
Lake Roosevelt
2003
Water Festival
September 23rd and 24th 9:00a.m.-2:00p.m. at the Lake Roosevelt Day Use Area
Bugs on the Bottom
Water Jeopardy
It's Hydrological
Hooks and Ladders
Grounded
Fish Homes
Fish Neighbors
Macroinvertebrate Mayhem
Riparian Welcome
Water is Like?
Soil: More Than Just Cheap Dirt
Habitat Haven
Just Passing Through
Insect Discovery
Hatchery Tour
Stream Sense
Salmon
Kids in the Creek
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(509) 694-7224 or email: khoneycutt@fs.fed.us

Riparian Welcome
Fish Homes
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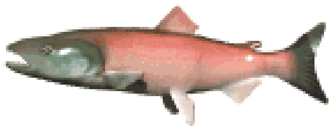
Salmon

The Life Cycle of Salmon

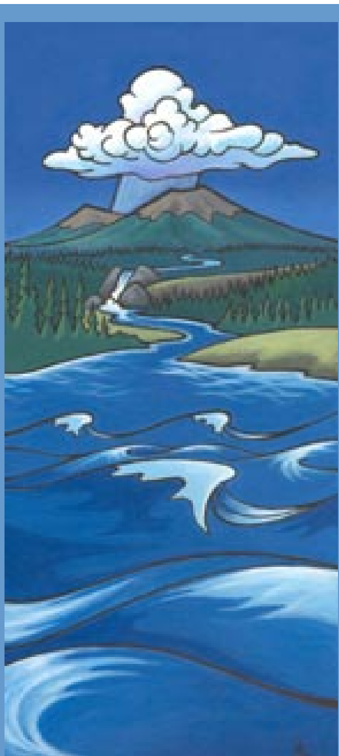


Curriculum Objective

To teach students about different species of salmon, salmon life cycles and habitat needs. To teach students about the affects of dams and other land management activities that have caused salmon populations to decline. To teach students about the importance of salmon to humans, particularly to Native Americans for whom the fish was a cultural and diet staple. To teach students about the history of salmon and the early fishing activities along the Columbia River by Native Americans. To present to students -- through a storyteller -- several tales about the yearly Return of the Salmon.

Washington State
Essential Academic Learning Requirements (EALRs)

Science: 1.1 (basis of biological diversity BM 1, 2&3)
Science: 1.2 (biological systems BM 2&3)
Science: 1.3 (life processes and the flow of matter and energy BM 2&3, environmental and resource issues BM 1&2)
Science: 2.2 (identifying problems BM 1, 2&3, designing and testing solutions BM 1,2 &3, evaluating potential solutions 1,2 & 3)
Science: 3.1 (intellectual honesty, BM 1,2&3, limitations of science and technology BM 1,2 &3, dealing with inconsistencies BM 1,2 &3, evolution of scientific ideas BM 1, 2&3)
Science: 3.2 (all peoples contribute to science and technology BM 1, 2&3)
Communication: 1.2 (listen and observe to gain and interpret information BM 1,2 &3)
Communication: 3.3 (seek agreement and solutions through discussion BM 1,2 &3)
Arts: 4.4 (Understands that the arts shape and reflect culture and history BM 1,2 &3)



Links: Salmon Facts | salmon biology | identifying salmon species | fish passages at dams | salmon extinction: where are all the salmon? |

Course Description

This course provides a comprehensive look at Pacific Northwest salmon, species identification and facts, and life cycles. Student learn about the salmon's habitat requirements and obstacles faced during its travels to the ocean and back to inland streams. The students learn about the fish's needs for:

Cover
Streamside trees and shrubs shade the stream and help to keep the water cool. The root systems of streamside vegetation help prevent erosion, while large organic debris (such as fallen logs) in the stream channel provides protection of fish from predators and floods. Streamside plants also filter water flowing over the ground surface before it reaches the water course.

Clean gravel
Salmon and trout require clean, un-silted gravel beds for spawning and egg incubation. All streams naturally carry silt and other sediments suspended in the water, but too much silt can cover up gravel beds and reduce spawning habitat. When the spaces between the gravel are plugged with sediments, oxygen rich water can not flow past eggs incubating in the gravel and the eggs will suffocate and die.

Clean Water
Fish like salmon and trout need cool, clean water for every stage of their life cycle and prefer temperatures around 15 or 16°C. Higher water temperatures stress them and can result in death. The water must be free of harmful levels of metal, organic contaminants, and other pollutants, which can be found in stormwater runoff, sewage, and industrial waste water. Some nutrients such as nitrogen and phosphorus are essential in streams, however, large amounts can cause too much algal growth, which robs water of oxygen when

Prework

Students should understand how salmon differ from other common, cold-water fish in that they travel from their birthplaces in streams to the ocean and back again -- to the same stream -- to spawn (see background information). Students may discuss the types of obstacles a salmon might encounter on its way from a stream to the ocean and how these obstacles can be overcome. The students may also discuss what obstacles are impossible to overcome and how humans can help.

Classroom Activity

Oh Salmon!

What does a salmon need to survive?

Come and play Oh Salmon! and find out! You'll need to get on your feet with the rest of your class! Count off in fours. All the ones, twos, threes, and fours go to their own separate areas. All the ones line up along one line. Everyone else line up along a line parallel to the ones' line, about 10 metres away.

All of the ones become "salmon." They are looking for food, shelter, and space. When a salmon is looking for food, it clamps its hands over its stomach. When a salmon is looking for shelter, it holds its hands above its head. When it's looking for space, it should hold its arms slightly out from its body.

the algae die. For further information about pollutants, see Pollution Issues.

Food

Insects like the stonefly, are the most important source of food for fish rearing in streams. This kind of insect lives in the gravel of the stream itself while others may fall into the stream from streamside vegetation. Plant material and algae, which insects eat, form the foundation of the food-producing process in the stream ecosystem. Things that interfere with this process - pollutants, silt, changes in water temperature or flow - will alter the food chain fish depend on. Increased sedimentation reduces critical fish food supplies by decreasing light needed for energy by algae and micro-organisms - the foundation of the aquatic food chain. Sedimentation also smothers the tiny organisms fish feed on, and by reducing visibility in the water makes it harder for the fish to see and catch their prey.

Unobstructed Travelways

Salmon require unblocked travelways of suitable habitat. For thousands of years, the Columbia and Snake Rivers were wild, vibrant river systems. They sustained the world's largest runs of chinook salmon and steelhead trout, myriad other plants and animals, and diverse human communities dwelling along their banks.

150 years ago, white settlers first came to the Northwest. 60 years ago, we began changing the Columbia and Snake by building huge dams. 20 years ago, the damming of the Columbia and Snake was complete. Eight dams have created a 400-mile long reservoir from Lewiston, Idaho nearly to Portland.

The dams harnessed the rivers' waters, producing electricity to fuel development, allowing irrigated agriculture to flourish, and creating inland navigation. But these benefits wreaked havoc with other economies and cultures, notably Tribal, commercial, and sport fisheries. Because juvenile salmon could no longer ride spring snowmelt to the sea, they died each year

The twos, threes and fours become food, shelter, and space. When a habitat component is being food, it clamps its hands over its stomach. When a component is being shelter, it holds its hands above its head. When it's being space, it holds its arms slightly out from its body.

Components of Habitat

Everyone individually chooses which habitat component they are looking for or representing at the beginning of each round of the activity. Players are not allowed to change their component until the next round (each player chooses again at the beginning of each round).

The game begins with all players lined up on their respective lines (salmon on one side; habitat components on the other side) - with their backs to the students in the other line.

Teacher asks students to make their signs. Once everyone is making their sign, count to three and each line of students turns to the other.

When the salmon see the habitat component they need, they are to run to it; and take the player representing food, shelter, or space back to the salmon side of the line (this player now becomes a new salmon). This represents the salmon successfully meeting its needs and reproducing as a result. Any salmon failing to meet its needs dies, and the player becomes part of the habitat.

Teacher records the number of salmon at the beginning of the game and at the end of each round. Play about 15 rounds at a brisk pace, each round representing one year. If the population of salmon becomes too high, the teacher states at the beginning of a round that a dam has been built, a log jam has occurred, or the river has flooded; killing a in huge numbers. In the upper Columbia and Snake Rivers, virtually all salmon runs are extinct or endangered.

The students identify problems experienced by salmon in migration, identify mitigations that have worked and those that have not, and discuss mitigations and project designs that may help.

Salmon Tent

The students sit inside a giant salmon tent and learn about the importance of salmon to Native American tribes in the Pacific Northwest and that everywhere that salmon swim, they have become a part of the local culture.

The students learn that people from Japan to Russia value salmon and include them in various ceremonies. And from Alaska to California, salmon have formed the base of tribal cultures. The students learn that Captain Meriwether Lewis, of the Lewis and Clark expedition, encountered salmon immediately after crossing the continental divide into the watershed of the Lemhi River. Lewis and his companions were out of food. The Shoshone offered the men salmon, along with other food. By the time the expedition reached the mouth of the Columbia River, they had seen chinook, sockeye, and coho salmon. They had also observed many tribes catching the fish, eating the fish, and preserving the fish for future consumption.

The students also listen to a storyteller who relates several tales about the salmon as a part of Native culture.

certain number of salmon, who then move over to the habitat line.

Discuss the activity with the students, encouraging them to talk about what they experienced and saw.
Ask the students during a discussion:

- What do salmon need to survive?
- What are some of the "limiting factors" that affect their survival?
- Are wildlife populations static, or do they tend to fluctuate as part of an overall "balance of nature"?
- Is nature ever really in "balance" or are ecological systems involved in a process of constant change?

Background Information

The life cycle of a salmon is one of the most interesting in nature. Salmon lay their eggs in cool, clean rivers and streams where they are protected in the underwater gravel. the young fish hatch in late winter or spring and are called alevins. they are very tiny, less than an inch long. Bulging yolk sacs provide nourishment until the baby fish can get food for themselves. During this time, they hide in the gravel, more like worms than little fish. When the yolk sacs are used up and disappear, they wiggle out of the gravel and move into deeper water.

The baby salmon are now called fry. The dark stripes or spots on their sides are called parr marks. These marks help to camouflage or hide the young so they will not be eaten. Larger fish and birds such as mergansers, cormorants and great blue herons are just a few creatures which love to feed on the baby salmon.

During this time, they stay together in groups. They grow quickly while feeding on tiny plants and animals. Some stay in fresh water only months, while others stay a few years before they migrate to the salt water of the sea.

When the juveniles are ready to leave fresh water and migrate to the sea, they undergo a special proces called smolting and are called smolts. They go through many amazing changes inside their bodies making it possible for them to live in salt water. Out side, their bodies turn silvery. The trip to the ocean is very dangerous because of all the predators and man-made obstacles along the way, so they swim at night and hide during the day.

For several weeks or months, the smolt stay in saltwater bays where the river meets the ocean. Eating tiny shrimp, other crustaceans and the young of other saltwater fishes, they grow very fast. Fainally, they disappear into the vast ocean.

Salmon Species

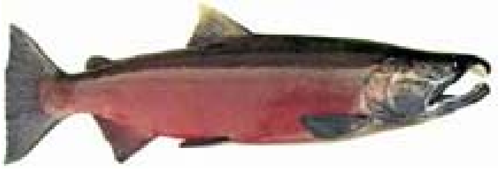
Chinook Female

Chinook Male

Chum Female

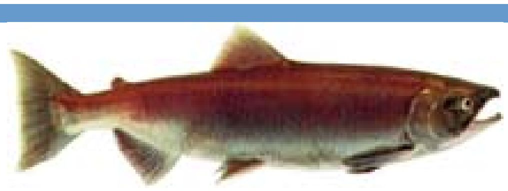
Chum Male

Coho Female



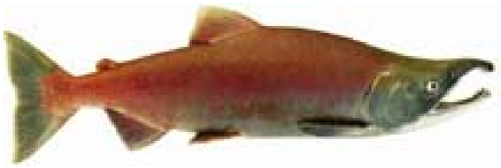
Coho Male

Fish which are born in fresh water, but migrate to the salt water oceans where they spend most of their adult life, are called anadromous fish.



Sockeye Female

How far a salmon travels in the ocean and the direction it goes can vary. Many salmon travel along with the ocean currents in circular routes. Some wander as far as 2,000 miles from their stream. Others stay closer to home. The salmon grow to adults on rich seafood diets including small fish like herring and anchovies. the Chinook salmon, for example, can grow up to five feet long and weigh from 22 to 100 pounds.



Sockeye Male

Salmon can be food for bigger animals like tuna, seals, dolphins and whales. But even in the ocean, a salmon has ways to help it escape these predators. They feed mostly at night when they are harder to see. Their color also helps to hide them. Seen from above, they look dark like the deep ocean. But since the water looks white or silvery from below, they have silver, shimmering bellies.

Steelhead Female

Steelhead Male

After a number of years, salmon are ready to lay their eggs or spawn. At first, they may find their way across the oceans using currents, stars and the earth's magnetic forces. They travel back to the exact place where they were hatched, no matter how small the stream may be. Once they get close to their home streams, scientists think the salmon smell their way home, remembering the smell of their own streams since they hatched from eggs. This is called a homing instinct. What makes a stream have its own special smell? It may come from the rocks, the soil and the decaying parts of dead animals and plants.

