

# Wetland Ecology



**An Environmental Study Unit  
For 9<sup>th</sup> – 12<sup>th</sup> Graders**

**MUHLENBERG**  
COLLEGE

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## Wetland Ecology - Unit at a Glance

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### Unit Overview:



This unit is about wetlands—the factors that determine whether an area of land is classified as a wetland, and the ecological services provided by wetlands. The particular emphasis of this unit is on the role of wetland plants in the wetland ecosystem.

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### Grade Level:

Ninth - Twelfth



### Subject Areas:



- Computer Literacy
- Language Arts
- Science
- Geography

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### State Standard Strands:

Environment and Ecology



- *Watershed & Wetlands*

- *Ecosystems and Interactions*

- *Threatened, Endangered and Extinct Species*

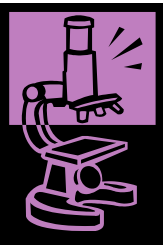


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### Unit Goal:



A study of a local wetland ecosystem becomes the focal point for students to develop skills in investigation and presentation of information. These skills will include research, making and recording observations in a systematic manner, using maps, and presenting information in a variety of ways including verbally, visually and through writing.



<p><b>Unit Objectives:</b></p> 	<p><b>Students will</b></p> <ul style="list-style-type: none"> <li>➤ Describe the characteristics of a wetland.</li> <li>➤ Identify the importance of wetlands to wildlife and humans</li> <li>➤ Explain the ecological functions of a wetland.</li> <li>➤ Use field guides and Web sites to find information about wetland plants.</li> <li>➤ Write a description of the plant and its key features, following a field guide template.</li> <li>➤ Point out key characteristics of their wetland plant in the field.</li> <li>➤ Share their wetland plant knowledge in a three to five minute oral presentations for their fellow classmates.</li> <li>➤ Make observations in plant life and soil characteristics to infer where wetland boundaries exist.</li> <li>➤ Define differences between upland and wetland plant communities.</li> <li>➤ Describe environmental conditions for wetland existence.</li> <li>➤ Observe and describe the physical differences between wetland and upland soils.</li> <li>➤ Use keys and tables to identify wetland soil characteristics.</li> <li>➤ Predict and test the permeability of different types of soil</li> <li>➤ Read a topographic map to the point where they can correctly discriminate between upland and lowland areas and identify bodies of water and their watersheds.</li> <li>➤ Infer from looking at a topographic map, areas that could be considered wetlands.</li> <li>➤ Identify developed land, farmland and forestland when looking at an aerial map.</li> <li>➤ Use topographic, aerial and road maps to determine land use patterns affecting wetlands.</li> <li>➤ Use maps as tools for making and assessing land-use decisions.</li> <li>➤ Compare their observations in the field to their impressions from the map.</li> <li>➤ Accurately describe the components of wetland ecology—soils, hydrology and plant indicators.</li> <li>➤ Create a brochure using teamwork, research, writing skills and creativity.</li> </ul>
<p><b>Unit Outline:</b></p> 	<ol style="list-style-type: none"> <li>1. Wetland Metaphors – Services Provided by Wetlands</li> <li>2. Wetland Plants</li> <li>3. Wetland Vegetation Survey</li> <li>4. Wetland Soils</li> <li>5. Wetland Hydrology</li> <li>6. Wetland Topography</li> <li>7. Culminating Activity - Design a Wetland Brochure</li> </ol>
<p><b>Assessment:</b></p> 	<ul style="list-style-type: none"> <li>➤ <i>Wetlands Field Study Log Books</i></li> <li>➤ Wetlands Brochure</li> <li>➤ Wetlands Worksheets <ul style="list-style-type: none"> <li>● True or False</li> <li>● Wetland KWL</li> <li>● Wetland Plant Natural History</li> <li>● Wetlands Concept Map</li> <li>● Wetlands Test</li> </ul> </li> </ul>

## Lesson 1 - Wetland Metaphors

Adapted from the activity “Wetland Metaphors” from *The Wonders of Wetlands Educators Guide*.

Adapted with permission from the PA Department of Education, Bureau of Curriculum, Office of Environment and Ecology.

**Grade Level:** 9<sup>th</sup>-12<sup>th</sup>

**Lesson Time:** 60 minutes

**Suggested Class Structure:** Guided group discussion.

**Subject Areas:** Science and Language Arts

### BACKGROUND



Wetlands offer important benefits to plants, animals, humans and the entire surrounding environment.

A rich diversity of wildlife species can be found in most wetlands due to their abundance of food, vegetative cover and water. For example, coastal and inland marshes provide breeding, resting and wintering habitats for thousand of migratory birds. Many commercial and recreational species of fish and shellfish reproduce and spend part or all of their life cycle in fertile wetlands. Wetlands offer habitat for a variety of reptiles, amphibians, insects and crustaceans to breed and live in, as well as food, shelter and water for many mammals.

Wetland vegetation is highly beneficial in absorbing nutrients and helping to cycle them through the food web. They maintain nutrient concentrations and keep them from reaching toxic levels. By producing oxygen through photosynthesis, wetland plants provide an important food source to other life forms.

Wetlands have an extremely effective method of natural filtering which gives them a unique ability to purify the environment. Sewage waste can be trapped and neutralized, silt is allowed to settle out, and the decomposition of many toxic substances is promoted.

Healthy wetlands provide a buffer zone to prevent flooding and erosion. They alleviate the harmful effects of seasonal fluctuations in the water supply—i.e. floods and drought. Wetlands help retain excess runoff from heavy rains and spring thawing, allowing it to gradually penetrate the soil and drain into nearby streams and rivers. They also help maintain a water supply during periods of drought.

Although wetlands are somewhat resilient, their functions can be compromised when portions are filled or drained for other uses. When such losses occur, the effects on wildlife, humans and overall environmental quality can be significant. Federal and state laws offer some protection, but there is a need for greater awareness to the role wetlands play as a unique and essential ecosystem

### GOALS

Students will gain an understanding of how a selection of common objects can be used as visual metaphors for natural wetland functions. At the end of the lesson they will understand the benefits of wetlands as resources for humans and other species and appreciate the many roles that wetlands play.

Object	Metaphoric Function
<b>Sponge</b>	Absorbs excess water caused by runoff; retains moisture
<b>Small Pillow</b>	Resting or wintering place for migratory birds and waterfowl
<b>Egg Beater</b>	Mixes nutrients and oxygen into the water
<b>Pacifier</b>	Provides a nursery that shelters, protects, and feeds young wildlife
<b>Strainer</b>	Strains silt and debris from water to keep water supply clean
<b>Coffee Filter</b>	Filters smaller impurities from water such as excess nutrients and toxins
<b>Hazmat Container</b>	Neutralizes toxic substances
<b>Lunch box</b>	Provides nutrient-rich food supply
<b>“Home Sweet Home” plaque</b>	Habitat for diverse wildlife
<b>Umbrella</b>	Protects soil from erosion
<b>Medicine</b>	Source of medicinal plants
<b>Water Bottle</b>	Water storage during drought

## OBJECTIVES

Students will

- Describe the characteristics of a wetland
- Identify the importance of wetlands to wildlife and humans
- Explain the ecological functions of wetlands.

## VOCABULARY

*Metaphor* - A figure of speech in which a word or phrase that ordinarily designates one thing is used to designate another, thus making an implicit comparison, as in “*a sea of troubles*” or “*All the world's a stage*” (Shakespeare).

One thing conceived as representing another-- a symbol.



## MATERIALS

- A *Mystery Metaphor* container (such as a large backpack or duffle bag)
- Sponge
- Small pillow
- Egg beater
- Pacifier
- Strainer
- Paper coffee filter
- “Hazardous Material” container or sign
- Umbrella
- “Home Sweet Home” plaque
- Lunch box
- Medicine
- Water bottle
- Wetlands Field Study Log Book* for each student

## ADVANCE PREPARATION

- ✓ Gather materials for wetland metaphors as listed in the *Materials* section. Most you can find most of them around the house, but you may have to buy the hazmat container or sign. Create a grab bag by placing these items in the large backpack.
- ✓ Check out the field study area and mark places where wetland functions are visible.
- ✓ Run off copies of the log books for each student. Copy masters are in the *Appendix* of the *Field Study Procedures* lesson, beginning on page 49.

## PROCEDURES – Outline and Narrative

### Introduction – 15 min.

Explain the concept of a metaphor to the class. Metaphors may be presented in two ways:

- Option A: Assign the metaphors to the class in advance during class time and have them research them before the field trip. Groups of students can then present the concept behind the metaphor they researched to the whole class on the field trip.
- Option B: Use the metaphoric functions as an introduction discussion during the field trip.

### Field Trip - 45 min.

While you are outside, observe the wetlands and discuss each of the metaphoric items contained in the prepared backpack. Using the *Wetlands Field Study Log Book* (pages 2-3) have the students discuss the meaning of wetlands and the important role they play in ecologic functions as they fill in the tables. This discussion can be led by students presenting their research (if you used introduction option A), or by the instructor, (if you used introduction option B).

## ASSESSMENT

Note: Copy masters for assessments are in the back of the *Lesson Appendix*.

## RESOURCES



### Books for the teacher:

Environmental Concern Inc. and The Watercourse. *WOW! The Wonders of Wetlands*.

St. Michaels, MD: Environmental Concern, Inc. 1995.

Horne, Alexander J. and Charles R. Goldman. *Limnology*. New York: McGraw-Hill, Inc. 1994.

Committee on Riparian Zone Functioning and Strategies for Management, Water Science and Technology Board, National Research Council. *Riparian Areas: Functions and Strategies for Management*. Washington D.C.: National Academy of Sciences, 2002.

### Books for the students:

Tiner, R. W. *In Search of Swampland*. New Brunswick, NJ: Rutgers University Press, 2002.



**Web sites:** Since the Web is constantly changing, check Muhlenberg's Outreach Web site for updated listings.  
[<http://www.muhlenberg.edu/cultural/graver/index.html>]

### Web sites for the teacher:

Association of State Wetland Managers.  
[<http://www.aswm.org/lwp/nys/section1.htm>]

U.S. Environmental Protection Agency.  
[<http://www.epa.gov/owow/wetlands/functions.html>] and  
[<http://www.epa.gov/owow/wetlands/>]

## PA Academic Standards for Environment and Ecology Covered by the Unit:

### 4.1.10 Watersheds and Wetlands

- B. Explain the relationship among landforms, vegetation and the amount and speed of water.
- D. Describe the multiple functions of wetlands.
- E. Identify and describe natural and human events on watersheds and wetlands.

## **PA Academic Standards for Environment and Ecology continued . .**

### **4.3.10 Environmental Health**

- A. Describe environmental health issues.
- B. Explain how multiple variables determine the effects of pollution on environmental health, natural processes and human practices.

### **4.8.10 Humans and the Environment**

- B. Analyze the relationship between the use of natural resources and sustaining our society.



# **Lesson 1 - *Wetland Metaphors***

## **Appendix**



**Copy Masters for:**

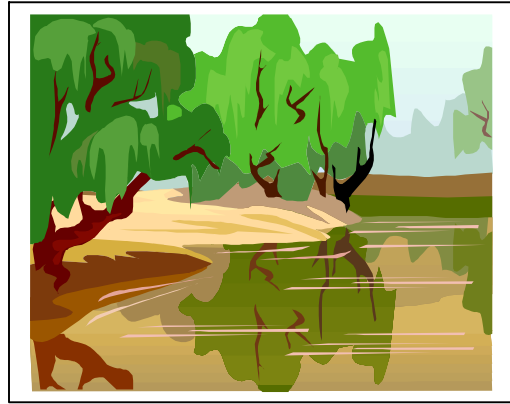
Wetlands KWL  
Wetlands True or False?

Name: \_\_\_\_\_

Date: \_\_\_\_\_

## Wetlands KWL

*Directions:* Answer the first two questions before visiting a wetland and answer question three after the visit.



1. What do you **know** about wetlands?
  
  
  
  
  
  
  
  
  
  
  
  
  
  
  
  
  
  
  
  
  
  
2. What do you **want** to know about wetlands?
  
  
  
  
  
  
  
  
  
  
  
  
  
  
  
  
  
  
  
  
  
  
3. What did you **learn** about wetlands?

-Name: \_\_\_\_\_

Date: \_\_\_\_\_

### Wetlands True or False?

Directions: Decide whether each statement about a wetland is true or false, and write it in the space provided.



1. Wetlands provide water storage in times of drought. \_\_\_\_\_
2. Wetlands release excess water from runoff. \_\_\_\_\_
3. Wetland plants discharge toxins into the water. \_\_\_\_\_
4. No endangered or threatened species live in wetlands. \_\_\_\_\_
5. Wetlands help control flooding. \_\_\_\_\_
6. Wetland vegetation protects soil from eroding. \_\_\_\_\_
7. Wetlands provide few benefits to humans. \_\_\_\_\_
8. Wetlands provide breeding habitats for fish. \_\_\_\_\_
9. Wetlands provide resting places for migrating insects. \_\_\_\_\_
10. Wetlands provide silt and debris to the water supply. \_\_\_\_\_
11. Wetlands mix nutrients and oxygen into nearby waters. \_\_\_\_\_
12. Wetlands provide food for many types of animals. \_\_\_\_\_
13. Wetlands do not provide any valuable crops for humans. \_\_\_\_\_
14. Wetland habitat has low biological diversity. \_\_\_\_\_
15. Wetlands can be used to treat sewage. \_\_\_\_\_



## Lesson 2 – Living Labels - Wetland Plants

**Author:** Laurie Rosenberg, Muhlenberg College

**Grade Level:** 9<sup>th</sup> – 12<sup>th</sup>

**Lesson Time:** One 30 minute time block and 2 hour-long time blocks.

**Suggested Class Structure:** Guided discussion with individual presentations, independent research, field study at a local wetland

**Subject Areas:** Science and Language Arts

### BACKGROUND



Wetlands are often thought of as dark, dangerous places containing undesirable plants and animals. However, wetlands actually provide beautiful scenery, as well as a habitat for interesting and beneficial plants and animals. The type of plants found in a wetland depends on the environment--the quality of the water and soil and other physical and chemical conditions required to maintain and support a habitat for that particular species.

### GOALS

In this lesson, students will learn to do independent research, using field guides and the World Wide Web to investigate the natural history of wetland plants. They will organize their research and write an entry in a class-created field guide to wetland plants. They will also prepare a verbal presentation of their research to share with the class.

### OBJECTIVES

- Students will use field guides and Web sites to find information about wetland plants. They will summarize this

information for a written entry in a class field guide

- Students will write a description of the plant and its key features, following the template for field guide entries.
- Students will point out key characteristics of their plant in the field.
- Students will draw a sketch of their wetland plant.
- Students will share their wetland plant research in a three to five minute oral presentation to their fellow class members.

