

West Virginia

WETLAND

SCIENCE TECHNOLOGY ENGINEERING ARTS MATHEMATICS



Activity Booklet

First publication, May 2023
Published in the United States of America

The West Virginia Wetland STEAM Activity Booklet was published by the West Virginia Department of Environmental Protection (WVDEP), which encourages you to copy and use without limit.

The booklet was written by Tomi Bergstrom of WVDEP's Project WET program, with help from West Virginia University Extension, West Virginia Water Research Institute, and WVDEP's Watershed Improvement Branch and Watershed Assessment Branch.

WV Wetland STEAM Activity Booklet Project Team
Tomi Bergstrom, Project Leader, Writer, Designer, WVDEP
Elizabeth Byers, Writer, Reviewer, WVDEP
Martin Christ, Writer, Reviewer, WVDEP
Sara Miller, Writer, Reviewer, WVDEP
Kylie Joins, Writer, Illustrator, Reviewer, WVDEP
Jason Fillhart, Writer, Reviewer, WV Water Research Institute
Megan Kruger, Writer, Reviewer, WVU Extension
Suzanne McDonald, Writer, WVU Extension
Matt Thompson, Illustrator, WVDEP
Callie Cronin-Sams, Reviewer, WVDEP
Alana Hartman, Reviewer, WVDEP
Thomas Aluise, Reviewer, WVDEP
Michael Huff, Video Producer, WVDEP
Olivia Canterbery, Writer, WVDEP (Intern)

ACKNOWLEDGEMENTS

This wetland booklet was developed by the WV Project WET Program hosted by the Department of Environmental Protection's Watershed Improvement Branch, in partnership with the WV Water Research Institute and WVU Extension. Funding for this booklet was provided in part through Assistance Agreement No. CD 96390401-0 awarded by the U.S. Environmental Protection Agency. The views expressed in this booklet are solely those of WVDEP and its partners.



WEST VIRGINIA
project WET
WATER EDUCATION TODAY



TABLE OF CONTENTS

Welcome.....	1
Equipment Decontamination.....	2
Introducing Wetlands.....	4
Defining a Wild & Wonderful Wetland.....	6
Wetland Habitats.....	8
Wetland Ecology.....	10
Wetland Phenology.....	15
Plant Survey.....	16
Plant Adaptations.....	17
Animal Adaptations.....	18
Bird Survey.....	19
Wetland Food Web.....	20
Wetland Observations.....	21
Wetland Clues.....	22
Wetland Biodiversity.....	24
Anuran Survey.....	26
Wetland Macroinvertebrates.....	27
Water Chemistry.....	28
Soil Survey.....	32
Field Trip to WVU Jackson's Mill.....	34
Wetland Locations.....	41
Wetland Resources.....	42



WELCOME

The activities listed in this booklet are designed to teach you about wetlands in the Wild & Wonderful state of West Virginia. As you work through this booklet you will gain knowledge about:

1. Wetland functions and their benefits to waterways and our planet.
2. Interconnections of wetland food webs.
3. Identification of insects, plants, and wildlife commonly found in wetland ecosystems.
4. Locations of wild and wonderful wetlands to explore.

Take this booklet and explore a wetland near you!



EQUIPMENT DECONTAMINATION

All equipment and tools that come in contact with wetland sites should be decontaminated to avoid spreading ranavirus, chytrid fungus, snake fungal disease, or invasive plant species between wetlands.



Decontaminate prior to leaving for the field if possible. If you must decontaminate at the field site, set up the decontamination area at least 30 meters (100 ft) from the wetland edge. There are four required steps for decontamination.



Thanks for doing your part to keep our wetlands healthy!

FOLLOW THESE FOUR EASY STEPS:

- 1** Brush off all soil, seeds, and vegetative matter.
- 2** Rinse clean with water. Use stiff brush as needed. Don't forget boot treads. A pump sprayer (2-gallon capacity or sized according to crew needs) makes it easy to rinse when away from a tap.
- 3** Spray with 10% bleach solution (1 part bleach to 9 parts water) and allow to soak for 5 minutes. Don't forget the bottom of your boots. The bleach solution must be used or replaced each week as it loses its effectiveness over time, unlike concentrated bleach which does not get "denatured" quickly. A small sprayer such as a plant mister or hairspray sprayer works well.
- 4** Rinse with water. Bleach should **not** be introduced into the wetland.

Watch a video of this process:



INTRODUCING WETLANDS

What is a wetland?

A land area that is flooded or saturated with water for at least part of the growing season, resulting in wetland soils and specially adapted wetland plants. Common wetland habitats in West Virginia are forested swamps, shrub swamps, emergent wetlands, aquatic beds, fens, and open ponds.



What are three characteristics that define an area as a wetland?

1.

2.

3.



Hint: Check out the graphic on the next two pages if you need help!

DEFINING A WILD & WONDERFUL WETLAND

In West Virginia, wetlands have water at or near the soil surface

Air-filled stems act like snorkels to bring oxygen to the roots.



Slots in the bark help woody stems breathe.



