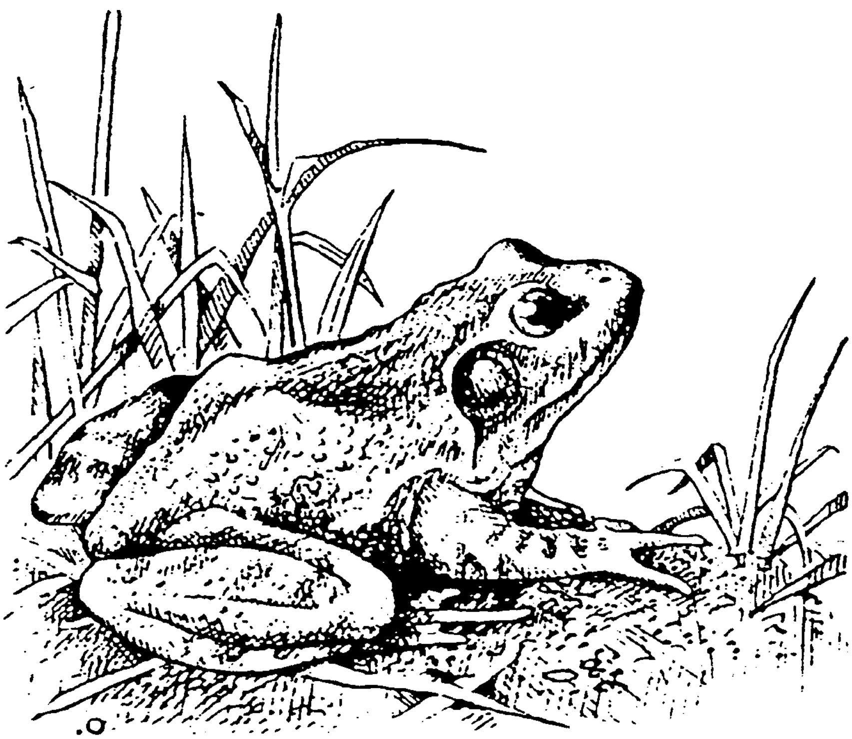
$6.00

4-H Wetland Wonders

A Water Quality Curriculum for Grades 4 and 5

Leader Guide



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OREGON STATE UNIVERSITY
EXTENSION SERVICE

4-H 3801L
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Dear Leaders,

Welcome to 4-H Wetland Wonders! We hope that you and your students or 4-H club members will have an enjoyable educational experience using the Wetland Wonders curriculum.

When you first receive 4-H Wetland Wonders, take some time to become familiar with its required equipment support. This will be helpful to you as you lead your group through the lessons. Also, please review this curriculum guide and locate the masters for the overhead transparencies, activity cards, and photocopy-ready worksheets. Don't forget to have an overhead projector or TV and VCR available at the appropriate times.

The lessons in Wetland Wonders are designed to be used sequentially as they appear in this curriculum guide in order to develop and reinforce the concepts. If you add to a lesson, use a different format, or come up with a creative way of explaining a concept, *please* share it with us at the Oregon 4-H Conference and Education Center so we can pass it along to other leaders using the program.

At the end of the lessons and program, we would be very grateful if you give us your candid evaluation on the forms provided. Be assured that we will take all your comments and suggestions into consideration in producing and editing future curricula.

What you hold in your hands is the current version of a program that began in 1993 with an Environmental Protection Agency grant. The original program has evolved over the years. The first edition was written strictly for schools using the 4-H Center as a field trip site. Teachers received training at a workshop, and for 6 weeks they had a kit of equipment on loan in their classroom to complete the activities. That is why you'll find that specific videos, books, and support materials are referenced in this curriculum. This is the first edition of 4-H Wetland Wonders developed to be used without the support material being provided to each educator. The transition to this "non-kit" version may not be perfect. Your assistance in providing feedback will help us with future editions of this project.

Above all, discover and enjoy. If you have any questions, we are available by phone, 503-371-7920, or mail to Oregon 4-H Center/Wetlands Program, 5390 4-H Road NW, Salem, OR 97304.

Sincerely,

The Wetland Wonders Development Staff of the Oregon 4-H Center:

Virginia Thompson, Extension specialist, 4-H youth development, Oregon State University

Dave Price, contributing editor and teacher, Brush College Elementary School, Salem, Oregon

Connie Reid, laboratory assistant, 4-H Center

Contents

Wetland Wonders Resource Library

The booklets, publications, and videos listed at right are used to support the Wetland Wonders curriculum. You may order them from the individual suppliers listed in the Resource section of this manual. No particular endorsement of any of these materials is implied. Others may be better suited to your needs, particularly if you are outside the state of Oregon.

1. A Tour of the Reserves .... National Estuarine Research Reserve System
2. *Adopting A Wetland, A NW Guide* .... Steve Yates
3. America's Wetlands: Our Link Between Land and Water .... EPA
4. Be Water Wise .... League of Oregon Cities
5. *Field Manual for Water Quality Monitoring* .... Mark K. Mitchell, William B. Stapp
6. (The) Heron Tribune, #1–5 .... Washington Dept. of Ecology
7. Just the Facts #1: National Wetland Inventory ...... Oregon Division of State Lands (ODSL)
8. Just the Facts #2: Local Wetland Inventories .... ODSL
9. Just the Facts #3: How Are Wetlands Regulated .... ODSL
10. Just the Facts #4: How to Identify Wetlands .... ODSL
11. Just the Facts #5: Wetland Functions .... ODSL
12. *Magic School Bus at the Waterworks* .... Scholastic Inc.
13. *Pond Life* .... Golden Guide Series
14. Poster: Eat or Be Eaten/Wetland Cafe .... TVA and EPA
15. Book: *Heron* .... Washington Dept. of Ecology
16. Poster: Life in a Freshwater Marsh .... National Audubon
17. Poster: Life in a Salt Marsh .... National Audubon
18. Poster: Rosa's Water Cycle Game .... 4-H Center
19. Protecting Our Wetlands .... EPA
20. Recognizing Wetlands .... US Army Corps of Engineers
21. (The) Richest Place on Earth .... South Slough National Estuarine Reserve
22. Riparian Areas .... Oregon Watershed Improvement Coalition
23. *Saving Our Wetlands and Their Wildlife* .... Karen Liptak
24. *Signs Along the River* .... Kayo Robertson
25. (The) State of Water in Oregon .... OSU Extension Service
26. Video: "Fabulous Wetlands" .... Washington Dept. of Ecology
27. Video: "(The) Ground Water Adventure"....... EPA/Water Pollution Control Federation (EPA/WPCF)
28. Video: "Healthy Watersheds" (VTP 019) .... OSU Extension Service
29. Video: "Saving Water—The Conservation Video" .... EPA/WPCF
30. Video: "(The) Surface Water Video" .... EPA/WPCF
31. Video: "Tide of the Heron" .... Friends of South Slough Reserve
32. *Wading Into Wetlands* .... National Wildlife Federation
33. Water Wise Plants .... Salem Public Works
34. Watersheds: Their Importance & Functions ..... Oregon Watershed Improvement Coalition
35. Wetlands Fact Sheet .... EPA
36. Wetland Plants of the Pacific Northwest .... US Army Corps of Engineers
37. Wetlands Reading List .... EPA

Introduction to Water Quality and Wetlands

Purpose

Leaders will be able to document the learner's increased knowledge after their participation in Wetland Wonders by taking the pre-survey before the program and the post survey upon completion.

Materials

- One copy of the Pre-survey per learner
- TV and VCR
- Video, "Fabulous Wetlands"

Background

View the entire 51 minutes of the Fabulous Wetlands tape prior to beginning to teach the Wetland Wonders program. This video will provide a comprehensive background to wetland functions and values, and will assist the leader in answering questions posed by learners.

Procedure

The learners should take the Pre-survey before starting any of the Wetland Wonders lessons. When the learners have taken the Pre-survey, leaders should collect the surveys and place them in a folder.

After the learners have completed the Pre-survey, they should view the first 8-minute video segment on Fabulous Wetlands featuring Bill Nye the Science Guy. This will get them thinking about wetlands and why they might find them interesting.

Answers

1 through 7 = F

8 T

9 F

10 T

11 F

12 F

13 through 15 = T

16 F

17 T

18 through 20 = F

Learner Pre-survey

1. Liquid water must always become vapor to be evaporated. .... T F
2. A wetland is a place where few plants and animals live: it's just wet. .... T F
3. Water is not found naturally in its solid form on earth. .... T F
4. Most water on earth is drinkable. .... T F
5. A watershed is a large building used to store clean water. .... T F
6. Wetlands have no value to people who live in cities. .... T F
7. Water moves on the earth only in streams and rivers. .... T F
8. A raindrop that falls in the Willamette Valley could eventually run into the Willamette River. .... T F
9. Mountain ranges do not have an effect on the amount of rain that falls in Baker City. .... T F
10. If you turn off the water while brushing your teeth, you can save 10 gallons of water. .... T F
11. People should water their lawns every afternoon to keep the grass cool and green. .... T F
12. Ground water stored in aquifers is always too dirty for people to use. .... T F
13. Soil is made up of minerals and rock pieces of different sizes. .... T F
14. Wetland soils may be very wet only part of the year. .... T F
15. Plants growing in wetlands can absorb some contaminants from water. .... T F
16. There is only one kind of wetland in Oregon. .... T F
17. Tide flats are home to plants and animals that are adapted to daily changes in water level. .... T F
18. Mammals and birds would have plenty to eat in a wetland that had no insects in it. .... T F
19. All types of aquatic insects can live in water that has a pH of 9 and is muddy. .... T F
20. Kids can't do much to save clean water or educate adults about how to conserve water. .... T F

Water Words

Objectives

Learners will be able to use vocabulary needed to discuss the properties of water and the processes that are part of the water cycle.

Methods

Leaders will set up a water cycle demonstration to assist learners in understanding and defining the vocabulary words needed to discuss the properties of water and of the water cycle. The Water Words Search will be used to reinforce understanding of these words.

Materials

- Copy "Water Word Search" worksheet (page 10), one per learner
- Copy the VOCABULARY Water Words (page 9), one per learner
- Water Cycle Demonstration
  —Large clear jar
  —Small jar or cup that will fit inside large jar
  —Sand
  —Re-sealable sandwich bag
  —Funnel
  —Ice
  —Hot water
- Leaders may wish to use the overhead transparency, "A Basic Water Cycle," from The Water Cycle lesson.
- The Water Cycle Game—create a game board. The example shown is a 50% reduction of the original game board. Purchase two corks and one die.

Procedure: Part 1

Leaders will set up the water cycle demonstration following descriptions in order to assist learners with defining some of the words on the vocabulary list.

Collect the equipment needed for the Water Cycle Demonstration. The large, clear jar must be large enough to allow the small jar to sit in the center of its bottom surface. Sand will be placed inside the large jar, but not in the small jar. The small jar can be secured to the bottom of the large jar with epoxy. The funnel should be large enough to sit in the mouth of the large jar. Make sure the inside of the small jar is completely dry.

In addition to the equipment, you'll need four or five ice cubes and a cup of very hot water. Place the sand in the bottom of the clear jar. Be careful not to get sand into the cup. Place ice cubes inside the sandwich bag and seal to prevent water leaking into the funnel and jar. The parts of the demonstration are now ready for the addition of the hot water. Since water cools rapidly, it should not be added to the jar until the learners are ready to view the demonstration.

Discussion

Explain to learners how the demonstration will be set up. Ask them if they think you will be able to move water from the large jar into the small jar without using a spoon or pouring it in. Ask learners if they know the names of any processes or forces that move the water on earth. (Evaporation, transpiration, heat, gravity. Some learners who know about steam engines will know that steam is energy.)

Procedure: Part 1, continued

To perform the demonstration:

—Place the small cup in the sand at the center of the jar.

—Pour a cup very hot water onto the sand in the large jar.

—Place the funnel (with the ice in the sandwich bag) into the mouth of the large jar.

The small end of the funnel should be over the small cup.

—Step back and watch what happens. (As an alternative procedure, you may wish to set the demonstration in a sunny window or use a strong lamp to warm the sand.)

Results

The hot water in the large jar will give off water vapor (steam). The water vapor will rise and cool on the walls of the large jar and on the underside (bottom surface) of the ice filled funnel. When the steam droplets join together they will begin to run (rain) down the sides of the jar and down the underside of the funnel. The steam that collects and cools on the funnel will run into the small cup. Water has been moved from the clear jar into the small cup.

Discussion

Use the vocabulary words Water Vapor, Atmosphere, Condensation, Ice, Gravity, and Infiltration in your discussion.

In the water cycle, "up energy" is provided by the sun. The sun evaporates water vapor from the oceans, lakes, and other bodies of water, and it powers photosynthesis which, in turn, leads to transpiration in plants. Do you see anything happening in the jar that could be called "up energy?" In the water cycle demonstration, what is the "up energy?"

In the atmosphere, temperatures drop as air moves further away from the earth's surface. When water vapor rises and cools, clouds are formed. The water in the demonstration condensed on the funnel and jar. What has cooled the water vapor in the water cycle demonstration?

How did heat ("up-energy") and gravity ("down-energy") move water from the large jar into the small jar?

What process moved the water into the sand? What was the "down energy"?

Procedure: Part 2

The Water Words Panel of Experts—(Leaders: This is best used after the water cycle demonstration.) Divide the class into six groups. Give a copy of the VOCABULARY Water Words to every two learners. Have the learners work in pairs to read through the terms and help each other with the definitions and concepts.

Each of the six groups should select someone to represent them in a "panel of experts." They should choose a group member who exhibits the best overall grasp of the Water Words.

Sit the "panel of experts" in front of the room and have the group ask the experts to tell which vocabulary word they are referring to as they paraphrase a word's meaning. (e.g., What do you call an area of water that is a mixing of fresh and salt water? An estuary.)

Procedure: Part 3

Use the Water Word Search to assist with reinforcing word familiarity. These are difficult words, and learners will need to use them in the Water Cycle unit to follow.

Procedure: Part 4

Small groups can play the water cycle game. The game allows learns to use the vocabulary words and to experience the elements of the water cycle in action.

Extension

The demonstration in Part 1 can be set up with room temperature water in the large jar on a window sill to demonstrate solar energy moving water. This demonstration needs to be left in place for several *sunny* days to be effective.

VOCABULARY Water Words

Water Vapor: Water in its gaseous form is called vapor. Water can evaporate (change from a liquid to a gas) at any temperature. This process is called **evaporation.** Water will always become vapor when it reaches its boiling point. We see water vapor over a pot of boiling water as steam.

Atmosphere: The name given to the gas (air) directly over the earth's surface that is acted on by the gravity of the earth.

Condensation: The process of water changing from vapor (gaseous form) to liquid. Small drops of water join together to become bigger drops. The bigger drops form **clouds.** We cannot see water vapor, but we can see clouds.

Ice: The solid form of water. When water freezes, it expands, but the weight remains the same. This is why ice cubes float on water.

Gravity: The downward force exerted by the earth. Gravity is the "down energy" of the water cycle; it causes water to flow downhill.

Infiltration: The process of a liquid (water) soaking into a dry material (soil). Water may infiltrate only the upper layer of soil, or it may soak deeply into the soil.

Percolation: The process of water moving through several layers of soil, often reaching the water table.

Water Table: The upper surface of water found stored underground. This is the first water reached when a well is dug. Often this is the top surface of the ground water.

Watershed: A watershed is the entire land area drained by a stream or river. The boundaries of a watershed are called divides, because they divide the direction that water on these slopes will flow. A series of small watersheds contribute to larger watersheds.

Glacier: A mass of ice formed from compacted snow. Snow falling in the Cascade Mountains may become part of the snow pack, which may melt in the spring, or it may become part of a glacier.

Transpiration: The process of water vapor leaving a plant, generally from pores on the leaves.

Photosynthesis: The process green plants (chlorophyll-containing) use to change light into (chemical) energy, which is used to create food (carbohydrates) from carbon dioxide and water. Oxygen is released as a waste product of this chemical reaction.

Estuary: A coastal wetland area where salt water from the ocean blends with fresh water draining from the upland watershed(s).

