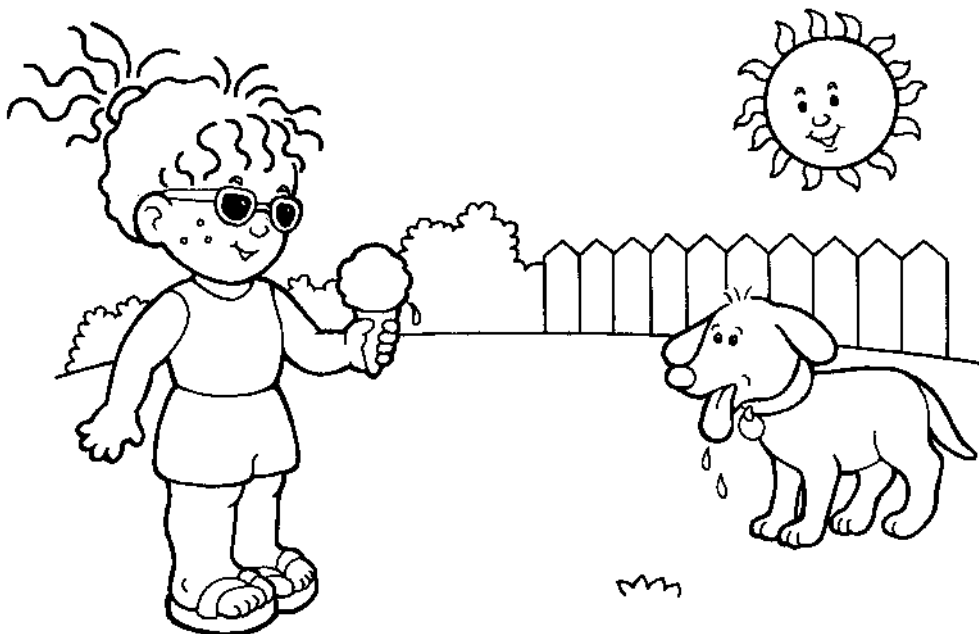
Example: Panting

Panting is breathing quickly with your mouth open.

Problem: Why do dogs pant when it is hot?

Hypothesis:

- A. When it is hot, dogs pant to cool off.
- B. When it is hot, dogs pant to get rid of extra water.
- C. When it is hot, dogs pant when they don't want to play.



ACTIVITY 2
1
 Answer Sheet

Problems and Hypotheses

Directions: Read the problem. Then circle the letter for the hypothesis you think is most correct.

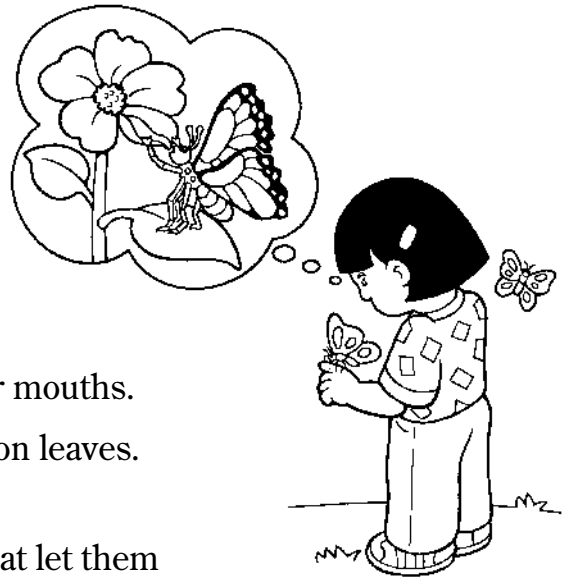
Nectar

Nectar is a sweet liquid in flowers.

1. Problem: How do butterflies drink nectar from flowers?

Hypothesis:

- A. Butterflies stand on leaves and let the nectar from a flower petal run into their mouths.
- B. Butterflies walk through nectar that is on leaves. Then they lick the liquid off their feet.
- C. Butterflies have special mouth tubes that let them suck nectar out of flowers.



Staying Warm

2. Problem: How do animals stay warm in the winter?

Hypothesis:

- A. Animals find warm houses to stay in during the winter.
- B. Animals have coats of fur or feathers that keep them warm.
- C. Animals wear coats and boots that people have thrown away.



ACTIVITY 3

1

Experiment

An experiment is one of the steps of the scientific method. An **experiment** is a test to answer a problem. An experiment has instructions, or steps, called the **procedure**. **Data** is collected and recorded information. A **result** is a summary of the data. A **chart** is one way to organize data for viewing

Directions: Read the procedure steps for the experiment and study the data. Then circle the letter for the correct result.

