

# Climbing Water

## OBJECTIVES

In this activity, students observe how water is absorbed by a paper towel. They then learn how plants are able to pull water up from the ground to their leaves.

### The students

- ▶ observe water moving up a paper towel
- ▶ explain how water is able to travel up a paper towel
- ▶ apply what they learned to a new situation in which celery pulls water up its length

## SCHEDULE

**Session I** About 30 minutes

**Session II** About 20 minutes, 1 hour after Session I

## VOCABULARY

absorb

## MATERIALS

### For each student

- 1 Activity Sheet 3
- 1 crayon, green\*
- 1 crayon, red\*

### For each team of two

- 1 celery stalk, with leaves\*
- 1 cup, plastic, 9-oz
- 1 dowel, wooden
- 1 sponge

### For the class

- 1 chart, Properties of Water (from Activity 2)
- 1 cup, plastic, 9-oz
- 1 btl food coloring, red
- 1 knife\*
- 1 marker, felt-tip\*
- 1 roll paper towels\*
- 2 pitchers\*
- 1 pair scissors\*
- 1 spoon, plastic
- 1 roll tape, masking water, tap\*

*All ready!*

\*provided by the teacher

## PREPARATION

### Session I

- 1 Make a copy of Activity Sheet 3 for each student.
- 2 Cut 16 approximately 5 cm (2 in.) × 28 cm (11 in.) strips of paper towel. Attach a piece of tape to one end of each strip.
- 3 Use masking tape to secure a dowel inside each of the plastic cups (see Figure 3-1). Half-fill each of these cups with water.
- 4 Using the knife, cut the bottoms off 16 stalks of celery, but leave the leaves attached. Fill the pitchers with tap water and add several drops of food coloring to one, stirring until the water is visibly red or pink. Place all of the celery stalks in the other pitcher of plain tap water. (Do not place them in the colored water.) Leave them in the water until they are distributed.

- 5 Set up a distribution station for students to collect their taped paper towel strips.
- 6 You will need to pour some water in the extra plastic cup and have it, along with a paper towel, on hand for a demonstration.
- 7 Each team of students will need a cup with a dowel, a celery stalk, a sponge, and access to the materials at the distribution station. Each student will need a green and a red crayon.

## Session II

Each team will need its celery stalk in water from Session I. Each student will need his/her activity sheet and a green and a red crayon.

## BACKGROUND INFORMATION

While cohesion is the force of attraction between particles of the same substance, **adhesion** is the name given to the attraction between particles of different substances. Raindrops stick to a windowpane because water adheres to glass.

In fact, water has a strong attraction to many materials. When water has a strong attraction to a solid material, like a paper towel, it seeks to come into contact with as much surface area of that material as possible. Because the paper towel is porous, the water moves to fill the small spaces between the particles that make up the paper towel. In this way, water is soaked up, or **absorbed**, by the paper towel.

In this activity, students observe that water moves up a paper towel strip. This is because water adheres to the paper towel and seeks to come in contact with as much surface area of the paper towel as possible.

As water moves up the paper towel to fill the spaces between the toweling particles, it leaves the towel below it relatively drier.

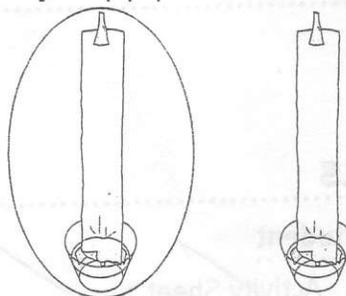
As a result, more water is pulled up into the towel (allowing more water to move higher up the towel and more to be pulled into it). This pull, called **tension**, continues until all the water in contact with the paper towel is absorbed, or until the paper towel becomes saturated. The adhesion (of the water molecules to the paper towel), cohesion (of the water molecules to one another), and tension all act together to pull the water up the paper towel.

Water moves up through the roots of plants in a similar way. Water is constantly evaporating from the leaves of plants in a process called transpiration. As water evaporates from the top of the plant, it leaves those parts below it relatively drier. As a result, more water is pulled into the plant from the soil. Adhesion (of the water molecules to the plant cells that line the tubes through which the water travels), cohesion (of water molecules to one another), and tension (the upward pull on the water caused ultimately by water evaporating from the leaf surfaces) all act together to pull the water up the plant.

### ▼ Activity Sheet 3

#### Climbing Water

1. Circle the picture that shows what happens when you dip paper in water.



2. Draw your celery stalk before and after the test.

Before

Drawings should show green stalk and leaves.

After

Drawings should show red lines "climbing" the stalk.