Water Word Search

E	I	C	A	G	I	T	P	H	G	W	A	P	E	S	C	V	A
T	N	E	V	A	P	O	R	A	T	I	O	N	R	V	O	N	W
A	F	V	O	T	R	N	M	F	T	R	C	O	L	A	N	T	A
V	I	A	I	M	T	A	D	O	R	A	R	E	S	G	D	E	T
N	L	I	L	O	R	E	I	C	A	L	G	E	A	W	E	S	E
P	T	G	A	S	A	T	S	N	N	T	O	S	C	P	N	T	R
P	R	Y	H	P	H	O	T	O	S	Y	N	T	H	E	S	I	S
R	A	I	Y	H	E	N	T	A	P	I	P	U	H	T	A	R	H
E	T	O	A	E	T	R	H	G	I	D	C	A	S	O	T	V	E
L	I	R	C	R	V	A	P	O	R	E	T	R	O	D	I	E	D
I	O	S	T	E	R	P	G	C	A	A	E	Y	R	C	O	A	W
R	N	Y	R	O	A	I	W	Y	T	S	V	I	T	I	N	R	E
N	S	O	V	S	U	N	A	T	I	H	F	I	K	A	M	S	T
P	E	R	C	O	L	A	T	I	O	N	A	C	T	G	C	O	M
W	F	M	K	Q	N	S	E	P	N	I	H	W	V	Y	D	I	C
H	C	L	O	U	D	H	R	F	E	K	Z	O	P	M	V	L	Q

Look for the following words sideways, downward, diagonally, or backward:

1. Estuary
2. Vapor
3. Gas
4. Ice
5. Rain
6. Water
7. Percolation
8. Watershed
9. Glacier
10. Photosynthesis
11. Transpiration
12. Infiltration
13. Gravity
14. Atmosphere
15. Condensation
16. Evaporation
17. Ocean
18. Cloud
19. Soil
20. Sun

Water Word Search Key

E	**I**	C	A	G	I	T	P	H	G	W	A	P	E	S	**C**	V	A
T	**N**	**E**	**V**	**A**	**P**	**O**	**R**	**A**	**T**	**I**	**O**	**N**	R	V	**O**	N	**W**
A	**F**	V	O	**T**	**R**	N	M	F	**T**	R	**C**	O	L	A	**N**	T	**A**
V	**I**	A	I	**M**	T	**A**	D	O	**R**	A	R	**E**	S	G	**D**	E	**T**
N	**L**	I	L	**O**	**R**	**E**	**I**	**C**	**A**	**L**	**G**	**E**	A	W	**E**	S	**E**
P	**T**	**G**	**A**	**S**	A	T	S	**N**	**N**	T	O	**S**	C	P	**N**	T	**R**
P	**R**	Y	H	**P**	**H**	**O**	**T**	**O**	**S**	**Y**	**N**	**T**	**H**	**E**	**S**	**I**	**S**
R	**A**	I	Y	**H**	E	N	T	A	**P**	I	P	**U**	H	T	**A**	R	**H**
E	**T**	**O**	A	**E**	T	R	H	**G**	**I**	D	C	**A**	S	O	**T**	V	**E**
L	**I**	R	**C**	**R**	**V**	**A**	**P**	**O**	**R**	E	T	**R**	O	D	**I**	E	**D**
I	**O**	S	T	**E**	R	P	G	C	**A**	**A**	E	**Y**	R	C	**O**	A	W
R	**N**	Y	R	O	**A**	I	**W**	Y	**T**	S	**V**	I	T	I	**N**	R	E
N	S	O	V	**S**	**U**	**N**	**A**	T	**I**	H	F	**I**	K	A	M	**S**	T
P	**E**	**R**	**C**	**O**	**L**	**A**	**T**	**I**	**O**	**N**	A	C	**T**	G	C	**O**	M
W	F	M	K	Q	N	S	**E**	P	**N**	I	H	W	V	**Y**	D	**I**	C
H	**C**	**L**	**O**	**U**	**D**	H	**R**	F	E	K	Z	O	P	M	V	**L**	Q

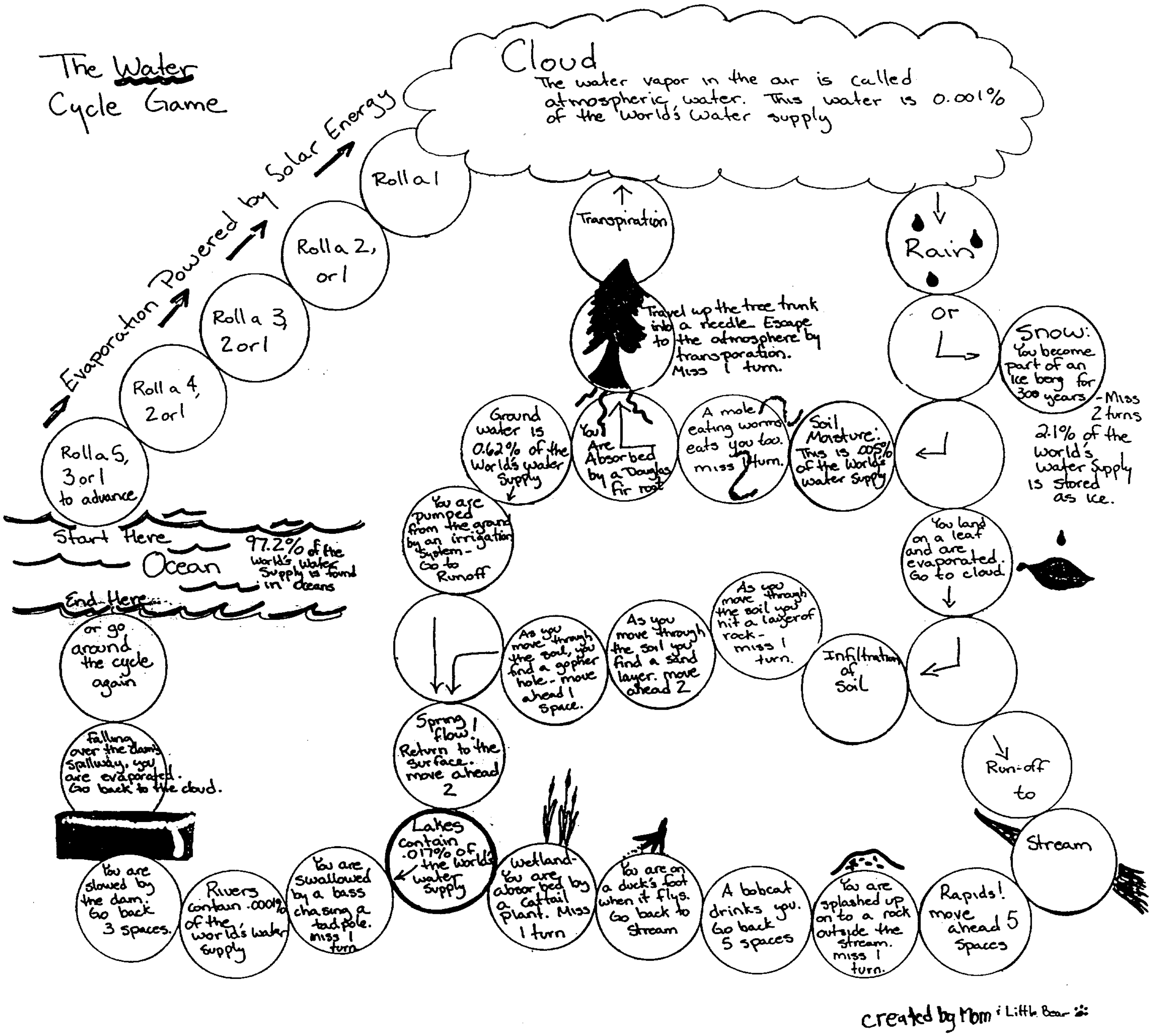
The Rosa Raindrop Water Cycle Game

Create a game board following the picture below. (This is a 50% reduction of the original game.) Use large corks as marking pieces. You may wish to copy the rules on cardboard and clip them to the game board. This game is for two players and takes 10 to 20 minutes.

Rules

The objective is to return to the ocean, completing the cycle. The youngest player moves first. Role the dice and follow the instructions on the game board for evaporating by Solar Energy into the Cloud.

From the Cloud follow the arrows around the board. Players may choose their own path around the board unless they land on a circle that contains an arrow. When a player ends their move on a circle that contains an arrow they must travel in the direction the arrow points on their next regular turn.



The Water Cycle

Objectives

Learners will be able to:

- Name the three forms of water found on earth (solid, liquid, gas)
- Use vocabulary introduced in Water Words
- Demonstrate the water cycle

Method

Learners will create a water cycle using processes introduced in Water Words. They will travel with Rosa Raindrop to review the world's water supply, listen to the poem "Recycled," and create a water poem of their own.

Materials

- Overhead projector and screen
- Transparencies: "A Basic Water Cycle," "The Water Cycle," and "Rosa Raindrop's Tally"
- One glass of water
- One set of Water Cycle Activity cards. Copy the Water Cycle Activity Cards Masters from Appendix III onto card stock. There are 21 main heading cards. If you are working with more than 21 learners, you may assign extra learners, up to 7 additional, as follows:
- Water vapor evaporating from the ocean, cards 2(b)–2(e) for one to four additional participants
- Rain, card 4(b) for one additional participant
- Soil Infiltration, card 8(b) for one additional participant
- Slushy melting snow, card 13(b) for one additional participant

Background

The water—or hydrologic—cycle is an endless process where water is circulated around the surface of the earth, through soil, plants, animals, and the atmosphere. The amount of water moving through the cycle has been approximately the same throughout 3.5 billion years. On average, a single water molecule will be evaporated once every 5,000 years, and will have moved through the cycle about 700,000 times.

In the Water Words lesson, learners were introduced to words that define the processes that are active in the water cycle.

Procedure: Part 1

Place the overhead transparency, Fgure 1: "A Basic Water Cycle," on the projector. Pass out the first seven Water Cycle cards. These are cards 1, 2(a), 3, 4(a), 5, 6, and 7. As you hand the card to each learner, have them read their FACT to the class, then take their place in a Basic Water Cycle circle. When the first seven learners are in place, ask them to read again the title of their card to the group. Ask the remaining learners if there are any ways not mentioned that water exists or moves on earth.

Put the overhead transparency, figure 2: "The Water Cycle," on the projector. Pass out Water Cycle cards 8–21, and, as needed, cards 2(b)–2(e), 4(b), 8(b) and 13(b). As you hand each card to a learner, have them read their FACT to the class, then take their place in the Water Cycle.

Have the learner with card 21, Rosa Raindrop, sit out the first part of the demonstration.

When all the other learners are in place, use Figure 2: "The Water Cycle," to check for correct placement of each learner.

Now Rosa Raindrop gets "her" turn. Put the "Rosa Raindrop's World Water Tally" sheet on the overhead projector. [Leaders: Please be sure to use erasable pens as you record the water amount in each blank.]

Ask Rosa to travel around the water cycle, pausing as each learner again reads their card's title. At each location with a world water supply percentage listed, Rosa "collects" this water, making sure the leader records it on "Rosa Raindrop's World Water Tally" overhead.

Discussion

With the learners still in their water cycle formation, ask them to raise their hand if: they represent a part of the water cycle in which water:

- Is a gas
- Is a liquid
- Is a solid
- Moves
- Is fresh
- Is salty

(Leaders: only one learner, the ocean, represents salt water. However, the majority of the water on earth is found in the oceans. Remind the learners of this using the World Water Tally. They should not be confused by the greater number of learners who represent forms of fresh water.)

Procedure: Part 2

Set out a glass of water where everyone can see it, and read the poem "Recycled" (next page). (Leaders: Read through it before attempting to read aloud to the learners!)

As a wrap-up you may wish to have the students write their own water poem.

Recycled

The glass of water you're about to drink
Deserves a second thought, I think,
For Avogadro, oceans and those you follow
Are all involved in every swallow.

The molecules of water in a single glass
In number, at least five times, outclass
The glasses of water in stream and sea,
Or wherever else that water can be.

The water in you is between and betwixt,
And having traversed is thoroughly mixed,
So someone quenching a future thirst
could easily drink what you drank first!

The water you are about to taste
No doubt represents a bit of the waste
From prehistoric beast or bird—
A notion you may find absurd.

The fountain spraying in the park
Could well spout bits from Joan of Arc,
or Adam, Eve, and all their kin;
You'd be surprised where your drink has been!

Just think! The water you cannot retain
Will some day hence return as rain,
Or be beheld as the purest dew.
Though long ago it passed through you!

—Verne N. Rockcastle

Watersheds: Rain Coming and Going

Objectives

Learners will be able to:

- Define a watershed
- Identify the contributions of watersheds to the public water supply
- Explain where rain falls most and least in Oregon
- Explain some reasons for Oregon's rainfall patterns
- Locate some of Oregon's major watersheds

Method

Leaders will use the Model Mountain to demonstrate water flow in a watershed.

Using the "Rain Coming and Going" worksheet, learners will locate and label major Oregon mountain ranges and rivers. They will discuss the reasons for Oregon's rainfall pattern.

Materials

- Video, "Healthy Watersheds"
- Topographic mountain model
- Water squirt bottle, labeled "cloud"
- "Rain Coming and Going" worksheet, one copy/learner
- Overhead projector and screen
- Transparencies of Oregon (a) landforms, (b) surface water, (c) drainage basin boundaries, (d) limit of migratory fish populations

Background

Read through the brochures recommended for the Wetlands Resource Library from The Oregon Watershed Improvement Coalition, "Watersheds" and "Riparian Areas." You also may wish to preview the "Heathy Watersheds" video.

As we learned in Water Words and The Water Cycle, a watershed is the entire land area drained by a stream or river. Watersheds are the part of the water cycle where *surface* water is channeled into specific streams or rivers on its return journey toward the ocean.

A watershed can be compared to a bathtub. All the water that falls *inside* the walls of the bathtub travels under the influence of gravity ("down energy") toward a common point, the drain. In fact, the land area that drains into a specific river is often called the drainage basin. The land area from which surface water flows toward the Willamette River is called the Willamette River Drainage Basin.

Continuing with the bathtub analogy, water that falls OUTSIDE the bathtub, onto the floor, is in a different "watershed." The bathtub wall is the divide between the two watersheds. High places such as mountains, hills, or ridges divide water flow into natural watersheds. A relief map can show the geographic features clearly. They also show where surface water moves, as in streams, or is stored, as in lakes or wetlands.

Wetlands can be an important contributor to the watershed. In wet seasons, they soak up water like a giant sponge. This may prevent or reduce seasonal flooding. In the drier seasons, this water is slowly released to the watershed, helping to maintain water quality downstream.

Where does it rain in Oregon?

In Oregon, the average annual rainfall varies widely from north to south and east to west. Some generalizations can be made about where it rains by comparing the average annual rainfall for several Oregon cities. The Coast Range keeps some of the moisture that gathers in clouds over the ocean from reaching the Willamette Valley. For example, the average annual rainfall in Newport is 71.93 inches, while for Salem the average annual rainfall is 39.16 inches.

As we learned in the Water Words and Water Cycle lessons, water vapor evaporates from the ocean, rises, cools, and forms clouds. The clouds are pushed inland by the onshore winds. As clouds move east, they must rise to go over the Coast Range. As the clouds rise, they become colder and can hold less moisture. This is why Newport on the east side of the Coast Range gets more rain than Salem on the west side of the Coast Range.

As the clouds travel east from Salem, they reach, and may pass over, the Cascade Mountains. The Cascade Mountains are higher than the Coast Range. These mountains also cause clouds to rise, cool, and drop some of their water as rain or snow. Cities on the west side of the Cascade Mountains get more rain than cities to the east of the mountains such as Bend. For this reason, the average annual rainfall in Bend is 11.70 inches.

Oregon's River Drainage System

Oregon has many large river basins that begin as a series of smaller watersheds in the mountains. The largest river basin associated with Oregon is the Columbia River Basin. The Columbia River brings water from as far north as Canada and as far east as the Idaho headwaters of the Snake River. Its major tributaries from Oregon are the Umatilla, John Day, and Deschutes Rivers in Eastern Oregon and the Willamette River in Western Oregon. The Grand Ronde, Malheur, and Owyhee Rivers of far Eastern Oregon drain east to the Snake River. Much of the rain that falls on Oregon could eventually return to the ocean in the Columbia River.

Procedure and Discussion: Part 1

View the video "Healthy Watersheds" with learners as an introduction to this unit. Students in the film are taking water tests for temperature, pH, and dissolved oxygen. They are collecting aquatic insects (macroinvertebrates) to assess the health of a stream. Learners will do some of these tests on their field trip. For more information on these water tests, refer to the Wetlands library for *Field Manual for Water Quality Monitoring*.

Have ready the topographic mountain model and the squirt bottle labeled "cloud." Add a few drops of food coloring to the water if you like. Discuss with learners the definition of a watershed. Ask them how the water travels from the ocean to the watershed. Use the "cloud" water bottle to "rain" some drops of water onto the mountain model. Discuss how the water travels down the mountains slopes, off ridges, down drainages. Can the learners predict where a raindrop falling in a specific spot on the mountain will go?

Procedures and Discussions: Part 2

Have ready the overhead projector and the transparencies of Oregon (a) landforms and (b) surface water. Pass out the "Rain Coming and Going" worksheet to learners and discuss with them Oregon's rainfall "pattern." To facilitate this discussion, learners will first locate and label the mountains and rivers on their worksheet map. Review with learners how water moves through the water cycle. How does the water cycle affect where it rains in Oregon?

Next, learners will complete the average annual rainfall (1941–1970) column for the cities that have no precipitation numbers shown, using one of the rainfall amounts given in the list on the right. Learners may find it helpful to label each city on the map with its average rainfall. This may be done in small groups or individually. **Answers are: Newport 72.00 inches; Salem 39.00 inches; Klamath Falls 13.00 inches; Baker City 11.00 inches**.

Using the transparency for (c) drainage basin boundaries, help learners locate the areas drained by each of Oregon's major rivers. You may draw on the transparency with *washable* pen. Remind learners of the definition of a watershed: the land area drained by a stream or river. A watershed may be as tiny as the area of land drained by a creek or as large as the area drained by the Columbia River. The term "drainage basin" may appeal to some learners as this depicts the "bowl" of land that drains towards one common location.

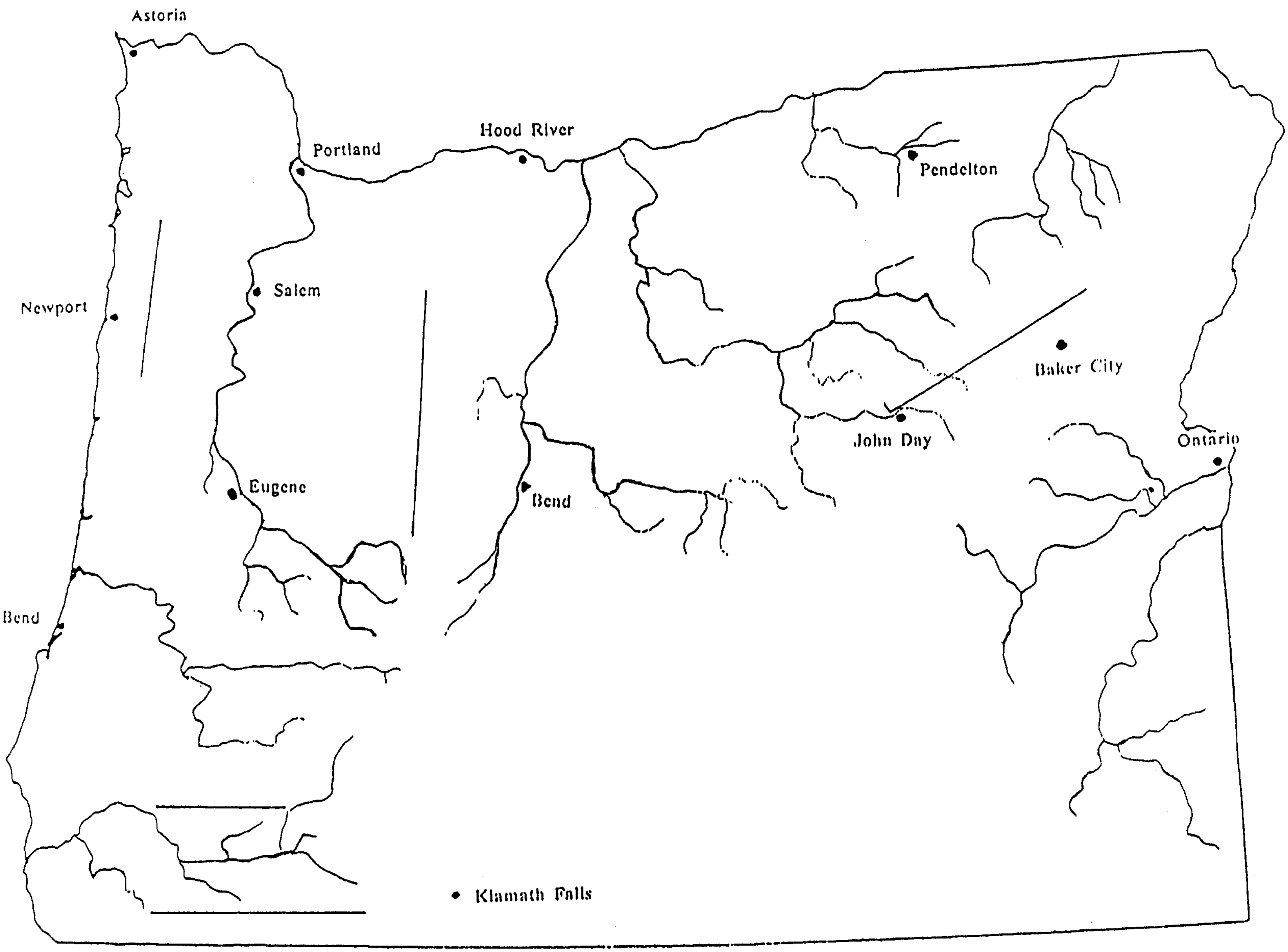
Lead learners into a discussion of the importance of not adding pollutants, fertilizers, or sediments to creeks and streams because the effects are felt by everyone (people and animals) downstream. Using the transparency for (d) limit of migratory fish populations, discuss the importance of protecting inland watersheds to the Coastal Fishing Industry and the long term survival of fish populations.

