Activity 1: Build a Watershed Model

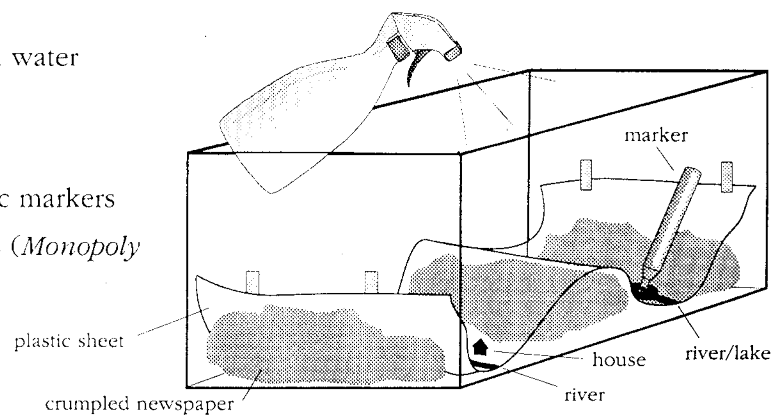
Overview The model built in this activity can be used again and again in other activities to illustrate the functions of wetlands and the effects that changes in land use have on wetland areas (see Chapter IV).

Objective *Activity 1A* will help students understand the concept of a watershed, one of the most fundamental concepts in ecology and environmental studies. If students understand these concepts, they will begin to develop an awareness of their "environmental address" – a sense of their place on the globe and in the natural community. *Activity 1B* introduces students to the concept of wetland functions within a watershed.

Activity 1A

Materials

- Container *
- Spray bottle with water
- Newspaper
- Plastic sheet
- *Waterproof* magic markers
- Miniature houses (*Monopoly* playing pieces)



* Since you will be using this watershed model repeatedly, use the largest container you can find. A 10-gallon aquarium or larger allows students to view the model from all sides. Otherwise, a clear plastic box or wash basin will do.

Procedure

1. If you have more than one container to work with, divide the class into groups to work on the watershed model set-up procedures below. If not, perform this activity as a demonstration.
2. Have the students crumple three sheets of newspaper and place them in the aquarium. Drape the plastic sheet over the paper, fitting it between the three pieces to form two valleys with a ridge in the middle. Tape the plastic to the walls of the aquarium to prevent water from running down the sides. Be sure that water will generally flow towards the valleys and the front side of the aquarium. You now have a model of three hills and two valleys.
3. Ask the students to describe what they think will happen when it "rains." Have them draw a river channel through the valleys on the plastic sheet, placing a few of the houses located alongside the river. Color in a lake where they expect the water to pool.
4. Gently spray some water into one half of the aquarium so that only one of the two watersheds gets wet. Point out how the water runs off the high points and forms a

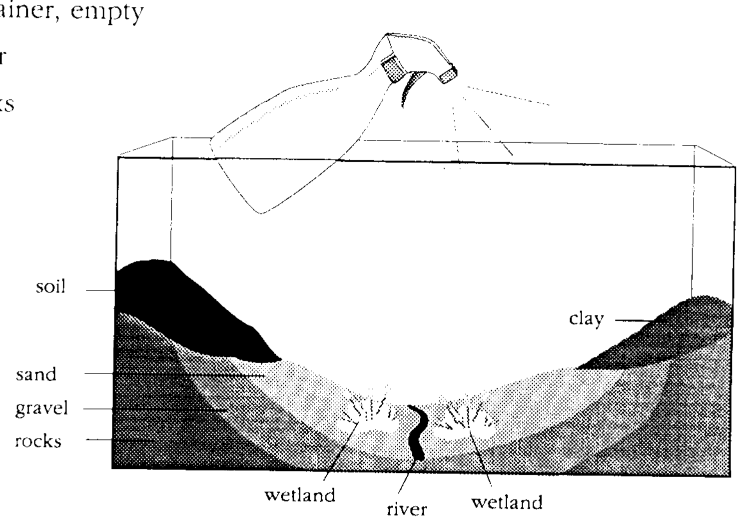
stream in the valley. This is how rain and melted snow run off the land. All of the land that drains into a stream is called a *watershed.* Ask the students to think of a stream in town and talk about where the water comes from that feeds that stream.

5. Now ask the students what will happen when they spray water directly into the middle of the aquarium. Spray water so it hits the ridge between the two valleys. Some water will run into one stream, and some will run into the other. The ridge between these streams is called the *watershed divide* – it's the highest point of land between two bodies of water.
6. Ask the students if they can think of another stream in town and where there is a watershed divide that separates the two systems. Talk about the *Continental Divide* in the Rocky Mountains, where water to the west flows toward the Pacific Ocean,and on the east to the Atlantic Ocean.
7. Call attention to how rapidly the water travels over the plastic surface. Ask the students what the plastic might represent in real life (pavement, roofs, other *impervious surfaces*). To lead into the next watershed model activity, ask the students what other kinds of surfaces exist where land is not paved over (grass, forest, dirt, rock outcrops, marshes, etc). You are now going to build a model of the earth that represents these land covers.