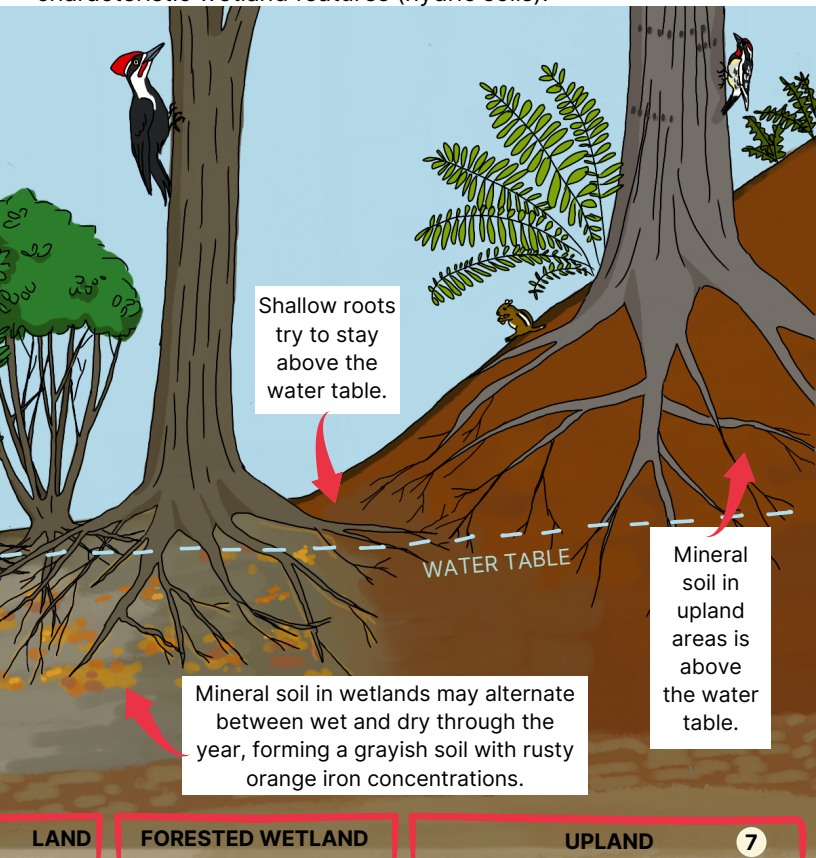
Dark organic soil often accumulates in saturated wetland conditions.

AQUATIC BED

EMERGENT WETLAND

SHRUB WET

for two weeks or longer during the growing season (hydrology). **Plants** have special adaptations to survive in the wet environment (hydrophytic plants) and **soils** develop characteristic wetland features (hydric soils).

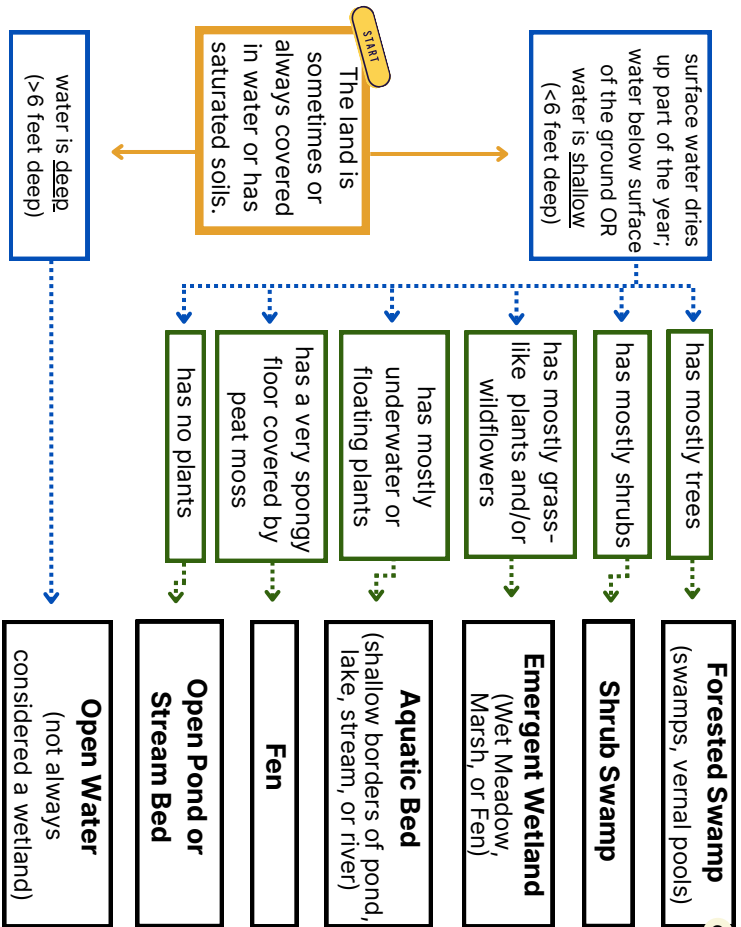


WETLAND HABITATS

In West Virginia, we have several different types of freshwater wetlands. These wetlands vary depending on their amount of water, type of soils, and the plants that grow in them.

Follow the key on the next page to determine which wetland habitats are within the wetland complex you are visiting!

