A wetland is the boundary between land and water, with some features of each and with some features that are uniquely different. Three characteristics are used in delineating wetlands: hydrologic regime, hydric soils, and hydrophytic plants. The presence of surface water or groundwater within the top eighteen inches of soil for approximately two weeks during the growing season is an indication of wetland hydrology.

If wetland hydrology is or has been present, typically it will cause soils to become gleyed where they are continually wetted (i.e. show subdued coloration from frequent or repeated wetting, like a colored T-shirt after repeated washing). Wetland soils may contain oxidized rhizospheres where oxygen leaks from plant rootlets. Wetland hydrology will produce mottling (red or black specks) where the soil is alternately wetted and dried, or have a deep organic layer due to slower decomposition rates under anaerobic conditions. Clay-based soils hold water more readily than sand-based soils, wick the water higher above the water table, and extend the hydric conditions closer to the soil surface. Silt-based (loam) soils also hold water, but not as well as clay.

In the presence of wetland hydrology and hydric soils, hydrophytic plants are uniquely adapted for survival in wet conditions. Most adaptations bring plant roots into contact with oxygen from the air, either by bringing roots to the air or air to the roots.

Several activities in *WOW! The Wonders of Wetlands* (1995) are helpful in developing skills for identifying hydric soils and hydrophytic plants. It is recommended that these activities from *WOW!* be experienced independently, before being integrated into this one activity:

This Plant Key Is All Wet! (pages 123-128)
Tracking Plants and Keeping Track (pages 138-142)
Do You Dig Wetland Soil? (pages 231-238)

PROCEDURE

Warm-Up

Sometimes wetlands do not seem wet at all. Encourage students to give examples of areas that are sometimes wet or have been wet in the past (puddles, ditches, drained and filled wetlands, vernal pools).

Introduce the three factors considered when determining whether an area is a wetland (soils, plants, hydrology), and discuss how they might be connected.

Activity

Grades K-4

Do as much of the activity listed for grades 5–12 as students can manage, using the worksheets provided when appropriate.

A. PLANTS

Look carefully around the planned wetland site. Are emergent or aquatic plants present? Are they found all over the site or just in one area? Are they all of the same kind (such as cattails)?

B. SOILS

Use the soil probes or soil shovels to examine the soil from the surface

to eighteen inches deep at the planned wetland site. Compare the soil colors with those of a soil chart. Could the soil be wetland soil? What is the texture of the soil? The presence of a large proportion of clay in the soil means it is more likely to hold water.

C. HYDROLOGY
Does the hole made with the soil probe or shovel fill with water? Are dried mud cracks present in low spots? Are plants water-marked or mud-stained, showing how high the water has been? Are there low spots where water could or does collect? Are signs of water erosion present, such as gullies and channels?

Grades 5-12
A. ESTABLISHING TRANSECTS
1. Choose a prominent object or feature near the wetland site from which compass bearings and distances can be measured to each transect. Mark and describe this benchmark object or feature on the site map or drawing of the area. If a tree, rock, sidewalk, or other semipermanent feature is not available, create one with a wooden stake and spray paint or plastic ribbon.

2. Divide the group into three, four, or five teams. Each team will be assigned a letter label and will collect data along one transect.

3. Place teams at three-meter (or ten-foot) intervals along one side of the wetland site. Mark the starting point for each team with a survey flag or stake to which the ball of string will be attached. Have each team unroll their string across the wetland site parallel to the other teams. The string marks the transect line for each team.

4. Measure the distance and compass bearing from the benchmark to the starting point of each transect. Mark both the distance and compass bearing on the site map or drawing of the planned wetland site, then mark the transect lines on the map and label them with the appropriate transect letters. See **Figure 8.3**.

B. PLANTS
1. Review the following definitions of types of plants:

- Tree–usually a single woody rigid trunk; more than 20 feet tall
- Shrub–multiple stems that are woody and rigid; less than 20 feet tall
- Vine–stems may be woody and rigid, but leaning on other plants
- Emergent–pliable stems; growing in wet soil or water with part of stem and leaves above water
- Aquatic–pliable stems; growing completely under water, floating on the surface, or with floating leaves

2. Aquatic and emergent plants are adapted to wetland conditions. Some trees, shrubs, vines, and grasses are also adapted to wetlands. Hydrophytic plants respond to the stimulus of prolonged soil moisture in some of the following ways:

- Shallow roots--Since water is readily available, roots need not grow deep. Oxygen is in short supply and is near the surface.

