Lesson 1- Watersheds 101
4th Grade Program

Lesson Outcomes:
Students will understand…

- that everyone lives in a watershed
- that there are smaller watersheds within a watershed
- that natural physical features define watersheds
- that the Potomac River Watershed is a sub-watershed within the Chesapeake Bay Watershed

Students will be able to…

- Define a watershed
- Construct a three-dimensional map of the Potomac River Watershed
- Investigate the states that compose the Chesapeake Bay Watershed
- Analyze topographic maps of the United States
- Locate on a map the major physiographic regions within the United States and the Potomac River Basin
- Locate key rivers important to Virginia's History

Duration of Activity & Setting: 1 hour; Indoors

Vocabulary:

Boundary, continental divide, headwaters, physiographic, sub-watershed, topography, tributary, watershed

Materials:

"Watershed Diagram" Image
Chesapeake Bay Map Puzzle Board
"Major Sub-Watersheds" Image
Raised Relief Maps for the United States
Rivers of Virginia Maps

Standards of Learning (SOL):

Earth Resources

4.9 The student will investigate and understand important Virginia natural resources. Key concepts include
a) watersheds and water resources;
b) animals and plants;
d) forests, soil, and land.

Virginia: The Physical Geography and Native Peoples

VS.2 The student will demonstrate knowledge of the physical geography and native peoples, past and present, of Virginia by

a) locating Virginia and its bordering states on maps of the United States;
b) locating and describing Virginia's Coastal Plain (Tidewater), Piedmont, Blue Ridge Mountains, Valley and Ridge, and Appalachian Plateau;
c) locating and identifying water features important to the early history of Virginia (Atlantic Ocean, Chesapeake Bay, James River, York River, Potomac River, Rappahannock River, and Lake Drummond and the Dismal Swamp);

Skills

USI.1 The student will demonstrate skills for historical and geographical analysis and responsible citizenship, including the ability to

f) analyze and interpret maps to explain relationships among landforms, water features, climatic characteristics, and historical events;

Essential Questions:

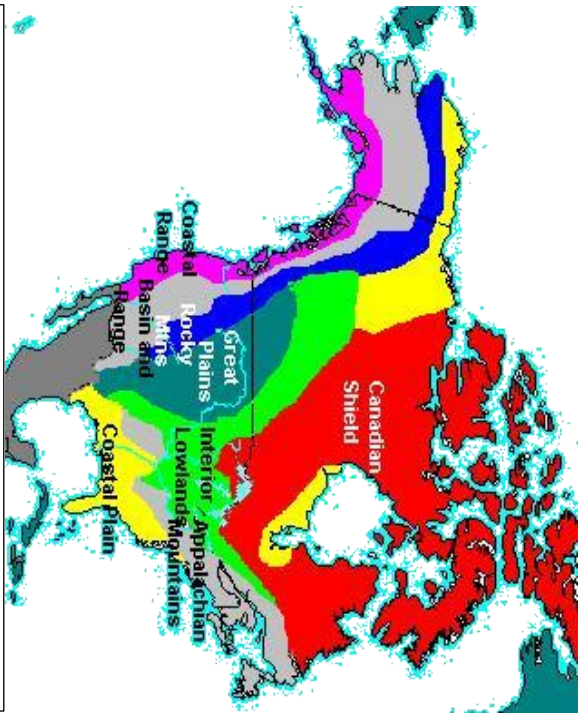
1. Where does water go when it rains?
2. What is a watershed?
3. As water flows down a river and stream, what does it carry with it?

Lesson Procedure:

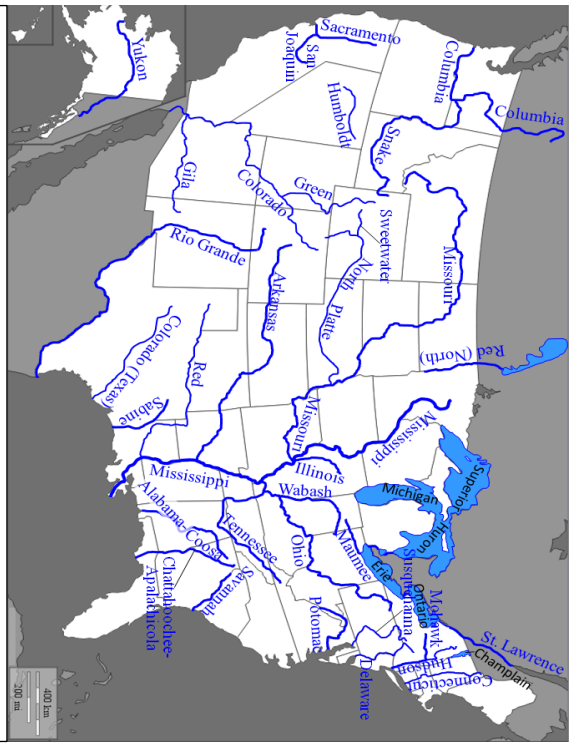
1. Introduce yourself and let students know about the Growing Native program, Cacapon Institute, and that you will be visiting over the next few weeks to educate students on environmental topics.
2. Show students the "Watershed Diagram" and ask students the essential questions.
3. Prompt students to define a watershed. *Definition: A watershed is an area of land that drains into a particular body of water, such as a stream, lake, or bay.* Write the definition on the board to help remind students throughout the lesson.
4. Ask students if they know what watershed they live in. *Chesapeake Bay Watershed*
5. Using the Chesapeake Bay Watershed Puzzle Poster lead the students in assembling the states that compose the Chesapeake Bay Watershed
    a. Starting from New York and working toward Virginia have students make observations of the state shapes and question what could cause the shapes to be different.
    b. Finally ask students where the Chesapeake Bay would fit on the map and ask students what ocean the Chesapeake Bay would empty into. A*dd the Atlantic Ocean label*
    c. Ask students what major geographic feature runs from Georgia to Maine and would explain why sections of Pennsylvania, West Virginia, and New York are cut off. *Attach Appalachian Mountains label*
    d. Remind students that points of high elevation define watershed boundaries. The Appalachian Mountains are the highest point in the area that defines the Chesapeake Bay Watershed and the Mississippi River Watershed.
        i. Political boundaries gave the states their shapes but geographical boundaries give watersheds their shapes.

        ii. Can use the bathtub analogy if students seem lost.

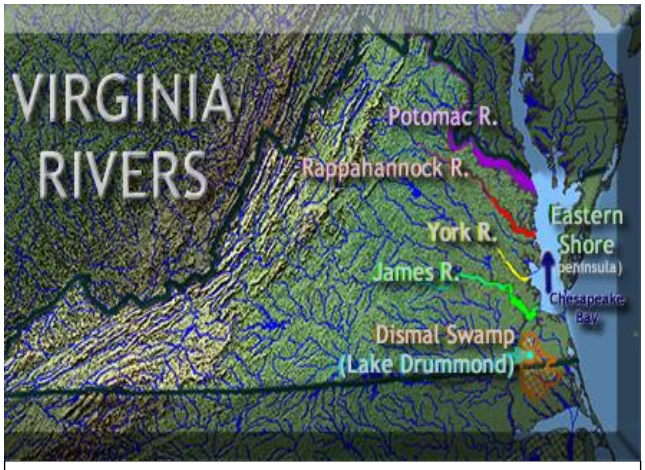
6. Tell students that watersheds are named after the river to which all of the water flows. Just by knowing the name of the watershed you know where the final destination for the water will be.
    a. For example: all of the water within the Chesapeake Bay Watershed will end in the Chesapeake Bay
        i. The Potomac River Watershed is all of the land with water flowing into the Potomac River.
        ii. The Potomac River is within the Chesapeake Bay Watershed. *Can use measuring cups/Russian nesting dolls as an example of smaller watersheds fitting into a larger watershed*
        iii. Show students the "Major Sub-Watersheds" Map and discuss how all of these areas have very small rivers that lead to one major river. That major river drains the water into the Chesapeake Bay.
    b. Just like all the blood veins end up leading to our heart our river systems do the same thing.
7. Pass out the United States Raised Relief Maps to groups of students. Work as a group to have the students all point each of the following locations:
    a. Have the students point to where they are in Virginia
    b. Instruct students to point out the states boarding Virginia. Start but traveling south, ask students to name the state (North Carolina), then travel west (Tennessee), north west (Kentucky), north to Northeast (West Virginia)
    c. Have the students work together to locate geographic regions of North America: Appalachian Mountains, Great Plains, Rocky Mountains. *see attached for highlighted areas*
        i. Explain that the United States is divided into three major sections. The Rocky Mountains and the Appalachian Mountains are the dividers. They are called continental divides.
    d. Have the students locate the Great Lakes, Atlantic Ocean, Pacific Ocean, Gulf of Mexico, and Chesapeake Bay. *See attached for highlighted areas*
    e. Have students travel east from the Appalachian Mountains to the Chesapeake Bay. Ask student how the topography on the map changes.
    f. Have students return maps
8. Pass out the Rivers of Virginia Maps
    a. Have students locate where they are in Virginia again
    b. Ask students if they are within the Chesapeake Bay Watershed Boundary
    c. Have students as a group; locate the Atlantic Ocean, Chesapeake Bay, James River, York River, Potomac River, Rappahannock River, Lake Drummond, and the Dismal Swamp. *See attached for highlighted areas*
9. Wrap Up:
    a. Ask students to…
        i. Define a watershed
        ii. Describe what watershed(s) they live in. *Chesapeake Bay Watershed, Potomac River Watershed…*
        iii. How does topography relate to watersheds?