Activity 1B

Materials

- Same aquarium / container, empty
- Spray bottle with water
- A few apple-sized rocks
- Sand, gravel, soil
- Plasticene or clay
- Paper towels or small sponges
- Food coloring
- Wetland plants – cotton swabs (painted brown), pine needles, dried flower heads



Procedure

1. Place the rocks in a heap at both ends of the aquarium. Put gravel around the rocks, and spread them out so that they slope downhill toward the middle of the tank. Place a layer of sand over the gravel, also sloping toward the middle. On one side of the tank, pack soil on top of the sand. On the other side, cover some of the sand with a thin layer of clay or plasticene.

2. Ask the students what will happen when it rains. How will rain affect this landscape differently from the completely impervious landscape? Spray water into the tank, and watch how some of it runs over the surface and some of it sinks in. The water that stays on top is called *surface water*, forming streams, rivers, ponds, lakes, oceans. The water that sinks into the earth (*infiltrates* or *percolates*) is called *groundwater*. As you continue spraying, water will accumulate in the air spaces (*interstices*) between the gravel and sand at bottom of the tank. This body of underground water is called an *aquifer*.
3. Now make a wetland. Review with the students the definition of a wetland and its characterstics: presence of water, special hydric soils, and water-loving *hydrophytic* plants. Take the small sponges, or a tightly rolled paper towel, and place it in the lowest part of your landscape alongside the river. Place the cotton swabs, pine needles, or other "wetland plant" materials in the sponge. Continue spraying water into the tank. Get the soil really wet to create excess water running down toward the wetland. The towel/sponge should absorb the water and become saturated, slowing the flow to the river.
4. Introduce the functions of the wetland: 1) by holding large quantities of water, it kept the river from flooding; 2) it slowed the velocity of water as it approached the river, preventing the sand and soil from eroding; 3) it acted as a filter by trapping soil from running directly into the river.
5. Now take the towel/sponge out and squeeze the water from it. This illustrates how wetlands act like a large sink by storing water during storms and releasing it slowly during dry spells. In this way wetlands help to maintain a more even flow of water in our rivers, streams, ponds, and lakes, which is very important for the plants and animals that live there.

Adapted from *Water Watchers* with permission from the Massachusetts Water Resources Authority.

Extension

1. Initiate a discussion about drinking water in your town. Ask students if they know where the water comes from when they turn on the tap. If you live in a rural or suburban area, chances are at least part your drinking water supply comes from groundwater. If you live in an urban area, you are more likely to get water from surface reservoirs. Call your local Water Department or Board of Health Officer for more information.
2. Manipulate your constructed wetland model to demonstrate how human impacts alter wetlands. See the *Manipulate the Washershed Model* activity in Chapter IV.

Activity 2: Investigate Wetland Soils

Objectives

1) To introduce students to the world of soil, the nexus of living and non-living components of the ecosystem;

2) To visually compare wetland soils to upland soils; and

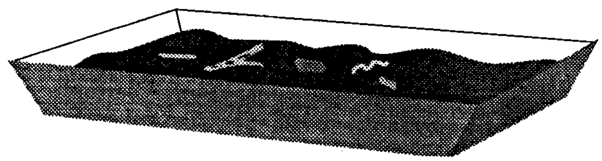
3) To introduce the concept that water affects both the biology and chemistry of soils.

Concepts

Soils are one of the three characteristics that distinguish wetlands from upland areas. Because wetlands are wet some or all of the year, the biological, chemical, and physical character of the soil is altered. The presence of water creates an oxygen deficiency (anoxia) so most oxygen-dependent bacteria and insects can not survive. As a result, decomposition of organic matter, such as fallen leaves and trees, proceeds very slowly and accumulates in the soil. Organic-rich soil is usually very black. Water-saturated conditions may also affect the soil by *reducing* (removing oxygen) the mineral constituents, creating grayish or blue-gray colors.

Materials

- Shovel or trowel
- Bucket or roasting pan
- Soils data sheet from field trip chapter (optional)



Procedure

1. For this activity, the teacher needs to bring both wetland and upland soil samples to the classroom. Alternatively, you could have each student or groups of students bring in their own soil samples. If you're already familiar with a nearby wetland, this should be easy. If you're not, this is your chance to do a little scouting in advance of the class (see Chapter V for suggestions). You can also contact your local conservation commission or planning board to assist you in locating wetlands in your community. Make sure you know who owns the land, and secure permission to use the area.
2. After you've found a suitable location, dig a small pit, remove a block of soil, and place it in a bucket. Do the same in an adjacent upland area. Keep the wetland soil moist otherwise the colors will dull.
3. In the classroom, place the two soil types side by side. Ask students to describe any differences they see (color, smell, texture, roots, insects). The soils data sheet from the field trip section may be used here. Discuss possible explanations for these differences using the background information in this chapter for reference.