Where does it rain in Oregon?

The average annual (yearly) rainfall for a sample of cities in Oregon is given on the chart below, second column. This average rainfall is for the years 1941 to 1970. Each of these cities is located on the map on the reverse side of this page. Match the average annual rainfall amounts from the list on the right with a city on the left that's missing its rainfall amount. Use the Oregon map to locate each city listed on the left. Think about how the ocean and mountains might affect rainfall.

City	**Average inches of rainfall**	**Match these average rainfall amounts with the cities listed**
Astoria	66.40	**11.00 inches**
Newport	____________	
North Bend	63.30	**72.00 inches**
Portland	37.61	
Salem	____________	**39.00 inches**
Eugene	42.56	
Hood River	30.82	**13.00 inches**
Bend	11.70	
Klamath Falls	____________	
Pendelton	12.00	
John Day	13.00	
Baker City	____________	
Ontario	10.00	

Reference: Oregon Environmental Atlas, *Oregon Department of Environmental Quality, Carolyn Young, editor, 1988.*



Label the following mountain ranges on the map: Coast Range, Cascade Mountains, Klamath Mountains, Blue Mountains.
Label the following rivers on the map: Willamette, Illinois, Umatilla, Umpqua, Deschutes, Malheur, Rogue, Snake, Owyhee, John Day, Columbia, Grande Ronde.

The Water Detective

Objectives

Learners will be able to:

- Explain how much water is used in their homes, where their home's water supply comes from, and where it goes
- Determine if less water could be used at their homes

Methods

Learners will complete the worksheet, "The Water Detective." The worksheet will lead them to some conclusions on their family's water use.

Materials

- "The Water Detective" worksheet, one copy/learner
- *The State of Water in Oregon* (EC 1426, January 1993)
- Transparency: Home Water Source
- Video, "Saving Water, The Conservation Video"

Background

The OSU Extension Service publication *The State of Water in Oregon* (EC 1426, January 1993) provides information on where Oregonians get their water.

Procedure: Part 1

Pass out "The Water Detective" worksheet. Give learners about 10 minutes to complete Section I. They may work in small groups or as individuals. Section II is homework. While the group is together, review how to do the "research" to get the answers for Section II. Show the learners the progression of equations required in part (5) **What's Drippin'** by doing a sample calculation. The homework sheet asks learners to tally their home water use over a 24-hour period.

Discussion

Ask learners to compare their hypothesis of home water use with their actual results recorded on Section II. How many learners' families use more water than they thought? How many used less? How many families plan to fix their leaky faucets and toilets? Water consumption in a single family home averages 50 to 75 gallons/person/day. How do the learners' families compare to this average? On the overhead transparency for "Home Water Source," record (with a water-based pen) the number of families that get their water from each source.

Extension

Graphing. Ask learners to create a bar graph that shows the percentage of the class that gets their drinking water from each source.

Procedure: Part 2

View the video "Saving Water" with learners. This should reinforce some of the ideas they have keyed in on about their own water use. How do learners see the future of their water supply?

The Water Detective

Section I: In the group, develop a hypothesis of your water use at home.

1) I think I use _____________ gallons of water each day.

2) I think my family uses _______ gallons of water each day.

3) I think there are ________ leaky, drippy faucets at my house.

4) My family gets their water from _________________________________ (well, spring, city, other source)

5) The drains in my home connect to a _______________________ (city sewer, septic tank system)

Section II: At home, test your hypothesis.

1) Home Water Supply

Ask an adult where the water supply for your house comes from.

_____________________________________ (well, spring, city, other source)

2) Home wastewater system

Ask an adult where the water leaving your house goes.

The drains in my home are connected to ___________________________ (city sewer, septic tank system)

3) My water use

Keep a tally of the number of times you use water over a 24-hour period. Record below.

	# of gallons used each time		**# of times/day**		**# of gallons/day**
Flush toilet	7	x		=	
Wash hands	1	x		=	
Brush teeth	3	x		=	
Take bath/shower	30	x		=	
Gallons of water/person/day				=(a)	

4) Family water use

in Family x (a) Gallons of Water/Person/Day = Gallons/Family/Day
__________ Family Members x (a)_______ = ________ Gallons/Family/Day

5) What’s Drippin’

—Take a tour inside your house and outside in your yard. How many faucets or hoses can you find that are dripping? (b)____________

—Ask an adult if you may borrow a 1-cup measuring cup. Place it under a dripping faucet. How long does it take to become full?

It took _________ minutes for the 1-cup measuring cup to become full.

—There are 60 minutes in 1 hour. How many cups of water drip out every hour? Use a separate piece of paper to do your calculations. (Hint: If it takes 20 minutes to fill the cup one time, 3 cups will drip out in 1 hour.) __________

In 24 hours (or 1 day) how many cups of water will drip out? __________

How many cups of water does the faucet waste in 1 week? (c)_________ (Hint: There are 7 days in a week, each day is 24 hours long.)

—Now you’ll use the data you have gathered to calculate the amount of water wasted on average in your home by all the leaky faucets. Use the numbers calculated in (b) and (c) above.

(b) # of Leaky Faucets________ x (c) Cups of Water Wasted/Faucet/Week________ = (d) ________ Total Cups of Water Wasted/Week

There are 16 cups of water in a gallon. To find the number of gallons of water wasted:

(d) Total Cups of Water Wasted/Week will be divided by 16 cups/gallon.

$$\frac{\text{(d) Total Cups of Water Wasted/Week}}{\text{16 cups/gallon}} = \_\_\_\_\_\_\_\_\text{Gallons of Water Wasted/Week}$$

—If your home uses water from a public water system, your family pays a bill each month for the amount of water they use. These bills are usually based on the number of cubic feet of water used as recorded on the water meter at your house. Ask an adult how much they pay for each cubic foot of water used at your home. One cubic foot of water equals 7.5 gallons. How much money could be saved each week if all the leaky faucets were fixed?

Ground Water

Objectives

Learners will:

- Be able to define ground water, the water table, and an aquifer
- Name possible sources of contamination to ground water
- Name ways people use ground water

Method

Learners will view the "Ground Water Adventure" video depicting a girl, Jennifer, playing a computer simulation game that defines ground water, shows possible sources of ground water contamination, and how the risk of contamination can be reduced. After viewing the video, leaders will lead a discussion of ground water.

Materials

- TV and VCR
- Video, "Ground Water Adventure"
- Book, *Adopting A Wetland*, pages 1–8
- Pamphlet, "The State of Water in Oregon"
- Overhead projector and screen
- Transparency "Fig. 1—Water recycles...."

Background

Review the pamphlet *The State of Water in Oregon* for information on how many Oregonians rely on ground water for their domestic water supply. The Fig. 2 graphic in this pamphlet shows sources of ground water recharge and pollution.

Wetlands may be found in low lying areas where the water table is at or above the surface. It is important to realize that while ground water may be found in sand and between stone layers deep in the earth, it can also emerge at the surface creating springs or wetlands.

Discussion

After viewing the video, place the transparency "Fig. 1 Water recycles..." on the overhead projector and discuss with students:

—How and where is water stored underground? (Video: "In sand and between stone layers." Please note: Water is stored in materials of *all* textures, not just sand. It *moves* more rapidly through sandy aquifers than through finer textured ones.)

—How is the aquifer recharged? (Mostly by rain water. In some places in the Midwest, ground water is very old, geologically, and receives very little recharge from rain.)

—What are some sources of ground water contamination? (Industry, Agriculture and Individual)

—How many learners benefit from the products of industry or agriculture? (All)

What's Soil Got To Do With It?

Objectives

Learners will be able to:

- Name three general kinds of soil: sand, silt, clay
- Understand how percolation rates differ with soil type
- Name two characteristics of wetland soils

Method

Learners will test soils to demonstrate how soil texture affects percolation rates and will "become" soil particles to experience soil types in an imaginary flower pot. Through experiment and discussion, they will understand how certain characteristics of wetlands (i.e., storing surface water, recharging ground water) are affected by soil type. Part 3 can be done prior to Parts 1 and 2 if the leader believes it will help learners with understanding how soil texture affects percolation rates.

Materials

- What's Soil Got To Do With It? one copy/pair of learners

Part 1

- Soil samples of sand (purchase sand box grade at a toy store or order from a nursery), a local clay soil, and a sample of a local soil. (If no clay soils are found locally, create your own. Locate a store that carries masonry supplies and purchase clay powder called " Mason's Clay" or "Mortar Clay." Mix in the desired proportions with "regular" soil.)
- Six petri dishes
- Two squeeze bottles filled with water

Part 2

- Soil samples of sand, a clay soil, and a local soil.
- Soil Tube Assembly: Set of three tubes each, labeled "sand," "local," "clay." Instructions for constructing the Soil Tube Assembly are found in Appendix I.
- Two measuring cups, 250 ml polypropylene beakers
- Six small collection cups, 50 ml polypropylene beakers

Part 3

- One set of Soil Texture Cue Cards. Copy the Activity Card Masters from Appendix III onto card stock: SAND; SILT; CLAY; SANDY CLAY LOAM = 55% SAND (16/30) + 20% SILT (6/30) + 25% CLAY (8/30)
- TV and VCR
- Video, "The Surface Water Video"

Preparations

For this lesson you'll need to collect three soil samples. If possible, obtain a sample of sand and clay. The third soil can be a local backyard soil from any learner's home.

Sand box sand can be obtained from toy stores or nurseries. It can be used "as is" or mixed with a garden soil. To determine if a local soil is a clay, you'll need to perform a test similar to the one the learners will be doing. Refer to the county Soil Survey book for help in locating soil types, or ask for help from your Extension Service or Natural Resources Conservation Service professionals.

To test for texture, slightly wet a small sample of soil in the palm of your hand. Feel the soil. The clay soil will not feel gritty. Clay will mould into a *sticky* ball and can be rolled into a long thin rod and bent into a ring without breaking. Silty soils feel smooth, like flour. They are neither gritty nor sticky. A loamy soil is intermediate between sand, silt, and clay. It will feel a little gritty and can be molded into a ball without feeling very sticky at all.

Collect the sand, clay, and local soil. Measure out a small amount of sand onto two dishes. Repeat for clay and the general soil. You should have two dishes each of sand, clay, and local soil. Have ready the two Soil Tube Assembly stands and six clear tubes. Check the condition of the Soil Tube Assembly and tighten the metal holding clamps around the clear tubes by using a screwdriver on the nut. The cheese cloth filters at the base of each tube should be held tightly in place by the black rings. For each set of three tubes, one should be labeled Sand, one should be labeled Clay, and one should be labeled Local. Fill each tube in turn as labeled with one of the three soil samples. Each tube should be filled to within 3 inches of the top opening.

Background

Brochures that will provide background information for this lesson include: EPA Wetlands Fact Sheets #2, 3, 9, 25, 26; America's Wetlands: Our Link Between Land and Water, page 2; and Just the Facts #4: How To Identify Wetlands. It may be helpful to obtain a copy of the Soil Survey Book for your county from your Agricultural Extension Agent or Natural Resources Conservation Service office. This book has a wealth of information about soil types and characteristics specific for each county. The aerial photos in the Soil Survey Book will be useful in identifying local wetlands your group might visit.

This lesson will introduce learners to some of the characteristics of soil and how these characteristics affect wetland function. Review with learners what they have been taught so far. Learners have been taught about the water cycle and watersheds. They know that water is stored in lakes and wetlands. They know that wetlands can be an important source of ground water recharge as water percolates down through the soil.

However, lakes and wetlands could not exist to store water where soils are very sandy. A sandy soil's texture does not allow it to hold water at the surface. The exception to this is sandy soil in estuaries and coastal areas where water is located in low lying pockets at the water table. Sandy soils may have a rapid percolation rate that allows quick recharge of ground water supplies; yet in these same soils, water may move so rapidly that plants are not allowed to take up the water they need to thrive.

Soils may be classified by the sizes of their mineral grains into four groups: sandy, silty, loamy, or clay. For simplicity we will look at only sand, silt, and clay. Sand has the largest size particles; they can be seen by the naked eye. Clay particles are very fine. They are extremely small and can be seen only with very high-powered microscopes. Silt is in between. Most soils are a combination of some percentage each of sand, silt, and clay. Soil scientists can be very precise about soil texture. For instance a "sandy clay loam" soil contains 25% clay, 20% silt, and 55% sand. In the Flower Pot activity, leaders will ask learners to "become" the components of this type of soil! Soil particle size distribution is responsible for the texture of a soil and its percolation rate.

Procedure: Part 1

Texture by Feel Test

Divide the learners into two groups and pass out one copy of the What's Soil Got To Do With It? worksheet to each group.

Have available the water squeeze bottles and the set of dishes of dry sand, clay, and local soil to each group. Demonstrate how to feel soil texture. Ask learners to fill in the chart and answer the questions under Part 1—Texture by Feel.

Procedure: Part 2

Percolation Test

Have available the Soil Tube Assembly, one measuring cup per group, and the collection cups. Have learners place the collection cups under the soil tubes. Read the learners the directions for the experiment and data collection on Part 2 of the worksheet. Ask learners to complete Part 2 of the worksheet. Caution learners to keep an eye on the collection cup as they add water to their soil tubes, so as not to overflow the cups and flood the table.

Discussion

Ask learners:

—How did the learners' prediction of percolation rate on the worksheet at (3) compare to their observations at (6)?

—Did water stand on the top of any soil types?

—How could learners tell that a soil had become saturated?

—Did water flow out of any soil at the same rate it was poured onto it?

Procedure: Part 3

Creating a Flower Pot

You may wish to hold this activity and have students view the videotape prior to presenting parts 1 and 2. This activity can be done in any open area making use of natural boundaries or painted lines on the playground. The leader might wish to use sidewalk chalk to draw a flower pot outline big enough for the group to stand in.

Take the learners and the Soil Texture Cue Cards outside. Ask the learners to stand in the flower pot. Have one learner step out of the flower pot to act as "Rosa Raindrop." The other learners will begin by becoming sand particles. Post the Cue Card for sand where everyone can see it. To "become" sand, each learner should stand with their arms outstretch and their hands clenched. They should stand so that they can turn around (gently!) and just touch their neighbor's knuckles.

When all the learner sand particles are in position, ask them to freeze. Then ask Rosa Raindrop to begin at the top of the flower pot, infiltrate the soil, percolate down through the sand, and out the bottom of the flower pot. How hard was it for Rosa Raindrop to infiltrate and percolate through sand?

Repeat this exercise with the learners becoming silt. Post the Cue Card for silt where everyone can see it. To become silt particles each learners will stand with their hands on their hips and their elbows extended. They should stand so that they can turn around and just touch their neighbor's elbow. How much of the pot do they occupy? Ask Rosa Raindrop to percolate down through the silt. How hard was it for Rosa Raindrop to percolate through the silt? How does silt compare to sand for ease of water percolation?

Repeat this exercise with the learners becoming clay. Post the Cue Card for clay. To become clay particles, each learner will stand with their arms at their sides and their shoulders touching the next person. How much of the pot do they occupy? Ask Rosa Raindrop to percolate down through the clay. How hard is it for Rosa Raindrop to percolate through clay? How does clay compare to sand and silt for ease of percolation?

If time allows, create a sandy clay loam soil in the flower pot. Post the Cue Card for Sandy Clay Loam. A sandy clay loam is made of 25% clay, 20% silt, and 55% sand. With 10 learners, a sandy clay loam would be 3 clay learners (arms at sides), 2 silt learners (hands on hips), and 5 sand learners (arms outstretched). Assign the number of learners needed to create the correct number of each soil particle size. Mix the learners up into a Sandy Clay Loam. Ask Rosa Raindrop to infiltrate and percolate once again. Compare Rosa's progress to the previous soil types.

Show the video, "The Surface Water Video." Discuss how surface water can become polluted. Ask learners how some wastewater treatment plants that treat ("clean up") sewer water take clues from nature.

Discussion

Which soil do learners believe is the most permeable? Which would learners expect to have the fastest percolation rate? Which of these soils would learners expect to find in a wetland? After the discussion, return the learners to the classroom.

Cleanup

Be sure to clean out the Soil Tube Assembly tubes thoroughly immediately after the lesson to avoid the soil materials solidifying and causing damage to the tubes when cleaned.

What's Soil Got To Do With It?

Part 1—Texture by Feel

1) Have one member of the group put some of the sandy soil sample on his or her palm. Add a few drops of water and try to form a ball. Try to squeeze the ball into a snake and bend it into a ring. How does the soil feel? Repeat with the other samples.

Can you…	**Sand**	**Local**	**Clay**
…form a ball?			
…form a "snake ring"?			
…feel grit or sand?			
…feel smooth, like flour?			
Does the soil feel gritty, but not sticky?			

2) Finish each sentence below by describing each soil's characteristics.

I would know I had a **sandy** soil if it ______________________________

I would know I had a **clay** soil if it ______________________________

I think our **local** soil is most like ______________________________

3) For the soil types listed below, predict which will have a slow, fast, or medium percolation rate. Draw a line from the soil type on the left to its percolation rate on the right.

Sand	Slow
Local	Fast
Clay	Medium

Part 2—Percolation Test

4) Pour $^1/_2$ cup of water into the top of the sand tube and begin timing. How long does it take for the half cup of water to soak into the soil? Record on the chart. Repeat with the local tube and the clay tube.