### VOCABULARY

**Scientific name:** Scientific names are part of a system of species identification whereby individual organisms are known by their genus and species name. For example, the blue flag iris goes by the scientific name *Iris versicolor*, *Iris* is the genus and *versicolor* is the species. This species can be differentiated from the yellow iris, *Iris pseudacorus*, which is in the same genus but has a different species name. The common cattail, *Typha latifolia*, has both a different genus and species name. Note that the genus name is capitalized and the species name is lower case. It also is common practice to italicize scientific names.

Scientific names are used when precision and clarity are needed. Many plants have several common names. Sometimes two completely different plants will have the same common name, but there is only one scientific name for each individual species. The system of naming organisms by genus and species was developed by Carl Linnaeus. Latin names were used because Latin was the common language of higher education in Europe during the time period when the system was developed.

Scientists all around the world use this same system for identifying organisms. This gives them a common language they all understand in exactly the same way when referring to the identity of living things.

## MATERIALS

- *Wetlands Field Study Log Books*
- Internet-connected computers for Web research
- Library books, including plant and wetland field guides. (There are suggestions for field guides and other books in the *Resources* section of this lesson on page 12.)
- Pencils
- Colored pencils (Optional)
- Digital or other type of camera (Optional)
- Color printer (Optional)

## ADVANCE PREPARATION

- ✓ Run off the list of wetland plants, list of Web sites, wetland natural history worksheet and sample, and the assignment rubric. Arrange for library or computer time for student research.
- ✓ Gather wetland and plant field guides.
- ✓ Run off a copy of the *Wetlands Field Study Log Book* for each student (There are copy masters for the log books in the Appendix of lesson 6.)
- ✓ Gather optional materials (colored pencils, cameras.)

## PROCEDURES – Outline and Narrative

### Introduction – The Role of Wetland Plants – 10 minutes

Hopefully the class has already been introduced to the “Wetland Metaphors” lesson and is familiar with the value of wetlands and the plants they contain. Now they are going to delve further into the plants topic. The

presence of certain plants, called “indicators” is one of the three prime characteristics, (along with soil and hydrology), that scientists use to determine whether or not a certain plot of land can be classified as a wetland. Both the US Army Corps of Engineers and the US Fish and Wildlife Service use plant observations and a plant classification system to identify wetlands. There are three categories for plants according to this system:

- Plant species that are only found in wetlands, called *obligate* wetland plants
- Plant species that thrive in wetlands but can survive in drier conditions, called *facultative* wetland plants,
- Plant species that are only found in non-wetland conditions, called *upland* plants.

Introduce this topic to the class and pass out the list of obligate and facultative plants found at Graver Arboretum. If students are not visiting the Arboretum but are instead doing this lesson strictly “in class” or at another wetland, the list is still a good collection of the common wetland plants found in the Lehigh Valley. Each student should pick a plant they would like to study, or the teacher can assign the plants to the students.

### What Is “Natural History” – 10 minutes

Students will be creating a “natural history” book for the wetland plants of the field study site. Show them examples of some other natural history books, including the ones listed in the *Resources* section of this lesson. Natural history guides are useful tools to have along when in the field. They provide quick references and bits of information about things people are likely to encounter along the trail. They usually give a written description of the plant or animal, some information about its habits and lifecycle, along with some observations on what makes the plant or animal unique. Other things a natural history may contain include the geographical range of the plant or animal, human uses, and its ecological role in the community.

The key to a good natural history book is to be short, yet thorough and interesting. That is the challenge to the class for their research and writing assignment. Show the class the example of a natural history sheet for the hemlock tree.

Assign each student a wetland plant. There is a copy master for a sign-up sheet in the appendix of this lesson on page 22. You can have the students sign up, or run off an extra copy of the sign-up sheet and cut out the names of the plants and have the students draw them out of a bag.

### **Natural History Research – 30 minutes**

Hand out the natural history worksheet, list of Web sites, and rubric for the wetland plant field guide entry that the students will be creating. If possible, demonstrate how to find information on plants using some of the field guides and Web sites listed. Students can begin their research at school in the library or computer lab and finish the assignment at home. They should include a picture of their plant, which they can draw, print from a Web site, or photocopy.

### **Wetland Plant Field Study – 90 minutes**

Students should bring their natural history sheets along with them on the field trip, and be ready to present their plant to the class when they find it. The instructor might want to walk the trail used for the field study prior to the class' trip, and mark the wetland plants with flags. As the class walks along the wetland trail, they should stop at each wetland plant and the student who wrote the natural history for that plant will become the "Living Label," and tell the class about it as they take notes and draw the sample plant in their field log books.

*Note:* due to habitat, time and attention constraints, every student may not get to present their plant in the field.

### **Extensions**

Now that they are familiar with the identification of wetland plants, students may want to make a herbarium with plant specimens collected from wetlands near their home or school. It is absolutely essential that the students obtain permission to collect prior to beginning such a project, and they should follow proper field ethics and not collect samples of locally rare or threatened species.

For more information on how to make a herbarium, see the *Forest Ecology* module available from Muhlenberg College Environmental Education Outreach.

Students can also take pictures of the wetland plants they encounter, rather than live samples. They can use the pictures to create posters, booklets, a PowerPoint show or Web site. These means of sharing what they have learned can be presented to parents or younger students from a nearby elementary school.

### **Assessment**

Natural history worksheet, student presentations, (see rubric in the lesson appendix on page 12), student log books.

### **RESOURCES**



#### **Books for the teacher and students:**

Borman, S., Korth, R. and Temte, J. *Through the Looking Glass, A Field Guide to Aquatic Plants*. Merrill, WI: Reindl Printing Inc., 1997.

Chadde, S. W. *A Great Lakes Wetland Flora*. Laurium, MI: PocketFlora Press, 2002.

Cobb, B. *A Field Guide to the Ferns*. New York: Houghton Mifflin Company. 1984.

## **Books for the teacher and students continued . . .**

Cox, D. D. *A Naturalists Guide to Wetland Plants*. Syracuse NY: Syracuse University Press, 2002.

Eastman, J. and Hansen, A. *The Book of Swamp and Bog: Trees, Shrubs, and Wildflowers of the Eastern Freshwater Wetlands*. Mechanicsburg, PA: Stackpole Books, 1995.

Foster, S. and Duke, J. *A Field Guide to Medicinal Plants*. Boston: Houghton Mifflin Company. 1990.

Harlow, W.M. *Trees of the Eastern and Central United States and Canada*. New York: Dover, 1957.

Knobel, E. *Field Guide to the Grasses, Sedges and Rushes of the United States*. New York: Dover, 1980.

Martin, A.C. *Golden Guide to Weeds*. New York: St. Martin's Press, 1987.

Peterson, R.T. P. and McKenny, M. *A Field Guide to Wildflowers Northeastern and Northcentral North America*. Boston: Houghton Mifflin Company. 1968.

Petridies, G.A. *A Peterson Field Guide to Trees and Shrubs*. New York: Houghton Mifflin Company, 1986.

Redington, C.B. *Plants in Wetlands*. Dubuque, IA: Kendall/Hunt Publishing Company. 1994.

## **Web sites for the teacher and students:**

**Web sites:** Since the Web is constantly changing, check Muhlenberg's Outreach Web site for updated listings. [<http://www.muhlenberg.edu/cultural/graver/index.html>]

See the copy master for the handout, in the *Appendix* of this lesson beginning on page 15.

## **PA Academic Standards for Environment and Ecology Covered by the Unit:**

### **4.1.10 Watersheds and Wetlands**

- A. Describe the physical characteristics of a stream and determine the types of organisms found in aquatic environments.
- Identify terrestrial and aquatic organisms that live in a watershed.
  - Explain the habitat needs of specific aquatic organisms.

### **4.1.12 Watersheds and Wetlands**

- C. Analyze the parameters of a watershed.
- Interpret physical, chemical and biological data as a means of assessing the environmental quality of a watershed.
  - Apply appropriate techniques in the analysis of a watershed (e.g., water quality, biological diversity, erosion, sedimentation).

### **4.7.10 Threatened, Endangered and Extinct Species**

- B. Explain how structure, function and behavior of plants and animals affect their ability to survive.
- Describe an organism's adaptations for survival in its habitat.

### **4.7.12 Threatened, Endangered and Extinct Species**

- A. Analyze biological diversity as it relates to the stability of an ecosystem.
- Examine and explain how a specialized interaction between two species may affect the survival of both species.
- C. Analyze the effects of threatened, endangered or extinct species on human and natural systems.
- Identify and explain how a species' increase, decline or elimination affects the ecosystem and/or human social, cultural and economic structures.

## **Lesson 2 – *Living Labels - Wetland Plants*** **Appendix**



### **Copy Masters for:**

Web sites for Information on Wetland Plants  
Wetland Plant Natural History Sample  
Wetland Plant Natural History Worksheet  
Wetland Plant Natural History Grading Rubric  
List of Wetland Plants

# Web sites for Information on Wetland Plants

(select the site you feel is most appropriate)

## **Boundary Waters Compendium – *Aquatic Plants of the North***

[<http://www.rook.org/earl/bwca/nature/aquatics/>]

## **Connecticut Botanical Society**

[<http://www.ct-botanical-society.org/index.html>] – Information on wildflowers, rare plants, and ferns.

## **Lady Bird Johnson Wildflower Center - *Native Plant Information Network***

[<http://www.wildflower2.org/NPIN/Gallery/Gallery.html>]– Photos to be borrowed, search by name.

## **NatureServe Explorer – *Online Encyclopedia of Life***

[<http://www.natureserve.org/explorer/index.htm>] - Information on the plants, animals, and ecological communities of the United States and Canada. This conservation resource includes more than 55,000 species and ecosystems, with particularly in-depth coverage for rare and endangered species.

## **North Carolina State University – *Marginal Aquatics***

[[http://www.ces.ncsu.edu/depts/hort/consumer/factsheets/water-garden/marginalaq/common\\_name.html](http://www.ces.ncsu.edu/depts/hort/consumer/factsheets/water-garden/marginalaq/common_name.html)] – Some good information and pictures for some species, others are sketchy.

## **Pennsylvania Department of Natural Resources, Bureau of Forestry – *Common Trees of Pennsylvania***

[<http://www.dcnr.state.pa.us/forestry/commontr/>] – A selection of native trees.

## **Plant Conservation Alliance - *Native Plants for Wildlife Habitat and Conservation Landscaping in Maryland***

[<http://www.nps.gov/plants/pubs/nativesMD/lists.htm>] -- Maryland Plant list by region (mountain, piedmont, coastal plain.) Specific for wet regions:

[<http://www.nps.gov/plants/pubs/nativesMD/piedmont/piedmont-wetlist.htm>] (no pictures)

## **Plant Conservation Alliance - *Plant Invaders of the Mid-Atlantic***

[<http://www.nps.gov/plants/alien/pubs/midatlantic/toc.htm>] - Plants listed by scientific name, includes picture, common name, description and alternatives.

## **Plants for a Future – *Online Database***

[[http://www.scs.leeds.ac.uk/pfaf/D\\_search.html](http://www.scs.leeds.ac.uk/pfaf/D_search.html)] - A resource center for plants, particularly those which have edible, medicinal or other uses.

## **Purdue University Center for New Crop and Plant Products – *Crop Search***

[<http://www.hort.purdue.edu/newcrop/SearchEngine.html>] – Look here if you think your plant might be edible.

## Web sites for Information on Wetland Plants – page 2

### **University of Maine Cooperative Extension – *Native Plant Recommendations***

[<http://www.umext.maine.edu/onlinepubs/htmlpubs/commonplants.htm>] -- Native plants of Maine listed by common name, divided into groups (no pictures.)

### **University of Pennsylvania– *PA Flora Project***

[<http://www.paflora.org/index.htm>] -- Search database by county, watershed, or species – includes status as threatened, endangered, invasive, etc.

### **University of Wisconsin – *Woodland Database***

[<http://wiscinfo.doit.wisc.edu/arboretum/woodland/scripts/query.html>] – Some wetland plants are listed, some are not, hit or miss.

### **US Department of Agriculture Natural Resources Conservation Service – *Plants Database***

[[http://plants.usda.gov/cgi\\_bin/topics.cgi?earl=wetland.html](http://plants.usda.gov/cgi_bin/topics.cgi?earl=wetland.html)] -- Search by common name for wetland plants found in region 1 (includes Pennsylvania) picture, description and location.

### **US Geological Survey – *Northeast Wetland Flora***

[<http://www.npwrc.usgs.gov/resource/1999/neflor/list.htm>] -- List includes Wetland plants of the Northeast -- glossary, pictures, locations, description, drawings by type-- (ferns, grasses, sedges, monocots, dicots, etc.)

### **Virginia Natural Heritage Program - *Native Plant Tables***

[<http://www.dcr.state.va.us/dnh/native.htm>] -- Guide table to native plants of Virginia by group includes uses, region, light and moisture requirements (no pictures)

### **Washington Natural Heritage Program - *Field Guide to Selected Rare Plants of Washington***

[<http://www.dnr.wa.gov/nhp/refdesk/fguide/htm/fgmain.htm>] - List of wetland plants by species name – picture and description.

