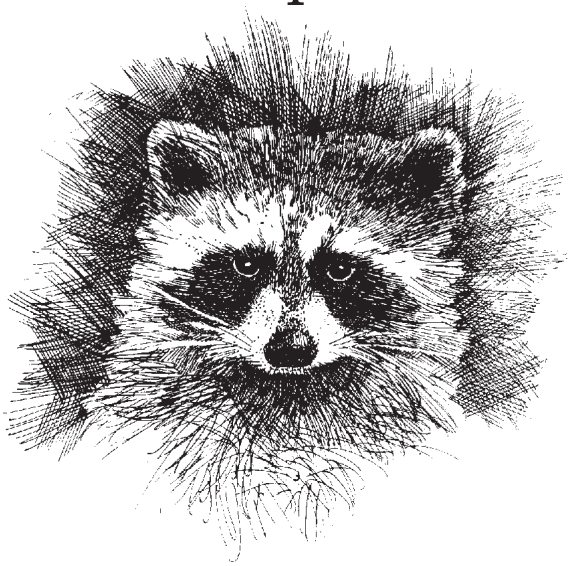
TUALATIN RIVER

National Wildlife Refuge

Pre-Field Trip Activities



Section C

Section C

Developing Nature Observation Skills

Overview
This lesson is designed to help students develop the observation skills necessary to view nature.

Duration
Three 45 min. sessions

Grades
K-8

Benchmarks
- Forming a question/ hypothesis
- Collecting & presenting data

Key Concepts
Students need to become aware of and develop methods for observing nature in order to fully appreciate the world around them.

Objectives
Students will be able to:
- become aware of and awaken their senses.
- use their new observation skills for detecting wildlife and the natural environment around them.

Materials
- blindfolds
- journals
- various liquids to taste, such as bottled water, tea, juice, etc.

Background Information

Naturalist Tom Brown, in his book *Tom Brown's Field Guide to Nature and Survival for Children*, illustrates the importance of developing observation in order to experience nature with the following story:

"One night I couldn't sleep, so I decided to go up to the Appalachian Trail and watch the sunrise. My wife, Judy, thought I was crazy because at that time of the year the trail was heavily used by backpackers. Disregarding her reservation I decided to go anyway, making my way up the trail and sitting under an old oak tree. The tree was located several yards away from a major crossroad, and a usually busy area, but it was early and the backpackers were not out yet. As I settled in, the sky began to grow light, and animal activity began to increase all around me. Birds landed on my head, chipmunks scurried across my legs, and deer passed along a run just a few inches from where I sat. The whole forest was active, and I sat unobserved, part of the whole life process.

Suddenly the whole woods went into a frenzy of animals running for cover. Squirrels chattered from high limbs, chipmunks dove down holes, and birds let out alarm cries. Within moments, the area that was once a peaceful blend of animal activity was now deserted. I knew also that to continue sitting would be somewhat futile, for most animals had now vacated the area, so I returned to the trail.

After a short walk, I encountered the origin of the disturbance. Three backpackers stumbled up the trail toward me, talking, shuffling, heads bowed toward the ground. They almost ran me down before they realized I was standing there. We got into a conversation and they told me that they had left their camp just before dawn, hoping to reach the second camp, twenty miles away, before nightfall. It was then I asked, "Did you see any animals?" One of them answered thoughtfully, "Naw, just a few birds." It was obvious their quest for time and destination overshadowed all they could have seen. In fact, I would venture to say they saw nothing more that day than "just a few birds." Teach your children to sit, patiently watching nature unfold before them.

Much of society today experiences nature disconnected, with dulled senses, and a strong sense of regimentation, schedules and time constraints. We are used to living in a fast-paced, technology- and industry-driven world. We no longer rely on our hunting-gathering senses to survive. As a result, we miss the richness that nature has to offer. Fortunately, we can reawaken our dulled senses with a few skills and practice to help us reconnect to nature.

As an educator, remember to slow down and practice the nature observation skills you teach your students. Allow time for unstructured wondering and exploring, as students often will learn more at these moments than during any well planned lesson.

Suggested Procedure

Relaxation and slowing down one's pace is the key to becoming more aware of one's own senses. Relaxation can be dynamic and moving. It is best to have students perform these skills in an outdoor setting.

Activity

Read aloud and have students follow these steps to develop patience and relaxation (may be adapted for different grade levels):

1. Clear your mind of all clutter that has accumulated during the process of daily living. This mental purification actually occurs quite naturally during an extended stay in the wilderness.
2. Slow down and escape the "time trip" of modern life. Walk and move at a snail's pace. A slower pace makes it easier for your eyes to pick up the flash of a bird's wing, the flick of a deer's tail, or the claw marks of a raccoon.
3. Sit down and stop altogether. Don't let speed and time rob you of discovery. Nature will begin to unfold its secrets.
4. Be quiet; it should be obvious that you will experience more in nature if you are silent. In nature, silence is the rule and noise is the exception. Most animals communicate more by gesture and touch than by sound. Since humans are the most lethal predator, the human voice almost always triggers a danger signal that causes wildlife to run and hide.

Have students practice the above steps on their own several times throughout the day. They may want to add a relaxation activity such as bead working, journaling, playing an instrument, etc. to help them relax.

Sensory Exercises

Sight

1. Have students begin by going through their relaxing steps. It is important that students do not talk during this exercise. Have them practice quiet patience.
2. Once students are settled, have them pick out a color, texture, shape, shadow or movement on the landscape. You may want to facilitate this task by giving each student a slip of paper with one of the above items for the student to start with. For example, find something that is red, or find something that has a sharp edge to it.
3. Have students search the landscape for less subtle colors and textures.
4. Study details carefully, and look deeply at flowers, blades of grass, leaf shapes, etc.
5. Observe closely the pattern of an item nearby.
6. Push their sight from near to far, and have them scan the landscape in ever-widening semicircles, from their feet to the horizon.
7. If possible, hand out magnifying glasses to scan the ground looking intently at pebbles, plants, insects, etc.
8. If your students are working on a nature journal, they can journal what they see, or you can begin a nature journal with this activity.

Wide-Angle Sight

As a society we are trained to view our world with tunnel vision. Much of what we need to see is usually straight in front of us whether it be a TV screen, computer monitor, or the road on which we are driving. In nature, we must retrain our vision to encompass a wider view in order to develop greater observation skills.

1. Have students look out into the landscape. Then, tell them to widen their view as though they were looking at an entire painting on a wall. Tell them to push out and stretch their view as far as possible.

2. Some students will have a difficult time simply widening their field of vision. For these students, have them stretch their arms out to their sides (like they do when they do windmills with their arms). Have students look straight ahead, and tell them not to move their heads but use only their eyes. Tell them to wiggle their fingers and slowly move their arms toward the center. Tell them to stop moving their arms the moment they see their fingers in their peripheral vision. Challenge students to see how wide they can keep their arms apart, and still see their fingers. Then, have them keep this wide-angle view and look at the landscape.
3. Once students begin mastering the concept of the wide-angle view, have students practice moving in and out of wide-angle and focused views. To do this, tell students to keep their wide-angle view, and the moment they spot something of interest, focus on that item for a bit, and then return to wide-angle view to spy something else of interest. They will find that they can see and take in a great deal of the landscape using this skill.
4. Once again, have students journal what they see, or even list what they see.
5. It would be interesting to try this on a different day with the same landscape, and challenge students to use their new skills to find changes in the landscape.
6. Encourage students to keep their wide-angle sight while moving through nature. Look at more than just the trail ahead. Challenge yourself to see things that are normally unseen. Keep their senses active, and moving. Show them exciting things along the way, or have students quietly share what they have seen.

Hearing

1. Have students close their eyes, or blindfold them.
2. Listen near and far, and encourage them to pinpoint the location and source of the sound they hear.
3. Focus hearing by cupping their hands around their ears. Tell them to cup their hands in different directions, and see if they notice different types of sounds.
4. Birding and hearing:
   a. Listen closely to what the birds are saying.
   b. Are they making long musical sounds? If so, they are singing and all is well with them.
   c. Are they making short, choppy, and hard to locate sound? If so, they are calling to each other or sending an alarm. Birds use alarm sounds to signal to other birds and animals of approaching danger.

Touch

1. Have students close their eyes, or blindfold them.
2. Tell students to lie on the ground and use their sense of touch to feel the earth, and sky, noting temperature and dampness.
3. You may want to turn this into a game, and have students try to identify common items found in nature based on their sense of touch.
4. One such game: a student leads another student who is blindfolded to a tree. The blindfolded student is allowed to explore the tree through their sense of touch. Once the student is done exploring, the guide leads them to a central location, and takes the blindfold off. The student who was blindfolded is now challenged to find the tree they explored with touch.

Taste and Smell

1. Have students hone their sense of smell by taking taste tests. Have students smell then taste the unknown liquid. Try using different kinds of water (tap, bottle, and spring), teas, fruits and vegetables.
2. In nature, have students smell the ground in various locations, and see if they detect a difference. Smell animal dens, runs, and trails. Do different leaves, barks, rocks have distinct smells?

Moving in Nature

By learning to move in nature, students will actually learn the proper way to walk. The current modern method of walking and the surfaces we walk on, are actually very damaging to our bodies.

The Fox Walk

A fox moves through the woods undetected because he is silent, quick, and sly. If you spy a fox moving through the forest, your sensory skills have been honed.

To walk like a fox you must:

1. Stop talking; use your relaxation/patience skills
2. Slow down your pace to where you are moving in slow motion
3. Shorten your stride
4. Lightly touch your foot on the ground before the weight of your body is committed
5. Place only the outside edge of your foot on the ground
6. Gently roll your foot down inwardly flat
7. Slowly move your weight forward in a flowing motion
8. Center your gravity at the center of your hips
9. Do not look at the ground; you should be using your wide-angle sight

The Rabbit Game

1. Form a circle around one person pretending to be the rabbit. When the rabbit looks at you, freeze. If you do not freeze, you are out. When the rabbit is not looking at you, fox walk toward it. See who can reach the rabbit first. Try two rabbits. This is the same way you sneak up on a real animal.
2. Practice the fox walk at home. See if you can sneak up on a cat or dog without scaring them.
3. Practice the fox walk outside. See if you can approach birds, beetles, frogs, squirrels, etc.

Assessment Ideas

Have students turn in their journals for periodic checks. Do not grade them for artistic impressions; instead, grade on effort, insight, and attention to the smallest of details.

Periodically change something in the classroom, and have students practice their observation skills to see if they can "spy" what it was that you changed. If you hear something, have students try to predict what made the sound before seeing the source of the sound.

References

Brown, Tom, JR. & Brown, Judy. *Tom Brown's Field Guide to Nature and Survival for Children*.

Websites:
Salmon Watch® Education Program – Oregon Trout

Outdoor Manners

Overview
Students brainstorm rules to follow while at the Refuge.

Duration
45 min

Grades
3-8

Benchmarks
- Organisms
- Diversity/Interdependence

Key Concepts
We all need to be good stewards of wilderness areas.

Objectives
Students will be able to:
- recommend appropriate actions in the outdoors, especially when visiting national parks and wildlife refuges
- create a class list of rules for their field trip to the Refuge

Materials
- large size paper or tag board
- pencils, colored pencils, markers, etc.

Background Information

Behavior expectations and rules are remembered better and become more personal when students generate them rather than being told.

Suggested Procedure

1. Ask students: "how does a visitor act in someone else's home?" Connect their replies to how we should act at the Tualatin River National Wildlife Refuge.
2. Have a discussion with students on the effects our actions can have on the outdoor environment – both positive and negative.
3. Make a student-generated list on the chalkboard of the types of outdoor behaviors and rules they recommend while visiting the Refuge.
4. Ideas should include:
   - Carry out all trash and if possible, pick up any litter left by others
   - Respect all wildlife and do not harass any animal
   - Stay on the trail
   - Taking shortcuts and going off trail can cause erosion and damage resources
   - Plants are protected and not to be picked, carved, or harmed
   - Loud noises / voices can scare off wildlife and disturb other people who are enjoying the Refuge
5. Have small groups of students choose one behavior statement or rule. Using the large paper or tag board each group neatly writes the rule and illustrates it, creating a poster.
6. Have each student write or type all the rules on one side of standard sized paper. If this is too much writing for the younger students the teacher could type the rules for students. Students illustrate this paper with a border so that it becomes a personal "mini-poster". Students will put their poster in their field trip journal for thei visit.
7. On the bus the teacher should have the students review the rules before they reach the Refuge.

Assessment Ideas

Small groups could create and act out skits that show acceptable and unacceptable behaviors at the Refuge. The skits could try to incorporate as many of the rules as possible.

References

Mount Rainier National Park. *Where the River Begins.*

Project Learning Tree. *Outdoor Manners Coloring Book.*

Nature Journal K-2

Overview
Students will create a nature journal for recording their observations and experiences while visiting the Refuge.

Duration
20 minutes

Grades
K-2

Benchmarks
- Forming a question/ hypothesis
- Collecting & presenting data

Key Concepts
Scientists often keep journals to record their observations. A journal can be used for a broad range of purposes. Keeping a journal while visiting the refuge can help students make careful observations of their surroundings. Students will be able to record their observations in writing or by drawing depending on their ability and grade level.

Objectives
Students will create journals following specific directions. Students will use their journals to record observations on nature walks and a visit to the Refuge. Students can use their journals as a record of observations for further study back in the classroom.

Materials
- colored paper 18" x 6" (one per student for cover)
- white paper 9" x 6" (for journal pages)
- colored paper 6" x 6" (one per student for cover)
- glue
- stapler
- hole punch
- yarn- 18" long
- pencils

Background Information

A nature journal is a way to record what students see, experience and feel in the world around them. Observations can be detailed, in narrative or in drawing and will be unique to the individual observer. Nature journaling helps students record what they have experienced and explore new ideas from these experiences. Data can be collected and memories saved for future reference.

Suggested Procedure

1. Give each student one colored paper 18" x 6". Have students fold the paper in half, ending with a 9" x 6" cover paper for their journals.
2. Staple white journal paper inside the cover, stapling the pages on the folded end of the cover. Use as many pages as you think your students will need for their observations.
3. Give each student a 6" x 6" piece of colored paper. Instruct students to fold the paper in half. Have students add this to the journal cover by gluing it over the top of the journal to cover the staples. Instruct students to leave a small opening at the top that will become a pencil holder.
4. Punch a hole near the top of the journal and tie a piece of yarn through the hole. Tie a pencil to the other end of the yarn. The yarn around the pencil can be reinforced with masking tape if necessary to keep the pencil from slipping out. Small "golf" scoring pencils are a perfect size for the journals, but any pencil will do.
5. Have students decorate the cover and put their name on their journal.