5) If water is not yet dripping from the bottom of any tube, add more water, $^1/_4$ cup at a time, until it does. How much water is added before it has percolated down to drip out the bottom of the tube? Record on the chart.

6) Compare and record the percolation rate you observe for each type soil.

7) If water is not yet standing on top of the soil, add more water, $^1/_4$ cup at a time, until it does. How much water was added before the soil became saturated?

8) The amount of water held in the saturated soil is equal to the amount of water added minus the amount in the drip cup at the moment there is no water standing on top of the soil.

	Sand	**Local**	**Clay**
4) Time for $^1/_2$ cup of water to soak into soil:			
5) Total amount of water added before dripping out bottom:			
6) Is the percolation rate slow, medium, or fast?			
7) Amount of water added before water sits on top of soil:			
8) When the soil is saturated, how much water is held in the soil?			

9) What type of soil would you expect to find in a wetland?

10) What characteristics would you expect to find in a soil in a wetland?

In the Water: In the Plants

Objectives

Learners will:

- Understand the capability of wetlands to cleanse water through storage of soluble substances in living plants.
- Understand that any natural systems (*wetlands*) can become overloaded if there are too many contaminants.

Method

Learners will observe the ability of plants to absorb soluble substances in water.

Materials

- "It's in the Water" data sheet, one copy per team
- Two sets of two plastic water cups per team, 250 ml polypropylene beakers
- Red food coloring
- Vinegar
- Two measuring cups, 250 ml polypropylene beakers
- One paring knife per team
- Several bunches of fresh celery stalks
- One ruler per team

Background

Wetlands play an important role in maintaining water quality. Water enters the wetland from surface runoff or from ground water. Either of these water sources may bring with them fertilizers and other waterborne contaminants.

Many things may be dissolved in the water that moves through plants. If the water carries pollutants, these pollutants may be left in the plant; if the plant is one used for food, then these pollutants may get into the people or animals who eat them.

In the summer when plants are actively growing, nutrients and contaminants are absorbed by wetland plants. In the fall and winter when plants die and decay, these nutrients are released. There is a lower concentration of nutrients in water from runoff and ground water in the winter so ecosystems downstream can generally make good use of these released nutrients.

Wetlands have been called natural "water treatment operations." In a time when humans introduced fewer pollutants and less silt to the waters entering wetlands, they were very efficient indeed.

Today heavy metals, petroleum products, and fertilizers are more abundant in the environment. Wetland's ability to purify water can be exceeded, resulting in degradation of other parts of the environment. As you study the ability of plants to remove contaminants from the system, remind students that the ultimate answer is to reduce the amount of these pollutants in the environment.

Procedure

Divide the group into two teams. Give each team two plastic cups and two stalks of celery. Have the learners trim the bottom end off each celery stalk. No stalk should be longer than 11 inches. Use stalks with leaves if possible. Label the plastic cups with masking tape: cup "A," cup "B."

In Cup A put $^3/_4$ cup water, several drops red food coloring, and $^1/_4$ cup vinegar. Add a trimmed celery stalk. In Cup B put 1 cup water, several drops red food coloring, and a trimmed celery stalk.

Place all the cups near a window and leave them there for a minimum of 4 hours, overnight, or up to several days. Ask the learners what they think will happen to each celery stalk. How will the results in Cup A differ from Cup B? Have the learners answer the questions on page 1 of the Data Sheet with what they expect to find for each celery stalk. If you are doing this activity as a demonstration, place the celery in the prepared cups 48 hours before you will show it to the learners.

Results

When the celery has been soaking a sufficient amount of time, some red color may show on the celery stalks that have leaves.

Ask the learners to observe their celery stalks beginning with Cup B. For this part of the investigation, learners will need a ruler, a knife, and a piece of notebook paper. Each team should answer all the questions on the data sheet. After the teams have completed their observations, bring the group back together and compare results.

Discussion

Could anyone tell, just by looking at the celery stalks, that a substance other than red colored water was in one of the celery stalks?

If the pollutant in the water used by the celery stalk had no color, no odor, and no taste, how would we know it was there?

Extension

A demonstration of the movement of water through the celery stalk and out of the leaves—*transpiration*.

Place an extra celery stalk containing leaves in one of the Cup B solutions. Over the leaves at the top end of the stalk, place a plastic sandwich bag. Secure the bag around the celery stalk with a rubber band. After a period of time, water droplets will collect in the bag. The water has moved from the cup, through the celery, and out into the air to be captured in the plastic bag.

Water droplets in the bag will be clear, not red. Why?

It’s in the Water

Cup A:
- $^{3}/_{4}$ cup water
- Several drops red food coloring
- $^{1}/_{4}$ cup vinegar
- One celery stalk with bottom end trimmed off; total length 11 inches or less

Cup B:
- 1 cup water
- Several drops red food coloring
- One celery stalk with bottom end trimmed off; total length 11 inches or less

Questions

After soaking the celery stalk in water, red color, and vinegar in Cup A, I expect the celery stalk will....

After soaking the celery stalk in water and red color in Cup B, I expect the celery stalk will....

Observations

	Cup A	**Cup B**
What is the volume of liquid in:		
Does the liquid have a color?		
Does the liquid have a smell?		
Does the liquid have a taste?		
Is the celery stalk firm and crisp?		

Results

Remove the celery stalk from Cup B. This will be called “Celery B.” Dry the celery with a paper towel. Place it lengthwise on a piece of notebook paper. Using a ruler, measure along the celery stalk, marking the paper every $^{1}/_{2}$ inch. Beginning at the bottom end, slice the celery stalk at every $^{1}/_{2}$ inch mark until there is no longer a red color visible in the stalk. Mark this spot on the paper and measure the distance the color traveled up the stalk.

Do the same for the celery stalk in Cup A, “Celery A.” Fill in the chart below.

	Celery A	**Celery B**
How far up the stalk did the color travel? (inches)		
How does the celery smell?		
How does the celery taste?		
Is the celery stalk firm and crisp?		

Compare Celery A with Celery B. How are they different?

Does Celery A have a vinegar taste where there is no red color in the stalk? Why or why not?

A Wetland Sampler

Objectives

Learner will:

- Be able to describe components of the salt marsh habitat and where they can be found
- Be able to name the primary differences between a salt marsh and freshwater marsh

Methods

Leaders will use the book *Saving Our Wetlands and Their Wildlife* and the video *Tide of the Heron* to introduce learners to types of wetlands.

Materials

- Book: *Saving Our Wetlands and Their Wildlife* by Karen Liptak.
- TV and VCR
- Video: *Tide of the Heron: The Story of South Slough* from the National Estuarine Reserve in Charleston, Oregon
- Large Oregon map to locate Coos Bay area landmarks
- Brochures: "The Richest Place on Earth," "A Tour of the Reserves," "Oregon Estuaries," "Recognizing Wetlands," "Just the Facts" sheets #1–5, EPA "Wetlands Fact Sheets."
- Posters: Audubon Posters, WETLANDS—Life in a Salt Marsh, WETLANDS—Life in a Freshwater Marsh

Procedure

Begin by reading from *Saving Our Wetlands* chapter 1, "Our Wonderful Wetlands" and chapter 3, "What Lives in the Wetlands." Discuss with learners the differences (and similarities) of saltwater and freshwater marshes.

Introduce the video *Tide of the Heron* by explaining that it was filmed at the South Slough National Estuarine Reserve, near Charleston, Oregon. South Slough is an arm of the Coos Estuary. Use an Oregon map to locate the city of Coos Bay, Coos Estuary, the city of Charleston, and the South Slough National Estuarine Reserve. The video begins in the "uplands" of the Coos Estuary, moves down to the freshwater marsh, through the estuary to the salt water marsh, into Coos Bay, and on to the ocean. The pamphlet "The Richest Place on Earth" will provide more background information.

Review the vocabulary list with learners prior to viewing the video. The Glossary at the back of *Saving Our Wetlands*, the pictures and definitions in the middle fold out of "The Richest Place on Earth," and the posters will all assist in defining words. Leaders may also use the same format as the Panel of Experts used in Water Words Lesson to review the vocabulary.

Extension

Ask learners to locate other bays and estuaries on an Oregon map and on a national map.

For help in locating estuaries in Oregon, refer to the pamphlet "Oregon's Fragile Few...Estuaries" published by the Pacific Northwest River Basins Commission. To locate estuaries in the National Estuarine Research System, refer to the pamphlet "A Tour of the Reserves" published by NOAA.

Vocabulary

Slough—A swamp, bog, or marsh that's part of an inlet or backwater.

Estuary—Where salt seawater and freshwater meet.

Uplands—The beginning of the estuary's watershed. The area inland from the coastal estuary, where the freshwater streams that feed the estuary begins.

Watershed—The watershed of the Coos Estuary is the entire land area that drains into the streams that run into the south side of Coos Bay.

Sundews—A plant that eats insects and spiders, related to the Venus-fly Trap. The insects/spiders become stuck to the sap on the sundew's specialized leaves and are absorbed by the plant.

Lichens—A large group of mosslike plants that are actually comprised of two plants, an algae and a fungi. These plants absorb some nutrients from the air.

Marshes (or Flats)—the freshwater marsh area at Coos Estuary.

Salt Water Marsh—The area of Coos Estuary where water is distinctly salty. A high salinity level is fatal to many common freshwater marsh plants and animals. In the salt marsh, the amount of salinity in the water changes with the tide over the day, the month, and the year.

Detritus—The small pieces of organic matter that collect in a layer on the soil below the water.

Tide Flats—The area of Coos Estuary most changed daily by the tidal surge, when 60 million tons of water move in and back out.

Open Channel—In the video, this is the area where the estuary enters Coos Bay.

Wetland Food Web

Objective

Learners will:

- Understand the interrelationships of plants and animals in a wetland habitat.

Method

Learners working in pairs read the "Wetland Food Web Clues" to detect the interrelationships of plants and animals, filling in the blanks on the "Wetland Food Web Puzzle."

Materials

- "Eat or Be Eaten in the Wetland Cafe" poster
- One set of Wetland Web of Life Clue Cards. Copy the Wetland Web of Life Clue Card Masters from Appendix III onto card stock.
- 100 feet of yellow poly rope
- One copy of the "Wetland Food Web Puzzle" per pair of learners
- "Wetland Food Web Clues" one sheet per pair of learners
- Transparency: Wetland Food Web Puzzle
- Overhead Projector

Procedure: Part 1

Begin the lesson by reviewing the things that animals and humans need to find in their habitats to be safe and healthy. Ask the learners where they can find clean water (drinking fountain), a food supply (cafeteria/lunch box/refrigerator), and shelter (house/apartment). Remind learners that animals must have all these habitat components available in sufficient quality and quantity to produce and raise healthy young. Without healthy young, a species will not survive.

Remind the learners of the interrelationships noted in the video "Tide of the Heron."

Ask the learners to stand in a circle. Pass out one Wetland Web of Life Clue Card to each learner. If there are not enough cards to go around, have the remaining learners choose the directions the rope will be passed after each card is read. Hand one end of the yellow poly rope to the learner with the "sun" card. Ask this "sun" learner to hang on to the end of the rope and pass the remaining coil to a "plant" or "animal" that gets or takes something from the "sun." "Sun" might pass the rope to grass, saying "Grass needs sunlight to grow."

The "grass" reads its clue card to the class. Then "grass" may choose to pass the rope to "dragonfly" because "dragonfly" rests on its stalks. Or if there are learners who have no cards, have them as a group choose where grass will pass the rope.

Each learner continues to hang onto their section of rope until all learners with cards are holding a piece of rope and a web design has been made in the middle of the circle. Be sure the rope is passed across the circle to form the web, not just passed around! This can be facilitated by mixing the cards in a fashion that guarantees the circle of learners creates a web.

Learners do not have to pass the rope to a plant or animal described on their clue card if they can explain a different interrelationship. For instance, wood ducks rely on woodpeckers to create holes in dead trees that the wood ducks use as their nest.

Discussion

Ask learners:

- Where do people fit in the web? (People eat crayfish, frogs, and bluegill sunfish.)
- What would happen to the web if there were suddenly no more insects? (Ask learners who are insects to drop their section of rope. What happens to the web?)

Collect the cards and poly rope.

Procedure: Part 2

Form the learners into teams and give each team a copy of the Wetland Food Web Puzzle and Wetland Food Web Clues. Learners read the Clues and decide where each animal or plant belongs on the blanks on the puzzle web. Have teams share results.

Ask learners where people would fit on the web. (People eat crayfish, frogs, and bluegill sunfish.)

Puzzle Answers:

(1) Algae and Phytoplankton

(2) Caddis Fly Larvae

(3) Crayfish

(4) Tadpoles

(5) Dragonfly Larvae

(6) Frog

(7) Snails

(8) Bluegill

(9) Red-winged Black Bird

(10) Shrew

Extension

Have each learner pick a favorite wetland animal and write a report about it.

Reference

American Wildlife & Plants, A Guide to Wildlife Food Habits, Alexander C. Martin, Herbert S. Zim, Arnold L Nelson, Dover Pubs. Inc., N.Y., 1961.

Wetland Food Web Worksheet Clues

The Wetland Food Web shows some of the interrelationships of certain plants and animals that live in a wetland.

Notice that the sun is on the left hand side of the page. Plants, such as the Duckweed, are in the second column. Plants use the sun's energy, through photosynthesis, to produce food. Then Wood Duck eats the Duckweed, transforming this plant energy into muscles, feathers, or even Wood Duck eggs. When Raccoon comes along, Wood Duck eggs may be transformed into Raccoon energy. Using the clues below, determine where in the Wetland Food Web Puzzle each plant or animal belongs.

____ CADDIS FLY LARVAE

I build a little home around my soft body to hide from Wood Duck and Crayfish. I wish they would leave me alone to eat my phytoplankton, so I can molt and have my wings! I want to swoop and dive above the pond in the sunshine.

_____ CRAYFISH

I am a member of the marsh sanitation department. I clean up anything dead, often using the body of a dead animal for a temporary home. I also eat algae, caddis fly larvae, and worms. Raccoon and some people consider me a delicacy.

_____ ALGAE AND PHYTO-PLANKTON

We are small single-celled or simple multicelled plants. We cannot run away when Wood Duck, Caddis fly larvae, Crayfish, Worm, Tadpole, or Snail come along. We grow very fast, because so many animals eat us.

_____ SHREW

I am only 3 inches long, but I am very feisty! Some people confuse me with moles or mice because I use the tunnels made by these other animals. I eat grass, leaves, insects, small fish, eggs, and occasionally other small mammals. When I am hunting, I try to stay under cover to avoid the sharp eyes of Marsh Hawk.

_____ SNAIL

When I spot a Water Strider, Red-winged Black Bird, or Bluegill Sunfish, I pull my foot into my shell and hope I don't get eaten. My eyes and mouth are on my foot. Pretty odd? Nope! It's convenient, because Algae grows where I crawl.

_____ BLUEGILL SUNFISH

I am a warm water pond fish, so you will not see me feeding unless the spring sun has warmed the pond. My main diet is insects and snails. I enjoy an occasional worm or piece of cheese; however, these can be tricky to get off the hook. Because I like the shallow, warm water edges of the pond, I have to watch out for Great Blue Heron.

____ DRAGONFLY LARVAE

I am a carnivorous larva that can eat other insects, worms, and even tadpoles. Because I have such a big, strong mouth, when I'm hunting I only worry about really big frogs and Raccoon.

_____ RED-WINGED BLACK BIRD

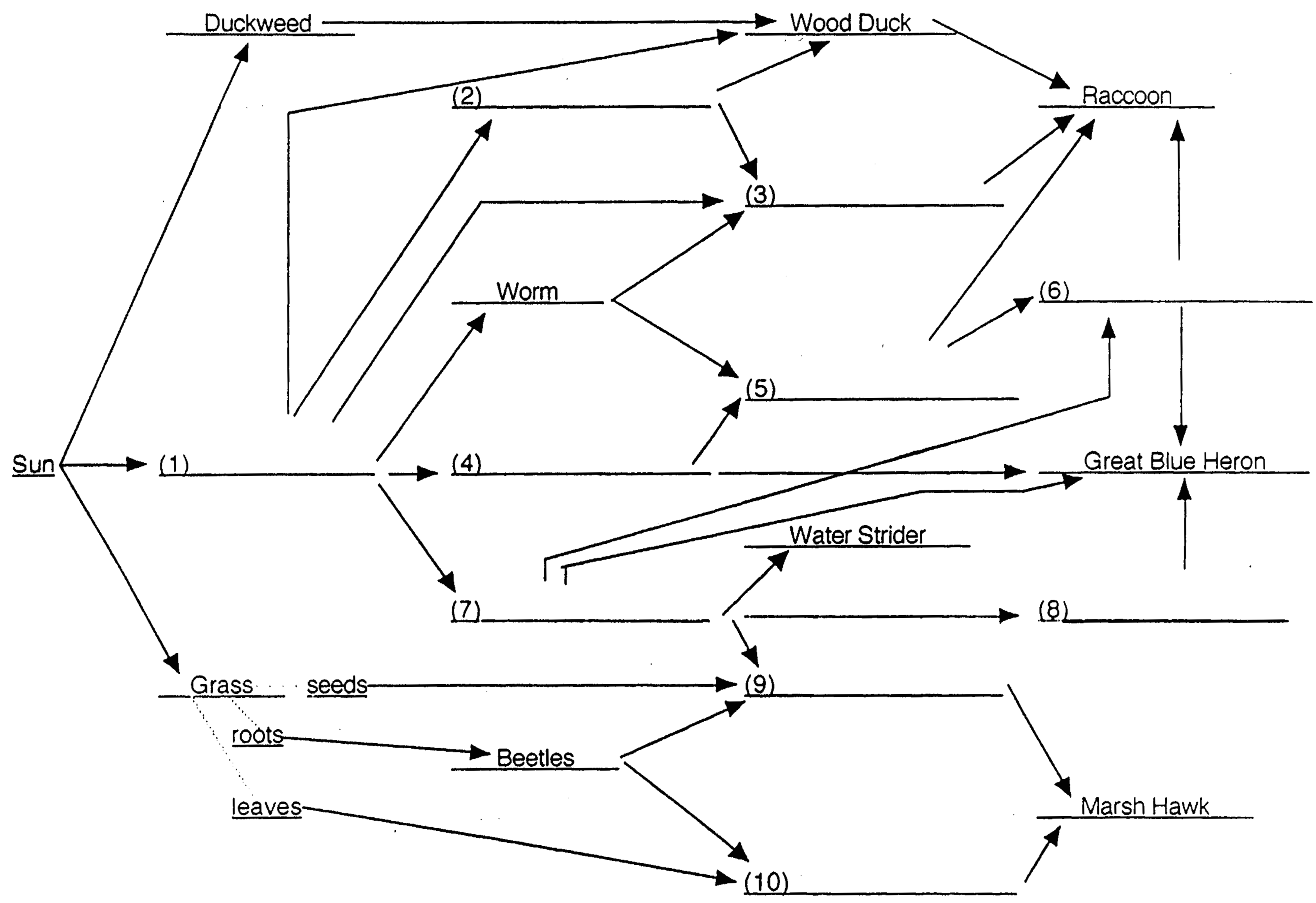
The bright red flash of my red wing is hard to miss as I cross the marsh in search of seeds, snails, and beetles. I build my nest among the cattails and must beware of Marsh Hawk cruising by.