Their journey up river is difficult. Salmon are known to travel up river 2,000 miles and clear six-foot water falls. They travel up the river in great numbers, called a salmon run.

At this time, they are not eating but are living on foods stored in their bodies.

Males develop hooked snouts and humps may form in front of the dorsal fin. their skin changes color, depending on the kind of salmon, changing from silver to shades of red, black or green.

The fish that spawn in a particular part of a river make up their own separate spawning population of wild salmon. Mainly, these fish reproduce with each other. Over the centuries, each salmon population has become suited, or adapted, to conditions in their home stream. Some return to rivers in the coastal rain forests. Others are more suited for rivers in ancient forests further inland. Yet other groups are adapted for rivers in deserts.

Once the salmon reach the upper, shallow parts of the stream, the female digs a nest, or redd, by turning on her side and flapping her tail vigorously. When the nest is finished, the female deposits a few hundred eggs into the depression. They are about the size of peas and can be from pink to red in color. A male swims up beside her and fertilizes the eggs with a stream of milky liquid called milt, which is full of sperm. Without the male's fertilizing fluid, the eggs would never hatch. The male will often chase away or fight off other male salmon.

These eggs are covered by the gravel thrown up when the female digs the next nest just a foot or so upstream. This continues until several thousand eggs are laid. The eggs stay in the nest all winter and hatch in the spring. Thus the cycle begins again.

Pacific salmon die after spawning, usually within two weeks. Other members of the salmon family, like the Atlantic salmon, can live to spawn again.

Pictures

Materials

Salmon tent, stories, costumes
Salmon identification cards
Salmon life cycle posters

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Friday, December 12, 2003

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Your name: [ ]

Your email address: [ ]

Enter your question or comment here:

[ ]

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Bugs on the Bottom

Curriculum Objective

To teach students how to identify common aquatic invertebrates by observing them live in trays and under microscopes. To teach students about the places of various benthic (seen with the naked eye) macroinvertebrates in the food chain. To educate students how to conduct experiments that measure the speed of swimming and crawling insects.

Washington State
Essential Academic Learning Requirements (EALRs)

Science: 1.1 (motion of objects BM 1,2 &3, basis of biological diversity BM 1&2)
Science: 1.2 (biological systems BM 1, 2&3, energy transfer and transformation BM 1,2 &3, structure and organization of living systems BM 1 & 2)
Science: 1.3 (forces to explain motion BM 1&2, life processes and the flow of matter and energy BM 1&2, interdependence of life BM 1&2)
Science 2.1 (questioning BM1, communication BM1)
Communications: 1.1 (identify visual information such as rom a science experiment BM1)
Communications: 1.3 (construct hypotheses BM2)
Communications: 2.2 (organize information with clear sequencing of ideas and transitions BM2)
Communications: 3.2 (work cooperatively as a member of a group BM2)

Links

macroinvertebrates | aquatic food chain/web | stream ecosystems | water quality

Course Description

Students will observe various macroinvertebrates taken from stream and lake environments of northeast Washington. They will learn about these stream environments and about the various habitats in which they live. As they observe the "bugs", they will learn to recognize them by their adaptive characteristics, learn their common and scientific names and categorize each species in relative placement in the biological food chain. The students will also use microscopes to examine each macroinvertebrate, as well as learn to identify different kinds of aquatic plants, plankton, bacteria and algae that also form basic parts of the food chain. Students will form groups to measure, record and compare the speeds of swimming and crawling insects. Students will examine different samples of water that reveal dissolved solids, bacteria and nutrients and learn about the effects these materials have upon water quality and temperature and, ultimately, upon the organisms living in the water.

Prework

Students should know and understand the principle behind a "food chain." Students should understand the concepts and terminology used to describe components of a food chain (*see Background Information*).

Students should have a basic knowledge of the difference between clear, cool water with few dissolved nutrients and warm water with too many nutrients and the implications for plants and animals living in the solution.

Classroom Activity

Have students cut out pictures of plants and animals from magazines and arrange these pictures into a giant food web.

Background Information

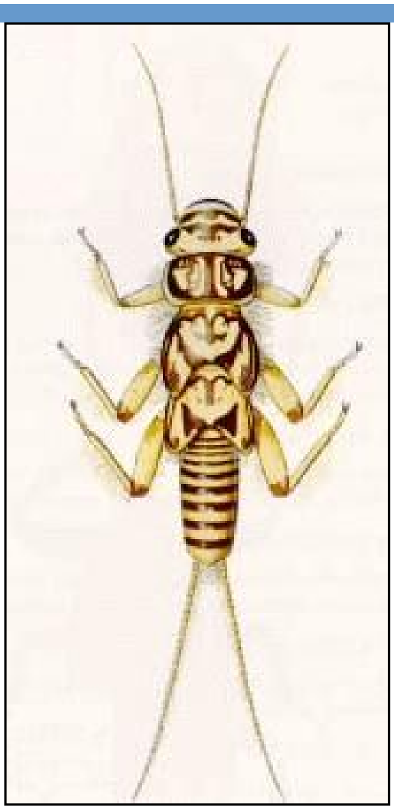
A food chain is formed as one organism feeds upon another. There are many food chains and some are very complicated and many overlap each other into a food "web." An example of a simple food chain begins with plankton which is eaten by insects that are then eaten by trout that are then eaten by eagles. When the eagle dies, it is eaten (decomposed) by bacteria.

The food chain begins with the sun because plants, which are eaten by many animals, need light to survive. Green plants convert carbon dioxide, water and energy from the sun into sugar (food). They store this food

Stone Fly

in leaves, stems and roots. Organisms that make their own food are called producers. Plants are producers. Organisms that do not make their own food are called consumers. Animals that eat plants are called herbivores. An animal that eats other animals is a carnivore. An animal that eats other animals and plants is called an omnivore. When the organism at the end of the food chain dies, it is broken down by bacteria, fungi, worms and insects. These organisms are called decomposers. Many food chains together make up a food web.

A macroinvertebrate is simply an invertebrate that is large enough to be seen without a microscope. An invertebrate is an animal without a backbone.



8-15 mm in length
2 tails
2 sets of wing pads
Branched gills between legs
Yellow to brown in color
2 claws at the end of each leg
Cannot tolerate low oxygen levels
Streamlined, flat body adapted to strong
stream currents

Pictures

Materials

Porclain Lab Trays. Microscopes, Sample of Macroinvertebrates.

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Friday, December 12, 2003

Soil ... More Than Cheap Dirt!

Curriculum Objective

To teach students the advantages and disadvantages of every soil type. To teach students how soil types influence erosion potential, infiltration rates and water-holding capacity. To teach students how the presence or absence of vegetation on top of the soil influences erosion potential, infiltration rates and water-holding capcity. To teach students about point-source pollution by observing and describing the movement of a point-source pollutant in a sandy soil. To teach students about erosion by distinguishing different sizes of soil particles, examining their interaction with water (settling rates and infiltration), and tracking the source of obvious erosion on the landscape.

Washington State
Essential Academic Learning Requirements (EALRs)

Science: 1.1 (properties of substances BM 1&2, motion of objects BM 1&2, nature and properties of earth materials BM BM 1&2))
Science: 1.2 (energy sources and kinds BM 1&2, energy transfer and transformation BM 1&2, physical/chemical changes BM 1&2)
Science: 1.3 (nature of forces BM 1,2&3, forces to explain motion BM 1,2&3, processes and interactions in the earth system BM 1&2,)
Science: 2.1 (questioning BM 1&2, designing and conducting investigations BM 1&2, modeling BM 1&2, communication BM 1&2)
Communication: 1.2 (listen and observe to gain and interpret information BM 1&2)
Communication: 3.2 (work cooperatively as a member of a group BM 1&2)
Social Studies: 2.1.1 (observe and describe the physical characteristics of a local area BM1)
Social Studies: 3.1.1a (identify and examine people's interaction with and impact on the environment BM 1,2 &3)
Mathematics: 1.1(understand and apply concepts and procedures from number sense BM 1,2 &3)
Mathematics: 1.2 (understand and apply concepts and procedures form measurement BM 1,2 &3)
Mathematics: 1.3 (understand and apply concepts and procedures from geometric sense BM 1&2)
Mathematics: 4.1 (gather information BM 1&2)

Links: soil characteristics | soil particle size | water-holding capacity | infiltration rates | runoff | effects of runoff on vegetated vs nonvegetated watersheds | point-source pollution | calculate soil texture from soil texture triangle |

Course Description

This course provides an opportunity for students to distinguish soil textures (sand from clay by observation and feel) and examine the settling and infiltration rates of these two soil types in water. This course provides students with an opportunity to model and track point-source water pollution and run-off in a watershed.

First, students are divided into groups of three. Each group designates a note-taker, a materials handler and an observer (these roles can rotate with each activity). (5 minutes)

Students view a model watershed which is already set up (crinkled, large blue tarp moistened with sand sprinkled over the "mountains"). Students take turns squirting water on the model. They observe the rapid movement of water through the plastic watershed model and discuss whether or not water actually runs this rapidly through a real watershed. Forests of tree sponges are then placed across the watershed and the students repeat the water squirting activity. This demonstrates that vegetation can actually slow down runoff. Student groups may then create their own watersheds using garbage bags and tree sponges. (10 minutes)

Student groups are provided with a ball of clay -- about the size of a peach pit -- from a yogurt container. They are also provided with a ball of sand the same size. Students are asked to make a ball that sticks together. The are asked to record their observations.

Students regroup as a class and the teacher places sand into one clear jar, clay in another, adds water to each and

Prework

Students should understand that there are different soils and how these soil are formed. Discuss five soil forming factors: parent material, climate, organisms, topography and time.

Classroom Activity

SEPARATING SOIL PARTICLES
Teacher Demonstration or small groups

Purpose: To illustrate to students that soil is composed of several different components.

Season: All - soil must be dry.

Materials: 4 soil sieves and bottom pan, 3 different types of soil, clipboard, paper, paper sack.

Procedure: Soil is composed of various particles which can be separated and identified. Soil particles range from gravel to sand to clay and each particle has its own identifiable characteristics. The investigation of soil particles is part of soil science, which is sometimes called pedology.

This activity is a small group activity with adult supervision or a teacher demonstration. Have students collect soil from three different areas. The soil should be dry and free of all plant materials. The soil should be crushed between the students fingers into individual soil particles. There are more than three soil types in the valley and Green Pool area.

shakes. The students are asked to make and record observations of the different particles. Students discuss settling rates and the implications for water quality. (5 minutes)

Students are introduced to the concept of porosity by observing three large plastic balls taped together versus three marbles taped together. Students compare the relative size of the air spaces between the spheres in each model. Students predict whether water would flow faster through the balls or marbles (balls simulate sand; marbles clay). (5 minutes)

Students add water to tin cans set in sand and clay by pouring water from one plastic cup through the plastic cup with holes in it (to simulate rain). They record the time it takes for the water to disappear into the soil and compare the relative rates of infiltration. Students then discuss infiltration rates, porosity, advantages (less surface runoff) and the disadvantages (faster spread of pollutants) of porous soils. (10 minutes)

As a class, the students observe the teacher place sand in a casserole and place a bit of red, dry KoolAid in one corner. One student rains on the corner while the casserole is tilted at an angle (water and KoolAid at the upper end). Students observe the plume and discuss point-source pollution the disadvantages of soil with high porosity. (5 minutes)

The instructor provides an example of the force behind uninhibited run-off by jumping off a desk directly onto the floor; then off the desk onto a chair and onto the floor. The first jump is louder, with considerably more impact. This example is equated to the impact of a raindrop hitting bare soil versus a raindrop hitting vegetation prior to hitting the soil. Students then observe a six-second storm at the erosion board. (5 minutes).

Students follow an eroded rut, channel, rivulet to its origin to determine the source of erosion. (5 minutes).

The screen sieves should be arranged with the largest screen size on top, proportionately decreasing in screen size to the closed-bottom container. Place one of the soil samples in the uppermost sieve, cover, and lightly shake it using a back-and-forth motion.

Carefully remove the particles from each sieve and place on paper.

The sieves should contain the following particles.
1st sieve - gravel
2nd sieve - fine gravel
3rd sieve - coarse sand
4th sieve - fine sand
Bottom pan - silt and clay

Questions: Ask students to make the following evaluations:

Which soil of the three you investigated has the most gravel? The most sand? The most silt and clay?

How does this difference occur?

Extension: Collect the soil in the different sieves and pan in separate paper sacks. Label each sack as to sieve number and soil name (brown soil or yellow soil, etc.)

Weigh each sample of soil from one of the soil types (brown soil) and record weight from each sieve.

Add the weights of all sieve samples to get total weight of the soil sample.

Determine the percent of gravel, fine gravel, coarse sand, fine sand and silt/clay.

EXAMPLE - Weight of 1st sieve/total weight of soil sample x 100 = % gravel

Repeat this for each soil sample for comparison purposes.

This could lead to such questions as: Which soil will water pass through the quickest or which soil will hold the most water. Students could be encouraged to design an experiment to answer the questions.