5. c. Geographic Regions of North America

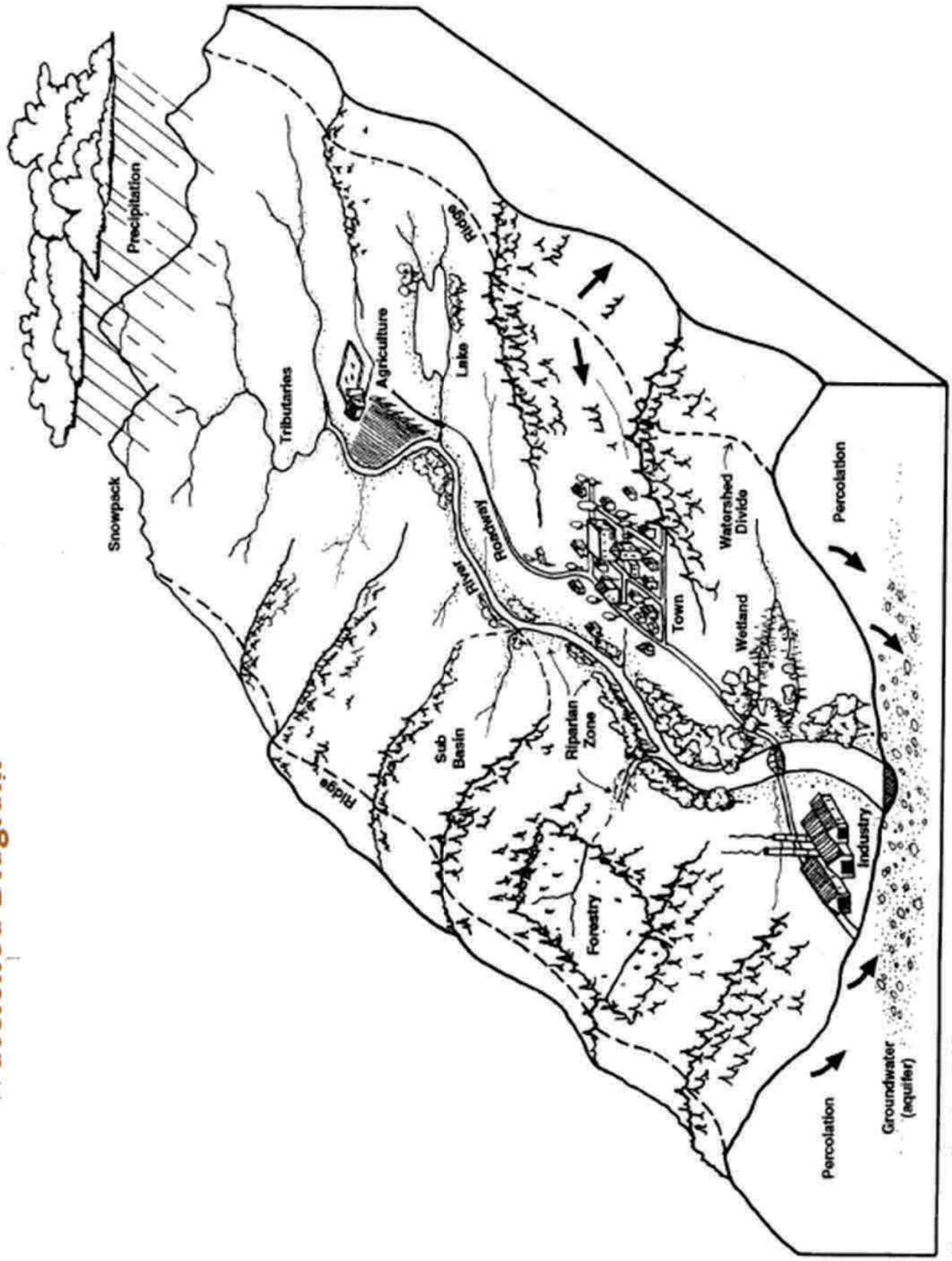


5. d. Major Rivers and Lakes Used for Migration in the United States



6. Location of Major Rivers in Virginia

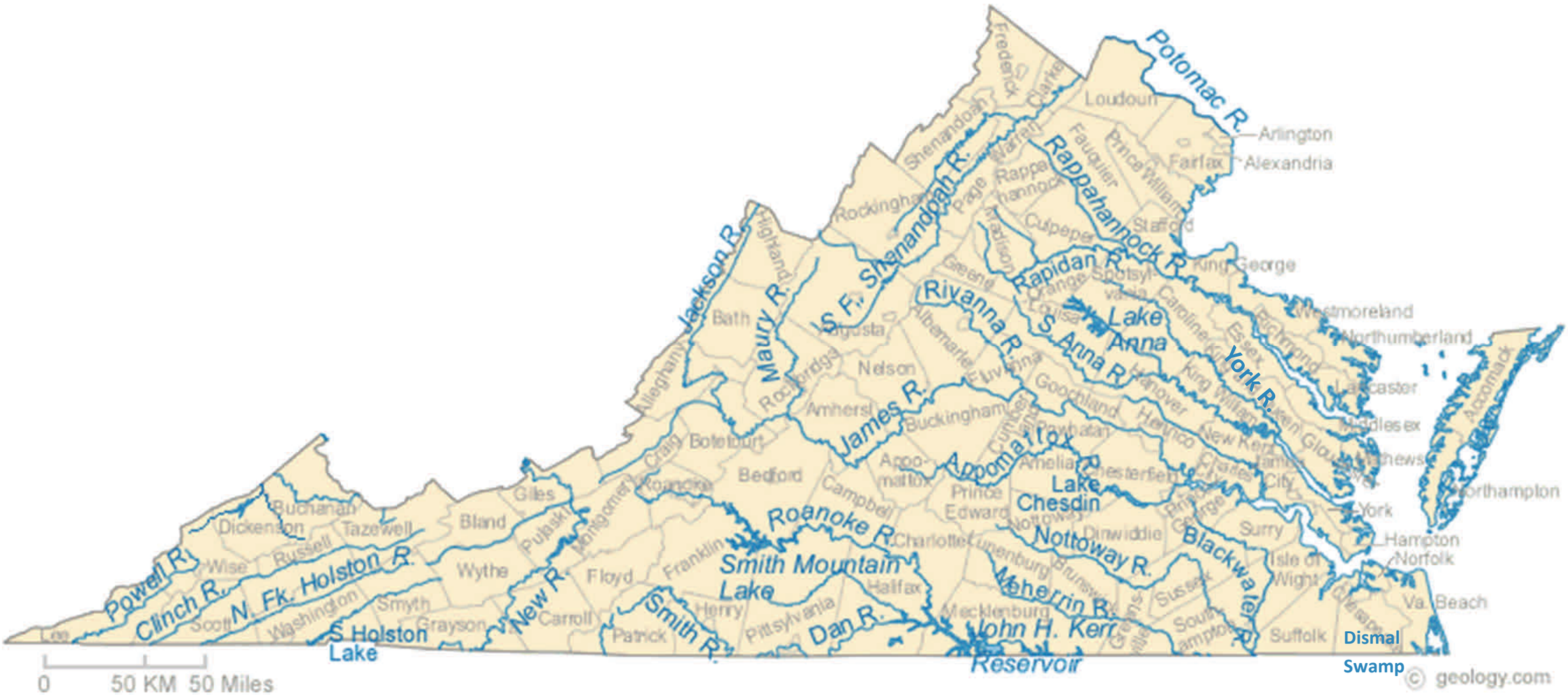
Watershed Diagram



Map courtesy of Lane Council of Governments

Major Sub-Watersheds of the Chesapeake Bay

Rivers of Virginia



Lesson 2- Trees Inside and Out
4th Grade Program

Lesson Outcomes:
Students will understand…

- how a tree's parts are essential to its health, growth, and reproduction
- that trees play a vital role in the ecosystem by reducing nutrients, preventing erosion, and sequestering carbon
- that humans could not live without trees
- the rings within a tree tell the age of the tree
- the rings show seasons with high moisture or drought conditions

Students will be able to…

- identify various tree parts
- use dendrology terms
- describe the contribution of each tree part to a tree' composition and biological process
- identify and describe the steps in the water cycle
- describe stormwater runoff pollution and how it is harmful to streams

Duration of Activity & Setting: 1 hour; Indoors

Vocabulary:

Canopy, cambium, carbohydrates, dissipation, groundwater, heartwood, molecules, phloem, xylem, photosynthesis, runoff, stomata, evaporation, condensation, precipitation, percolation, watershed

Materials:

Reading: "Raindrop Journey" by Edward Dix
Tree ID board and cards
Tree Cookies
"Identifying the Parts of a Tree" worksheet

Standards of Learning (SOL):

Earth Resources

4.9 The student will investigate and understand important Virginia natural resources. Key concepts include
- a) watersheds and water resources;
- b) animals and plants;
- d) forests, soil, and land.

Life Processes

4.4 The student will investigate and understand basic plant anatomy and life processes. Key concepts include
a) the structures of typical plants and the function of each structure;
b) processes and structures involved with plant reproduction;
c) photosynthesis; and
d) adaptations allow plants to satisfy life needs and respond to the environment.

Essential Questions:

1. What is a native tree?
2. How do trees grow?
3. Are trees important to other living things? If so, how?

Lesson Procedure:

1. Pass out and have students take turns reading aloud "Raindrop Journey" by Edward Dix
    a. Discuss the journey water can take throughout the watershed. Be sure to discuss the topics of :
        i. Review the water cycle: *evaporation, condensation, precipitation, percolation, runoff*
        ii. Runoff/ Stormwater Runoff pollution: *Rainwater that travels over hard surfaces and downhill to collect any form of pollution that is carried to a stream; examples of pollution include: trash, extra nutrients, sediment, salt, oil and gas*
        iii. Photosynthesis
2. Handout the "Parts of a Tree" worksheet to students and hang the poster on the board. Tell the students that they will be working together to identify all of the parts of a tree. Also, tell students that they will be playing a game follow the identification process and that you would be giving clues for the game answers throughout the lesson so they needed to pay really close attention!
3. Students will follow along and write the answers on their worksheet as you identify each part as a class. Tell students that there is a word bank on the side to help with spelling.
4. Begin with the easier parts to identify such as the roots, seed, leaves, flower, branches, etc. leaving the center of the tree for last.
    a. Point to a part on the tree and ask students to identify it. Once they give the correct answer you can either have that student come to the board and place the answer on the Velcro or you can do it yourself. After getting the answer placed on the board, ask students what they believe this part of the trees does for the tree. Give hits to the answers in the upcoming game.
    b. Examples for the basic structure:
        i. Roots. The roots help to hold the tree upright in the ground, keep soil from eroding, and absorb water and nutrients for the tree.
        ii. Leaf. Photosynthesis occurs here and that process creates the food for the tree.
        iii. Flower. Ascetically pleasing, important for pollinators to exchange pollen, and enables the tree to make seeds or fruit.
        iv. Seed. The next generation of trees and is food for wildlife.

v. Branch. Provides a location for animals to create homes, spreads out the leaves so they can all get sunlight.
vi. Bark. Protects the tree from any damage.

c. Examples for the inside of the tree. Students need more help with understanding these; have students repeat aloud the name of each part. Work from the outside to the inside.
   i. Phloem. Moves sugars (food) created in the leaves **DOWN** the tree.
   ii. Cambium. This makes new phloem and xylem cells for the tree. It is found in-between the two layers.
   iii. Xylem. This transports water from the roots **UP** the tree.
   iv. Heartwood. Provides support for the tree and is actually dead wood at the very center of the tree.

5. Ensure the students filled in all of the answers on their worksheet and have them place them to the side.
6. Separate the class into two teams. You can call them team A and team B or any names you choose. You are welcome to keep score or not depending on the students.
7. Explain the rules of the game before passing out any materials to students.
   a. Each team will get "The Function within Tree" game board. Each board has the same pieces just in different locations on the board.
   b. Explain that one card will match up with one part of the tree on the board and that's why we talked about the role of each tree part while identifying the parts.
   c. They will need to work as a team. The instructor will name a part of the tree, the students will need to have the correct function that part plays within the tree, and be the first team to raise their hand to share their answer. *It is the instructor's duty to call on the team they believe raised their hand first.*
   d. If the team does not have the correct answer it can then be passed to the other team to answer. If you are keeping track of the score the second team would have a chance to steal the point.
   e. If no correct answer is given, move on to the next part and come back to it later in the game.
   f. The group that answers correctly will place their game piece on the board next to the corresponding part.
   g. Each group will be given five minutes to work as a team prior to starting the game. This time should be used to start matching up the game cards with the tree parts. This helps to ensure they have familiarity with the answers and keeps the game moving forward.
8. Hints for successful game play:
   a. Encourage the students to each have a game piece and know their tree part for the card. They can work as a team in the time given to get the answers prior to starting the game.
   b. The team that did not add their card to the board should move it off to the side or reattach it to the game board so it is known that it is out of play and cannot be used for future answers.
   c. Ensure that students are listening to the answer read by the team that raised their hand first. They could have the wrong answer and do not want to repeat the same answer they just gave losing the point. (if score is being kept)
9. Clean up game and Wrap up:
   a. Ask students to….

i. Name all of the steps in the water cycle.
ii. Define stormwater runoff pollution
iii. Name the major roll the leaves play in the overall health of the tree
iv. Major parts of a tree. *i.e. - leaves, trunk, roots, bark….*

Reading: Raindrop Journey by Edward Dix

Instructions:

Assign a student volunteer to read the following "Raindrop Journey" story aloud while the other students follow along silently.

A raindrop falls through the air at fourteen miles per hour. It smacks into a leaf at the top of an oak tree and splashes into many droplets, **dissipating** the energy from its fall.

The droplets join together with other raindrops to form larger drops that fall from the leaf to the ground under the tree. They land on other plants, mosses, and the layer of dead leaves on the forest floor. Slowed by the leaf **canopy** and absorbed by the forest floor, almost all of the rain drops soak into the **groundwater**, creating little or no **runoff**.

The water soaks slowly into the ground, where the tree's roots absorb it. The tree also takes in minerals—especially nitrogen, phosphorus, potassium, sulfur, magnesium, and calcium—from the soil.

Like all living things, the tree's roots are made of tiny cells. Within the roots, water passes from cell to cell until it reaches the **xylem**. The xylem contains long hollow cells that form continuous pipelines through the trunk to the leaves at the top of the tree.

