

Have a Foggy Idea

ACTIVITY SUMMARY

Either as a student activity or a demonstration, "fog" is created in a bottle.

CONCEPTS TO BE LEARNED

1. Fog forms when relatively warm, moist air is cooled, causing the water vapor to form droplets.
2. In northern California, the cool ocean currents provide cooling for fog formation.

STANDARDS ADDRESSED

Focus Standards:

- Grade 4: Life Sciences 3.a: Ecosystems are characterized by living and non-living components.
Science Investigation and Experimentation S.S. 6: Students ask meaningful questions and conduct careful investigations.
- Grade 5: Earth Sciences S.S. 3: Water moves between oceans and land via evaporation and condensation.
Science Investigation and Experimentation S.S. 6: Students ask meaningful questions and conduct careful investigations.
- Grade 6: Science Investigation and Experimentation S.S. 7: Students ask meaningful questions and conduct careful investigations.
- Grade 7: Science Investigation and Experimentation S.S. 7: Students ask meaningful questions and conduct careful investigations.

Other Standards:

- Grade 6: Ecology (Life Sciences) 5.b

ANTICIPATED OUTCOMES

1. Students will understand how fog forms in northern California.

GROUPING

If done as a demonstration, whole class.

Student groups may be from two to six students.

TIME

20-30 minutes, including discussion

MATERIALS

- Electric hotplate, electric teapot or coffee pot, or other source of hot water
- Beaker or pan in which to heat water
- Ice—approximately one to two cups per group
- Thin aluminum pie pan
- 500-1000 mL beaker, clear milk bottle, or canning jar
(NOT a mayonnaise jar or similar type of jar, as it may break when hot water is poured into it!)



TEACHER PREPARATION

1. Obtain the materials listed above.

PROCEDURE

1. Discuss the importance of fog as a water source for the coast redwoods.
2. Ask the students if they know how fog is formed.
3. Tell them that fog is formed the same way that clouds are formed, except that fog is a cloud at ground level.
4. Ask if there is water in the air. Point out that they have all seen "steam" from their breath on cold mornings, condensation on windows and mirrors, and even on glasses or cans of cold drinks on warm days.
5. Ask if they have ever been to the ocean beach in northern California. Point out that even on a hot day, the ocean water in northern California is very cold. (The ocean currents off of the northern California coast come from the cold north Pacific.)
6. If you are doing this as a demonstration:
 - o Heat about a cup of water almost to the boiling point.
 - o While the water is heating, place the ice on the aluminum pie tin to allow the tin to start to cool.
 - o When the water is hot, pour it into the beaker or jar. Tell the students that the hot water is now evaporating, making warm moist air.
 - o Ask the students to predict what will happen if the cold pie tin is placed on top of the jar. Place the cold pie tin with ice on top of the jar.
 - o The warm, moist air should form a cloud or fog as the water droplets cool and condense.
 - o Carefully bring the jar of fog around the class for students to observe, or have them file past the demonstration.

If students are doing this as an activity:

- o **CAUTION** THE STUDENTS ABOUT HANDLING HOT WATER SAFELY AND THE USE OF GLASS!
- o Explain the process and write the steps on an overhead transparency, a handout, or the board.



VARIATIONS, ADAPTATIONS, DIFFERENTIATION

1. Some people do this activity by placing an ice cube in the opening of a milk bottle containing hot water.
2. On a foggy day, place a cup beneath a redwood branch and observe and collect the water that drips from it.

ASSESSMENT

1. Call on students to explain how this experiment is similar to fog forming along northern California's coastal area.

How Big?

ACTIVITY SUMMARY

Students learn about the size of redwoods by painting a life-size tree on the school grounds.

CONCEPTS TO BE LEARNED

1. Redwood trees can grow to great sizes.
2. Not all redwood trees are huge.
3. Scale drawings can represent large or small things.

STANDARDS ADDRESSED

Focus Standards:

- Grade 4: Mathematics Number Sense S.S. 3.0: Solve problems
- Grade 5: Mathematics Number Sense S.S. 1.0: Computation
Mathematics Number Sense S.S. 2.0: Calculate and solve problems
- Grade 6: Mathematics Number Sense S.S. 1.0: Solving problems
Mathematics Number Sense S.S. 2.0: Calculate and solve problems
- Grade 7: Mathematics Mathematical Reasoning S.S. 2.0: Using estimation

Other Standards:

- Grade 4: Mathematics: Measurement and Geometry S.S. 1.0
- Grade 5: Mathematics: Measurement and Geometry S.S. 1.0
- Grade 6: Mathematics: Measurement and Geometry S.S. 1.0

ANTICIPATED OUTCOMES

1. Students will comprehend the size of coast redwoods and, possibly, other trees.
2. Students will increase their understanding of scale illustrations.

GROUPING

Whole class

TIME

Varies

MATERIALS

- Paint brushes...size and number vary
- Rags and water for cleanup
- Exterior latex (water base) paint (for a tree shaped like the one drawn in the grid that follows, assuming one coat coverage):
 - For a 360' tall redwood tree on the school yard:
 - 20-25 gallons of green
 - two to three gallons of red-brown
 - ½-1 pint of some other color(s) for a person
 - For a 6-foot scale painting on the classroom door or wall:
 - ½ pint each of red-brown and green
 - (less than) ½ pint of some other color(s) for a person

- Gloves
- Newspapers or paper plates on which paint cans can be placed

TEACHER PREPARATION

1. Get permission from your principal and buildings and grounds department.
2. Obtain the paint and brushes and cleanup materials. Paint stores often have cans of "mistints" that they will donate, but are unlikely to have large quantities of a given color. You might be able to obtain one-gallon cans of several shades of brown (or green) and mix them. Parents or school district buildings and grounds departments can often be helpful with this.
3. Prior to, or while on a field trip to a redwood park, find out the size of the largest tree that the students are likely to see.

PROCEDURE

1. To paint on the playground:
 - a. Arrange to have a portion of the blacktop cleaned well, possibly with a power washer. Your buildings and grounds department or a parent may do this for you.
 - b. Outline the tree in chalk on the blacktop. Since each tree has a different shape, there is no "perfect" shape for the tree. You may use the following drawing with a grid system. For a 360' tall playground tree, one side of a grid square would equal 30 feet.
 - c. Assign a team of responsible students to paint two- to three-inch-wide outlines of the green and brown sections. This will provide "lines" for other students to paint within. Arrange for supervision while the outlines dry.
 - d. When the outlines have dried, assign teams of students to paint within the outlines. Arrange for supervision while the painting dries.
2. To paint on the classroom door:
 - a. Thoroughly clean the door. Place newspaper or a tarp under the door.
 - b. Outline the tree in pencil. Since each tree has a different shape, there is no "perfect" shape for the tree. You may use the following drawings with a grid system.
 - c. Assign a team of responsible students to paint 1/2" wide outlines of the green and brown sections. This will provide "lines" for other students to paint within. Arrange for supervision while the outlines dry.
 - d. When the outlines have dried, assign students to paint within the outlines.

VARIATIONS, ADAPTATIONS, DIFFERENTIATION

1. Paper can be used to make a scale illustration indoors.
2. Students can make scale drawings of various organisms to add to the indoor tree.
3. Students can figure out the scale for various size representations on walls or on the playground.
4. Students can paint circles to represent the circumferences of trees.

ASSESSMENT

1. Do students follow directions?
2. If students calculate the sizes of representations, are they accurate?

ANSWERS TO SELECTED STUDY GUIDE QUESTIONS

1. If three inches equals 360 feet, a half-inch square would be 60 feet on a side.
2. The giant sequoia base is about half of a square across, or about 30 feet.
3. Since a half-inch square represents 60 feet and the giant sequoia drawing is about five squares tall, the giant sequoia would be about 300 feet tall.
4. If you want to enlarge the drawing of the 360' tall tree using 12 squares, each square in the grid would represent 30' of tree height.
5. Since a half-inch square represents 30 feet, and the base of the coast redwood is about a third of a square, the base of the coast redwood tree would be about 10' in diameter.

Coast redwood tree for enlarging to paint:

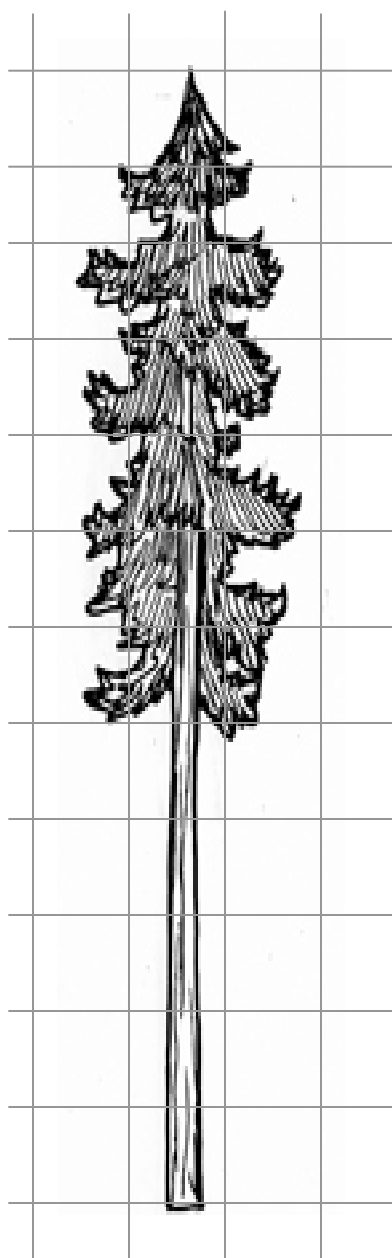


Figure 121

If this tree is 360' tall, each box of the grid is 30' on a side.

If the tree is six feet tall (as on a classroom door), each box would be six inches on a side.

To estimate how much paint it would require to paint the tree on a playground, for example, one could divide the tree into geometric shapes and calculate their areas. The top of the tree is a triangle, and the rest of the foliage could be considered a rectangle, as could the trunk (bole).