Background Information

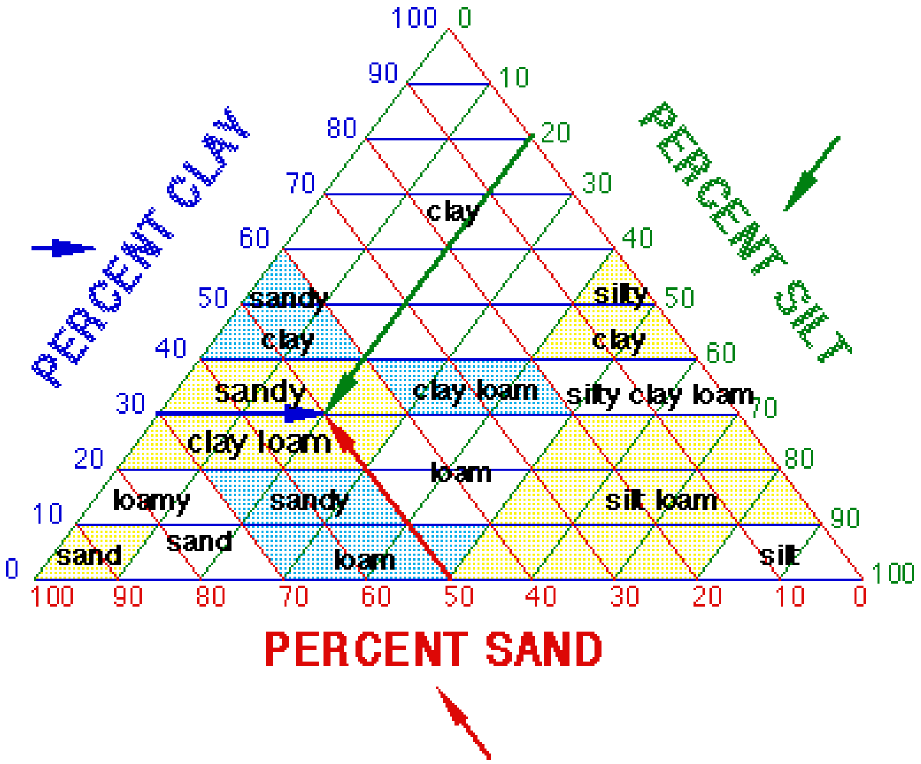
There are many different types of soil, from clay to sand to silt. Each soil type has different properties as they relate to water, and these properties are a direct function of particle size. Sand has a very large particle size, compared to clay, which has microscopic particles. Soils with larger particles are more porous (more air space between particles), and therefore water moves through these soils more quickly than through soils with small particles, such as clay.

Materials

Tape
Marbles
Three large plastic balls of the same size
Bucket of clay (powdered and mixed)
Bucket of sand
Water in a large 1-5 gallon container
20 tin cans with both ends removed, all the same size, no sharp parts
10 plastic cups; three with holes in bottom for pouring
10 plastic containers such as yogurt containers
Mallet
Three squirt bottles
Data sheets:10
Unsweetened, colored KoolAid (1 packet for demonstration)
Clear casserole dish
Large blue tarp
Black garbage bags
Newspaper and rocks
Three sponges (cut up into tree shapes)
Erosion Boards (need to be constructed)
Three glass jars to catch runoff from erosion boards
One watering can (for erosion boards)

Pictures

Soil Triangle



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Water Jeopardy

Curriculum Objective

To test students' knowledge of the Water Festival preparatory study materials. To provide students a chance to compete in teams to answer questions about water in the same manner used in the television show Jeopardy. To provide a fun game that will help students recall information that they have learned in the classroom and learn and apply again at other Water Festival study areas.

Links: sample jeopardy game | play jeopardy on-line |

Course Description

The Water Jeopardy game requires pre-designating five-person teams in the classroom. These Jeopardy teams can be assigned names and members should be in the same classroom, if possible.

The entire class determine which of its teams will go first, second, etc. While the team is competing, it may caucus before hitting the buzzer. Any student on the team may answer the question.

Each Jeopardy game includes five Water Festival categories of up to five questions each. Questions of increasing difficulty have higher point values (100-500 points).

Three teams play the Jeopardy Game at one time. Each team is provided a buzzer box with a button. One student on the team is

Prework

Students should study a packet of Jeopardy study materials prior to playing the game. Some of the study materials involve short activities. Students may wish to watch the television show Jeopardy several times to see how the game is played.

Classroom Activity

Introduce important information that is taught in all of the study areas of the Water Festival using the study materials packet and the following:

- Hangman Creek Watershed Poster (Spokane County Conservation District)
- Sportfish of Washington Poster or CD Rom (Washington Department of Fish and Wildlife)
- Watershed Glossary, particularly the definition of the following words: anadromous fish, drought, ecosystem,

assigned the job of pushing the button. All of the progressively difficult answers to Water Festival questions are listed under five categories on a large, gameboard, similar to the one on the Jeopardy television show ... hidden from view by a small, sliding window.

A team is selected to begin. The student with the buzzer asks for a question by its category name and point value. Students must answer the lower-pointed questions in each category before advancing to the next level. For example, if one category is WATERSHEDS, the student says, "Watersheds for 100, " after which the master of ceremonies slides open the window, revealing the answer to a specific question. In this example, the answer is, "The continuous movement of water from the ocean to the air, to the land and back to the ocean."

Each team is given a chance to press their buzzer if they know the appropriate question to the answer. A red light bulb in front of each team will signify who was first to press the buzzer and that team is offered the first chance to respond by asking, "What is the water cycle?" By responding correctly, the team wins 100 points. If they do not provide the right question, the other teams are provided a chance to buzz again and answer accordingly. If no team answers correctly, the points are unassigned and another team is selected to begin.

The game proceeds until all of the questions on the gameboard are answered. The team with the highest score wins the game (15 minutes). Teams that did not have a chance to play the first game may then play a second game. There will be 1-2 games per 30-minute block.

erosion, habitat, non-point source pollution, point-source pollution, riparian area, salmonid, turbidity, watershed salt water fish and fresh water fish.

- Reading materials:
  - Saving Energy with Zippie, Splash, and Sam N. Coloring Book (Bonneville Power Administration (BPA))
  - Hydropower Curricula (National Energy Education Development Project)
  - Electrifying Fish Facts (BPA).
  - Pacific Salmon Life Cycle Hexaflexagon (BPA)
  - The Water Cycle Hexaflexagon (BPA)
  - The Biodiversity Hexaflexagon (BPA)
- Lesson Plans:
  - A Guide to Your River Basin. Washington State Unviersity Cooperative Extension. Pub. No. 4863 and 4864 (student guide) $2.
  - Tree Factory (reprinted with permission, American Forest Foundation, Copyright 1993-6, Project Learning Tree Environmental Education Activity Guide Pre-K-8. For more information, call the National Project Learning Tree office at (202) 463-2462)

Background Information

The History of the Jeopardy Television Show (from the Jeopardy Home Page):

Q: How successful is JEOPARDY!?
A: Jeopardy! is the #1 quiz show in America: It has ranked first in Nielsen ratings for the genre for nearly 950 weeks, and as the #2 series in syndication for 63 consecutive ratings sweeps periods.

Q: Who created JEOPARDY!?
A: Merv Griffin created Jeopardy! in 1964 in the dining room of his apartment. Griffin also composed the show's "think" theme music.

Q: How many Emmys has the show won?
A: Since its 1984 syndication debut, Jeopardy! has been the recipient of 21 prestigious Daytime Emmy Awards.

Q: Which television shows were the first to become Olympic Sponsors?
A: Jeopardy! and Wheel of Fortune were the first television shows to become Olympic Sponsors. In honor of its participation as a sponsor of the Atlanta Olympic Summer Games, Jeopardy! presented the first-ever OLYMPIC GAMES TOURNAMENT, featuring English-speaking contestants from countries that produce their own versions of Jeopardy!. Ulf Jensen, a teacher at Uppsala University in Sweden, was the big winner of the Jeopardy! OLYMPIC GAMES competition, and Michael Daunt of Canada won the follow-up Jeopardy! INTERNATIONAL CHAMPIONSHIP.

Q: Which celebrities have competed on JEOPARDY!?
A: Jeopardy! is the favorite quiz program to numerous stars and famous personalities, some of whom have appeared on the show for charity and fun. Star contestants who have played in the celebrity competition to date include Jodie Foster, Nathan Lane, Martha Stewart, Harry Connick, Jr., David Duchovny, Camryn Manheim, Brandi Chastain, Star Jones, Jane Seymore, Jason Alexander, Alyssa Milano, Scott Hamilton, Mike Piazza, Mark McEwen, Larry King, Kirsten Dunst, Kelsey Grammer, General H. Norman Schwarzkopf, Kareem Abdul-Jabbar and Brian Dennehy. Their efforts have paid off in millions of dollars donated to their favorite charities nationwide.

Q: Who is the all-time winner?
A: The all-time winner is Brad Rutter a 24-year-old record store employee and certified network administrator with five wins totaling $55,102 and a new car in regular season play, $100,000 in the Jeopardy! 2001 Tournament of Champions winnings and $1,000,000 as winner of the Million Dollar Masters for a total of $1,155,102 in CASH. Brad's total winnings, including the value of the car, are $1.2 million.

Q: Who researches and writes the JEOPARDY! categories and questions?
A:The quiz show's production staff includes six full-time researchers and nine writers whose job is to create and assemble categories and questions for the show.

Q: Who else uses the answer-question format?
A:The unique answer-question format of Jeopardy! has become a popular tool with educators across the country. **Teachers recommend that their students watch the show and often create their own versions of Jeopardy! to encourage student participation in the classroom.** In an issue of Dartmouth magazine, a powerful testimony to Jeopardy!'s ability to teach while it entertains was made by Assistant Professor of Government Thomas M. Nichols, who said that Jeopardy! is "the SAT of

television game shows."

Q: How can I get on Jeopardy!?
A: Register here. Auditions for Jeopardy! are open to anyone 18 years of age and older and take approximately two hours. Those who pass the 50-question video test participate in a mock version of the game and a short interview session. There are special tryouts for the Teen, College, and Kids Week competitions.

Materials

Jeopardy Game Board & answer cards (Washington State University Cooperative Extension Energy Program, Spokane, Washington)
Buzzers (3)
Score Board
3 tables (small, 3'x3'), one for each team's buzzer
Podium & microphone

Sample Jeopardy Gameboard with Questions

	100	200	300	400	500	NOTES
The USA	**100** How many states are there in the United States? (50)	**200** How many colors are there on the American flag? (3)	**300** Where is the White House? (Washington D.C.)	**400** Who was the first President of the United States? (George Washington)	**500** If the President dies, who becomes the new President? (Vice President.)	**All answers must be given in complete sentences.**
The Opposite of ___ is ___.	**100** What is the opposite of sad? (happy)	**200** What is the opposite of cheap? (expensive)	**300** What is the opposite of clean? (dirty)	**400** What is the opposite of dangerous? (safe)	**500** What is the opposite of hungry? (full/ satisfied)	**All answers are in this form: "The opposite of ____ is ___."**

There are ___	100 How many hours are there in a day? (24)	200 How many cards are there in a deck of cards? (52)	300 How many letters are there in the English alphabet? (26)	400 How many days are there in a leap year? (366)	500 How many eggs are there in a dozen eggs? (12)	**Answers must begin with "There are" and be a complete sentence.**
It's spelled ____	100 How is the -ing form of eat spelled? (eating)	200 How is the -ing form of dance spelled? (dancing)	300 How is 14th spelled? (Fourteenth)	400 How is vegetable spelled?	500 How is refrigerator spelled?	**Answers must begin with "It's spelled___" and be a complete sentence.**
That's not true!	100 Bananas are purple. (Bananas aren't purple.)	200 Tigers live in the ocean. (Tigers don't live in the ocean.)	300 Monkeys go to school. (Monkeys don't go to school.)	400 Elephants don't eat fruit. (Elephants eat fruit.)	500 A snake needs to have a bicycle. (A snake doesn't need to have a bicycle.)	**All answers must be given in complete sentences.**
Science and Nature	100 How many seasons are there in a year? (4)	200 What color are panda bears? (Black & White)	300 How many colors are there in a rainbow? (7)	400 How many legs does a spider have? (8)	500 How many toes does a cat usually have? (18)	**All answers must be given in complete sentences.**
Geography	100 How many continents are there in the world? (7)	200 What is the largest ocean in the world? (Pacific Ocean)	300 What is the biggest state in the United States? (Alaska)	400 How many prefectures are there in Japan? (49)	500 What is the capital of California? (Sacramento)	**All answers must be given in complete sentences.**

Pictures

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Friday, December 12, 2003

Stream Sense

Curriculum Objective

To teach students how to use different senses to observe and learn about a stream environment. To provide opportunities of solitude for students to reflect upon the stream environment using their senses and to record their perceptions through artistic drawings, writing, comparisons and other creative means. To teach students about how individual senses can be "heightened" to provide more information about the environment when others are blocked or not functioning.