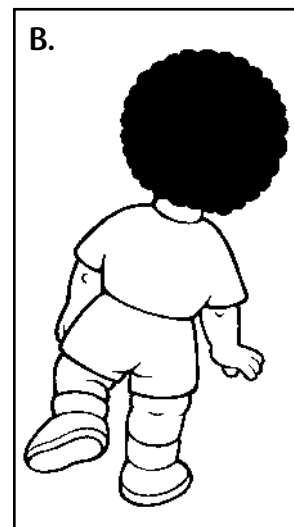
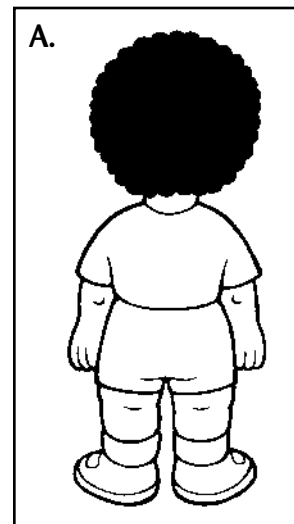
Procedure:

1. Observe Figure A in the Balancing Data Chart. Notice that the figure does not lean.
2. Like Figure A, stand with your feet about 12 inches (30 cm) apart and your hands to your sides.
3. Notice that your body does not lean.
4. Observe Figure B in the Balance Data Chart. Notice the direction that the figure leans.
5. Like Figure B, balance on your right foot by lifting your left foot.
6. Notice the direction that your body leans.

Results:

- A. To balance on your right foot, you must lean your body toward the right.
- B. To balance on your right foot, you must lean your body toward the left.
- C. To balance on your right foot, you do not have to lean your body.

Balancing Data Chart



ACTIVITY 4
1**Conclusion**

A conclusion is a step in the scientific method. A **conclusion** is a summary of the information collected, including research and experiment results.

Directions: Read the story, the experiment, and its result. Then circle the letter of the best conclusion.

**1. Evaporation**

Evaporation is the change of a liquid to a gas. It takes energy for a liquid to evaporate. When water evaporates from a surface, the water absorbs energy from the surface. This causes the surface to cool off.

You sweat when you get hot. When sweat evaporates from your skin, your skin cools off.

Experiment: Wet your arm with water, then blow across the wet area on your arm.

Result: Your arm feels cooler.

Conclusion:

- A. When water evaporates from your skin, it causes the skin to feel cooler. This means that evaporation of sweat is one of the ways your body has of keeping your body warm.
- B. When water evaporates from your skin, it causes the skin to feel cooler. This means that evaporation of sweat is one of the ways your body has of keeping your body cool.
- C. When water evaporates from your skin, it causes the skin to feel cooler. This means that evaporation of sweat doesn't change your body temperature.

ACTIVITY 4

1

Conclusion (continued)

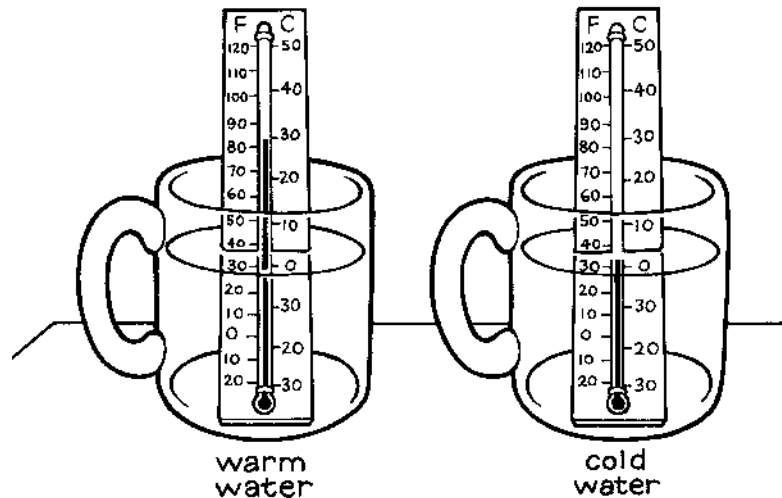
Directions: Read the story, the experiment, and its result. Then circle the letter of the best conclusion.

2. Thermometer

A **thermometer** is an instrument that measures temperature. When the liquid line in a thermometer goes up, it indicates an increase in temperature. When the line goes down, it indicates a decrease in temperature.

Experiment: Stand one thermometer in a cup of warm water. Stand a second thermometer in a cup of cold water.