CLASSIFY YOUR WETLAND HABITAT



WETLAND ECOLOGY

Wetlands provide habitat to many different plants and animals, including many species of birds, amphibians, reptiles, mammals, and insects. The more diverse a habitat is, the more species of wildlife it can support. Wetlands offer four basic requirements that all living things need for survival:



WATER



SPACE



FOOD



SHELTER

Survey the habitat around you. Which animals may have their needs met by this habitat? (List below)

☐

☐

☐

☐

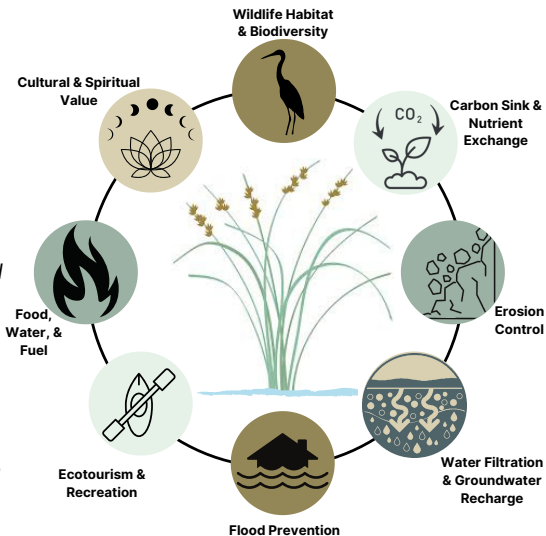
☐

WETLAND ECOLOGY

Wetlands offer many ecosystem services.

Ecosystem goods and services produce the many life-sustaining benefits we receive from nature—clean air and water, fertile soil for crop production, pollination, and flood control. These ecosystem services are important to environmental and human health and well-being, yet they are limited and often taken for granted.

- US EPA



Wetlands are referred to as “Earth’s Kidneys.” This is because they act as sponges absorbing and filtering pollutants from water before it goes into rivers and oceans.



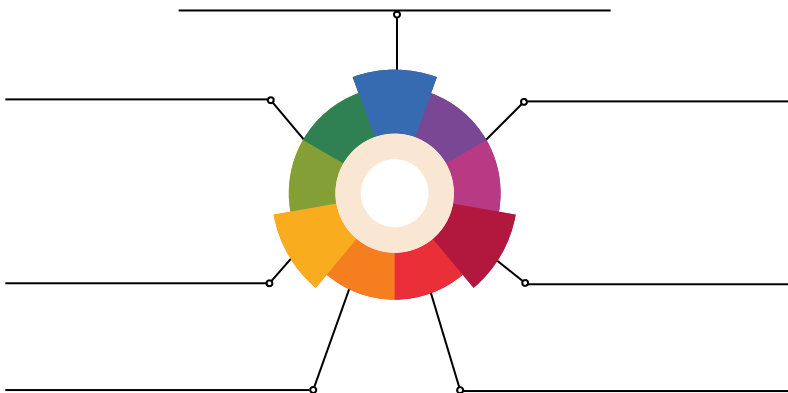
WETLAND METAPHORS

Match the object to the wetland metaphoric function. The first one is done for you.

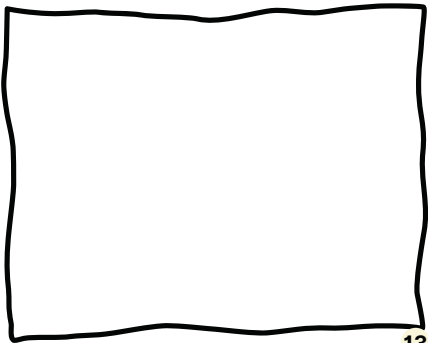
1	Soap	<input type="checkbox"/>	Strains and filters dirt and debris from water
2	Rice	<input type="checkbox"/>	Neutralizes toxic substances
3	Zoo	<input type="checkbox"/>	Development of animals from babies to adults, circle of life.
4	Cradle	<input type="checkbox"/>	Provides nutrient-rich foods for wildlife and humans
5	Strainer	<input type="checkbox"/>	Provides a nursery that shelters, protects, and feeds young wildlife
6	Antacid	<input type="checkbox"/>	Resting place for migratory birds
7	Sponge	1.	Helps clean water & the environment
8	Pillow	<input type="checkbox"/>	Provides shelter to wintering waterfowl and other wildlife
9	Cabin	<input type="checkbox"/>	Habitat for diverse flora & fauna
10	Bracelet	<input type="checkbox"/>	Absorbs excess water caused by runoff; temporarily retains moisture

WETLAND ECOLOGY

Through their biodiversity and water features, wetlands exhibit complex color arrangements. Label the color wheel with things you spot in the wetland habitat.



Wetlands are so full of life that it is easy to overlook things. Careful observation can lead to new discoveries! In the box sketch something new that caught your eye.



WETLAND ECOLOGY

Field guides are a reliable tool to use when identifying plants. Botanists observe the arrangement, size, color, shape, and other features of leaves, as well as the location and flowers for identification. Compare the leaves and flowers of two common wetland plants below. Can you note four differences?



1. _____

2. _____

3. _____

4. _____

WETLAND PHENOLOGY

Plants do not always look the same; their looks may change with the season. The study of these biological changes that occur in relation to the season is called **phenology**. Phenology is "Nature's Calendar," and it impacts all living things. Common Buttonbush is shown in each of the four seasons below. Based on your knowledge of the seasons, label the buttonbush photos below.



PLANT SURVEY

Scientists use vegetation plots to survey and record plants and their density in a specific area. To conduct your own plant survey, estimate a 1-by-1 meter area. Scan the QR code to access the Field Guide to Common Wetland Plants of West Virginia. Record your findings in the table below.