_____ TADPOLE

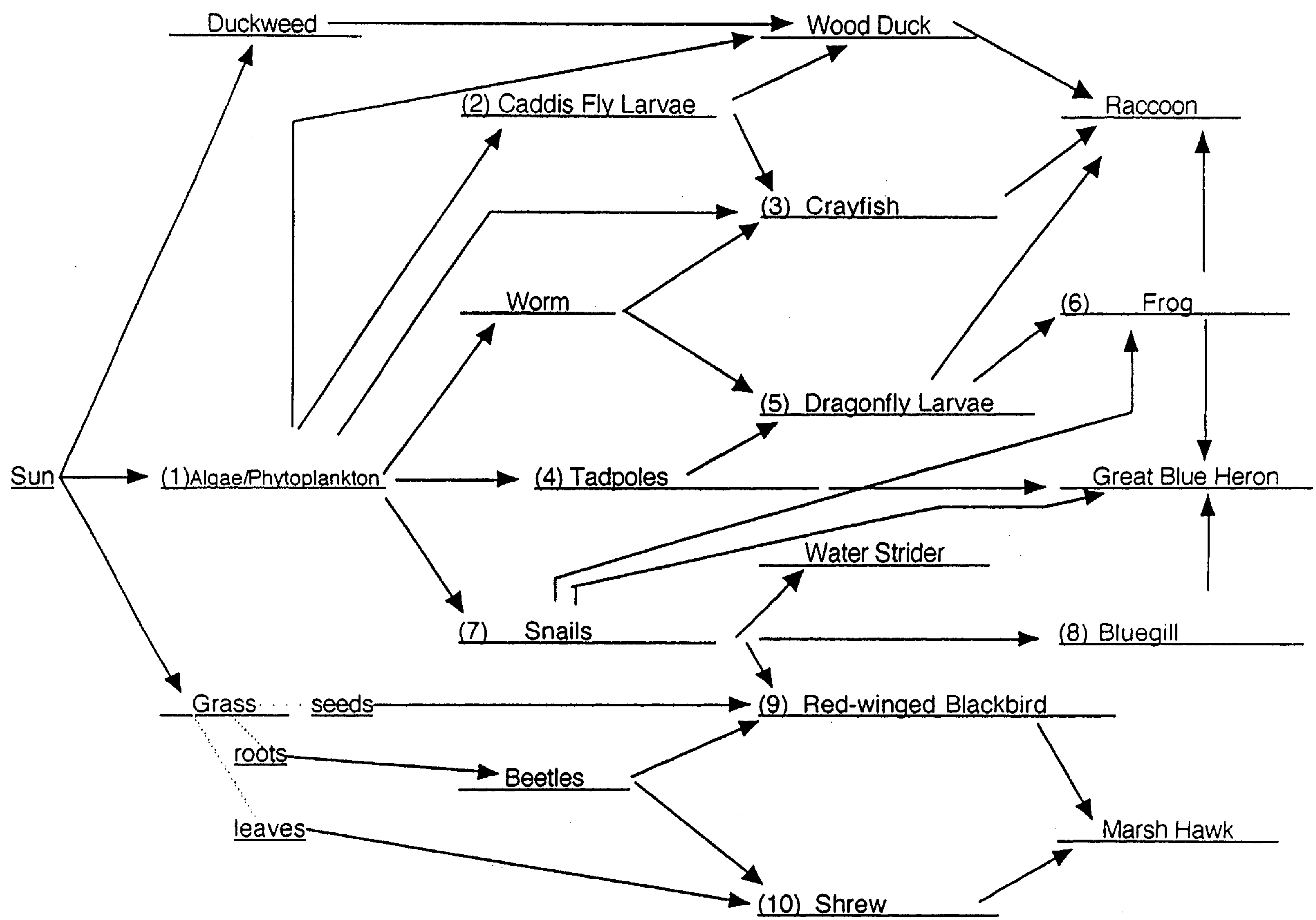
I am entirely a vegetarian, eating only plants such as algae. When I grow up I will be carnivorous like my parent frogs. Very few of my thousands of brothers and sisters will survive to have eggs, because so many animals like us in their diets. We must be especially careful of Great Blue Heron and the big-mouthed Dragonfly larvae.

_____ FROG

I am mainly a carnivorous animal, and as you have seen in cartoons, I love to eat insects. I also enjoy worms, snails, and small crustaceans. When feeding along the edge of my marsh, I have to watch out for Raccoon and Great Blue Heron.



Wetland Food Web Puzzle



Wetland Food Web Puzzle-Answer Sheet

People and Wetlands

Objectives

Learners will:

- Increase their wetlands knowledge base by writing and sharing reports on a wetland topic
- Develop a question they might answer on the wetland field trip

Methods

Learners do library research and write reports on selected wetland topics. Working in groups, they will share their information and begin to develop some questions that might be answered on their field trip.

Procedure

Ask each learner to select a report topic. Some suggested topics are listed below. Using the local or school library, learners will write a 1- to 2-page report on their topic. Learners should share their reports with the full group. Each learner will develop one question to be answered on the field trip. Each group member should write the question on the inside cover of their field trip booklet before leaving on the field trip.

Possible topics

Plants of a wetland

How wetland plants differ from plants in your backyard

The animals of a wetland

A single wetland animal, such as beaver, mallard, raccoon, or types of insects

A single wetland plant, such as cattail or Cypress trees in the southeastern U.S.

How wetlands are used by migratory water fowl, and the flyways of North America

Wildlife refuges in Oregon that have wetlands: Basket Slough, Malheur

Estuary ecosystems, animals, or functions, including interdependence of life forms

Select a particular Oregon estuary

Research a wetland ecosystem outside of Oregon, such as the Everglades or Okefenokee National Wildlife Refuge in Georgia. Include a discussion of interdependence of life forms.

Explain how to identify a wetland

Animal signs to be found in a wetland

Types of freshwater wetlands (shallow marsh, deep marsh, wet meadow), how they differ; plants and animals typical of each.

Wetlands Odyssey—Field Books and Information

Objectives

Learners will:

- Create a journal to be used on the field trip
- Know how to prepare for their wetlands odyssey
- Inform parents about the wetlands odyssey

Methods

By creating their field books and taking information home to parents, learners will be fully briefed on the expectations for their upcoming field trip.

Materials

- Book: *Signs Along the River*
- Wetland Odyssey Parent Information letter, one per learner
- One copy of the "Wetlands Odyssey" field trip booklet for each group. (If copy budget allows, provide one for each learner.)
- Copies of the "Leader's Pages" and "Wetlands Odyssey" booklet for each group leader. (These should be sent to the parent leaders *at least* 1 week before the field trip.)
- Corrugated cardboard to make backings for the booklets, one @ 9" x 12" per booklet
- String for binding pages to backing
- Pencils, one per booklet
- Hole punch
- Items to be collected to make a Secchi Disk.

  —A pie plate or old plastic plate
  —Black marking pen
  —Black waterproof paint
  —White waterproof paint
  —Yellow poly rope, 20–50 feet long
  —Large fishing weight

Preparations

If you plan to have parents transport youth on the field trip, check with your local County Extension office for travel procedure guidelines.

A significant amount of duplicating is needed in preparation for the field trip. A copy of the Wetland Odyssey Parent Information letter should be sent home with learners a week or so before the field trip. Leaders may wish to edit the parent letter provided to reflect their own specific program. If interest and time permit, learners might visit one wetland site three or four times over several months to record changes that may occur.

Parents who will lead groups should receive the leader's booklet at least a week before the field trip. The leader's booklet consists of the leader's pages and the student data sheets. Each leader will need to take the equipment required for their session into the field with them. Some items must be constructed before the trip. See "Procedures: Part 1." Carefully read the *Wetlands Odyssey* Leaders Pages for this information.

Learners will make booklets out of the data sheets as described in "Procedures: Part 2" below. Learner booklets are made with only the data sheets and cover page. If the copy budget allows, copy one booklet per learner. The minimum needed is one booklet per group of three.

Procedures: Part 1

Obtain an old pie tin or plastic plate at a secondhand store. Drill a small hole in the center of the plate. Use a black marker to make a + across the full bottom surface of the tin, dividing it into four equal parts. Paint two opposite quarter pieces black. Paint the remaining two quarters white. Put a rope through the center of the hole, with the black and white pattern toward the length of rope. Knot the rope on the unpainted side and tie a large fishing weight to this lower surface.

Procedures: Part 2

One of the most important pieces of equipment a learner should bring on the field trip is the Wetlands Odyssey field notebook. In teaching outdoors, stress observation of natural events. Most of what will be seen cannot be predicted. Watching a house wren slip into its nest box is not an everyday sight. It is important to record these observations and so, it's important to keep a field book.

Learners may not see the long term value of keeping field notes. The leader can stimulate interest in the field book and in taking notes. Here are some ideas:

Read the book *Signs Along the River* to learners. Ask them how keeping a field journal may have helped the author write this book. How do the illustrations contribute to our understanding of the story?

Ask learners to practice taking notes on a vacation trip, on a walk in the park, or on the wildlife in their own backyard. Have them share the notes with others in the group several days later. Discuss how much would have been forgotten if nobody had taken notes!

Have each learner, or group of learners, assemble their field books. Be sure to have them write:

1) their question on the inside cover of the field book

2) their name, or the names of all group members, on the cover

For each booklet you'll need cardboard, string, and a pencil. Ask learners to bring cardboard, string, and pencils to assist in constructing the booklets. Punch two holes in the top of the learner pages and in the top of the cardboard. Use the string to bind the pages to the cardboard. Use an additional piece of string to tie the pencil to the booklet.

Procedures: Part 3

Give each learner a copy of the Parent Information Letter to take home. Before the field trip, review the following Ground Rules for Behavior. Ask learners if there are any rules that should be added to the list. You may wish to have your learners sign a "code of conduct" and discuss the consequences of not following these rules. Safety is always a primary consideration any time a group ventures out into the field.

Suggested Ground Rules

- The field trip is an educational experience in an outside laboratory. Learners are expected to behave as is appropriate in the school.
- If bug spray/repellent is to be applied, do so before leaving the parking lot.
- Carry out anything you carry in. This includes leftover lunch pieces and field equipment. Nothing should be left at the Wetland.
- Do not pick plants or take home any animals. Aquatic insects that are removed from the water for study should be returned quickly.
- Stay on any established walkways and trails.
- If a bird nest or active animal home is discovered, move quietly away from the area to avoid further disturbing the animals. Observe from a distance. Record observation in the field book.
- Wetland Odyssey gear for each explorer should include: waterproof/rubber boots, raincoat, hat, gloves, sack lunch, and backpack.
- Leaders: Please add to this list as needed to ensure a safe and enjoyable field experience.

Wetlands Odyssey Information Letter

Dear Parents:

Over the past few weeks, your child has been enrolled in the Wetland Wonders 4-H Program. We hope that the program has generated an interest in wetlands for your child and that you have been hearing about some of the lessons she or he has completed.

Wetland Wonders is a water quality and wetlands education program made possible through an Environmental Protection Agency Environmental Education grant, with curriculum support from the Oregon State University Extension 4-H Program and the Oregon 4-H Conference and Education Center.

The major educational objective of Wetland Wonders is to develop a stewardship ethic among youth and adult participants through a hands-on, intimate look at the ecology of wetlands. Following their 20 hours of classroom lessons, learners will participate in a field trip to a local wetland site to explore a wetland.

In order to be prepared for the field trip, each child should be provided with the following equipment:

A sack lunch and drink
Waterproof/rubber boots
Raincoat
Hat and gloves
Backpack

Adults also will be needed to assist to drive cars, supervise learners, and to lead field investigations. If you are available to help, please contact your child's leader at:

Leader's phone:___________________________

The field trip is scheduled for:

Date and time:________________________________

To (location):_________________________________

Sincerely,

Wetlands Data Gathering

Objectives

Learners will:

- Be able to use observations skills to record data
- Recognize equipment needed to collect data in a wetland
- Demonstrate data gathering techniques needed on the field trip

Methods

Learner will compare the pH of water samples and common items, discussing how pH ranges affect aquatic insect diversity. They will discuss how pH, temperature, turbidity, and species diversity can be used as indicators of environmental health. Learners will become familiar with equipment needed to collect data on a wetland field trip.

Materials

- Books: *Saving Our Wetlands and Their Wildlife; Field Manual for Water Quality Monitoring*
- Wetland Data Gathering Worksheet and pH Ranges That Support Aquatic Animal and Plant Life chart—one per student
- Transparency: pH Ranges That Support Aquatic Life
- Two sets of equipment for two groups of learners as follows: four paper cups, one each containing 1 Tablespoon of:
  - Lemon juice
  - Baking soda
  - Cola
  - A sample of pond/stream water
- pH paper/meter
- Soil thermometer
- Secchi Disk (if you constructed one as part of preceding lesson)

Background

The books listed above will provide the background for this lesson. *Field Manual for Water Quality Monitoring* is an excellent reference for leaders who wish to begin a stream monitoring program or go into more depth in studying the health of aquatic environments. The section in the field manual on pH monitoring (page 34), temperature (page 47), turbidity (page 66), and Chapter 6, "Benthic Macroinvertebrates," will help you to lead a discussion of water quality tests and aquatic critter diversity as indicators of environmental health. You may wish to use the video "Healthy Watersheds" to remind learners about these concepts.

Preparations

The day before learners will participate in the Wetland Data Gathering lesson, ask them to bring in water samples in clean plastic bottles from neighborhood streams or ponds. These water samples will be used by to practice testing pH.

Procedure: Part 1

Pass out the Wetland Data Gathering Worksheet and the pH Ranges That Support Animal and Plant Life chart. Divide learners into two groups to complete the pH tests. Before learners begin the test, review the pH range chart to confirm that students understand that certain pH levels are toxic to some aquatic animals and plants.

Ask learners to work through the worksheet answering the questions for each section. If more than one water sample is to be analyzed, have learners write their results on a sheet of notebook paper.

Review the answers for each question, taking extra time with question 5. It is important that learners understand that the diversity of aquatic animals and the readings on the water quality tests are indicators of environmental health.

Procedure: Part 2

In the previous lesson, learners constructed their field books. These books detail the field tests to be taken by learners on the field trip. Briefly read through each Investigation, showing learners the equipment they will be using.

Wetlands Data Gathering Worksheet

Test the pH of each item listed below and then use the chart pH Ranges That Support Aquatic Animal and Plant Life to see which plants and animals might live in this pH. Use the Quick Reference Guide to Aquatic Invertebrates poster to see which of the animals are sensitive to pollution, somewhat tolerant of pollution, or tolerant of pollution.

1) The pH of lemon juice is:______________

Which aquatic animals and plants can live in this pH?

How do these animals react to pollution?

2) The pH of baking soda is:____________________

Which aquatic animals and plants can live in this pH?

How do these animals react to pollution?

3) The pH of cola is:____________________

Which aquatic animals and plants can live in this pH?

How do these animals react to pollution?

4) The pH of the water from________________________________is___________

Which aquatic animals and plants can live in this pH?

How do these animals react to pollution?

5) You are a scientist studying a marsh. The water samples you collected have tested at pH 9. There are many midge larvae living there. How clean and healthy is this aquatic environment? How do you know?

Wetland Odyssey
Field Trip Book Copy Pages

Thirsty Soil Investigation Leader's Page

Materials to be collected before the field trip

- Four number 10 cans calibrated with 1-inch lines for water level
- Four gallon jugs of water
- Four trowels
- Four 12-inch rulers

There are many different types of soils and we will look at several soil characteristics on the field trip. In this lesson, learners will investigate the texture of a soil and its ability to hold water. Soils are made of small mineral particles called silt, clay, or sand. They also contain tiny pieces of leaves, needles, or other organic material. The amount and kind of mineral and organic material in a soil determine some of its characteristics.

Leaders: Read the following information to learners.

No matter what types of particles make up a soil in a wetland, all wetland soils have one thing in common: they are saturated. That means the soil is full of water. As water soaks into a soil, it pushes the air out of the spaces between soil particles. When the soil is saturated, the air spaces are full of water. Then no more water can get into the soil and water will stand on top of the soil. Remember the lesson called "What's Soil Got To Do With It?" where you studied percolation rates. One person was Rosa Raindrop. Rosa Raindrop's job was to percolate through the soils created by the group. Which type of soil had the slowest percolation rate? (Clay)

In this investigation we will look at soils in different locations and predict which soils can take in and hold the most water. Site A will be the test of a wetland soil. Site B will be a test of soil 4 feet uphill from the Site A location. Site C will test a soil 8 feet uphill from Site A. Site D will be the test of soil 12 feet up the hill from Site A.

Help learners work through the data sheets by reading the procedures to them and supervising the use of equipment. Specific instructions are provided as needed for equipment handling. Some questions will require written answers in the Wetland Odyssey booklet. Other questions are for group discussions. If all the learners have a booklet, be sure to allow time for them to record their answers.

Thirsty Soil Investigation Data Sheet

One member of the group will be the Texture Tester. The Texture Tester will use a trowel to dig up a small handful of soil. If the soil has already been disturbed in this area, the Texture Tester should dig in the same spot. This will help to reduce the impact of our investigations on this wetland.

If the soil the Texture Tester has collected is very dry, add a drop or two of water. The group will help the Texture Tester to:

(1) Use the color chart to describe the color of the soil

(2) Describe the smell of the soil

(3) Try to roll a ball

(4) Try to squash the ball between thumb and forefinger to form a snake

(5) Describe the feel of the soil

Complete the chart below for the soil at each site.

Site	**Soil color**	**Soil smell**	**Texture by feel**		
			Forms a ball	**Forms a snake ring**	**Feels smooth? Gritty? Not smooth or gritty? Feels sticky?**
Wetland A					
Plus 4 feet B					
Plus 8 feet C					
Plus 12 feet D					

Is the soil at each location more like sand? more like clay? or a combination?