Washington State
Essential Academic Learning Requirements (EALRs)

Science: 1.1 (motion of objects BM 1,2&3, wave behavior BM 1&2)
Science: 1.3 (forces to explain motion BM 1&2)
Communication: 1.1 (focus attentionBM 1,2&3)
Communication: 1.2 (listen and observe to gain and interpret information BM 1)
Communication: 2.1 (communicate clearly to a range of audiences for different purposes BM 1)
Communication: 2.3 (use effective delivery BM 1)
Communication 2.5 (effectively use action, sound, and/or images to support presentations BM 1,2&3)
Arts:1.2 (developes arts skills and techniques BM 1&2)
Arts: 2.1 (applies a creative process in the arts BM 1, 2&3)
Arts: 3.1 (uses the arts to express and present ideas and feelings BM 1,2&3)
Arts: 3.2 (uses the arts to communicate for a specific purpose BM 1&2)
Health and Fitness: 2.3 (aquire skills to live safely and reduce health risks BM 1)
Health and Fitness: 3.1 (understand how environmental factors affect one's health BM 1)
Mathematics 2.1 (investigate situations BM 1&2)
Mathematics 5.3 (relate mathematical concepts and procedures to real-life situations BM 1&2)
Writing: 1.1 (develop concept and design BM 1&2)
Writing: 1.2 (use style appropriate to the audience and purpose BM 1&2)
Writing:2.2 (write for different purposes BM 1,2&3)
Writing: 2.3 (write in a variety of formsBM 1,2&3)

Links: investigating the environment using our senses | smell | taste | sight | hearing | touch | living without one of the five senses |

Course Description

Students are provided copies of the Sensory Observation Sheet before visiting a stream where they will use different senses to observe the environment. Stream walk safety rules are discussed with the students prior to the visit.

Touch-and-feel bags are distributed to groups of students who are then asked to identify the objects inside by touch alone.

At the stream, students are asked to write things down or draw pictures of things as they perceive them with their senses. For example, when a student looks at elements of the stream environment, he or she can describe those things through shapes and colors. The student can write imitations of the sounds (e.g., peep, peep, gurgle, gurgle, swish, swish, shoooosh).

Students will be asked to find a quiet spot near the stream and sit very still to look, smell, listen and feel. Older children may want to sit for 15 minutes or more, while 2 to 3 minutes for younger students may be enough time. During this quiet time, students can complete their observation sheets. If they bring their journals, they may be inspired to write poems or draw pictures. Students may want to make photographs or tape record sounds they hear.

Other sensory activities that students could do at the stream include the following:

- Have the students block one or more of their senses (e.g., close their eyes, cover their ears, plug their noses). Ask them to think about how blocking one sense affects their other senses. Could

Prework

Review the five senses (sight, sound, touch, smell, and taste). Discuss how they are used in daily life. Ask students about previous trips or visits to natural areas. How were their senses involved in these visits?

Ask students to describe how they observe things. Do they think it is possible to observe using all their senses.

Explore more information about the Five Senses with students.

Classroom Activity

Test to see how smell affects our moods

Conduct a psychological study on the affects of smell on the mood of students in the classroom. What kind of results do you think you will have with the smells selected? Have the class hypothesize on what you think people's reactions will be.

Materials:
lavender oil
cinnamon oil
vanilla
rose
pine
smelling salts
vinegar
ammonia
log book
pencil
glass bottles for scents

Instructions:

2) Select a group of students to test.

they hear better when they could not see?

- Have the students guide a blind-folded partner to his or her quiet site. Have the partner recall the sounds, smells, and feelings he or she experienced along the way.
- Supply students with ways to improve the ability of their senses (e.g., use binoculars, spray water on their noses (moisture helps trap scent particles), cup their hands behind their ears).
- Ask students to record the following observations at the stream:
  - Sight: What plants and animals do they see? Does the appearance of the stream vary with location? Is the stream fast or slow-moving? How can they determine its speed?
  - Sound: What sounds does the stream make? Can they hear animals? What does the wind sound like?
  - Smell: How do smells near the stream compare to those on a road or in a home? Does the water smell the same as tap water?
  - Touch: What does the stream water feel like? How does soil near the stream feel compared to soil in the woods or schoolyard? Are the rocks in the stream smooth or rough?
  - Sixth Sense: Was the stream or environment strangely familiar? What peoples have lived along its shores and what did they do there? Can the student imagine what life must have been like living there? Is there any sense of danger?

3) Have the student close their eyes and relax.

4) Place each bottle, one at a time, under their nose and have them tell you how the smell makes them feel. Take your time; record results after each scent.

5) Give the person a moment to clear the smell and continue with your testing.

6) Go through each scent with each person to create a graph that records everyone’s response.

7) What were the results of your testing? Were their similarities in their response to each smell? What can the class conclude about the results?

Sixth Sense

Ever have a hunch, an instinct or an intuition? Some research psychologists claim that hunches might actually foretell the future. Others aren't so sure.

There are several possible explanations for why such "intuitive hunches" sometimes play out. One is that on a subconscious level, we are always thinking and coming to conclusions, but that these register only as hunches to our conscious mind. Another is that we pick up telling cues from body language, subliminal sounds or peripheral vision without being consciously aware of doing so. A third is that for each amazing coincidence we remember, we forget all the times we had a hunch and it didn't pan out. A fourth possibility is that we modify our memories for our own convenience, creating a connection where it may not have existed. And so on. These sorts of prosaic explanations probably account for many intuitive hunches. But they don't explain them all.

Background Information

Many people enjoy the sights and sounds of a babbling brook. People find comfort through the sense of touch and recall distant memories through certain smells. Often people depend on only their vision to gather details about their environment. By making careful observations, students experience how their other senses (besides sight) provide them with additional information about the environment.

Sensing organs -- eyes, ears, nose, tongue, and skin -- are needed to detect the surrounding environment. With information it receives through the senses, the brain interprets what we see, hear, smell, taste, and feel. In addition to translating the information it receives, the

Extensions

Ask students (after the field activity, in the classroom) to share their Sensory Observation Sheets (below) with the class. Have them each create a mobile that includes things they observed with each of their senses at the stream.

Provide a display board titled Sensory Observations of a Stream for students to embellish.

Create a class sensory guide sheet to educate others about what they might see, hear, touch and smell at a stream.

Sights	Smells
Touch	**Sounds**
Tastes	**Feelings or "Sixth Sense"**

brain also relates these details to memories and thought processes. In this way, recognition and learning take place.

In most humans, sight is the predominant sensing organ. When an individual uses all of his or her senses to investigate the environment, the brain receives a broader range of information. This information provides the opportunity for more thorough learning.

A stream provides an ideal opportunity for people to use all their senses. People hear water rushing over rocks and lapping at the banks. They feel a breeze against their skin, and hear insects buzzing and chirping among the willows. The air around the stream feels moist and carries a variety of particles from flowers, damp earth, and chemicals in the water to their noses. Along the banks and in shallow portions of the stream, a variety of materials of different shapes and textures can be touched.

It is important to protect the senses. Safety rules should be followed when students explore a stream.

Our Sense of Smell

Smells are detected in the nose by the specialised receptor cells of the olfactory epithelium. These are called olfactory receptor neurones.

Smell is one of the chemical senses, the other being taste. They are so called because they sense chemicals, and smells are, of course, chemicals. With these senses we sample our environment for information. We are continuously testing the quality of the air we breathe (this will alert us to potential dangers, e.g. smoke) as well as using this sense to inform us of other relevant information, such as the presence of food or another individual. The chemicals detected by our sensory systems need to have certain properties. For instance, odor molecules must be small enough to be volatile (greater than 300-400 relative molecular mass) so that they can vapourise, reach the nose and then dissolve in the mucus. This tells us that smell, unlike taste, can signal over long distances (an early warning device). We appear to have an innate ability to detect bad, aversive smells. One-day old babies give facial expressions that indicate rejection when given fish or rotten egg odor.

But, is our olfactory system doing more than just giving us warnings? Yes, of course. Amongst other possibilities, it serves a recognition function.

Dogs can distinguish between the smell of T-shirts worn by non-identical twins (they couldn't tell the difference between identical twins - presumably because they smell identical!). Children can distinguish between the smell of their siblings and other children of the same age. Babies recognize their own mothers' smell and mothers recognise their own babies' smell. Emotion can be communicated by smell. Dogs and horses are very sensitive to the smell of fear in humans. The emotions of others, for example fear, contentment, sexuality, may therefore be experienced and communicated by smell. Memory is often associated with smell. Smell and memory are intimately linked - although this phenomenon is not well understood .

How we smell (some estimates suggest we can distinguish around 10,000 different smells), why we smell and the impact of smell to our everyday life are poorly understood. We certainly underestimate the importance of smell to our well-being - ask an anosmic (someone who has lost some or all of their sense of smell). Some anosmics suffer from depression and their quality of life is severely affected - at the moment there is little that can be done to help them.

There are suggestions that smell can influence mood, memory, emotions, mate choice, the immune system and the endocrine system (hormones). We can communicate by smell - without knowing it.

Pictures

Comming soon

Materials

Touch-and-feel bags (a dark-colored bag with sample materials that could be found near a stream: a cattail, a pebble, a shell, a twig, etc.,).
Copies of the Sensory Observation Sheet
Pencils and crayons
Journals (optional)
Camera (optional)
Tape recorder (optional)
Magnifying lenses (optional)
Sample foods (edible plants and seeds) that could be found near a stream (optional)
Spray bottle (optional)
Collecting apparatus, such as buckets, tweezers, nets, etc. (optional)

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Friday, December 12, 2003

Lake Roosevelt 2003 Water Festival

September 23rd and 24th 9:00a.m.-2:00p.m. at the Lake Roosevelt Day Use Area

Riparian Welcome
Fish Homes
Fish Neighbors
Hooks and Ladders
Just Passing Through
Macroinvertebrate Mayhem
Water is Like?
Grounded
It's Hydrological
Water Jeopardy
Soil: More Than Just Cheap Dirt
Bugs on the Bottom
Habitat Haven
Hatchery Tour
Insect Discovery
Kids in the Creek
Stream Sense
Salmon

Kids in the Creek

Curriculum Objective

To teach students about the plants, animals and insects that live in and near Sherman Creek. To provide an opportunity for the students to explore the stream habitat and collect stream insects. To teach students how to identify the insects they collected and how to determine the health of the stream by using the macroinvertebrate water quality testing method. To provide students with the knowledge that plants, animals and insects need a healthy home in order to survive and that the interconnection of these species and their habitat is vital to the circle of life: they provide for us and we, in turn, must make every effort to protect them.

Washington State
Essential Academic Learning Requirements (EALRs)

Science: 1.1 (basis of biological diversity BM 1,2&3)
Science: 1.2 (biological systems BM 2&3, structure and organization of living systems BM 2 &3)
Science: 1.3 (life processes and the flow of matter and energy BM 2&3, biological evolution BM 2, interdependence of life BM 1,2&3, environmental and resource issues BM 1&2)
Science: 2.1 (designing and conducting investigations BM 1,2&3, explanation BM 1&2, modeling BM 1&2, communication BM 1, identifying problems BM 1&2)
Science: 3.1 (dealing with inconsistencies BM 1&2, evaluating methods of investigation BM 1&2)
Communication: 3.1 (work cooperatively as a member of a group BM 1,2&3)
Communication: 3.3 (seek agreement and solutions throug discussion BM 1,2 &3)
Mathematics: 1.1 (computation BM 1,2&3, estimation BM 1,2&3)
Mathematics: 2.1 (investigate situations BM 1,2&3)
Mathematics: 2.2 (formulate questions and define the problem BM 1,2&3)
Mathematics: 3.1 (analyze information BM 1,2&3)
Mathematics: 3.3 (draw conclusions and verify results BM 1,2)
Mathematics: 4.1 (gather information BM 1,2&3)
Mathematics: 4.2 (organize and interpret information BM 1,2)
Mathematics: 5.3 (relate mathematical concepts and procedures to real-life situations BM 1,2)

Links: macroinvertebrate identification | scientific observations and methods | macroinvertebrate anatomy | benthic sampling | macroinvertebrate on-line key | macroinvertebrate identification key

Course Description

This activity provides students with a simple method of assessing the long-term health of a stream by viewing and identifying the aquatic insects and observing the world they inhabit. It explains the importance of a healthy watershed and the effect of a vibrant forest canopy and riparian area of the stream and its water quality. It also connects the conditions of the stream being explored to the immediate food chain as well as the entire ecosystem.

Stream Investigation

Each student will be provided with a pair of rubber boots. In the stream, they will locate a riffle that has not been disturbed or pose unsafe conditions. A leader will be selected to carry a white bucket with stream water for collected specimens.

The class will approach the sample area to find rocks which they will hold to the sunlight until they can see movement. Then, they will carefully wash off the "bugs" and place them in the white plastic bucket.

Once enough of a variety of bugs has been collected, the students will take them back to the stream bank and select similar species for placement into a cubical in an ice tray.

The students will identify

Prework

Help prepare students for this field trip by taking a few minutes in the classroom to go over some of the vocabulary words and their meanings as well as the objective of this outside classroom activity.

Take your students on a virtual stream tour!

Vocabulary Words

Forest Canopy: Trees and foliage. Overhead cover. It provides leaves, woody debris, and insects to the stream; it prevents your stream from evaporation, as well as providing shade necessary to keep water temperatures cool.

Macroinvertebrate: These are creatures without backbones. They are a primary link in the stream food chain. They eat smaller organisms like bacteria, fungi, leaves and woody debris and in turn they are eaten by fish, birds, amphibians and reptiles.

Habitat: A place that provides food, water and shelter for living things.

Watershed: An area that surrounds and drains into a body of water. The water collects into little streams that join into bigger ones forming a drainage system. Your stream is part of the drainage system. With this runoff comes a lot of substances in the form of sediment, dissolved minerals, chemicals and pollutants.