Date: _____

Surveyors: _____

Plant Name	% Cover

Example
% covers:



1-5%



6-10%



11-25%



26-50%



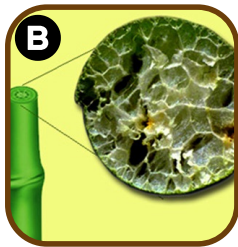
51-75%



76-100%

PLANT ADAPTATIONS

Wetland plants are known as hydrophytic and need special adaptations to survive underwater or in saturated soils. Just like us, they need to breathe air, and they have developed interesting ways to keep their leaves and roots oxygenated. Can you match the following plant adaptation photos to their descriptions?



buttressed roots that spread wide to stabilize the plant in wet soils



air-filled tissue in its stems (aerenchyma tissue)



floating leaves stay above the water where they can breathe



multi-stemmed shrubs have lots of surface area to breathe

ANIMAL ADAPTATIONS

Eighty percent of all breeding bird populations in the United States, along with up to half of North America's bird species, rely on wetlands for survival. Some birds, such as the Great Blue Heron, are totally dependent on wetland habitats. Review the photos below. Record the different specialized adaptations of the Great Blue Heron that allows it to thrive in a wetland.









BIRD SURVEY

Ornithologists conduct bird surveys to understand the importance of different habitats. Wetlands are important resting, foraging, and mating habitats for many birds. Some common wetland birds are listed below. Scan the QR code to download the Merlin ID App to learn more about each bird. Conduct a 15-minute bird survey for this wetland habitat based upon what you hear and see.

- Northern Harrier
- Common Yellowthroat
- Canada Warbler
- Great Blue Heron
- Canada Goose
- Red-winged blackbird
- Wood Duck
- Yellow Warbler
- American Woodcock
- Hooded Merganser

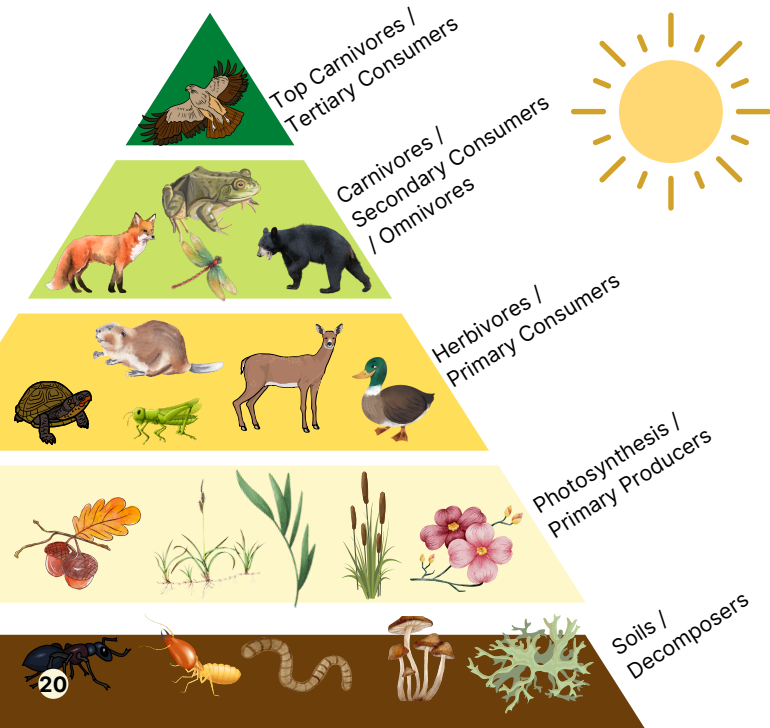


Date & Time: _____ Weather: _____

Species Name	Observed (viewed, heard, etc.)	How many do you count?	Behavior (mating, foraging, etc.)

WETLAND FOOD WEB

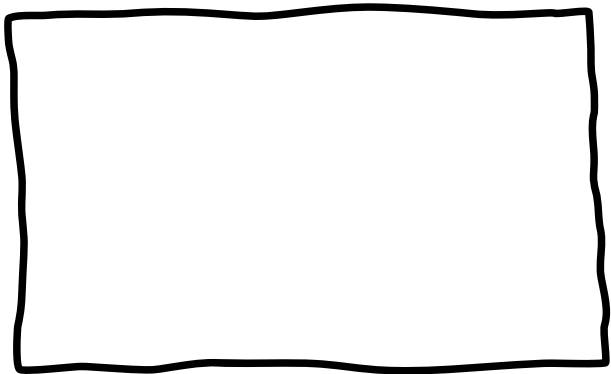
The base of productivity in a wetland is plants, dying organisms, and detritus. Populations of larvae, protozoa, bacteria, and fungi live off detritus. They are, in turn, the food of fish, worms, birds, and other life further along in the energy web. Review the food web concept below and think about what animals eat and who eats them.



WETLAND OBSERVATION

Animal identification is important, but understanding animal behavior and how each one fits into the food web is equally important. Observe an animal in your wetland habitat. Answer the questions below to understand how the animal fits into the wetland habitat.

IDENTIFICATION: Sketch or describe the animal in the box.



HABITAT DESCRIPTION:



WHAT MIGHT IT EAT?



WHAT EATS IT?



OTHER NOTES:

WETLAND CLUES

Firsthand observation of clues in the field is a critical step in biological research and assessment. Tracks are some of the most obvious clues of an animal's presence. Each type of animal has a unique track distinguished by the number of toes, claw marks, size, and pattern of the tracks. Other clues, such as pathways, tunnels, nests, and scat are important indicators that animals were present. Can you identify the animals from the clues below?