Extension & Other Activities

1. Have the students perform a percolation *(perc)* test. Dig identical small soil pits in different locations – sandy soils, wetland soils, upland forest, school playing fields – and fill the pits with water and time how long it takes each pit to drain the water.
2. *Microsmos Curriculum Guide to Exploring Microbial Space,* Dr. Douglas Zook, Boston University School of Education, Kendall/Hunt Publishing, Inc. Dubuque, Iowa. 1992. The *Building A Microbial City* activity in this curriculum explores microbes found in samples of marsh soils.

Activity 3: Experiments with Wetland Plants

Objectives The following activities will give students a better understanding of the special adaptations that allow wetland plants to survive in waterlogged environments.

Background Plants that grow in wetland areas have some special adaptations that allow them to live in conditions that other plants would find too stressful to survive. Wetlands, by definition, are entirely saturated for at least part of the year. During these times, the soil becomes anoxic or depleted of air that most plants need for respiration.

Activity 3A: Drown a Plant

Time required Long term activity, approximately 1-2 weeks.

Materials

- Two identical garden variety house plants in transparent plastic containers (e.g., geraniums, coleus, rubber plants, etc.)
- Wetland plants such as pitcher plants & bladderworts*
- Deep dishes or plastic containers
- Many types of plants not available through a local garden center can be mail ordered from the Carolina Biological Supply Company, 1-800-334-5551.

Procedure

1. Place the two garden variety plants near a window that gets some sunlight. Water one plant every few days when it seems dry. Keep the other plant totally saturated with water in the dish below. See how long it takes the saturated plant to wither, rot, and die (approximately 1-2 weeks).

2. Place a wetland plant in a transparent container and keep the soil well saturated. Over time, have students compare the condition of the wetland plant to the saturated house plant.

3. Have the students make predictions about what might happen to the saturated house plant and list their reasons.
4. Review plant biology with the students and have them revisit the predictions they made earlier. Why do plant leaves need sunlight, water, and carbon dioxide? Why do plant roots need oxygen? Why is the saturated plant wilting while the other one is growing just fine?

Wetland Plant Adaptations

- *Special air spaces called aerenchyma in roots and stems allow oxygen to diffuse from the aerated portions of the plant to its roots.*
- *Some plants can "pump" oxygen from their leaves to roots in saturated soils. This allows the root cells to respire and carry on necessary nutrient exchange reactions with the surrounding soils.*
- *Many trees develop shallow root systems, swollen trunks, or roots that grow from the trunk above the soil surface.*
- *Plants in coastal wetlands develop structural barriers to prevent or control the entry of salt in their roots and excrete salt through special glands in their leaves.*

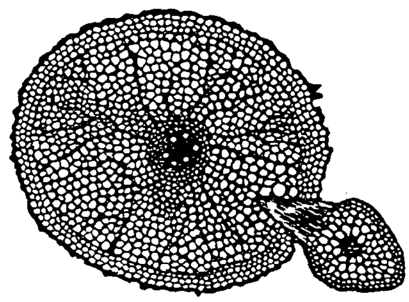
Activity 3B: Under the Microscope

Materials

- Cattail from a nearby wetland
- Stalks of grass from a lawn or open field
- Microscopes or magnifying glasses
- Optional: a few samples of other wetlands plants (burreed, spatterdock, pickerelweed, arrow arrum)

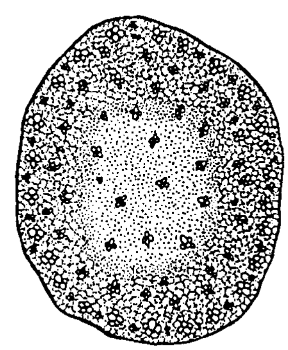
Procedure

1. Explain the structural adaptations of wetland plants to students and have them feel the stems and leaves of the cattail and any other wetland plants you can collect (e.g., burreed, pickerelweed, spatterdock). The low density tissues of these plants feel "spongy" because of their numerous air spaces.
2. Have students cut the stalk of the cattail into several thin cross-sectional pieces. Have them look at the different channels through the microscope or magnifying glass and draw what they see. The center of the stalk is hollow, and the stem itself has small air channels throughout. These are called *aerenchyma,* and they transport air from the stem and roots to the rest of the plant. They also act as structural support that allows such a tall, thin plant to remain upright even in high winds.



cattail cross-section

3. Now examine and draw the cross-sections of the *nodes* of the upland grass (the nodes of grasses are solid). How do these compare with the cattail? (They lack the hollow spaces – *aerenchyma* – observed in the cattail.) What does this tell you about the cattail's ability to adapt to watery conditions?



upland grass node cross-section

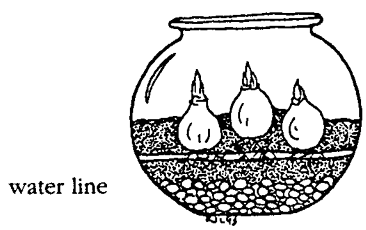
Time Required A few weeks.