- Adventitious roots--These roots can be seen at or above the soil surface; they seem to assist in obtaining oxygen.
- Shoot elongation--During high water events, fast shoot growth can keep stems and leaves out of the water so photosynthesis and movement of oxygen to the roots may continue.
- Hypertrophied (enlarged) lenticels or their scars may be seen on woody wetland plants. Lenticels permit gas exchange through bark and enlarge during floods.

Wetland plants have adaptations that allow them to live in wet conditions. Some adaptations that are readily visible are:

- Aerenchyma--This tissue of enlarged cells (readily visible in cattail stems) moves oxygen downward to the roots.
- Hollow stems--Most easily seen in reeds, this adaptation moves oxygen downward to the roots.
- Buoyant fruits and seeds--Many wetland plants use water to disperse their progeny.

3. Provide each team with copies of the *Plant Transect* Student Page (where they will record the letter label for their transect), a ball of string, and a meter stick or tape measure. Beginning with the survey flag or stake marking the beginning of each transect, measure three meters (or ten feet) along the transect, and mark or knot the string. This is Section #1. Tally each type of plant seen along this section of the transect. Tally all plants touching the string, hanging over the string, under the string, or within one foot of the string on both sides of the string. Identify the most common plants found along this section of the transect.

4. Measure another three meters (or ten feet) along the transect; mark or knot the string. This is Section #2. Tally the plants for this section, again identifying the most common plants. Repeat until the team has crossed the wetland site. Leave the transect lines in place for use in part C.

5. Optional. Determine the wetland indicator status of the most common plants identified along the transect. This information is available in Chapter 7 and at the USDA plant data website (see Resources).