Practice taking nature walks with your students and have them create either pictures or written observations in their journals. Share with students that scientists record lots of information in their journals like the date, time, weather and place to help them remember what they observed. There does not need to be a set format for the journal observations. Students can develop their own recording style.

Nature Journal Ideas

Take a nature walk. Draw something in nature that represents every color in a rainbow. Find something that is red, orange, yellow, green, blue, indigo and violet.
Make a pencil rubbing of objects that you find on a nature walk. Look for leaves, seeds, bark of trees, rocks, etc.
Draw plants or animals that you observe.

Draw a flower that you find on your walk.
Draw something that is moving.
Pretend you are a bird flying over your school. Draw what the ground below you would look like as you fly over.
Look for signs of wildlife. These can include nests, holes in leaves or in the ground, slug trails, broken plants and animal tracks. Draw a picture in your journal of what you find.

Assessment Ideas

Have students discuss and share their writing and drawings.

References

Lomsteat, A. *My Nature Journal: A Personal Guide for Young People*.

Leslie, C.W. & Roth, C. E. *Keeping a Nature Journal: Discover a Whole New Way of Seeing the World Around You*.

Salt Marsh Manual: An Educators Guide.

Rhythms of the Refuge: Educators Guide.

Creating a Nature Journal 6-8

Overview
Students will make a nature journal to keep track of their observations, thoughts, and feelings about the natural world around them at the Refuge. They should use all of their senses and a variety of recording techniques.

Duration
Varies - use for pre-visit activities, during your refuge visit, plus future journaling activities at school or home

Grades
6-8

Benchmarks
- Organizing information
- Expressing ideas appropriate to audience

Key Concepts
Journaling gives you time to stop, look, think, and reflect using a variety of methods. Journaling is a creative way of recording; there's no right or wrong way to do it.

Objectives
Students will be able to:
- record observations while visiting the refuge
- learn about the interactions of living and nonliving things
- remember how they felt while visiting the refuge
- reflect on actions that can make a positive difference in the world around them

Materials
- 3-5 sheets 8.5 x 11" paper for each student
- pencils
- erasers
- colored pencils
- black pens

Background Information

Nature journaling is not new. Humans have been recording their observations on cave walls, animal hides and stone tablets for thousands of years. Today, people of all ages use nature journals to record their experiences on vacation, at school, in the workplace and in everyday life.

Journaling can be done with words such as stories, poetry and notes. It can include sketches, detailed drawings, photographs and nature samples such as leaves, flowers, seeds and feathers. It can be recorded using pencil, ink, paint, black, white, color…..the possibilities are endless. Use a variety of recording styles such as curving your writing around a corner of a page, drawing from a microscopic viewpoint, writing with different fonts styles—small, large, fancy, bold, colorful, italic, etc. Everyone's journal will look different.

Nature journaling increases our awareness of the things that surround us, and gives us the opportunity to observe and sense the interactions that take place among living and nonliving things. It allows us time to "see" things that we normally wouldn't see because we're in a hurry. It creates a memory record of a specific time and place that we can go back to and reflect on so that we can see how our thoughts and feelings about the environment have changed over time. It allows you to be creative.

Suggested Procedure

1. Fold all sheets of paper in half to form a booklet that is 8.5 x 5.5".
2. Attach the pages together using staples, yarn, raffia or any other method you choose.
3. The front cover should include a title, date, student's name and colorful drawing. If you are going to use the journal only for your field trip, have students write "Tualatin River National Wildlife Refuge" as their title and the day of your visit for the date. They can make the drawing on the cover before or after their visit.
4. Instead of using "student handout sheets" at the Refuge, you could have students do some or all of their recording in their journal. If they are doing a specific activity at a site, be sure they write a title at the top of their page.
5. Observe using all your senses: see, smell, touch, hear (taste is optional).
6. Be sure to allow <u>time</u> for journaling. Have students pause before or after visiting a site to reflect, think, write and draw.

At school before visiting the Refuge, practice observing by choosing a site, make a large circle, sit down and record everything you see, hear, etc. for 10 minutes. No talking. Another method would be to sit and observe for 5 minutes without writing. When time is up, record everything you can remember.

Introduce the "Journaling Ideas" to help students be more creative while using a variety of recording techniques (Journal for K-2, see pages 70-71). You may want to give students a copy of the ideas to refer to in case they have a hard time getting started. You can also prompt them by choosing an idea from the list that everyone should respond to.

Journaling Ideas

1. What is the season, time, weather or temperature?
2. Word pairs—blowing wind, chirping birds, scratchy grass, sparkling water.
3. How are you feeling? What kind of mood are you in?
4. Read the history of the landscape. What happened here?
5. Give a voice to the voiceless:

"I am a willow tree growing next to a creek….."

"I am a mallard getting ready to migrate…."

"I am a brand new butterfly stretching my wings for the first time….."

"I am a very, very old rock who has seen a lot of changes over the years….."

6. Describe a typical day as a frog, dragonfly, ant or ??
7. Free Write—write about whatever comes to your mind.
8. Draw a spider's web in detail.
9. Find a bird and observe its behavior for as long as you can. Record your field notes.
10. Memories—standing near the pond reminded me of last summer when I went fishing…..
11. Find something outdoors to observe. Record a list of quantitative information (using numbers) and qualitative information (using adjectives).
12. Tell how something "feels" (rock, grass, moss, tree bark, leaf).
13. Compare and contrast living and nonliving things. How do they depend on each other?
14. Find an area that you consider to be beautiful or interesting. Sketch a small part of the scene without looking at your journal or pencil. How did this method help you observe more carefully?
15. Search the area for the largest plant and the smallest plant. Make a list of how they are the same and how they are different.
16. Keep a record of the things that "catch your eye." Why do you think they attract your attention?
17. View from different perspectives: distance, up close, eye level, overhead.
18. Record animal sounds—chchch CHCHCHCH, stireeeep-stireeep-stireeep...
19. Write some poetry; there are lots of ways to do it!

Picture poetry—Draw the outline of a tree. On the inside of the tree, write all the uses of trees that you can think of.

Cinquain—consists of 5 lines and each line has a purpose and number of syllables.

a. title has two syllables

b. a description of the title using two words with two syllables each

c. a description of action in six syllables

d. a description of a feeling in eight syllables

e. another word for the title in two syllables

Example: Forests,
graceful, growing,
climbing among the clouds,
calmly awaiting the sunrise;
Alive.

Acrostic—the first letter in each line, when read vertically, spells out the name of something or conveys some other kind of message.

Example: **T**owering
Reaching
Extending
Embracing the sky

20. Slow down, appreciate the details. Remember—there's not a "right" or "wrong" way to do it.

Assessment Ideas

Ask the students the following questions about their journal:

Did you use all of your senses while observing? Which one did you use the most?

What did you observe that you have never seen before? felt before? heard before? smelled before?

What did you learn while recording in your journal?

When students return to school, have them reflect on things they can do which will make a positive difference in the world around them.

References

Leslie, C.W. & Roth, C.E. *Keeping a Nature Journal.*

Project Learning Tree. *Poet-Tree Diversity.*

Leopold Education Project. *Lessons in a Land Ethic.*

Nature Walks with Homemade "Binoculars"

Overview
Students will create "binoculars" out of cardboard tubes to help them learn to focus and observe while going on nature walks.

Duration
30 minutes

Grades
K-2

Benchmarks
- Organisms
- Diversity/Interdependence
- Heredity
- Science & Social Perspective
- Collecting & presenting data

Key Concepts
Using homemade binoculars will help students focus on a small part of nature while observing large areas. While walking and observing, students can be distracted by so many things to see at once. Narrowing in on small areas will help students to focus on one or two items at a time.

Objectives
Students will:
- create pretend binoculars with cardboard tubes.
- practice using homemade binoculars to focus on nature walks.
- discuss and share their observations from their nature walks.

Materials
- 2 toilet paper tubes per student
- yarn
- hole punch
- craft glue or white glue
- paper scraps
- crayons or markers

Background Information

Students love to go on nature walks and observe the life around them. A fun way to help students pay attention on walks is to make binoculars. Using individual binoculars, students can focus on one area to observe and eliminate distractions.

Suggested Procedure

1. Give each student two paper tubes. Allow time for students to decorate the tubes with paper scraps, crayons, markers, or whatever you have available.
2. When students are finished decorating the tubes, have them glue the tubes together along one side. Allow the glue to dry overnight or for several hours.
3. To make a strap for the binoculars, punch a hole in each tube and thread yarn through the holes to make a loop of yarn long enough to fit around the student's neck.

You can also make a telescope out of one tube for each student if you do not have enough tubes for each student to have two.

Going for a Walk

Discuss with your class what they might see with their binoculars on nature walks around the school. Remind them to stop and focus on one area with their binoculars. They may have to observe one area for several minutes before they see signs of life or any activity. They can focus on one small area like the bark of a tree, the leaf of a bush, or a patch of grass. They can focus on a larger area like a whole tree or bush. Give students an idea of what you want them to look for to help them focus their observations.

Take your students on several nature walks with a different objective for each walk. Have students observe the area chosen for specific things like signs of insects, animal activity, damage from weather, insects, humans, etc. It's helpful to keep track of what they are observing by writing or drawing in small journals so they can remember what they saw when returning to the classroom.

Assessment Ideas

1. Have students discuss and share their observations from their nature walks. Students can share any writing or drawing that they completed while on their walks.
2. Once students can use their binoculars and share observations, have them practice with real binoculars to see the difference between the

two. Discuss the advantages and disadvantages of using binoculars on a nature walk.

3. Ask students to draw what they observed in one spot while on a nature walk. Use circular paper shaped like the view from binoculars. Have students share their drawings and discuss how everyone notices different things while on the same nature trail.

References:

Showers, P. *The Listening Walk*.

Arnosky, J. *Crinkleroot's Guide to Walking In Wild Places*.

Arnosky, J. *Field Trips: Bug Hunting, Animal Tracking, Bird-Watching, Shore Walking*.

Meet a Tree

Overview
Students will test their tree observation skills using all senses except for their eyes. Students will blindfold a partner and lead them to a tree to make observations.

Duration
30 min

Grades
K-8

Benchmarks
- Forming the question/ hypothesis
- Analyzing & interpreting results

Key Concepts
By learning to rely on senses other than sight, students enhance their observation skills that will help them get the most out of their field trip to the Refuge.

Objectives
Students will be able to:
- practice using their tactile and olfactory senses to make observations
- increase their awareness of different tree characteristics

Materials
- blindfolds

Background Information

At first glance, you may think all trees of the same species are alike. With closer examination, students will be able to determine differences in the trunk, limbs and bark without using their sense of sight. By covering their eyes with a blindfold, their tactile and olfactory awareness is enhanced. Students might notice the heat from the angle of the sun, sounds from close proximity to a street or creek or texture from lichen and moss on the bark. All of these characteristics will help students become better acquainted with "their tree". Once their blindfold is removed and the student begins searching for her/his tree, instead of seeing a forest full of trees, they will see each tree as a separate individual with unique characteristics.

Suggested Procedure

1. Go outside to a wooded area.
2. Have students find a partner.
3. Stand in a large circle and explain rules before passing out blindfolds.
   a. Help your partner put on a blindfold. Be sure it is positioned so that they can't see.
   b. Carefully turn them around a few times to disorient them.
   c. Lead them to a tree that is 20 – 30 meters away, by taking an indirect route.
   d. Remember: when you are leading someone who is blindfolded, they are trusting you to keep them from running into anything. Hold onto their hand or shoulder and slowly lead them to a specific tree.
   e. Give them 2 – 3 minutes to get acquainted with "their tree" using any of their senses except sight.
   f. With blindfold still in place, lead them back to the starting point by taking a different route.
   g. Carefully turn them around a few times to disorient them.
   h. Take off the blindfold and see if they can find "their tree".
   i. Now blindfold the other partner and repeat step 3.
   j. When both students have completed this activity, they should meet back in the beginning large circle to share what they discovered.
4. Give one blindfold to each pair of students and let them begin.

Assessment Ideas

When all students have finished, have them come back to the large circle to share.

1. Have students raise their hand if they were able to find "their tree".
2. Was it easy or hard to find your tree?
3. What observations did you make when you were blindfolded that helped you find your tree once the blindfold was removed? (Allow time for all to share.)
4. How could this activity relate to the people standing here in this circle?

References

Cornell, J. *Sharing Nature with Children*.

Parts of a Tree

Overview
All students are familiar with trees and what many different types of trees look like. By doing this activity, students will be able to identify the parts of trees and the function of those parts.

Duration
30-45 min

Grades
K-2

Benchmarks
- Organisms
- Diversity/interdependence
- Collecting & presenting data
- Unifying concepts & processes

Key Concepts
Trees are an important part of our environment. They have many different functions and come in a variety of shapes and sizes.

Objectives
Students will be able to:
- examine trees and identify the basic parts of trees
- describe the function of a tree and the various parts
- create a diagram of a tree and label the parts

Materials
- 12 x 18" white construction paper
- crayons
- scissors

Background Information

Trees are all around us and are an important part of our environment. Trees provide many things for us like wood for building, pulp for paper, shade, etc. They also help freshen the air, provide homes for wildlife and help make the world a beautiful place to live. While trees vary in shape and structure, they all have similar parts and various functions.

Suggested Procedure

1. Show students pictures of many different trees. Ask what they know about trees. See if they can identify the different parts of a tree.
2. Write the following words on the board:

   tree, crown, trunk, roots, bark, branches, leaves

   Read the words with students and see if they know the meanings of each word. Remind students that a crown is the top part of a tree that includes the leaves, branches, seeds and flowers. Some trees have rounded crowns (broadleaved trees) while other have triangular crowns (conifers). The trunk of the tree is the stem. Bark covers the trunk and helps protect it, like our skin protects us. The roots are like branches underground that help get water and nutrients from the soil. Some roots grow deep in the ground while other roots grow close to the surface.
3. Take students on a walk around the school grounds to examine trees of various shapes and sizes. Remind students to look for the crown, trunk, branches, leaves, bark, and even the roots.
4. Discuss with students the different parts of a tree that they observed and review the function of the different parts.
5. Tell students that they are now going to make a diagram of a tree that they examined. Give each student a 12" x18" piece of paper and have them fold the paper in half lengthwise. Draw a line on each paper approximately four inches from the bottom of the paper, keeping the fold on the left. The line is the ground for a tree.
6. Have students place one arm on the paper so that their hand is near the top of the paper. Tell students to keep their fingers outstretched to resemble the branches of a tree. Trace the arm and hand, stopping at the line near the bottom of the paper. The tracing of their arm becomes the trunk of a tree and their fingers become the crown of a tree. Students can turn the paper upside down and trace their hand below the ground line they drew. Their fingers become the roots of the tree.