Results: The liquid line of the thermometer in the warm water went up. The liquid line of the thermometer in the cold water went down.



Conclusion:

- A. The liquid line of the thermometer went down in cold water and up in warm water. This means the temperature of the warm water was higher than the temperature of the cold water.
- B. The liquid line of the thermometer went down in cold water and up in warm water. This means the thermometers are not accurate.
- C. The liquid line of the thermometer went down in cold water and up in warm water. This means that thermometers cannot be used to measure how hot or cold water is.

Elbows

Purpose: To determine why elbows are wrinkly.

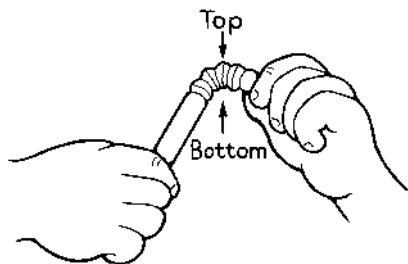
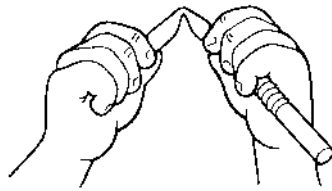
Problem: Why are elbows wrinkly?

Round Up These Things

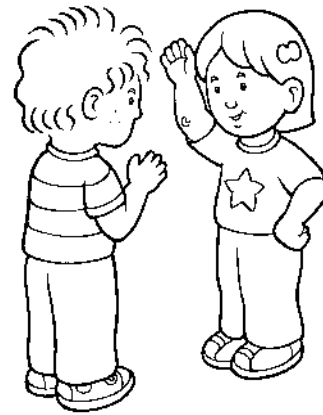
- 1 flexible drinking straw
- 1 partner

Things to Do

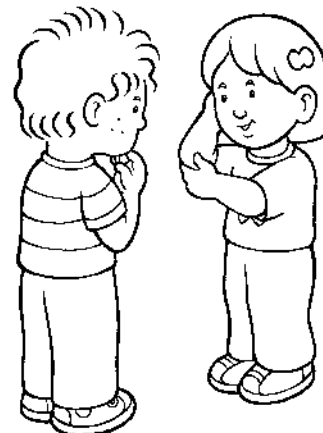
1. Try to bend the straw where it is not wrinkled. It is difficult to bend and may break.
2. Try to bend the straw where it is wrinkled. Look at the top and bottom of the wrinkles. In the Wrinkled Skin Data table, check the column that completes statements 1 and 2. A **table** is a type of chart with columns and rows.



3. Ask a friend to hold his or her arm straight up. Look at the skin on your friend's elbow. Then, in the data table, check the column that completes statement 3.



4. Ask your friend to bend his or her elbow. Look at the skin on your friend's elbow. Then, in the data table, check the column that completes statement 4.





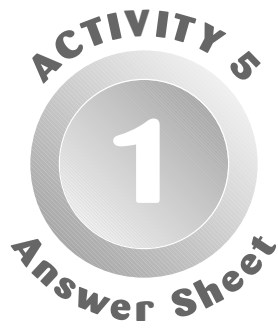
Elbows

Wrinkled Skin Data

Statements	Stretched Out	Squeezed Together
1. The wrinkles on top of the straw are		
2. The wrinkles on the bottom of the straw are		
3. When the elbow is straight, the skin covering it is		
4. When the elbow is bent, the skin covering it is		

Directions: Read the sentences that follow and fill in the circle beside the two sentences that should be part of the conclusion for the experiment.

5. **A.** The straw easily bends where there are no wrinkles.
- B.** The wrinkled skin on the elbow stretches out when the elbow bends.
- C.** Wrinkles keep your skin from breaking when your elbow bends.



Investigation

Directions: Identify the parts of the scientific method in the story. Fill in the circle beside the correct answers.

1. The purpose of Phoebe's investigation:
 - A. To find out how butterflies fly.
 - B. To find out how butterflies drink.
2. The science problem:
 - A. How do butterflies fly?
 - B. How do butterflies drink?
3. Phoebe's hypothesis:
 - A. Butterflies stand on leaves and let water from a flower petal run into their mouths.
 - B. Butterflies do not drink. Instead, they hold their heads up and catch raindrops.
4. How Phoebe checked the correctness of her hypothesis:
 - A. Testing butterflies.
 - B. Reading about butterflies.
5. The conclusion:
 - A. Butterflies have sponges that soak up liquids.
 - B. Butterflies do not let water run into their mouths. They drink through special strawlike mouth tubes.