_____ feather

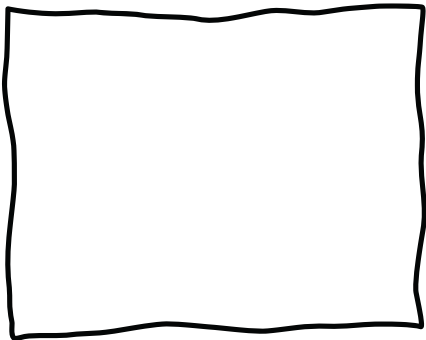


_____ scat



_____ chewed tree

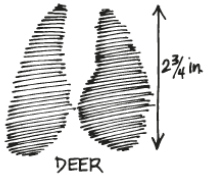
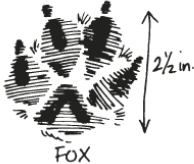
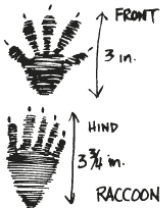
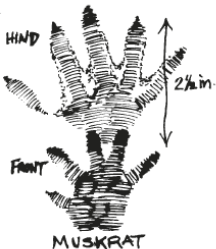
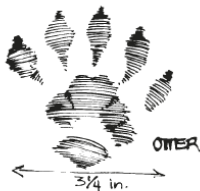
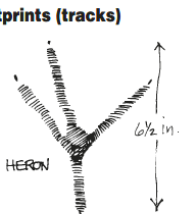
Draw a clue that you found in the box! Does it indicate a specific animal? What was the animal doing?



WETLAND CLUES

Circle any tracks that you can identify in the wetland you are visiting.

Footprints (tracks)



WETLAND BIODIVERSITY

The Mountain State is home to 36 salamander species, 24 snake species, 15 frog and toad species, 14 turtle species, and 6 lizard species. Frogs and toads are collectively known as Anurans, meaning a tailless amphibian. Herpetologists estimate anuran populations and diversity by recording which animals they hear calling in an anuran survey.



A male American Toad calling. (Photo courtesy of Jeffrey Bailey)

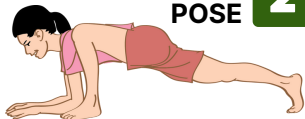
Herpetology Yoga

Take a photo of yourself or a friend in their favorite herpetology yoga pose. Can you do all four?

1 SNAKE POSE



LIZARD POSE 2



3 FROG POSE



TURTLE POSE 4



Make a paper jumping frog with origami!
Scan the QR code for instructions.



WETLAND BIODIVERSITY

A complete list of all anurans found in West Virginia is below. There are three (3) toads and twelve (12) frogs in our wild and wonderful state.

- ☐ Blanchard's Cricket Frog (*Acris blanchardi*)
- ☐ Eastern Cricket Frog (*Acris crepitans*)
- ☐ Eastern American Toad (*Anaxyrus a. americanus*)
- ☐ Fowler's Toad (*Anaxyrus fowleri*)
- ☐ Cope's Gray Treefrog (*Hyla chrysoscelis*)
- ☐ Gray Treefrog (*Hyla versicolor*)
- ☐ Mountain Chorus Frog (*Pseudacris brachyphona*)
- ☐ Spring Peeper (*Pseudacris crucifer*)
- ☐ Upland Chorus Frog (*Pseudacris ferriarum*)
- ☐ American Bullfrog (*Lithobates catesbianus*)
- ☐ Green Frog (*Lithobates clamitans*)
- ☐ Pickerel Frog (*Lithobates palustris*)
- ☐ Northern Leopard Frog (*Lithobates pipiens*)
- ☐ Wood Frog (*Lithobates sylvaticus*)
- ☐ Eastern Spadefoot (*Scaphiopus holbrookii*)

Each species of frog and toad has a unique call. They call for several reasons, but primarily, to attract a mate. Hear each species' unique sound by scanning the QR code!



ANURAN SURVEY

Anuran surveys should be conducted from early spring to early summer when the air is damp or with a light rain. Air temperatures should be between 45 to 65 degrees Fahrenheit, with low wind. To conduct an anuran survey complete the following steps: (1) select a monitoring area, (2) listen for 3 minutes, and (3) record the vocalizations you hear.

ANURAN CALL INDEX DEFINITIONS

- 1 Individual** calls can be counted; there is space between calls.
- 2** Some calls are **overlapping**; but individuals are still distinguishable.
- 3 Chorus** is continuous/overlapping; impossible to count individuals.
- OB** Indicates a species was observed, but not heard during the survey.

Date & Time: _____ Air Temperature: _____

Weather: _____ Wetland Habitat: _____

Anuran Species	Anuran Call Index	What does the call sound like?

WETLAND MACROINVERTEBRATES

A **macroinvertebrate** is an animal without a backbone that is large enough to be observed without the aid of a microscope or other magnification. They spend all or part of their lives in water. These aquatic organisms tend to be more sensitive to environmental changes, such as temperature, pH, or dissolved oxygen level.

Dragonfly larva attached to vegetation.



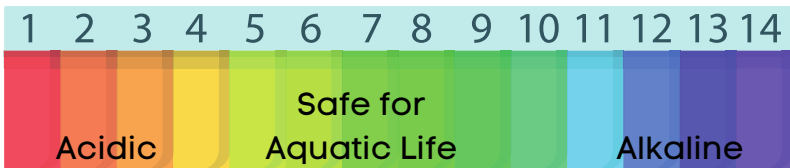
Ebony jewelwing (damselfly) resting on pondweed.

Humans often play a role in environmental changes. For example, if an herbicide is sprayed on the edge of a wetland, not only will the chemical spread quickly through the water, but the removal of the vegetation will decrease the hiding spots for young aquatic organisms and increase sunlight exposure and water temperature.