## Guiding the Activity

## Additional Information

### Session I

- 1 Remind the students how water drops stick together by asking, **What happened when you pushed two water drops together in the last experiment?**

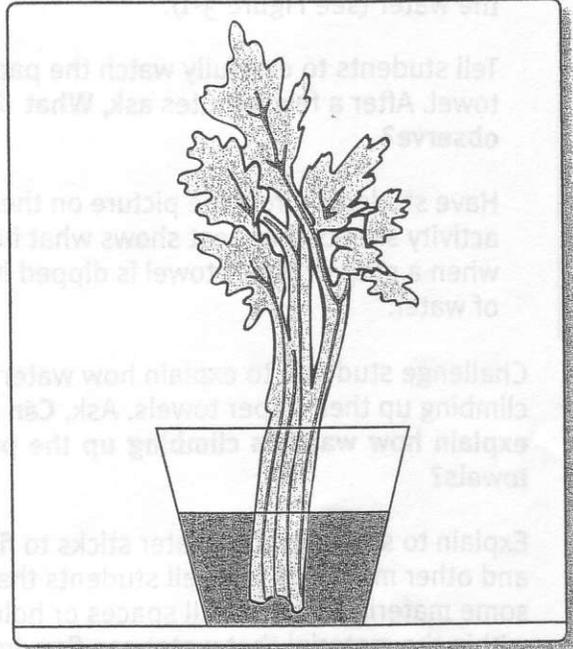
Tell the students to examine their celery stalk and then draw a picture of it on their activity sheet (in the box on the left), using their green crayon.

*Students should remember that the water drops stuck together and that it was hard to separate them.*

- 2 Tell students to place their celery stalk in the red water so the leaves are sticking out the top of the cup (see Figure 3-2).

Tell them that they will leave their celery stalks in the red water for an hour. (If you leave the celery stalk in longer, even the leaves will begin turning red.)

Place all the cups in a safe place for 1 hour. Collect the activity sheets and crayons for use again in Session II.



▲ Figure 3-2. Water climbs up a celery stalk.

- 3 Pour a little water on the table and hold up a paper towel. Ask, **What will happen if I place this paper towel on top of the water?**

Put the paper towel over the water. When the water has soaked into the paper towel, hold up the wet towel and show students that the water on the table is gone. Ask, **Where did the water go?**

Write the word *absorb* on the board, saying it aloud as you write it. Explain to students that the paper towel **absorbed**, or soaked up, the water. Tell students that next they are going to find out whether a paper towel will absorb water when only a small portion of the paper towel touches the water.

*Most students will say the paper towel will get wet.*

*Students should say the paper towel soaked up the water.*

4

Distribute a cup of water with attached dowel to each team, along with a sponge to wipe up any spills. Distribute a copy of **Activity Sheet 3** to each student.

Have one person from each team collect a paper towel strip with a piece of masking tape on it from the distribution station.

Show students how to stick the paper towel strip onto the dowel and suspend the strip in the water (see Figure 3-1).

Tell students to carefully watch the paper towel. After a few minutes ask, **What do you observe?**

Have students circle the picture on their activity sheets that best shows what happens when a strip of paper towel is dipped in a cup of water.

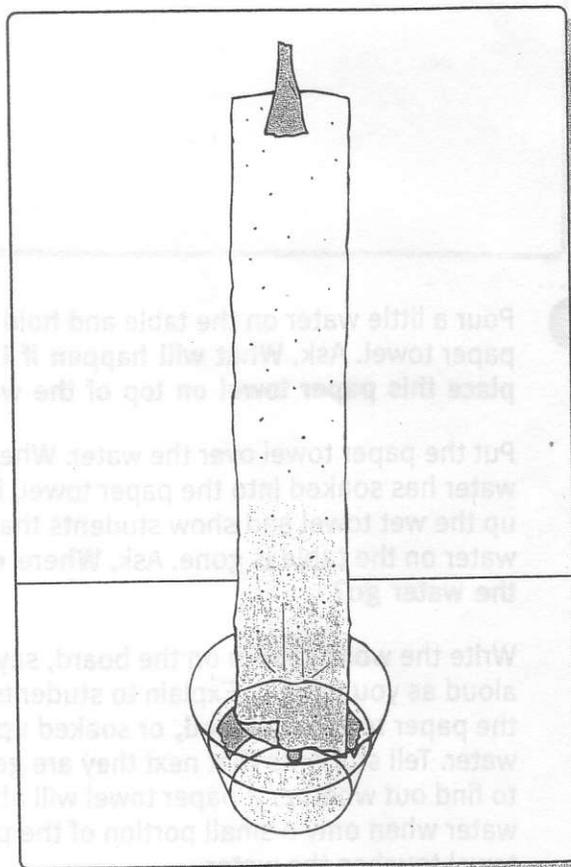
Challenge students to explain how water is climbing up their paper towels. Ask, **Can you explain how water is climbing up the paper towels?**

Explain to students that water sticks to fibers and other materials too. Tell students that some materials have small spaces or holes within the material that water can flow into. Paper towels are made of a material that has these spaces. Whenever water touches a material with spaces, it clings to that material and fills the spaces between it. As water on the paper towel moves higher to fill in empty spaces, it leaves some of the spaces below it empty again, so more water moves from the cup to fill in those spaces. As a result, water "pulls" itself up the paper towel.

*Tell students to be very careful not to get any part of the paper towel wet, yet.*

*Students should say that they see water moving up the paper towel.*

*Some students may say that the paper towel soaks up the water and that this water pulls more water up with it because water sticks to itself.*



▲ Figure 3-1. Water climbing up the paper towel strip.