If the drawing is on a 30' grid, the triangle would have a base of about 30' and a height of about 30'. Its area would be about 450 square feet.

The rest of the foliage would be a rectangle about 60' wide and 150' tall. The area of that rectangle would be 9000 square feet.

The sum of the foliage would be about 9,450 square feet. If a gallon of paint covers about 400 square feet, about 23 gallons would be required to cover this area. However, not all of the foliage reaches the edge of the rectangle, and some of the bole or trunk is visible, so one might be able to get by with 20 gallons of green paint. To be safe, though, one should probably buy 25 gallons in case a gallon doesn't actually cover 400 square feet.

The trunk below the foliage would form a rectangle about 10' wide and 50' tall, or 500 square feet. This would require about a gallon and a quarter, but some of the trunk and some branches are visible within the foliage, so one ought to consider buying two or three gallons of brown paint.



Figure 122

Since every tree has a different shape, the precise shape of the tree isn't as important as illustrating the size that coast redwoods can reach. Students should be reminded, though, that while most redwoods are less than 300 feet tall, some are over 370 feet tall!

How Big? Study Guide

How can you accurately draw something that is very large on a small paper? One way is to use a system of grids. The same method can be used to enlarge an illustration.

If you have an illustration that you want to **enlarge**, draw a series of grid lines on the original illustration. Draw similar but larger grid lines on the paper on which you want to make the enlarged drawing. Or, you might use graph paper with different sized grids.

Then simply copy the part of the image from the small grid to the corresponding larger grid.

To **reduce** the size of a picture, use similar but smaller grid lines on the paper and copy the part of the image from the larger original grid to the corresponding smaller grid.

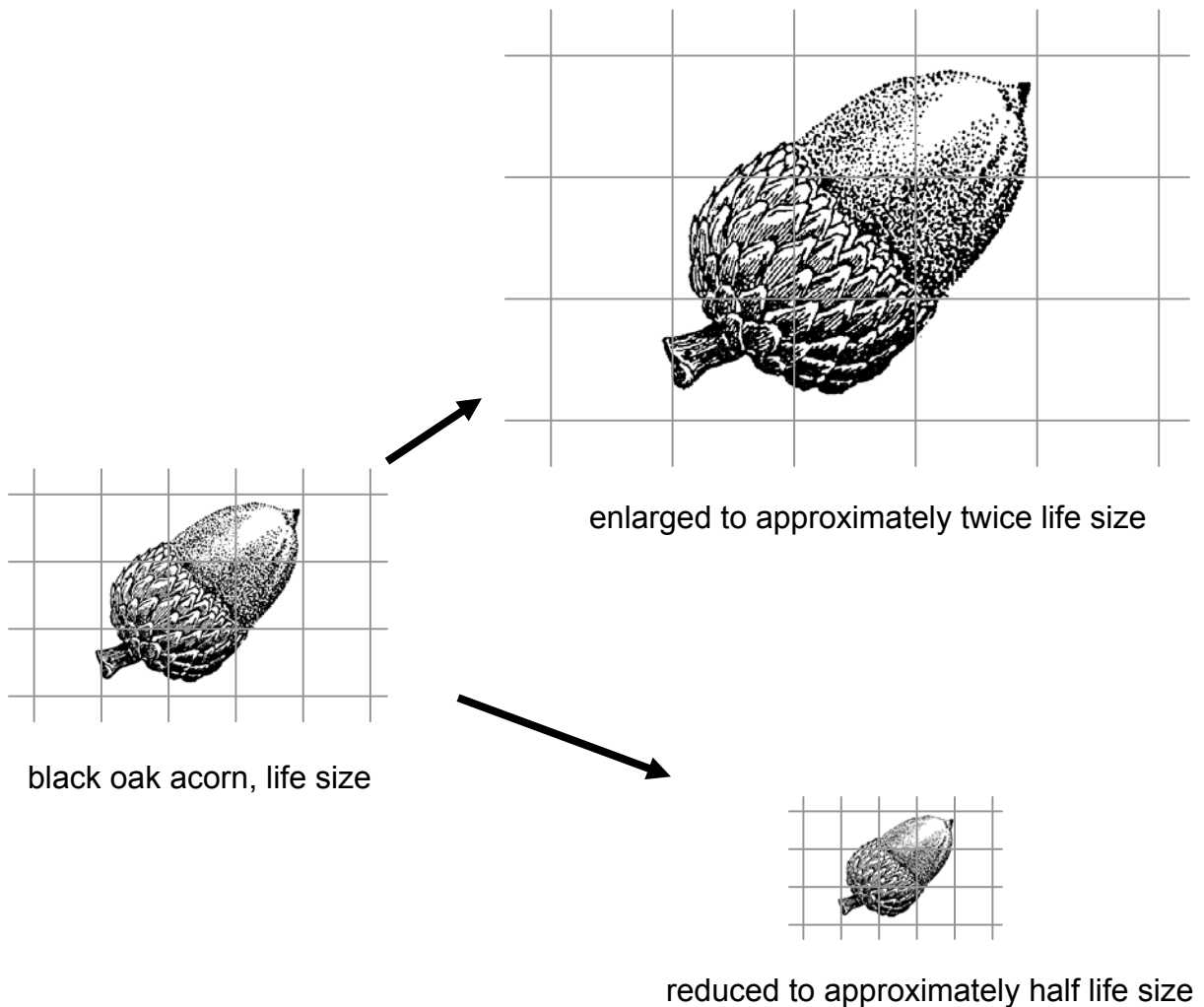
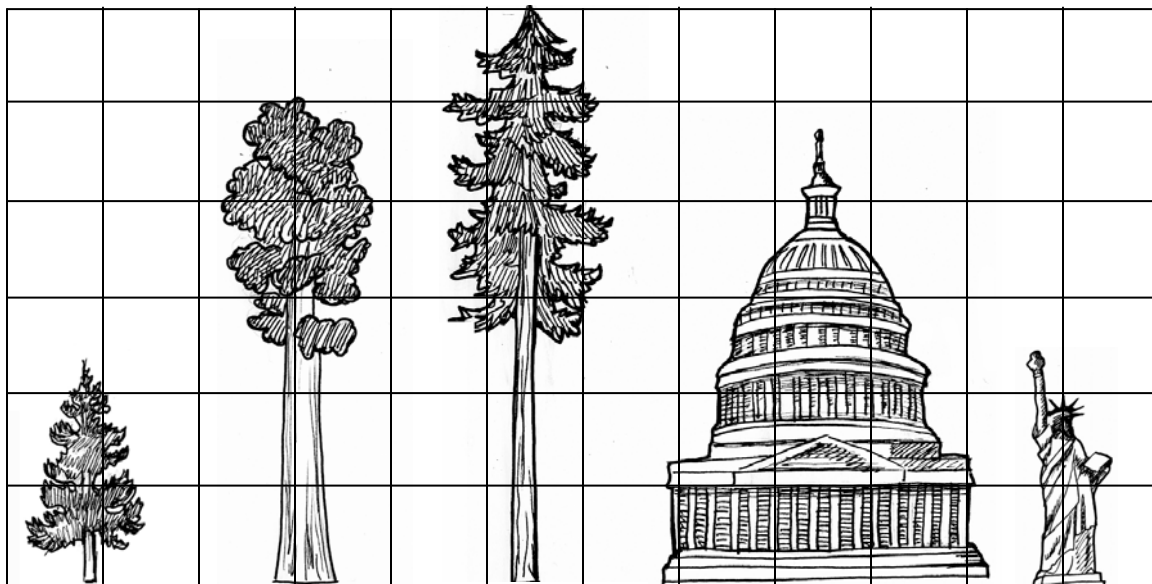


Figure 123

How Big? Questions

1. If the coast redwood tree drawn below is actually 360 feet tall, how many feet does each one-half inch square on the drawing represent?
2. If the coast redwood tree is 360 feet tall, how wide is the giant sequoia tree at its base?
3. If the coast redwood tree is 360 feet tall, how tall is the giant sequoia?
4. If you wanted to use a 12 square tall grid to draw the 360' coast redwood on a 6' door, how many feet would each square represent?
5. If you want to draw the coast redwood tree life-sized, how wide would the base be?

Most coast redwoods are shorter than 360 feet, but some are more than 370 feet tall, and many are over 250 feet tall, especially in the streamside alluvial flats.



dawn redwood (140' tall)

giant sequoia

coast redwood (360' tall)

Capitol Building (287' tall)

Statue of Liberty (151' from feet to torch)

Figure 124

Let's Stick Together!

ACTIVITY SUMMARY

Students learn about some properties of water through experiments and observations of cohesion, adhesion, surface tension, and capillary action.

CONCEPTS TO BE LEARNED

1. Water molecules tend to stick together, to be attracted to each other.
2. Trees have cells that are arranged like tubes and transport water throughout the tree.

STANDARDS ADDRESSED

Focus Standards:

- Grade 4: Science Investigation and Experimentation S.S. 6: Students ask meaningful questions and conduct careful investigations.
- Grade 5: Science Investigation and Experimentation S.S. 6: Students ask meaningful questions and conduct careful investigations.
Life Sciences S.S. 2: Plants . . . have structures for life processes.
- Grade 6: Science Investigation and Experimentation S.S. 7: Students ask meaningful questions and conduct careful investigations.
- Grade 7: Science Investigation and Experimentation S.S. 7: Students ask meaningful questions and conduct careful investigations.

Other Standards:

- Grade 5: Earth Sciences 3
- Grade 6: Ecology (Life Sciences) 5.b

ANTICIPATED OUTCOMES

1. Students will increase their ability to conduct experiments and make accurate observations.
2. Students will increase their understanding of water molecules, cohesion, adhesion, surface tension, transpiration, and the importance of humidity for redwood trees.

GROUPING

Groups of two to four students

TIME

30-60 minutes

MATERIALS

- Water: approximately two cups for each group
- Three- to four-inch rectangular glass or plastic plates (flat sheets, not dinner plates!): two per group (Look in the yellow pages under "plastics" for companies that sell sheet plastic. They may well donate scraps that can be cut on a table saw. Window and mirror companies may cut glass squares. Be sure to get the edges beveled and that the glass is thicker than normal window glass.)