At the center of its trunk, the tree's heartwood is made of old xylem cells that no longer transport water. Instead, these old cells make the trunk strong so that it can hold its branches and leaves high, where they can receive the most sunlight.

Leaves are the tree's "kitchens," and it is important that they receive light energy to make food through the process of **photosynthesis**. Water **molecules** that reach the leaves from rain mix with carbon dioxide. Through photosynthesis, **chlorophyll** molecules in the leaves capture energy from sunlight and use it to "cook" the carbon and water into simple sugars, called **carbohydrates**. Through pores called **stomata**, the leaves release oxygen and water vapor resulting from photosynthesis into the air. The tree uses the sugars for energy, and through chemical processes, it creates proteins, fats, and other necessary compounds from the sugars.

Phloem cells in the tree's inner bark pass the sugars from cell to cell down the trunk to the roots, feeding all of the tree's living cells along the way. Each growing season, the tree trunk grows wider because cells of its **cambium** layer divide to form new phloem cells (inner bark) on the outside and new xylem cells (sapwood) on the inside. As new growth in the cambium pushes older phloem cells outward, the cells die and form the outer bark. This bark helps to protect the tree's tender inner tissues from injury by bugs, fungi, or fire.

Minerals Critical to a Tree's Survival

- **Nitrogen** is a major component of chlorophyll, proteins, enzymes, hormones, and vitamins.
- **Phosphorus** is necessary for seed germination, photosynthesis, protein synthesis, and almost all aspects of growth and metabolism in plants. It is essential for flower and fruit formation.
- **Potassium** is necessary for the formation of sugars, starches, carbohydrates, and proteins, and for cell division in roots and other tree parts.
- **Sulfur** is a structural component of amino acids, proteins, vitamins, and enzymes, and is essential for chlorophyll production.
- **Magnesium** is a critical structural component of chlorophyll molecules, and is necessary for the functioning of plant enzymes to produce carbohydrates, sugars, and fats.
- **Calcium** is a structural component of cell walls; influences water movement in cells; activates enzymes; and is necessary for cell growth and division.

Identifying the Parts of a Tree

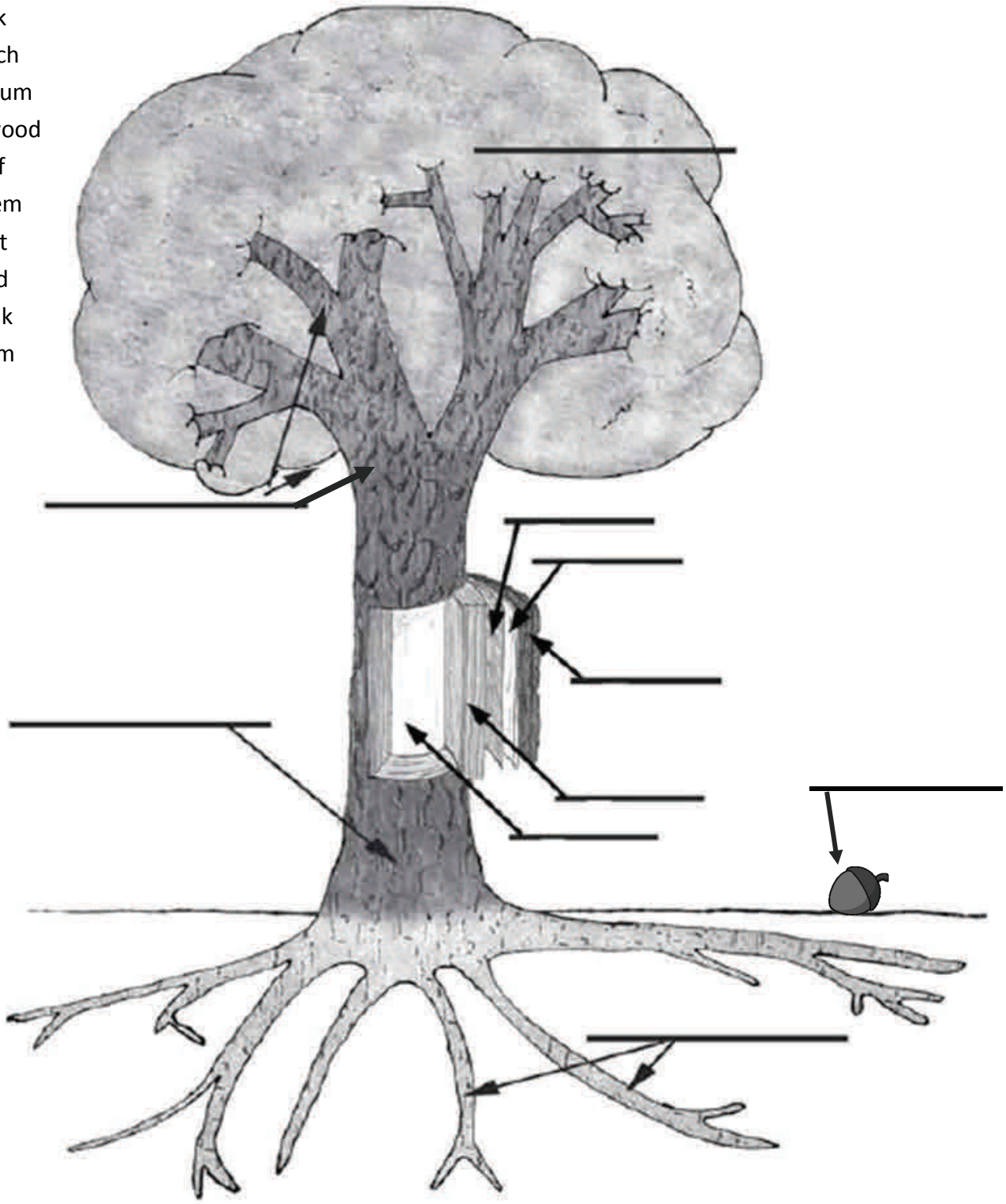
Name:_____

Date:_____

Class:_____

Tree Parts

Bark
Branch
Cambium
Heartwood
Leaf
Phloem
Root
Seed
Trunk
Xylem



Identifying the Parts of a Tree

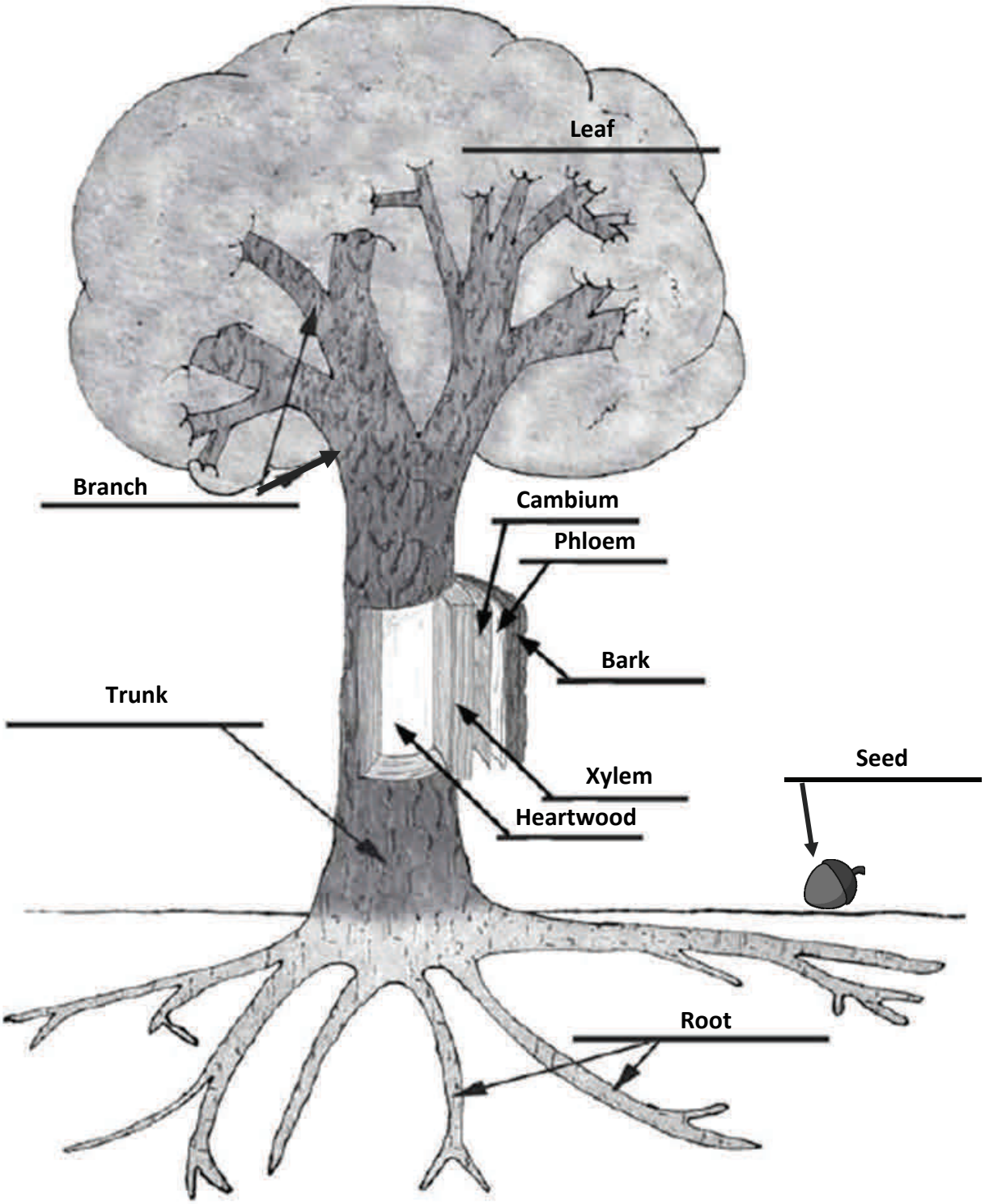
Name: Teacher Guide

Date:

Class:

Tree Parts

Bark
Branch
Cambium
Heartwood
Leaf
Phloem
Root
Seed
Trunk
Xylem



Tree Cards: Tree Parts

(Print on green paper and cut into 11 individual cards)

Seed	Cambium	
Branch	Bark	Heart-wood
Leaf	Root	Xylem
Flower	Trunk	Phloem

Tree Cards: Tree Functions

(Print two copies on yellow paper and cut into 22 individual cards)

Captures sunlight and carbon dioxide to produce food for the tree, using the process of photosynthesis	Outer layer of the tree that protects it from weather, animals, insects, fire, and disease	Transports water and nutrients from the roots up the trunk to the leaves; also called sapwood	Spreads out leaves so they receive sunlight; where upward growth takes place and new buds are formed
Contains an embryo and nutrients to produce new offspring/trees	Transports sugars (food) from the leaves down to the roots and branches; also called inner bark	Exchanges pollen with other trees to fertilize the next generation; enables the tree to produce seeds	Grows to bring leaves above competing trees so they are in contact with sunlight; supports branches
Absorbs water and nutrients from the soil and anchors the tree in the ground to provide support	Found between the phloem and xylem, a "growth layer" of cells that produces a new layer of xylem and phloem each year	Provides support for the tree; actually dead wood at the very center of the tree	