7. Have students complete their diagrams by filling in the leaves, and bark and coloring the rest of the tree and ground. Have them label the crown, trunk and roots of the tree.

8. On their tree diagrams, make two horizontal cuts on the front cover for students about six inches from the top and bottom of their paper. This should divide the trees into three parts: the crown, trunk and roots. Opening each part of their diagram, have students write the function of each part.

crown
trunk
roots

Discussion Questions

Ask your students the following questions:

1. Why are trees important to us?
2. How do we use trees?
3. What do animals and insects use trees for?
4. How can we protect trees from overuse?
5. What is a crown of a tree?
6. What is the trunk?
7. How does the bark help a tree?
8. What are the roots of a tree?
9. What can we do to help trees grow healthy?

Assessment Ideas

1. Collect leaves, sticks, seeds, pine needles and other parts of a tree on a nature walk. Have students use these collections to make a picture of a tree by gluing the parts onto paper. Label the parts of the tree.
2. Have students practice making bark or leaf rubbings of trees that they have examined.
3. Review the life cycle of a tree with students. Have them become a tree by pretending to grow like a tree. Start by having them curl up into a ball on the floor and slowly grow, becoming a trunk, branches growing, leaves added, etc.
4. Make a mural of the school grounds adding the many different types of trees the students examined. Discuss the benefits of having lots of trees and where more could be planted.

References

The Mailbox Magazine for Primary Teachers, August/September 2002.

Project Learning Tree Environmental Education Activity Guide Pre K-8.

Gibbons, G. *Tell Me, Tree – All about Trees For Kids.*

Lauber, P. *Be a Friend to Trees* .

Balla, C.R. *A Tree is a Plant.*

Davis, W. *Douglas Fir.*

The Energy Game

Overview
Students are able to experience the energy flow of a food web through an ecosystem by playing a form of freeze tag.

Duration
30 - 45 min

Grades
3-6

Benchmarks
- Organisms
- Diversity/Interdependence

Key Concepts
Food webs are an integral part of an ecosystem. The components of an ecosystem interact to produce a balance

Objectives
Students will be able to:
- Know that energy in a food web begins with the sun
- Know that plants, herbivores, carnivores, and decomposers gain and lose energy in a food web
- All parts of an ecosystem are interdependent

Materials
- Sunflower seeds, lima beans (or some other small hard seed) are used as "energy bundles"
- Small, re-sealable (Ziploc-type) bags to hold the energy bundles
- Name tags for students to wear: "sun", "plant", "herbivore", "carnivore", "decomposer"
- Game area (the game area should be about the size of ½ a basketball court)
- Whistle to stop the game periodically

Background Information

Refer to "Refuge Web of Life" page 59 of this manual.

Vocabulary

ecosystem – dynamic interactions between plants, animals, and microorganisms and their environment working together as a functional unit.

food chain – an arrangement of the members of an ecological community according to the order in which each uses the next (usually lower) member for food. For example: a seed is eaten by a mouse, which in turn is eaten by a snake, which in turn is eaten by an owl.

food web – the totality of interacting food chains in an ecological community.

photosynthesis – the conversion by plants of carbon dioxide and water into a sugar called glucose using sunlight energy. Oxygen is produced as a waste product.

producers – green plants that can produce food from sunlight, carbon dioxide and water (photosynthesis).

consumer – an organism that obtains its food by eating other organisms.

herbivore – an organism that only eats plants.

carnivore – an organism that only eats animals.

decomposer – any organism that breaks down dead plant and animal matter into nutrients. For example, mushrooms, earthworms, etc.

Suggested Procedure

Preparation:

Prior to playing this game, the students should have a basic idea of what a food web is. Create nametags for students to identify what their role is in the ecosystem. Each student has a Ziploc-type bag to hold their "energy bundles".

Student roles:

1. sun (one student)
2. plant (several students)
3. herbivores (fewer number than the plants)
4. carnivores (fewer number than the herbivores)
5. decomposers

A lima bean, sunflower seed, or other type of seed serves as an "energy bundle"

1. The "sun" has a large supply of energy bundles
2. The plants each get 4 energy bundles (4 seeds)

Game:

1. Make sure students know the boundaries of the playing field (about ½ of a basketball court) before they begin.
2. To begin, each plant receives four energy bundles (4 seeds) from the sun. Plants must say "photosynthesis" to the sun in order to receive their energy bundles. Plants can return to the sun as often as they want to get more energy bundles.
3. The herbivores chase and tag plants and receive half of the plant's energy bundles.
4. Carnivores tag herbivores and receive half of the herbivore's energy bundles.
5. Tagged plants and herbivores that die - must "freeze".
6. However, decomposers tag dead plants and herbivores to gather their remaining energy bundles.
7. After giving the rest of their energy bundles to the decomposers, dead plants and herbivores become new plants and herbivores and re-enter the game.
8. After *two minutes* the game stops and students tally their energy bundles. Anyone with fewer than ten seeds dies.
9. The class keeps track of the number of players that survived. Students now can examine how the game differs from a real ecosystem (what happens to the carnivores?) and can add rules or components to the game to make it more accurate to reflect a real ecosystem.

Enrichment Ideas

Students can make changes to the game, for instance:

1. "Night" could be added so that during a certain time period (1-3 minutes) plants could not photosynthesize
2. Omnivores, organisms that eat both plants and animals (bears, people) could be added
3. Humans could be added: with humans comes habitat loss

Assessment Ideas

Discuss with the students the balance of the ecosystem:

1. Why are there more plants than herbivores? why are there more herbivores than carnivores? What is the role of the decomposers? Imagine a world with a lot of dead plants and animals piling up - this helps students to understand the role of decomposers.
2. What if there was a population explosion of rabbits (herbivores) to this ecosystem?
3. What would happen if there was a fire in this ecosystem?
4. What if a subdivision of houses was planned for this ecosystem area?

References

Science and Children. *Ecosystem*

Refuge Web of Life

Overview
This lesson is designed to visually and physically depict the concept of a food web.

Duration
45 min

Grades
K-8

Benchmarks
- Diversity/interdependence
- Dynamic Earth
- Forming a question/ hypothesis
- Collecting & presenting data
- Analyzing & interpreting results

Key Concepts
The food web is comprised of both living and nonliving elements. In a balanced ecosystem the food web is in equilibrium, but when stress is applied to the food web the entire ecosystem is impacted or damaged.

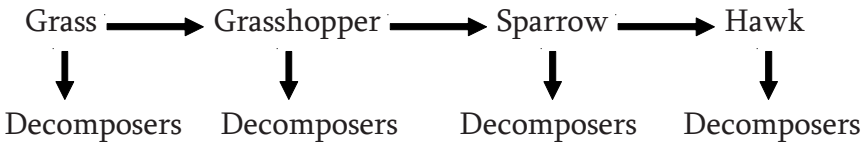
Objectives
Students will be able to:
- explain how the living and nonliving parts of the natural world are connected to each other
- appreciate the interconnectedness of all parts of the refuge
- describe the elements of restoration in the refuge

Materials
- web of life cards
- two large balls of string or yarn
- scissors

Background Information

The plants, animals, and physical environment of an ecosystem are interconnected and interdependent. Some relationships are direct, and simple to understand. For example, a deer has a direct relationship with the plants it consumes. Indirect relationships are less obvious. A mountain lion consumes deer, but it also has an indirect relationship with plants because without plants, the deer could not live. Because of these direct and indirect relationships, a change in one part of an ecosystem can bring changes in other parts of an ecosystem. All of these connections can together be thought of as a web of life.

Beyond understanding simply that organisms are connected with one another and their physical environment, it can be helpful to discuss their relationships more specifically. Food chains are often used to illustrate some of these relationships. An example of such a food chain is:



The various levels of the food chain can be defined in the following way:

- Producer: an organism that produces its own food (example: algae, plants, some bacteria)
- Consumer: an organism that ingests other organisms or organic matter. Consumers are divided into 4 subgroups:
  - Herbivore: an organism that feeds chiefly on plants (sometimes called a primary consumer; example: grasshopper)
  - Carnivore: a flesh-eating organism (example: sparrow, hawk)
  - Omnivore: an organism that eats both plants and animals (example: raccoon)
  - Decomposer: any of the various organisms that feed on and break down organic substances (such as dead plants and animals). Decomposers are involved at every level of the food chain and play an integral role in the recycling of nutrients (example: bacteria, fungi).

Expanding this food chain into a food web is simple. A grasshopper can be eaten by a number of other organisms. It may eat several types of grass. A hawk will eat multiple species of animals, not just one species of sparrow. Omnivores, by definition, eat a variety of organisms. In addition, decomposers play an essential role in all parts

of any ecosystem, by returning the organic matter of dead plants and animals to an inorganic form that can again be taken up by plants.

A food web can be further expanded into a web of life by considering the role of air, water, and nutrients. While often less obvious, these components play an essential role in the ecosystem. For instance, without nutrients, plants may not grow well and may not be as nourishing for herbivores.

In the end, it is clear that the web of life has many connections between organisms and their environment. Direct and indirect connections between the components make for the incredible complexity of an ecosystem.

Suggested Procedure

1. Photocopy and cut out the Refuge Web of Life cards. These plants and animals are found on the Refuge, as are the basic components of the physical environment (sun, air, etc.). For pre-readers, pictures depicting the plant or animal can be added to the back of the card.

2. Divide the students into groups of 10 – 15 students. Ask each group of students to stand facing one another in a circle. Hand each student one of the cards, and give them a moment to read the information on the card. Each student's card should be placed where other students can see it.

3. Begin the "webbing" by handing the ball of yarn/string to one of the students in the circle. This student will declare who they are and their role in the refuge. He/she will then pass the ball of yarn/string, and explain their relationship with the player to whom they are passing the yarn. For example, a student will declare, "I am Red-tailed Hawk, and my role in the Refuge is to help maintain the natural balance of the ecosystem by eating a variety of small animals and fish. I breathe air." Then the Hawk student will pass the ball of yarn/string to the student holding the Air card.

   Relationships can be direct or indirect. For example, a Hawk depends on Rabbits for food, but it also depends on Plants because the Rabbits eat the Plants. If a student receives the yarn/string a second time, he/she should pass it to a student that he/she has not already tossed to.

   Note: For young children, this activity works better when the students are seated and the yarn is rolled between players.

4. Once the webbing is complete, have students shift so the web is taut. Have students discuss how sometimes a plant or animal's role in the web may change, or may disappear entirely (example: pollution, habitat loss, etc.). How will this affect the web as a whole?

5. Begin to announce the different destructive forces (found on page 60) that can occur within this intact, pristine refuge. Use the Refuge Impacts chart as a guide through this part. For example, announce that within the Refuge, small mammals die off. Have students that represent small mammals raise their yarn/string up. Any students that feel a tug on the yarn/string should also raise their hands. Continue announcing things and events that cause tension in the web of life until most of the students' hands are raised. Reverse the process by asking students how the damage can be healed. Show the recovery by having students put their hands back down.

6. Discuss the meaning of the activity with the class:

   a. Are any parts of the web more important than others to the survival of the whole?

   b. Are you surprised that some of the plants, animals or physical elements you had considered unimportant are actually essential to the survival of the web?

7. When you are done with your discussion, have everyone place their yarn carefully on the floor. Have one of the students roll up the yarn.

Extension/Adaptations

When students are passing the yarn, have them name their "role" ecosystem (example: carnivore, decomposer, producer, etc.) This reinforces the meanings of these words.

Have students research the food habits and predators of their animals, the needs of their plants, or the importance of their physical components. Students can include this information on the back side of their cards.

Assessment Ideas

Have students identify the animals, plants, and physical components in another food web and describe their role (carnivore, herbivore, omnivore, etc.).

Have students write the name of their plant, animal or physical component at the center of a page, and draw a web of life that shows the connections of their element with the other organisms and physical components of the ecosystem.

References

Rhythms of the Refuge: Educators Guide

Websites:
Salmon Watch® Education Program – Oregon Trout

National Wildlife Refuge Association

What Impacts the Refuge?

- agricultural pesticides
- agricultural irrigation
- roads, buildings, and runoff
- housing and commercial development
- global warming
- acid rain
- household toxic wastes
- floods
- industrial pollution
- exotic plant and animal intrusion
- El Nino
- volcanic eruption
- erosion
- people walking off the paths
- overpopulation
- poor refuge management practices

Web of Life Cards

Customize: Develop cards with the names of plants and animals found on the refuge, and short descriptions of the role this plant or animal plays or the habitat it lives in and what it eats. Include a variety of plants and animals, including insects, bacteria, reptiles, mammals, and birds to show the diversity of life found on the refuge.

Refuge Part	Refuge Role
I represent cold, clean, free-flowing water in the stream.	Part of my role in the Refuge is to provide habitat for fish, aquatic insects, beavers and a host of other wildlife.
I represent riparian (streamside) grasses and shrubs.	Part of my role in the Refuge is to provide cover, in addition to shade, for temperature regulation. In autumn, my leaves drop into the stream and eventually provide food for aquatic bugs that are eaten by salmon.
I represent grasses, sedges & rushes.	Part of my role in the Refuge is to provide food and habitat for numerous species of wildlife and insects, and to prevent soil erosion.
I represent soil (it's a dirty job).	Part of my role in the Refuge is to provide essential nutrients for plants and habitat for many insects like millipedes and wildlife like shrews.
I represent deciduous trees like maples, madrones, oaks and ashes.	Part of my role in the Refuge is to provide food and habitat for numerous wildlife species and shade to cool streams for fish. I also produce oxygen, stabilize the soil from erosion, and replenish soil nutrients.
I represent conifer trees like firs, hemlocks, pines, spruces and cedars.	Part of my role in the Refuge is to provide food and habitat for numerous wildlife species and shade to cool streams for fish. I also produce oxygen, stabilize the soil from erosion, and replenish soil nutrients.