- Plastic cup (preferably clear)
- Pie tin or shallow pan to catch spilled water and into which plates can be placed in the capillary action observation
- Paper clips or pennies: 25 per group
- Rubber band
- Approximately four inches of masking tape per group
- Small pieces of tag board: approximately $\frac{3}{4}$ " wide and as long as the glass plates or microscope slides
- Plastic or glass capillary tubing or other tubing with a small inside diameter
- Sponges or towels for cleanup
- "Pop beads" (about 10"-12" chain) (or small paper clips)
- Tubing through which the pop beads (or paper clips) can pass
- Optional: food coloring to color the water

TEACHER PREPARATION

1. Obtain the materials above.
2. Duplicate the Let's Stick Together Study Guide.
3. It is extremely important that you try out these experiments to be sure that they will work with your particular materials!

4.



Caution! If you use glass tubing or plates, be sure to warn the students not to break them. Be sure that edges of glass plates are beveled. (A local window or mirror company may do this for you, or you can simply sand them with sandpaper.)

PROCEDURE

1. Ask students how water can get to the top of a blade of grass. Of a rose bush? Of a 300-foot-tall redwood tree?
(The answer seems to be a combination of various properties of water molecules and physical processes. Leaves have tiny holes called stomata through which water evaporates. Due to their chemical structure, water molecules tend to stick together. This is called cohesion. When a molecule evaporates from a leaf, it tends to tug its neighbors upward. Also, water molecules tend to stick to things (adhesion), which contributes to their upward movement through the xylem cells of plants. In small tubes such as xylem tubes, this upward movement, caused by a combination of adhesion and cohesion, is called capillary action. Another factor may be osmotic pressure; water from the soil may enter root cells, pushing water upward. Capillary action seems to be the main way that water is moved upward in plants, but it doesn't fully explain how water can reach the top of a tall tree.)
2. Issue the Study Guides and show the students the materials and explain how the lab is to be conducted—moving from station to station or each group to complete all of the experiments at their own station.

3. After the students have done their experiments, demonstrate adhesion and transpiration:
 - a. Use pop beads or a paper clip chain to represent water molecules attracted to each other (cohesion).
 - b. Pass the chain through a tube or straw, which represents the xylem of a plant.
 - c. At the top end, remove one bead or clip, which represents evaporation of water from the leaf—transpiration. As you do so, show that the "water molecule" pulls on the next molecule in the chain, which pulls on the next one, etc.

VARIATIONS, ADAPTATIONS, DIFFERENTIATION

1. This activity can be done as a series of stations to which student groups move, or each group can have the materials to do all parts. Station labs require less material, but require the students to move.
2. Rather than pop beads or paper clips for the teacher demonstration of transpiration, a chain of connected circles can be cut from paper. Each circle represents a water molecule, and the chain is pulled through the tube and "molecules" are removed by tearing them off, which represents evaporation.

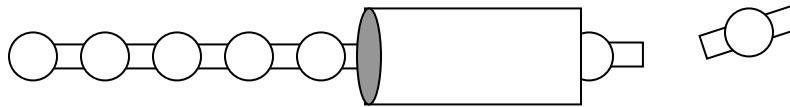


Figure 125

3. Have students use a dry sponge to try to clean up some spilled water, then use a damp sponge. The damp sponge tends to pick up the water better partly due to cohesion with the water molecules on the sponge. (Another factor is the flexibility of the sponge, allowing more of it to come in contact with the spilled water.)
4. See the activity "Transpiration."

ASSESSMENT

1. The Study Guide can be used for assessment.
2. Students can design, conduct, and report on other experiments of their own design or experiments that they find on the Internet or in other resources.

ANSWERS TO SELECTED STUDY GUIDE QUESTIONS

1. The tendency of water molecules to stick together and form a layer at the top surface is called surface tension.
4. The students should observe that the water rises higher on the end of the plates where the glass is closest together, and their drawings should show this.
5. Transpiration (evaporation) would happen more or faster when the air is warm and dry. Fog increases the humidity, which reduces water loss through transpiration. It also tends to cool the air, further reducing water loss. Some use the term "evapotranspiration" for this process.

REFERENCES AND RESOURCES

Hone, et al: *A Sourcebook for Elementary Science*.

The Watercourse and the Council for Environmental Education. *Project WET: Water Education for Teachers*. Bozeman, MT: Project WET, 1995.

Science supply companies listed in Appendix IV sell capillary tubing.

Let's Stick Together Study Guide

Water is necessary for life, and trees need to get water to all of their branches and leaves. How can water travel from the soil, through the roots, and to the top of a 300-foot tall redwood tree?

Water has several properties that enable trees to move water to their uppermost limbs and leaves. To help understand water's special properties, some vocabulary will be helpful.

Adhesion is the tendency of water molecules to be attracted to other materials. You have seen adhesion when you have observed water droplets stick to a mirror or window, or when you have seen water being soaked up by a sponge or paper towel.

Cohesion is the tendency of water molecules to be attracted to each other. You have seen cohesion when you have observed that water forms little droplets or “piles” on a counter top or waxed paper.

Surface tension results from the cohesion of water molecules at the surface of a liquid. It results in a skin-like layer of water molecules at the surface. In this activity you will do some experiments and make some observations of surface tension.

Capillary action is the movement of water through small spaces such as tiny tubes or plant cells as a result of cohesion and adhesion.

Transpiration is the loss of water from a plant, primarily through the leaves, which have small holes called stomata (or stomates) through which gases such as carbon dioxide, oxygen, and water vapor can enter and leave the plant.

As you do the following experiments, record your observations in the space provided.

1. Observing Surface Tension:

Place a plastic cup in a pie tin or shallow pan and add water until the cup barely overflows.

View the cup from the side. Does the water bulge upward from the top of the cup? Sketch the appearance of the water at the top of the cup.

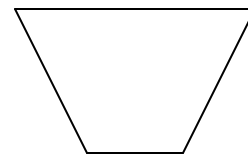


Figure 126

Do you think that you can add paper clips or pennies to the full cup? Predict how many you think you can add, then try it!

I predict that ____ can be added before the water will spill.

- a. What do we call the tendency of the water molecules to stick together and form a layer at the top surface? (Answer with a complete sentence.)

2. Observing Cohesion

Dip your finger tip into the cup of water. Withdraw your finger and hold it in front of your eye. Draw what you see.

Are the molecules of water sticking together? This is an example of **cohesion**.

3. Observing Adhesion:

In the cohesion experiment above, the water molecules not only stuck to each other, but they stuck to your finger. When something adheres or sticks to something else, that is called **adhesion**. When you soak up a spill with a sponge or paper towel, the molecules of water that were spilled adhere or stick to the sponge or paper towel.

4. Observing Capillary Action

Be careful with glass!

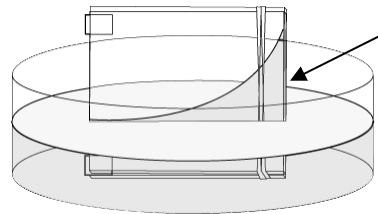


a. Place the tip of the small tube in the water. Observe what happens. Draw what you see.

b. Use masking tape to attach a piece of tag board (or two if the plates are large) to one edge of one of the glass or plastic plates. (The tag board serves as a thin spacer between the plates.)

Wet one of the plates or slides.

Use a rubber band to secure the plates together.



Grasp and gently squeeze here.

Figure 127

Carefully lower the edge of the plates into a bowl or pan of water to which food coloring has been added.

(Because the layer of water between the plates is so thin, it may be difficult to see. Dark food coloring will make it easier to see, especially if the plates are viewed against the sides of a white bowl.)

Gently squeeze the glass plates.

Observe and draw what happens.

The movement of water through such small spaces is called **capillary action**.

5. Teacher Demonstration of Transpiration

Plants need to obtain carbon dioxide from the air. They also need to get rid of gases such as oxygen and water vapor. To accomplish this, they have small holes or pores in their leaves. Those pores are called stomata. This process of water loss or evaporation through leaves is called **transpiration**.

When a water vapor molecule evaporates from a leaf, it tends to pull its neighbors with it. As millions of water vapor molecules leave the plant through transpiration, more water is pulled up from below.

- Do you think that water would evaporate or transpire more when it is warm or when it is cool?
- Do you think that water would evaporate or transpire more if there is lots of water already in the air, as on a foggy day, or when the air is dry?
- Redwoods live best where the summers have many foggy days. How might fog help redwoods reduce water loss through transpiration?

Microhabitats

ACTIVITY SUMMARY

Students study and compare small areas.

CONCEPTS TO BE LEARNED

1. Within a large area such as a stand of redwood trees, there are a variety of microhabitats, each of which has its own physical conditions and communities of organisms.

STANDARDS ADDRESSED

Focus Standards:

- Grade 4: Life Sciences S.S. 3: Living organisms depend on one another and their environment.
Science Investigation and Experimentation S.S. 6: Students ask meaningful questions and conduct careful investigations.
- Grade 5: Life Sciences S.S. 2: Plants and animals...have structures for life processes.
Science Investigation and Experimentation S.S. 6: Students ask meaningful questions and conduct careful investigations.
- Grade 6: Ecology/Life Sciences S.S. 5: Organisms exchange energy and nutrients among themselves and with the environment.
Science Investigation and Experimentation S.S. 7: Students ask meaningful questions and conduct careful investigations.
- Grade 7: Science Investigation and Experimentation S.S. 7: Students ask meaningful questions and conduct careful investigations.

Other Standards:

- Grade 4: Mathematics: Number Sense S.S. 3.0
Mathematics: Measurement and Geometry S.S. 1.0
Mathematics: Statistics S.S. 1.0
- Grade 5: Mathematics: Measurement and Geometry S.S. 1.0:
Mathematics: Statistics S.S. 1.0
- Grade 6: Mathematics: Number Sense S.S. 1.0
Mathematics: Number Sense S.S. 2.0
- Grade 7: Mathematics: Mathematical Reasoning S.S. 2.0

ANTICIPATED OUTCOMES

1. Students will increase their understanding of how plants and animals interact with each other and with their environment.
2. Students will increase their ability to make, record, and interpret observations.