Tree Cards Answer Key

TREE PART	FUNCTION WITHIN TREE	FUNCTION WITHIN ECOSYSTEM
Leaf	Captures sunlight and carbon dioxide to produce food for the tree, using the process of photosynthesis	Provides shade and evaporates water; absorbs carbon dioxide and releases oxygen; provides food for animals and insects
Bark	Outer layer of the tree that protects it from weather, animals, insects, fire, and disease	Provides habitat and food for many insects; when decomposing, releases nutrients back into the soil; may be used for paper products and mulch
Trunk	Grows to bring leaves above competing trees so they are in contact with sunlight; supports branches	Stores carbon dioxide, reducing greenhouse gases; provides material for products such as paper and furniture
Root	Absorbs water and nutrients from the soil and anchors the tree in the ground to provide support	Holds soil in place so the tree does not wash away in rain and wind; takes up nutrients in the soil
Flower	Exchanges pollen with other trees to fertilize the next generation; enables the tree to produce seeds	Provides food in the form of nectar to bees, birds, and other pollinators
Seed and associated parts	Contains an embryo and nutrients to produce new offspring/trees	Often a source of food for wildlife and humans; may be used for medicinal purposes, dyes, or cosmetics
Phloem	Transports sugars (food) from the leaves down to the roots and branches; also called inner bark	Transfers sugars (food) the tree creates from sunlight, water, and carbon dioxide, making this energy available to the ecosystem (including humans!)
Xylem	Transports water and nutrients from the roots up the trunk to the leaves; also called sapwood	Absorbs water from the ecosystem and stores it for use in dry times; produces sap such as maple syrup
Branch	Spreads out leaves so they receive sunlight; where upward growth takes place and new buds are formed	Provides habitat for animals and insects; organic material for soil; and shelter from wind and rain
Cambium	Found between the phloem and xylem, a "growth layer" of cells that produces a new layer of xylem and phloem each year	Protects forests by enabling the tree to grow strong for protection from wind and storms; produces pectin, used in jellies, jams, and candies
Heartwood	Provides support for the tree; actually dead wood at the very center of the tree	Strong wood ideal for building materials; may eventually hollow out from the center of the tree and provide prime animal habitat

Lesson 3- Tree Characteristics
4th Grade Program

Lesson Outcomes:
Students will understand…

- that trees have species specific characteristics
- that trees can be identified by their leaves, bark, and branches
- why trees are beneficial to the environment

Students will be able to…

- identify basic dendrology and botany terms
- use a key to identify tree species
- recognize several native trees common to the Potomac River Watershed

Duration of Activity & Setting: 1 hour; Indoors

Vocabulary:

Alternate, compound leaf, cones, conifers, deciduous, ecosystems functions, entire, evergreen, fruit, leaf scar, lobes, midrib, margin, opposite, palmate, pinnately, persistent, petiole, photosynthesis, seedlings, simple leaf, spurs, transpiration, terminal bud, watershed

Materials:

A Tree Mystery: Identifying Trees
Tree Species Packets

Tree structure ID sheets
Common Native Trees of Virginia- Dichotomous Key

"Tree Match Up" Cards
Laminated Images of Deciduous and Evergreen Trees

Standards of Learning (SOL):

Life Processes

4.4 The student will investigate and understand basic plant anatomy and life processes. Key concepts include
a) the structures of typical plants and the function of each structure;
b) processes and structures involved with plant reproduction;
c) photosynthesis; and
d) adaptations allow plants to satisfy life needs and respond to the environment.

Earth Resources

4.9 The student will investigate and understand important Virginia natural resources. Key concepts include

b) animals and plants;
d) forests, soil, and land.

Essential Questions:

1. How are different species of trees similar?
2. How can you tell tree species apart?
3. What are dominating native tree species in our region?

Lesson Procedure:

1. Review the major parts of the tree from the last lesson. Review the importance of the function of the leaves (photosynthesis)
2. Tell the students they are going to be working to identify native tree species found in Virginia and the Potomac River Watershed.
3. Explain that there are multiple types of trees and scientists organized trees into groups
    a. Show the picture of a deciduous tree and an evergreen tree
    b. Ask students what the differences between the two are. *One drops its leaves for the winter and the other does not.*
    c. Explain that even though they are both trees they are broken into two different categories. *Deciduous Trees and Evergreen Trees(Conifers)*
    d. Explain that each tree has certain adaptations to live in different conditions. Some thrive in warm dry environments while others thrive in wet. Each tree is important to its region and can tell you about the climate. We call these Native Tree Species.
        i. Have students name trees and plants that would not be native to Virginia. Examples would be orange trees, cactus, palm trees, pineapple bushes, etc.
        ii. Have students understand that all of the trees they will be working with today are native to the Virginia area.
    e. Today we will be looking at trees native to the Potomac Basin's climate and land conditions.
4. Tree Matching Game
    a. Ask students if they have ever played the game memory before?
    b. Review the rules of the game.
        i. Students are to place the cards face down on their desks in neat rows and columns. Note: they should not look at the cards as they are placing them.
        ii. Each student will take turns flipping over two different cards. In order to get a point the cards must match.
            1. If they do not match, they must be returned to their original position, face down
            2. If they get a match, they can take the cards and place them on the desk in front of their spot.
        iii. The rotation should continue until ever card has been matched.
    c. Divide students into five groups.
    d. Pass out the Tree Matching Game cards.
    e. Walk around the room to observe the game.
5. Collect all of the cards and review.
6. Students now have the opportunity to be scientists to identify native trees. In order to identify the trees explain they will be using a dichotomous key. A dichotomous key is composed of two

"yes or no" questions. Students must pick one answer and will be instructed to move onto the next question until they get to the final answer.

a. Use the "A Tree Mystery: Identifying Trees" Packet to review the way scientists use leaves and parts of the tree to identify them. *Make sure students understand these basics because they are the foundation for the dichotomous key.*

7. Divide the class into even groups for the ten Tree ID Packets. Pass out the packets.
    a. Instruct the students to spread out the contents on their desks. *Contents should include: a laminated leaf, laminated tree identification sheet, tree characteristics sheet with multiple pictures, and Key to Common Native Trees of Virginia, leaf ID sheet.*
    b. Students will be using the Key to Common Native Trees of Virginia to determine the species of tree they have.
    c. Stress the importance of using the tree identification sheet to answer the questions.
    d. Instruct everyone to look at question 1 on the Key to Common Native Trees of Virginia booklet.
        i. Ask a student to answer read a. and b.
        ii. Instruct the students to look at their laminated leaf and the Tree identification sheet to answer the questions. *All students should answer b. and move on to question 14.*
        iii. Have the students continue to work within their group to get the answer.
        iv. Once they feel they have the correct tree species have them go to the instructor for the answer sheet to find out if they got it correct.
            1. If not correct, ask the students to try answering the questions again using the facts on the answer sheet
            2. If correct, congratulate them and ask them to wait for another group to finish and switch materials.
        v. If students are getting the hang of the activity encourage them to switch packets and identify more tree species.
    e. Ask students to….
        i. name the species of trees that were identified using the packets.
        ii. name major characteristics of trees used for identification.
        iii. explain the difference between opposite and alternate leaves.

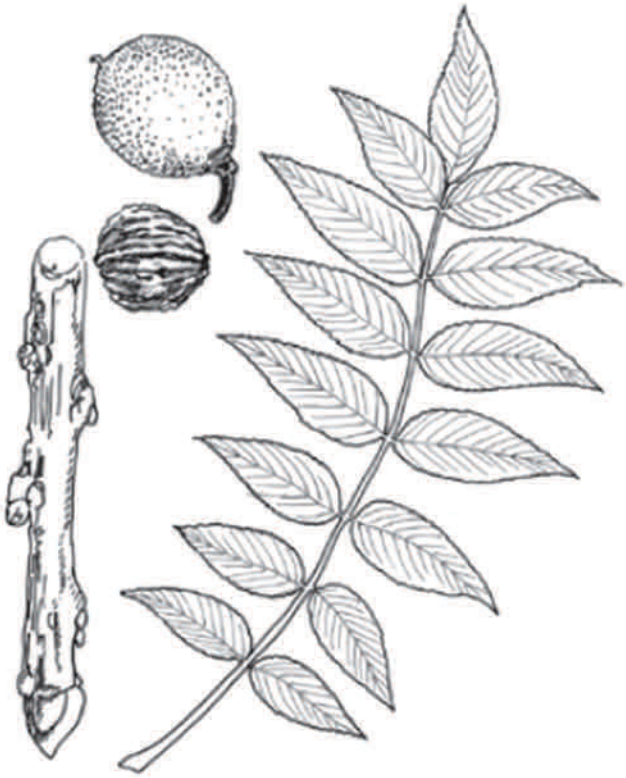
Tree Match Up

Growing Native

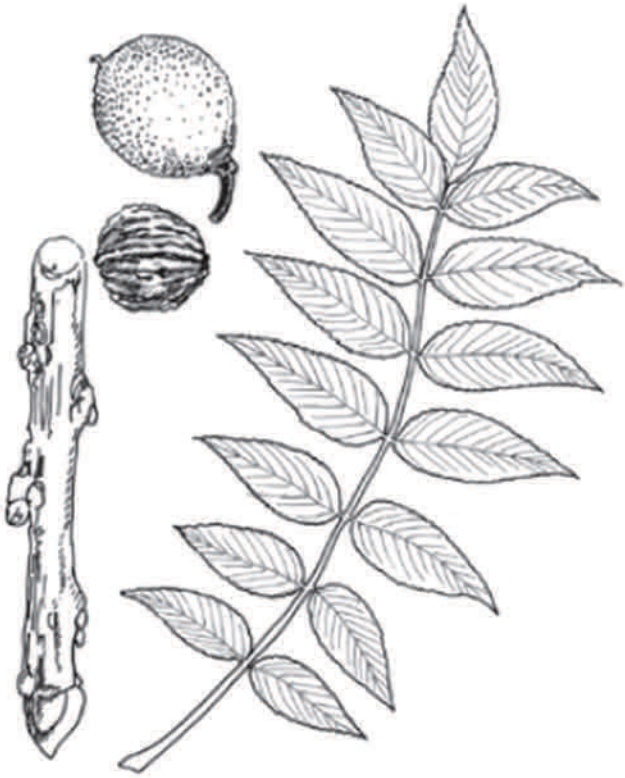
Lesson 3: Tree Characteristics

Directions:

Print enough copies for students to be broken into teams of 3-4 students. Cut playing cards out along dotted line. To play: shuffle cards and have students arrange cards face down on their desks in neat lines. Students take turns flipping over cards until they have found a matching pair. The student with the most matches after all cards have been collected wins.