Riparian: The area of vegetation adjacent to the stream. Composed of foliage, shrubs and trees. All around the waters edge it is very green with vegetation. This is important because it insects according to the pictures on a macroinvertebrate pocket chart provided by the instructor, recording each type of organism on an aquatic insect record (see below). Once the students have identified several types of organisms, they will compare what they have found to the "tolerant-intolerant" species grouping on the chart and make some conclusions about the health of the stream. Their conclusions will be based upon: 1) the types of organisms identified; 2) observations of streambed conditions; and, 3) observations of the riparian area and forest canopy.

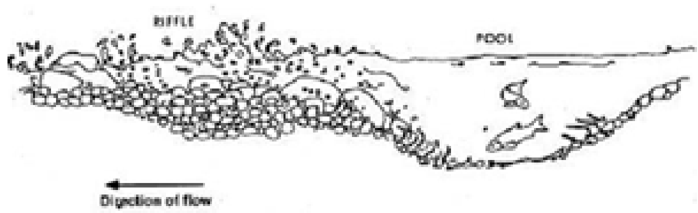
Aquatic Insect Record

- Keep a record of each type of organism you find in your search.
- Observe and record the descriptive features of the insect you are looking at.
- Look at the two identification sheets included in your packet. ONce you have found an insect that looks like the one you have just described, find its common name.
- Identify to which group the insect belongs (tolerant or intolerant of water pollution.

Descriptive Features	Common Name	Tolerant/ Intolerant

helps prevent erosion and provides shelter and food to the inhabitants of the area.

Riffle & Pool Description



Background Information

Gazing into the cold water of a small stream in winter reveals little animal activity. The stream, like the woods around it, seems lifeless. But, take a closer look. Skeletons of leaves with only the main ribs remaining provide evidence of animal activity.

The leaves are eaten by aquatic invertebrates, especially insects that spend most of their lives in water. They change their forms, grow wings and emerge from water only during spring or summer when they mate.

During late fall and winter, small streams in wooded areas are menageries of aquatic insects. This is because most of the leaves and wood (containing energy for the insects) fall into the stream during this time. At other seasons of the year, you would probably find a different assemblage of animals.

If you were to collect a handful of leaf litter or a rock from the stream or kick up some bottom material from under rocks and let the current carry the material into a fine mesh net, you would be able to collect a winde range of insects you probably had not known were present. These insects can be placed into groups according to how they feed (functional feeding groups):

Shredders: Feed on leaves or wood that falls into streams and eat the softer plant material, leaving the leaf skeleton.

Collectors: Feed on fine material in streams. Some filter the water for their food (filtering collectors), while others burrow in the stream bottom, feeding as they go (gathering collectors).

Scrapers: Feed by scraping the surface of rocks and logs, removing algae.

Predators: Feed on insects and other invertebrate animals

The following aquatic insect guide will help students discover what kinds of insects live in the stream. This is just a general guide but it will help identify most insects to a particular group:

Aquatic Insect Guide	
Builds a portable "house" or case to live in	Caddisfly
• If case is made of material that was once living (wood, leaves, etc.,)	Shredder
• If case is made of mineral material (rocks, sand grains)	Scraper
Has two tails, without abdominal gills	Stonefly
• If dark and uniformly colored	Shredder
• If large and brightly colored and/or mottled	Predator
Has three tails (sometimes two), with abdominal gills	Mayfly
• If flat, sometimes egg-shaped	Scraper
• If cigar-shaped	Gatherer Collector
Worm-like, without true legs	Flies
• If <1cm long, 1 pair stubby "legs," head well developed	Gathering Collector (Midge)
• If>1.5 cm long, head reduced, often found in leaf litter	Shredder (Cranefly)
• Antennae modified as tiny fans	Filtering Collector (Blackfly)
Free-living, 3 pairs of legs	Odonates/Beetles
• If large, with gills at end of abdomen	Predator (Damselfly, Dragonfly)
• If no gills, usually tough outer covering, jaws often easy to see	Beetles
• Dark brown; tough outer covering	Gathering Collector (Riffle Beetle)
• Color varied; abdomen soft-bodied	Predator (Beetle

Classroom Activity

Pint jars make excellent aquariums for pond life if fish and other large animals are left out. Every pupil should have one of his or her own to watch and enjoy, even if the windowsills and bookshelves are filled for a time!

Such aquariums encourage pupils to make observations on their own and to share their discoveries with classmates. This is so much better than merely feeding goldfish in a classroom aquarium that has become just part of the furniture!

To make a fish-less aquarium, a pupil should place a centimeter or two of pond-bottom sediment in a jar, stick in a small water plant or two, and add pond water. Then put in a snail or two and a few water insects. The water will become clear after a while, allowing many tiny animals to be seen, perhaps for the first time! A magnifying glass will help.

Ideally, a class should set up jar aquariums at a nearby pond. Borrowing in a sense, small parts of the pond for a little while. Early fall is a good time to do this. Then the experience may be repeated in the spring to see what seasonal changes have occurred.

Well in advance of the trip to a pond, notes should be sent home to advise about clothing, especially rubbers or boots. Also, one or two parents may be invited along to participate as well as to provide additional supervision. Possibly a primary grade teacher and an upper-grade teacher can take their classes at the same time, having each older pupil be responsible for a younger one. It surprising how well they shoulder this responsibility!

If the whole class cannot be taken to the pond, perhaps you and a few pupils can bring the material to school. For a class of 30 pupils, you should fill four gallon jugs with pond water and get a small pail of sand or silt from the pond bottom. Also borrow some plants and animals from the pond - not too many!

Gather a few handfuls of small plants, and use a large kitchen strainer to collect some water insects, snails, and other small animals. Put them in a gallon jar of water.

If each sample is first dumped into water in a white pan, the creatures will be more easily seen. Then they can be spooned out. At school, they may be transferred to shallow pans for pupils to select the ones they want. To make the experience a really pleasant one, be sure that pupils:

Put only a few animals and plants in a jar, too few rather then to many. Crowding may cause them to die.

Keep the jars in a cool place, away from radiators. As a rule they should not be left in direct sunlight.

Move or shake the jars a little as possible. The creatures that live in them should be observed, not disturbed.

Add no food. The green plants make their own food, and the animals eat plants, or animals whose food came from plants.

Use pond water to replace any water that evaporates. Tap water containing chlorine is harmful to some creatures.
Over several days, pupils may investigate questions such as these:

How do the animals get around by legs, or by other means? Do any stay in one place, attached to objects?

What do the animals eat and how do they eat? How do they keep from being eaten?

Which animals carry bubbles of air with them, or get air through little tubes? Do any get air by moving gills through the water?

Do some animals avoid light? If you leave a paper bag over a jar and later remove it, can you see things you did not see before?

Where do the plants show signs of most growth in leaves, stems, or roots? Do they all have these parts?
Among the many other things that pupils may discover are these:

Hydra, named after a monster of mythology, snaring other small animals with their “arms”.

Tiny water “fleas”, such as Daphnia and Cyclops, darting through the water.

Small shrimp like animals with curved backs and many legs, called scuds, swimming along.

Diving beetles carrying their own air supply with them.

Caddis larvae pulling their cases along.

Mosquito eggs later changing into “wigglers” hanging from the water surface and later hatching as adults.

Ananchairs (once called Eldea) plants giving off tiny streams of bubbles in sunlight.

After a week or so, before interest wanes, have pupils return the plants and animals to the community from which they were borrowed. Take another trip to the pond - make it just as important as the first one, for the express purpose of putting the creatures back.

Doing this instead of flushing them down the drain or throwing them out helps to instill respect for living things. A basic environmental ethic!

Source: "Teaching Science with Everyday Things"

Safety in the Creek

Crossing a tranquil stream can be a pleasant experience, however unsafe stream crossings by hikers or "investigators" can result in injuries or deaths. Often people in unfamiliar areas do not adequately size up the situation before attempting a crossing or they ignore dangerous changes which have taken place at crossings with which they are familiar. The purpose of this article is to remind everyone of some all-too-often forgotten elements in hopes of sharpening your judgement skills.

- Do not attempt to cross a stream over 2 feet deep and/or with very fast (3.4 MPH) water.
- Pick a good crossing, on a straight stretch of water, free from soft mud, snags and large, slippery rocks.
- Prevention is always the best cure. When navigating unfamiliar streams make sure the group is in agreement that they will size up every significant crossing before anyone starts across. Mishaps don't happen that often, but they can have devastating consequences.
- It is sometimes difficult to know exactly what a water crossing has in store until you are out in it. Water is heavy and the impact that it has on humans is dependant upon depth, velocity (speed), and direction (which includes turbulence).
- Since fast moving water causes most stream bed erosion, channels are generally deepest where water is flowing the fastest.
- Avoid crossing at bends.
- Smooth water is generally the safest, and most desirably should appear with the least visible changes in velocity as one looks across the stream.
- Wide, shallow crossings are generally desirable as water velocity is consistently lower.
- Gravel stream beds are generally the safest, particularly when water is clear enough to see the bottom and avoid the more obvious submerged hazards.
- Roots, snags and other entanglements should be avoided for obvious reasons. Avoid banks crowded with water loving trees, dead branches and such.
- Finally, when walking out in rocky stream beds, there is always the possibility that you could get a foot stuck in a hole or crack. If this occurs, it may be necessary for someone to help you keep your balance while you attempt to extract your foot. To attempt to do so prematurely can result in your falling over and not being able to get back up!

Pictures

Materials

Boots for students
White Bucket
Ice Cube Trays
Pocket Macroinvertebrate Guides
Aquatic Insect Records

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Friday, December 12, 2003

Lake Roosevelt 2003 Water Festival

September 23rd and 24th 9:00a.m.-2:00p.m. at the Lake Roosevelt Day Use Area

Insect Discovery

Curriculum Objective

To teach students about the various methods of aquatic insect capture. To introduce students to a creek environment (Sherman Creek) where they will observe and collect aquatic insects. To teach students how to recognize the characteristics of different aquatic insect species and to use a dichotomous key to identify them. To teach students how to relate the taxonomic Order of the insects to the species tolerance to stream conditions. To teach students how to measure the temperature and pH of the water in a stream and to relate the measurements to the types of aquatic insects that tolerate these conditions.

Washington State
Essential Academic Learning Requirements (EALRs)

Science: 1.1 (basis of biological diversity BM 1, 2&3)
Science: 1.2 (biological systems BM 2&3)
Science: 1.3 (life processes and the flow of matter and energy BM 2&3, environmental and resource issues BM 1&2)
Science: 2.1 (designing and conducting investigations BM 1)
Science: 3.2 (careers and occupations using science, mathematics and technology BM 1&2)
Communication: 3.2 (work cooperatively as a member of a group BM 1, 2&3)
Mathematics: 1.2 (systems and tools BM 1&2)
Mathematics: 2.3 (construct solutions BM 1,2 & 3)
Mathematics: 3.1 (analyze information BM 1,2 & 3)
Mathematics: 3.3 (predict results BM 1,2 & 3)

Links: Aquatic Insect Orders | Measuring pH of Water | Stream Temperature and Its Affect Upon Aquatic Insects | Biological Testing For Water Quality Sampling Aquatic Insects

Course Description

This course provides an opportunity for students to accompany a fisheries biologist to a stream (Sherman Creek), capture samples of aquatic insects that live in the stream, measure the water temperature and pH of the water and relate these measurements to the tolerance of the captured insects to the health of the creek ecosystem. The students learn how to use of a dichotomous key to identify the Order and Family of various insects they have collected.

Each class is divided into four groups and each group will go to a pre-identified site along the stream. These sites have been flagged in advance. There, they will twice measure the temperature and pH of the water. They will then begin biological testing by wading into the creek, placing their nets downstream of some rocks and turn the rocks over. They will collect insects from the rocks in their nets for one minute. After collecting the insects, they will classify them using a dichotomous key.

Students in each group will write down the different Orders of insects they found and identify those insects to the Family level.

Prework

Students should practice using a simple dichotomous key in the classroom. A simple key can be developed for the students in class using categories such as gender, hair color, shirt color, etc.

Classroom Activity

Students can cut pictures of different types of living organisms out of natural history magazines, and attempt to group them (or differentiate them) by physical features.

Background Information

This activity assesses the health of creeks and rivers by using information about insects that live there. Certain aquatic insects can be classified as pollution-tolerant (they thrive in polluted water). Others are intolerant of pollution (they will die, even in mildly-polluted water).

Until recently, the water quality of rivers, creeks and lakes was monitored through chemical testing. It has been found, however, that biological testing can also provide information about water quality. Biological testing consists of collecting and analyzing the numbers and types of insects found in creeks or rivers.

Insect Order Odonta

Wings with many veins;
Long slender insects with equal-sized long narrow wings, tiny antennae

Order Odonta
Dragonflies
Damselflies
Found near water
Simple metamorphosis, Aquatic nymphs

Other Orders include:
Order Mecoptera (Scorpionflies), Order Plecoptera (Stoneflies) Order Neuroptera (Lacewings), Order Isoptera (Termites)

Pictures

Comming soon

Materials

Proper clothing and rubber boots
Thermometer
Universal pH paper
Homemade nets
Porcelain trays for sorting insects
Tweezers
Probes
Insect Classification Key (attached)
Jars or small vials for collecting insects

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Friday, December 12, 2003

Sherman Creek Hatchery Tour

Curriculum Objective

To teach students about fish hatcheries, how they operate and why fish are raised in this fashion versus "natural" spawning. To teach the students about the benefits and shortcomings of hatchery-raised fish in natural ecosystems. To provide students a chance to view and feed kokanee and rainbow trout fingerlings from the hatchery walkways. To instill in students an appreciation of good water quality for the survival of fish in the hatchery and once they are released into the wild. To teach students about "imprinting" the hatchery's location in fish so that they return to spawn in Sherman Creek.