Review the definitions on the next page to learn more about water chemistry.

WATER CHEMISTRY

pH is a measure of acidity or alkalinity of a solution. A neutral pH is a 7 on the pH scale, with most aquatic life preferring a pH range of 5.5-8.5. Wetlands provide a natural buffer to neutralize acids (acidic) and bases (alkaline) in a solution.



Dissolved Oxygen (DO) is a measure of how much oxygen is dissolved in a solution. Both plants and animals need oxygen to survive. If the levels are too low, it can stress the aquatic life. DO can be affected by weather (wind, rain, etc.) and temperature (cold water holds more oxygen than warm). On a scale of 1-10 parts per million (ppm), 5.5 or higher is ideal for aquatic life.

Temperature is an important measurement of how hot or cold a solution is. Most creatures that live in water are cold-blooded, so their body temperatures, metabolism and growth rates are determined (and limited) by the surrounding water temperature.

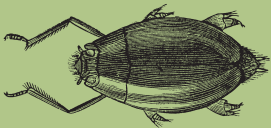
MACROINVERTEBRATE SURVEY

Scud /
Sideswimmer



seven pairs of legs, the first two are claw-like, swims with a sideways motion

Whirligig Beetle



three-pairs of legs, body covered by a hard exoskeleton

Mayfly Larva



three-pairs of legs with a single hook at the end, 2-3 tail filaments, gills attached to the abdomen

Dragonfly Nymph



three-pairs of legs, large eyes, long spoon-like jaws, no tails on abdomen



Review the WV Save Our Streams (SOS) Macroinvertebrate Identification Guide for a list of all insect groups.



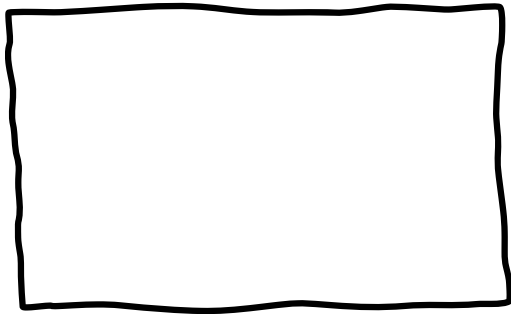
MACROINVERTEBRATE SURVEY

Date & Time: _____ Weather: _____

Average pH: _____ DO: _____ Average Water Temp: _____

Draw a sketch of the area you're sampling, include important features such as trees, vegetation, paths, etc.

Type of wetland habitat: _____

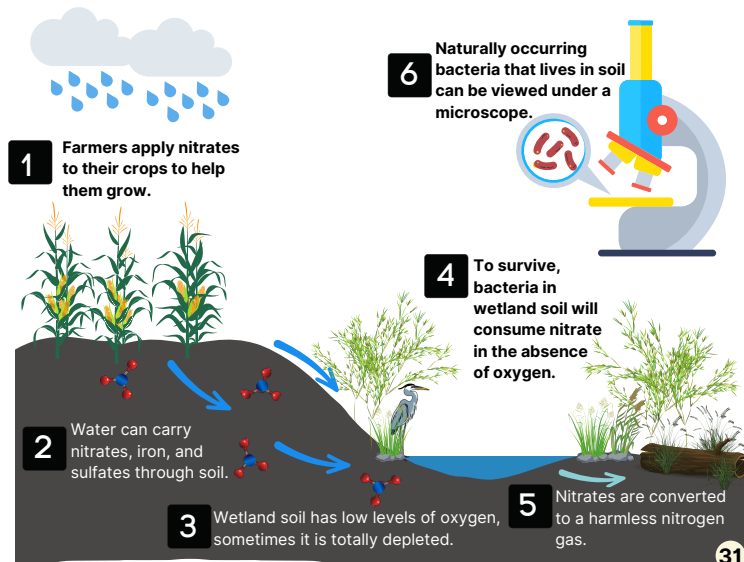


Collect a macroinvertebrate sample by submerging a net, disturbing the bottom substrate, and then sweeping it through the water for a distance of one meter. Place the animals in a pan of water to record your observations.

Common Wetland Macroinvertebrates	Abundance (%)	Notes
Crayfish		
Mayfly Larva		
Caddisfly Larva		
Dragonfly Nymph		
Damselfly Nymph		
Scud (sideswimmer)		
Whirligig Beetle		
Leeches/Worms		
30 Pouch Snails		

WATER & SOIL CHEMISTRY

One of the smallest forms of life on our planet is bacteria. Many of them use oxygen in the same way animals do: they combine it with organic matter and turn it into carbon dioxide, water, and energy. Bacteria have adapted to live in a wetland setting, just like plants. In low oxygen environments, like wetland soils, bacteria use nitrates, iron, sulfates, and other chemicals instead of oxygen to get the energy out of organic matter. Removing these chemicals from the water is one of the ways wetlands purify water.



SOIL SURVEY

Soil scientists are often consulted to evaluate and interpret soils. Review the chart on the next page. Soil data can tell us important information, such as whether the area qualifies as a wetland or how much carbon is stored underground. Try your hand at identifying soil textures by digging 10cm down and working through the chart on the next page. Record your observations below for **two** samples.