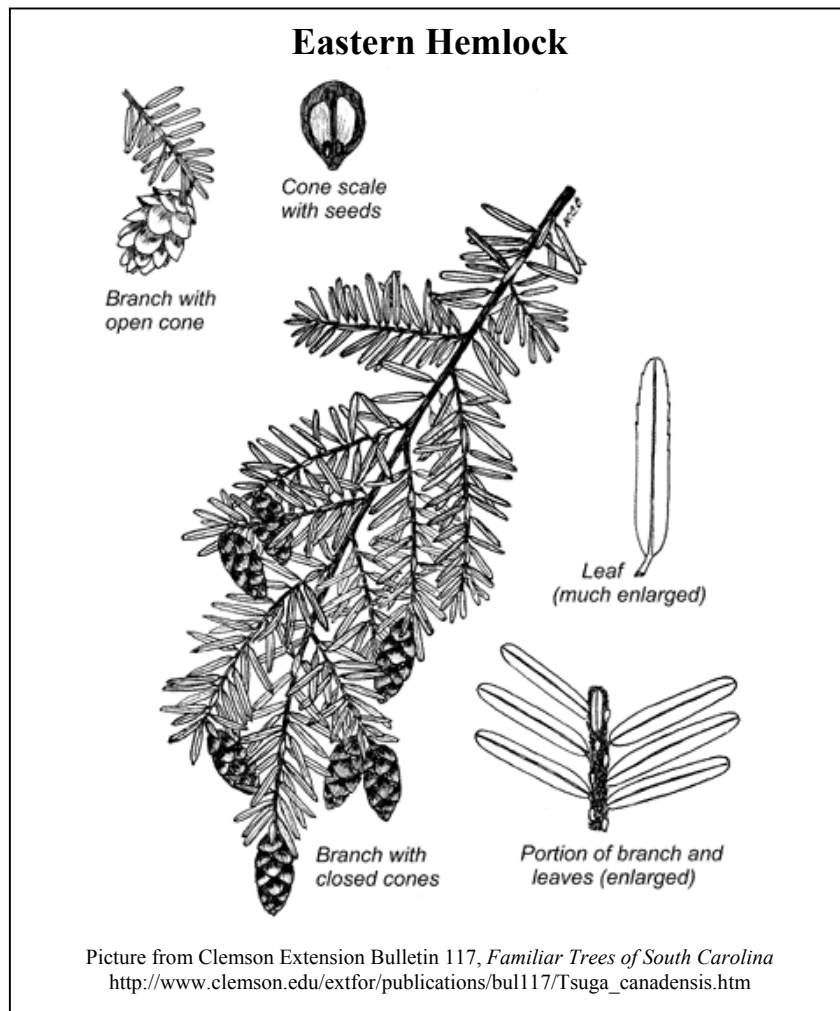
### **Wellesley Collge – *Web of Species***

[<http://www.wellesley.edu/Activities/homepage/web/directory.html>] -- Search by Scientific name includes pictures, description, characteristics, and history.

# Wetland Plant Natural History Sample

Plant Common Name: Eastern Hemlock

Plant Scientific Name: *Tsuga canadensis*



**Description of plant:** Hemlocks are evergreen trees with needle-shaped leaves. Hemlock needles are flat and rounded at the tip, and the underside is marked with two white lines. Needles are about  $\frac{1}{2}$  inch in length, and are soft and flexible.

The branches of the hemlock are also flexible and spread out in flat sprays that droop slightly at the end. Mature trees have a pyramid shape overall. The tree can live over 300 years and can reach heights of 100 feet or more. The bark of mature hemlock trees is reddish brown or gray, and divided into flat-topped ridges.

Hemlocks have both male and female plant parts on the same tree. The male pollen cones are small and barely noticeable. Mature seed-bearing cones are about  $\frac{3}{4}$  inch in length and have an oval shape with rounded cone scales. The seeds are contained within these cones and are less than  $\frac{1}{4}$  inch long. They are dispersed by wind or buried by wildlife.



**Hemlock habitat:** Hemlocks are shade-loving trees. They are often found on the north slopes of hillsides and along river gorges. They are a facultative wetland plant and prefer cool moist soil.

**Hemlock status:** Hemlocks are common trees. Currently hemlocks in the northeast are threatened by the Woolly adelgid, an invasive insect pest species brought over from Asia. When it feeds on the tree in large number, the woolly adelgid drains away vital sap; it is causing a high numbers of hemlock deaths in areas that it has infested.

**Hemlock survival traits:** Hemlocks are one of the few native evergreen trees that can tolerate shade. The trees have shallow, extensive root systems, which are able to stabilize the soil on steep slopes. This can result in dense stands of hemlock trees dominating the habitat on the shady, moist spots they prefer.

**Hemlock ecological role:** Besides stabilizing the soil on steep slopes, hemlock provides vital food and year round cover for many wildlife species. Porcupines strip the bark and eat the fresh sapwood. White footed mice, deer mice, Voles, red squirrels, ruffed grouse, black-capped chickadees and pine siskins are some of the many animal species that depend on hemlock seeds for food. Several birds prefer to nest in hemlock trees, including the sharp shinned hawk, red-shouldered hawk, northern saw-whet owl and veery. Northern, dusky, spring and two-lined salamander adults live under the bark of fallen hemlocks, along stream and brook edges. The hemlock is the larval food for several moths, including the bicolored, northern variable dart, pale-marked angle, hemlock angle, and porcelain gray moth.

**How people use hemlocks:** The leaves of the hemlock tree are high in vitamin C and were used in medicinal preparations by Native Americans. The bark is high in tannins, chemicals that were used to "tan" or preserve leather. The bark was also used for a brown dye. Hemlock's soft wood with hard knots makes rough looking lumber so it is used to construct non-showy items like framework and pallets. The trees are also used for paper pulp. Because of their tolerance of shade and moist conditions, and beautiful color and form, hemlocks are popular trees for landscaping and ornamental planting. They are often used for tall screens and hedges.

**Fun fact:** Hemlock is the state tree of Pennsylvania.

#### References

Harlow, W.M. *Trees of the Eastern and Central United States and Canada*. New York: Dover, 1957.

Pennsylvania Department of Natural Resources, Bureau of Forestry. *Common Trees of Pennsylvania*. Accessed June 13, 2004 from <http://www.dcnr.state.pa.us/forestry/commontr/>

Redington, C.B. *Plants in Wetlands*. Dubuque, IA: Kendall/Hunt Publishing Company. 1994.

USDA, NRCS. *The PLANTS Database, Version 3.5* Baton Rouge, LA: National Plant Data Center. Accessed June 13, 2004 from <http://plants.usda.gov>.

# Wetland Plant Natural History Worksheet

Plant Common Name: \_\_\_\_\_ Plant Scientific Name: \_\_\_\_\_

Description of the plant:

Include the life cycle of the plant (how and when it reproduces) what the leaves, stems, seeds and flowers look like, and what are the plant's key characteristics (what differentiates this plant from all others).

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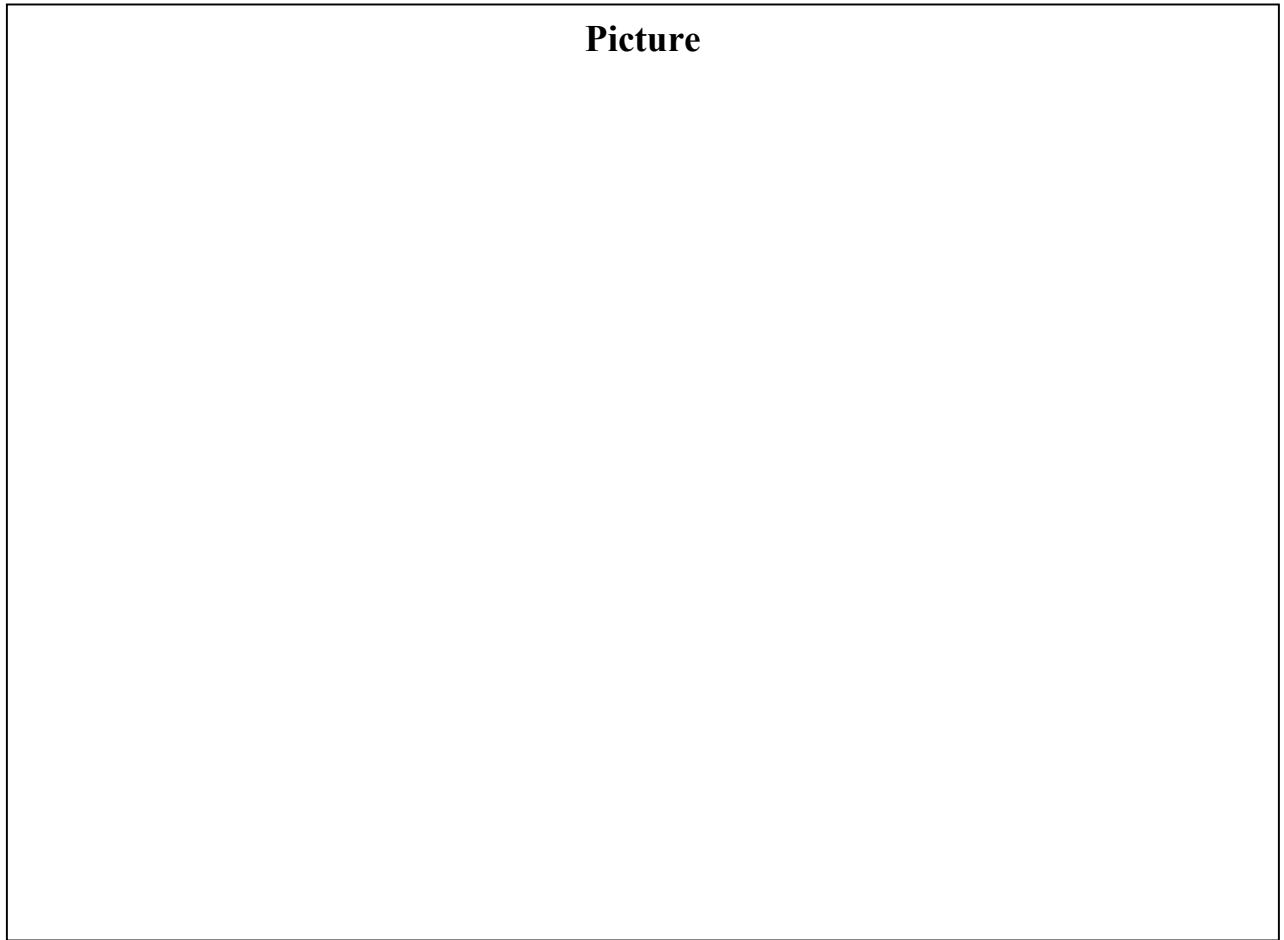
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## Wetland Plant Natural History Worksheet – page 2

Where is the plant found, what type of habitat? \_\_\_\_\_

What is the status of this plant—common, rare, threatened or endangered? \_\_\_\_\_

Describe any traits this plant has that help it survive in its habitat: \_\_\_\_\_

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What role does this plant play in the ecological community? (For example: does it provide food or shelter for other organisms, do any animals depend on it for any reason, is it commonly associated with other plants or animals, do certain insects pollinate this plant, are there predators or prey species camouflaged to look like this plant, does it colonize disturbed areas, does it control soil erosion, etc.)

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Do people use this plant in any way—food, medicine, crafts, beauty, conservation, etc.?

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Any other fun facts about this plant? \_\_\_\_\_

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**References (Use another sheet if necessary)**

## Wetland Natural History Grading Rubric

<b>Neatness</b>		
Good work – 3 points	Acceptable – 2 points	Poor quality work – 1 point
Very clear, easy to read and visually appealing	Neat and clear	Hard to read in places, sloppy looking

<b>Research</b>		
Good work – 3 points	Acceptable – 2 points	Poor quality work – 1 point
At least three sources or more, all properly cited, reliable scientific information.	Three sources, small citation mistakes, some sources less than reliable	Less than three sources, not cited properly, not reliable scientific sources

<b>Clarity (Easy to read and understand)</b>		
Good work – 3 points	Acceptable – 2 points	Poor quality work – 1 point
A clear and straightforward presentation of the information. Reads like the author genuinely understands what they are talking about. No grammar mistakes. Proper spelling and word use.	Some confusing parts. Some grammar and spelling mistakes. Awkward sounding sections.	Confusing and incomplete. Not in the author's genuine voice. Many grammar and spelling mistakes.

<b>Style</b>		
Good work – 3 points	Acceptable – 2 points	Poor quality work – 1 point
Interesting to read, shows evidence that the author was concerned about capturing the reader's interest, and went out of his or her way to find interesting information and engage the reader in how special their plant was.	Good basic information, nothing extra or special.	Minimal concern for the reader, no effort to engage him or her in learning about the plant.

<b>Oral presentation to class</b>		
Good work – 3 points	Acceptable – 2 points	Poor quality work – 1 point
Clear, audible, good voice pacing (not too fast or slow). Short and sweet. The presenter feels comfortable with the information and knows it thoroughly.	Clear basic presentation. Presenter reads many sections verbatim from their notes.	Hard to hear or understand. Presenter does not have all their facts straight, shows no interest in the subject.

## List of Wetland Plants a Graver Arboretum

<b>Obligate Wetland Plants</b>	<b><u>Student Reporter</u></b>
Bald Cypress	
Bur Marigold	
Common Cattail	
Common Arrowhead	
Common Smartweed	
Fringed Gentian	
Forget-me-not	
Narrow-leaved Arrowhead	
Wild mint	
Skunk Cabbage	
Soft Rush	
Spike rush	
Swamp Saxifrage	
Turtlehead	
Watercress	
Water Hemlock	
Water Horehound	
Water Plantain	

<b>Facultative Wetland Plant</b>	<b><u>Student Reporter</u></b>
Beggar's Ticks	
Blue Beech	
Blueberry	
Boneset	
Buttercups	
Carrion Flower	
Cinnamon Fern	
Clearweed	
Elderberry	
Spike Rush	
False Hellebore	
False Nettle	
Golden Alexander	
Interrupted Fern	
Ironweed	
Jack-in-the-Pulpit	
Jewelweed	
Joepyee Weed	
Larch/Tamarack	

<b>Facultative Wetland Plant</b>	<b><u>Student Reporter</u></b>
Poison Ivy	
Sensitive Fern	
Shadbush	
Spicebush	
White Cedar/Arborvitae	
Wild Cucumber	
Witch Hazel	
Yellow Birch	

## Lesson 3 - Wetland Vegetation Survey

Adapted from the activity “Run for the Border” from *The Wonders of Wetlands Educators Guide*.

Adapted with permission from the PA Department of Education, Bureau of Curriculum, Office of Environment and Ecology.

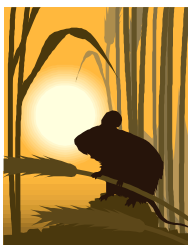
**Grade Level:** 9<sup>th</sup>-12<sup>th</sup>

**Lesson Time:** Approximately 2 hours.

**Suggested Class Structure:** Guided group discussion.

**Subject Areas:** Science and Language Arts

### BACKGROUND



It is not always easy to tell where wetlands begin and end. Since wetlands may gradually fade into upland at one limit, and into a waterway at the other, it can be hard to tell where the boundaries lie.

Scientists look closely at the plants, soils and “wetness” of an area to help them decide.

Some obvious indicators of borders include changes in plant communities and different degrees of wetness. Generally, when wetland plants known to be indicators, wetland soils, and a certain degree of wetness prevail, the area is called a wetland. When these conditions do not prevail, the area is called an upland.

The environmental conditions of an area will determine which plants will grow there. They include soil type, slope, climate, amount of sunlight, and hydrology (wetness). The plants that share certain conditions within an area are called a plant community. Some examples of plant communities would be a forest or a field. Cattails and rushes would exist in a community different from that of shrubs.