I represent shrubs like salal, Indian plum, vine maple, and red huckleberry.	Part of my role in the Refuge is to provide food and habitat for numerous wildlife species and shade to cool streams for fish. I also produce oxygen, stabilize the soil from erosion and replenish soil nutrients.
I represent herbaceous plants like stream violets, Douglas' asters, large-leaved lupine and common red paintbrush.	Part of my role in the Refuge is to provide food for wildlife and insects, stabilize soil from erosion and replenish soil with nutrients.
I represent wetland plants like cattails, Wapato, yellow pond lilies and water-plantain.	Part of my role in the Refuge is to provide habitat for an incredible number of wildlife, fish and insects. I also filter sediments and pollution for streams and provide a buffer against flooding.
I represent macro invertebrates or aquatic insects like stonefly, caddis fly, and mayfly nymphs.	Part of my role in the Refuge is to be the major food source for fish in streams and other aquatic and terrestrial life including birds. I also am a key indicator in determining pollution levels in streams.
I represent waterfowl birds like grebes, herons, geese and ducks.	Part of my role in the Refuge is to be one of the critical indicators of the biodiversity and health of the watershed ecosystem.
I represent perching or song birds like kingfishers, sparrows, robins and warblers.	Part of my role in the Refuge is to eat fruit and berries from trees and plants and deposit seeds throughout the Refuge.
I represent birds of prey or raptors like hawks, eagles, falcons, owls and osprey.	Part of my role in the Refuge is to help maintain the natural balance of the ecosystem by eating a variety of small animals and fish.
I represent small mammals like shrews, bats, rabbits, chipmunks, skunk and squirrels.	Part of my role in the Refuge is to invigorate the soil for plants and to be a food source for larger animals like coyotes and birds of prey like the red-tailed hawk.

I represent large mammals like deer, elk, and coyotes.	Next to humans, I occupy the highest level on the food chain. I help maintain the natural balance of the ecosystem by eating a variety of small animals, fish and plants.
I represent reptiles like turtles, lizards, and snakes.	Part of my role in the Refuge is to be food for such wildlife as hawks and to help maintain the balance of the ecosystem by consuming insects and adding nutrients to the soil.
I represent amphibians like salamanders, newts, toads, and frogs.	Part of my role in the watershed is maintaining the balance of the ecosystem by consuming insects and adding nutrients to the soil.
I represent beetles, worms, centipedes, and millipedes.	Part of my role in the Refuge is to create high soil nutrient quality through constant consumption of woody and plant materials on the forest floor.
I represent the sun.	Part of my role in the Refuge is to provide energy so plants can grow.
I represent the water.	Part of my role in the Refuge is to provide the necessary ingredient for life – water. Some animals and plants can only live in water.
I represent the air.	Part of my role in the Refuge is to provide oxygen for the animals to breathe, and carbon dioxide for plants to make their own food. Bearded moss is an indicator of how clean I am.

No-Trash Lunch

Overview
Students will learn where the food and packaging in their lunch comes from and the importance of waste reduction.

Duration
20 min

Grades
K-8

Benchmarks
- Dynamic Earth
- Analyzing & interpreting results

Key Concepts
Nothing can ever really be "thrown away." Just because we can't see it anymore doesn't mean it's not still sitting in a landfill somewhere. By being aware of the problem of waste materials, we can work together to help reduce, reuse, and recycle everyday products.

Objectives
Students will be able to:
- learn where the food in their lunch came from
- recycle as much of their lunch waste as possible
- understand the importance of reducing, reusing, and recycling

Materials
- students' lunches
- labeled recycling and trash bins:
plastic beverage containers, aluminum pop/juice cans, biodegradable food, paper, plastic wrappers or containers, other

Background Information

Biological breakdown time depends on the type of garbage and under what conditions the breakdown occurs (e.g., sunlight, oxygen, heat, rainfall, etc.).

The United States of America has over 270 million residents. We make choices every day that affect the plants, and animals that also live here. The way we raise and package food and care for the land all have impacts on the environment. Excess product packaging ends up in landfills. Long distance transportation of food requires fossil fuels which affect plants, animals and their habitat. Amazingly, the average person generates about 1500 pounds of garbage each year or 4 pounds every day!

Many of the items made in the U.S. today are thrown away after one use. Often these items are not biodegradable, which is a big problem. Household trash usually contains about 60% paper, 10% glass, 10% metal cans, 15% plastic containers and 5% food material. All of these materials can be recycled or reused. Much of the waste that goes into landfills could be eliminated by reducing, reusing, recycling and composting. When we "throw something away" it doesn't really go "away." Instead it sits in a landfill somewhere for hundreds of years. After the landfill is full, another one has to be made, which has a negative impact on plants, animals and their habitat.

Material	Source	Biological Breakdown Time
paper	trees	30 days
plastic	oil (ancient aquatic microorganisms)	500 years - forever
aluminum	rocks and minerals	200 - 500 years
glass	water, sand, minerals	500 years
food products	plants or animals	14 - 90 days

We need to think of ways to decrease the negative impact we have on wildlife in our everyday choices. We can reduce the amount of products we use. We can buy products with less packaging. We can buy products in bulk. We can reuse our "throw-away" products. Did you know that it takes 80 acres of trees to produce all of the copies of the New York Times for one Sunday? Seventeen trees are saved every time one ton of paper is recycled. Aluminum cans can be remelted for new cans. Glass can be crushed and used again.

Vocabulary

biodegradable—a material that breaks down or decomposes naturally, turning back into soil

recycle—to take used materials and use them over again, to make new materials

reduce—to make or use less

compost—to allow plant materials to break down naturally into soil

Suggested Procedure

After students finish eating their lunches, have them put their waste materials into the appropriate recycling bins. Discuss the contents of the bins, including where the products came from (see table above). Ask students questions like, "Who had a tree in their lunch box?" and "Who had rocks in their lunch?" to get them thinking about the original source of the products. Tell them that the ancient relatives of the microorganisms that they looked at in the pond/creek today were used to make plastic. They can be reduced, reused, or recycled.

Discuss the importance of recycling and reusing materials. What would happen if we didn't recycle anything? Remind students that if each person recycles and reuses a little, all together we can make a big difference.

How does nature recycle things? Decomposers like bacteria, worms, insects and fungi help biodegrade or break things down by eating them. Eventually the materials change back into soil.

What are some specific things you can do to help solve the problem of waste? Examples:

- Reduce by not buying products that have lots of packaging.
- Reduce by not using disposable containers.
- Reuse paper bags.
- Reuse plastic baggies.
- Recycle cans, plastic bottles, paper, glass and cardboard.

Assessment Ideas

1. Have students trace the path of their lunch food all the way back to its origin.
2. If you were going to pack a "no-trash" lunch, what would you include?
3. Have students keep track of the garbage produced at home for one week. How many of the items could be recycled or reused? Challenge them to help their parents recycle.

References

Rhythms of the Refuge: Educators Guide

Stickler Hunt

Overview
In this activity, students will hunt for a new "animal" called a stickler and discover the needs a living thing has to survive.

Duration
Two 30-45 min sessions

Grades
K-2

Benchmarks
- Organisms
- Heredity
- Diversity/Interdependance
- Unifying concepts & processes

Key Concepts
Living things need food, shelter, water, and air to survive. This activity helps students gain an understanding of habitats, food chains, camouflage, and predator-prey relationships.

Objectives
Students will be able to:
- define habitat, food chain, predator, prey, and camouflage
- identify what is needed for a living thing to survive
- create a habitat for a stickler on paper

Materials
- toothpicks or green straws
- glue
- paper
- crayons

Background Information

Sticklers are pretend animals that are used to introduce students to the idea of habitats and the needs of living things. Make sure that students are careful with the toothpicks. For younger students it is recommended that green straws are used for safety.

Suggested Procedure

Session One

1. Prior to this activity you need to place toothpicks or straws outside in a grassy area for students to go out and find. If the weather is not permitting then place the sticklers in a place within the school for students to go on a hunt. Be sure that the sticklers are partially hidden and not easy to find.
2. Begin by telling students that there is a new animal around school that lives in the grass (or wherever you have placed the sticklers). Describe the sticklers by telling what they look like, where they live and what they eat (you can make up anything you want the sticklers to eat like grass, worms, insects, etc.). Do not show the students the sticklers yet. Tell the students that they are going on a hunt to find some sticklers and must each come back with two sticklers. Explain that the sticklers are safe to touch but to be careful with them. Right before going out of the room, show the students a stickler so they know what to look for.
3. Take the students to the area where you have hidden the sticklers. Allow 5-10 minutes for students to hunt for sticklers. Remind students to notice the area where the sticklers were found and to each take only two sticklers.
4. Gather the students together and ask what the area is like where they just found their sticklers. Ask what made it easy or hard to locate the sticklers. Take the sticklers back to the classroom with you.
5. Once back in the classroom have students glue their two sticklers onto a piece of paper. Save these papers for session two.
6. Remind students that all living things need food, shelter, air and water to survive. Ask students the following questions about sticklers.
   What did we just find?
   Why was it hard/easy to locate the sticklers?
   What made it easy for them to survive?
   What do you think sticklers eat?
   What enemies do you think sticklers have?
   Describe the area where we found the sticklers.
   What type of shelter do you think sticklers might have?
   Did the sticklers have water nearby?

7. Explain to the students what a habitat is and describe the sticklers' habitat. Go over what the sticklers might eat and draw out a food chain involving the sticklers. Discuss what might happen if a part of the food chain is gone.
8. Discuss why it was hard for the students to find the sticklers. Explain that this was camouflage and is a way that an animal or plant protects itself from predators. Explain that a predator is looking for a plant or animal to eat and what the predator finds to eat is the prey. Have students brainstorm for examples of the predator/prey relationship.

Have students save their sticklers that are glued onto paper for session two.

Session Two

1. Review what a stickler is and what type of habitat that they are found in. Remind students that they are make believe but are helping us learn about real plants and animals and how they live. Have students share examples of habitats from other animals that they are familiar with.
2. Review with students the vocabulary terms camouflage, food chain, predator and prey. Have students role play the various parts of a food chain and discuss what happens if one part of the chain is broken.
3. Have students recall the meaning of predator and prey. Have them work with partners and come up with several examples of a predator/prey relationship to share with the class.
4. Have students look at their sticklers glued on the paper from session one. Recall that a plant or animal needs food, water, shelter and air to survive. Assign students to draw with crayon the habitat that the stickler was found in. Students can be creative and add arms, legs and faces to their sticklers to make them more real. Remind students about camouflage and ask them to show an example of camouflage in their drawings. Ask students to add parts of the food chain to their picture to show how a stickler would survive. Remind the students to think of a predator that might try to get the sticklers and add that to their drawings.
5. Have the students meet in small groups when their drawings are finished. Have each student share their pictures with their group, identifying the habitat that the sticklers are living in, the food chain, an example of camouflage and a predator in the drawings.
6. End this session with a class discussion recalling the terms habitat, camouflage, food chain, predator and prey.

Assessment Ideas

1. Students can make a food chain out of paper strips glued together to form a chain. Put one part of the food chain on each paper strip.
2. Using the paper chain examples of a food chain, discuss how some food chains interconnect. Show students how you can connect several food chains and form a food web. Ask students to describe their food chains or food webs.
3. Have students draw pictures of predator/prey relationships found in nature.
4. Have students draw examples of various other habitats like a forest habitat, ocean habitat, etc.
5. Have students look in nature magazines for examples of camouflage and predator/prey relationships. Have them cut out the pictures to share with the class.

References

Relf, P. & Stevenson, N. *About Animal Habitats*.

Hablitzel, M. & Stitzer, K. *Animal Habitats-On Lands, Ponds, Rivers and Oceans Draw, Write, Now.*

Where's My Home?

Overview
In this activity, students will play a game to show how wildlife is often displaced by humans as trees are cut down for land development.

Duration
20-30 min

Grades
K-2

Benchmarks
- Organisms
- Diversity/Interdependence
- Heredity
- Science & Social Perspective
- Forming a question/ hypothesis
- Analyzing & Interpreting Results

Key Concepts
Wildlife has been forced to adapt to the human life around it. As we develop land for housing, lumber, and commercial use we must keep in mind the wildlife that lives on the land and what will happen to it when we take natural habitats away.

Objectives
Students will be able to:
- recognize the need for land use regulations and thoughtful planning by developers to help protect wildlife

Materials
- large space to play the game

Background Information

The NWR is home to many species of animals and plants throughout the year. Near the NWR you can see examples of how people have taken over and developed neighborhoods, roads, shopping centers, and schools while disrupting the native wildlife. It is important for students to understand the importance of a NWR and how we are constantly trying to seek a balance between our own needs and the needs of wildlife. By playing a simple game students will see how the needs and wants of people can disrupt and destroy the wildlife in a given area. Students are encouraged to form their own opinions on the importance of preserving space for wildlife versus the need for development by people.

Suggested Procedure

Divide students into two equal groups. Have one group be trees and one group be birds. You can give the bird group and tree group names of common birds or trees that the students are familiar with.

Have each student in the tree group find a space to stand still in a playing area. Instruct the birds to fly around the trees. The birds must keep flying until a whistle is blown. When the birds hear the whistle, they must find a tree to become their home. Only one bird can live in one tree. Repeat the flying and finding a tree several times and then change the game. Remove one of the trees and have the birds fly and find a tree. The bird without a tree is out of the game. Repeat this several times, each time removing one more tree until only one tree and one bird remain.

Assessment Ideas

After completing the game, have students discuss what will happen to the birds without a tree to live in. Ask students where the birds will go and what impact it will have on birds in areas where the homeless birds are forced to move to. What impact on the food supply will this have if too many birds are living in one area?

Discuss ways that we can help wildlife forced out of their natural habitats. Remind students that we have laws to help protect wildlife from humans that want to take over natural habitats of wildlife. Ask students what more can be done to protect wildlife as cities grow and more housing is needed for humans.

Ask half the class to draw their idea of what a NWR should look like. Ask the other half of the class to draw an area that has been developed into a neighborhood or shopping center. Ask both groups to include people and wildlife in their drawings.

Have students compare and contrast the two sets of drawings, looking for ways that humans and wildlife can live together and share the land.

Have students write their ideas on what will happen to wildlife when their homes are destroyed by human development.