Site A__________ Site B__________ Site C__________ Site D__________

Discussion Questions

What do you remember about soil texture from your lessons? Predict how easily the soil will become saturated and allow water to stand on the surface. Which type of soil in the soil tubes ("What's Soil Got To Do With It?" lesson) held water at the surface? (Clay.)

Testing for Soil Saturation

The procedure for each group is:

1. Select a timer—someone with a watch.
2. Choose a level spot in the assigned study area.
3. Using the trowel, clear away any leaves or plants. Cut a circle the size of the can through the grass roots.
4. Twist the can into the soil or tap it lightly until it sinks to the 2-inch line. If the ground is very hard, do not bend the can; just sink it as far as possible.
5. Have the timer get ready.
6. Using the gallon jug, pour water into the can to the 3-inch line (1 inch of water on top of the soil) and begin timing.
7. Watch the water, timing how long it takes to soak into the soil. If all the water is not soaked in at the end of 10 minutes, record the level of the water left in the can on the data sheet.

Site	Start time	End time	Total time	Ending water level
Wetland A				
+ 4 feet B				
+ 8 feet C				
+ 12 feet D				

Was the soil saturated at any location? Which one(s)? How could you tell?

Wetland Habitat Transect Investigation Leader's Page

Materials

- Transect line, two poles (dowels) connected by a string 6 feet long, with a knot at each 1-foot mark
- Pencil
- Soil thermometer
- Booklet "Wetland Plants of the Pacific Northwest"

Leaders: Learners will identify some wetland plants and record the soil moisture and temperature at five locations along a transect line. Read the following information to learners.

Today you'll be using a Linear Transect to sample the plants and soil conditions in the wetland habitat.

The Linear Transect is a piece of string 6 feet long, connected to two dowels. The string is marked at 1-foot intervals. You will observe and record information about each of the five intervals on the string. At each mark on the string, you'll identify the habitat type (a), the amount of soil moisture (b), take the soil temperature (c), and identify the plants, recording your observations on the ***Wetland Transect Data Sheet****. You will find pictures to help you identify the common wetland plants in the paperback booklet "Wetland Plants of the Pacific Northwest."*

Important: *To use the soil thermometer, make a hole in the soil with a pencil. Before putting the soil thermometer into the ground. Please be careful, soil thermometers are expensive!*

You will be divided into four teams, one each for:

—Habitat Type Identification
—Soil Moisture Identification
—Soil Temperature
—Plant Identification

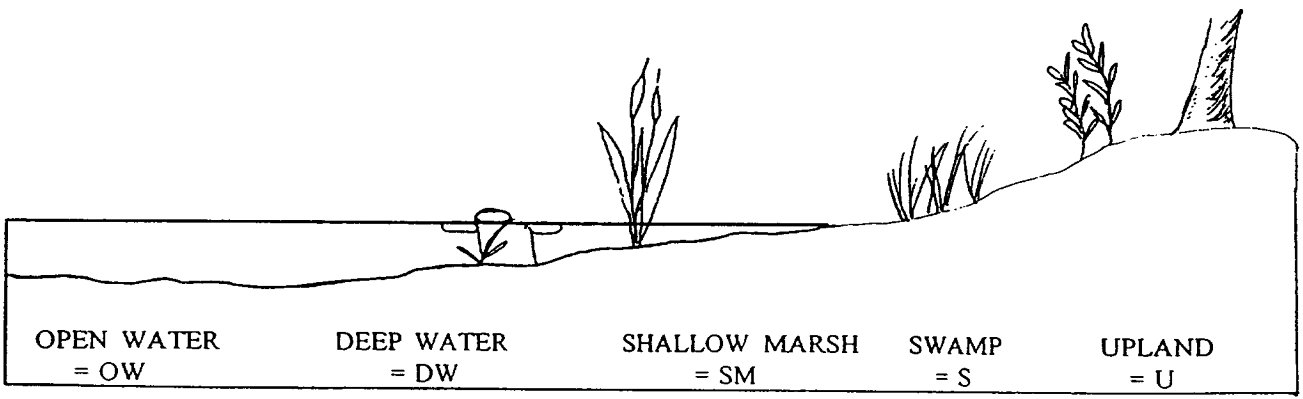
(Leader: assign these groups; or, the full group can do the investigations together.)

Work as a team to fill in the Wetland Transect Data Sheet. Begin by marking your transect. One student or the adult leader should hold one of the poles as far as possible into the marsh without getting water over the top of their boots. The other pole should be placed on relatively dry land, upslope, forming a straight line. This line is your transect. It marks the area you will sample.

Wetland Transect Data Sheet

Line Location	Habitat Type *(a)	Soil Moisture *(b)	Soil Temperature *(c)	List the PLANT(S) directly under the transect line
1				
2				
3				
4				
5				

***(a)** Select the Habitat Type from the chart below (Open Water, Deep Water, etc.) that best describes each Line Location. Enter the letter code on the chart for the Habitat Type you choose.



***(b)** Select the Soil Moisture that best describes the soil at each Line Location. Enter the letter code on the chart for the Soil Moisture you choose.

STANDING WATER = SW SATURATED SOIL = SS

WET/DAMP SOIL = WDS DRY SOIL = DS

***(c)** Create a hole in the soil with a pencil before putting the soil thermometer into the ground. Wait 5 minutes, then read.

Is dry soil warmer or colder than wet soil?

Wetland Investigation Leader's Page

Materials

- Thermometers
- pH paper dispenser with color chart or pH meter
- Secchi Disk (black and white plate on a rope)
- pH Ranges That Support Aquatic Animal and Plant Life chart in student field book
- Poster: Quick Reference Guide To Aquatic Invertebrates
- Book: *Pond Life*
- Aquatic Critter collection pans
- Dip nets

Information on the correct method for sampling the temperature, pH, and turbidity are given under the data chart for these readings. To determine temperature, three readings will be taken at different depths. These readings will be averaged to give the final reading. If it isn't possible to take readings at three depths, the group may take the average of two readings. In this case, remember to divide by 2.

Learners will be familiar with using pH paper from their lesson "Wetland Data Gathering." Assign one learner to make the test using a 2-inch piece of pH paper. Please do not allow multiple tests that waste paper. Please be sure that the used paper is not dropped on the ground.

The Secchi Disk is read by lowering it into the water until the black and white border line becomes obscured by the water. This test should be done at least twice to obtain reliable results.

Learners generally like to spend time collecting and identifying aquatic critters. Please be sure that learners place the critters in water in collection pans while they look them up in the *Pond Life* book. All the critters should be returned to the pond/marsh when the lesson concludes.

Wetland Investigation Data Sheet

Date________________________

Weather

☐ Sunny ☐ Partly cloudy ☐ Cloudy ☐ Heavy overcast

Precipitation type_______________________ Amount in gauge_______________

Air temperature: 4 feet above ground_________________

At surface of ground_________________

Vegetation

☐ Barren ☐ Rushes/Sedges ☐ Grasses ☐ Broadleaf, non-woody

☐ Brush/shrub ☐ Broadleaf Trees ☐ Conifer ☐ Other__________________

The most common plant at this location is____

Water Level Observation—check all that apply

☐ Water nonexistent on surface of soil

☐ Water on surface of soil, no floating vegetation

☐ Water on surface of soil, plants growing in, on water

☐ Water on surface of soil at high water

☐ Water on surface of soil at low water, bare soil exposed on bank

Wetland Water Quality Tests

Water Temperature: **a** <u>Reading 1 + Reading 2 + Reading 3</u> 3 =	pH : **b**	Turbidity Secchi Disk Reading : **c** <u>Reading 1 + Reading 2</u> 2 =
<u>(1 =) + (2 =) + (3 =)</u> 3		<u>(1=) + (2 =)</u> 2

a) Take three temperature readings:

- Reading 1 at the water surface
- Reading 2 at the mid-water level
- Reading 3 at the bottom of the pond/marsh. [If it isn't possible to take a bottom surface reading, divide Reading 1 + Reading 2 by 2.]

b) To use the pH paper to take a reading: tear off a 2-inch piece of paper and dip it in the water. Check the color change on the chart on the side of the dispenser. The pH meter will give a display on the screen. Using the pH range chart at the back of the field book, predict which aquatic animals could be found in this water.

—Our group believes that we will find the following aquatic insects and animals:

c) Secchi Disk Reading

- Reading 1: Slowly lower the disk into the water until it's no longer visible. Note the depth mark on the rope and record as reading 1 on the chart.
- Reading 2: Lower the disk more, then slowly raise the disk until it's just visible. Note the depth mark on the rope and record as reading 2 on the chart.
- The Turbidity Reading is calculated when reading 1 is added to reading 2 and divided by 2.

pH Ranges That Support Aquatic Animal and Plant Life

<table>
<tr><th></th><th>1</th><th>2</th><th>3</th><th>4</th><th>5</th><th>6</th><th>7</th><th>8</th><th>9</th><th>10</th><th>11</th><th>12</th><th>13</th><th>14</th><th></th></tr>
<tr><th>Most Acid</th><th>Battery Acid</th><th>Lemon Juice</th><th>Vinegar</th><th>Cola</th><th>5.6 = Normal</th><th>Rain water</th><th>Pure water</th><th>Sea water</th><th></th><th></th><th>Ammonia</th><th>Bleach</th><th></th><th></th><th>Most Basic</th></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td colspan="2">Snails, clams, mussels</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td><td colspan="3">Largest variety of animals trout, mayfly nymphs, stonefly nymphs, caddisfly larvae</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td><td colspan="2">Bass, bluegill</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td><td colspan="4">Carp, suckers, catfish, aquatic worms some insects such as midge larvae and black fly larvae</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td><td colspan="6">Plants (algae, floating, rooted)</td><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td colspan="12">Bacteria</td><td></td><td></td></tr>
</table>

Wetland Aquatic Critter Diversity Sample

Refer to *Pond Life* (page numbers given below) for help with identification of aquatic critters.

Worms, page 82

1____

2____

3____

Crustaceans, page 86

1____

2____

3____

Insects, pages 94–95

1____

2____

3____

4____

5____

6____

7____

8____

9____

10____

Wrapping It All Up

Objectives

Learners will:

- Analyze and make conclusions from their field trip data
- Review the wetland lessons and field trip
- Write articles to communicate information about wetlands to friends and families

Methods

After completing the field trip, learners will review the gathered data to see what the information can tell them about the health of the wetland they visited. They will write articles for a newsletter, "The Wetland Reporter," on the subjects of their group lessons, the field trip, and their library research or other investigations.

Materials

- Quick Reference Guide to Aquatic Invertebrates information sheet
- A typewriter/word processor to create newsletter
- Photocopier to make copies of "The Wetland Reporter" for distribution to friends and families

Procedure: Part I—Field Trip Review Discussion

Soon after the field trip, plan a time to review and analyze the gathered data. This will be one of your learners' only opportunities to share the information and data they gathered on the field trip.

Group Questions—Ask a spokesperson from each group to report on the group's question and its answer. The groups may need time to confer and develop an answer after returning from the field trip.

Thirsty Soils—Review the information gathered so that each person has a complete chart. How did the soil change as it got further from the wetland?

Wetland Investigation—Ask the groups to review their readings for water temperature, pH, and turbidity at each location. Create a list of the aquatic worms, crustaceans, and insects found at each site on a large sheet of butcher (or similar) paper. What do the aquatic critters found tell the learners about the environmental health at this wetland? Use the Quick Reference Guide To Aquatic Invertebrates to help answer this question.

Wetland Habitat—Ask learners how the findings at Line Location 1 differed (or were the same) as at Line Location 5. Did they find any "dry" soil? Did they find the dry soil to be warmer or colder than the wet soil?

Procedure: Part II—Spreading the Word

Creating a publication for your community to read requires learners to use what they have learned in the Wetland Wonders program in a purposeful way.

Discuss the purpose of creating a "Wetlands Reporter Newsletter" —develop a mission statement! What did the learners discover about water quality and wetlands that they want to tell the world?

Brainstorm a list of possible topics for learners to write about. Leader input counts too! Your groups' pool of ideas should be as diverse and extensive as they can make it. Some groups may wish to report on how they answered their wetland question. Refer back to the reports done for People and Wetlands for some topic ideas.

Some sample topics for articles:

- Aquatic Critter Up Close
- Aquatic Critters as Water Quality Signposts
- Meet a Wetland Mammal (or bird, plant, etc.)
- Famous Wetlands of These United States
- Swamp Lore

As learners write, provide times to share what they have written. Authors need an audience as they are writing.

Line up parent volunteers for such jobs as:

1. Proofing and typing
2. Cutting and pasting

Find clip art to use in the layout process or print the works of group artists. Design a logo for the cover page. This makes a great group contest. Above all: *Have fun!*

Concluding Water Quality and Wetlands Post-survey

Purpose

Leaders will be able to document the learner's increased knowledge after their participation in the Wetland Wonders program by comparing the scores of the pre-survey and post-survey forms.

Materials

- One copy of the Post-survey per learner

Procedure

The learners should have taken the Pre-survey before starting any of the Wetland Wonders lessons. After the learners took the Pre-survey, leaders should have collected the survey and placed them in a folder.

Once the learners have completed the Wetland Wonders lessons and field trip, they should complete the Post-survey. Give learners 15 minutes to complete the survey, then give each learner their copy of the Pre-survey. Ask learners if any of their answers have changed.

Answers: See Pre-survey, page 7.

Water Quality and Wetlands Learner Post-survey

1. Liquid water must always become vapor to be evaporated. .... T F
2. A wetland is a place where few plants and animals live: it's just wet. .... T F
3. Water is not found naturally in its solid form on earth. .... T F
4. Most water on earth is drinkable. .... T F
5. A watershed is a large building used to store clean water. .... T F
6. Wetlands have no value to people who live in cities. .... T F
7. Water moves on the earth only in streams and rivers. .... T F
8. A raindrop that falls in the Willamette Valley could eventually run into the Willamette River. .... T F
9. Mountain ranges do not have an effect on the amount of rain that falls in Baker City. .... T F
10. If you turn off the water while brushing your teeth, you can save 10 gallons of water. .... T F
11. People should water their lawns every afternoon to keep the grass cool and green. .... T F
12. Ground water stored in aquifers is always too dirty for people to use. .... T F
13. Soil is made up of minerals and rock pieces of different sizes. .... T F
14. Wetland soils may be very wet only part of the year. .... T F
15. Plants growing in wetlands can absorb some contaminants from water. .... T F
16. There is only one kind of wetland in Oregon. .... T F
17. Tide flats are home to plants and animals that are adapted to daily changes in water level. .... T F
18. Mammals and birds would have plenty to eat in a wetland that had no insects in it. .... T F
19. All types of aquatic insects can live in water that has a pH of 9 and is muddy. .... T F
20. Kids can't do much to save clean water or educate adults about how to conserve water. .... T F

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Oregon State University Extension Program Evaluation

We continually seek to improve the quality of Extension educational programs. You can help us make improvements in Wetland Wonders by completing this evaluation. Thank you for your candid evaluation.

Directions: Circle the number on the following items that indicate your rating of the program with 5 being excellent and 1 being poor. (Indicate "n/a" if not applicable.)

	Poor				**Excellent**	
1. Ease of use of the lesson background and preparation information	1	2	3	4	5	n/a
2. Ease of use of learner's worksheets	1	2	3	4	5	n/a
3. Ease of use of field trip Leader's Pages	1	2	3	4	5	n/a
4. Ease of use of learner field book	1	2	3	4	5	n/a
5. Ease of use of transparency and activity card masters	1	2	3	4	5	n/a

For each lesson listed, indicate how well it met its listed educational objectives.

6. Water Words	1	2	3	4	5	n/a
7. The Water Cycle	1	2	3	4	5	n/a
8. Watersheds: Rain Coming and Going	1	2	3	4	5	n/a
9. The Water Detective	1	2	3	4	5	n/a
10. Ground Water:	1	2	3	4	5	n/a
11. What's Soil Got To Do with It?	1	2	3	4	5	n/a
12. In the Water: In the Plants	1	2	3	4	5	n/a
13. A Wetland Sampler	1	2	3	4	5	n/a
14. Wetland Food Web	1	2	3	4	5	n/a
15. People and Wetlands	1	2	3	4	5	n/a
16. Wetland Odyssey—Field Books and Information	1	2	3	4	5	n/a
17. Wetland Data Gathering	1	2	3	4	5	n/a
18. The Field Trip	1	2	3	4	5	n/a
19. Wrapping it Up	1	2	3	4	5	n/a
20. Overall rating for program	1	2	3	4	5	n/a

Please make any additional comments here:

After completing this evaluation, please send to: Wetland Wonders, Oregon 4-H Conference and Education Center, 5390 4-H Rd. N.W., Salem, OR 97304

Appendix I—Soil Tube Assembly

Soil Tubes

Parts

30" of 3/4" Schedule 40 PVC pipe
One 3/4" Schedule 40 PVC coupling
Two 3/4" Schedule 40 PVC 90° elbows
Two 3/4" Schedule 40 PVC tees
Three #12 hose clamps
Three #24 hose clamps
One small can PVC cement
One 48" clear plastic fluorescent light tube cover
Three end caps for above
Nylon stocking material or cheesecloth

Tools

5/16" nut driver
Hack saw (for cutting PVC)
Sharp knife (for cutting tube)
Tape measure or ruler

Assembly

__1. Cut Schedule 40 PVC pipe into the following sizes.

Qty	Length	Description
1	10 1/2"	Cross Piece
2	8"	Legs
1	3"	Support

__2. Cement the coupling to one end of the support—see Figure 1. Push the pieces together quickly because the cement sets up very fast.

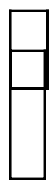


Figure 1

__3. Cement a 90° elbow to one end of each leg—see Figure 2.

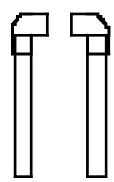


Figure 2

__4. Cement the cross piece to one of the 90° elbow and leg assemblies—see Figure 3.

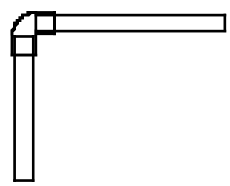


Figure 3

__5. Lay the cross piece and leg assembly on a flat surface. Cement the other end of the cross piece to the other leg assembly so both leg assemblies lay on the flat surface—see Figure 4.