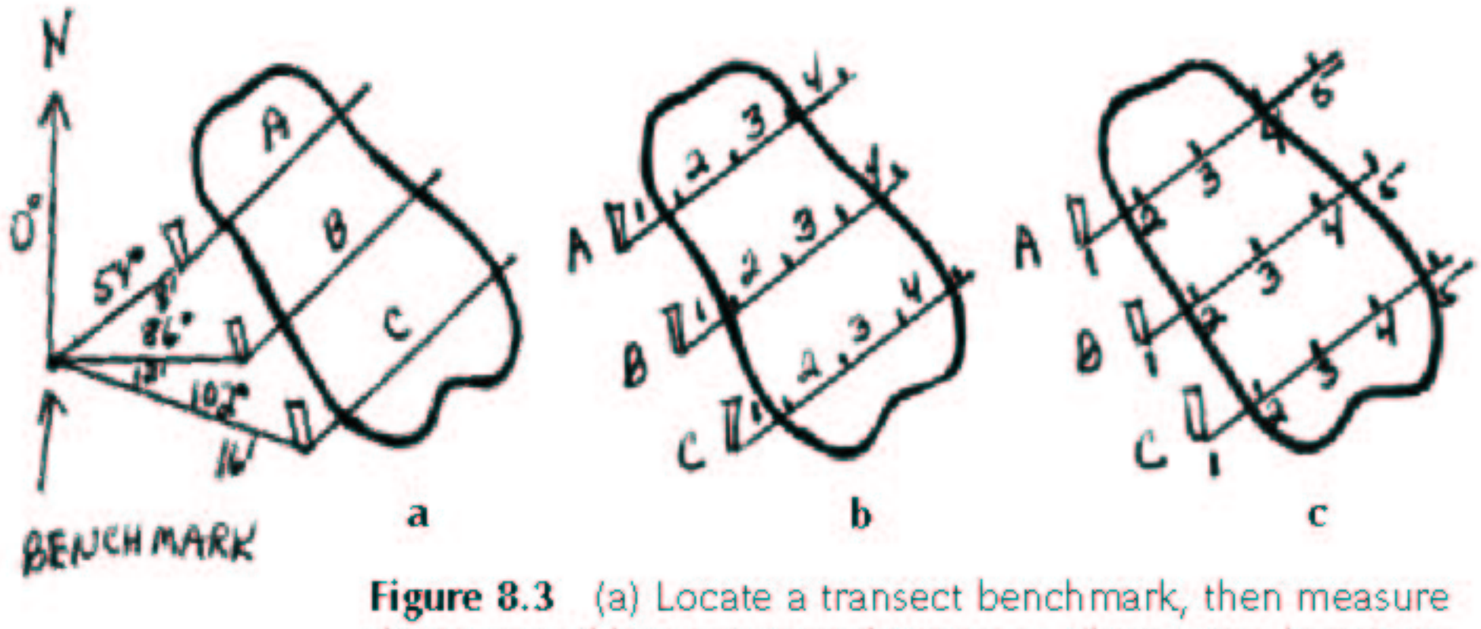


Figure 8.3 (a) Locate a transect benchmark, then measure distance and bearing to each transect. (b) Section locations along plant and hydrology transects. (c) Sample stations along soil transects.

C. SOILS
1. Provide each team with a soil color chart, the Key to Soil Texture, water, a soil probe or soil shovel, and a copy of the *Soil Transect* Student Page.

2. Following the same transect as in part A, each team should examine one soil sample at the beginning of Section #1, at the beginning of each succeeding section, and at the end of the last section. See **Figure 8.3c**. Examine the soil moisture, color, texture, and other features at depths of 6 inches (15 cm), 12 inches (30 cm), and 18 inches (45 cm). This data should be recorded on the *Soil Transect* Student Page. (To sample soil 18 inches below the surface, insert the probe into the hole formed when the shallower soil sample was collected.)

In the Northeast, soils are considered hydric if a peat or muck surface layer is $\geq$ 8 inches deep, or if the matrix color has a chroma $\leq$ 2 with mottles, or if the matrix color has a chroma of $\leq$ 1 without mottles. Check with the local Soil Conservation Service for information on what constitutes a hydric soil in your area.

D. HYDROLOGY
1. Observe the hydrology of the planned wetland site. Is standing water or tidal water present? Does water collect in a hole 18 inches deep (the zone where most plant roots are located)? Do other signs indicate that water has been present during the growing season?

2. Complete the *Wetland Characteristics* Student Page for each transect. Under **Yes**, **Maybe**, and **No**, record the sections of the transect to which each answer applies.

Wrap-Up
Students will evaluate the planned wetland site according to the following criteria:
a. Are wetland plants present? Yes, maybe, no.
b. Are wetland soils present? Yes, maybe, no.
c. Is water present during the growing season? Yes, maybe, no.

On the site map or drawing, students will label each section of their transect with their evaluations: green Y (yes), M (maybe), or N (no) for vegetation; brown Y, M, or N for soils; and blue Y, M, or N for hydrology.

ASSESSMENT
Have students evaluate whether all, some, or none of the area assessed is a wetland, and give reasons for their evaluation. This may be done orally as one large group, within teams and then reported to the larger group (orally or in writing), or individually in writing.

- If the area is a wetland, do students think it is healthy?
- Does it have a variety of plants, or are there large patches (the size of a table) of the same kind of plant?
- Do some areas show signs of erosion from stormwater runoff?
- Could silt be seen on the leaves of the plants in the wetland?
- If the area is not now a wetland, could it become one?
- Would the soils present hold water?
- Is there a source of water nearby?

EXTENSIONS

Investigate further and suggest how this site could be improved for wildlife. Assess and compare other possible wetland sites.

RESOURCES

Environmental Science: Water and Air. 1995. Globe Fearon Education Publisher, Paramus, NJ. [Especially: How do different soils affect the rate of absorption?]

Kesselheim, A.S. and B.E. Slattery 1995. *WOW!: The Wonders of Wetlands*. Environmental Concern Inc., St. Michaels, MD.