Tell students that we have many protected areas set aside for wildlife, like parks and even the National Wildlife Refuge!

References

Project Learning Tree Environmental Education Activity Guide Pre K-8

Duck Feathers

Overview
In this activity students will create a drawing of a duck feather, using crayon to demonstrate why water doesn't soak into the feathers of a duck.

Duration
30 min

Grades
K-2

Benchmarks
- Diversity/interdependence
- Organisms

Key Concepts
Ducks have special adaptations that help them survive in water. Water rolls off the feathers of a duck because the outer coat of a duck's feathers are covered with waxy oil.

Objectives
Students will be able to:
- understand how a duck stays dry in water
- learn what adaptations are and how they help animals survive

Materials
- drawing paper or newspaper
- crayons
- straws or eyedroppers
- water

Background Information

Ducks use their bills to rub the waxy oil from a gland located at the base of their tails all over their feathers. The feathers become covered with a waxy oil that makes the water roll off the ducks' feathers. The feathers underneath the outer coat stay dry and soft to keep the duck warm.

Suggested Procedure

1. Students draw a feather with crayon on the drawing paper or newspaper. Have them color one half of the feather in any color crayon so that the paper does not show through. Leave the other half of the feather blank.
2. Keeping the paper flat over a towel, drop a few drops of water from the straw or eyedropper on the feather. Be sure to drop 2-3 drops of water on both sides of the feather.
3. Hold the paper at an angle over the towel. Observe what happens to both sides of the feather with water on it.

Assessment Ideas

Discuss with students what happened to their drawings of the feather. Why did one side of the feather stay dry and one side get soaked? How is the colored part of the feather like a real duck feather? What other birds do you think have feathers like a duck?

If you have them available, pass around real duck feathers and feathers from other types of birds so students can feel the difference in the feathers.

References

Davis, W. *Douglas Fir.*

A Visual Hypothesis

Overview
Working in five groups students will create murals or posters depicting what they think the five habitats of the Refuge will look like before they visit.

Duration
60 minutes (with additional time needed after the field trip)

Grades
3-8

Benchmarks
- Forming a question / hypothesis
- Creating & Presenting Ideas
- Analyzing & Interpreting Results

Key Concepts
Students use pre-existing knowledge to form a visual hypothesis of what they think they will see and experience at the Refuge.

Objectives
Students will be able to:
- use prior knowledge to anticipate what they will see at the Refuge by drawing what they think is there.
- work cooperatively in small groups
- cross out misconceptions they had about the Refuge and add details they learned about the Refuge once they've returned from their field trip

Materials
- approx. 1 yd. X 1 yd. white bulletin board paper
- pencils
- markers
- crayons

Background Information

The purpose of a hypothesis is to start the students with a "good educated guess" before they begin an experiment or experience. The students then build new knowledge based on what they already know. By creating a "Visual Hypothesis" students will use prior knowledge to create a detailed mural / poster of what they anticipate they will experience at the Refuge.

After they return from their field trip students revisit their mural and decide what was correct with their hypothesis and what needs to be deleted or changed.

Vocabulary

riparian – an area of land adjacent to a stream, river, lake or wetland that contains vegetation that, due to the presence of water, is distinctly different from the vegetation of other areas

oak Savanna – grassland containing scattered oak trees

hypothesis – an educated guess, estimation, or prediction

Suggested Procedure

1. Begin by asking students to think about a forest, meadow, or creek area in Oregon or Washington that they've visited and what they experienced there. What did they see? Hear? Smell? What were the plants and trees like? Did they see any birds or animals? Did they hear birds singing? Did they notice any insects?
2. Tell students to jot down notes of their outdoor memory, writing as many sensory things as they can.
3. Next divide the class up into 5 groups: one for each habitat of the Refuge. If the class is large or you want a smaller number of students in each group, two posters could be made of each habitat.
4. Give each group a large piece of white paper (poster size) and the name of one of the habitats of the Refuge:
   - Pond
   - Oak Savanna
   - Oak Savanna / Riparian Transition
   - Riparian/ River
   - Riparian Forest
5. Teach or review the terms "riparian" and "oak savanna" with the students.

6. Using their notes, students will cooperatively draw what they think their habitat will look like. They should try to draw as many details as they can. Even if they just heard an animal (birds, frogs, etc.) they should draw the animal that they heard. They should draw the types of trees (deciduous vs. conifers), bushes, and other plants they saw or think they will see.
7. Teachers' input should be minimal so that students can analyze their drawings and find their mistakes when they return from the field trip.
8. The habitat drawing should take up most of the mural paper. Often students (especially younger ones) will use the top half of their paper to draw the sky. The sky should be minimal so that students concentrate on the vegetation and animal life of their habitat.
9. After the field trip students analyze their mural. They should cross out any incorrect drawings they made (perhaps using a red crayon or marker). Details should be added using their field journals for reference. For instance if they drew a "generic" duck on their mural but saw and identified a pintail, then they could draw a pintail, label it, cut it out and tape it on top of their generic drawing. Labeling specific plants, trees, and other animals they saw would enhance their mural as well.

Assessment Ideas

Have students share their murals with the rest of the class after they have created them.
Post field trip: Have students share their murals with the rest of the class to explain the changes they made after experiencing the Refuge.

Enrichment Ideas

This activity could be started a few weeks before the field trip. When students finish their assignments early, they can add details to their habitat mural.

References:

Science and Children. *Ecosystem*

What is a Wildlife Refuge?

Overview
Students work in small groups to learn about specific refuges, as well as the mission of the National Wildlife Refuge System (NWRS) and the role of individual refuges within the system.

Duration
Three 45 min sessions

Grades
6-8

Benchmarks
- Diversity/interdependence
- Dynamic Earth
- Forming a question/ hypothesis
- Collecting & presenting data
- Analyzing & interpreting results

Key Concepts
There are many types of refuges which comprise the NWRS. Each refuge has similar and unique characteristics.

Objectives
Students will be able to:
- explain the mission of the NWRS and its importance to wildlife
- name at least two refuges and describe resources that they protect
- describe appropriate conduct on a refuge

Materials
- copies of student handout "National Wildlife Refuge Expert's Notes"
- map of the United States
- push pins
- internet access
- National Wildlife Refuges: Video and Visitor's Guide brochure

Background Information

Rachel Carson wrote the following about wildlife refuges in the introduction to her essay series, "Conservation in Action."

If you travel much in the wilder sections of our country, sooner or later you are likely to meet the sign of the flying goose — the emblem of the national wildlife refuges.

You may meet it by the side of a road crossing miles of flat prairie in the Middle West, or in the hot deserts of the Southwest. You may meet it by some mountain lake, or as you push your boat through the winding salty creeks of a coastal marsh.

Wherever you meet this sign, respect it. It means that the land behind the sign has been dedicated by the American people to preserving, for themselves and their children, as much of our native wildlife as can be retained along with our modern civilization.

Wild creatures, like men, must have a place to live. As civilization creates cities, builds highways, and drains marshes, it takes away, little by little, the land that is suitable for wildlife. And as their space for living dwindles, the wildlife populations themselves decline. Refuges resist this trend by saving some areas from encroachment, and by preserving in them, or restoring where necessary, the conditions that wild things need in order to live.

Suggested Procedure

1. Explain to the class that they will be visiting a national wildlife refuge on their field trip. On the trip, they will have the chance to explore the refuge and participate in activities. The purpose of this lesson is to discover what refuges are and why they exist.
2. Brainstorm with the class what they think of when they hear "national wildlife refuge". Record students' answers on an overhead or on the board. Save this list for wrap-up discussion.
3. Discuss the history of the Refuge System.
4. Organize the class into cooperative groups of 3 – 4 students. If the activities that you plan to do on your field trip require group work, you may wish to use this activity to establish the groups for the trip. Ask the students to think of a name for their group. Tasks for students working in groups may include the following:

a. Time keeper - makes sure the group stays on task and finishes in the allotted time

b. Recorder - records the group's ideas or writes the group's answers to specific questions

c. Reporter - presents the group's findings to the class

d. Materials manager - responsible for any materials that the group needs

e. Facilitator - makes sure everyone in the group participates in the activity and feels that they are part of the process

5. Brochures on various wildlife refuges can be found by going to the National Wildlife Refuge System's home page (http://refuges.fws.gov). Have students investigate the refuge you have assigned them on the Internet. Give each group one copy of the Student Page "National Wildlife Refuge Expert's Notes". Each brochure on the website contains a variety of information about a particular refuge.

   When the students map the location of their refuge, they will begin to see that some refuges play an important role in the migration of water birds. Such refuges provide resting and eating areas along migration routes.

6. Make learning about the different refuges fun by challenging your students. Tell them that each group's assignment is to become experts on a refuge and that they need to create an advertisement, Powerpoint presentation or brochure that will encourage young naturalists like themselves to visit the refuge. Part of their task during the group presentation is to demonstrate their expertise to the class. They need to be convincing experts about their refuge. Explain that the Student Page will help them get started, but they will need to seek out other information in their brochure. If possible, provide them with props (hats, shirts, etc.) to help them get into their roles, or have students bring props from home.

7. Have each group present their advertisement for their refuge, and place a marker on the map of the United States where the refuge is located.

8. After the groups have presented their information, ask them if they notice a pattern on the map related to the locations of the refuges. The refuges picked for this lesson are all in the western area of the United States and illustrate a "pathway" for migratory birds. Discuss this as one of the values of the refuges. You may also want to remind the students that these refuges are just a few examples of the approximately 530 refuges. Show them the map included in the "National Wildlife Refuges – A Visitor's Guide" brochure to give them a fuller understanding of the Refuge System, and show the movie "National Wildlife Refuge System".

9. Ask the class if there is anything they would like to add or delete from the list they developed concerning what they think of when they think of a refuge.

10. Ask the students to make inferences as to what they think the purpose of the National Wildlife Refuge System is, based on what they know and what they have learned from the brochures. As a class, try to brainstorm a mission statement for the Refuge System.

11. Copy the National Wildlife Refuge System's mission statement onto the board or an overhead (see Introduction section). Have the students compare the two statements and discuss the mission of the National Wildlife Refuge System.

12. Explain to the class that even though the National Wildlife Refuge System was established to protect our nation's plants and animals, the U.S. Fish and Wildlife Service cannot do this job alone. The plants and animals that every refuge protects are threatened in some way. Environmental degradation, such as water and air pollution, loss of habitat, exotic plant and animal species, and other problems, affect natural resources. Vandalism, acid rain, adjacent

development, and other problems also affect natural resources.

13. Explain that the Refuge System belongs to us all. It is everyone's responsibility to learn about the care of the refuges.

14. Refer to Rachel Carson's essay and discuss what the quote means (see Background Information). Ask the students to imagine they are on a talk show and the interviewer asks them to answer the question, "What do you think of the National Wildlife Refuges?" Have them record their own responses.

15. Close the session by having the students brainstorm a code of conduct for how they should behave when they visit the Refuge on their trip. Explain that because refuges are protected, Federal law prohibits removing anything from the refuge. Use the motto: "Take only memories, leave only footprints."

Assessment Ideas

Evaluate student group presentations using Presentation Rubric.
Collect and evaluate student page National Wildlife Refuge Experts' Notes.

References

Rhythms of the Refuge: Educators Guide

Websites:
U.S. Fish & Wildlife Service

National Wildlife Refuge Experts' Notes

Group Name: _____

Group Members:

You and your group are about to become EXPERTS on a national wildlife refuge. The challenge is that you will not be able to visit this refuge in order to see the area firsthand. All you will be given is Internet access to a brochure from that refuge.

You will create an advertisement for your refuge to present to the class. Your ad must convince young naturalists such as yourselves to visit your refuge. Your presentation must include one visual aid that your group has created.

When speaking to the class, you will be able to use your notes, so use this worksheet to write down information that an expert would know about the refuge. The questions listed below will help get you started, but you will find that there are other interesting tidbits of information you want to write down and share with the class to convince them that they should visit your refuge.

1. Basic Information
    a. What is the refuge's name?

    b. How long ago was the refuge established?

    c. In what town and state is the refuge located? (Be ready to place a marker on a map to show where the refuge is located.)

2. What kinds of plants and animals can people expect to see on this refuge?

3. What activities can people do on this refuge?

4. What are three things that make this refuge special?

5. What are two reasons this refuge should be preserved and protected for future generations?

Is there other information about the refuge you want to include?

National Wildlife Refuge Choices

Access refuge brochures by going to http://refuges.fws.gov and clicking on the refuge brochure button, then select one of the refuges below to investigate.

1. Alligator River NWR
2. Arctic NWR
3. Arthur R. Marshall Loxahatchee NWR
4. Attwater Prairie Chicken NWR
5. Back Bay NWR
6. Bald Knob NWR
7. Oregon Coast NWR
8. Bayou Cocodrie NWR
9. Big Lake NWR
10. Savannah Coastal NWR
11. Blackwater NWR
12. Eastern Massachusetts NWR
13. Crystal River NWR
14. Farallon NWR
15. Florida Keys NWR
16. Imperial NWR
17. Lacassine NWR
18. Lake Woodruff NWR
19. Rocky Mountain Arsenal NWR
20. Refuge of your choice – check with teacher to verify

Group Members _____

National Wildlife Refuge Presentation Rubric

Speech presentation

Speakers use expression in voices and gestures to show excitement/interest in topic	_____/2
Speakers are audible (good volume), enunciate (pronounce) words correctly, and speak neither too rapidly nor too slowly	_____/2
Speakers refer to notes but maintain eye contact throughout the speech	_____/2
Speakers stay within the 2-5 minute time limit	_____/2
	_____/8

Content

Covers all required information from Experts' Notes in detail – demonstrates expertise in knowledge of refuge	_____/15
Includes additional tidbits of information to entice middle school students to visit the refuge	_____/5
Information covered is appropriate for the topic	_____/5
Presentation is organized in a logical, easy to follow way	_____/5
	_____/30

Visual Aid/Creativity

Visual aid supports topic	_____/5
Visual aid is neat and well organized	_____/10
Creativity/care taken to meet goal of enticing middle school students to visit the refuge	_____/10
	_____/25

Notes/Bibliography

Notes on presentation have been turned in	_____/2
Three sources (minimum) have been cited	_____/3
All information is correctly cited	_____/2
	_____/7

What's Special About TRNWR?

Overview
Students will learn about the Tualatin River National Wildlife Refuge by reading the brochure, searching the website, and using field guides to research species that are found on the Refuge.