☐

Date & Time: _____

☐

Location of soil sample: _____

☐

Does the soil have smell? If so, describe it: _____

☐

What color(s) do you see in the soil? _____

☐

Is there organic material in the top layer? _____

☐

What is the texture of the soil? _____

☐

Date & Time: _____

☐

Location of soil sample: _____

☐

Does the soil have smell? If so, describe it: _____

☐

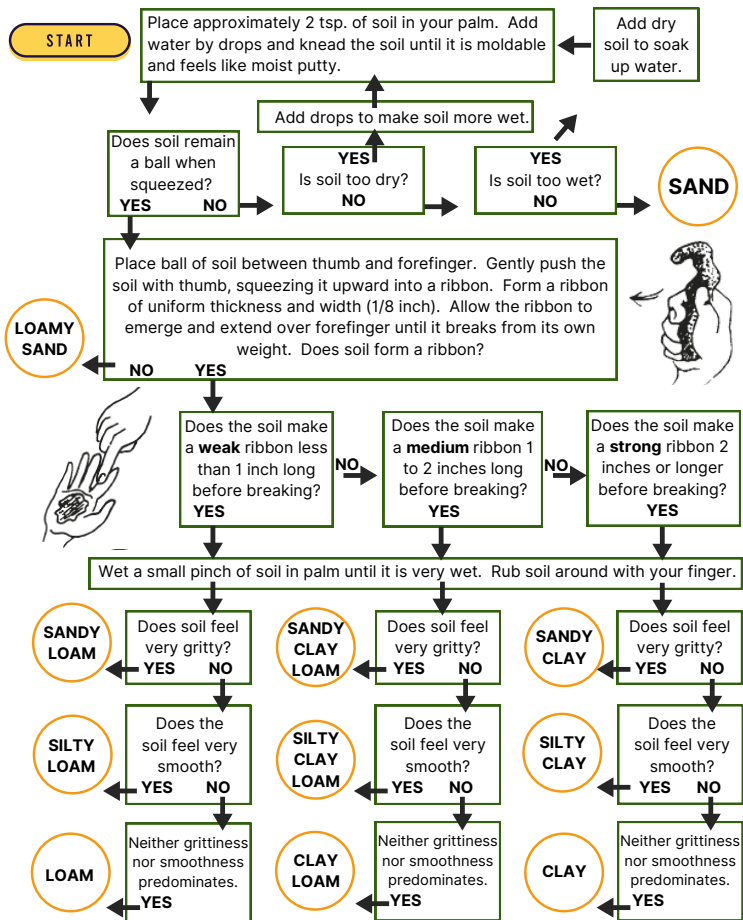
What color(s) do you see in the soil? _____

☐

Is there organic material in the top layer? _____

What is the texture of the soil? _____

MINERAL SOIL TEXTURE SURVEY

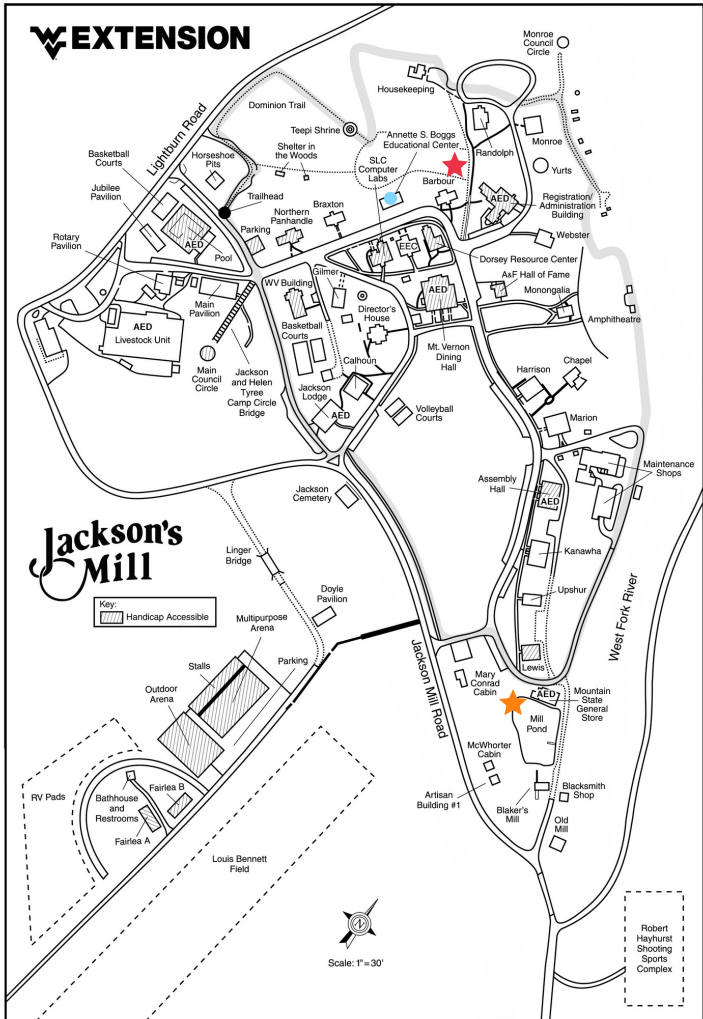


FIELD TRIP TO WVU JACKSON'S MILL

Nestled in Lewis County you'll find WVU Jackson's Mill, a 500-acre historic and educational facility owned and operated by WVU Extension. We invite you to visit this area, as it is the historic home to West Virginia's 4-H camping. Today it continues to serve thousands of 4-H'ers each summer and throughout the year.

At Jackson's Mill there are paved, gravel, and dirt trails that you can utilize to explore **two different wetlands**, an **emergent wetland on a pond edge** and a **forested swamp**. Visit the "Classify Your Wetland Habitats" on page 12 to key out each wetland habitat. The following pages encourage you to observe the differences between the two wetlands and go on a scavenger hunt to locate plants and animals that live there.