Black Walnut



Black Walnut

White Oak

Yellow– Poplar

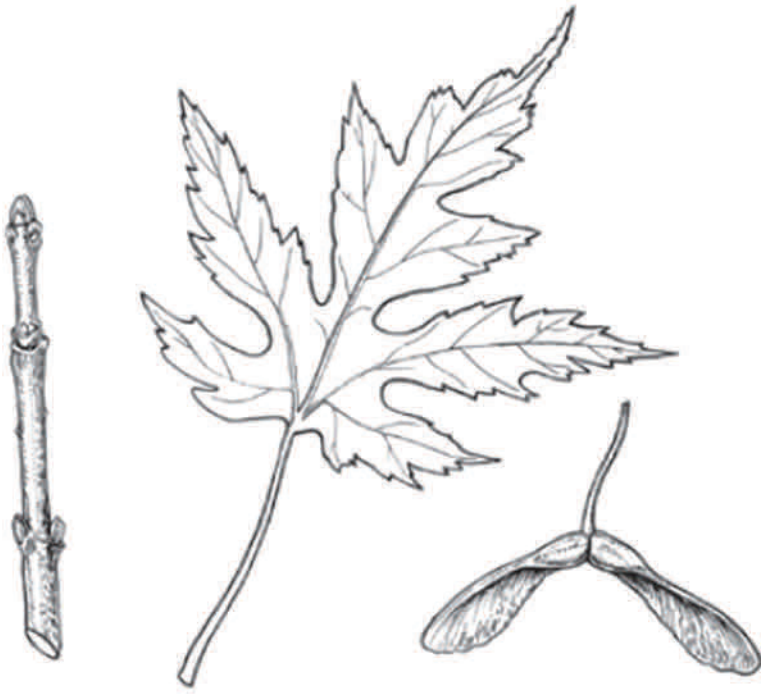
Red Oak

Red Oak

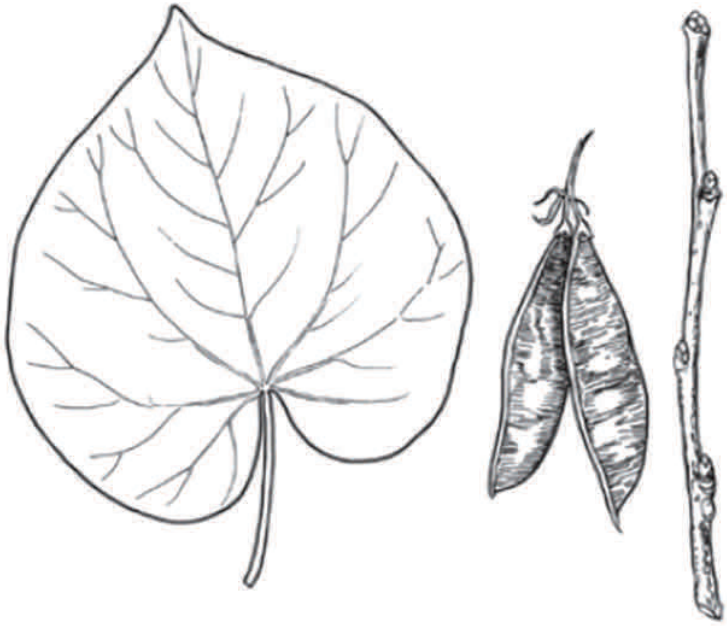
Yellow– Poplar

White Oak

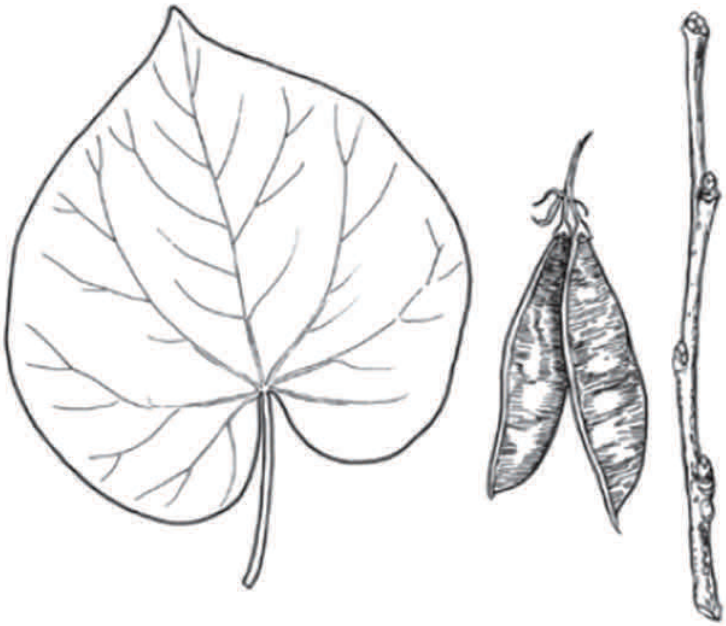
Sweet Gum



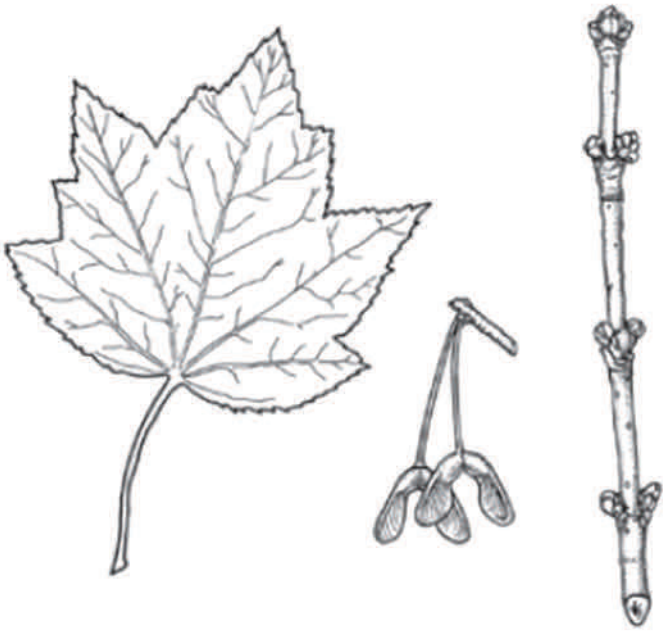
Silver Maple



Eastern Redbud



Eastern Redbud



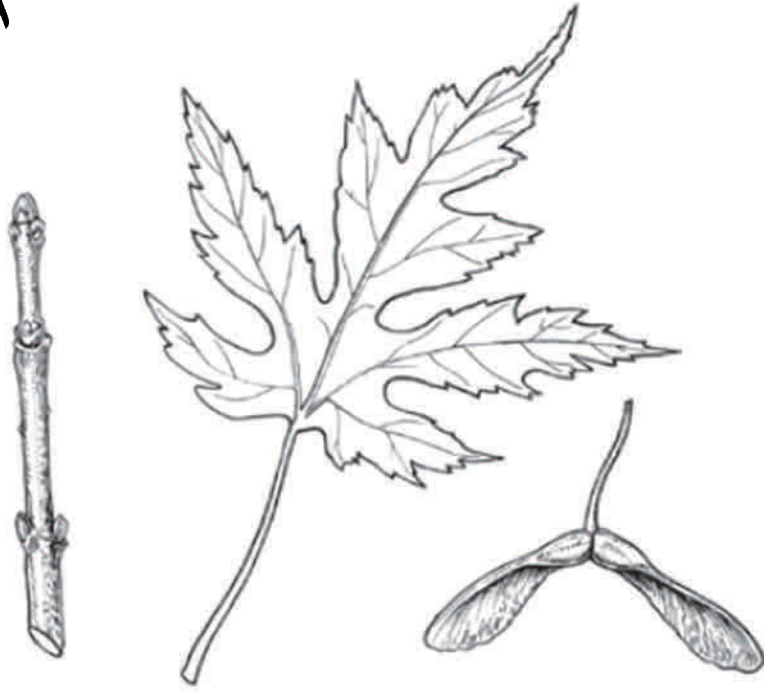
Red Maple

Red Maple

Sugar Maple

Sugar Maple

Sweet Gum



Silver Maple

Flowering Dogwood

Flowering Dogwood

A Tree Mystery: Identifying Trees

Growing Native

Lesson 3: Tree Characteristics

Conifer vs. Deciduous

Tree remains green all year

Leaves are needle or scale like

Tree drops leaves every fall and regrows them in the spring

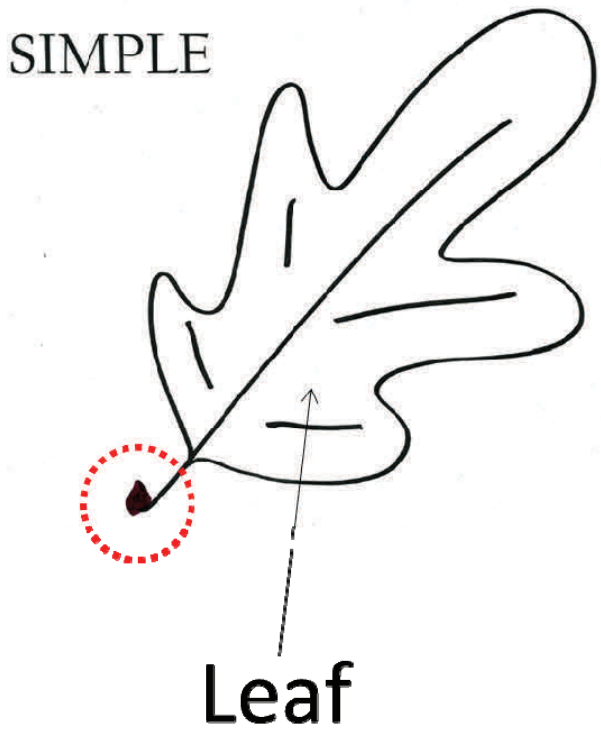
Leaves are broad and flat

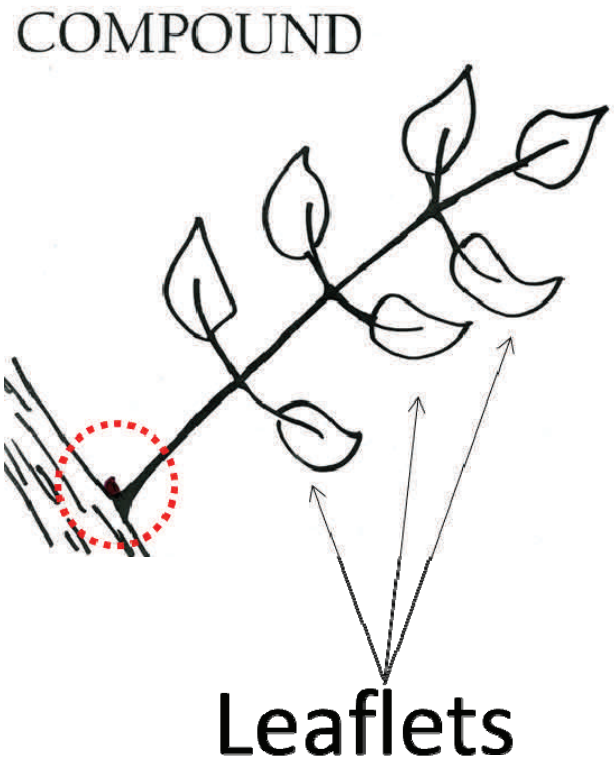
Eastern Redbud

White Oak

Identification by Leaves

Simple vs. Compound Leaves:



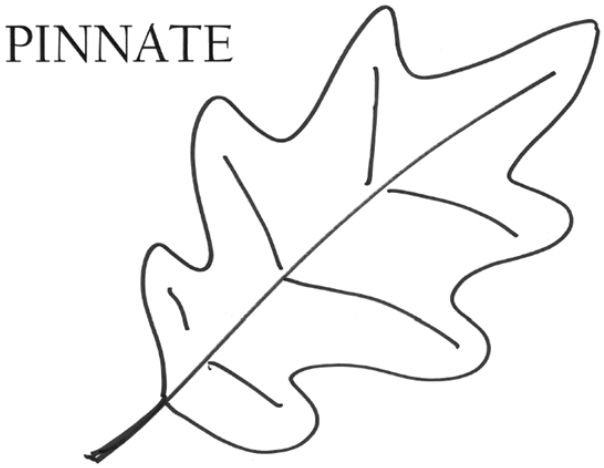


Tulip Poplar

Black Walnut

Identification by Leaves

Pinnate vs. Palmate Leaves:

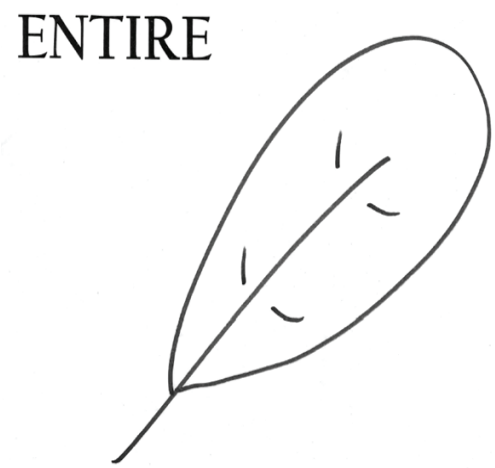


Hackberry

Eastern Redbud

Identification by Leaves

Leaf Margins (edges):