Duration
Two 45 min sessions

Grades
6-8

Benchmarks
- Diversity/interdependence
- Dynamic Earth
- Forming a question/ hypothesis
- Collecting & presenting data
- Analyzing & interpreting results

Key Concepts
The Tualatin River National Wildlife Refuge has unique characteristics and is an important member of the National Wildlife Refuge System.

Objectives
Students will be able to:
- explain why TRNWR was established
- describe several species that they may see at TRNWR
- use a field guide to identify a given organism

Materials
- copies of student page "What is Special About TRNWR?"
- TRNWR brochures
- rulers
- species list from TRNWR
- field guides
- internet access
- video of TRNWR

Background Information

Date established: 1992
Refuge size will grow to be 3,058 acres (as of March 2004, 1,218 acres acquired)

History

In the early 1990s, the U.S. Fish and Wildlife Service began studying the idea to create a National Wildlife Refuge along the bottomlands of the Tualatin River. Many local residents and leaders recognized that the river and its floodplain had been highly modified by both agriculture and urbanization within Washington County. This recognition fueled a desire to preserve open green space and create an area where future generations could enjoy outdoor recreation and interpretation, and leave an educational legacy for children. The Service identified a need to protect and enhance floodplains, wetlands, riparian habitats, and upland buffers for a variety of wildlife and for the enjoyment of people. An Environmental Assessment identified several options for protection of the area. The study culminatd in a decision, issued in February of 1992, to create the Tualatin River National Wildlife Refuge by acquiring and managing up to 3,058 acres of land by fee title purchase, conservation easement, and/or agreement.

Tualatin River National Wildlife Refuge is located at the northern end of the Willamette Valley near Sherwood, Oregon. The concept of creating the refuge originated from local citizens, cities, and governments, and so it enjoys strong popular support, stemming from a desire to preserve green space where future generations can take part in outdoor recreation and education.

Habitat

Tualatin River Refuge is a developing refuge and one of 10 urban refuges in the National Wildlife Refuge System. Its topography is predominately flat bottomland bordered by uplands, and characterized by rivers and streams, wetlands, riparian woodlands, grasslands, and forested uplands. Refuge habitats consist of emergent, shrub, and forested wetlands, Oregon ash riparian hardwood and conifer forests, Oregon white oak and pine grasslands, meadows, and mixed deciduous/coniferous forests common to Western Oregon prior to settlement. When final acquisition is completed, the refuge will total over 3,000 acres and preserve a floodplain wetland ecosystem.

When flooded in fall and winter, the Tualatin River floodplain wetlands support thousands of ducks, arctic nesting Canada geese, tundra swans, and a variety of other water birds. Dominant ducks consist of northern pintail, mallard, and wigeon. Canada geese include dusky and cackling sub-species. Tualatin River National Wildlife

Refuge supports significant breeding populations of wood ducks and hooded mergansers and, to a lesser extent, cinnamon teal and mallards. These habitats are also known for their importance to salmon and steelhead, and for providing breeding habitat for songbirds.

Using the Internet to learn about the Refuge also provides an opportunity to practice computer skills. Understanding how to use a field guide is an important skill for learning about the natural world. Field guides vary in organization – the organization is usually explained in the opening pages of the field guide. For example, some wildflower guides are arranged by flower petal color. In contrast, many bird field guides are arranged into family groups.

Some field guides are organized as dichotomous keys. With this system, students examine an "unknown" plant or animal, and read a description, which requires them to make a choice between two possibilities. For example, if a student is looking at a tree, they may read the following descriptions:

1a. Leaves needle-like or scale-like, mostly evergreen, seeds in cones, not enclosed in a fruit (conifers).

1b. Leaves broad and annually deciduous; seed enclosed in a fruit.

The student must select the correct description by examining the tree, and continue through sets of descriptions until they have identified the species.

If you want your students to learn how to use dichotomous keys, you may want to have them practice making a key using a familiar object. You could have them construct a dichotomous key of shoes. In this case, the first level of the dichotomous key might distinguish shoes with laces from shoes without laces. Students should continue to make the key until every shoe is distinguished from every other shoe. After students have constructed their own dichotomous key, the basic concept should be more straightforward.

Suggested Procedure

1. Set up three stations: Refuge Brochures, Field Guides, and Refuge Web Page.
2. Divide your class into three groups of approximately equal size. Explain to the students that they are going to be learning about the Tualatin River National Wildlife Refuge by examining the Refuge brochure and web page. They will also be using field guides to learn about some of the plant and animal species that live at Tualatin River National Wildlife Refuge. During this activity, they will answer questions about the Refuge on the Student Page – "What is Special About Tualatin River National Wildlife Refuge?"
3. Refuge Brochure Station (materials: brochures and rulers): Tualatin River National Wildlife Refuge brochure covers a variety of topics including:

   a. History of the Refuge

   b. Basic geography of the Refuge

   c. Wildlife management tools on the Refuge

   d. Refuge regulations

   This station is mostly self-explanatory. Students need to use the materials to answer the questions provided on the Student Page.
4. Field Guide Station (materials: field guides, species lists of plants and animals found on the Refuge): Provide guides for a variety of organisms, including plants, birds, mammals, animal signs/tracking, amphibians, reptiles, insects, and aquatic invertebrates (provide as many as possible). Have several bird field guides because birds are often the most visible wildlife during a field trip. Also, try to include several different plant field guides.

   a. Bring these field guides on the trip because students will already be somewhat familiar with how to use them.
5. Refuge Web Site Station: You may want to provide the students with the web address of

the U.S. Fish and Wildlife Service and/or the Tualatin River National Wildlife Refuge so they will not waste time searching for the web page.

a. U.S. Fish and Wildlife Service
http://www.fws.gov

b. National Wildlife Refuges
http://refuges.fws.gov/

c. Tualatin River NWR

http://refuges.fws.gov/profiles

index.cfm?id=13600

d. In some cases, it may not be possible to use computers for this activity. If computer access is not possible, print and photocopy the relevant pages from the Refuge website beforehand so students can at least get a general idea of the information they can obtain from the website.

6. If available, show Tualatin River National Wildlife Refuge video, and have students add information to their Student Page.

7. Bring the class back together. Go over the following points to help students prepare for the field trip:

a. What did they learn about the Refuge? (Example: Why was Tualatin River National Wildlife Refuge created?)

b. How was the information in the brochures different from the information on the Refuge website?

c. How is a field guide used?

d. What are some of the plant and animal species they expect to see at the Refuge? In what habitats do they expect to see these species?

e. Make a list of students' predictions of both the species they expect to see and the habitat in which they expect to see them. Distribute a copy of this list to the students so they can keep track of what they actually see on the Refuge and in what habitats they see these species. After the trip, make comparisons between the students' predictions and what was actually seen. What did they see? Where did they see it? Were the species seen in the predicted habitats? Why were there differences between the predictions and results?

Assessment Ideas

Have students make brochures or posters for Tualatin River National Wildlife Refuge using the information they learned. Include information about the history of the Refuge, a picture/drawing and natural history description of one of the plants or animals found on the Refuge, recreational activities that are allowed on the Refuge, etc.

Give the students pictures (or actual specimens, if available) of different plants and animals. Have them identify the organism and describe its natural history by using the appropriate field guide.

Collect and assess the Student Page – "What is Special About Tualatin River National Wildlife Refuge?"

References

Rhythms of the Refuge: Educators Guide

Websites:
U.S. Fish & Wildlife Service

What is Special About Tualatin River National Wildlife Refuge?

Name(s):

Brochure Station:

1. Finding Tualatin River National Wildlife Refuge: Look at the map that shows where Tualatin River National Wildlife Refuge is found.

a. Draw the outline of Oregon.

b. Draw and label the location of Tualatin River National Wildlife Refuge on your state map.

c. What town is closest to Tualatin River National Wildlife Refuge? _____
Draw and label the town on your own map.

d. How many miles is the closest town from Tualatin River National Wildlife Refuge? (Use the map scale to answer this question) _____

2. Map of Tualatin River National Wildlife Refuge: Look at the map that shows the different areas of the refuge.

a. What is the scale of the map? _____

b. What is the distance from the most southern point of the Refuge to the most northern point of the Refuge? (Use the map scale) _____

c. What is the map symbol for the Refuge boundary? _____

Draw your own map of the Refuge, using the symbol for the Refuge boundary.

d. What is the map symbol for nature trails? _____

Draw the nature trail(s) on your map.

e. Draw and label the rivers/creeks that run through and around the Refuge on your map.

f. What do you see on the brochure map that you would like to see on the field trip?

Draw and label it on your own map.

Field Guide Station:

1. Look at the lists of plants and animals that are found on Tualatin River National Wildlife Refuge. Select four of these plants and animals to learn about. Write their names below:

_____ _____

_____ _____

2. Use the field guides to look up each of these plants or animals. Fill in information about each plant or animal in the boxes below:

Name of plant or animal:
Draw it or describe what it looks like:

In what kind of habitat will you find it? (Pond, forest, prairie, etc.)

Name of plant or animal:
Draw it or describe what it looks like:

In what kind of habitat will you find it? (Pond, forest, prairie, etc.)

Name of plant or animal:
Draw it or describe what it looks like:

In what kind of habitat will you find it? (Pond, forest, prairie, etc.)

Name of plant or animal:
Draw it or describe what it looks like:

In what kind of habitat will you find it? (Pond, forest, prairie, etc.)

Internet Station:

Web Address: _____

1. The National Wildlife Refuge System is part of what agency?

2. How many refuges are in this state? _____ What are the names of the other refuges in this state?

3. Why AND when was Tualatin River NWR established?

4. What are some animals and plants that you might see on the Refuge? In what habitats will you see these animals and plants?

I predict that I will see:	I will see this plant or animal in this habitat:
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

Wetland Metaphors

Overview
Students are presented with a selection of objects for investigation as metaphors for the natural functions of wetlands.

Duration
Two 45 min sessions

Grades
6-8

Benchmarks
- Diversity/interdependence
- Dynamic Earth
- Forming a question/ hypothesis
- Collecting & presenting data
- Analyzing & interpreting results

Key Concepts
Wetlands are an integral part of the National Wildlife Refuge System, and are key to maintaining the health of our world.

Objectives
Students will be able to:
- describe the characteristics of wetlands
- evaluate the importance of wetlands to wildlife and humans

Materials
- large pillowcase, bag, or box
- sponge
- small pillow
- soap
- eggbeater or mixer
- small doll cradle
- sieve or strainer
- paper coffee filter
- antacid tablets
- small box of cereal

Background Information

Wetlands are many different things to many different people. Some people have never heard or thought about wetlands. Others are working actively to protect wetlands because of their importance.

Wetlands include freshwater and saltwater marshes, wet meadows, swamps, lagoons, bogs and prairie potholes. All wetlands, whether coastal or inland, provide special habitats that serve areas far beyond their boundaries. Wetlands are uniquely important to plants, animals, humans, and the total environment. Because of the abundance of food, vegetative cover (shelter), and water found there, most wetlands are rich with diverse wildlife species.

Coastal and inland marshes, for example, provide breeding, resting and wintering habitats for thousands of migratory birds – including ducks, geese, swans, cranes and shorebirds. Many species of fish that are important for commercial and personal use by humans reproduce and spend part, or all, of their life cycles in fertile wetlands adjacent to larger, more open bodies of water. These fish species include bass, salmon, walleye, perch and pickerel. A wide variety of reptiles, amphibians, insects, and crustaceans also breed and live in wetlands. Frogs and toads, turtles of all kinds, salamanders, snakes, dragonflies, water striders, and crayfish flourish in wetland habitats. Many mammals – from muskrats and beaver to whitetail deer and moose – also depend on wetland areas.

Wetlands are often referred to as “nurseries” because they provide critical breeding and rearing habitats for countless numbers and kinds of wildlife.

Wetlands also have the unique ability to purify the environment. They act as natural filtering systems and have been shown to be extremely effective. For example, they can trap and neutralize sewage waste, allow silt to settle, and promote the decomposition of many toxic substances.

The importance of vegetation associated with wetlands cannot be overlooked. Plants absorb nutrients and help distribute them through food webs. Plants also keep nutrient concentrations from reaching toxic levels. Plants slow down water flow, causing silt to settle out. Through photosynthesis, plants add oxygen to the system and provide food to other life forms.

Of great importance to humans are the flood control characteristics of wetlands. When runoff from rains and spring thaws is high, wetland areas absorb excess water, thereby helping the runoff gradually drain away down streams and rivers and through the soil. Acting as buffers, healthy wetlands reduce flooding and erosion. In drier periods, wetlands hold precious moisture after open bodies of water have disappeared.

The many activities that take place in wetlands make them among the most productive ecosystems in the world.

As remarkable and resilient as wetlands are, these unique areas have limits. Their destruction and/or abuse can have devastating effects on wildlife, humans, and overall environmental quality.

Wetland habitats are being converted to other uses (agriculture, roadways, housing developments) or otherwise being altered (drained for pest control or polluted) at the rate of about a half million acres per year. And although many wetlands are protected by Federal and State laws, there still appears to be a significant need to create a greater understanding of the importance of wetlands as ecosystems and as wildlife habitat.

Before You Begin

Many of the major attributes of wetlands can be explored through the use of metaphors. To use a metaphor is to apply a word or phrase to an object or concept that it does not literally denote, in order to suggest a comparison between the two. A metaphor represents a concept of idea through another concept or idea. "A tree is a home" and "Books are windows of thought" are two examples. In this activity, a variety of everyday objects are used to represent the natural functions of wetlands. For example:

Object:	Metaphoric function:
Sponge	Absorbs excess water caused by runoff; retains moisture for a time even if standing water dries up
Pillow / Bed	A resting place for migratory birds
Mixer / Eggbeater	Mixes nutrients and oxygen into the water
Cradle	Provides a nursery that protects and feeds young wildlife
Sieve / Strainer	Strains silt, debris, etc. from the water
Antacid	Neutralizes toxic substances
Cereal	Provides nutrient-rich food
Soap	Helps cleanse the environment

The major purpose of this activity is for students to develop an appreciation and understanding of wetlands through the power of metaphor linking the characteristics and natural functions of wetlands to the familiar realm of everyday life.