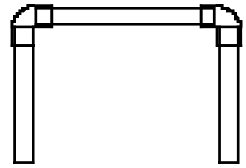


Figure 4

__6. Cement a tee to each leg—see Figure 5.

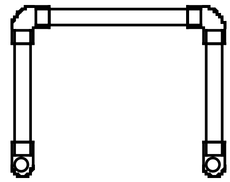


Figure 5

__7. Cement the support to one of the tees—see Figure 6.

__8. Measure and cut the fluorescent tube cover in half.

__9. Measure and cut each of the halves in half.

__10. Open the three #12 hose clamps completely.

__11. Place a mark on the cross piece 3/4" from each end—see Figure 6.

__12. Measure and mark the center of the cross piece—see Figure 6.

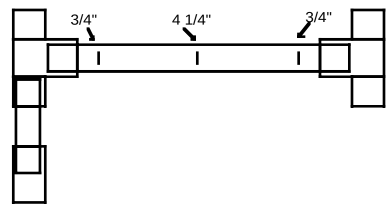


Figure 6

__13. Fasten the #24 clamps to the cross piece using the #12 clamps—see Figure 7 for proper orientation of the clamps.

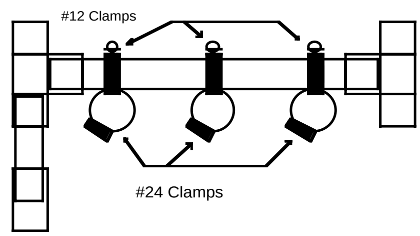


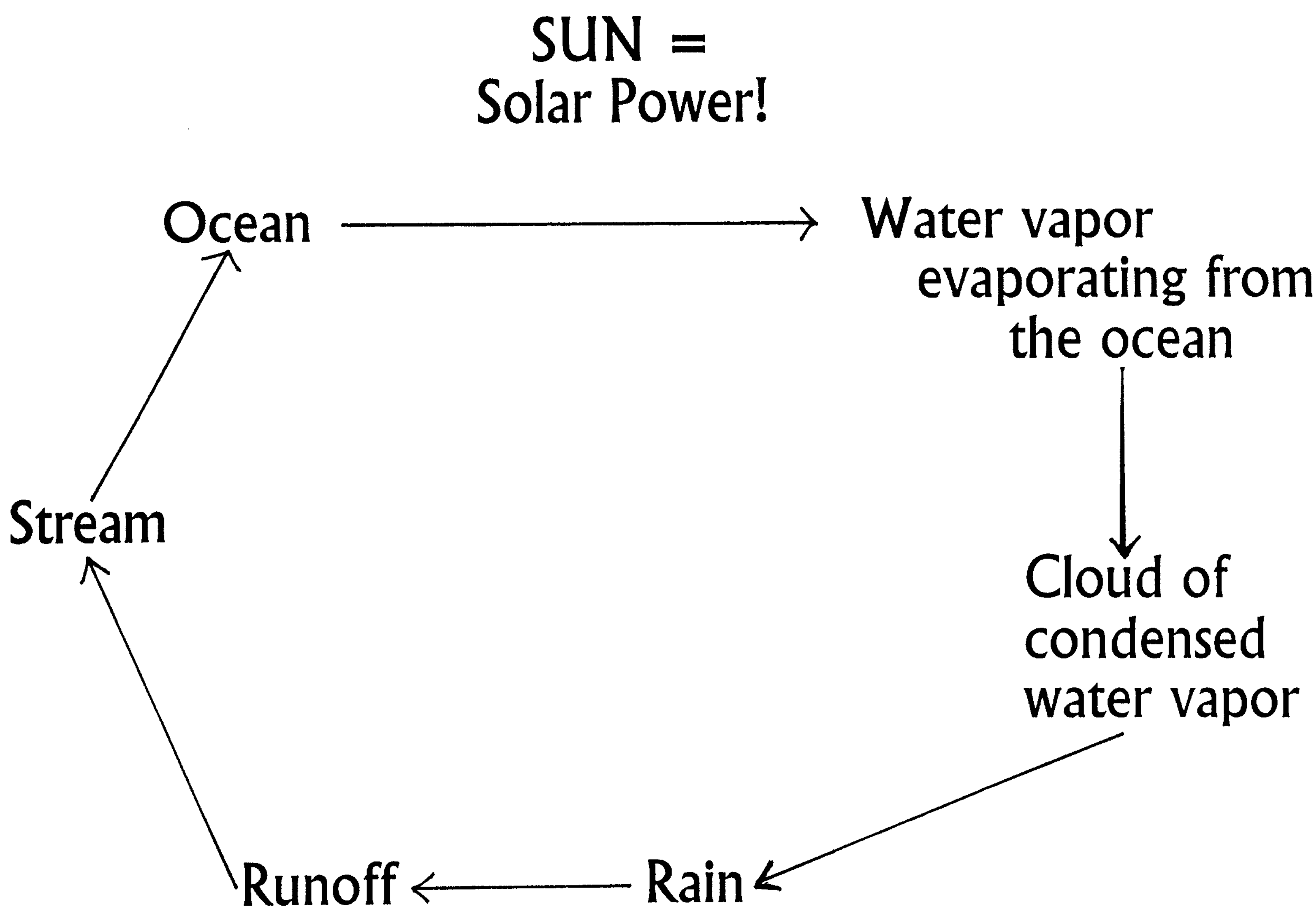
Figure 7

__14. Insert the fluorescent tube covers and hold in place with the #24 clamp. Do *not* overtighten clamps.

__15. Cut three pieces from the nylon or cheese cloth approximately 2" square.

__16. Place a square on the bottom of each tube and press the tube cap on to hold it in place.

Appendix II—Transparency Masters

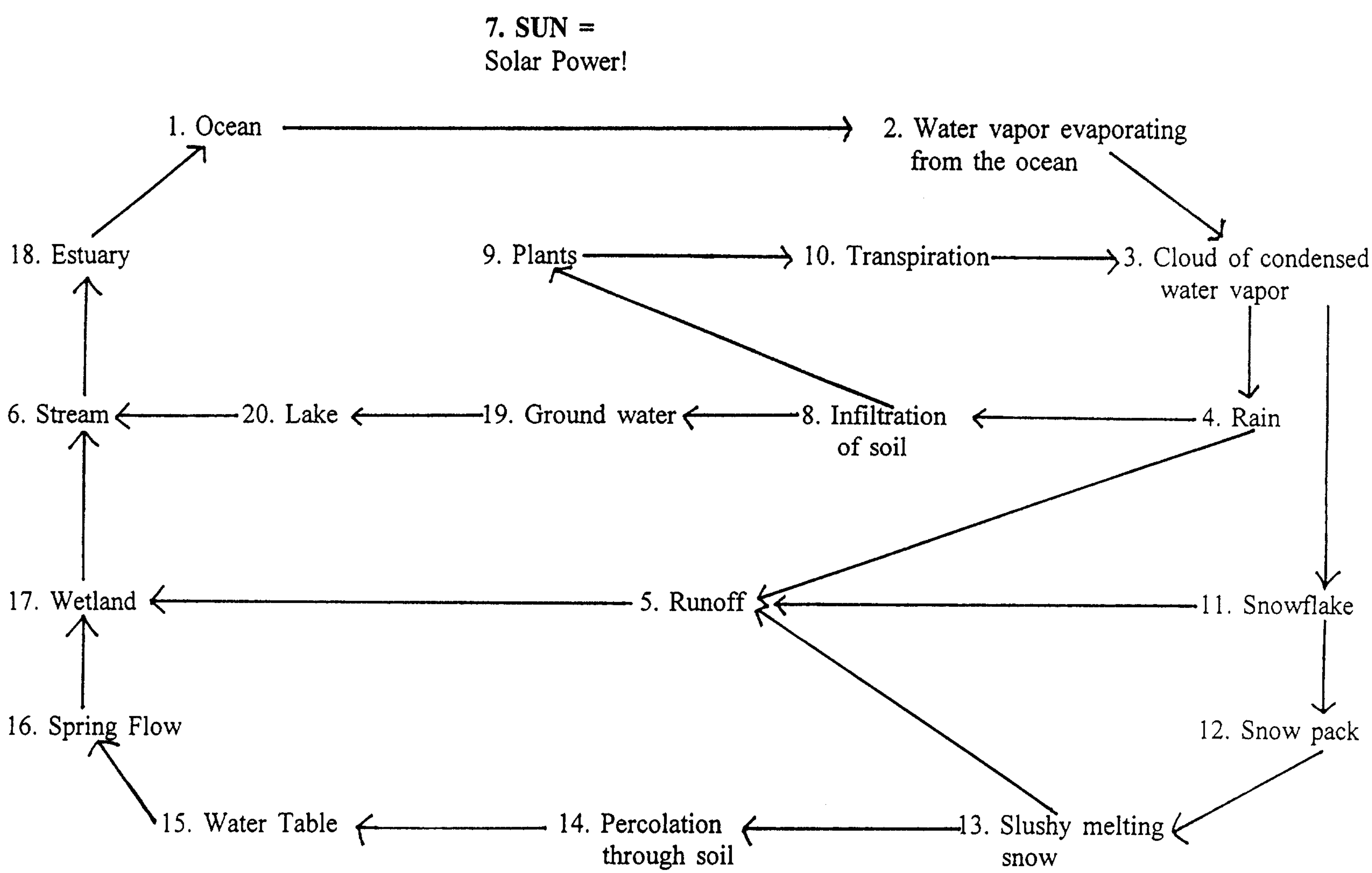


A Basic Water Cycle

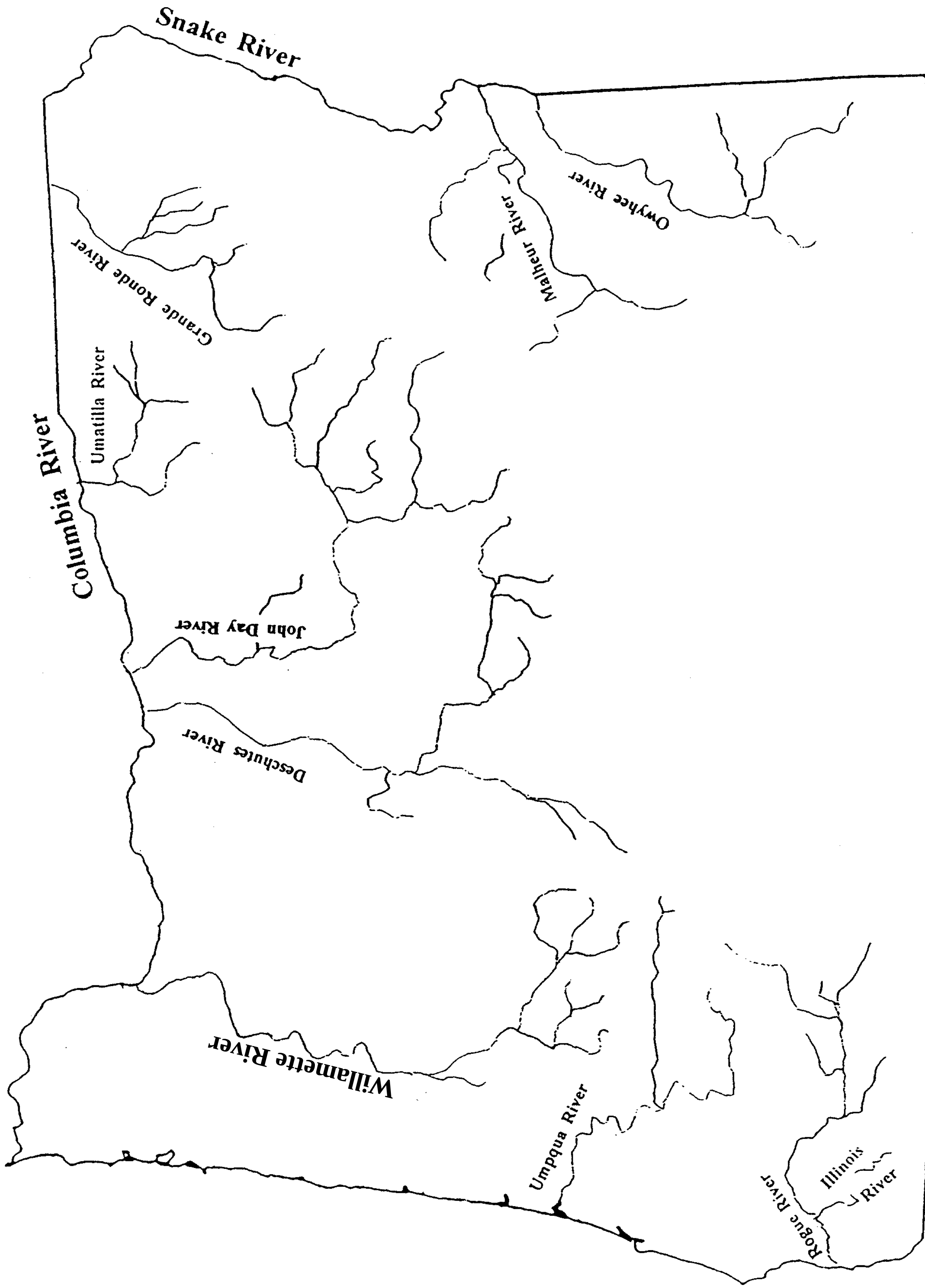
Rosa Raindrop's

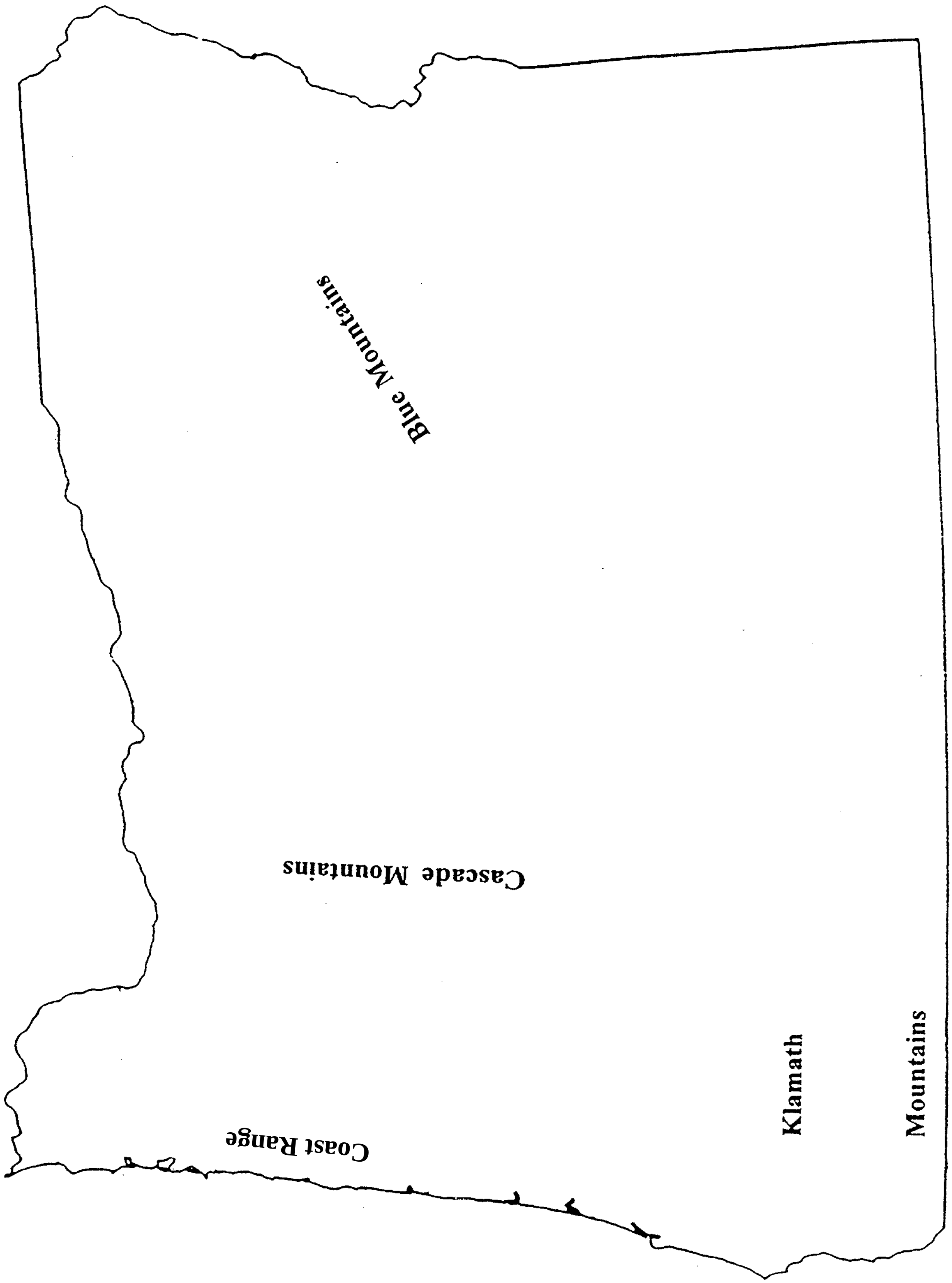
World Water Tally

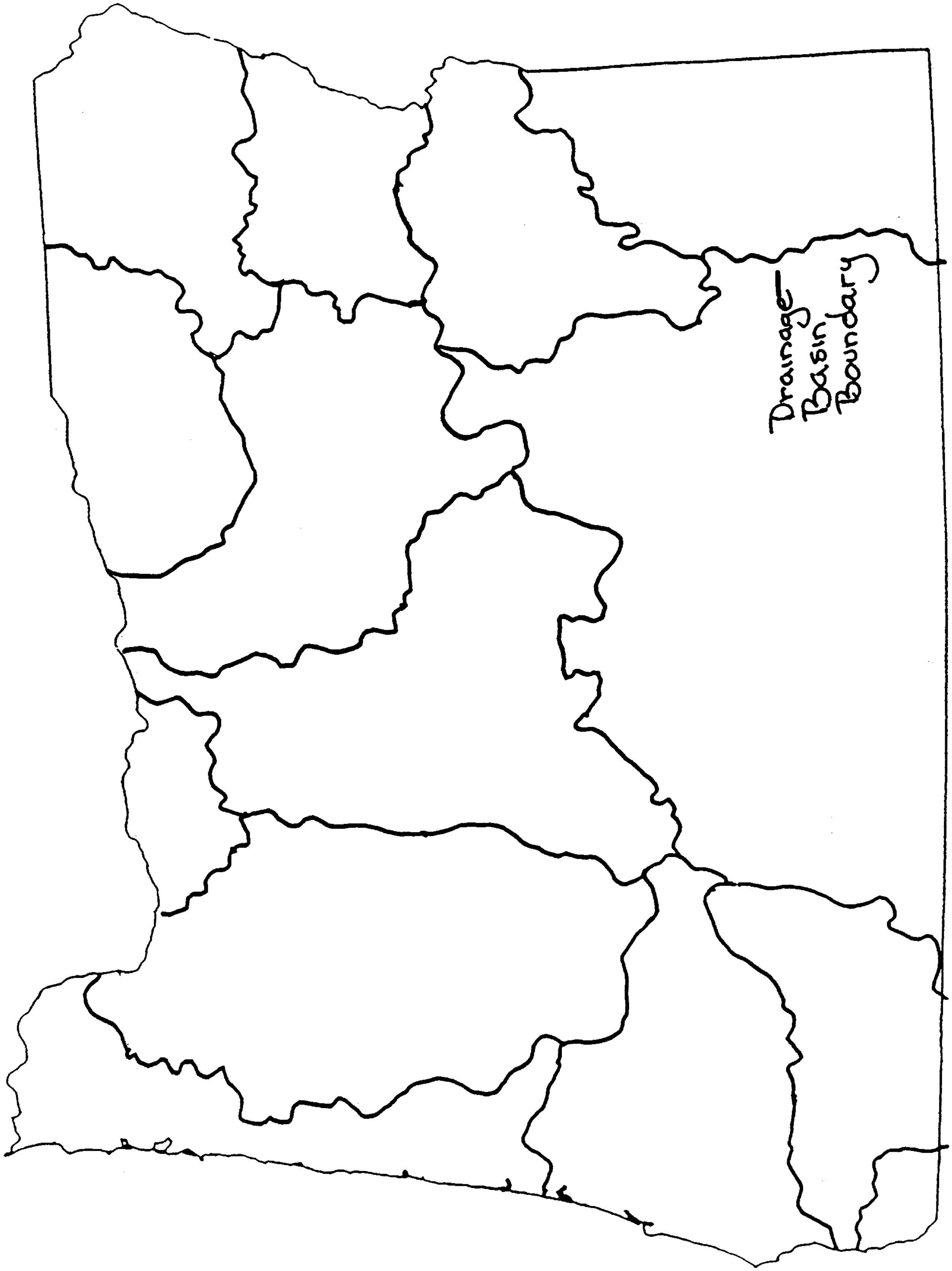
Source	Percent of Total Water (approximate)
Lakes	________
Oceans	________
Soil Moisture	________
Ground Water	________
Rivers/Streams	________
Ice Cap/Glaciers	________
Atmospheric Water	________
Total +/-	100.00 %