### GOALS

Students will gain an understanding of how to recognize wetland boundaries as they make observations in changes in plant communities and different degrees of wetness of an area. They will recognize physical differences in plants that will help characterize them and place them in a specific plant community.

They will examine conditions of an area (soil type, slope, climate, amount of sunlight, and hydrology) to determine which plant will grow there. They will use these indicators to determine boundaries between wetland and upland conditions.

### OBJECTIVES

- Students will make observations of plant types and soil characteristics in order to infer where wetland boundaries exist.
- Students will describe differences in plant communities.
- Students will describe conditions for wetland existence.

### VOCABULARY

**Upland** – Uphill from the wetland. By definition it must have good drainage because if it doesn't it will form part of the wetland itself rather than a drier slope above it.

**Indicators** – plant or animal species that can be used to assess environmental conditions.

### MATERIALS

- Appropriate waterproof footwear
- Pictures or samples of various plants

## **MATERIALS continued**

- Wetlands Field Study Log Book* for each student
- Plant identification guidebooks
- Marker flags
- Meter sticks or hula hoops
- Tape measures
- Clipboards
- Pencils

## **ADVANCE PREPARATION**

- ✓ Gather materials for plant identification, including pictures, samples and identification guide books.
- ✓ Run off copies of the *Wetlands Field Study Log Book*. The copy masters are found in the *Field Study Procedures Appendix*, starting on page 49.
- ✓ Gather equipment needed for field study including flag markers, tape measures, clipboards and pencils.

## **PROCEDURES – Outline and Narrative**



### **Introduction – Wetland Observations – 30 min.**

Explain to the students that they will be going to a wetland area to investigate the composition of the vegetation in the habitat. Review the observation page titled “Wetland Vegetation Zones” found on page 4 of the *Wetlands Field Study Log Book*. Discuss how the students will use it as they work in teams to make observations.

Next, take some time to have the students practice identifying plants using pictures and samples. Distinguish similarities and differences by raising questions such as: Are these plants the same? Why not? Have students describe plants in as much detail as possible. Note that plants classified as trees and shrubs are woody plants and plants

classified as herbs are non-woody plants. For more specific information on how to teach plant identification and classification, see the *Forest Ecology* module available through Muhlenberg College’s environmental education outreach.

Explain that scientific observations describe what we see. We make inferences when we use logic to explain our observations. One set of observations may lead to many different inferences or even none. Since wetland conditions are not always obvious, this activity may be used as a case study in scientific observation.

Students will set up a 15-30 meter transect line along the border between a wetland and upland area. A fifteen meter line can be set up if time is limited, but ideally a longer transect will yield more interesting observations. Students should use a tape measure to measure the distance, and then place flags every three meters along the line. They can then use a meter stick set perpendicular to the flag and identify the plants touching the meter stick, or in wet meadow areas they can use a hula-hoop touching the flag, and identify all the plants inside the hoop. Students should also take soil samples at each flagged point using a soil core borer.

### **Wetland Field Observations – 60 min.**

Divide the class into groups and have each group set up a transect and make observations using the *Wetland Field Study Log Book*. Be sure to have observations documented so they may be used for later discussion and inferences.

### **Wrap Up and Summary of Wetlands - 15 min.**

After observations are finished and the log books are completed, have the students summarize ways to identify wetlands by making plant



observations. Discuss the students' field observations by and inferences, by posing the questions listed below. Suggested answers are also listed.

1. *Where do you think the upland ends and the wetland begins?*

Changes in vegetation and soil usually mark the upper limits of wetlands. In many marshes, there is a clear transition from trees and shrubs to tall, grass-like plants such as cattails, sedges, and rushes. The vegetation changes on the upper edges of forested wetlands such as swamps are less clearly defined. There, the soil color and moisture might be the best clues. Unless there have been recent rainy or dry spells, the wetland soil will be noticeably wetter, often squishy or even inundated with water.

2. *Does the wetland have another boundary? If so, what is it?*

The lower limit will usually be the adjacent waterway. Some wetlands seem clearly bounded on all sides by uplands, some will seem to stretch indefinitely.

3. *What conditions seem necessary for a wetland to thrive?*

By observing the upper and lower limits of a wetland, students can infer what the optimum conditions for wetlands would be, such as relatively flat topography and an abundance of water, (but not deep or swift moving water with currents or waves.)

4. *Where might the wetland be changing or experiencing destruction?*

Geologically speaking, wetlands are dynamic places undergoing rapid change. Trapped sediments resulting from the natural or increased influence of human activities can fill wetlands. Rising water levels can flood coastal

wetlands, and erosion can wash them away. Erosion is the most easily observed factor along the lower limits of wetlands bordering swift creeks, streams that flood with heavy rain, open bays or rivers.



5. *What human activities might be affecting the wetland?*

The effects of human activities might include the following observations:

- Damming the waterway downstream may flood wetlands.
- Damming the waterway upstream may dry up the wetlands.
- Usage of water from the waterway for irrigation or use of ground water for excessive wells could dry up the wetlands.
- Cutting a ditch across a wetland could drain it.
- Construction practice of pushing dirt into a waterway might fill in or destroy a wetland.
- Excessive disturbance of the soil on the nearby upland might fill the wetland with sediment.
- Erosion from wakes produced by boat traffic could destroy a marsh.

## Assessment

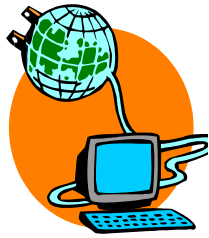
*Wetlands Field Study Log Book* page 4, "Wetland Vegetation Zones" found in the appendix of the Field Study Procedures section of this module.

## RESOURCES



### Books for the students and teacher:

See lessons one and two.



**Web sites:** Since the Web is constantly changing, check Muhlenberg's Outreach Web site for updated listings.  
[<http://www.muhlenberg.edu/cultural/graver/index.html>]

### **Web sites for the teacher and students**

West Coast (of British Colombia)  
Environmental Law, *Selected Wetland Glossary*  
[[http://www.wcel.org/wcelpub/1996/11580/11580\\_glos.html](http://www.wcel.org/wcelpub/1996/11580/11580_glos.html)]

### **PA Academic Standards for Environment and Ecology Covered by the Unit:**

#### **4.2.10 Watersheds and Wetlands**

- B. Explain the relationship among landforms, vegetation and the amount and speed of water.
- E. Identify and describe natural and human events on watersheds and wetlands.

#### **4.2.12 Watersheds and Wetlands**

- C. Analyze the parameters of a watershed.
- D. Analyze the complex and diverse ecosystems of wetlands.

#### **4.6.10 Ecosystems and Their Interactions**

- A. Explain the biotic and abiotic components of an ecosystem and their interaction.
- B. Analyze how ecosystems change over time.

#### **4.6.12 Ecosystems and Their Interactions**

- A. Analyze the interdependence of an ecosystem.

- Analyze the relationship between components of an ecosystem
- Understand how biological diversity impacts the stability of an ecosystem.
- Analyze the positive or negative impacts of outside influences on an ecosystem.
- Analyze how different land use practices can affect the quality of soils.

- C. Analyze how human action and natural changes affect the balance within an ecosystem.

#### **4.7.10 Threatened, Endangered and Extinct Species**

- A. Explain the significance of diversity in ecosystems.
  - Identify a species and explain what effect its increase or decline might have on the ecosystem.
  - Identify a species and explain how its adaptations are related to its niche in the environment.
- B. Explain how structure, function and behavior of plants and animals affect their ability to survive.
  - Describe an organism's adaptations for survival in its habitat.
  - Compare adaptations among species.
- C. Identify and explain why adaptations can lead to specialization.
  - Explain factors that could lead to a species' increase or decrease.
  - Explain how management practices may influence the success of specific species.

#### **4.7.12 Threatened, Endangered and Extinct Species**

- A. Analyze biological diversity as it relates to the stability of an ecosystem.
  - Examine and explain what happens to an ecosystem as biological diversity changes.

## Lesson 4 - Wetland Soils

Adapted from the activity “Do You Dig Wetland Soil?” from *The Wonders of Wetlands Educators Guide*.

Adapted with permission from the PA Department of Education, Bureau of Curriculum, Office of Environment and Ecology.

**Grade Level:** 9<sup>th</sup>-12<sup>th</sup>

**Lesson Time:** Approximately 1.5 hours

**Suggested Class Structure:** Guided group discussion, field study soil observations with small groups.

**Subject Areas:** Science and Language Arts

Soils that contain little or no organic matter are called mineral soils and contained a variety of sand, silt, and clay. Mineral soils are either gleyed or mottled. *Gleyed* soil is saturated all the time, anaerobic, and usually neutral gray, greenish, or bluish gray in color. Mottled soil is found in areas that exhibit wet and dry periods, alternating anaerobic and aerobic conditions. The soil color includes splotches of brown, orange, red or yellow. Minerals like iron and manganese that are present in wet soils will be oxidized and rust during dry periods leaving shades of red, orange, and yellow or mottles of black.

### BACKGROUND



There are many different types of soils and classification systems. Most soils are well-drained, non-wetland types. Prolonged presence of water, however, creates wetland (hydric) soils which are quite different physically from non-wetland (upland) soils.

Wetland soils are saturated, flooded, or “ponded” long enough during the growing season to have anaerobic conditions. The lack of oxygen and presence of water causes chemical reactions that ultimately affect the color of the soil. Scientists can study the color of soils to determine how long and how frequently an area has been wet, even if the sample is not wet at the time of investigation.

The two major types of wetland soils are organic and mineral. Organic wetland soil contains a noticeable amount of partially decomposed plant material. Due to the lack of oxygen, these soils exhibit decreased bacterial decomposition. They look like black muck or black to dark brown peat.

### GOALS

Students will gain an understanding of how color, texture, moisture, and soil particle content are used to identify and classify soil types as wetland and non-wetland. They will observe a study plot for variations in soil types along a transect and make documentation in a field log book. Using these observations, they will determine whether their site is a wetland or non-wetland of organic or non-organic nature, and make inferences as to the water content over a period of time.

### OBJECTIVES

- Students will describe the physical differences between wetland and upland soils.
- Students will use keys and tables to recognize and correctly identify wetland soils.

### VOCABULARY

**Anaerobic** – without the presence of oxygen

**Gleyed soil** – Clay soil that is greenish-gray or bluish-gray in color.

**Hydric soil** – Soil that exhibits the characteristics of wetland soils—moisture content, color, texture, composition, etc.

**Mottled soil** – Soil that has blotches or spots of different shades or colors.

**Organic soil** – Soil that contains a high amount of organic material that is only partially decomposed.

**Oxidize** – to combine with oxygen. Iron turns red when it is oxidized.

## MATERIALS

- Appropriate waterproof footwear
- Wetlands Field Study Log Book* for each student
- Soil Characteristics Reference Tables
- Geotechnical gauge for each group
- Marker flags
- Meter sticks or tape measures
- Clipboards
- Pencil(s)
- Trowels for each group
- Soil core borer

## ADVANCE PREPARATION

- ✓ Run off copies of the Soil Characteristics Reference Tables for each group. Copy masters are found in the Appendix of this lesson, beginning on page 32.)
- ✓ Run off copies of the *Wetlands Field Study Log Book* for each student, (the copy masters are found in the *Field Study Procedures Lesson Appendix* on page 49.)
- ✓ Gather the equipment needed for field study.



## PROCEDURES – Outline and Narrative

### Introduction – Wetland Soil Observations – 15 min.

Explain to the students that they will be going to a wetland area to investigate various soil samples to determine how soils can be classified. Review the observation page titled “Wetland Soils” found on page 5 of the *Wetlands Field Study Log Book*. Discuss how the students will use it as they work in teams to make observations. Then, have the students practice identifying soil samples using charts and samples. Have students describe soils in as much detail as possible.

Explain that students will be using a soil borer to obtain soil samples. Describe proper use of borer, (***do not step on handles***), to obtain soil samples at A and B layers.

### Wetland Soil Field Observations – 60 min.

Divide the class into groups and have them set up a transect and select and mark their sampling sites. Collect soil samples at each marked site using trowels and the soil borer. Make observations of both A and B layers as outlined in the *Wetland Field Study Log Book*. Be sure to have observations documented so they may be used for later discussion and inferences.

### Wrap Up and Summary of Wetland Soils - 15 min.

After observations are finished and the log book is completed, have the students summarize the types of soil they observed in their plot by answering the questions below. Review their observations and inferences, providing suggested answers listed below.

1. *What soil characteristics did you observe?*

Have students share the data and observations they collected in their charts. Wetland soils will have some of the characteristics listed below, particularly if students were able to dig down to the wetland soil level.

- Shades of dark brown or black (organic wetland soils.)
- Feels like sticky clay and is shades of gray, green, or darker
- Made up of peat or organic material, sand and/or other minerals, clay, silt, loam, or combinations in layers or mixtures
- Sticks together or oozes through fingers like ribbons when squeezed
- Mottles or splotches of color are seen throughout sample in shades of red, orange, or yellow
- Shades of red or orange found in soil surrounding roots caused by oxidation of iron in the soil
- No earthworms present in wet, saturated soil
- Sulfur gas smell from anaerobic activity

2. *How did soil in layer A and B differ in color and texture?*

This will depend on the type of wetland and level of the water table. Usually wetland soils have a dark aerobic layer of organic soil at the top, and a mineral or organic anaerobic layer below.

3. *Is it apparent where the water and soils in this area are coming from? What watershed drains to this spot?*

Have students look at factors bringing water to the area, since the degree of wetness affecting soil conditions is of interest. Observe topographic and weather conditions and the effect they may have, such as slope, runoff, and water seeping into the soil.

4. *Compare wetland soil to soil you have seen in other areas such as home or*

*school. How do they differ, and what makes them different?*

The main difference is that wetland soil is wet or saturated for extended period of time and upland soil is not. The colors differ because of chemical reactions that occur in anaerobic soils. Differences may vary depending on the areas students chose to sample.

## Assessment

*Wetlands Field Study Log Book*, soils pages, and answers to the questions above.

## RESOURCES



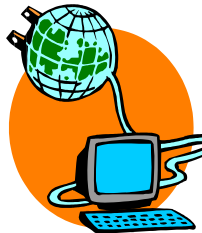
### Books for the students and teacher:

Soil and Water Conservation Society. *Soil Biology Primer*.