Suggested Procedure

1. Prepare a "Mystery Metaphor Container" (pillowcase, bag or box). It should be possible for students to put their hands into the container and pull out an object without being able to see inside the container. Educators may want to collect as many as one metaphoric object per student, but at least have enough for one per group of four students. Put the container aside to use later.
2. Discuss the variety of wetlands found in your local area, state, country, etc. Then invite the students to sit quietly and close their eyes. Ask them to picture a wetland. Have them "examine" what it looks like. Have them "look" carefully at the plants and animals, including insects and small creatures. What does the air "feel" like? How does it "smell"?
3. Invite the students to tell what they imagined. Compile a list of their offerings. Encourage discussion and mutual sharing.
4. With their lists as a point of reference, help the students identify which plants and animals are most likely to be found in a wetland. If possible, have them classify the plants and animals according to the kind of wetland in which they would be found. State or Federal wildlife officials and representatives of private conservation or nature-related organizations can be helpful.
5. Next, provide the students with background information to serve as an overview of the basic ecological activities that characterize the wetland habitat. For example, educators might include the following:

   a. Sponge effect - absorbs runoff

   b. Filter effect – takes out silt, toxins, wastes, etc.

c. Nutrient control – absorbs nutrients from fertilizers and other sources that may cause contamination downstream

d. Natural nursery – provides protection and nourishment for newborn wildlife

Suggest that these activities, and many more that they could probably think of, are taking place in wetlands all the time.

6. Bring out the "Mystery Metaphor Container". Tell students that everything in the container has something to do with a wetland. Have students divide into groups of four. Announce that when it is their turn, a representative of each group will draw an object from the container. Then, as a group, they must figure out how the object could represent what a wetland is or does.

7. Have the designated student reach into the container and withdraw one object. When each group has an object, ask them to work as a team to describe the relationships between the metaphoric object and the wetland. Encourage the students to build on each other's ideas. You can also assist by strengthening their connections. Note: allow the students time to discuss their ideas with each other before doing so in front of the entire class.

8. Ask each group to report their ideas to the class.

9. Following the discussion and review of the functions represented by each metaphor, ask the students to summarize the major roles that wetlands perform in contributing to habitat for wildlife.

   a. List the ways in which wetlands are important to humans.

   b. Why do humans convert wetlands to other uses?

   c. Ask the students if their own attitudes about wetlands are different now. If yes, how? If not, why not?

For the final part of this activity, encourage the students' understanding of how the wetlands' condition depends on each of us. Many kinds of wildlife depend upon wetlands. Our own well-being requires wetland ecosystems. Strengthen the students' understanding of how humans are connected to wetlands. Recreation, aesthetics, utilitarian uses, environmental quality, and nature study are but a few of the connections we each have with wetlands.

Extension/Adaptations

Visit a wetland to verify the appropriateness of the metaphors explored in the classroom. Identify and discuss any limitations to the appropriateness of these metaphors. Identify what seem to be the most compelling attributes of the metaphors in helping you understand the characteristics and nature of the wetland. Expand your understanding of these metaphors. Identify new and appropriate metaphors.

Assessment Ideas

Explain why wetlands are called one of the world's most productive ecosystems.

(Wetlands are important to a range of organisms in the animal kingdom, from zooplankton to humans. Select five species of animals and describe how wetlands are important to each.)

References

Rhythms of the Refuge: Educators Guide.

What is a Watershed?

Overview
These activities allow students to brainstorm the definition of "watershed" in teams, make a drawing, and create a model watershed.

Duration
30 min

Grades
3-8

Benchmarks
- Diversity/interdependence
- Dynamic Earth

Key Concepts
All land and water on earth is part of a watershed. Human actions can have negative effects on entire watersheds. Healthy watersheds are important for all plants and animals to survive.

Objectives
Students will be able to:
- learn the meaning of "watershed"
- model how polluted runoff water affects the whole watershed
- understand the importance of a healthy watershed

Materials
- notebook paper
- 8.5 x 11" white paper
- blue and red overhead pens (or other felt tip, water soluble pens)
- spray bottle full of water

Background Information

All the land on earth is part of a watershed. A watershed is often called a drainage basin. It is the land area that drains water from high headwaters to low wetlands, ponds or streams, by a network of channels called "tributaries." Tributaries increase in size as the water moves downhill, collecting more water, sediment, and dissolved materials.

All watersheds have an aquatic area, a riparian area and an upland area. "Aquatic areas" include standing water like ponds, lakes, wetlands, bogs and running surface water such as streams and rivers. The corridor of land and vegetation next to the aquatic area is called the "riparian area." A healthy riparian area should have abundant trees and plants to prevent erosion and filter runoff before it enters the aquatic area. The "upland area" borders the riparian area and is farther away from the aquatic area. Uplands also help filter runoff and provide homes for many types of wildlife.

Some of the factors that affect watersheds are the area and shape of the land, slope, soil type and vegetation. Pollutants that collect or are deposited on the ground in upland areas eventually travel downhill through tributaries to streams and rivers. Each watershed is part of a larger watershed whose downstream portion is affected by upstream activities. Everyone depends on the resources watersheds provide. As the human population continues to grow, the demand on those resources intensifies. Humans and their influences play an important and essential role in protecting watersheds.

Vocabulary

watershed—an area of land that drains water through soil and vegetation to the lowest point, which is usually a wetland, pond, stream or river.

headwaters—the ridge line or top of a mountain where a creek or stream begins.

tributaries—a network of channels of water which drain the land.

aquatic area—pond, lake, wetland, bog, stream, river.

riparian area—the strip of land (20 m or more) that borders a pond, creek, river or other aquatic area.

upland area—land that borders the riparian area and is farther away from the aquatic area.

Suggested Procedure

Defining "watershed"

Have students work in teams of 4. Each team should get out one sheet of notebook paper and a pencil. Write the word "watershed" on the board or overhead.

Have students brainstorm the meaning of "watershed" with their team. After 3 – 5 minutes when students are finished discussing, tell them that someone in the group should write one sentence explaining the meaning of the group's definition for "watershed" and draw a picture of a "watershed."

Call on teams to read their definitions and show their drawings. As they do this, write key words from their definitions, on the board and circle commonly used words (water, shed, land, etc.). When all teams have shared, review the circled words and come up with a definition. "A watershed is an area of land that drains water through soil and vegetation to the lowest point, which is usually a wetland, pond, stream or river."

Model watershed

Give each team one piece of white paper and two pens, one blue and one red. Have one person in the team wad up the white piece of paper. Then uncrumple it partway and spread it out on the desk so that parts of the paper still stick up. This represents a landform with mountains.

Have a student use the blue pen to draw along the top "ridge line" of the mountains. The blue ink will represent the headwaters of the creek or river below. Use the red pen to put 5 spots of ink in various places (high and low) on the landform. The red ink will represent pollutants such as oil, fertilizers or other chemicals.

Let's see what happens when it rains. The teacher should go from team to team and spray some "rain water" on top of each landform. Students should watch what happens as the water and pollutants travel downward through the watershed.

Remind students that a watershed includes soil, water and plants. The purpose of a watershed is to filter runoff before it is added to a stream or river. Is the pollution confined to one area or does it affect the entire watershed? Help students understand that anything that happens within a watershed affects the <u>whole</u> watershed.

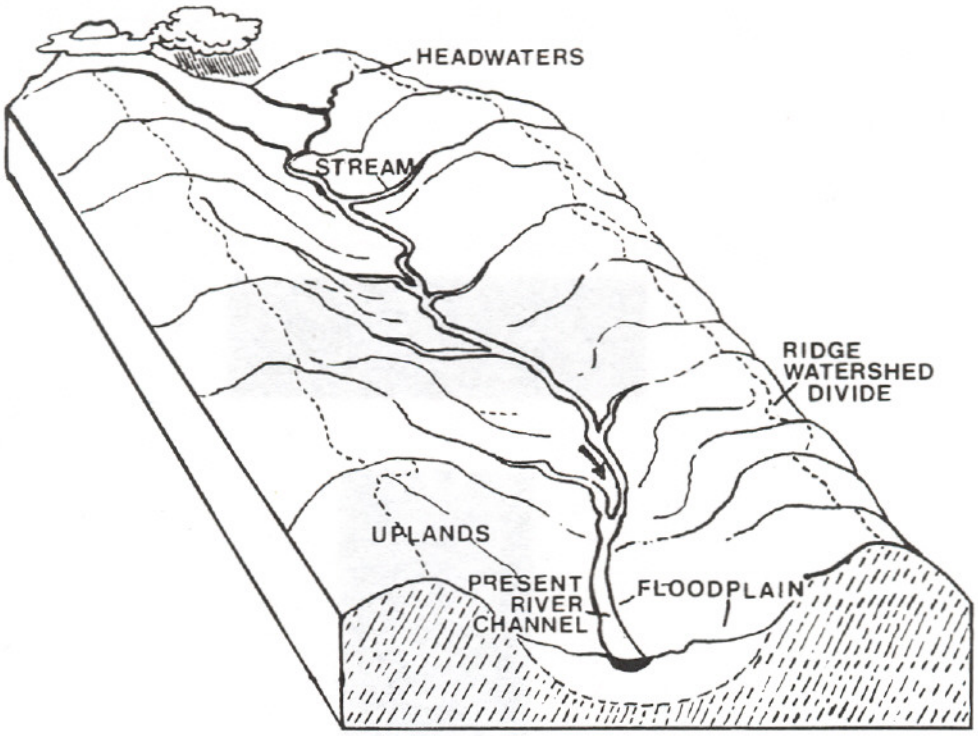
Assessment Ideas

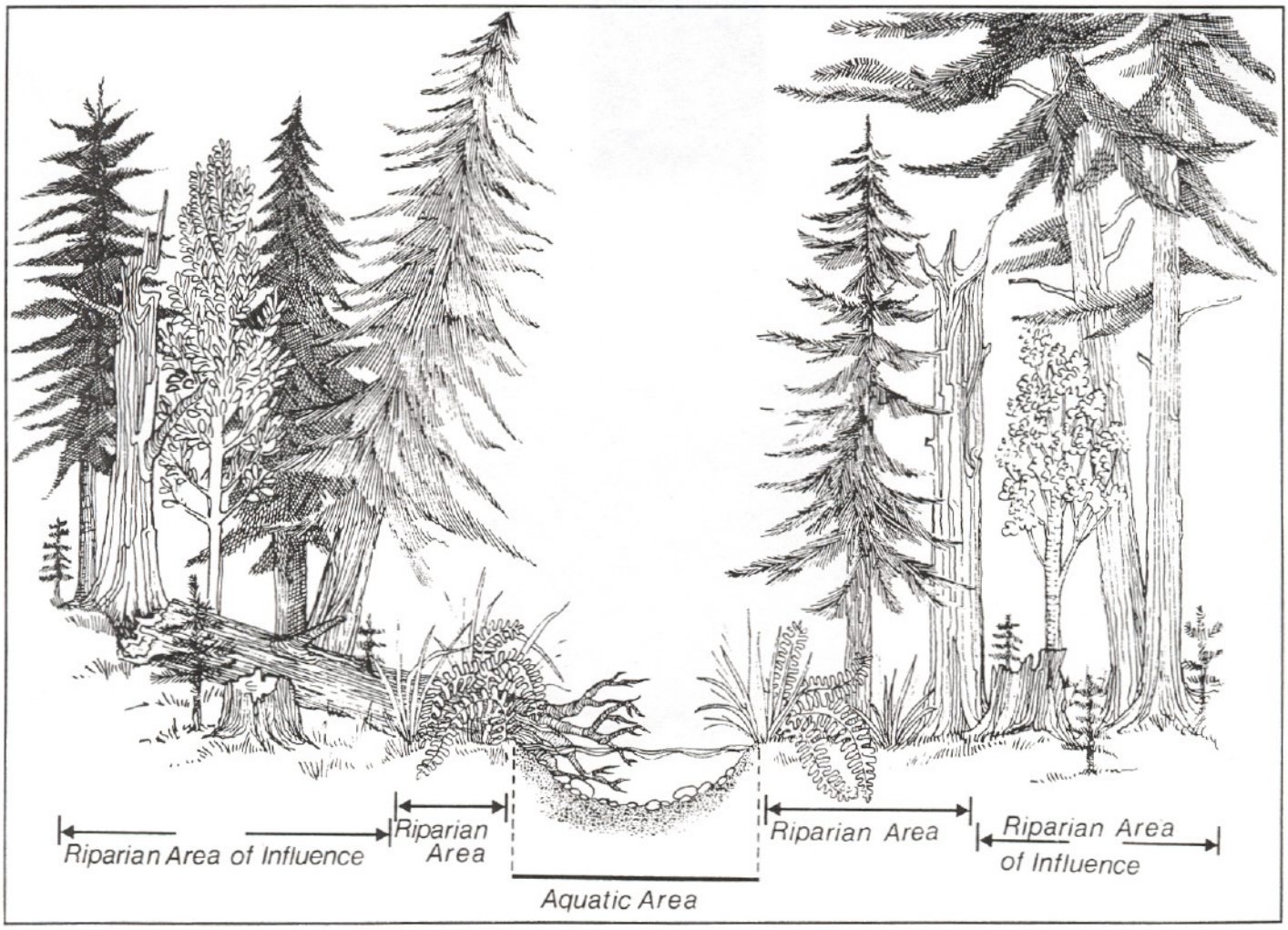
1. The next day, have each student draw a picture of a watershed and write three sentences describing it.
2. Why is it important for us to protect our watersheds?
3. What are some activities that humans can do to have a positive impact on their watershed?