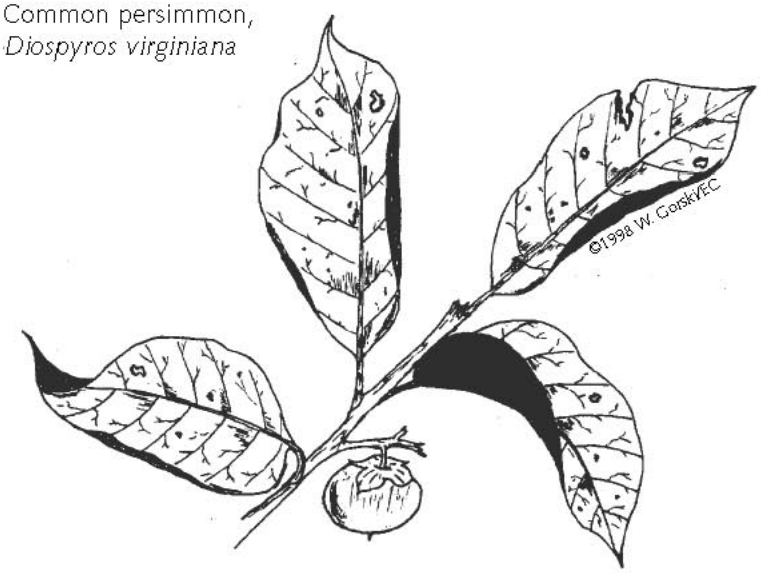
Lewis, W.M. Jr., Chair. 1995. *Wetlands: Characteristics and Boundaries*. National Academy Press, Washington, DC.

Tiner, R.W. 1998. *In Search of Swampland: A Wetland Sourcebook and Field Guide*. Rutgers University Press, New Brunswick, NJ.

On-line resources:

Wetland indicator status, information, and pictures for plants in all regions of the U. S. are located at: plants.usda.gov/plants/index.html.