Materials

- 6 iris bulbs (available at garden shops)
- Two small glass fish bowls or transparent plastic containers
- Gravel
- Potting soil

Procedure

1. Place about 2–3 inches of gravel in the bottom of the fishbowls for drainage. Fill the bowls with potting soil, and place three bulbs in each so they are about 3/4 covered with the potting soil. Place the bowls by a window with some sunlight. In this experiment, it's important to maintain water levels in the two bowls at different, but consistent, heights. In the *wetland bowl,* keep water about 1/2 inch below the bulb. In the *upland bowl,* keep water so it's just above the gravel.
2. As the bulbs sprout, pay particular attention to the rooting patterns. The *wetland* bulbs should grow a shallow network of fine roots whereas the *upland* bulbs will generate deeper taproots. Why are the bulbs growing differently? Discuss the ability of plants to adapt to different environmental conditions.



wetland bowl

upland bowl

Activity 4: Create a Wetland Plant Wheel

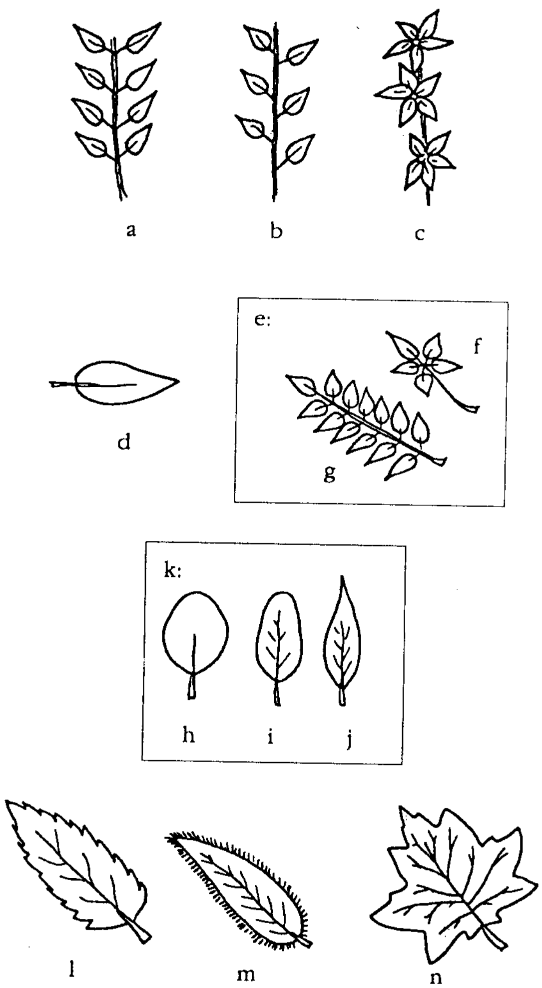
Objective Students will be able to recognize common New England wetland plant species during a visit to a wetland using the wetland plant wheel they construct in class.

Materials

- Construction paper
- Copies of wetland wheels and direction piece
- Scissors, markers
- Paper fasteners

Helpful Facts on Plant Identification

Review this information with the students before constructing the wheel:



- A plant does not always look the same; it may change with the seasons. In winter, most soft plants *die back*, though some leave behind woody stalks, e.g., a cattail. Many trees and shrubs do not have leaves in winter while some do. *Evergreen* plants keep their leaves in winter; *deciduous* plants lose their leaves.
- Many plants do grow flowers though we do not call the plant "a flower." Flowers appear and transform into fruits. Seeds form within the fruits.
- Leaves and twigs are arranged in different patterns on different plants. They may be *opposite* (a), which means that they grow out of the same place on the stem but on opposite sides of the stem.

  Alternate (b) leaves sprout at different places on the stem, alternating from one side of the stem to the other. *Whorled* (c) leaves grow out of the same place on the stem all the way around the stem, like the spokes of a wheel.
- Leaves may be *simple* (d) (one leaf on a stem) or *compound* (e). Compound leaves have several *leaflets* on a stem, arranged in the shape of a hand – *palmate* (f) or like a feather – *pinnate* (g).
- The shape and edges of leaves also are important in identifying plants; leaves may be *round* (h), *oval* (i), *long and/or pointy* (j); edges may be *smooth (entire)* (k), *toothed (jagged edges)* (l), *hairy* (m), *lobed* (n), etc.