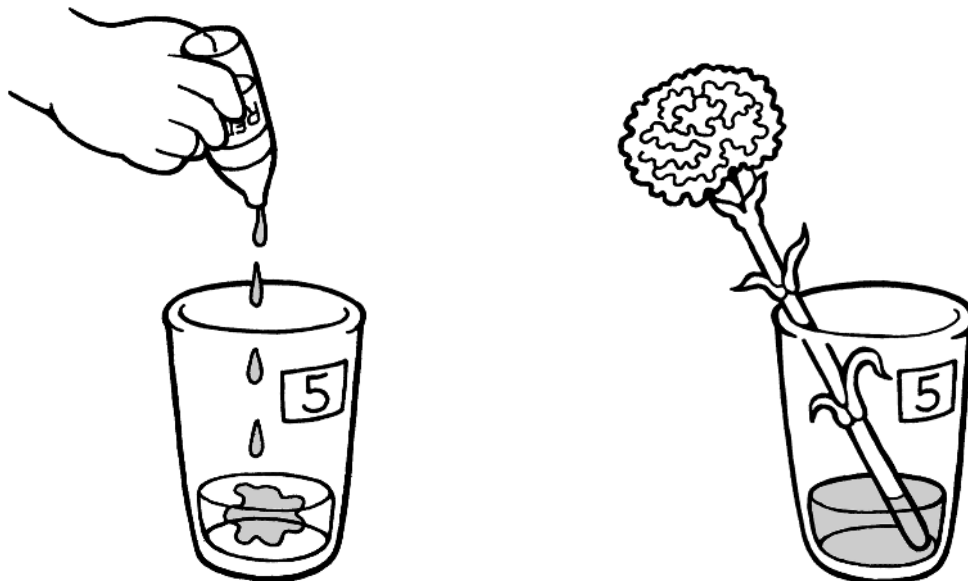
ACTIVITY 6
1
Instruction Sheet

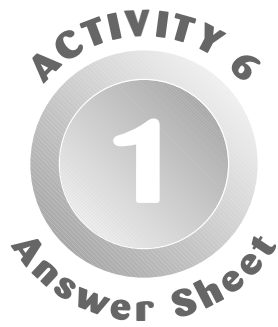
Control

Some investigations have a control. A **control** is a test that other tests are compared to.

Directions: Read the story. Then follow the instructions on the answer sheet.

Lacey put six white carnations in a vase of water. She wondered if the cut flowers would turn bright red if she put food coloring in the water. She guessed that the more coloring she added to the water the redder the petals would be. But Lacey wanted to know for sure. So she decided to experiment to find out. She filled six identical containers with equal amounts of water. In five of the containers, she put a different number of drops of red food coloring. She labeled each container with the number of drops of added food coloring. Then she stood a cut flower in the water of each container. To tell how much the petal colors changed, Lacey wanted one of the flowers to stay white. So she did not put any color in the water for this flower.



A circular graphic with 'ACTIVITY 6' at the top, 'Answer Sheet' at the bottom, and a large '1' in the center.

ACTIVITY 6
1
Answer Sheet

Control



1. Read the following questions. Fill in the circle beside the sentence that tells the problem for Lacey's investigation.
 - A.** How does the type of container affect the color of the petals of cut flowers standing in water inside the container?
 - B.** How does the amount of coloring in water affect the color of the petals of cut flowers standing in the water?
 - C.** How does the amount of water affect the color of the petals of cut flowers standing in the water?
2. Read the following statements. Fill in the circle beside the sentence that tells Lacey's hypothesis.
 - A.** As the amount of red coloring in the water increases, the color of the flower petals will be a lighter red.
 - B.** As the amount of red coloring in the water decreases, the color of the flower petals will be a darker red.
 - C.** As the amount of red coloring in the water increases, the color of the flower petals will be a darker red.
3. Read the following statements. Fill in the circle beside the sentence that tells the control that Lacey used.
 - A.** A white carnation was placed in water with no coloring added.
 - B.** All the containers were identical with the same amount of water.
 - C.** The same kind of flowers was used for each test.

INVESTIGATION 2
1
Instruction Sheet

Colored Leaves

Purpose: To make a hypothesis and conduct an experiment to see if the hypothesis is correct.

Problem: Will red dye in water move through a plant and color its leaves?

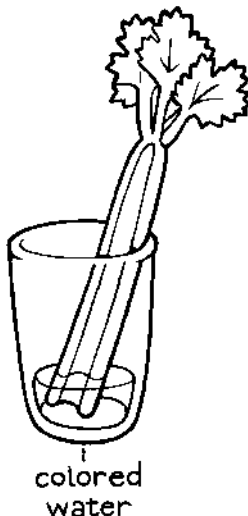
Hypothesis: (Before starting the experiment, circle your answer on the Colored Leaves answer sheet.)