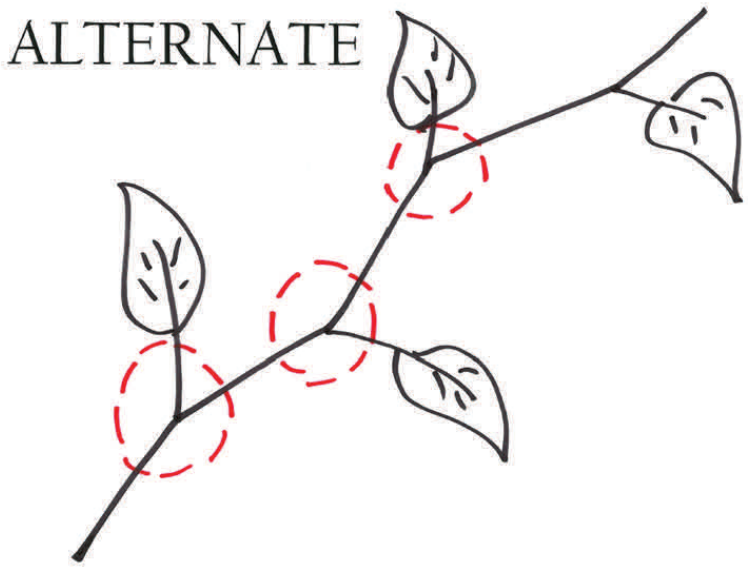
Paw Paw

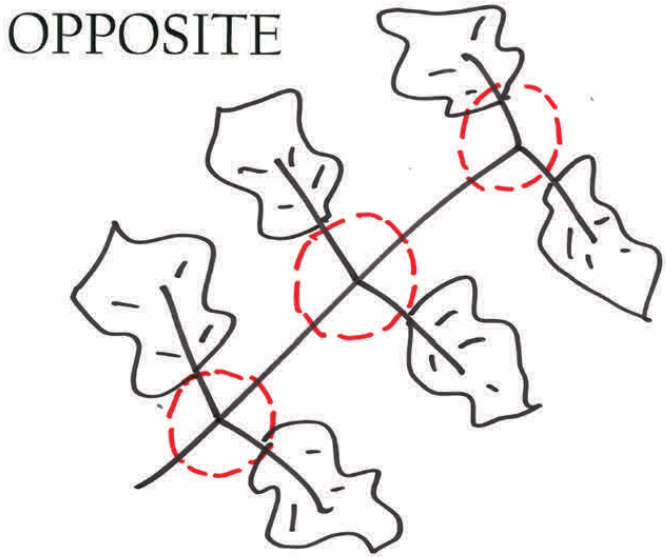
Red Maple

White Oak

Identification by Leaves

Alternate vs. Opposite Leaves:





Eastern Redbud

What Tree Am I?

1.

What Tree Am I?

2.

What Tree Am I?

3.

What Tree Am I?

Answer Key:

1. Red Maple
2. Red Oak
3. Flowering Dogwood

Tree Identification Packet

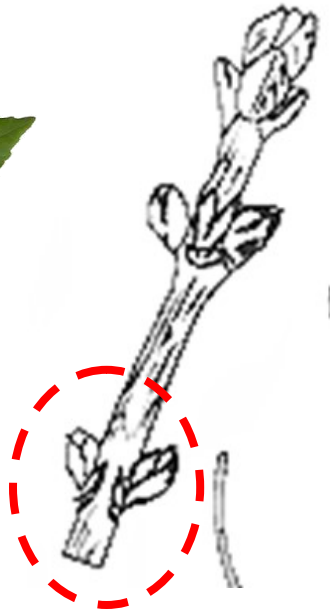
Growing Native

Lesson 3: Tree Characteristics

Answer Key:

1. Red Maple
2. Silver Maple
3. Sugar Maple
4. Red Oak
5. White Oak
6. Black Walnut
7. Eastern Redbud
8. Tulip Poplar
9. Flowering Dogwood
10. Sweet Gum

1



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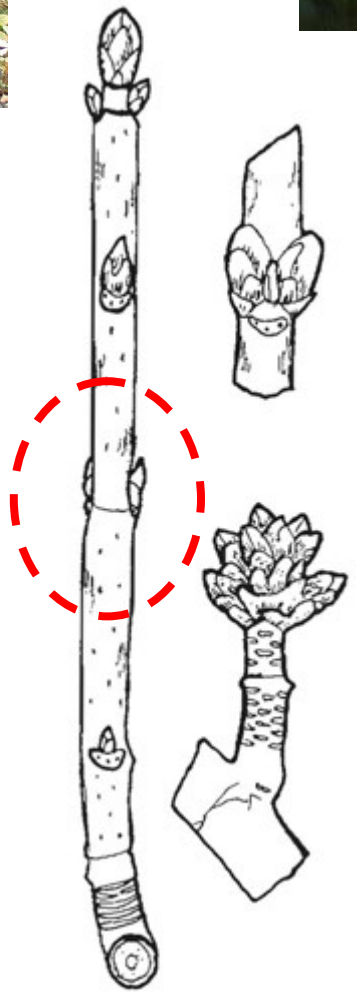

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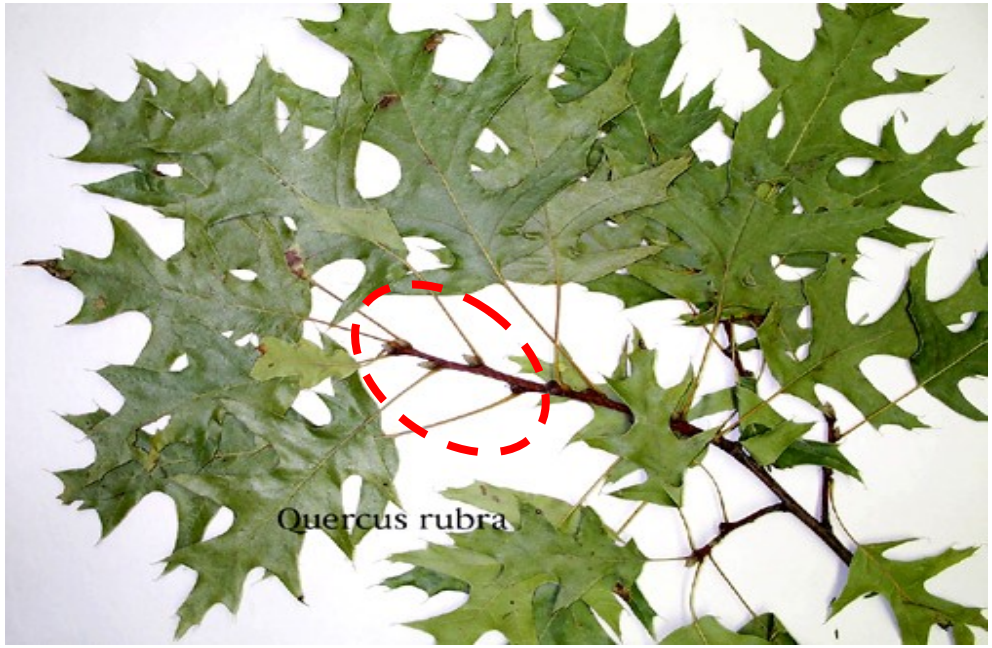


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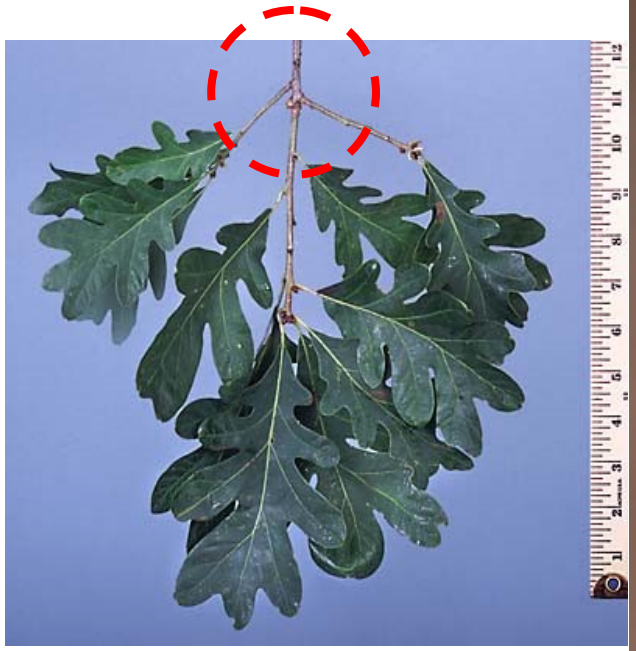

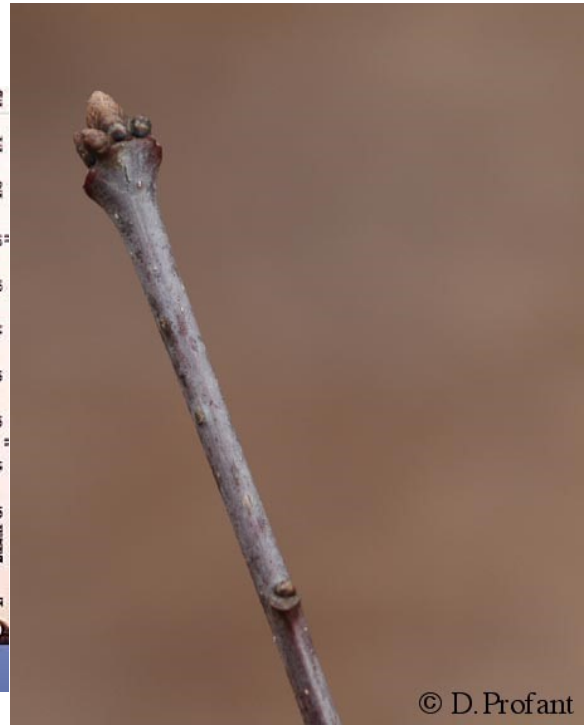
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Karren Wcisel © 2007


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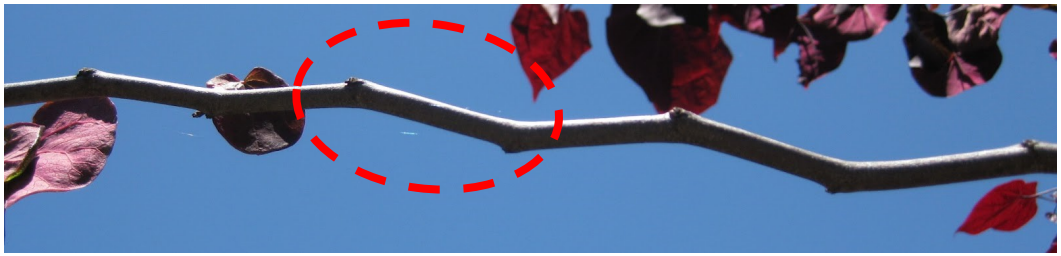