FORESTED SWAMP



Species Highlight



Great Rhododendron

Rhododendron is West Virginia's state flower. It is also a beautiful pollinator in our wetlands, attracting butterflies and hummingbirds to feed on its nectar. It grows in acidic soils, moist dry forests, and in swamps.

Did you know that rhododendrons are also nature's thermometer? Tell the temperature by looking at their leaves. Are they flat or curled?



>40°F
Flat Leaf



25°-40°F
Curled Leaf



<25°F
Tightly
Curled Leaf



EMERGENT WETLAND ON POND EDGE



Species Highlight

The Northern Green Frog has an average length of 2 to 3.5 inches and is commonly found in emergent wetlands. They are known as "sit-and-wait" predators, and will commonly feed on invertebrates, insects, and small fish.



Northern Green Frog



Invasive Cattail

Did you know that broadleaf and narrowleaf cattails have hybridized? This means all cattails in West Virginia are now considered invasive. While cattails are highly specialized to live in wet areas, they can grow in dense clusters, which cuts off resources to other plants.

SPRINGO!



Invasive Cattail



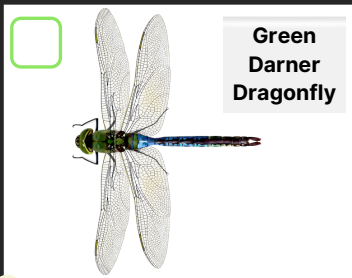
Sallow Sedge



Canada Goose



Box Elder Tree



**Green
Darnier
Dragonfly**



Common Rush

Look for things that live and grow in this habitat. As you spot photos in the table, shout "SPRINGO"! How many can you find?



**Common Blue
Damselfly**



Black Medick



Water Strider



**Northern
Green
Frog**



**American
Sweetgum Tree**



Eastern Crayfish

SITE SKETCH

Now that you are familiar with both wetlands, **make a sketch of each wetland**. You can draw it up close or from far way. What are the main differences you notice?

Forested Swamp

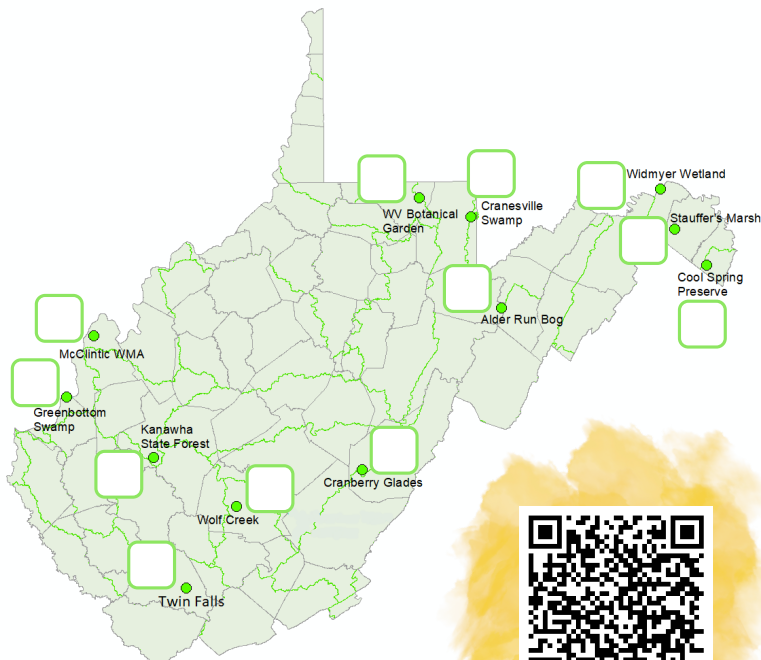


Emergent Wetland on Pond Edge



WETLAND LOCATIONS

There is no shortage of wetlands to visit in our Mountain State. To highlight West Virginia's wetland diversity, short videos and fact sheets have been created for 12 wetlands. Scan the QR code below to learn more!



Visit the wetland near
you or check out all 12!

WETLAND RESOURCES

Many of the activities in this STEAM Wetland Booklet have been adapted from WOW! The Wonders of Wetlands: An Educator's guide. To become trained in the Curriculum Guide visit www.projectwet.org and look up your local Project WET Coordinator. In West Virginia, this training workshop is provided free of cost to both formal and informal educators!



With 70 pages of background material followed by more than 40 cross-referenced activities, this guide is a valuable resource for K-12 teachers. Activities are neatly organized into five sections: wetlands definitions, wetlands plants and animals, water quality and supply issues, soils and people. The appendix also provides instructions for planning and developing a schoolyard wetland habitat.

WETLAND RESOURCES

Wetlands across the state have inspired past and present cultures to create music, art, and literature.

Scan the QR code to learn more about basket weaving, an Appalachian Folk Art that the Cherokee tribe is known for. Plants and trees utilized for this art form are often sourced from wetland habitats.



www.dep.wv.gov
www.projectwet.org
extension.wvu.edu

<https://wvri.wvu.edu/>
<https://extension.wvu.edu/stemcare>



WEST VIRGINIA
project WET
WATER EDUCATION TODAY



STEMCARE.
TURNING POSSIBILITIES INTO OPPORTUNITIES



West Virginia University
WEST VIRGINIA
WATER RESEARCH INSTITUTE



EXTENSION