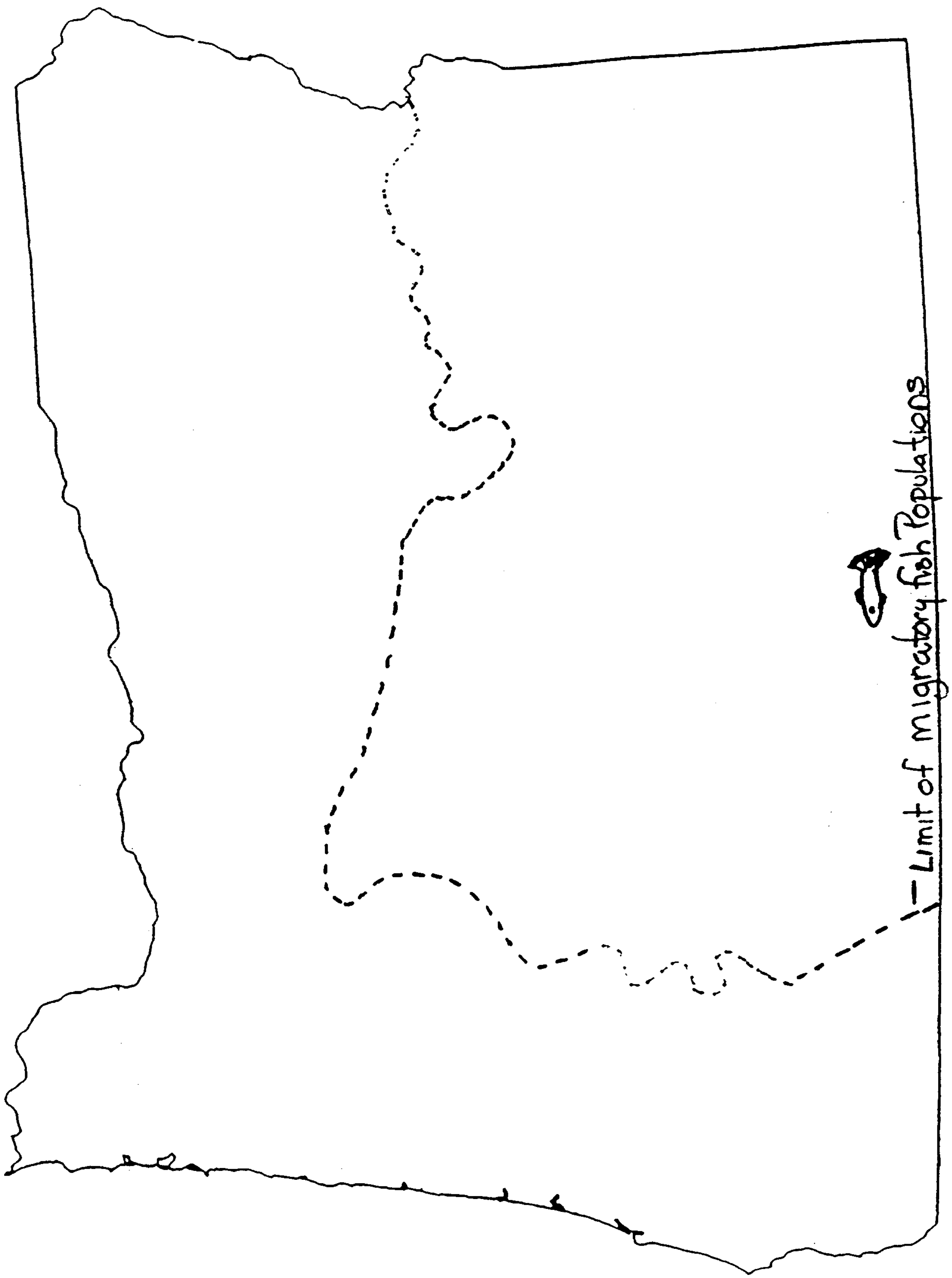


The Water Cycle


Snake River
Owyhee River
Malheur River
Grande Ronde River
Umatilla River
Columbia River
John Day River
Deschutes River
Willamette River
Umpqua River
Illinois River
Rogue River


Blue Mountains
Cascade Mountains
Coast Range
Klamath
Mountains


Drainage Basin Boundary


Limit of Migratory fish Populations

Home Water Source

Springs—

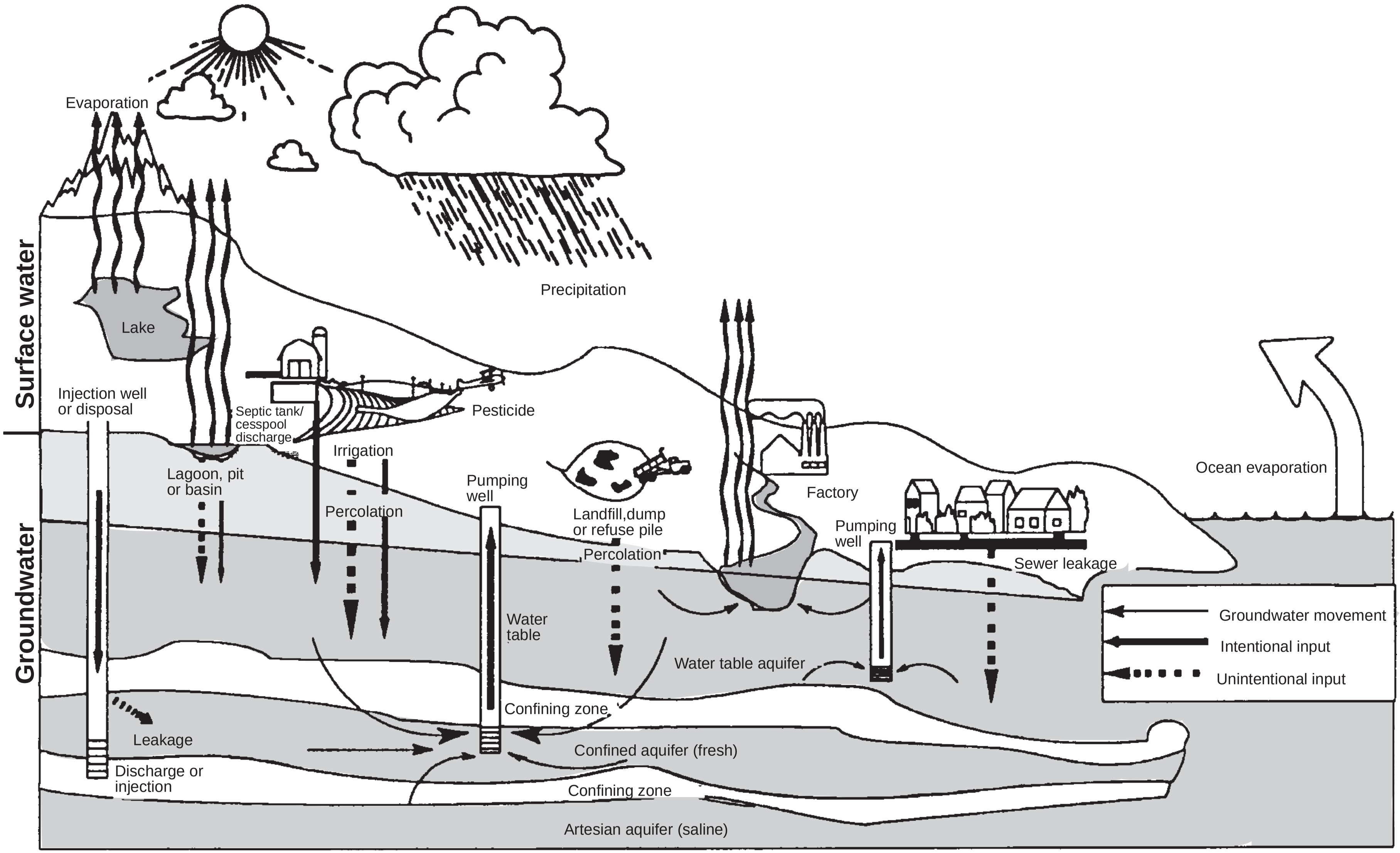
City of______________________________________

Small Community System—

Well—

Other—

Other—



Water recycles over and over as rain or snow falls to earth, percolates into the ground or evaporates into the atmosphere, and returns again to earth. This process is called the hydrologic cycle. As water moves through the hydrologic cycle, there is a potential for both purification and contamination. (Illustration by Karen Mahler, University of Idaho Department of Plant, Soil, and Entomological Sciences.)

Appendix III—Activity Card Masters

Water Cycle Activity Cards

1. Ocean

FACT: 97.21% of the world's water is salt water.

2. (a) Water Vapor Evaporating from the Ocean

FACT: The water in the air above the earth is called atmospheric water. It is 0.001% of the world's water supply. Water is evaporated into the air by the sun.

2. (b) Water Vapor Evaporating from the Ocean

FACT: Water is in its most pure form as water vapor. When water is a gas it's called vapor.

2. (c) Water Vapor Evaporating from the Ocean

FACT: Pure water has no smell, taste, or color.

2. (d) Water Vapor Evaporating from the Ocean

FACT: Water will always become vapor (steam) when it reaches its boiling point.

2. (e) Water Vapor Evaporating from the Ocean

FACT: Water is a chemical combination of two atoms of hydrogen (H) and one atom of oxygen (O). This chemical combination is written as the formula H_20.

3. Cloud of Condensed Water Vapor

FACT: The water vapor evaporating from the ocean cools as it gets higher in the air. When the vapor cools, it condenses into a group of tiny water droplets that we see as clouds.

4. (a) Rain

FACT: Rain falls when tiny water droplets join together with other water droplets. When the water droplets join they form bigger rain drops that are too heavy to stay in a cloud. They fall out as rain.

4. (b) Rain

FACT: There are approximately 2 quarts of water in the air above every square foot of land on an average day.

5. Runoff

FACT: As rain water runs off a parking lot, it carries oil spilled by leaky cars. Where is the oil going?

6. Stream

FACT: Only about 0.0001% of the world's water supply is found in streams or rivers.

7. Sun

FACT: The energy needed to move water "up" in the water cycle is provided by the sun. The sun's energy is needed to power evaporation and transpiration. Gravity causes rain to fall and water to flow downhill. Together the sun and gravity are the natural forces that power the water cycle.

8. (a) Infiltration of Soil

FACT: The water in soil accounts for about 0.005% of the world's water supply.

8. (b) Infiltration of Soil

FACT: When water soaks into and through a soil, this is infiltration. Water infiltrates soil slowly. When rain or garden sprinklers put water on the soil too fast, it does not soak into the soil. Water that does not infiltrate the soil becomes runoff water.

9. Plant

FACT: Both pollutants that are bad for plants and minerals plants need to grow enter the plants through the water they absorb with their plant roots. When water leaves the plant, the pollutants and minerals stay in the plant's stems and leaves.

10. Transpiration

FACT: During the process of photosynthesis, a plant is making food and releasing both oxygen and water vapor. Water vapor is evaporated from the surface of leaves in a process called transpiration. What powers the transpiration process?

11. Snowflake

FACT: Water must be at or below 32 degrees Fahrenheit (F) [0 degrees Celsius (C)] to be in a solid form. The freezing point is the temperature at which liquid water changes to the solid form called ice. A snowflake is a crystal of ice.

12. Snow Pack

FACT: When water freezes, it expands, but the weight remains the same. This is why ice cubes float in a glass of water. Snow falling in the Cascade Mountains may become part of the snow pack, which may melt each spring or it may become part of a glacier. A glacier is formed when the individual snowflakes freeze together to make a block of ice.

13. (a) Slushy Melting Snow

FACT: Polar ice caps and mountain glaciers contain 2.15% of the world's water. This water is stored for long periods of time and is released only by melting.

13. (b) Slushy Melting Snow

FACT: The North Santiam River flows west toward Salem from the Cascade Mountains. The City of Salem takes a large percentage of its public water supply from this river. The river is supplied by the snow pack in 650 square miles of forest land within the North Santiam Watershed.

14. Percolation Through Soil

FACT: As water moves through the soil toward the water table, it picks up contaminants from the soil. Spilling common everyday things like a single quart of motor oil onto soil is enough to pollute 250,000 gallons of water.

15. Water Table

FACT: The water table is the upper surface of ground water. If you could dig a hole straight into the earth, you would eventually reach water. This water would be the water table. Where the water table is exposed by the slope of a hill, a spring might be found.

16. Spring Flow

FACT: An average person drinks 1,500 pounds of water every year. This is equal to nearly eight 8-ounce glasses each day.

17. Wetland

FACT: Inland freshwater wetlands occur along the shores of lakes, ponds, rivers, and streams. There are few trees, but a great variety of plants and animals.

18. Estuary

FACT: The type of wetland richest in plants and wildlife is the coastal salt marsh. This is the place where the fresh water of rivers meets the salt water of the oceans.

19. Ground Water

FACT: Water stored in pockets in the earth is called ground water. Ground water makes up 0.62% of the world's water supply. People who use wells to provide water to their homes are using ground water.

20. Lake

FACT: Freshwater lakes and inland seas and salt lakes make up 0.017% of the world's water.

21. Rosa Raindrop

SANDY CLAY LOAM =

55% SAND +

20% SILT +

25% CLAY

SAND

SILT

CLAY

Wetland Web of Life Clue Cards

CADDIS FLY LARVAE:

I build a little home around my soft body to hide from Wood Duck and Crayfish. I wish they would leave me alone to eat my phytoplankton, so I can molt and have my wings! I want to swoop and dive above the pond in the sunshine.

CRAYFISH:

I am a member of the marsh sanitation department. I clean up anything dead, often using the body of a dead animal for a temporary home. I also eat algae, caddis fly larvae, and worms. Raccoon and some people consider me a delicacy.

ALGAE AND PHYTOPLANKTON:

We are small, single-celled or simple multicelled plants. We cannot run away when Wood Duck, Caddisfly larvae, Crayfish, Worm, Tadpole, or Snail come along. We grow very fast, because so many animals eat us.

SHREW:

I am only 3 inches long, but I am very feisty! Some people confuse me with moles or mice because I use the tunnels made by these other animals. I eat grass leaves, insects, small fish, eggs, and occasionally other small mammals. When I am hunting, I try to stay under cover to avoid the sharp eyes of Marsh Hawk.

WOOD DUCK:

I'm a traveler, going to Mexico for the winter. In summer you'll find me raising babies in the hollow trunk of a tree near water. I eat small plants, insect larvae, and other small swimmers.

RACCOON:

I just love water; clean, clear water to catch my food and wash in, too. I am not afraid of any other marsh folks. I like to dine on Frog, Crayfish, and small creatures found in mud along the shore.

WATERSTRIDER:

I skate along the water surface looking for snails and soft-bodied insects. I have to watch out for Frog and Great Blue Heron.

GREAT BLUE HERON:

I can see Frog hiding in the cattails, and I sneak up on him with my big, wide feet. If Frog gets away, I'll poke in the mud with my long bill to find a crayfish.

MARSH HAWK:

I sail high over the marsh looking for any small thing that moves. I don't care to catch things that are as big as Raccoon—it's too much work.

BEETLE:

I hide under leaves or swim fast to keep from being eaten by Frog or Bluegill. I would like to be left alone to eat my Grass.

SNAIL: When I spot a Water Strider, Red-winged Black Bird, or Bluegill Sunfish, I pull my foot into my shell and hope I don't get eaten. My eyes and mouth are on my foot. Pretty odd? Nope! It's convenient, because Algae grows where I crawl.

BLUEGILL SUNFISH:

I am a warm water pond fish, so you will not see me feeding unless the spring sun has warmed the pond. My main diet is insects and snails. I enjoy an occasional worm or piece of cheese; however, these can be tricky to get off the hook. Because I like the shallow, warm water edges of the pond, I have to watch out for Great Blue Heron.

DRAGONFLY LARVAE:

I am a carnivorous larva that can eat other insects, worms, and even tadpoles. Because I have such a big, strong mouth, when I'm hunting I only worry about really big frogs and Raccoon.

RED-WINGED BLACK BIRD:

The bright red flash of my red wing is hard to miss as I cross the marsh in search of seeds, snails, and beetles. I build my nest among the cattails and must beware of Marsh Hawk cruising by.

TADPOLE:

I am entirely a vegetarian, eating only plants such as algae. When I grow up I will be carnivorous like my parent frogs. Very few of my thousands of brothers and sisters will survive to have eggs, because so many animals like us in their diets. We must be especially careful of Great Blue Heron and the big-mouthed Dragonfly larvae.

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