2000. To obtain a copy contact

them at 7515 Northeast Ankeny Road, Ankeny, IA 50021. Phone: (800) 843-7645, ext. 24. E-mail: [pubs@swcs.org](mailto:pubs@swcs.org). Online:

[<http://www.swcs.org>]



**Web sites:** Since the Web is constantly changing, check Muhlenberg's Outreach Web site for updated listings.

[<http://www.muhlenberg.edu/cultural/graver/index.html>]

### Web sites for the teacher

NOAA/Forecast Systems Laboratory. *GLOBE, Global Learning and Observations to Benefit the Planet*. [<http://www.globe.gov>]

This site has lesson plans and directions on how to inventory soil characteristics. When you get to the home page, click on "Teacher's Guide" in the left hand toolbar. Then select "Soil Chapter" from the guide menu. You

can download a PDF of the entire chapter to keep as a reference.

**US Forest Service. *Investigating Your Environment***

[<http://www.na.fs.fed.us/spfo/ce/iye/contents.htm>] A PDF version of an extensive forestry curriculum, including a soil survey, watersheds, ponds, wildlife and vegetation. Includes all data sheets and background information.

**Web sites for the students**

University of Illinois Extension. *Four Major Components of Soil.*

[<http://www.urbanext.uiuc.edu/gpe/case2/c2facts1.html>] This is part of a larger Web-based plant investigation unit.

National Aeronautics and Space Administration (NASA) *Soil Science Education Homepage.*

[<http://ltpwww.gsfc.nasa.gov/globe/index.htm>] June 26, 2002. Produced in conjunction with the GLOBE program. An excellent site with good graphics and a compelling presentation of information.



**PA Academic Standards  
for Environment and  
Ecology Covered by the  
Unit:**

**4.2.12 Watersheds and Wetlands**

- C. Analyze the parameters of a watershed.
- D. Analyze the complex and diverse ecosystems of wetlands.

**4.6.10 Ecosystems and Their Interactions**

- A. Explain the biotic and abiotic components of an ecosystem and their interaction.

# Lesson 4 - Wetland Soils Appendix



## Copy Masters for:

### Soil Characteristics Reference Tables

- Table 1 – Soil Color, Table 2 -- Soil Texture
- Table 3 – Soil Structure
- Table 4 – Soil pH

# Soil Characteristics Reference Tables

**TABLE 1a.**  
**Topsoil (A Horizon).**

Condition	Topsoil color		
	<i>Dark (dark grey, brown to black)</i>	<i>Moderately dark (brown to yellow-brown)</i>	<i>Light (pale brown to yellow)</i>
<i>Amount of organic material</i>	High	Medium	Low
<i>Erosion factor</i>	Low	Medium	High
<i>Aeration</i>	High	Medium	Low
<i>Available Nitrogen</i>	High	Medium	Low
<i>Fertility</i>	High	Medium	Low

**TABLE 1b.**  
**Subsurface Soil (B horizon)**

Subsurface soil color	Condition
Dull grey (if in low rainfall soils, 0-2 inches of rain)	Water-logged soils, poor aeration
Yellow, red-brown, black (if in forest soils)	Well drained soils
Mottled grey (if in humid soils)	Somewhat poorly to poorly drained soils

**TABLE 2a.**  
**Common Soil Textures**

Particle Size	Feel	Air Space	Water Availability
<i>Clay (.002 mm)</i>	Sticky	Few, tiny	Slow movement of water; may result in low availability
<i>Silt (.002-.05 mm)</i>	Smooth	Many, small	Good
<i>Sand (.05-2.0mm)</i>	Gritty	Many, large	Low

**TABLE 2b.**  
**Some effects of texture on soil conditions**



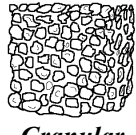
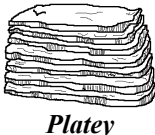
Texture	Water holding capacity	Looseness of soil
Sandy	Poor	Good
<i>Loamy</i>	Good to excellent	Good
<i>Clayey</i>	High (water held too tightly for plant use)	Poor



# Soil Characteristics

## Reference Tables – page 2

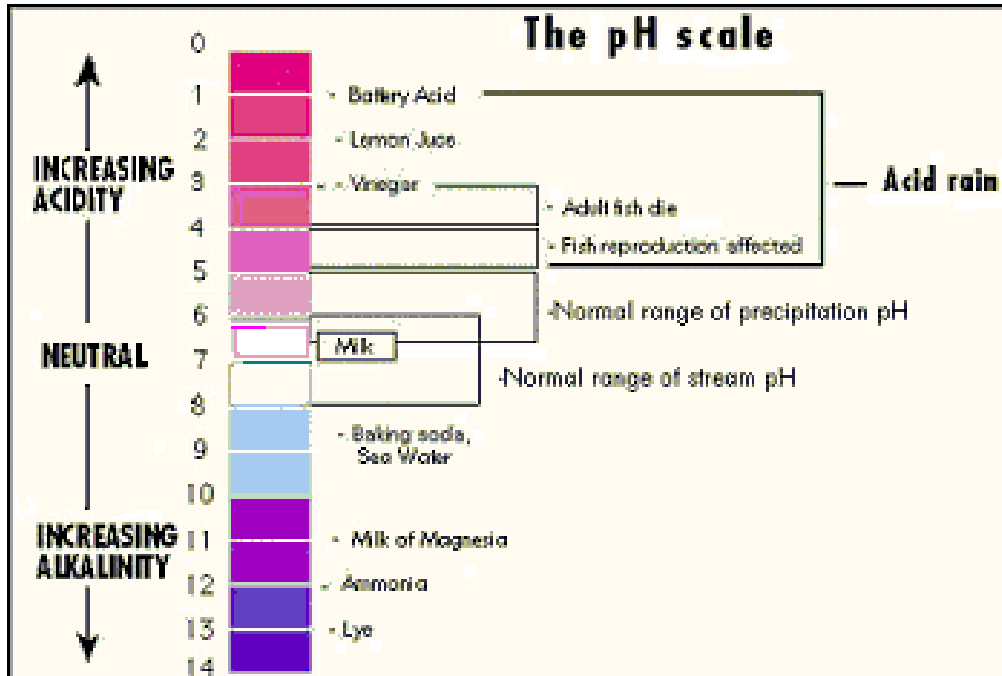
**TABLE 3.**  
Some effects of structure on soil conditions

Type	Penetration of water	Drainage	Aeration
 Columns	Good	Good	Good
 <i>Blocky</i>	Good	Moderate	Moderate
 <i>Granular</i>	Good	Best	Best
 <i>Platey</i>	Moderate	Moderate	Moderate



# Soil Characteristics

## Reference Tables – page 4



**TABLE 4.**  
Relationship of soil pH to plant species

### Tree Species Suitable for Soil Conditions based on pH and Drainage

pH	Poorly Drained (Wet)	Well Drained (Moist)	Excessively Drained (Dry)
7.0 – 8.0	Beech		
5.5 – 7.0	European Alder Green Ash Pin Oak Sycamore Willow Silver Maple	Sugar Maple Basswood Yellow Poplar Black Walnut Aspen Red Oak	Red Pine Pitch Pine
4.0 – 5.5	Swamp White Oak Eastern Hemlock Yellow Birch Red Cedar?	White Pine White Oak Scarlet Oak Rhododendron Azaleas Ferns Blueberries	Chestnut Oak Virginia Pine

## Lesson 5 – Wetland Hydrology

Adapted from the activity “How Thirsty Is the Ground?” from *The Wonders of Wetlands Educators Guide*.

Adapted with permission from the PA Department of Education, Bureau of Curriculum, Office of Environment and Ecology.

**Grade Level:** 9<sup>th</sup>-12<sup>th</sup>

**Lesson Time:** 1.5 hours

**Suggested Class Structure:** Guided group discussion, teacher demonstration, experiments by student groups.

**Subject Areas:** Science

### BACKGROUND



Soils are made up of many materials including organic matter, pieces of rock, and mineral deposits. The most common components of soil are sand and clay. The mixture of these materials determines how porous the soil is, depending on the size and shape of soil particles, and the amount of air space through which water can move.

Water will seep, or percolate, into certain soils faster than others. Soils containing more sand will allow water to percolate, or move down through faster than soils of clay. This is because sand particles are fairly large and irregularly shaped, allowing large pore spaces for water to trickle through. Clay particles are finer and closer together, leaving smaller spaces that trap water.

A simple percolation test can determine the permeability of soil and whether the ground is already saturated with water or will allow water to infiltrate. Permeability is the rate at which water percolates through the soil. The slower the percolation rate, the less permeable

the ground. Permeability is a key factor in the formation of wetlands. Soil that drains quickly is usually not wetland, with sandy soils near the water table as an exception.

Wetlands form in areas where soil is saturated for extended time periods, or impermeable and poorly-drained. A high water table can also saturate soil enough to slow percolation and cause formation of wetlands. When water from precipitation or runoff percolates into the soil, air is forced out causing low oxygen anaerobic conditions. These anaerobic conditions result in physical, chemical, and biological reactions that affect the wetland soil, plants, and animals, especially when present for extended time periods.

### GOALS

Students will gain an understanding of how water drains through the air spaces present in soil as a result of the particle composition of the soil. They will perform a simple percolation test to observe the permeability of soil in a selected plot. They will record data and make observations on how water seeps, or percolates into soils at different rates and how soil permeability is a key factor in the formation of wetlands.

### OBJECTIVES

- Students will predict and test permeability of different types of soil.
- Students will relate makeup of the soil and use of the area to permeability.
- Students will analyze this information to explain how some wetlands are formed.
- Student s will consider oxygen levels of wetland soils versus well drained soils.

## VOCABULARY

**Permeable** – having pores that permit liquids to pass through. *Permeability* – the rate of flow of a liquid through porous material.

**Percolate** – drain or seep through.

**Porous soil** – Soil that is able to absorb fluids due to having small spaces between the soil particles.

**Saturated** – full, unable to hold or contain more water.

**Water table** – The level below which the ground is completely saturated with water, the upper limit of the groundwater.

## MATERIALS

- Appropriate waterproof footwear
- Wetlands Field Study Log Book* for each student
- Empty coffee can with ends removed for each group
- Hammer for each group
- Flat piece of wood large enough to fit over the coffee can for each group
- Liter of water (for each measurement)
- Stopwatch for each group, (can use watches with second hands)
- Marker Flags for each group
- Meter sticks or tape measures for each group
- Clipboards
- Pencil(s)

## ADVANCE PREPARATION

- ✓ Gather materials and equipment for soil percolation testing, including coffee cans, stopwatches and water.
- ✓ Run off the *Wetlands Field Study Log Book* for each student, (copy masters are in

the *Field Study Procedures Lesson Appendix*, beginning on page 49.)

## PROCEDURES – Outline and Narrative



### Introduction – Wetland Hydrology Observations - 15 min.

Explain to the students that they will be going to a wetland area to investigate the permeability of wetland soil by testing several sites. Review the observation page titled “Wetland Hydrology – The Flow of Water Over Land” found on page 5 of the *Wetlands Field Study Log Book*. Discuss how the students will use it as they work in teams to make observations and measure the soil percolation rate.

### Wetland Soil Field Observations – 60 min.

Divide the class into groups and have them select and mark their study site using flag markers for the 5 sites to be tested (every 3 or 6 meters along a perpendicular transect from their baseline, depending on whether you mark a 15 meter or 30 meter transect). Have students place the coffee can at the site to be measured. Place a piece of wood over the can and hammer the can in place. The can should be imbedded into the soil to a depth of one inch. Carefully pour 1 liter of water into the can while someone starts the stopwatch. When the water has completely seeped from the can, record the finish times in the charts provided in the *Wetland Field Study Log Book*. Be sure to have observations documented so they may be used for later discussion and comparison with results from other groups in the class.

## Wrap Up and Summary of Wetland Hydrology - 15 min.

After observations are finished and the log book is completed, have the students summarize the types of soil they observed in their plot. Students may want to graph their results. Percolation rates should be expressed as inches per minute. Review their observations and inferences, noting that Sandy areas will likely percolate the fastest, followed by forest/garden areas, grassy areas, muddy areas, and lastly compacted areas. A paved area will not allow water to permeate at all.

## Assessment

*Wetlands Field Study Log Books*, “Wetland Hydrology” page 5.

## PA Academic Standards for Environment and Ecology Covered by the Unit:

### 4.2.12 Watersheds and Wetlands

- C. Analyze the parameters of a watershed.
- D. Analyze the complex and diverse ecosystems of wetlands.

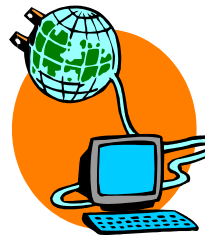
## RESOURCES



### Books for the teacher and students:

See lesson one and three.

**Web sites:** Since the Web is constantly changing, check Muhlenberg’s Outreach Web site for updated listings. [<http://www.muhlenberg.edu/cultural/graver/index.html>]



### Web sites for the teacher

See lesson three.

## Lesson 6 - Wetland Topography

**Author:** Laurie Rosenberg, Muhlenberg College  
Theresa Ehrenreicht, Whitehall High School

**Grade Level:** 9-12th

**Lesson Time:** One 45 minute time block for the introduction to topographic map reading, and 45-60 minutes for the wetlands topography exploration.

**Suggested Class Structure:** Guided discussion, hands-on map reading activities, group worksheet.

**Subject Areas:** Science and Geography

### BACKGROUND

The area of land around an aquatic community where water runs off the higher land into the wetlands is called the *watershed*. The lay of the land determines the boundaries of the watershed. Areas of higher elevation, called *ridges*, separate watersheds. Smaller water-sheds drain into larger ones.

Runoff water picks up residues from the land depending on what types of land use activities are taking place in the watershed. These residues are carried into the aquatic community. They include particles of soil, inorganic chemicals from roads, households and business sites, bits of organic material from plants growing in the watershed, animal residues, and many other microscopic materials that cross the water's path.

### GOALS

Students will learn to identify the features of a topographic map. They will use the maps to visualize and assess an area's topography and determine the interplay between topography and water flow. They will also look at aerial maps and road maps and identify different kinds of land use, and look at how topography

influences land use, and how land use interacts with topography to impact wetlands.

### OBJECTIVES

Students will be able to:

- Read a topographic map to the point where they can correctly discriminate between upland and lowland areas and identify bodies of water and their watersheds.
- Infer from looking at a topographic map areas that could be considered wetland.
- Identify developed land, farmland and forestland when looking at an aerial map.
- Use road maps to locate areas of urban development.
- Use topographic, aerial and road maps to determine land use patterns affecting wetlands.
- Use maps as tools for making and assessing land-use decisions.
- Compare their observations in the field to their impressions from a map.

### MATERIALS

- Topographic maps of a nearby wetland
- Aerial maps of a nearby wetland area
- Road maps of a nearby wetland area
- Wetland topography log book pages
- Colored wax pencils or erasable markers
- Rulers

### ADVANCE PREPARATION

- ✓ Gather maps and laminate.
- ✓ Gather rulers and colored wax pencils or erasable markers for each group of students.
- ✓ Run off copies of the *Wetland Field Study Log Books* for each student.