GROUPING

Depends on the availability of study sites. Ideally, teams of two to four students for each site.

TIME

Varies

MATERIALS

- ☐ Varies with the types of data to be collected. Depending on the site, such tools as:
 - Cameras
 - Measuring devices
 - Magnifiers
 - Thermometers
 - Pans
 - Forceps
 - Books including keys and field guides (see Appendix IV and V)
 - Notebooks
 - Colored pencils or crayons

TEACHER PREPARATION

1. Arrange for the sites. Be aware of such issues as damaging the microhabitats, staying on trails, trampling plants, etc.
2. Obtain the materials listed above, or others as needed.
3. Study areas might be on the school grounds, or at a field site in a park or forest. Some possible study sites might be logs in various states of decay, bark of various species of trees, rocks (on the rock and under it), different parts of a stream (stream bank, sandy area, rocky area, area where water moves slowly or rapidly, etc.)

PROCEDURE

1. Have the students develop a system and forms for recording data.
2. Record such things as a description of the microhabitat, types and numbers of organisms, air or water temperature, moisture availability, etc.
3. Students should draw, as accurately as possible, the whole site and any organisms found.
4. Photographs can be helpful.

VARIATIONS, ADAPTATIONS, DIFFERENTIATION

1. Student teams can either study similar sites or different types of sites.
2. Students can compare the physical and biological data that they collect from different microhabitats.
3. Consider setting up a variety of microhabitats such as decaying logs, rocks, and various types of plants on the school grounds for ongoing studies over several years.

Mystery Objects

ACTIVITY SUMMARY

Various objects from a redwood forest are placed in boxes or bags. Students describe and try to identify the objects without seeing them.

CONCEPTS TO BE LEARNED

1. All senses can be useful in gathering information.

STANDARDS ADDRESSED

Focus Standards:

- Grade 4: Science Investigation and Experimentation 6.a: observations and inferences
- Grade 5: Science Investigation and Experimentation 6.a: classify objects
Life Sciences 2.a: Plants and animals have structures for life processes.
- Grade 6: Science Investigation and Experimentation 7a: develop a hypothesis

ANTICIPATED OUTCOMES

1. Students will increase their ability to use their sense of touch.
2. Students will increase their ability to identify various objects from a redwood forest.

GROUPING

Individual

TIME

Depends on the number of objects. Approximately one to three minutes per object.

MATERIALS



Remember that it is illegal to take materials from state or national parks.

Also tell the students not to use their sense of taste!

- Various objects from a redwood forest. Examples include:
 - ✓ Cones: coast redwood, Douglas-fir, alder, others
 - ✓ Pieces of bark: coast redwood, Douglas-fir, others
 - ✓ Leaves: coast redwood, Douglas-fir, sword fern, tanbark oak, others
 - ✓ Deer or elk antlers, jawbones, fur (from a taxidermist?)
 - ✓ Rocks: sandstone, serpentine, shale, other
 - ✓ Leaf litter/duff: from beneath a redwood, fir, oak
 - ✓ Litter: plastic water bottle, soda can, candy wrapper
 - ✓ Other objects?

- For each object: a box such as a shoebox, with a hole cut in the end, through which a student can insert his or her hand. Possibly attach a cloth flap to the inside to serve as a "door" and prevent peeking.
- Cloth or even paper bags can be used instead. Bags are easier to store, but students seem to take the activity more seriously if "mystery boxes" are used.
- Mystery Object Study Guide for each student

TEACHER PREPARATION

1. Create the boxes and obtain suitable objects.
2. Be sure to have extras in case the object becomes damaged.

PROCEDURE



Note: If possible, ascertain whether any students have allergies to items in the mystery boxes, including redwood bark.

1. This activity can be done either before or after the students have been taught about the objects.
 - a. If they have been taught about the objects, students try to identify them without seeing them.
 - b. If the students have not yet been taught about the objects, they should describe them in as much detail as they can tell from feeling them. They can then make up a name for the object.

VARIATIONS, ADAPTATIONS, DIFFERENTIATION

1. Consider giving the students a list of objects, making it a multiple choice activity.
2. This activity can be used with objects from any environment.
3. Mystery objects can be displayed in the classroom, perhaps on a tray, before or after a trip to the redwoods.

ASSESSMENT

1. The Study Guide can be used for assessment.
2. Have students read their descriptions; encourage students to use precise adjectives and similes.

ANSWERS TO SELECTED STUDY GUIDE QUESTIONS

Will vary according to the objects.

Mystery Objects Study Guide

For each mystery object, first write down the number of the mystery box or bag.

Then, carefully reach into the opening and feel the object. **BE CAREFUL NOT TO DAMAGE THE MYSTERY OBJECT!**

Describe the object in as much detail as possible.

- Is it hard? How hard? Hard as a rock, hard as a piece of wood, or?
- Is it flexible? How flexible? Flexible like a hose? A straw? A hair? A paper?
- Is it smooth? How smooth or how rough? Smooth like a ____, rough as ____?
- Does it have different parts, or is it all one piece? Are all parts the same?
- Based only on feel, can you draw the object?
- What else can you tell?

If you don't know what it is, make up a name that describes the object.

Record your observations below.

#	Description	Made-up name	Actual name

The Mystery of the Disappearing Leaf!

ACTIVITY SUMMARY

Students place different materials in various soils and observe decomposition (or lack thereof) over time.

CONCEPTS TO BE LEARNED

1. Some materials will decompose and some won't.
2. Different soil types and conditions can either support or inhibit decomposition.

STANDARDS ADDRESSED

Focus Standards:

Grade 4: Life Sciences S.S. 2: All organisms need energy and matter to live and grow.

Life Sciences S.S. 3: Living organisms depend on one another and their environment.

Science Investigation and Experimentation S.S. 6: Students ask meaningful questions and conduct careful investigations.

Grade 5: Science Investigation and Experimentation S.S. 6: Students ask meaningful questions and conduct careful investigations.

Grade 6: Ecology (Life Sciences) S.S. 5: Organisms exchange energy and nutrients among themselves and with the environment.

Science Investigation and Experimentation S.S. 7: Students ask meaningful questions and conduct careful investigations.

Grade 7: Science Investigation and Experimentation S.S. 7: Students ask meaningful questions and conduct careful investigations.

ANTICIPATED OUTCOMES

1. Students will increase their understanding of the process of decomposition.
2. Students will increase their ability to conduct scientific investigations.
3. Students will understand that not everything decomposes readily.

GROUPING

Groups of two to four students

TIME

Start: 15-30 minutes

Then: 10-15 minutes, observing every two to three days for an indeterminate amount of time

MATERIALS: for each group

- One clear two-liter soda bottle (or something similar), with five to ten ¼" holes drilled in the bottom
- Plastic/nylon screening: circle approximately the size of the bottle's bottom
- Pie tin or other device to catch water draining from the bottle

- Masking tape
- Measuring cup, graduated cylinder, or similar measuring device for measuring liquid volumes
- Approximately 1 quart (1 liter) of soil
- Various materials such as leaves, glass, plastic, aluminum, fruit, paper
- The Mystery of the Disappearing Leaf! Study Guide

TEACHER PREPARATION

1. Obtain materials above.
2. Cut off the top of the bottle so that it is about eight inches tall.
3. Drill five to ten ¼" holes in the bottom.
4. Place the screen in the bottom of the bottle to retain the soil and allow drainage.
5. This investigation can be as simple or as complex as you (and the students?) decide:
 - ✓ All can use the same soil, or they can investigate decomposition in various soil types such as redwood forest, potting soil, backyard soil, compost, etc.
 - ✓ Only one type of leaf may be used, or various types of leaves and other materials such as orange peels, aluminum cans, plastics, or other materials can be used.
 - ✓ All samples can receive the same amounts of water, or students can investigate various watering amounts and timing.
 - ✓ Samples can be in the dark, in the light, or in varying conditions.
 - ✓ For a longer-term experiment, students can use small samples of different types of wood.

PROCEDURE

1. Ask the students what happens to a leaf that falls to the forest floor. Introduce the term decomposition and discuss its meaning and importance to the forest (or any other) ecosystem.
2. Ask the students how they might design an experiment to see how long it takes a leaf to decompose. Elicit the idea of placing the leaf in some soil and checking it periodically. Discuss the idea that the living things that cause decomposition need moisture and some air to effectively decompose materials.
3. Decide on variables—types of soils, materials, moisture, etc.
4. Students place leaves and, possibly, other materials in soil in the 2-liter bottles so that the leaf is about three inches from the bottom and has about three to five inches of soil on top of it, and so that the leaf and/or other item is visible through the side of the bottle.
5. Bottles are placed in the pie tins and watered so that the soil stays damp but not soggy. (The microorganisms need air and moisture.) All bottles can be given the same amount of water with the same frequency, or water can be an experimental variable.
6. Students observe their bottles every two to three days, recording their observations on the Study Guide.

VARIATIONS, ADAPTATIONS, DIFFERENTIATION

1. Many variations are possible. Consider having the students all do the same experiment (same soil type, same leaf type, same watering schedule) for two to four weeks, and then let them design other variables such as leaf types, amount of water, and frequency of watering, soil types, etc.)

ASSESSMENT

1. Do students follow directions?
2. Questions on the Study Guide can be used for assessment.

ANSWERS TO SELECTED STUDY GUIDE QUESTIONS

2. Decomposition depends on living organisms such as bacteria, which require moisture to survive. They also need air (oxygen), so too much water will kill them.
3. Without decomposition, nutrients would not be returned to the soil for new organisms to use.
4. Buried deep under a soil cover (to prevent access by rats and birds, and reduce leaching of chemicals from rains), the garbage was cut off from air and moisture, so microorganisms couldn't live and decompose it.
5. Plastic bags cut off the supply of air and water that microorganisms need to effectively decompose the garbage.