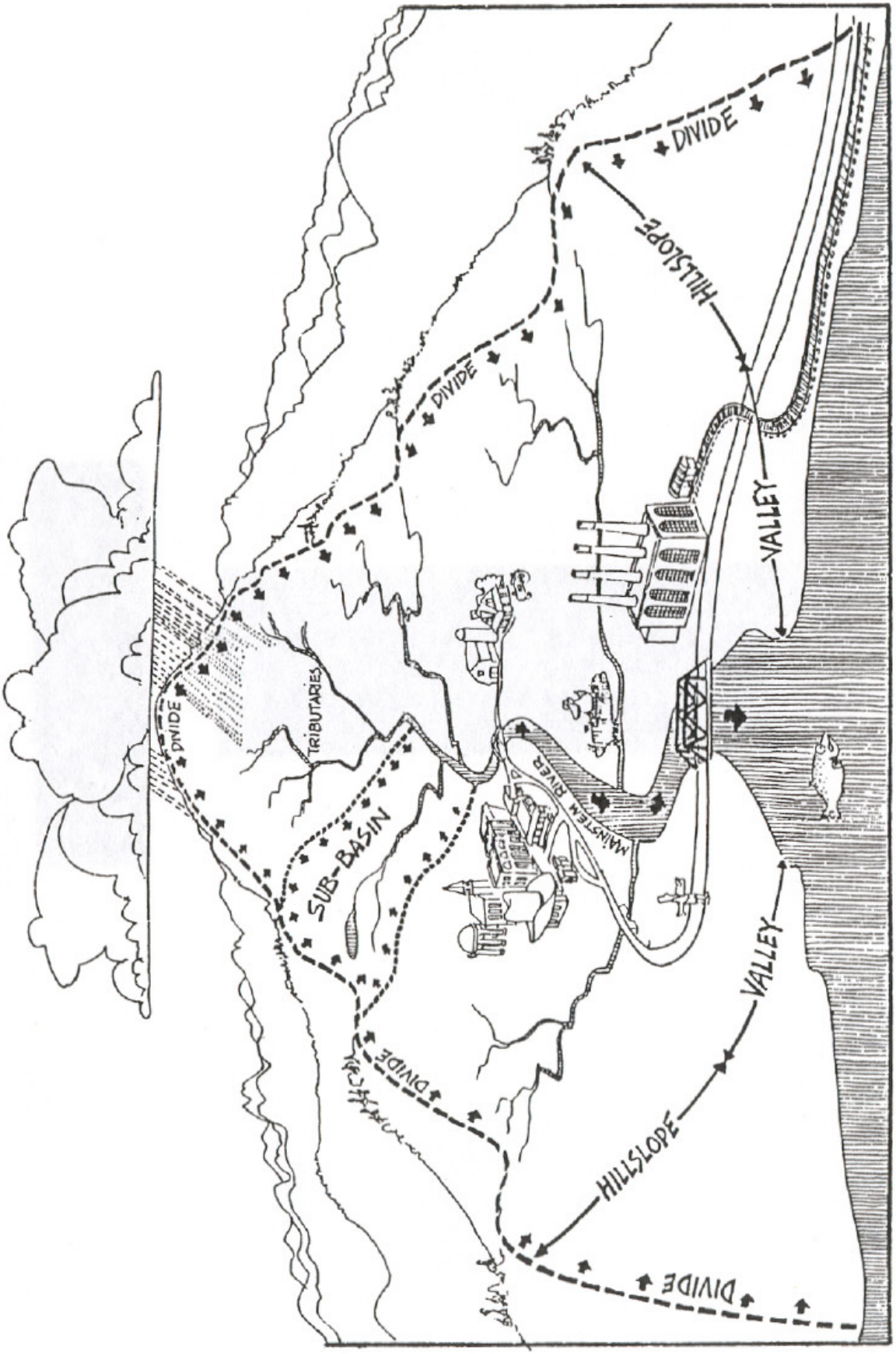
References

Oregon Department of Fish & Wildlife. *The Stream Scene: Watersheds, Wildlife & People.*

What is a Watershed?
Student Handout






DIVIDE
HILLSLOPE
VALLEY
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DIVIDE
TRIBUTARIES
SUB-BASIN
MAINSTEM RIVER
VALLEY
HILLSLOPE
DIVIDE

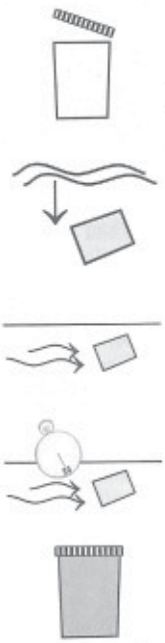
Water Monitoring Instructions

Background Information

The following pages contain the instructions for the Water Monitoring Testing Kit available for use through the Refuge's equipment supply list. Laminated manuals are available for use with the kit at the time of the field trip. Please check off what items are needed on the Equipment Needs Request Form.

Basic Instructions: Collecting Water

collection procedure river-site testing



1. Remove the cap of the sampling container.
2. Wear protective gloves. Rinse the bottle 2-3 times with the stream water.
3. Hold the container near the bottom and plunge it (opening downward) below the water surface.
4. Turn the submerged container into the current and away from you.
5. Allow the water to flow into the container for 30 seconds.
6. Cap the full container while it is still submerged. Remove it from the river immediately.

Basic Instructions: Phosphate

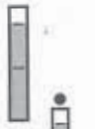
phosphate

Phosphate is a nutrient needed for plant and animal growth and is also a fundamental element in metabolic reactions. High levels of this nutrient can lead to overgrowth of plants, increased bacterial activity, and decreased dissolved oxygen levels.

Phosphate comes from several sources including human and animal waste, industrial pollution, and agricultural runoff.

Basic Instructions continued: Phosphate

phosphate procedure



1. Fill the test tube (0106) to the 10 mL line with the water sample.

2. Add one Phosphorus TesTab (5422).

3. Cap and mix by inverting until the tablet has disintegrated. Bits of material may remain in the sample.

4. Wait 5 minutes for the blue color to develop.

NOTE: If the sample does not develop a blue color (sample is colorless), record the result as 0 ppm.

5. Compare the color of the sample to the Phosphate color chart. Record the result as ppm Phosphate.

Basic Instructions: Dissolved Oxygen

dissolved oxygen

Dissolved Oxygen (DO) is important to the health of aquatic ecosystems. All aquatic animals need oxygen to survive. Natural waters with consistently high dissolved oxygen levels are most likely healthy and stable environments, and are capable of supporting a diversity of aquatic organisms. Natural and human-induced changes to the aquatic environment can affect the availability of dissolved oxygen.

Dissolved Oxygen % Saturation is an important measurement of water quality. Cold water can hold more dissolved oxygen than warm water. For example, water at 28°C will be 100% saturated with 8 ppm dissolved oxygen. However, water at 8°C can hold up to 12 ppm of oxygen before it is 100% saturated. High levels of bacteria from sewage pollution or large amounts of rotting plants can cause the % saturation to decrease. This can cause large fluctuations in dissolved oxygen levels throughout the day, which can affect the ability of plants and animals to thrive.

Basic Instructions continued: Dissolved Oxygen

dissolved oxygen procedure

1. Record the temperature of the water sample (see page 28).

2. Submerge the small tube (0125) into the water sample. Carefully remove the tube from the water sample, keeping the tube full to the top.

3. Drop two Dissolved Oxygen TesTabs® (3976) into the tube. Water will overflow when tablets are added.

4. Screw the cap on the tube. More water will overflow as the cap is tightened. Make sure no air bubbles are present in the sample.

5. Mix by inverting the tube over and over until the tablets have disintegrated. This will take about 4 minutes.

6. Wait 5 more minutes for the color to develop.

7. Compare the color of the sample to the Dissolved Oxygen color chart. Record the result as ppm Dissolved Oxygen.

Locate the temperature of the water sample on the % Saturation chart. Locate the Dissolved Oxygen result of the water sample at the top of the chart. The % Saturation of the water sample is where the temperature row and the Dissolved Oxygen column intersect.

For example: if the water sample temperature is 16°C and the Dissolved Oxygen result is 4 ppm, then the % Saturation is 41.

Basic Instructions continued: Dissolved Oxygen

% saturation

Temp °C	Dissolved Oxygen 0 ppm	4 ppm	8 ppm
2	0	29	58
4	0	31	61
6	0	32	64
8	0	34	68
10	0	35	71
12	0	37	74
14	0	39	78
16	0	41	81
18	0	42	84
20	0	44	88
22	0	46	92
24	0	48	95
26	0	49	99
28	0	51	102
30	0	53	106

**Calculations based on solubility of oxygen in water at sea level, from Standard Methods for the Examination of Water & Wastewater, 18th edition.*

Basic Instructions: Nitrate

nitrate

Nitrate is a nutrient needed by all aquatic plants and animals to build protein. The decomposition of dead plants and animals and the excretions of living animals release nitrate into the aquatic system. Excess nutrients like nitrate increase plant growth and decay, promote bacterial decomposition, and therefore, decrease the amount of oxygen available in the water.

Sewage is the main source of excess nitrate added to natural waters, while fertilizer and agricultural runoff also contribute to high levels of nitrate.

Drinking water containing high nitrate levels can affect the ability of our blood to carry oxygen. This is especially true for infants who drink formula made with water containing high levels of nitrate. **You should always have a professional lab test your drinking water for the presence of nitrate.**

Basic Instructions continued: Nitrate

nitrate procedure

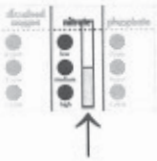
1. Fill the test tube (0106) to the 5 mL line with the water sample.

2. Add one Nitrate Wide Range CTA TesTab (3703).

3. Cap and mix by inverting until the tablet has disintegrated. Bits of material may remain in the sample.

4. Wait 5 minutes for the red color to develop.

   NOTE: If the sample does not develop a red color (sample is colorless or yellow), record the result as 0 ppm.



5. Compare the color of the sample to the Nitrate color chart. Record the result as ppm Nitrate.

Basic Instructions: Temperature

temperature

Temperature is very important to water quality. Temperature affects the amount of dissolved oxygen in the water, the rate of photosynthesis by aquatic plants, and the sensitivity of organisms to toxic wastes, parasites and disease. Thermal pollution, the discharge of heated water from industrial operations, for example, can cause temperature changes that threaten the balance of aquatic systems.

use of the thermometer

The two thermometers have an adhesive back. Adhere them to the kit container or another object to make grasping them easier.

The temperature is indicated by a liquid crystal number on the Low Range thermometer and a *green* display on the High Range thermometer.

Basic Instructions continued: Temperature

temperature procedure

1. Wear protective gloves. At each site, place the thermometer four inches below the water surface for one minute.
2. Remove the thermometer from the water, read the temperature and record the temperature as degrees Celsius.
3. Repeat the test approximately 1 km upstream as soon as possible.
4. The difference between the temperature upstream and the temperature at the sampling site is the change in temperature.

Basic Instructions: pH

pH

pH is a measurement of the acidic or basic quality of water. The pH scale ranges from a value of 0 (very acidic) to 14 (very basic), with 7 being neutral. The pH of natural water is usually between 6.5 and 8.2. Most aquatic organisms are adapted to a specific pH level and may die if the pH of the water changes even slightly.

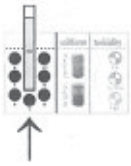
pH can be affected by industrial waste, agricultural runoff, or drainage from improperly run mining operations.

pH procedure

1. Fill the test tube (0106) to the 10 mL line with the water sample.

2. Add one pH Wide Range TesTab (6459).

3. Cap and mix by inverting until the tablet has disintegrated. Bits of material may remain in the sample.



4. Compare the color of the sample to the pH color chart. Record the result as pH.

Basic Instructions: Biochemical Oxygen Demand

BOD Biochemical Oxygen Demand

Biochemical Oxygen Demand (BOD) is a measure of the quantity of dissolved oxygen used by bacteria as they break down organic wastes. In slow moving and polluted rivers, much of the available dissolved oxygen is consumed by bacteria, robbing other aquatic organisms of the dissolved oxygen needed to live.

BOD procedure

1. Submerge the small tube (0125) into the water sample. Carefully remove the tube, keeping the tube full to the top. Cap the tube.

5 days

2. Wrap the tube with aluminum foil and store it in a dark place at room temperature for 5 days.

3. Unwrap the tube. Add two Dissolved Oxygen TesTabs® (3976) to the test tube.

4. Cap the tube. Make sure there are no air bubbles. Invert until tablets have disintegrated. Wait 5 min.

5. Compare the color of the sample to the Dissolved Oxygen color chart.

The difference in the Dissolved Oxygen level between the uncovered tube and the covered tube is the Biochemical Oxygen Demand (BOD) of the water sample.

Basic Instructions: Turbidity

turbidity

Turbidity is the measure of the relative clarity of water. Turbid water is caused by suspended and colloidal matter such as clay, silt, organic and inorganic matter, and microscopic organisms. Turbidity should not be confused with color, since darkly colored water can still be clear and not turbid. Turbid water may be the result of soil erosion, urban runoff, algal blooms, and bottom sediment disturbances which can be caused by boat traffic and abundant bottom feeders.

turbidity procedure

The water testing kit container is used to perform the Turbidity test. If possible, adhere the Secchi disk icon sticker to the jar 8-24 hours before use to allow the adhesive to cure.

1. Remove the backing from the secchi disk icon sticker.

2. Adhere sticker on the inside bottom of the large white jar (kit container). Position the sticker slightly off center.

3. Fill the jar to the turbidity fill line located on the outside kit label.

4. Hold the Turbidity Chart on the top edge of the jar. Looking down into the jar, compare the appearance of the secchi disk icon in the jar to the chart. Record the result as Turbidity in JTU.

NOTE: Allow jar to dry thoroughly before replacing kit contents for storage.

Basic Instructions: Test Results

ranking test results

Rank the results of each water quality test on a 1-4 scale:

test factor:	result:	rank:
dissolved oxygen	91-110% Sat	4 (excellent)
	71-90 % Sat	3 (good)
	51-70 % Sat	2 (fair)
	<50 % Sat	1 (poor)
BOD	0 ppm	4 (excellent)
	4 ppm	3 (good)
	8 ppm	2 (fair)
coliform bacteria	negative	3 (good)
	positive	1 (poor)
pH	4	1 (poor)
	5	1 (poor)
	6	3 (good)
	7	4 (excellent)
	8	3 (good)
	9	1 (poor)
	10	1 (poor)
temperature change	0 - 2°C	4 (excellent)
	3 - 5°C	3 (good)
	6 - 10°C	2 (fair)
	>10°C	1 (poor)

ranking test results

test factor:	result:	rank:
nitrate	5 ppm	2 (fair)
	20 ppm	1 (poor)
	40 ppm	1 (poor)
phosphate	1 ppm	4(excellent)
	2 ppm	3 (good)
	4 ppm	2 (fair)
turbidity	0 JTU	4 (excellent)
	>0 to 40 JTU	3 (good)
	>40 to 100 JTU	2 (fair)
	>100 JTU	1 (poor)

Now that you have used your monitoring kit to make a preliminary assessment of the health of your water it is time to check with other sources about what you have learned. Your local health department, environmental agency or conservation group may be able to tell you more about your watershed. You can also visit the Earth Force website (www.earthforce.org) to learn more about your specific test results. By clearly identifying the issues or problems surrounding your watershed, you have taken the first step toward taking action and improving water quality in your community.