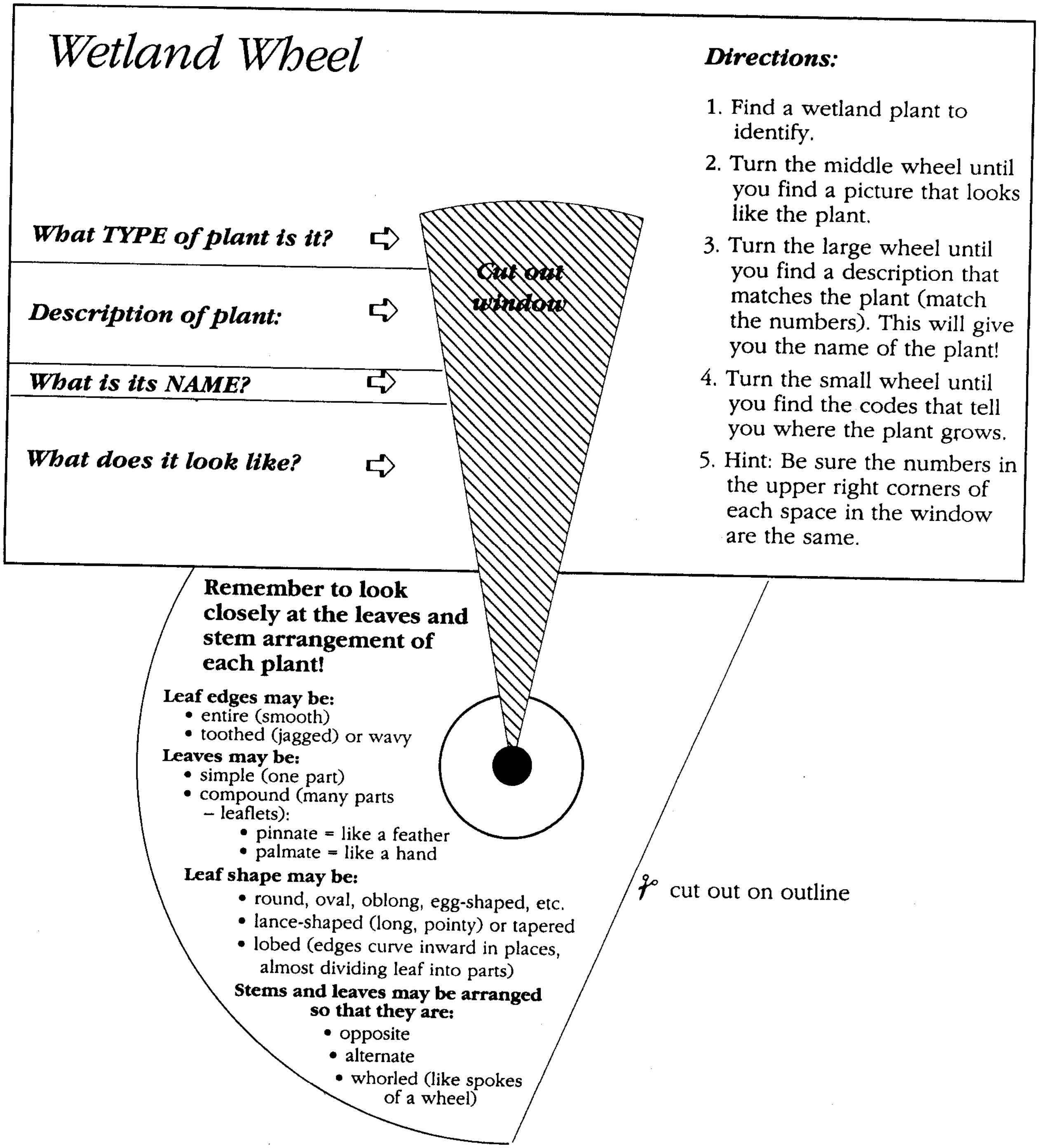
Constructing the Wetland Wheel

Use this wheel to help students identify freshwater wetland plants only. Use one of the field guides listed in the *Appendix* for trips to saltwater wetlands.