The Mystery of the Disappearing Leaf! Study Guide

- Your teacher will provide you with a 2-liter bottle with a screen in the bottom, a leaf, and some soil.
- Use masking tape to put your name on your bottle.
- Place about three to five inches of soil in the bottom of the bottle.
- Then place the leaf (paper, plastic, or other item to be observed) so that you can see it through the bottle.
- Add three inches more of the soil on top.
- Place your experiment in the pie tin and water as directed by your teacher.
- Record your observations in the table below. You will observe your experiment over several days, so be sure to make accurate observations each time.

Soil type: _____ Watering: _____ every _____ days
(amount)

Other conditions being tested:

Date	Item being observed	Observations of the item	Other observations

Questions:

1. What changes did you observe in the leaf or other item?
2. Why is it important to keep the soil moist, but not too wet?
3. Why is decomposition important in a natural ecosystem?
4. Some years ago scientists dug up a garbage dump and were surprised to find newspapers that were 20 years old that had not decomposed. Why do you think the papers had not decomposed?
5. Many people put their garbage into plastic bags before placing it in the garbage can. What effect might this have on the decomposition of the garbage?
6. What is composting, and how can it help the environment?

Organism of the Year

ACTIVITY SUMMARY

Students do research on an organism and prepare a poster, brochure, or other presentation telling why that organism should be the "Organism of the Year."

CONCEPTS TO BE LEARNED

1. Every organism has a role in the environment and has value.

STANDARDS ADDRESSED

Focus Standards:

- Grade 4: Life Sciences S.S. 3: Living organisms depend on one another and their environment.
English: Writing 2.3: Write information reports.
English Listening and Speaking Standard Set
- Grade 5: English: Writing 2.3: Write research reports.
English Listening and Speaking Standard Set
- Grade 6: Ecology (Life Sciences) S.S. 5: Organisms exchange energy and nutrients among themselves and with the environment.
English: Writing 1.4: Use electronic text to locate information.
English: Writing 1.5: Compose documents...use word processing skills
English: Writing 2.3: Write research reports.
English Listening and Speaking Standard Set
- Grade 7: Life Science...Evolution 3.1: Biological evolution accounts for diversity.
English: Writing 1.4: Research and Technology
English: Writing 1.5: Citing sources
English: Writing 1.6: Creating documents using word-processing skills
English: Writing 1.7: Revising
English: Writing 2.3: Write research reports.
English Listening and Speaking Standard Set

ANTICIPATED OUTCOMES

1. Students will improve their research and writing skills
2. Students will increase their knowledge about a particular organism.
3. Students will increase their knowledge of ways that organisms interact.

GROUPING

Individuals or groups of two to three

TIME

Introduce assignment: 10-20 minutes

Research, production, and presentation of poster, brochure, or other product: varies

MATERIALS

- Depends on presentation method: materials for making posters or brochures, computers for PowerPoint presentations, video recorder, or?

TEACHER PREPARATION

1. Obtain pictures or slides of various types of organisms of the redwood forest. Sources might include *Redwood Ed*, the Internet, calendars, and magazines.
2. Obtain materials needed for the type of presentation planned.
3. Decide on group size and time to be allocated.
4. Duplicate the Organism of the Year Study Guide.
5. Optional: Obtain books for student use.

PROCEDURE

1. Show students pictures of various organisms of the redwood forest. As you show the pictures, tape them on the wall or write their names on the board.
2. Have the students "vote" for their "favorite" organism. Generally, mammals and large "charismatic" species will receive more votes.
3. Ask students why they voted as they did.
4. Discuss the idea that all organisms are important in an ecosystem.
5. Give the students the Organism of The Year Study Guide.
6. Have the students select their organism (or assign them). Some possibilities include the following, but many others are possible. Consider resources available, but information on most can be found on the Internet. Not assigning "charismatic" species such as mountain lions, black bears, raccoons, or organisms of obvious value such as trout, salmon, redwood trees or Douglas-fir trees makes it more interesting and challenging, and may be more useful.

poison oak	stinging nettle	spikenard	miner's lettuce	horsetail
hound's tongue	manzanita	madrone	wild cucumber	coltsfoot
skunk cabbage	big-leaf maple	alder	bay (laurel)	willow
moss	mushrooms	algae	various ferns	lichens
earthworms	mosquito	crane fly	yellowjacket	mayfly
stonefly	caddis fly	termite	bottle fly	millipede
centipede	sow bug	tick	black widow	wolf spider
snail	banana slug	newts	salamanders	tailed frog
tree frog	red-legged frog	pond turtle	rattlesnake	garter snake
rubber boa	gopher snake	fence lizard	ringneck snake	skink
alligator lizard	Steller's jay	scrub jay	red tailed hawk	winter wren
woodpecker	marbled murrelet	crow	snowy plover	spotted owl
flying squirrel	gray squirrel	chickaree	wood rat	voles

7. After completing their research and poster or other product, students present their products to the class.

VARIATIONS, ADAPTATIONS, DIFFERENTIATION

1. Consider students' abilities when forming groups.

ASSESSMENT

1. Does the product show knowledge of the organism?

REFERENCES AND RESOURCES

Roa, Michael: *Environmental Science Activities Kit: "Endangered Species II – Who Cares?"*

Council for Environmental Education: *Project WILD K-12 Activity Guide: "Interview a Spider"*

Organism of the Year Study Guide

It is easy to care about cute animals such as raccoons and spectacular plants like the coast redwood trees. But what about other plants and animals? Are mosquitoes, worms, poison oak, and moss important and worth caring about?

In this activity, you will prepare an advertisement to convince the class that your organism is an important part of the coast redwood community. Your teacher will provide details, but be sure that your advertisement includes the following:

- the name of your organism
- a picture or drawing of the organism
 - ✓ Include information about its size.
- its range—Where in the world is it found? A map might help.
- its habitat within the forest—Where in the forest does it live?
- its niche—its role in the forest
 - ✓ What does it eat?
 - ✓ What eats it?
 - ✓ How else is it important?
- some other interesting or important information

and, especially...

- **Why does this organism deserve to be the Organism of the Year?**

Be sure to give the source(s) of your information—author, title, publisher, date.

Redwood Crosswords

ACTIVITY SUMMARY

Four crossword puzzles are provided:

- Basic Redwood Ecology
- Advanced Redwood Ecology
- Redwood Forest Organisms
- Humans and the Redwoods

CONCEPTS TO BE LEARNED

Vocabulary

STANDARDS ADDRESSED

Vocabulary is useful in discussing all Standards and Environmental Principles.

ANTICIPATED OUTCOMES

1. Students will increase their knowledge of vocabulary.

GROUPING

Individual or any other configuration

TIME

Varies

MATERIALS

- Copies of crossword puzzles
- Transparencies of crossword puzzles and answers

TEACHER PREPARATION

1. Duplicate crossword puzzles and make transparencies.

PROCEDURE

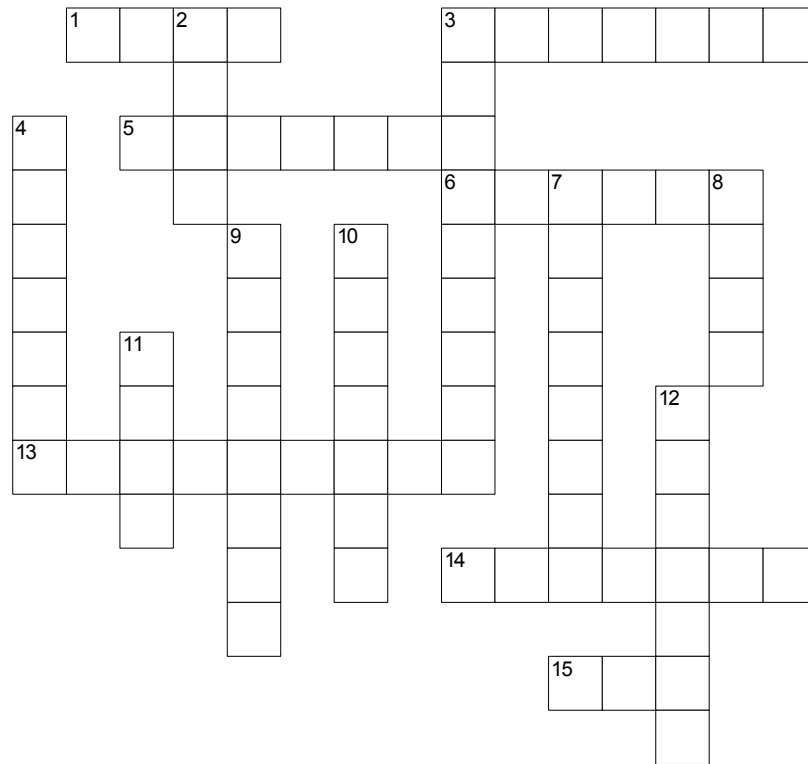
1. Crossword puzzles can be given as homework or class work.
2. Transparencies can be used to go over the answers.