Washington State
Essential Academic Learning Requirements (EALRs)

Science: 1.3 (interdependence of life BM 1,2 & 3, environmental and resource issues BM 1,2 &3)
Science: 2.2 (identifying problems BM 1,2 &3, evaluating potential solutions BM 1,2 &3)
Science: 3.1(limitations of science and technology BM 1, 2 & 3))

Links: fish hatchery policy and management guidelines | homing & straying in hatchery fish | fish hatchery controversy | Columbia River Kokanee Net Pen Program|

Course Description

Students arrive at the Sherman Creek Fish Hatchery and receive a guided tour of the facility. They learn about how hatcheries operated and maintained, how the runways are cleaned, how the fish are delivered and handled throughout their stay. They learn about the net pens in the Columbia River where the fish will eventually be acclimatized before release into the wild.

The students are allowed to investigate the fish runways, view and feed the fish from the walkways. They are shown posters of yearling-aged fish and learn about their requirements for survival. The students learn about how important the quality of water is for fish survival.

Prework

Students should have basic understanding of the purpose and need for fish hatcheries. They should understand both the positive and negative impacts that hatchery-bred fish have on natural ecosystems. They should discuss some of the issues that concern scientists about the effectiveness of hatchery programs.

Students should discuss and list potential solutions to the problems faced and caused by fish hatcheries.

Students can view a video of a Pacific Northwest hatchery.

Background Information

The Sherman Creek Hatchery

The Sherman Creek Hatchery "holds" yearling kokanee and rainbow trout for release in the Columbia River system until they are large enough to survive in the wild. Approximately 275,000 kokanee and 300,000 rainbow trout spend several months in the Hatchery before being released into net pens near creek outlets along the river.

The eggs are hatched and kept for a year at the Spokane Tribal Hatchery before they come to the Sherman Creek Hatchery. Kokanee arrive in

March and are released into 12 different pens during the first week of July. Rainbow trout arrive in May and are released into 10 pens at the end of July.

The fish are released from the pens in September.

The Hatchery uses water from Sherman Creek which is gravity-fed into runways. The fish are fed pellets comprised of shrimp and herring until they are large enough -- or until the hatchery water warms to that in the main body of the river to allow for their transfer without stress.

Approximately five percent of the fish die during the first month after release into the Columbia River due to predation, starvation, maladaptation, disease and affects of dams.

Salmon Hatcheries in General

In the late 19th century, elements of a hatchery system for Pacific salmon started to develop. Hatcheries are fish breeding and raising centers that have been built primarily to enhance harvest in commercial, sport, and Tribal fisheries, and reduce the impacts of development that destroys or degrades salmon habitat and blocks migratory routes.

Salmon have existed for millions of years and are a critical part of the Pacific Northwest's economy and culture. As the demand for salmon has grown, so has our dependence on hatcheries. Hatcheries currently contribute between 70-80% of the fish in coastal salmon and steelhead fisheries in the Pacific Northwest.

Over the past several decades, wild salmon populations have declined dramatically, despite, and perhaps sometimes because of, the contribution of hatcheries. Many salmon stocks in Washington and Oregon are now listed as either threatened or endangered under the U.S. Endangered Species Act. With this decline has come an increased focus on the preservation of indigenous wild salmon stocks.

Hatcheries have the potential to assist in the conservation of wild stocks, but they also pose some risks. At this time, scientists still have many questions about the extent to which hatchery programs enhance or threaten the survival of wild populations. Additional research and investigation is needed.

What Do Fish Rearing Facilities Look Like?

Egg Incubation

Four 8 tray vertical stack incubators
UV Disinfection
Temperature Control for Year Round Operation

Fry Rearing and Research Tanks

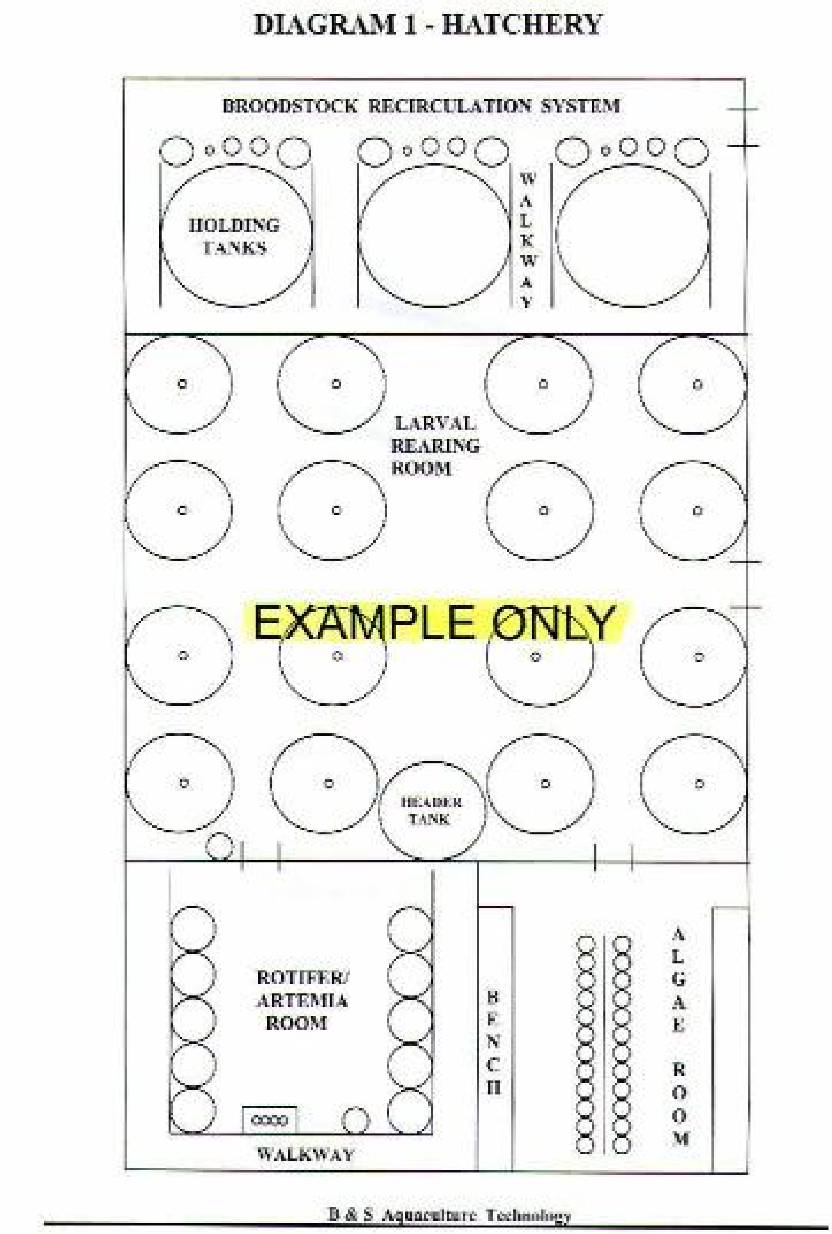
Sixteen 100 gallon 3' diameter tanks
Eight 150 gallon 4' semi-square tanks

Yearling and Broodstock Rearing

Six 10' diameter circular ponds
Two 100' x 5' raceways

Algae Room

Typical Hatchery Layout



Classroom Activity

Students can take a virtual tour of several, lower-Columbia River fish hatcheries. Address the following questions with the students about fish hatcheries:

- Why is salmon conservation important?
- What are hatcheries?
- What happens at a hatchery?
- Why are there hatcheries?
- Why should we focus on conserving "wild" populations? Why not rely instead on hatcheries?
- Why worry about salmon conservation? Why don't we just wait until ocean conditions change?
- Why are hatcheries controversial?
- What risks do hatcheries pose to wild populations?
- What benefits can hatcheries provide to wild populations?
- Are there different types of hatcheries?
- Have hatcheries improved in recent years?

The following list of answers to the above questions provides some general information about hatcheries and the interaction of hatchery fish with wild stocks. The answers were prepared by scientists at the National Marine Fisheries Service's Northwest Fisheries Science Center. The answers provided do not represent the official views of the National Marine Fisheries Service or the National Oceanic and Atmospheric Administration. A list of references is provided for further information:

Why is salmon conservation important?

Salmon conservation is important for biological, economic, cultural, and religious reasons. Salmon play a major role in aquatic and terrestrial ecosystems. When salmon return to their natal streams to spawn and die, they bring large amounts of nutrients from the marine environment into rivers and streams, where they enrich both plant and animal life.

Salmon are a part of Native American spiritual and cultural identity. Salmon support religious ceremonies held by Pacific Northwest Indian Tribes and are a vital part of Tribal economies. Salmon also support the greater Pacific Northwest economy. In 1996, fish caught by Washington commercial fishers were worth an estimated $148 million. In addition, recreational anglers spent approximately $700 million on fishing related expenses, which translates into about $1.3 billion and over 15,000 jobs.

Life in the Pacific Northwest would be very different without salmon.

What are hatcheries?

Hatcheries are facilities where fish are bred and raised for at least part of their life cycle.

What happens at a hatchery?

Hatcheries vary in their practices but the general process is as follows:

• salmon returning to spawn in hatcheries or in rivers and streams are captured
• eggs and sperm are collected and mixed together
• fertilized eggs are incubated
• hatched fish are placed in holding tanks to grow and develop
• fish are released into the river
• fish spend 1-3 years in the ocean
• fish that are not harvested return to the hatchery or spawning grounds

Why are there hatcheries?

Hatcheries improve the survival of young salmon (eggs, fry, and juveniles). More young salmon survive in the hatchery than would survive in the wild because there are no predators in hatcheries, food is abundant, and the environment is relatively constant.

Why should we focus on conserving "wild" populations? Why not rely instead on hatcheries?

Wild salmon have existed for millions of years. The oldest salmon fossil dates back about 50 million years. Pacific salmon, as we know them today, emerged about 2 million years ago. Remaining natural salmon populations provide the best chance for long-term survival of salmon because they have had to evolve and respond to significant environmental changes over many thousands of years, and can be expected to do so in the future.

Salmon hatcheries can provide a number of benefits to society, but reliance on salmon hatcheries as a substitute for the conservation of wild populations is risky as a long-term conservation strategy. While wild salmon populations have existed for many thousands of years, most hatchery populations have only existed for several decades or less. We do not know if hatchery stocks have the same resilience as wild salmon populations. If hatchery stocks can't survive on their own in the wild, they will need a hatchery to sustain them forever. This can be problematic because:

> • mechanical and technical difficulties occur periodically in hatcheries, such as disruption of power or water supplies or disease outbreaks; and
>
> • hatcheries are expensive to operate, requiring a large and constant source of funds.

Why worry about salmon conservation? Why don't we just wait until ocean conditions change?

Ocean conditions (e.g., air and sea temperature, currents, and productivity) fluctuate from year to year, as well as during periodic events, such as El Nino and La Nina. Because salmon typically spend between 1-3 years in the ocean before returning to their natal streams to spawn, ocean conditions impact salmon survival and growth. It is true that even if we don't take any direct salmon conservation actions, we may temporarily see higher adult returns, as a result of more favorable ocean conditions. For example, adult salmon returns in many parts of the Pacific Northwest were higher in 2000 and 2001 than they had been for many years–a result that is primarily attributed to favorable ocean conditions. But waiting for improved ocean conditions is not a good conservation strategy for salmon because:

• No one is sure whether we are about to enter a more favorable period of ocean conditions for Pacific Northwest salmon or, if we are, how long it will last; and

• Even if salmon do experience a long period of better ocean conditions, if we don't address the underlying causes of salmon decline (habitat loss and degradation, hydropower, development, harvest, and hatchery propagation), any "recovery" the salmon experience will be temporary, and the next time ocean conditions decline we could see widespread extinction of salmon populations.

Why are hatcheries controversial?

Hatcheries are controversial because:

1) For more than a century they have been viewed as a substitute for addressing the root causes of salmon decline, like loss and degradation of habitat, blockage of migratory routes, and over-harvest.

2) While it is not hard to identify risks that hatcheries pose for wild populations, it is not so easy to predict whether damaging effects to natural populations will occur in any specific case, and if they do, how serious the effects will be.

3) Critics of hatcheries sometimes disagree among themselves and don't always present consistent proposals for change.

4) They have strong support from groups that rely on them to provide fish for commercial, recreational, and Tribal harvest, as well as jobs.

5) There has been little effort to develop a comprehensive cost-benefit analysis that outlines the value and costs of hatcheries.

Are there different types of hatcheries?

Each hatchery program is unique. The easiest way to differentiate hatcheries is to look at their goals and how they implement those goals. Hatcheries have one of three basic goals:

1. To Produce Fish for Harvest

2. To Recover Wild Populations

3. Fish for Harvest and Recover Wild Populations

What benefits can hatcheries provide to wild populations?