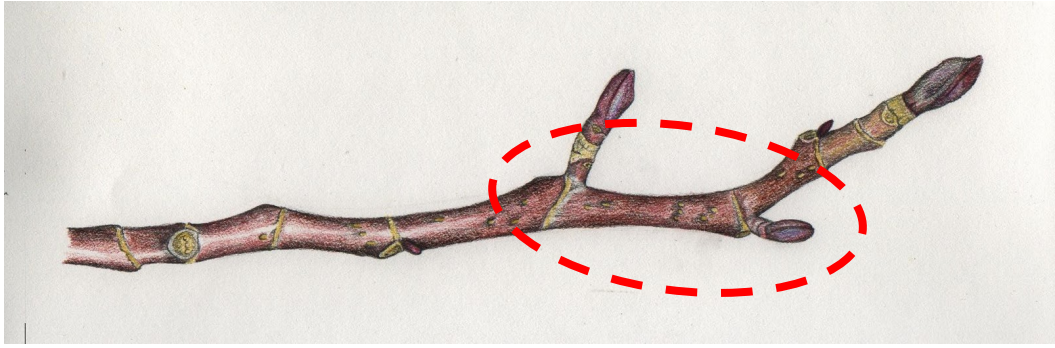


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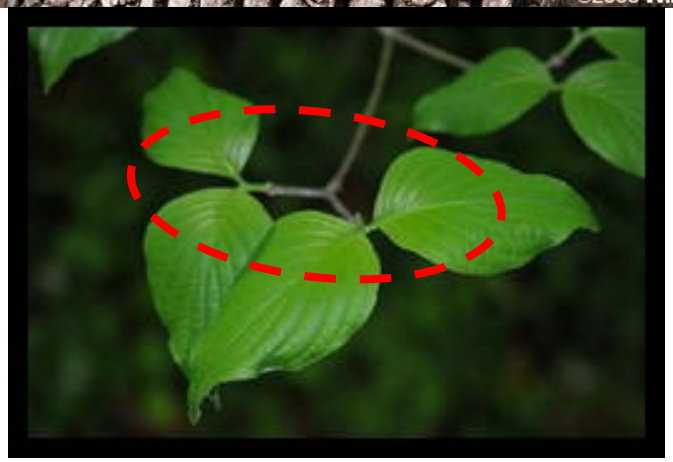
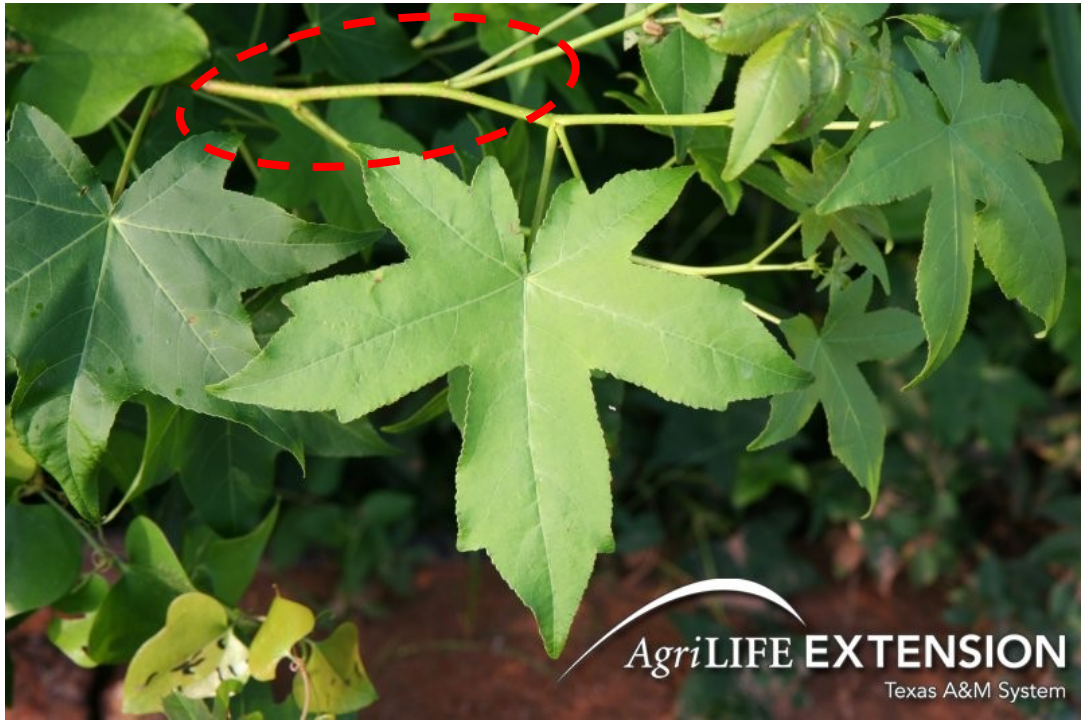



AgriLIFE EXTENSION
Texas A&M System

Lesson 4- Pollution and Buffers
4th Grade Program

Lesson Outcomes:
Students will understand…

- the difference between the two primary categories of pollution sources: point and non-point
- that pollution sources exist in their own neighborhoods
- how pollutants impact the health of waterways, ecosystems, animals, and humans
- that humans can take action to reduce pollution
- that riparian forest buffers are transitional zones between aquatic and terrestrial environments
- how riparian forest buffers protect aquatic environments and reduce the amount of pollution entering a stream

Students will be able to…

- define and understand water quality terms, including pollution, point source, and non-point source pollutants
- develop a graphic organizer to illustrate pollution types
- collect and compile information on a data table
- analyze and interpret data
- assess the differences between forested and unforested riparian areas through a role playing activity

Duration of Activity & Setting: 1 hour; Indoors

Vocabulary:

Aquatic, erosion, impervious, nitrogen, non-point source pollution, nutrients, phosphorus, point source pollution, pollutants, riparian forest buffer, runoff, sediment, species, stormwater, watershed

Materials:

"Picture Water Pollution" handouts
Graphic Organizer example
"Riparian Forest Buffer" reading
"Riparian Forest Diagram"
Tarp & plastic balls

Standards of Learning (SOL):

Living Systems

4.5 The student will investigate and understand how plants and animals, including humans, in an ecosystem interact with one another and with the nonliving components in the ecosystem. Key concepts include

b) organization of populations, communities, and ecosystems and how they interrelate;
c) flow of energy through food webs;
d) habitats and niches;
f) influences of human activity on ecosystems.

Essential Questions:

1. What is pollution?
2. How do pollutants affect water quality?
3. What is the difference between point and non-point source pollution?
4. How are streamside forests important to clean water?

Lesson Procedure:

1. Ask students to tell you some of the tree species that were discussed last session. Indicate that they will be talking more about the importance of those trees toward the end of class.
2. First students will discover the difference between point and non-point source pollution.
    a. Explain that pollution in our rivers comes from the land through the process of runoff especially stormwater runoff.
        i. Ask students to break down the word stormwater runoff pollution. Ask them what they think it is. *Stormwater is water that comes from rain events. Runoff is water that travels over land to enter the stream. Pollution is materials that are harmful to an ecosystem.*
        ii. Students should conclude that stormwater runoff pollution is any form of pollution that is transported from the land to a river by rain water.
    b. Write on the Board the definitions of Point Source and Non-point Source
        i. Point Source Pollution is pollution that enters a waterway through one point, typically a pipe.
            1. Can be from an Industrial Factor or Plant and Sewage Treatment Plants.
            2. Water can be tested for pollutants and traced back to one source.
        ii. Non-point Source Pollution is any form of pollution, natural or human-made that is picked up and carried to a local river or lake by rainwater or snowmelt.
            1. Agricultural Land and Residential Areas- fertilizers, pesticides, herbicides
            2. Urban Runoff- oil, gas, grease, toxic chemicals
            3. Construction Sites, Crops, Eroding stream banks- Sediment
            4. Livestock, pet waste, Faulty Septic Systems- Bacteria and Nutrients
    c. Pass out the Picture Water Pollution laminated sheets to groups of students.
        i. Ask the students to work as a group to identify the pollution on the page as Point Source Pollution (PS) or Non-Point Source Pollution (NPS) on their sheets.

        ii. Discuss the answers after enough time has passed*. Answers: all non-point source other than Industrial waste and Landfill.*

3. Graphic Organizer Activity (optional-based on time)
    a. Place "Non-point Source Pollution" card at the top of the graphic organizer board.
    b. Pass out all of the information tabs to the class.
    c. Have students read their card and think about some other events that might be associated with their cards.
    d. Explain that they will focus on one "Pollution Event" at a time. (blue cards)
    e. Ask a student with a blue card to raise their hand and read the card aloud before placing it on the board.
        i. This will be the first pollution event that will be discussed.
        ii. Students will work to fill in the labels following the event.
        iii. See answer key at end to guide the students through all pollution events.
        iv. It might be helpful to have one full event listed on the board as a starting point to follow.
    f. At conclusion, ask students what they have learned about pollution and its harm to the aquatic environment.
    g. Ask students where all of the pollution came from.
4. Ensure the students that there is a way to reduce the amount of pollution entering our streams and the trees they have been learning about are a key ingredient to that.
5. Pass out the "Riparian Forest Buffer" Reading and Diagram to the students.
    a. Ask students to take turns reading aloud
    b. Ask students throughout….
        i. What does riparian mean?
        ii. How do Riparian Forest Buffers protect rivers and streams?
        iii. What does aquatic mean? What does terrestrial mean?
        iv. How do trees help these areas?
    c. Talk about the diagram of the Riparian Buffer helping students see the trees along a river in a different perspective.
6. Explain to the students that they are going to make up our Riparian Forest Buffer by being trees along a stream
    a. Lay out the blue tarp- tell students it is their local stream
    b. Show students the plastic balls and tell them that each color represents a different form of pollution. Write pollution code on board.
        i. Orange= Nutrients
        ii. Blue= Gas/Oil
        iii. Red= Trash
        iv. Yellow= Pesticide
        v. Green= Sediment/Soil
    c. Each piece (ball) of pollution = 100 pounds of pollution that will be recorded on the class chart.
    d. Write on the board the following table:

	Pounds of Pollution
Stream with Buffer	
Stream without Buffer	

i. 1 ball= 100 pounds of pollution
ii. Calculate the amount of pollution after each demonstration

e. Follow the "Buffer Benefits Readings" for each round. Attached (pg. 5)
   i. In between each reading ask the students to collect all of the pollution and return it to the front after the number has been recorded in the table.

f. At the end ask these key questions:
   i. Which stream collected more pollutants?
   ii. What does the data tell you about riparian forest buffers?
   iii. Which stream is probably healthier, and why?

7. Wrap-up:
   a. Let students know that they will be working on their planting project the next visit (fill in the information per project)
   b. If time allows….
      i. Ask students to share what they have learned during these lessons

Graphic Organizer Answer Key- Non-Point Source Pollution

Fertilizers are used on a nearby field	Trash is thrown onto a sidewalk	Oil leaks from a car	Construction begins for a new business
Stormwater washes over the land and carries nutrients into the stream	A rain storm causes trash to float into a ditch	The oil runoff enters a storm drain during a rain storm	Bulldozers clear all vegetation
Excess nutrients cause algae to grow rapidly in the stream	The ditch leads to the stream	The storm drains empties into a local river	Sediment fences are not properly installed
Algae Bloom blocks the sunlight for aquatic plants	Trash floats in stream until a river otter finds it	Oil harms the fish population causing them to leave the area	A rain storm causes loose sediment to runoff the lot to a storm drain
The aquatic plants die and no longer undergo photosynthesis	The river otter mistakes the trash for food and eats it	Local Fishermen do not have any fish to catch	The storm drain empties into the stream
Dissolved Oxygen decreases in the stream		Fewer fishing license are purchased next season	Sediment in the river clogs fishes gills and fills in the spaces between rocks
Fish have less Oxygen			Benthic Macroinvertebrates living between rocks are covered

Buffer Benefits Readings

Instructions

Read the below readings aloud to the class, following the instructions to roll marbles as indicated throughout each reading. To calculate the pounds of pollution after each demonstration, use this conversion factor: 1 marble = 100 pounds of pollution.

Demonstration Number One: With Riparian Forest Buffer

It is August and a big thunderstorm is brewing. It begins to rain hard, and water rushes across the landscape of {Insert name of community} and downhill, toward {Insert name of local stream}. As the water flows over the land, it picks up various pollutants in its path.

Passing the grocery store parking lot, it picks up oil that leaked from cars. [Roll a handful of marbles toward the trees.]

Down the road, the land has been cleared for a new shopping center and here, the rainwater picks up sediment from the bare ground. [Roll another handful of marbles, preferably of a different kind or color, toward the trees.]

In the Whispering Creek subdivision, Mr. McKenzie just fertilized his lawn, and the water flowing across his land carries away the fertilizer. [Roll another handful of marbles, preferably of a different kind or color, toward the trees.]

[Note: Most of the marbles should hit a student and stop, without making it to the stream.]

Demonstration Number Two: Without Riparian Forest Buffer

It is August, one year later, and a new housing development has been built along {Insert name of local stream}. Because the landowners do not like the trees blocking their view of the river and want to develop additional parking areas, they have decided to clear trees. [Select all but a few students to sit down, explaining that they represent the trees that have been cut down.]

A big thunderstorm is brewing. It begins to rain hard, and water rushes across the landscape of {Insert name of community} and downhill, toward {Insert name of local stream}. As the water flows over the land, it picks up various pollutants in its path.