ASSESSMENT

1. The puzzles can be used to assess vocabulary knowledge.

SOLUTIONS TO CROSSWORD PUZZLES FOLLOW THE PUZZLES

Basic Redwood Ecology Crossword Puzzle



www.CrosswordWeaver.com

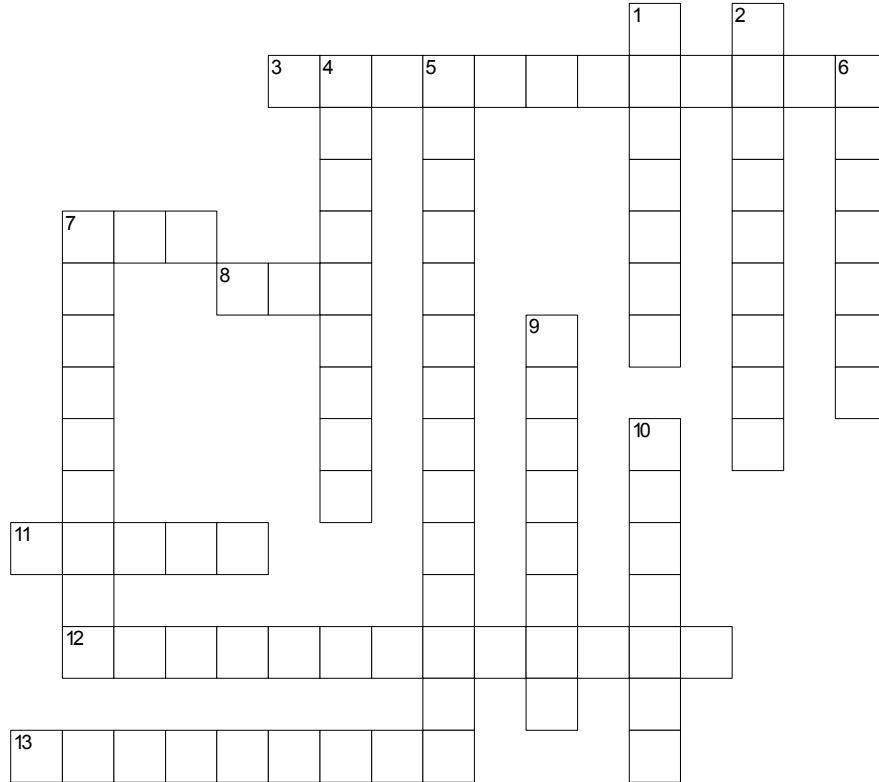
Across

- 1 I'm thick and I help protect redwoods from fire and insects.
- 3 A place where an organism grows is its ___.
- 5 A tree that produces seeds in a cone is a ___.
- 6 ___ factors include plants and animals.
- 13 I like to eat animals for dinner!
- 14 Redwood leaves are called ___.
- 15 I'm wet, I drip, and I help redwoods grow.

Down

- 2 I absorb minerals and water from the soil.
- 3 I like to eat plants for dinner!
- 4 ___ factors include air, water, sunlight, and minerals.
- 7 I'll eat plants and animals.
- 8 Redwoods produce their seeds in a ___.
- 9 There's not much of this in a dense redwood forest, but plants need it.
- 10 The coast ___ is the world's tallest tree.
- 11 Redwoods may sprout from me, especially if the tree is injured.
- 12 The study of organisms and how they interact with each other and the environment

Advanced Redwood Ecology Crossword Puzzle



www.CrosswordWeaver.com

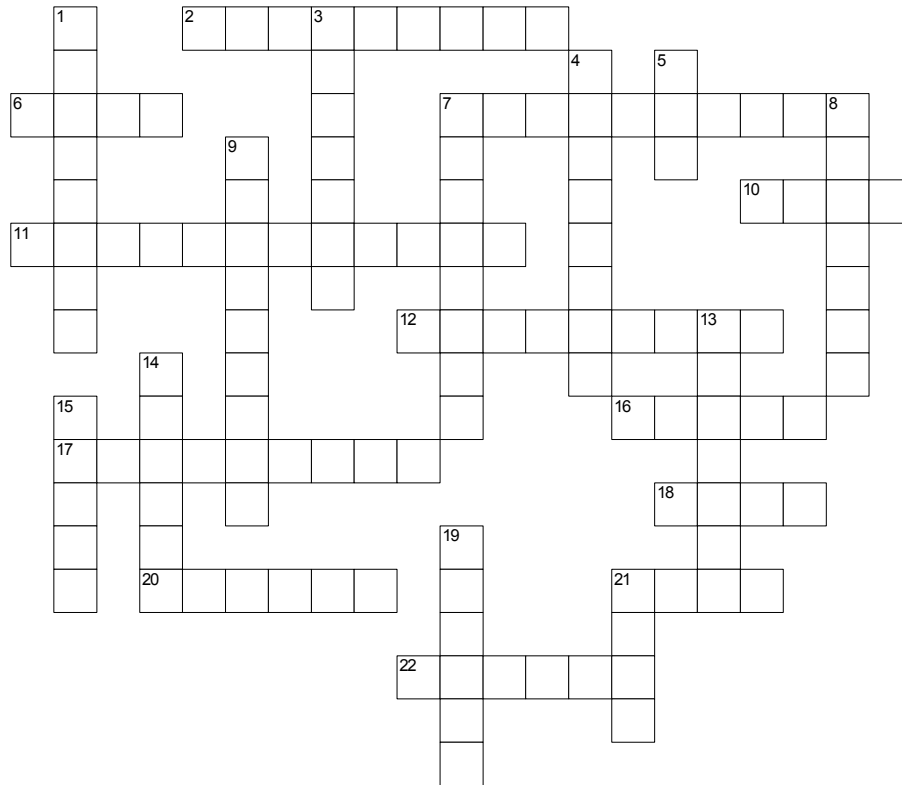
Across

- 3 Species of coast redwood
- 7 A food ___ shows what eats what.
- 8 ___ drip provides water for redwoods in the summer.
- 11 A food ___ is a simple way to show what eats what.
- 12 Why fallen trees and leaves don't stay on the forest floor forever
- 13 ___ trees lose their leaves in the winter.

Down

- 1 Trees help remove carbon ___ from the atmosphere.
- 2 Has lots of insect- and rot-resisting tannin, and is the non-living center of the tree.
- 4 ___ trees don't lose their leaves in the winter.
- 5 Produces oxygen
- 6 Genus of coast redwood
- 7 The land from which water flows into creeks and rivers
- 9 Carrying ___ tells how many can live in a place.
- 10 The study of organisms and their relationships with each other and the environment

Redwood Forest Organisms Crossword Puzzle



www.CrosswordWeaver.com

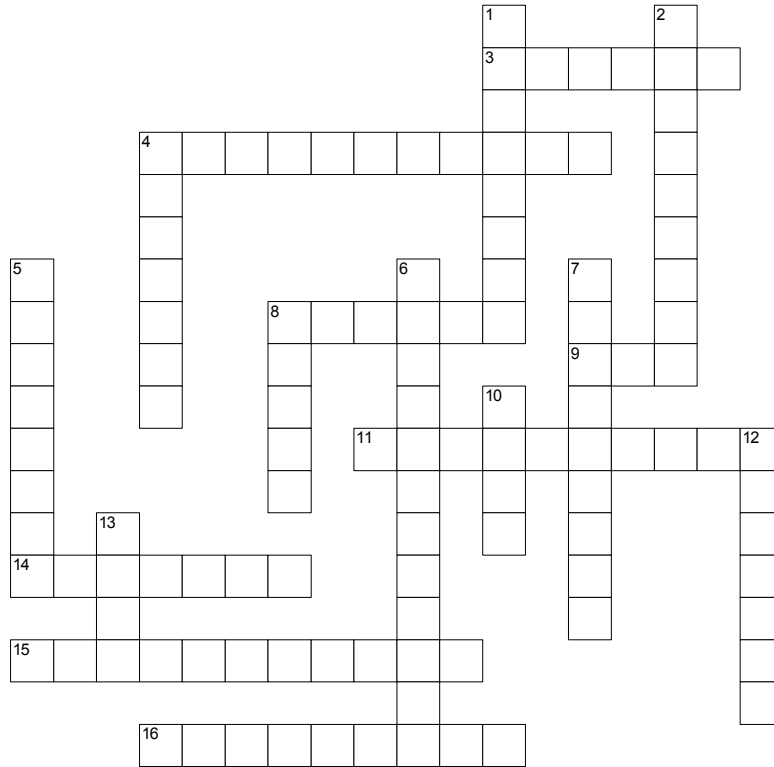
Across

- 2 Leaflets three, leave me be!
- 6 I'm green, I reproduce with spores, and I can get pretty big.
- 7 Pacific giant __
- 10 Blood sucker, spider relative
- 11 Species of the coast redwood
- 12 Two pairs of legs per segment
- 16 Smelly and striped
- 17 One pair of legs per segment
- 18 I may look like a banana, but I'm not!
- 20 I need clean, cold water.
- 21 I need a damp place to live, I'm small, and I reproduce with spores.
- 22 I look like a large clover.

Down

- 1 I'm a jaybird with a pointed crest.
- 3 Genus of coast redwood
- 4 I'm tiny, but I can get rid of the largest dead plant or animal.
- 5 Some call me pepperwood or laurel. My leaves have an odor, and I can be used in soups.
- 7 Nettle
- 8 I look like a bandit.
- 9 Scouring rush
- 13 They call me a fir, but I'm not.
- 14 Mushroom
- 15 Listen for the sound of an __ woodpecker.
- 19 My acorns were used for food by Native Americans, and my bark was used to make leather.
- 21 I'm a deer with big ears.

Humans and the Redwoods Crossword Puzzle



www.CrosswordWeaver.com

Across

- 3 Boards
- 4 Platform for lumberjacks
- 8 Redwood's ability to stump ___ helps it regrow rapidly after logging.
- 9 Old time tree cutter
- 11 Redwood's ___ to insects and rot is one of the things that makes it valuable
- 14 A long hand saw
- 15 Taking care of the forest
- 16 With ___ yield forestry, trees are planted for future generations.