The primary goal of a hatchery is to ensure high survival of eggs, fry, and juveniles–life stages that typically experience high mortality in the wild. By collecting broodstock from the wild, a successful salmon hatchery can produce more returning adults than would have occurred in the wild.

Potential benefits to society include:

- Continued harvest
- Reducing the impacts of development or blockage of access to habitat
- Recovery of wild stocks

Potential benefits of hatcheries in wild stock recovery include:

- Minimizing short-term extinction risks for endangered populations
- Helping to maintain a population at a safe level until factors for decline can be addressed, such as habitat degradation and loss
- Speeding recovery by providing a demographic boost to an existing population
- Reintroducing salmon into vacant habitat

What risks do hatcheries pose to wild populations?

Scientists have known for decades that salmon spawned and reared in hatcheries tend to become different from their wild ancestors. Risks to wild populations from hatchery fish include the following:

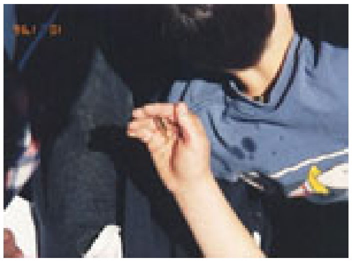
- Genetic
- Ecological
- Behavioral
- Overfishing
- Fish Health

Have hatcheries improved in recent years?

Considerable improvements have been made in fish culture and fisheries management. Some of these improvements include:
• more focus on local broodstocks
• better broodstock collection and mating protocols
• more natural rearing conditions
• more natural release strategies

These changes have helped to reduce the direct and indirect effects of hatchery programs on natural fish populations (and in some cases have also increased hatchery productivity). It is important to note, however, that these changes can not make the risks that hatcheries pose to natural populations disappear altogether.

Pictures



Materials

Posters of yearling fish
Posters of fish hatcheries

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Friday, December 12, 2003

Riparian Welcome
Fish Homes
Fish Neighbors
Hooks and Ladders
Just Passing Through
Macroinvertebrate Mayhem
Water is Like?
Grounded
It's Hydrological
Water Jeopardy
Soil: More Than Just Cheap Dirt
Bugs on the Bottom
Habitat Haven
Hatchery Tour
Insect Discovery
Kids in the Creek
Stream Sense
Salmon

Habitat Haven

Curriculum Objective

To teach students about the adequacy of physical characteristics of a stream for fish. To provide an opportunity for students to view a stream model and to examine the different habitat characteristics in the model, including cover and spawning habitat. To teach students what fish need to live and the abundance and/or levels of such requirements, including food, cover, oxygen, cool temperatures, and spawning habitat. To teach students how to recognize habitat characteristics that do and do not support suitable habitat.

Washington State
Essential Academic Learning Requirements (EALRs)

Science: 1.1 (basis of biological diversity BM 2&3)
Science: 1.2 (biological systems BM 2&3, structure and organization of living systems BM 2 &3)
Science: 1.3 (life processes and the flow of matter and energy BM 2&3, interdependence of life BM 1,2&3, environmental and resource issues BM 1&2)
Science: 2.1 (questioning BM 1&2, explanation BM 1&2, modeling BM 1&2, identifying problems BM 1&2)
Science: 3.1 (limitations of science and technology BM 1&2, dealing with inconsistencies BM 1&2, evaluating methods of investigation BM 1&2)

Links: fish of the Columbia River & their requirement | effects of silt on fish habitat

Course Description

This course presents to students, through the use of models, the various habitat characteristics required by fish. Five habitat requirements along with necessary quality levels will be presented, including water purity, water chemistry, food, cover and spawning.

Students will hypothesize the reasons for the presence or absence of certain fish species, sizes, life stages (ages) or

Prework

Students should understand how fish breathe, how and where they find and eat food, how and where they rest, find cover and lay their eggs. Students should discuss the types of things that can disrupt or remove these essential "life supports" from their home in a stream.

genders under varying habitats. They will be asked to describe where certain fish would live in a stream given these habitat and fish characteristics. These inter-relationships will be discussed by the entire group of students. The students will be asked to point out various habitat features in the model stream that constitute plusses or minuses for certain fish.

Students will discuss the environmental actions that reduce habitat quality and the steps that can be taken to prevent this reduction or restore habitat conditions.

Classroom Activity

Present a video about a day in a fish's life that reveals how a fish meets its requirements for food,air, cover and reproduction. After viewing the video, have the students list the various physical conditions and materials they saw that the fish depend upon to sustain life. Have them make two other lists of the ways these conditions could be changed to better or worsen the fish's chance for survival.

Background Information

Freshwater fish have five basic needs for survival: clean water, proper water chemistry, food, shelter, and spawning areas. A fish's entire body is in water and it uses the water for drinking and breathing.

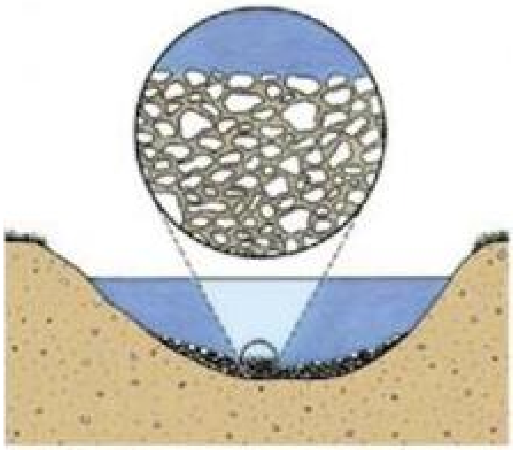
Some amounts of certain pollutants like motor oil can kill fish. Dirty water is also caused by silt, which is often the result of erosion. Silt can clog fish gills and make it difficult for fish to breathe. Silt smothers fish eggs incubating in gravel nests, and can smother stream bugs that juvenile fish need for food.

Fish "breathe" oxygen with their gills, and levels of dissolved oxygen in freshwater need to be sufficiently high.

Fish need food. Most fish eat plankton, insects, or other fish.

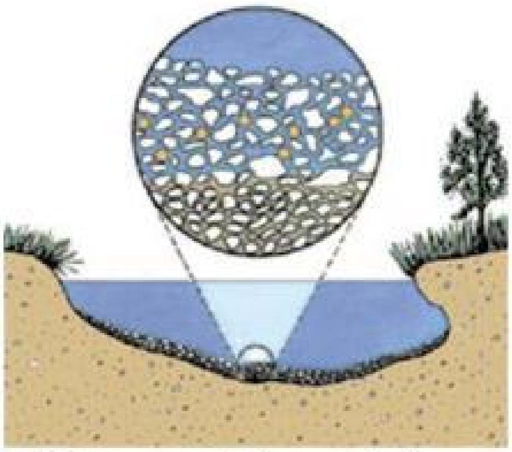
Fish also need shelter to hide from predators. This is particularly important for small fish, because they have more predators. Shelter can be provided by rocks, logs, or at the bottom of a deep pool.

Siltation



Silted gravel stream bottom.

Fish need a place to spawn. Most trout need gravel on which to spawn that is free of silt and well-oxygenated by flowing water.



Clean gravel stream bottom.

Pictures

Comming soon

Materials

Stream model, carved from plywood and painted Habitat features, including rocks, log dams, and streamside vegetation.
Small plastic fish for interest.

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Friday, December 12, 2003

Contact > Home > **It's Hydro-Electric!**

Riparian Welcome
Fish Homes
Fish Neighbors
Hooks and Ladders
Just Passing Through
Macroinvertebrate Mayhem
Water is Like?
Grounded
It's Hydrological
Water Jeopardy
Soil: More Than Just Cheap Dirt
Bugs on the Bottom
Habitat Haven
Hatchery Tour
Insect Discovery
Kids in the Creek
Stream Sense
Salmon

It's Hydrological!

Curriculum Objective

To teach students about hydroelectric power, the basics of how a hydroelectric dam operates. To teach students about the benefits of renewable energy and why it is important. To teach students, through the use of an interactive question and answer "race" game," about the water cycle, hydropower and renewable versus non-renewable energy sources.

Washington State
Essential Academic Learning Requirements (EALRs)

Science: 1.1 (nature and properties of earth materials BM 1,2&3)
Science: 1.2 (energy sources and kinds BM 1,2&3, energy transfer and transformation BM1,2&3)
Science: 1.3 (nature of forces BM 1,2&3, forces to explain motion BM 1,2&3, hydrosphere/atmosphere BM 1&2, environmental and resource issues BM 1,2&3)
Science: 2.1 (modeling BM 1&2, identifying problems BM 1&2, designing and testing solutions BM 1&2)
Science: 3.1 (limitations of science and technology BM 1&2)
Science: 3.2: (all peoples contribute to science and technology BM 1&2)
Mathematics: 3.1 (analyze information BM 1,2&3)
Mathematics: 5.2 (relate mathematical concepts and procedures to real-life situations BM 1,2)
Health & Fitness:1.2 (safely participates in a variety of developmentally appropriate physical activities BM 1&2)

Links: hydroelectric power generation | hydrological cycle | positive & negative impacts of hydroelectric dams | renewable and non-renewable energy sources | Columbia River hydropower | turbines and generators

Course Description

Part I (10-15 minutes)

This portion of the course illustrates how the hydrologic (water) cycle can provide renewable energy through a brief discussion of renewable versus non-renewable energy sources. Students receive handouts that describe how a hydroelectric dam operates. Students learn how a dam produces electricity by viewing a scale model of a complete hydroelectric system that includes a miniature hand-crank generator. The model shows how more energy must be produced when additional electrical appliances are being used (periods of peak power usage). Students learn that in order to meet this demand by society for more electricity they must turn the hand crank faster to produce a greater amount of electricity.

Part II RACE (15 minutes)

Students form six teams and compete in a "race" along a concrete pathway. A representative from each group is placed at a starting block along the pathway. The members of each representative's team are asked questions about hydropower. Questions range from easy (one point) to difficult (three points) and advance the associated number of spaces for each correct answer. Prizes are awarded to the two winning teams.

Prework

Students should have basic knowledge of the hydrologic or water cycle and understand the difference between renewable and non-renewable energy sources.

Students should list the positive and negative impacts of hydroelectric power generation, discuss them in class and brainstorm solutions to the problems. Students should write down some of the solutions and learn if some of their ideas are presently being implemented and the reasons why or why not.

Classroom Activity

Present a video about hydropower generation along the Columbia River wherein the hydrologic cycle and renewable versus non-renewable sources of electrical generation are discussed.

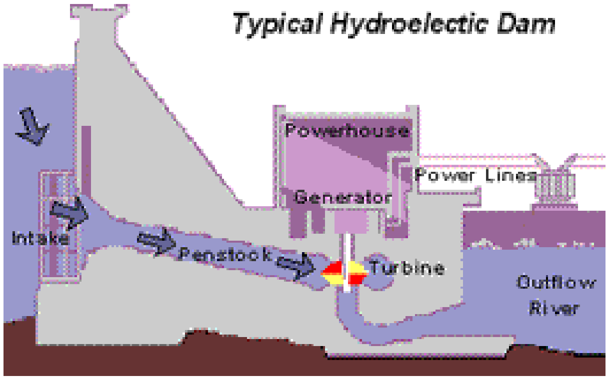
Students may also visit an actual dam. Dam tours are available for dams at Post Falls, Upper FAlls, Cabinet Gorge, Grand Coulee, Long Lake, Nine Mile, Noxon Rapids and Long Lake. The best time for tours of local dams is in the Spring (April or May) when spillgates are open and students can observe cascading water. To arrange for a tour, contact Washington Water Power at 1-800-727-9170 extension 8759.

Background Information

As a part of a continuous natural water cycle, the sun heats up water and draws (evaporates) water up from oceans, rivers, lakes and streams. The water, in the form of a gas, condenses into a liquid as it cools and rises, forming clouds. This water then returns to the earth in the form of precipitation (rain, snow, sleet, etc.,). Rain and runoff from melting snow fills rivers and streams. Hydroelectric plants use the force of this flowing water to generate power. After this water passes through the plants' turbines, it is returned to the river.

Hydropower is a clean energy resource. It doesn't pollute the river, contribute to acid rain, deplete the ozone layer, or increase global warming. Of all the renewable electrical energy sources -- including geothermal, biomass, wind and solar -- hydropower currently costs the least and is the most reliable and efficient.

Hydroelectric Power Generation



Pictures

Materials

Three-dimensional scale model of a hydroelectric system
Sidewalk "gameboard"
Miniature, hand-crank generator
Colored chalk
Crepe-paper wristbands in six different colors for distinguishing teams
Optional prizes for two winning teams

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Friday, December 12, 2003

Contact > Home > **Grounded**

Riparian Welcome
Fish Homes
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Water is Like?
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It's Hydrological
Water Jeopardy
Soil: More Than Just Cheap Dirt
Bugs on the Bottom
Habitat Haven
Hatchery Tour
Insect Discovery
Kids in the Creek
Stream Sense
Salmon

Grounded

Curriculum Objective

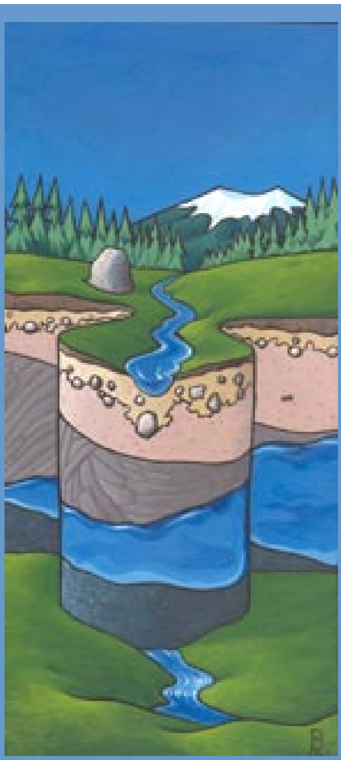
To teach students how to define and understand **groundwater.** To educate students how to conduct experiments to demonstrate groundwater movement.