Common persimmon,
Diospyros virginiana

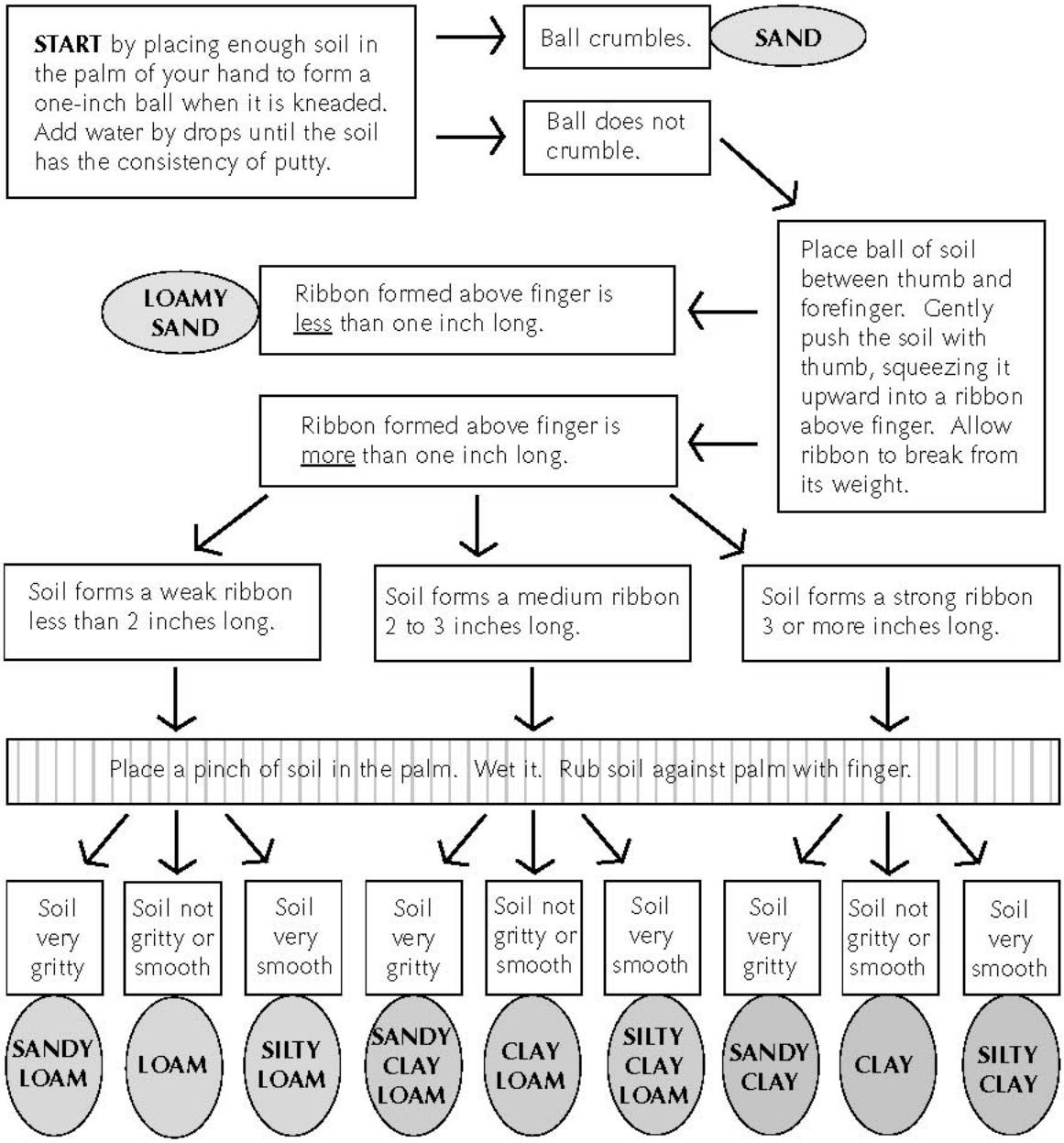


PLANT TRANSECT

Transect ____

Type of Plant	Species	Wetland Indicator Status	Number of Plants Counted					
Section Number:			**1**	**2**	**3**	**4**	**5**	**6**
Trees								
Shrubs								
Vines or grasses								
Emergent plants								
Aquatic plants								

KEY TO SOIL TEXTURE



Adapted from *WOW!: The Wonders Of Wetlands* (1991) with permission.

SOIL TRANSECT

Transect _____

Record the words or phrases that apply to each soil sample in the chart below.
Moisture: Indicate whether dry, moist, wet, very wet, or drippy.
Texture: Designate as sand, loamy sand, sandy loam, loam, silty loam, sandy clay loam, clay loam, silty clay loam, sandy clay, clay, silty clay.
Color: Record number if using *Color Me Wet!*; record hue/value/chroma if using commercial soil color chart.
Other: Note pebbles, organic matter, rotten egg smell, mottling, oxidized rhizospheres.

Depth of Soil from Surface	Feature	Station 1	Station 2	Station 3	Station 4	Station 5	Station 6	Station 7
6 inches (15 cm)	moisture							
	texture							
	color							
	other							
12 inches (30 cm)	moisture							
	texture							
	color							
	other							
18 inches (45 cm)	moisture							
	texture							
	color							
	other							

WETLAND CHARACTERISTICS

Transect _____

Record the sections of the transect, or the stations along the transect, to which each statement applies.	Yes	Maybe	No
A. HYDROLOGY			
1. Is standing water or tidal water present?			
2. Does water collect in a hole 18 inches deep?			
3. Are there depressions where water might collect?			
4. Do low spots have mud or dried mud cracks?			
5. Do tree trunks and other vegetation appear water-stained?			
6. Is vegetation mud-stained from previous flooding?			
7. Are gullies, stream channels, or signs of water erosion present?			
B. SOILS			
1. Are soils wet?			
2. Excluding the surface organic layer, are soil colors those of hydric soils (green, dark gray, brown, black)?			
3. Are soil colors gleyed?			
4. Do soil samples show mottling or contain oxidized rhizospheres?			
5. Do soil samples have a high percentage of clay?			
6. Do the soils have a rotten egg smell?			
C. PLANTS			
1. Are aquatic or emergent plants present?			
2. Are any of the common plants typically found in wetlands?			
3. Are obligate wetland plants present?			

D. SUMMARY FOR THIS TRANSECT

1. Along which sections are wetland plants present? _____

2. At which stations are wetland soils present? _____

3. Which sections have water present during the growing season? _____