Down

- 1. Cutting all of the trees in an area
- 2. In ___ logging, only a few trees are taken from a stand.
- 4. White colored wood; becomes heartwood
- 5 Modern tree cutter
- 6 Using resources wisely
- 7 Who put the red in redwood?
- 8 Leftover branches
- 10 Where trees become boards
- 12 May result without proper care and planning
- 13 Can kill trees, but in nature helps remove competition

Crossword Puzzle Solutions

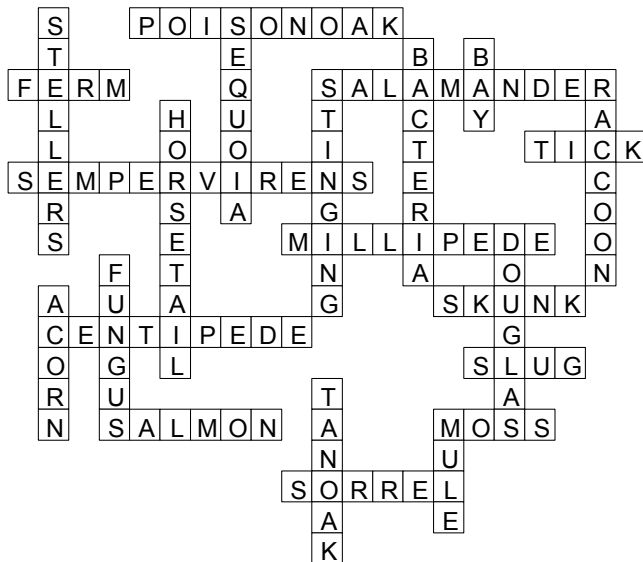
Basic Redwood Ecology



Advanced Redwood Ecology



Redwood Forest Organisms



Humans and the Redwoods



Slow Growth or Fast Growth?

ACTIVITY SUMMARY

Students compare samples of wood that show different growth rates.

CONCEPTS TO BE LEARNED

1. Depending on environmental conditions, trees grow at different rates.
2. As trees grow, cells are added by the cambium.
3. When a tree is growing rapidly, large cells are formed. When a tree is growing slowly, smaller cells are added. These different-sized cells form growth rings in the wood.
4. Growth rings in wood indicate the growth rate and age of a tree.

STANDARDS ADDRESSED

Focus Standards:

Grade 4: Life Sciences 3.a: In any environment, some organisms survive well, some less well, and some don't survive.

Science Investigation and Experimentation 6.a: observation and inferences

Science Investigation and Experimentation 6.b: measure and estimate

Grade 5: Life Sciences 2.a: Plants...have specialized structures

Grade 6: Science Investigation and Experimentation 7.a: develop a hypothesis

Other Standards:

Grade 4: Mathematics Number Sense S.S. 3.0

Grade 5: Mathematics Number Sense S.S. 1.0

Mathematics Number Sense S.S. 2.0

Grade 6: Mathematics Number Sense S.S. 1.0

Mathematics Number Sense S.S. 2.0

Grade 7: Life Sciences 5.b

Mathematics Mathematical Reasoning S.S. 2.0

ANTICIPATED OUTCOMES

1. Students will understand that environmental factors such as sunlight (and competition for sunlight) affect the growth rate of plants.
2. Students will be able to compare the growth rates of wood samples based on the size of the growth rings.
3. Students will describe some possible causes of different growth rates of trees as indicated by the size of growth rings.

GROUPING

Two or three students per group

TIME

30 minutes

MATERIALS

For each team, provide at least two samples of wood. One sample should have close growth rings, indicating slow growth and the other should have widely spaced rings, indicating rapid growth. The wood samples might be tree rounds ("cookies") or they might be samples cut from boards.

TEACHER PREPARATION

1. Obtain the wood samples. A lumber yard, builder, or parent may have scraps from boards. Rounds might be obtained from sawmills, a tree-trimming service, a state or county forester, or a firewood company.
2. If you don't have the resources to cut and sand the samples, a local junior high or high school wood shop teacher, or a parent, might help.

PROCEDURE

1. Give the teams the wood samples and ask them to describe what they see.
2. Discuss the process by which rings are formed. (See the activity "The Great Tree Cookie Mystery." Consider making an overhead transparency.)
3. For various samples, have the students determine:
 - a. how many years it took the tree to grow 1 inch in radius,
 - b. how many years it took the tree to grow 1 inch in diameter (half as long as an inch in radius, since the diameter is two radii),
 - c. how many years' worth of growth is represented by the sample,
 - d. the average growth rate represented by the sample: x inches per year.
4. Discuss why trees might have different growth rates. (The main factor in the growth of coast redwoods is usually the availability of sunlight.)

VARIATIONS, ADAPTATIONS, DIFFERENTIATION

1. Obtain samples of different types of wood (fir, redwood, oak, etc.). Have students compare the growth rates of the different samples.
2. See the activity "The Great Tree Cookie Mystery."
3. See the activity "Fence Post Studies."

ASSESSMENT

1. Give an individual student or a group of students a wood sample showing a change in growth rate, either speeding up (release) or slowing down (suppression), and ask them to explain what might have caused the change.

REFERENCES AND RESOURCES

Tree cookies can be purchased from various sources. See Appendix IV.

American Forest Foundation: Project Learning Tree: *Pre K-8 Environmental Education Activity Guide: "Tree Cookies"*

Transpiration

ACTIVITY SUMMARY

Students conduct experiments to see that transpiration results in the loss of water from a plant's leaves.

CONCEPTS TO BE LEARNED

1. Plants have cells that are arranged like tubes and transport water throughout the tree.
2. Plants lose water through their leaves in a process called transpiration.

STANDARDS ADDRESSED

Focus Standards:

- Grade 4: Science Investigation and Experimentation S.S. 6: Students ask meaningful questions and conduct careful investigations.
- Grade 5: Life Sciences S.S. 2: Plants . . . have structures for life processes.
Science Investigation and Experimentation S.S. 6: Students ask meaningful questions and conduct careful investigations.
- Grade 6: Science Investigation and Experimentation S.S. 7: Students ask meaningful questions and conduct careful investigations.
- Grade 7: Science Investigation and Experimentation S.S. 7: Students ask meaningful questions and conduct careful investigations.

Other Standards:

- Grade 5: Earth Sciences 3
- Grade 6: Ecology (Life Sciences) 5.b

ANTICIPATED OUTCOMES

1. Students will increase their ability to conduct experiments and make accurate observations.
2. Students will increase their understanding of transpiration and of the importance of humidity for redwood trees.

GROUPING

Groups of two to four students

TIME

Part 1: 30 minutes to set up the experiment
15 minutes to observe it at the end of the day
30 minutes to observe it and answer questions the next day

Part 2: 15-30 minutes to set up the experiment
15 minutes to observe it at the end of the day
30 minutes to observe and dismantle it the next day and answer the question

MATERIALS

- For each student: Transpiration Study Guide

Part 1: For each group:

- Three stalks of celery, with leaves
- A beaker or cup (250 mL or more)
- Food coloring
- Petroleum jelly (a small amount - a half teaspoon or less)
- Metric ruler
- Paper towels for cleaning petroleum jelly from fingers
- Sharp knife (or an adult to do the cutting)
- Materials for cleaning up—sponge or towel

Part 2: For each group:

- Two sandwich size plastic bags
- Six inches of masking tape
- Petroleum jelly (a small amount...a half teaspoon or less)
- Two branchlets or large leaves on living plants

TEACHER PREPARATION

1. Obtain the materials listed above.
2. Duplicate the Transpiration Study Guide.

PROCEDURE

Be sure to try both experiments before having students do them.

Part 1:

1. Depending on the age and abilities of the class, consider cutting the celery yourself or having another adult cut it.
2. Issue the materials, including the Study Guide. Go through the procedure, demonstrating what the students are to do, with emphasis on being safe with the knife if the students are to do their own cutting.
3. Students should observe at the end of the period or day, and again the next day.
4. Discuss the observations and Study Guide questions.



Part 2:

1. Take the class outdoors to the plant(s) that you have selected and go over the procedure.
2. Have the students begin the experiment.
3. Observe at the end of the period or day, and again the next day.
4. Discuss the observations and Study Guide questions.

VARIATIONS, ADAPTATIONS, DIFFERENTIATION

1. Part 2 can be done with potted plants in the classroom, which might be preferable if the outdoor plants are not secure from vandalism or because of weather.
2. Both experiments can be tried with different types of plants.
3. See the activity "Have a Foggy Idea."

ASSESSMENT

1. The Study Guide can be used for assessment.

ANSWERS TO SELECTED STUDY GUIDE QUESTIONS

Part 1:

Data Table: We would expect the colored water to rise the most in the stalk with leaves and no petroleum jelly, as the stomata are open, allowing more transpiration. We would expect that the water would rise the least in the stalk without leaves.

Question 1: Removing the leaves should reduce the height to which the water rose.

Question 2: Covering the leaves with petroleum jelly should reduce the height to which the water rose.

Question 3: Desert plants generally have their leaves reduced in size. In cacti, the leaves are reduced to spines. Others have few leaves. Most have leaves covered with a waxy coating to reduce water loss.

Part 2:

Data Table: The leaves without the petroleum jelly would be expected to lose more water through transpiration.

Question 4: Foggy days have high humidity, which reduces evaporation and transpiration. Fog also helps keep the air cool, which further reduces evaporation and transpiration.

REFERENCES AND RESOURCES

Miller, Kenneth and Joseph Levine. *Prentice Hall Biology*.

Transpiration Study Guide

Part 1: Transpiration Through Celery Stalks and Leaves

1. Pay attention as your teacher demonstrates the procedure for this activity.
2.
 - a. **Carefully** cut about 1 cm (1/2 inch) from the bottom of all three celery stalks. Try to end up with stalks that are about the same size.
 - b. Remove the leaves from one stalk. (This is stalk #1)
 - c. Use your finger to apply petroleum jelly to both sides of all of the leaves of stalk #2.
 - d. Place all 3 stalks in a beaker or cup with an inch of water with food coloring.
 - e. Place the beaker in a sunny area. Record your observations on the data table at the start of the experiment, at the end of the day or period, and on the next day.

	Height of colored water (indicate units...cm, mm, in. or?)		
	At the start	End of period/day	Next day
Stalk 1 (no leaves, no petroleum jelly)			
Stalk 2 (leaves with petroleum jelly)			
Stalk 3 (leaves, no petroleum jelly)			

Part 2: Transpiration In a Living Plant

1. Pay attention as your teacher demonstrates the procedure for this activity.
2. Write your name or group number on two 1-inch pieces of masking tape. Attach the tape to the two plastic bags.
3. Place one of the plastic bags around a leaf or branchlet of the selected plant, bunching the opening up and wrapping the opening securely with a couple of inches of masking tape.
4. Use your finger to apply petroleum jelly to both sides of the leaf (or leaves) of a second branch of the same plant. Then enclose the leave(s) with the second bag as in step 3. **Try to use branches with the same number and sizes of leaves.**
5. Record your observations on the data table at the start of the experiment, at the end of the day or period, and on the next day.