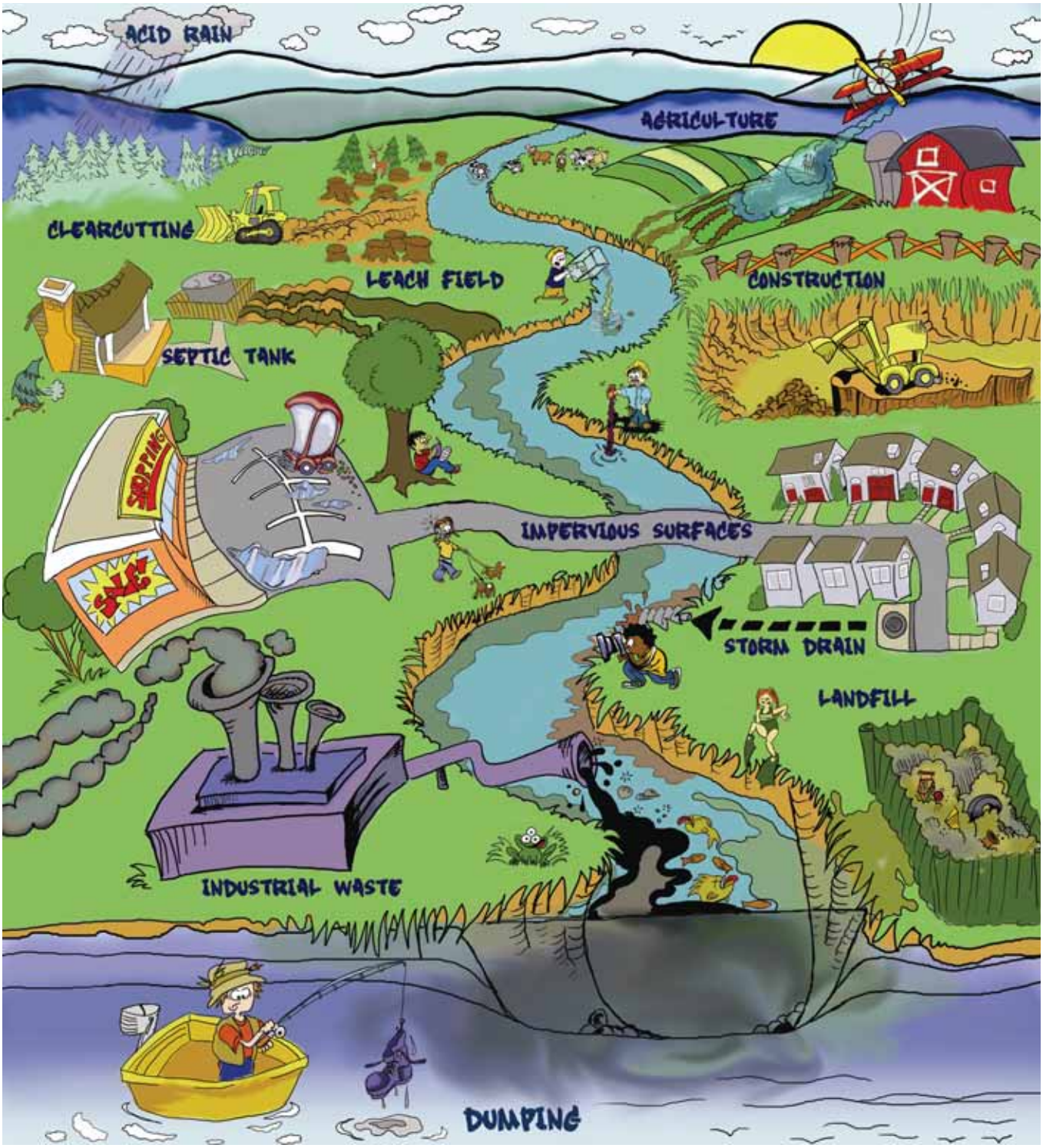
Passing the grocery store parking lot, as it did last year, it picks up oil that leaked from cars. [Roll a handful of marbles toward the trees.]

Down the road, the land has been cleared for another new shopping center and here, the rainwater picks up sediment from the bare ground. [Roll another handful of marbles, preferably of a different kind or color, toward the trees.]

In the Whispering Creek subdivision, Mr. McKenzie just fertilized his lawn, and the water flowing across his land carries away the fertilizer. [Roll another handful of marbles, preferably of a different kind or color, toward the trees.]

[Note: Most of the marbles should collect in the stream.]

Picture Water Pollution



Riparian Forest Buffers

Copyright, Ed Neville, 2002.

What are Riparian Forest Buffers?

Riparian forest buffers (also called **riparian forests**) are areas of trees, shrubs, and other vegetation located along a body of water. Riparian forest buffers provide a number of benefits to a river ecosystem: regulating the water temperature; providing food and essential habitats to migratory birds and other animals; and preventing pollutants from entering the waterway.

Threats to the Potomac River watershed

Increasing development and decreasing forest cover pressure rivers and streams throughout the Potomac River watershed. Up to 32 acres of open space are lost to development each day in the Potomac River watershed. With the building of houses, shopping malls, roads, parking lots, and other hard surfaces that prevent rainwater from soaking into the ground, stormwater runoff is much greater than it once was, causing increased pollution of our rivers and streams.

Riparian Forest Buffers: Protectors of the River

Riparian forest buffers protect streams from pollution. They act as sponges, absorbing major pollutants—especially sediment and nutrients—before they enter our rivers and streams.

- **Sediment:** Riparian forest buffers trap sediment that runs off of farmland, construction sites, and other areas of soil disturbance before it reaches nearby waterways. They also slow the speed of stormwater runoff, protecting streambanks from erosion. Riparian forests are less expensive and more efficient than man-made sediment removal techniques.

- **Nutrients:** Fertilizers and animal waste contain high levels of nutrients, especially nitrogen and phosphorus. Rainwater washes these nutrients into rivers and streams. But riparian forests absorb nitrogen and phosophorus for their own use, preventing them from reaching waterways. Forest buffers can remove 30 to 90 percent of the phosphorus and nitrogen from agricultural runoff.

Riparian Forest Buffers (con't)

Photo courtesy of Don Chernoff, 2004

Supporting Aquatic Communities

Riparian forests serve an important role in the aquatic food web. Fallen leaves from streamside trees provide nutrients and habitat for aquatic insect larvae, crayfish, and other invertebrates. Minnows, fungi, bacteria, and algae feed on disintegrated leaf material. These organisms, in turn, serve as food for fish, which are a food source for still larger animals. Riparian forest buffers also shade streams and rivers, helping to maintain a stable water temperature. Without this shade, summer and winter temperature fluctuations would render the water uninhabitable for many insect larvae and fish species.

Supporting Terrestrial Communities

Because of the diversity of habitats in riparian forest buffers, they generally support more wildlife than inland forests. These forests provide a great variety of vines, shrubs, and trees that offer nesting and food to a broad array of animals, and more extensive buffers serve as important flyways for migrating birds. Temporary pools of water in riparian forests provide habitat for frogs, toads, and salamanders. Turtles, river otters, beavers, muskrats, water snakes, deer, squirrels, wood duck, cottontail rabbits, herons, eagles, foxes, and songbirds are just some of the animal species that frequent riparian forests in the Potomac River watershed.

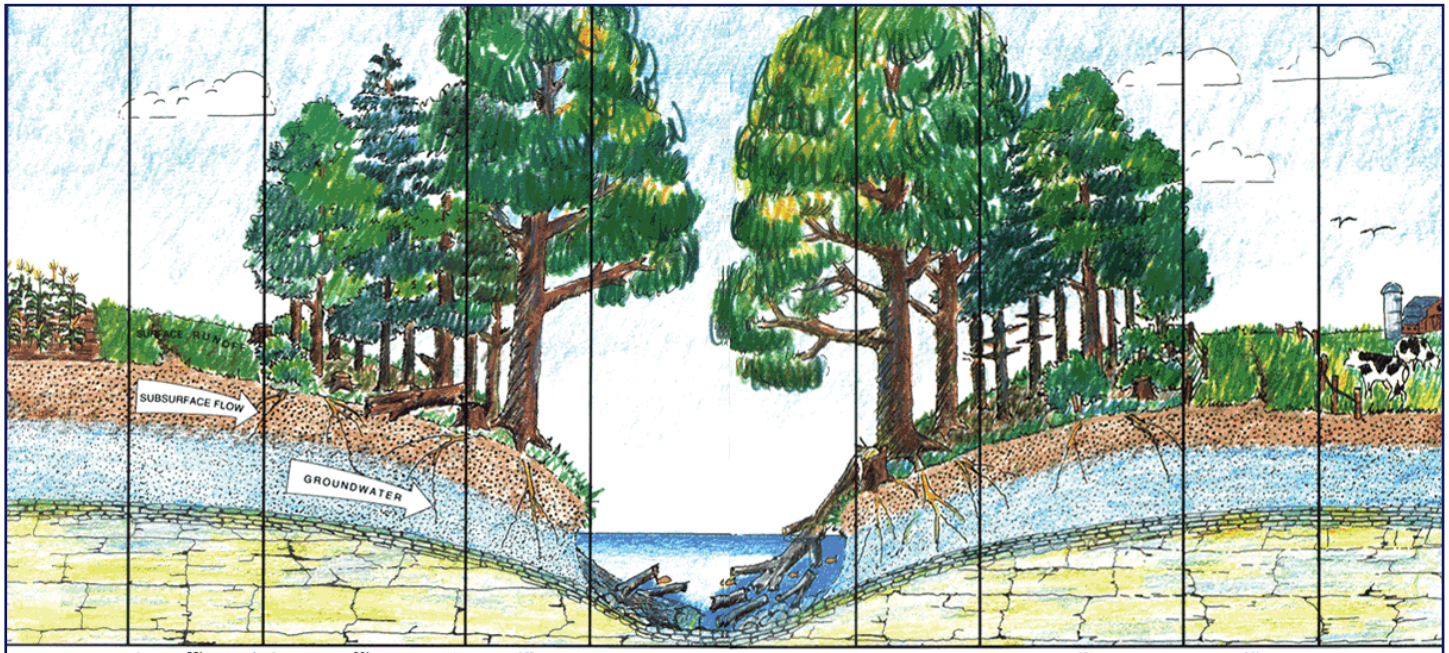
Photo courtesty of Don Chernoff, 2004

What You Can Do to Protect Riparian Forests

1. Volunteer for *Growing Native* by planting trees or collecting native tree seeds.
2. Reduce or eliminate fertilizer and herbicide use in your family's yard.
3. Talk to your family and friends about why riparian forests are important, and what they can do to help protect and restore them.

Riparian Forest Diagram

Source: Chesapeake Bay Program



CROPLAND	ZONE 3 RUNOFF CONTROL (20')	ZONE 2 MANAGED FOREST (60')	ZONE 1 UNDISTURBED FOREST (15')	STREAM BOTTOM	ZONE 1 UNDISTURBED FOREST (15')	ZONE 2 MANAGED FOREST (60')	ZONE 3 RUNOFF CONTROL (20')	PASTURE
Sediment, fertilizer and pesticides are carefully managed.	Concentrated flows are converted to dispersed flows by water bars or spreaders, facilitating ground contact and infiltration.	Filtration, deposition, plant uptake, anaerobic denitrification and other natural processes remove sediment and nutrients from runoff and subsurface flows.	Maturing trees provide detritus to the stream and help maintain lower water temperature vital to fish habitat.	Debris dams hold detritus for processing by aquatic fauna and provide cover and cooling shade for fish and other stream dwellers.	Tree removal is generally not permitted in this zone.	Periodic harvesting is necessary in Zone 2 to remove nutrients sequestered in tree stems and branches and to maintain nutrient uptake through vigorous tree growth.	Controlled grazing or haying can be permitted in Zone 3 under certain conditions.	Watering facilities and livestock are kept out of the Riparian Zone insofar as practicable.

Instructions

Read the definition of a riparian forest buffer and study the diagram.

"Riparian" refers to the area along a river, stream, or other body of water. **A "riparian forest buffer" is an area of trees, shrubs, or other vegetation located along a body of water.** The wider a buffer area, the more benefits it provides to the overall environment.

This diagram displays the benefits of riparian forest buffers of various widths. Keep in mind that although the age of a forest is not considered in this diagram, it is an important factor that affects overall ecological benefits. A mature forest provides more and greater benefits to wildlife and water quality than a young forest does.