Note: in order to do this lesson you will need an aerial and topographic map for each group. If you plan on reusing the maps, you should laminate the maps and use wax pencils or fine-lined erasable markers for this activity.

The best map resources for this lesson are full-size aerial and topographic maps done by the United States Geological Survey. They can be ordered from the USGS directly, (see their Web site for more information), [<http://ask.usgs.gov/products/>] or call them at 1 - (888) 275-8747. You will have to specify the location for the maps, which can be done by indicating place names, longitude and latitude coordinates, or using the Web-based map locator software on the Web site. Aerial maps come in various sizes and prices.

In the Lehigh Valley, topographic maps may be purchased at Nestor's Wilderness Travel Outfitters, 2510 Macarthur Road, Whitehall, PA, phone 610-433-6051.

A GIS mapping CD is available from Muhlenberg College which will allow you to create aerial and topographic maps of Graver Arboretum; you can use the Graver site as a case study.

## **PROCEDURES – Outline and Narrative**

### **Introduction – How to Use a Topographic Map, 30 min.**

For this section of the lesson, refer to the USGS tutorial, *What Do Maps Show?* [<http://interactive2.usgs.gov/learningweb/teachers/mapsshow.htm>], or the "Aquatic Landscapes" lesson in the *Aquatic Ecology* middle school module available from Muhlenberg College.

### **Identifying Land Use Patterns on a Topographic Map – 45 min.**

The next activity explores specific wetland features on a topographic map. Students will use the topographic and aerial maps of the area around Graver Arboretum to fill out the pages in their Wetlands Field Study Log Books. If your class is not visiting Muhlenberg's Graver Arboretum for a field trip, you will need to obtain a USGS topographic map and aerial or road map for an wetland area in your community, preferably near your school. Ideally, these maps should all be of the same size and scale and geographic orientation.

Instruct the students to follow these procedures with their maps. You can substitute the names of nearby streams, ponds and rivers for the Graver names listed here if you are using a different set of watershed maps.

1. Find the Bushkill Stream on the map and color it blue.
2. Find Lee's Pond (note, it is right next to Bushkill Center Road. Put a circle around the pond and label it with the word's "Lee's Pond." Also identify and circle any other large ponds in the area around the Bushkill Stream.
3. If you followed the Bushkill Stream from Copella to Aluta, how far would you walk? (Measure the distance with a ruler and use the map scale to figure the distance.)
4. Using your ruler, draw a perpendicular line intersecting the Bushkill Stream and put a red "x" on the highest point of land that the line intersects on either side. Continue doing this every inch along the whole length of the Bushkill. When you are finished, connect the x's along the ridge tops, and this will give you the outline of the Bushkill watershed.

5. Once you have located the Bushkill watershed, look for flat areas near the stream, areas where the distance between the topographic lines is large. Circle these areas in brown pencil; they are potential wetlands. There also may be symbols for wetlands on the map.
6. Next, look at the aerial map of the Bushkill. Color the stream blue on this map. Circle areas of housing or commercial development in yellow pencil, circle areas of farming in red, and areas of forest in green. If possible, outline the major roads in another color.
7. Compare the aerial map to the topographic map. What are the land use patterns in the wetland areas, what types of land use is going on there?

Now that you have identified the land use patterns in the Bushkill Stream watershed in the area of the Moorestown Wetlands, use your map to answer the questions in the Wetlands Field Study Log Book.

## Assessment

Wetlands Field Study Log Book, “Wetlands Topography” page.

## RESOURCES

### Books for the teacher and students:

Kjellström, Bjön. *Be Expert with Map and Compass*. John Wiley and Sons, 1994. Revised classic.

**Web sites:** Since the Web is constantly changing, check Muhlenberg’s Outreach Web site for updated listings. [<http://www.muhlenberg.edu/cultural/graver/index.html>]

### Web sites for the teacher

**Great Lakes Aquarium.** *Mapping the Watershed*. [<http://www.glaquarium.org/learn/lakematters/lessonplans/mappingthewatershed.html>]

Online lesson with additional suggestions on how to study watershed maps.

**US Geological Survey Learning Web.** *What Do Maps Show?*

[<http://interactive2.usgs.gov/learningweb/teachers/mapsshow.htm>] A teacher’s guide with examples and lesson plans.

## PA Academic Standards for Environment and Ecology Covered by the Unit:

### 4.1.10 Watersheds and Wetlands

- A. Explain the relationship among landforms, vegetation and the amount and speed of water.
  - Describe how topography influences streams.
  - Explain how vegetation affects storm water runoff.
  - Delineate the boundaries of a watershed.
  - Describe factors that affect the quality of groundwater.
- E. Identify and describe natural and human events on watersheds and wetlands.
  - Identify the effects of humans and human events on watersheds.

### 4.1.10 Watersheds and Wetlands

- A. Explain the relationships that exist within watersheds in the United States.
  - Understand that various ecosystems may be contained in a watershed.
  - Examine and describe the ecosystems contained within a specific watershed.
- E. Evaluate the trade-offs, costs and benefits of conserving watersheds and wetlands.
  - Evaluate the effects of human activities on watersheds and wetlands.



# **Lesson 6 - *Wetland Topography* Appendix**



**Wetland Topography Instructions and Questions**

**Bushkill Stream Watershed: Benders Junction – Aluta**

**Topography of the Bushkill Watershed**

## **Instructions for Wetlands Topography**

**Using a topographical map of the area around Graver Arboretum, complete the following steps:**

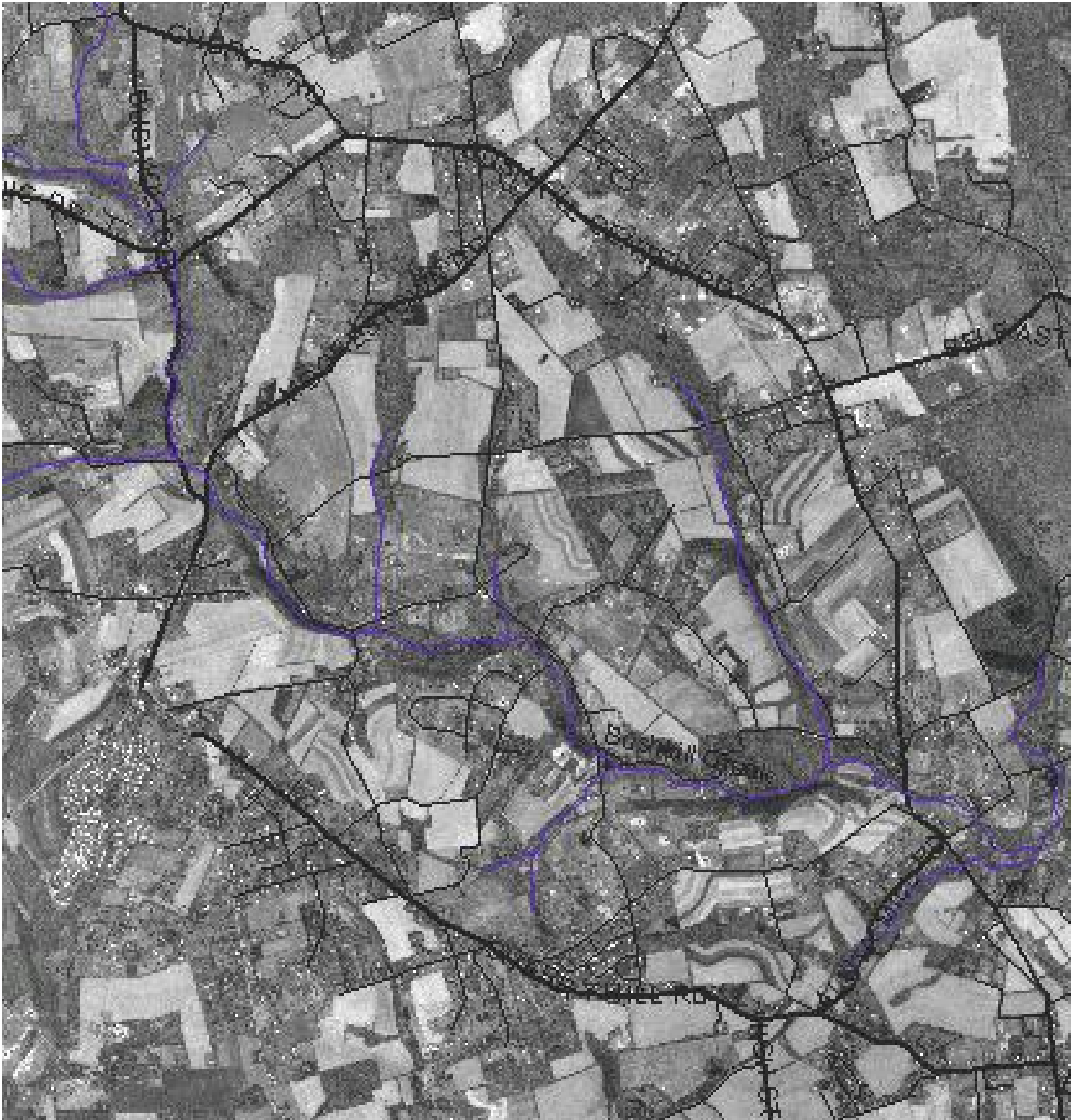
1. Find the Bushkill Stream on the map and color it blue.
2. Find Lee's Pond (note, it is right next to Bushkill Center Road.) Put a circle around the pond and label it with the words "Lee's Pond." Also identify and circle any other large ponds in the area around the Bushkill Stream.
3. With a ruler, draw a perpendicular line intersecting the Bushkill Stream and put a red "x" on the highest point of land that the line intersects on either side. Continue doing this every inch along the whole length of the Bushkill. When you are finished, connect the x's along the ridge tops, and this will give you the outline of the Bushkill watershed.
4. Once you have located the Bushkill watershed, look for flat areas near the stream, areas where the distance between the topographic lines is large. Circle these areas in brown pencil; they are potential wetlands. There also may be symbols for wetlands on the map.
5. Next, look at the aerial map of the Bushkill. Color the stream blue on this map. Circle areas of housing or commercial development in yellow pencil, circle areas of farming in red, and areas of forest in green. If possible, outline the major roads in orange pencil.
6. Compare the aerial map to the topographic map. What are the land use patterns in the wetland areas, what types of land use is going on there?

**Now that you have identified the land use patterns in the Bushkill Stream watershed in the area of the Moorestown Wetlands, use your map to answer the questions in the Wetlands Field Study Log Book.**

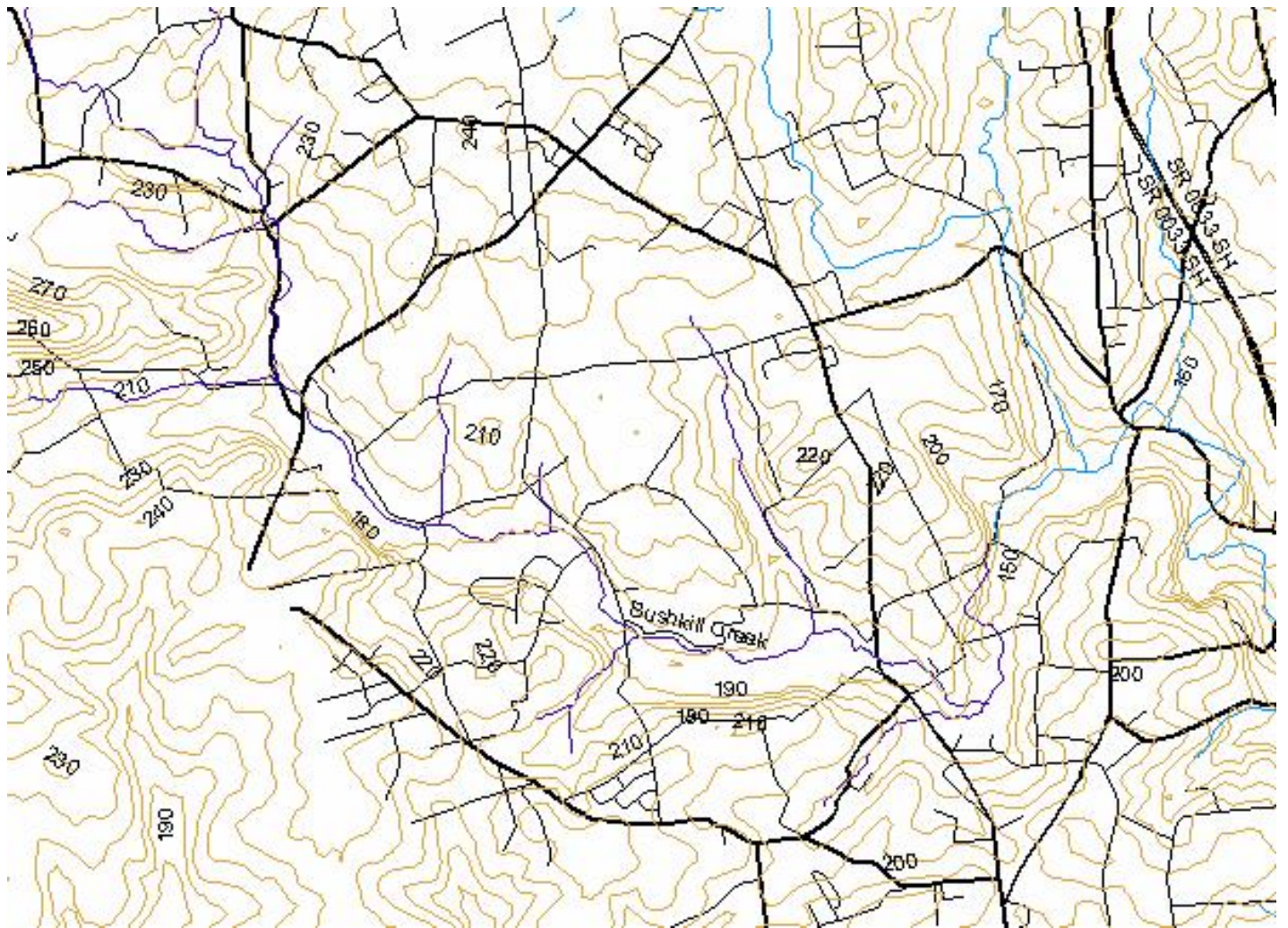
1. If you walked from Copella to Aluta, following the Bushkill Stream, how far would you walk? (Measure the distance with a ruler and use the map scale to figure the distance.)
2. What is the highest elevation in the Bushkill watershed? What type of land use is taking place in that area? How does this affect the Moorestown wetlands?
3. Name five major roads on the map. What are the major intersections called?