	Observations...including water in the plastic bag		
	At the start	End of period/day	Next day
On branchlet/leaves without petroleum jelly			
On branchlet/leaves with petroleum jelly			

Continued next page

Transpiration Questions

Answer the following questions with complete sentences.

In **Part 1**, the colored water moved up through special water-transporting cells called xylem cells. These cells form long tubes to bring water and minerals from the roots to the leaves. Leaves have special openings called stomata or stomates (singular: stomate) through which water vapor is given off to the environment by the plant.

1. In Part 1 (celery stalks), what was the effect of removing all of the leaves on the movement of the colored water? (Compare to stalk #3.)

2. In Part 1, what was the effect of coating the leaves with petroleum jelly? (Compare to stalk #3.)

3. If you were designing a plant to live in the desert, would you make a plant with large leaves with lots of stomata, or a plant with small leaves with few stomata? Explain.

In **Part 2**, you observed water loss through leaves, which is called transpiration. Warm, dry air increases evaporation of water, and, therefore, it also increases transpiration.

4. Redwoods live best in areas where there is lots of fog, especially in the summer. How might fog reduce water loss through transpiration? (Hint: Discuss both temperature and humidity (the amount of water vapor in the air.))

Water Cycle in a Jar (or Two)

ACTIVITY SUMMARY

Students observe evaporation, condensation, runoff, and infiltration as parts of the water cycle.

CONCEPTS TO BE LEARNED

1. Water moves around in the environment in the water cycle.

STANDARDS ADDRESSED

Focus Standards:

- Grade 4: Science Investigation and Experimentation S.S. 6: Students ask meaningful questions and conduct careful investigations.
- Grade 5: Earth Sciences S.S. 3: Water moves between oceans and land via evaporation and condensation.
Science Investigation and Experimentation S.S. 6: Students ask meaningful questions and conduct careful investigations.
- Grade 6: Science Investigation and Experimentation S.S. 7: Students ask meaningful questions and conduct careful investigations.
- Grade 7: Science Investigation and Experimentation S.S. 7: Students ask meaningful questions and conduct careful investigations.

Other Standards:

- Grade 4: Life Sciences 2
- Grade 5: Earth Sciences 4
- Grade 6: Earth Science 2

Environmental Principles and Concepts

- Principle I: Humans depend on natural systems.
 - Concept a: Humans depend on natural systems for goods and materials.
 - Concept b: Humans depend on ecosystems.
 - Concept c: The health of ecosystems affects their usefulness for people.
- Principle III: Natural systems have cycles on which humans depend and that can be altered by humans.
 - Concept a: Natural systems have cycles.
 - Concept b: Humans depend on and utilize natural cycles and processes.
 - Concept c: Human practices can alter natural cycles and processes.
- Principle IV: The exchange of matter between natural systems and human societies affects the long-term functioning of both.
 - Concept a: Effects of human activities on natural systems depend on quantities of resources used and the quantity and characteristics of the byproducts of use.
 - Concept b: Byproducts of human activities affect natural systems.
 - Concept c: The ability of natural systems to adjust to human-caused alterations depends on several factors.

ANTICIPATED OUTCOMES

1. Students will increase their understanding of the water cycle.

GROUPING

Either teacher demonstration or
Groups of two to five students

TIME

Begin: 15-30 minutes

Activity: 30-60 minutes or more

MATERIALS

- Large clear container such as gallon jar, deep glass bowl, or plastic tub
- Aluminum foil
- Masking tape
- Ice cubes
- Salt water (mix about four teaspoons of salt in two cups of water. The amount varies depending on the size of the jar, bowl, or tub)
- Cup, glass, jar, or plastic tub such as margarine or cream cheese might come in
- Lamp with flexible "neck" with 100 watt bulb, preferably clear, or a sunny windowsill
- About one cup of sand or soil. The amount varies depending on the container size.

TEACHER PREPARATION

1. Obtain the materials above for each group or for the demonstration.
2. To determine the time needed, try out the activity before having students do it.

PROCEDURE

1. Place about two cups of salt water in the bottom of the jar. Explain to students that this represents the ocean. (Or ask the students what it might represent.)

(As you go through the steps, diagram and label the water cycle on the board or on a piece of chart paper.)

2. Place the sand or soil into the "ocean" in the jar, off center. Add enough so that the sand rises above the ocean. Explain (or elicit) that this represents the land.
3. Place an empty cup, glass, jar, or tub in the jar, off center. Explain (or elicit) that this represents a lake. (If you use a plastic tub, you may need to weigh it down with a rock.)
4. Place a strip of masking tape across the top of the jar so that it bisects the opening.

5. Cover the top opening of the jar with aluminum foil. Extend the foil far enough down the side of the jar so that it is held firmly in place. Press down on the cover on either side of the tape so that some of the condensing water will drip into the cup/lake and some will drip onto the sand/soil.
4. Shine the light directly on the "ocean." Explain that this represents the sun. (Or place the jar on a sunny windowsill.) Ask the students what effect the sun will have on the water in the ocean. Elicit the response of evaporation.
5. Place about six to ten ice cubes on top of the (indented) cover. Explain that this represents the cooling that happens as air rises.
6. After a while, some water should begin to condense on the underside of the foil and run down the indentations so that some drips into the cup (lake) and some drips onto the land. Ask the students what this represents (precipitation). They will probably say rain, but point out that snow, hail, and fog are other forms of precipitation. Add more ice cubes if necessary. Point out that the dripping water is not from the ice cubes, but rather from condensation of water that is evaporating from the ocean.
7. Ask the students what happens to the rain that falls on the land. (It may soak in, collect in ponds or lakes, or run off the land. If it soaks in, it may be used by plants or may flow downhill in the underground water system known as the aquifer. If it collects in a lake or pond, it may be used by plants or animals, it may soak in, or it may run off into a creek or river.)
8. Discuss how plants and animals fit into the water cycle as they use water and give off waste water as urine, perspiration, water vapor in breath, or through transpiration. Add these to the diagram.
9. After some water has collected in the cup, ask the students whether it is salt water or fresh water. After they have guessed, have a volunteer or two taste it. Discuss the idea that the salt is left behind as the water evaporates.

VARIATIONS, ADAPTATIONS, DIFFERENTIATION

1. Rather than bisecting the top with tape, two jars can be set up, one with a cup/lake and one with sand/soil/land.
2. Plastic animals can be placed in the jar. Plastic or real plants can be placed in the jar.

ASSESSMENT

1. Have the students draw and label a water cycle.

REFERENCES AND RESOURCES

Allen, Maureen et al.: *All About Water*

American Forest Foundation: *Project Learning Tree Pre K-8 Activity Guide: "Water Wonder"*

The Watercourse and the Council for Environmental Education: *Project WET* (several activities)

Water Environment Federation: *Water Sourcebook*

Council for Environmental Education: *Project WILD Aquatic Education K-12 Activity Guide: "Where Does Water Run?"*

Contact your local water agency for additional resources. Many have posters and student activity guides.

Who Am I?

ACTIVITY SUMMARY

Students are each given an "identity" by having a picture of something from the redwood forest either pinned to the back of their shirt or by having the picture mounted on a string which is hung around the neck with the picture on the student's back. The student then asks other students yes/no/maybe questions to try to determine their identity.

CONCEPTS TO BE LEARNED

1. Plants, animals, and other things can be described and can be identified by their descriptions.

STANDARDS ADDRESSED

Focus Standards:

- Grade 4: Science Investigation and Experimentation 6.a: Students ask meaningful questions.
- Grade 5: Life Sciences 2.a: Plants and animals have structures for various life processes.
Science Investigation and Experimentation 6: Students ask meaningful questions.
English Listening and Speaking Standard Set
- Grade 6: Science Investigation and Experimentation 7: Students ask meaningful questions.
- Grade 7: Science Investigation and Experimentation 7: Students ask meaningful questions.

ANTICIPATED OUTCOMES

1. Students will increase their ability to describe and identify objects, including plants and animals of the redwood forest.

GROUPING

Whole class

TIME

30 minutes

MATERIALS

For each class member, a picture or specimen mounted on a string long enough to go around a student's neck so that the picture hangs on the student's back. (24"-32") The illustrations in Section I of *Redwood Ed* might be used.

TEACHER PREPARATION

1. Obtain pictures or drawings of various plants and animals of the redwood forest.
2. Affix the pictures to cardboard or tag board, or laminate.

3. Leaves or other specimens can be mounted on cardboard and covered with clear plastic or inserted into a re-sealable plastic bag.
4. Punch holes in the two top corners and tie a piece of string (24 to 32 inches long) so that the picture will hang on the student's back when the string is around the student's neck.

PROCEDURE

This activity can be done in two ways.

1. Students can be called to the front of the class and then given their identity while their back is turned to the class. (Be sure that the student doesn't see the picture.) They then ask yes/no/maybe questions and the class responds. (If there is a question that the class can't answer, or answers incorrectly, the teacher can help.) When the student has guessed his/her identity, or has given up, it is another student's turn.
2. All students can be given their identities at once. They then circulate, asking each other the questions. When students have correctly determined their identity, they turn the picture so that it is on their chest.

VARIATIONS, ADAPTATIONS, DIFFERENTIATION

1. This activity can be done with pictures or specimens from any ecosystem.
2. It can be used to teach the names of plants and animals in other languages.

ASSESSMENT

1. Teachers can provide descriptions of plants or animals and students can try to identify the described organism.
2. Students can be shown or given a specimen or illustration and asked to describe it using appropriate vocabulary.

REFERENCES AND RESOURCES

Cornell, Joseph: *Sharing Nature With Children*

Several sources of posters and pictures that can be used are included in Appendix IV.

Pictures of organisms can be found on the Internet.

Illustrations found in Section I of *Redwood Ed* might be colored and laminated.

NOTES