Round Up These Things

- crayons
- 2 stalks of celery
- 1 glass of red-colored water
- 1 glass of water marked "control"

Things to Do

1. On the answer sheet, color the colored water in the glass red.
2. Stand one of the celery stalks in the glass of red-colored water so that the cut end is underwater.



3. Stand the second celery stalk in the glass of water without coloring. This will be the control.



4. Observe the color of the leaves on the celery stalk in the glass of colored water. Then color the leaves on the drawing in the Colored Leaves Data table marked "Start" to match the color of the leaves.
5. Repeat step 3, observing the color of the leaves of the control.
6. After 5 or more days, again observe the color of the leaves on the celery stalks. Then color the leaves on the drawings in the data table marked "Finish."
7. Follow the instructions on the Colored Leaves answer sheet.

ACTIVITY 1
1
Answer Sheet

Colored Leaves



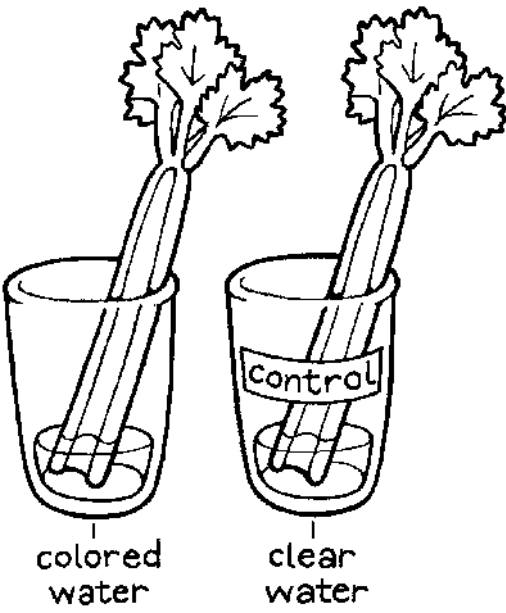
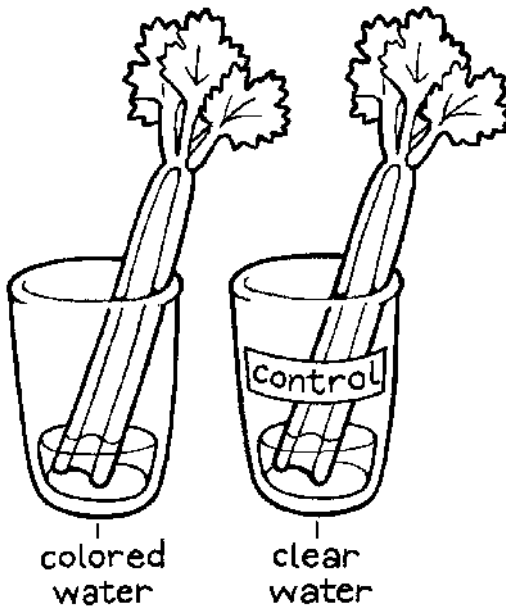
Directions: Follow the instructions for each part.

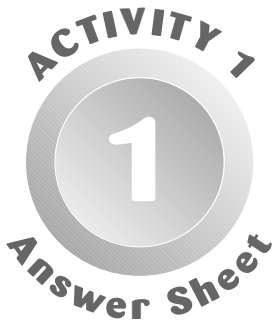
Hypothesis: Circle the answer that completes your guess.

Red dye in water will:

- A. not move through a plant and color its leaves.
- B. move through a plant and color its leaves.

Colored Leaves Data

Start	Finish
	



Colored Leaves (continued)



Results: Write a T in the blank if the sentence is true. Write an F in the blank if the sentence is false.

1. _____ The pale green leaves on the celery stalk standing in red-colored water changed to a reddish-green color.
2. _____ The pale-green leaves on the celery stalk standing in red-colored water remained pale green in color.
3. _____ The pale-green leaves on the control celery stalk changed to a reddish-green color.
4. _____ The pale-green leaves on the control celery stalk remained pale green in color.

Conclusion: Write a T in the blank if the sentence is true. Write an F in the blank if the sentence is false.

5. _____ The experiment supported my hypothesis.
6. _____ If a cut end of a stalk of celery is placed in red-colored water, the red color in the water moves up the stalk to the leaves. The pale-green leaves change to a reddish-green color. This takes about 5 days.