1. Glue each direction piece to a manila folder or piece of cardboard and cut along the solid outline. Cut out the pie-shaped piece to make a window. Place the pieces back to back, match them up, then glue or staple them together across the top only.
2. Carefully cut out each wheel along the solid outline.
3. Glue the two large wheels together, back to back, so that the centers match.
4. Align the smaller wheels with the larger wheels so that the edge of the smaller wheel lines up with the inside circle (line) on the larger wheel. Match up the two wheels that have numbers 1-16; then poke a small hole through the center of *both wheels at once* with the paper fastener. Now match the smaller wheel numbered 17-32 with the other side of the larger wheel; thread it onto the paper fastener. You should now have a two-sided wheel.
5. Now add the direction piece. Place the two-sided wheels between the two pieces of the direction piece. The top edge of the larger wheel should fit just behind the top edge of the window. Remove the paper fastener. Keeping the direction piece flat, poke holes through the center dots to match the holes in the wheel. Fasten the paper fastener again, and your wetland plant wheel is ready for use!
6. Your students can use the wheel to identify plants on their own at home or during an organized field study (see Chapter VI).

Direction Piece:

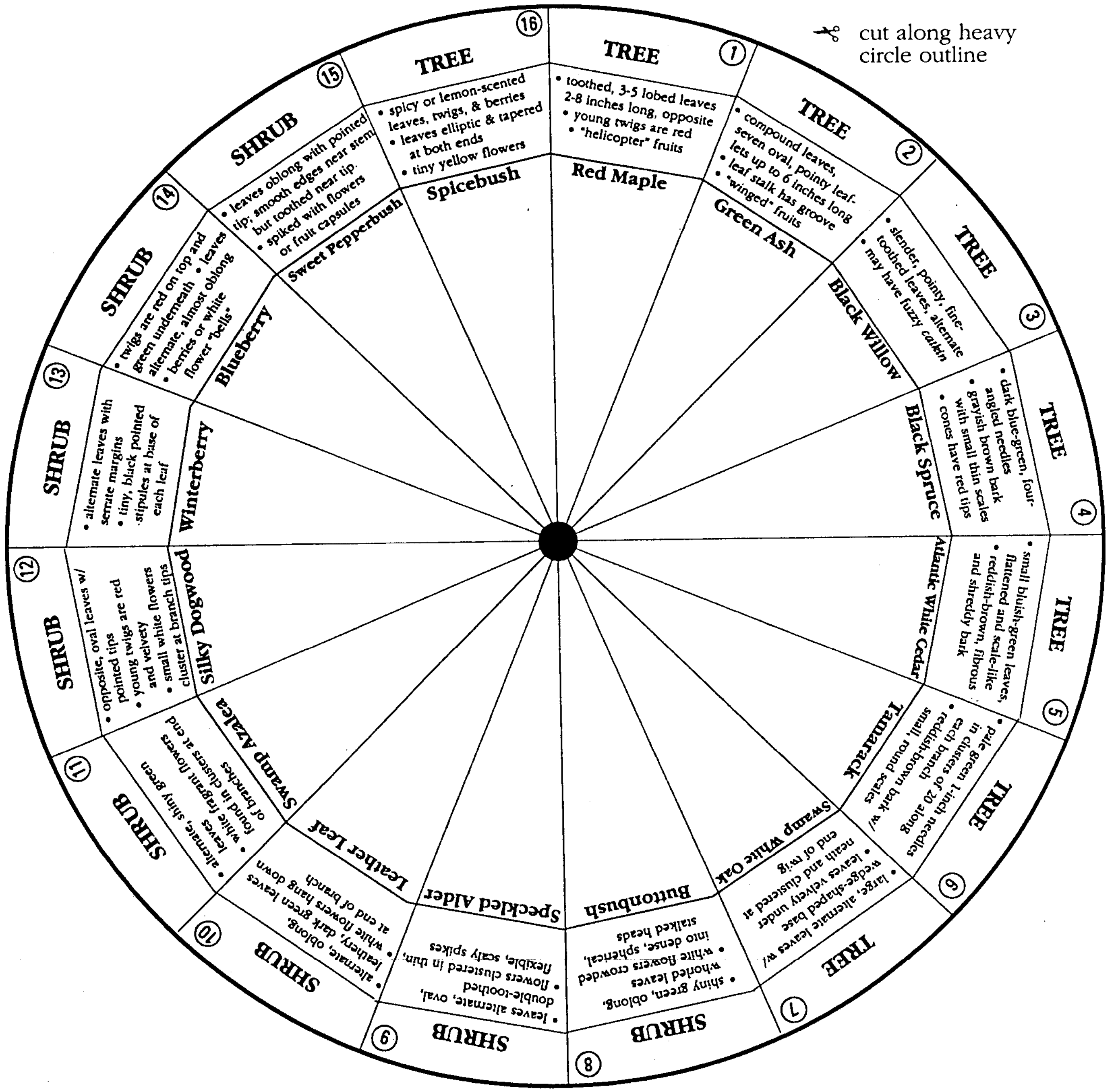
Photocopy and cut out **two** direction pieces for each wetland wheel.



Large Wheel #1:

photocopy and cut out
one for each wetland wheel.