4. List the land use in the Bushkill Stream watershed from the highest amount to the lowest, using these categories—housing or commercial, farmland, forestland.
  
5. What other evidence of past land use or natural resource use can you determine by looking at the map? Use clues from road names or town names.
  
6. If you were on the local planning commission and you were going to decide how to spend money to buy land and protect open space, particularly wetlands, what areas in the Bushkill stream watershed would you have as your top three priorities for purchase? Put a large blue star on the areas of open space (farmland or forest land, that you would buy if they came up for sale. Explain why you chose these sites.
  
7. Use the map and the features you see to list as many factors as you can that can potentially influence the water quality in the Moorestown wetlands area. Examples are pollution, runoff, habitat alteration, water use, erosion, flooding, hunting and trapping, etc.
  
8. Do you see any areas on the map where two different types of land use might conflict with each other? Describe the area and the conflict.
  
9. Where do you think the best spot would be on this map for a picnic? Put a smiley face on that spot.

# Bushkill Watershed Aerial Photograph



# Bushkill Watershed topographic map



## Wetlands Field Study Procedures

### Author:

Laurie Rosenberg, Muhlenberg College

**Grade Level:** 9<sup>th</sup> – 12<sup>th</sup>

**Lesson Time:** 2.5-3.5 hours

**Suggested Class Structure:** Small groups

**Subject Areas:** Science, Language Arts

### BACKGROUND



See individual lessons.

### GOAL

Students rotate through a series of stations, investigating a different aspect of wetland ecology at each station. At the end of the field trip, students will discuss how the pieces fit together to illustrate the uniqueness and importance of wetlands.

### OBJECTIVES

The students shall:

1. List the services provided by wetland ecosystems.
2. Draw wetland plants. Identify their key characteristics.
3. Use an aquatic plant wheel and field guides to identify common wetland and upland plants and use plant observations to make inferences about the borders of a wetland area.
4. Make observations about soil color, structure and texture, and draw

inferences about the drainage conditions of the soil.

5. Test the permeability of various soils.
6. Use a topographic and aerial map to identify wetland areas and make inferences about land use related to wetlands.

### MATERIALS

- Appropriate wetland footwear for all students
- Bag of “Wetland Metaphors”
- Five liters of water for each group
- 10 flags for each group
- Meter stick for each group
- Percolation can for each group (coffee can with both ends removed)
- Hammer for each group
- Flat piece of wood large enough to fit over the coffee can for each group
- Stopwatch for each group, (can use watches with second hands)
- 50 meter tape measure for each group
- Wetland plant field guides
- Soil Characteristics Tables for each group
- Trowel for each group
- Copies of *Wetlands Field Study Log Book* for each student (copy masters in the *Appendix* of this lesson on page 49.)
- Pencils for each student
- Each student should bring his or her wetland plant natural history sheet for the “Living Labels” activity.
- Laminated topographic maps of a nearby wetland
- Laminated aerial maps of a nearby wetland area
- Laminated road maps of a nearby wetland area

- Set of wax pencils or erasable fine lined markers
- Ruler for each group
- Clipboards (optional)
- Calculator for each group (optional)
- pH paper and distilled water (optional)
- Plastic petri dish and plastic spoon (optional)
- Camera (optional)

### ADVANCE PREPARATION

- ✓ Gather all materials and divide into large containers for carrying out in the field.

### PROCEDURES – Outline and Narrative

#### Introduction

Introduce the leader to the group. Go over safety rules and class expectations for the field study. (10 min.)

**First Activity:** Wetland Metaphors (50 min.)

**Second Activity:** Living Labels (60 min.)

**Third Activity:** Wetland Vegetation and Soil Survey (60 min)

**Fourth Activity:** Wetland Hydrology (optional, 30 min.)

**Fifth Activity:** Wetland Topography (optional, 30 min.)

**Note:** Instructors may mix and match activities depending on their time and specific curriculum needs.

### ASSESSMENT

- See *Design a Wetland Brochure* culminating activity on page 63.)
- “What Do You Know About Wetlands” Final Test (see Appendix, page 58 for the copy masters.)
- “Wetlands Concept Map,” (see Appendix page 60.)

### RESOURCES

See individual lessons in the module.

### STATE STANDARDS FOR ENVIRONMENT AND ECOLOGY

See individual lessons.



# ***Wetlands Field Studies Procedures*** **Appendix**



## **Copy Masters for:**

### *Wetlands Field Study Log Book*

- Cover Page and Back Page
- Pages 12 and 1
- Pages 11 and 2
- Pages 10 and 3
- Pages 4 and 9
- Pages 8 and 5
- Pages 6 and 7

### Wetlands Concept Map

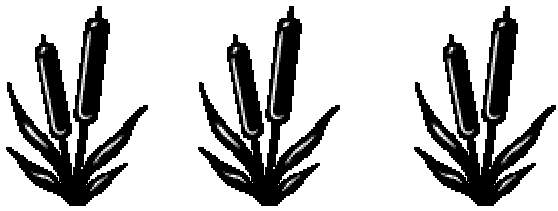
What Do You Know About Wetlands? – Test



# Wetlands



MUHLENBERG  
COLLEGE



## Field Study Log Book

Name: \_\_\_\_\_

School: \_\_\_\_\_

Grade: \_\_\_\_\_ Year: \_\_\_\_\_

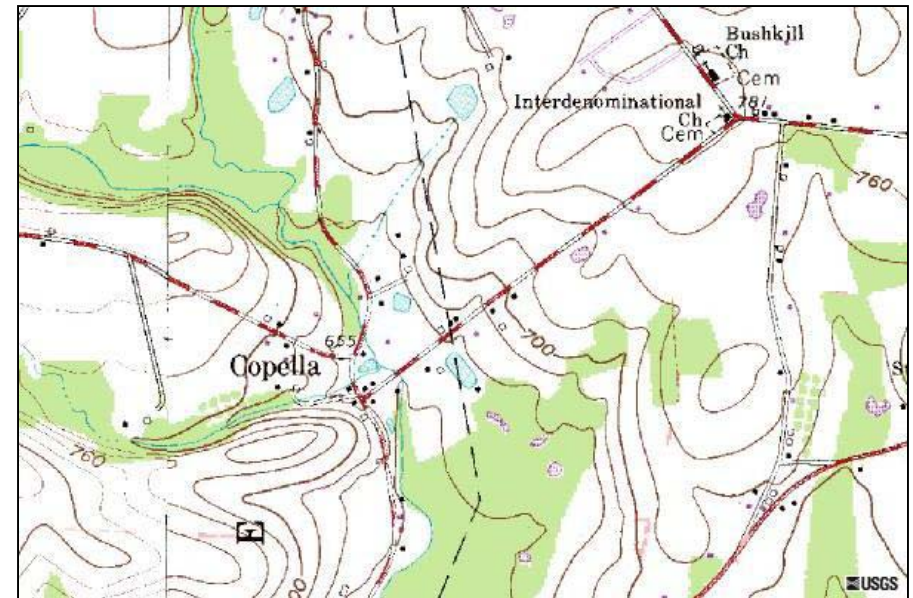
# Equipment Checklist



- Calculator
- Flat piece of wood
- Five liters of water
- Hammer
- Meter stick
- Percolation can (coffee can with both ends removed)
- Stopwatch for each group, (optional)
- 50 meter tape measure
- Wetland plant field guides
- 10 flags
- Soil Characteristics Tables
- Trowel for each group
- Soil core borer
- Pencils
- Clipboards (optional)
- pH paper (optional)
- Spoon (optional)
- Petri dish (optional)

Notes:

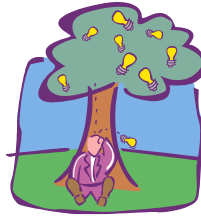
**Graver Topographic Map**



**Graver Aerial Map**



## Wetland Metaphors



Student/Group Name \_\_\_\_\_

Date \_\_\_\_\_

Time \_\_\_\_\_

### Display Object

### Meaning

Umbrella

‘Home Sweet Home’ Sign

Sponge

Pillow

Pacifier

### Sketch of Wetland Plant

Common Name: \_\_\_\_\_

Scientific Name: \_\_\_\_\_

Description: \_\_\_\_\_  
\_\_\_\_\_

Where Found (type of habitat): \_\_\_\_\_  
\_\_\_\_\_

Other Interesting Facts (how people use it, special characteristics, fun facts): \_\_\_\_\_

### Sketch of Wetland Plant

Common Name: \_\_\_\_\_

Scientific Name: \_\_\_\_\_

Description: \_\_\_\_\_  
\_\_\_\_\_

Where Found (type of habitat): \_\_\_\_\_  
\_\_\_\_\_

Other Interesting Facts (how people use it, special characteristics, fun facts): \_\_\_\_\_

### Sketch of Wetland Plant

Common Name: \_\_\_\_\_

Scientific Name: \_\_\_\_\_

Description: \_\_\_\_\_  
\_\_\_\_\_

Where Found (type of habitat): \_\_\_\_\_  
\_\_\_\_\_

Other Interesting Facts (how people use it, special characteristics, fun facts): \_\_\_\_\_

### Sketch of Wetland Plant

Common Name: \_\_\_\_\_

Scientific Name: \_\_\_\_\_

Description: \_\_\_\_\_  
\_\_\_\_\_

Where Found (type of habitat): \_\_\_\_\_  
\_\_\_\_\_

Other Interesting Facts (how people use it, special characteristics, fun facts): \_\_\_\_\_

# Wetland Vegetation Zones



Select an area along the trail. Using the trail as a baseline, set a 30 meter perpendicular transect. Place a flag every 3 meters along the transect and make observations on either side of the line.

Flag	Trees		Shrubs		Herbs	
	Name	Number	Name	Number	Name	Number
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						

How many different species of plants did you see? \_\_\_\_\_

Are some plants found in some plots and not in others? \_\_\_\_\_

If so, are there some found only in wet areas and some in dry areas? \_\_\_\_\_

Wet area plants: \_\_\_\_\_

Dry area plants: \_\_\_\_\_

Is there a transition zone between the dry and wet areas? \_\_\_\_\_

Which flags on the transect are in the transition one? \_\_\_\_\_

Where do you think the upland ends and the wetland begins?

Wetland zone: \_\_\_\_\_

Upland zone: \_\_\_\_\_

<p><u>Sketch of Wetland Plant</u></p>	<p>Common Name: _____</p> <p>Scientific Name: _____</p> <p>Description: _____</p> <p>Where Found (type of habitat): _____</p> <p>Other Interesting Facts (how people use it, special characteristics, fun facts): _____</p>
<p><u>Sketch of Wetland Plant</u></p>	<p>Common Name: _____</p> <p>Scientific Name: _____</p> <p>Description: _____</p> <p>Where Found (type of habitat): _____</p> <p>Other Interesting Facts (how people use it, special characteristics, fun facts): _____</p>
<p><u>Sketch of Wetland Plant</u></p>	<p>Common Name: _____</p> <p>Scientific Name: _____</p> <p>Description: _____</p> <p>Where Found (type of habitat): _____</p> <p>Other Interesting Facts (how people use it, special characteristics, fun facts): _____</p>
<p><u>Sketch of Wetland Plant</u></p>	<p>Common Name: _____</p> <p>Scientific Name: _____</p> <p>Description: _____</p> <p>Where Found (type of habitat): _____</p> <p>Other Interesting Facts (how people use it, special characteristics, fun facts): _____</p>

<b><u>Sketch of Wetland Plant</u></b>	Common Name: _____ Scientific Name: _____ Description: _____ Where Found (type of habitat): _____ Other Interesting Facts (how people use it, special characteristics, fun facts): _____
<b><u>Sketch of Wetland Plant</u></b>	Common Name: _____ Scientific Name: _____ Description: _____ Where Found (type of habitat): _____ Other Interesting Facts (how people use it, special characteristics, fun facts): _____
<b><u>Sketch of Wetland Plant</u></b>	Common Name: _____ Scientific Name: _____ Description: _____ Where Found (type of habitat): _____ Other Interesting Facts (how people use it, special characteristics, fun facts): _____
<b><u>Sketch of Wetland Plant</u></b>	Common Name: _____ Scientific Name: _____ Description: _____ Where Found (type of habitat): _____ Other Interesting Facts (how people use it, special characteristics, fun facts): _____

**Display Object****Meaning**

Strainer

--

Coffee Filter

--

Lunch Box

--

Medicine Bottle

--

Water Bottle

--

Eggbeater

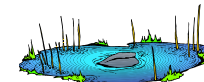
--

Hazmat Container

--

<p><b><u>Sketch of Wetland Plant</u></b></p>	<p>Common Name: _____</p> <p>Scientific Name: _____</p> <p>Description: _____</p> <p>Where Found (type of habitat): _____</p> <p>Other Interesting Facts (how people use it, special characteristics, fun facts): _____</p>
<p><b><u>Sketch of Wetland Plant</u></b></p>	<p>Common Name: _____</p> <p>Scientific Name: _____</p> <p>Description: _____</p> <p>Where Found (type of habitat): _____</p> <p>Other Interesting Facts (how people use it, special characteristics, fun facts): _____</p>
<p><b><u>Sketch of Wetland Plant</u></b></p>	<p>Common Name: _____</p> <p>Scientific Name: _____</p> <p>Description: _____</p> <p>Where Found (type of habitat): _____</p> <p>Other Interesting Facts (how people use it, special characteristics, fun facts): _____</p>
<p><b><u>Sketch of Wetland Plant</u></b></p>	<p>Common Name: _____</p> <p>Scientific Name: _____</p> <p>Description: _____</p> <p>Where Found (type of habitat): _____</p> <p>Other Interesting Facts (how people use it, special characteristics, fun facts): _____</p>

## Wetland Soils



Using the same perpendicular transect, place a flag every 6 meters and make soil observations.

Flag	Soil Texture/Moisture		Soil Particle Content		Soil Color	
	A layer	B layer	A layer	B layer	A layer	B layer
1						
2						
3						
4						
5						

**Texture/Moisture:** Dry, moist, wet, drippy, falls apart, sticks together, clay-like, slippery, oozes, bits of vegetation.

**Particle Content:** *Sand* feels gritty, *clay* feels very smooth, *silt* feels slightly gritty and somewhat smooth.

**Soil Color:** Light brown, Yellowish orange, Greenish gray, Olive gray, Light gray, Dark gray. Any streaks? What color?



## Soil Percolation Rate

Using a coffee can and a stopwatch, measure the percolation rate of 1 liter of water at each of the observation sites.