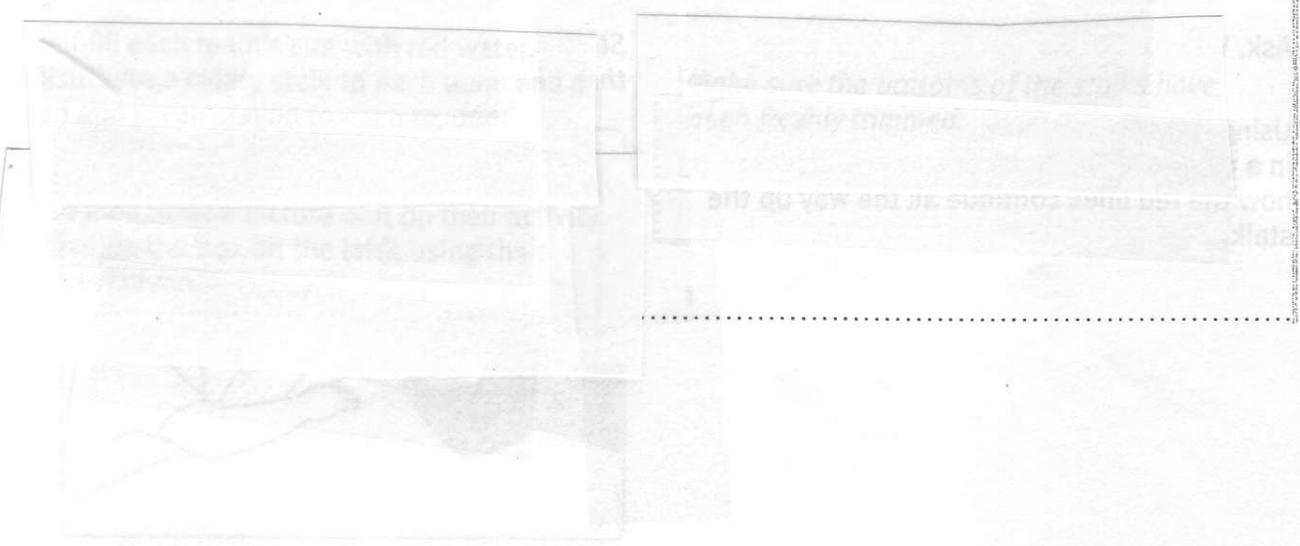
## Guiding the Activity

5

Tell students that it is this property of water—that water can pull itself up things—that accounts for how water gets from the roots of plants to the leaves. Explain that the roots of plants pull water out of the soil. The water then moves up the stem of the plant to the plant's leaves. As was true with the water and the paper towel, water sticks to the inside of the stem. As water moves up the stem, it leaves spaces below it empty and it pulls more water up behind it to fill those spaces.

Have students pour the water out of their cups and dispose of their paper towel strips. Students can detach the dowel from the cup and return it to the kit.

## Additional Information



▲ Figure 3-4. Students observe how water moves up a celery stalk.

Remind students of the experiment. Lead them to conclude that water sticks to itself and other molecules and so can pull itself up things.

Ask how did the water climb up the stalk?

White water can pull itself up some materials on the Properties of Water chart, saying the sentence aloud as you write it.

## Guiding the Activity

### Session II

6

After an hour, give each student his or her copy of Activity Sheet 3 and a red and a green crayon. Tell the students to remove the celery from the water and, after examining their stalk, draw a picture of what it looks like on the activity sheet (in the box on the right). Ask, **What do you observe?**

Ask, **Were these red lines there before you put the celery in the water?**

Ask, **Where did the red lines come from?**

Using a knife, cut the celery stalks cross-wise in a couple of locations to show each team how the red lines continue all the way up the stalk.

Ask, **How did the water climb up the stalk?**

Write *water can pull itself up some materials* on the Properties of Water chart, saying the sentence aloud as you write it.

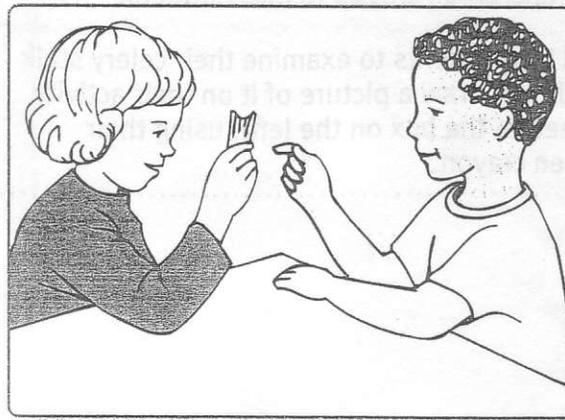
### Additional Information

*\*The teacher will choose a couple of stalks to take to the class and follow-up with!*

*Students should see thin red lines in the celery (see Figure 3-3). If students cannot see the red lines, tell them to hold their stalk up to a bright light. The light makes the red lines stand out.*

*Students should say that they were not.*

*Students should explain that the red water in the cup climbed up the celery stalk.*



▲ *Figure 3-3. Students examine how water traveled up a celery stalk.*

*Remind students of the paper towel experiment. Lead them to conclude that water sticks to itself and other materials and so can pull itself up things.*