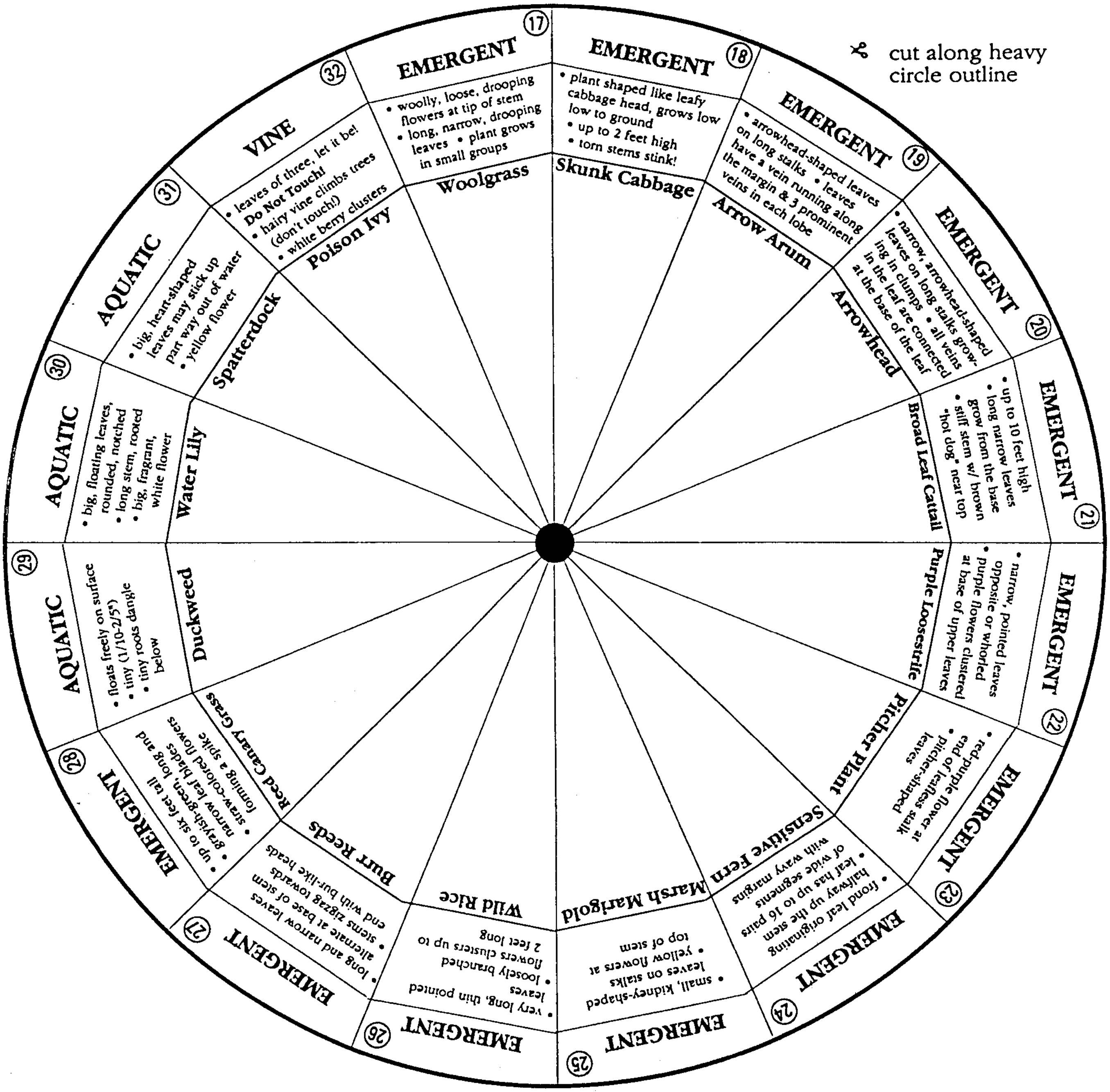
✂ cut along heavy circle outline



Large Wheel #2:

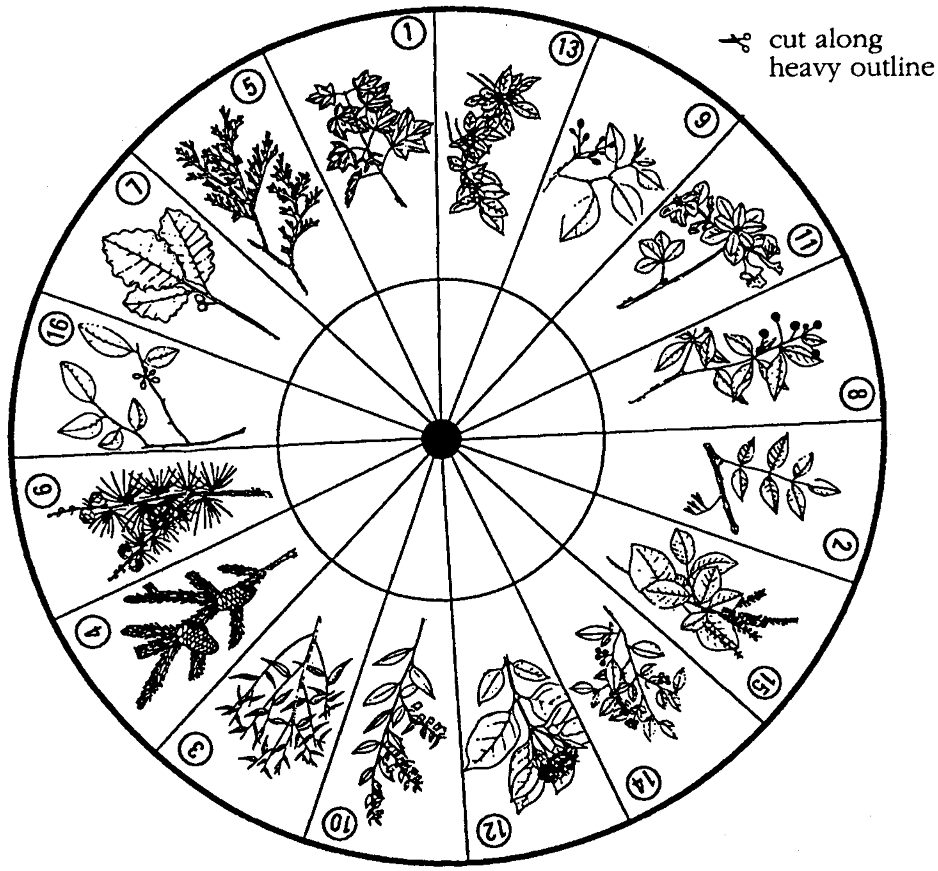
photocopy and cut out
one for each wetland wheel.

✂ cut along heavy circle outline



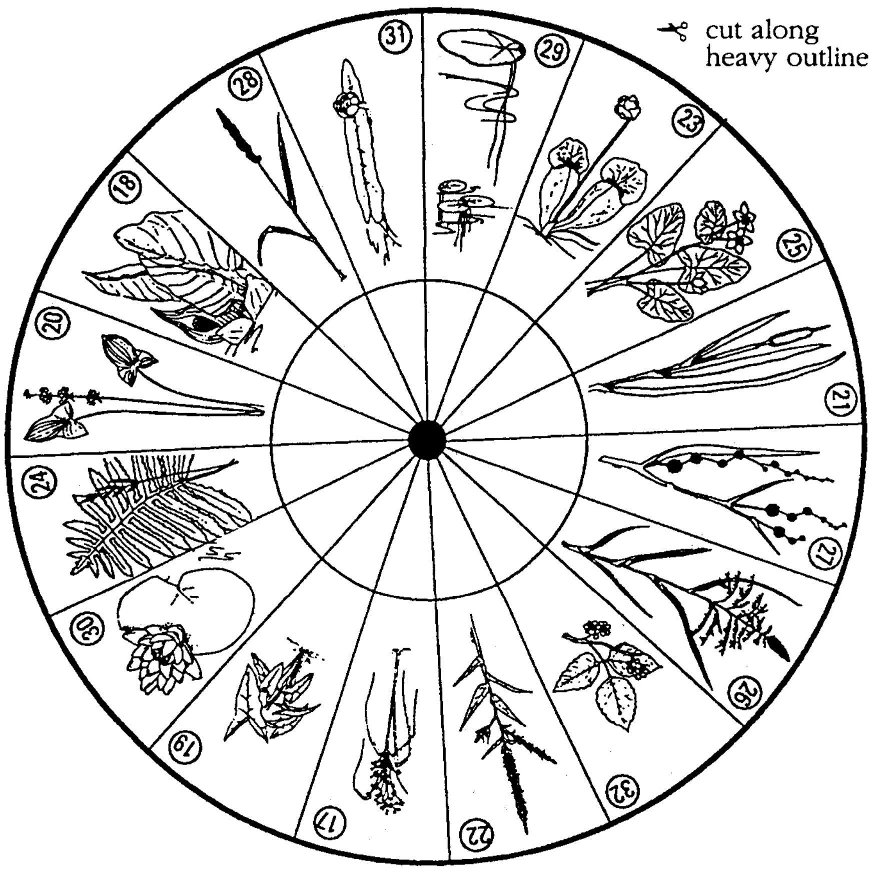
Small Wheel #1:

photocopy and cut out
one for each wetland wheel.



Small Wheel #2:

photocopy and cut out
one for each wetland wheel.



cut along
heavy outline