Flag	Start Time	Finish Time	Total Percolation Time
1			
2			
3			
4			
5			

## **Instructions for Wetlands Topography**

**Using a topographical map of the area around Graver Arboretum, complete the following steps:**

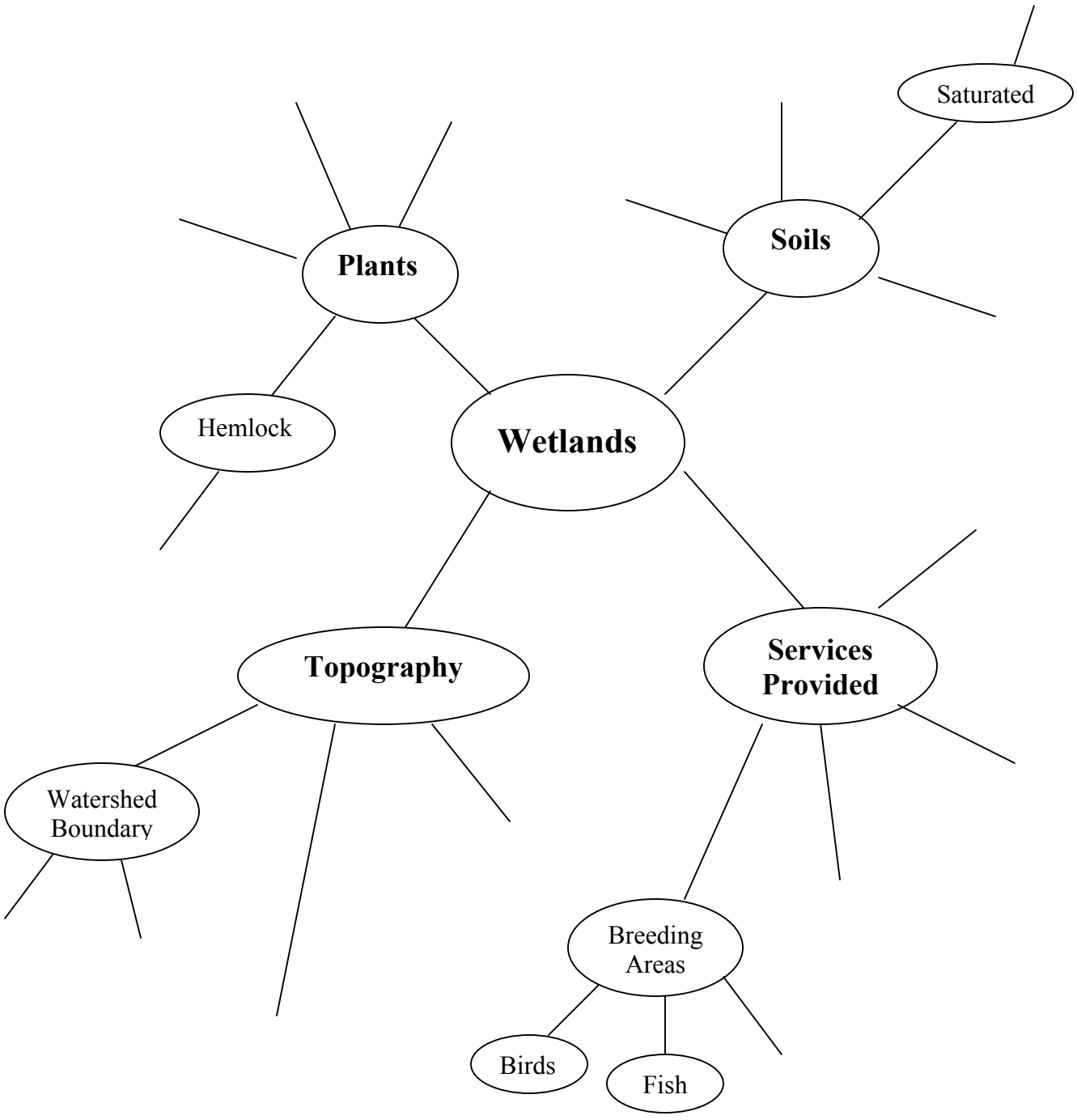
1. Find the Bushkill Stream on the map and color it blue.
2. Find Lee's Pond (note, it is right next to Bushkill Center Road. Put a circle around the pond and label it with the word's "Lee's Pond." Also identify and circle any other large ponds in the area around the Bushkill Stream.
3. Once you have located the Bushkill watershed, look for flat areas near the stream, areas where the distance between the topographic lines is large. Circle these areas in brown pencil; they are potential wetlands.
4. Next, look at the aerial map of the Bushkill. Color the stream blue on this map. Circle areas of housing or commercial development in yellow pencil, circle areas of farming in red, and areas of forest in green. If possible, outline the major roads in orange pencil.
5. Compare the aerial map to the topographic map. What are the land use patterns in the wetland areas, what types of land use is going on there?

**Now that you have identified the land use patterns in the Bushkill Stream watershed in the area of the Moorestown Wetlands, use your map to answer the following questions:**

1. If you walked from Copella to Aluta, following the Bushkill Stream, how far would you walk?
2. What is the highest elevation in the Bushkill watershed? What type of land use is taking place in that area? How does this affect the Moorestown wetlands?

3. Name five major roads on the map. What are the major intersections called?
4. List the land use in the Bushkill Stream watershed from the highest amount to the lowest, using these categories—housing or commercial, farmland, forestland.
5. What other evidence of past land use or natural resource use can you determine by looking at the map? Use clues from road names or town names.
6. If you were on the local planning commission and you were going to decide how to spend money to buy land and protect open space, particularly wetlands, what areas in the Bushkill stream watershed would you have as your top three priorities for purchase? Put a large blue star on the areas of open space (farmland or forest land, that you would buy if they came up for sale. Explain why you chose these sites.
7. Use the map and the features you see to list as many factors as you can that can potentially influence the water quality in the Moorestown wetlands area. Examples are pollution, runoff, habitat alteration, water use, erosion, flooding, hunting and trapping, etc.
8. Do you see any areas on the map where two different types of land use might conflict with each other? Describe the area and the conflict.

**Wetlands Concept Map**  
Fill in the map with circles containing related ideas.





Name: \_\_\_\_\_

Date: \_\_\_\_\_

### **What Do You Know About Wetlands? - Test**

Directions: As best you can, give the definition of the term listed.

1. Wetland:

2. Watershed:

3. Natural History:

4. Upland:

5. Permeability:

9. List and explain FIVE services provided by wetlands:

10. List three types of land use and explain their effects on nearby wetlands:



## Culminating Activity – Design a Wetland Brochure

**Author:** Laurie Rosenberg, Muhlenberg College, Terry Ehrenreicht, Whitehall High School

**Grade Level:** 9-12th

**Lesson Time:** Four 50 minute periods.

**Suggested Class Structure:** Small group work, student presentations

**Subject Areas:** Science and Language Arts

- ✓ Gather optional layout tools—paper, scissors, etc.

### PROCEDURES – Outline and Narrative

#### Introduction – Assignment and Brainstorming Session- 50 min.

Students will need to bring their *Wetlands Field Study Log Books* for this activity. Introduce the assignment to the class—their task is to find a way of creatively demonstrating what they have learned about wetlands by designing a wetlands brochure to share with the whole class. Each group should decide on a topic and layout, and make their own unique brochure. Instructions are detailed in the assignment handout, found in the Lesson Appendix on page 64. Go over the handout with the class. Also go over the rubric, the criteria by which their brochure will be evaluated. The rubric is found in the Lesson Appendix on page 67.

Give students the opportunity to brainstorm and create a tentative outline of their brochure to hand in for feedback. The instructor should make sure each group has a practical topic that meets the assignment criteria and does not directly duplicate another group's approach.

#### Project Work – Variable time

After each group's brochure outline has been OK'd, schedule additional work times as needed. The suggested time frame is one 50-minute session for creating a rough draft, and an additional 50-minute session for preparing the final product. Students will probably want to delegate tasks to group members and schedule additional work time at home. Individual instructors can alter the schedule to fit their class time frame, you may want to give students shorter time blocks to work on

### GOALS

After going on a field trip to a wetland, students design a brochure to demonstrate their knowledge of wetland ecology.

### OBJECTIVES

Students will:

- Accurately describe the components of wetland ecology
- Create a brochure using teamwork, research, writing skills and creativity

### MATERIALS

- Computers with word processing, graphics and desktop publishing software, (students can use Microsoft WORD for desktop publishing).
- Wetlands reference books
- Paper
- Photocopier
- Scissors, rubber cement (optional)

### ADVANCE PREPARATION

- ✓ Create student work groups
- ✓ Arrange for computer and/or library time
- ✓ Run off copies of the assignment and rubric for each student
- ✓ Make arrangements for students to run off copies of their brochures

the project over a longer time period, or assign the project for them as homework.

### **Brochure Presentations– 60 min.**

On the date the brochures are due, students groups should run off enough copies of their brochure to hand out to everyone in the class. Each group should present its brochure to the class as well as the teacher. The instructor may want to have the students critique the brochures and provide feedback to the student groups.

### **Assessment**

See the rubric in the lesson appendix for the brochure. There is also a copy master for a test in the lesson appendix.

### **PA Academic Standards for Environment and Ecology Covered by the Lesson:**

See individual lessons in the module.

# **Culminating Activity - *Design a Wetland Brochure* Appendix**



## **Copy Masters for:**

Wetland Brochure Assignment

Wetlands Brochure Grading Rubric

## Wetlands Brochure Assignment

1. Choose a topic and theme. Using your *Wetlands Field Study Log Book* data and field study experiences, find a topic your group is interested in presenting. Brainstorm a theme and key points that support and enhance the theme.

**Notes**

**Outline due date:** \_\_\_\_\_

2. Create an outline of your brochure

Title: \_\_\_\_\_

Cover page main points:

Inside page 1:

Inside page 2:

Back page:

Scientific Information – which one of these topics have you included in your brochure:

- Wetland roles and functions
- Wetland soils
- Wetland land use concerns
- Wetland plants
- Wetland boundaries

Describe the illustrations you plan to make. You must have at least two illustrations in the brochure.

Information Sources: (You must cite at least two different sources)

2. Make a rough draft of your brochure. Works cited must appear on the back of each brochure. You can sketch it out in pencil. Decide how you will divide up the tasks of creating the brochure. You may want to break down the text into pieces and have each person in the group responsible for a different piece. Take time to proofread and critique your fellow group members work so that the brochure flows together.

**Notes:**

**Rough draft due date:** \_\_\_\_\_

3. Prepare your final copy for assessment. Make sure it is complete, meets the rubric criteria, and is neatly done. Run off a copy of the brochure for everyone in your class.

**Notes:**

**Final copy due date:** \_\_\_\_\_

4. Present your brochure to the class



Name(s): \_\_\_\_\_ Block/Period: \_\_\_\_\_ Date: \_\_\_\_\_

### WETLANDS BROCHURE SCORING RUBRIC

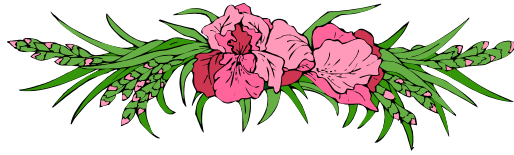
WEIGHT: _____	9 - 10 POINTS	6 - 8 POINTS	3 - 5 POINTS	0 - 2 POINTS
<b><u>BROCHURE DESIGN</u></b> <b>Design</b> <b>Neatness</b> <b>Illustrations</b> <b>Cites Sources (2+)</b>	<b>Creatively</b> designed with attractive headings and print. 2+ appropriate, well-made illustrations. Cites 2+ sources.	<b>Well-designed</b> with attractive heading and print. 2 appropriate and neatly done illustrations. Cites 2 sources.	Brochure is <b>fairly well</b> designed and includes 1 appropriate illustration. 1+ sources cited.	Brochure is <b>poorly</b> designed and includes inappropriate illustrations or lacks illustrations. 0 sources cited.
<b><u>Scientific Info:</u></b> Describe the relationship between the abiotic and biotic factors in a wetland environment. Illustrate the services provided by a wetland ecosystem. Describe the plants and animals that depend on the wetland as their habitat.	<b>Accurate, well-written, interesting.</b> Includes <b>major scientific information.</b> Gives a <b>good</b> sense natural history and environmental <b>science.</b>	<b>Accurate, interesting.</b> Includes <b>most</b> wetland characteristics and organisms. <b>Fairly good</b> sense of environmental science and natural history.	<b>Mostly accurate.</b> Includes <b>some of the concepts.</b> Shows a <b>limited</b> understanding of the environmental science concepts relating to wetlands.	<b>Mostly inaccurate.</b> Includes <b>few</b> major concepts. <b>Poor</b> sense of the environmental science of wetlands.

**Note:** “Well written” means correct grammar and spelling, and clear wording with simple, direct language.

**WETLANDS BROCHURE SCORING RUBRIC continued . . .**

WEIGHT: _____	9 - 10 POINTS	6 - 8 POINTS	3 - 5 POINTS	0 - 2 POINTS
<p><b><u>Humans and the Environment Info:</u></b> Identify and describe natural and human events on watersheds and wetlands.</p>	<p><b>Accurate, well-written, interesting.</b> Includes a good sampling of human interest in wetlands. Gives a <b>good</b> sense of human-environmental interactions and influences.</p>	<p><b>Accurate, interesting.</b> Includes <b>most</b> human interactions with <b>wetlands</b>. Fairly good sense of the human-environment connection.</p>	<p><b>Mostly accurate.</b> Includes <b>some</b> human interactions with the environment.</p>	<p><b>Mostly inaccurate.</b> Includes <b>few accurate references to the human-environment connection.</b></p>
<p><b><u>PRESENTATION</u></b> <b>Each group will use their Brochure to present their wetland information to the class. (5 minutes)</b></p>	<p><b>Meets or exceeds</b> the obvious facts. <b>Compels</b> people to take notice of wetlands and their importance. <b>Interesting, clear, fun, and well-organized. Creative.</b></p>	<p>Discusses <b>more</b> than the obvious. <b>Offers</b> things to pique the interest of the reader. <b>Interesting and fairly well organized.</b> <b>Good</b> use of info.</p>	<p>Explains <b>some</b> facts clearly, some sketchy areas. Shows <b>some</b> interest, clarity, and organization. <b>Fair</b> use of info.</p>	<p><b>Does not explain</b> info. Presentation is <b>unclear</b> and <b>disorganized.</b> <b>Does not</b> use information effectively.</p>
<b>TOTAL POINTS</b>				

Adapted from the *Lehigh Valley Watershed* module by Theresa Ehrenreicht  
E-mail: ehrenreicht@cliu.org



## NOTES