Washington State
Essential Academic Learning Requirements (EALRs)

Science: 1.1 (motion of objects BM 1,2 &3, basis of biological diversity BM 1&2)
Science: 1.2 (biological systems BM 1, 2&3, energy transfer and transformation BM 1,2 &3, structure and organization of living systems BM 1 & 2)
Science: 1.3 (forces to explain motion BM 1&2, life processes and the flow of matter and energy BM 1&2, interdependence of life BM 1&2)
Science 2.1 (questioning BM1, communication BM1)
Communications: 1.1 (identify visual information such as rom a science experiment BM1)
Communications: 1.3 (construct hypotheses BM2)
Communications: 2.2 (organize information with clear sequencing of ideas and transitions BM2)
Communications: 3.2 (work cooperatively as a member of a group BM2)

Links:

groundwater basics | water education | Biology And Environment



Background

Water can exist in three different states. It can be solid, like ice; liquid, like water to drink; or invisible, as a gas called water vapor. In the water cycle, water is in all of these states. What is the water cycle (= hydrologic cycle)? The water cycle is the continuous water movement from the ocean to the air, to the land, and back to the ocean again.

When water in the ocean is heated by the sun, the smallest units of water (called molecules) lift up, or evaporate, into the air. Evaporation is when solid liquid or water becomes vapor, or gas.This invisible water vapor cools, attaches itself to bits of dust, sea salt, or smoke and becomes a droplet. This is called condensation. When these droplets travel in large groups in the sky, they are clouds. Eventually, droplets cling together, becoming so heavy that they fall to the earth as precipitation. Precipitation can also be snow, mist, sleet or hail. Some of that water will flow into rivers, streams, lakes, and oceans. This is called runoff. Some water will move downward through the soil. This is called infiltration or percolation. Water that infiltrates or percolates becomes groundwater. Groundwater is defined as water beneath the lands surface.

Classroom Activity

Have students cut out pictures of sand, gravel, or rock and paste them onto a piece of cardboard in percolation order. Color in the water that has been infiltrated through the layers above.

Prework

Some knowledge of the water cycle will be helpful for the students, as well as familiarity with the concept of groundwater.

Did you know?

The city of Colville uses groundwater for its city water source! How? Some groundwater is strored in an aquifer, wich is an underground layer of sand, gravel or rock that can store water. This stored water can be trapped by a well or spring.

Friday, December 12, 2003

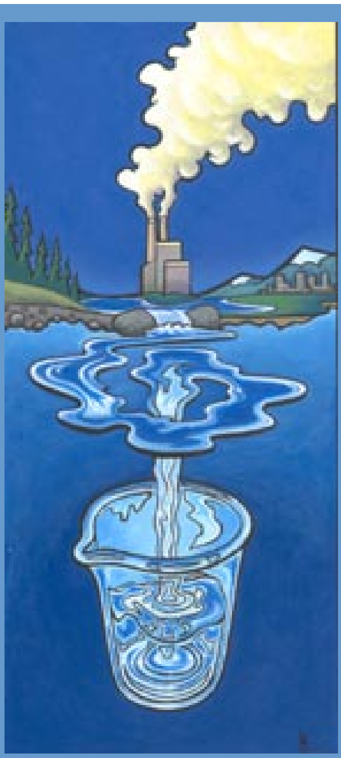
Water is Like?

Curriculum Objective

To teach students that water varies in its quality, and that its quality can be measured a number of ways. To teach students how to test characteristics of water using various pieces of equipment including a portable water analyzer and a Hach titration kit for water hardness. The students test for: dissolved oxygen (DO), fecal coliform, nitrates, pH, phosphates, temperature, and turbidity. To provide an opportunity for students to see what is "hidden" in clear, seemingly clean water as they observe water quality measurements and compare characteristics to the "ideal" for fish and for drinking.

Washington State
Essential Academic Learning Requirements (EALRs)

Science: 1.1 (properties of substances BM 1&2, nature and properties of earth materials BM BM 1&2))
Science: 1.2 (structure of matter BM 1, 2&3, physical/chemical changes BM 1&2)
Science: 1.3 (environmental and resource issues BM 1,2&3)
Science: 2.1 (questioning BM 1&2, designing and conducting investigations BM 1&2, modeling BM 1&2, communication BM 1&2)
Science 3.1 (evaluating methods of investigation BM 1,2 & 3)
Communication: 1.2 (listen and observe to gain and interpret information BM 1&2)
Communication: 3.2 (work cooperatively as a member of a group BM 1&2)
Social Studies: 2.1.1 (observe and describe the physical characteristics of a local area BM1)
Social Studies: 3.1.1a (identify and examine people's interaction with and impact on the environment BM 1,2 &3)
Mathematics: 1.1(understand and apply concepts and procedures from number sense BM 1,2 &3)
Mathematics: 1.2 (understand and apply concepts and procedures from measurement BM 1,2 &3)
Mathematics: 1.3 (understand and apply concepts and procedures from geometric sense BM 1&2)
Mathematics: 4.1 (gather information BM 1&2)



Links: [fecal coliform testing|testing water in creeks, ponds, lakes|acidity &alkalinity in Lakes]|

Course Description

Students first discuss whether there might be anything living in a sample of clear, clean drinking water. The instructor explains how scientists can make "the invisible visible" by adding certain chemicals to the water.

Students then use testing equipment according to manufacturers instructions to test the water for certain elements. Water quality testing involves the abiotic (nonliving) factors which affect water quality: dissolved oxygen, pH, temperature, nitrates, phosphates, turbidity

Students are divided into groups of 2-4 with a kit for each group. An older student or adult chaperone is assigned to assist each group. Students are given field notebooks, such as Rite in the Rain field books, to take and keep notes. Groups are spaced along the shoreline. Students monitor the testing and record results.

Temperature:

Each group measures the temperature of the water from the river using inexpensive Celsius/Fahrenheit thermometers with appropriate precautions on its safe handling (the most fragile part of the thermometer is the bulb at the end; thermometers using red alcohol are preferable over ones using mercury, especially for younger students). The students get 3 samples of water and record the temperatures of each sample on their recording sheets, making sure to record it appropriately with the degree sign and either F for Fahrenheit or C for Celsius. The students look carefully at their temperatures, calculate the average of the three samples. The students discuss the temperature of the water body and compare it to others in the local area (a chart of these temperatures is provided).

Prework

Share some information about water characteristics with the students before the festival. pH is important and difficult concept to grasp, but the following activity would familiarize the students with the idea of acidic substances:

Testing the pH of a substance determines whether it is an acid or base. An example of an acidic substance would be vinegar. An example of a basic substance would be lye. The pH can be expressed on a scale between 0 and 14. The lower the number, the more acidic the substance.

The concentration of hydrogen ions in a solution is called pH. It is how basic or acidic the water is. For elementary students it is enough for them to understand a more basic definition that can be enlarged upon later - pH can be described as "how much acid is or isn't in the water". It is the amount of hydrogen in the water, and hydrogen is a chemical that is found all over the earth.

The pH scale ranges from 1 (acid) to 14 (basic) with 7 as neutral. For students it can be very helpful to tell them the pH of some common household items (see handout "pH Scale".) The scale is logarithmic so a change on one pH unit means a tenfold change in concentration. Most organisms have a narrow pH range in which they can live. Some fish can tolerate a range of 5 to 9, while others cannot tolerate a change of even one pH unit.

Turbidity:

Turbidity is a measure of the cloudiness of water. Water cloudiness is caused by material, such as dirt and residue from leaves, that is suspended (floating) in the water. Turbidity may be composed of organic and/or inorganic constituents. Organic particulates may harbor high concentrations of bacteria, viruses, and protozoans.. Thus, turbid conditions may increase the possibility for waterborne disease.

Students measure turbidity by comparing a sample of stream water against a standard using the Jackson Turbidity Test. The fuzziness of a mark at the bottom of a clear tube filled with sample stream water is compared to the mark in a similar tube filled with distilled water; if there is a difference in clarity, a reagent is added and the number of drops needed for both marks to appear equally clear is counted. The number is the "Jackson Turbidity Unit" or JTU's.

pH:

Groups dip either litmus paper or pH paper into the water samples (use forceps for dipping). The students check to see if these samples indicate an acid or a base by comparing the color change against the chart to get the approximate pH value. The students can repeat the procedure three times, recording and averaging results

Interesting Note: Just as litmus or pH paper indicates acidity or how basic something is, nature has its own litmus paper, in the form of the hydrangea plant, which will have blue flowers if grown in acidic soil, or pink flowers if grown in a more basic, or alkaline, environment. Areas with a lot of rain tend to have more acidic soil, and therefore hydrangeas in these areas are usually blue. Gardeners can add chemicals to the soil to change the color of their hydrangeas.

Disolved Oxygen:

For this quantitative field test, students use a modification of the Winkler Method, the standard method for measuring dissolved oxygen, which involves a titration. A solution

When rain falls through the atmosphere the gases it contacts come into solution. Air pollution from automobile exhaust and fossil fuel burning also increases the concentrations of sulfur and nitrogen oxides in our air. These fall and cause "acid rain".

pH Science Experiment

In the classroom, have students measure different levels of pH of common household items using pH testing kit or litmus paper. You will compare items acidity levels.

Use the scale at http://ga.water.usgs.gov/edu/phdiagram.html to determine acidity of the products.

End result: Students will create a definition based on the observations they have made during this experiment. Students will also closely examine how acidity in products contributes to pH levels. Students will also create a venn diagram to display similarities and differences between products.

Materials:

*5 labeled cups (label to match each ingredient)

*pH testing kit (paper strip sample)- 5 strips for five samples

* 2 tablespoons of tap water

* 2 tablespoons of vinegar

* 2 tablespoons of milk

* 2 tablespoons of salt water

* 2 tablespoons of soda (carbonated beverage)

of known strength is added to a specific volume of treated sample water from the river. The volume of titrant required to change the color of the sample reflects the concentration of dissolved oxygen in the sample. The titrant is dispensed using a drop bottle; each drop dispenses the same known volume of titrant. The students test three water samples, record and average their results.

Phosphates:

The students must use safety goggles and gloves for protection against caustic agents in the phosphate and nitrate testing kits.

Phosphate occurs naturally in our rivers and wetlands. It is an essential nutrient for plant growth. Algae only require a small amount of phosphate to live. Increased levels of phosphate in creeks, rivers and wetlands can cause increased growth of algae and can lead to algal blooms. They can smell and be poisonous to humans and animals. Increased levels of soluble phosphate can come from human and animal faeces, washing powders, detergents, fertilizers, run off from agricultural and urban \residentialareas and sewage treatment plants.

Students rinse the test vessel with the water to be tested, fill the test vessel to the 5 ml mark with the water to be tested, add 5 drops of reagent 1 and swirl. The students then add 1 level microspoon (attached to the lid) of reagent 2 and dissolve by swirling,

After 2 minutes the students place the test vessel against the colour card provided and compare their results. The students record one test result

Nitrates:

The students use a professional Hach Water Quality Testing Kit to determine the nitrate level of their water samples.

Nitrate is a nutrient needed by all aquatic plants and animals to build proteins. The decomposition of dead plants and animals and the excretions of living animals release

Procedure:

Label each of the five cups with the ingredient names.

Measure two tablespoons of each ingredient and pour into matching labeled cup.

Place one litmus paper strip into each cup.

Record color and check at website for acidity level at http://ga.water.usgs.gov/edu/phdiagram.html

pH observations:

Item color acidity level

Water:__________________

Vinegar_________________

Milk____________________

Salt Water_______________

Soda___________________

Definition of pH:

Draw a Venn Diagram:

nitrate into the aquatic system. Excess nutrient like nitrate increase plant growth and decay, promote bacterial decomposition and therefore decrease the amount of oxygen in the water. Sewage is the main source of excess nitrate added to natural waters, while fertilizer and agricultural runoff also contribute to high levels of nitrate. Drinking the water containing high nitrate levels can affect the ability of our blood to carry oxygen. This is especially true for infants who drink formula made with water containing high levels of nitrate.

Students fill theirs test tube to the 5 ml with the water sample and add one (1) nitrate wide range CTA test tab. They cap and mix by inverting until tab is dissolved and wait five minutes for the red color to develop. Students compare the color of the sample to the Nitrate color chart and record the result as ppm nitrate.

Fecal Coliform Biological Testing:

Fecal coliform bacteria are naturally present in the human digestive tract but are rare or absent in unpolluted waters. Coliform bacteria should not be found in well water or other sources of drinking water. Their presence in water serves as a reliable indication of sewage or fecal contamination. Although coliform bacteria themselves are not pathogenic, they occur with intestinal pathogens that are dangerous to human health. This presence/absence total coliform test detects all coliform bacteria strains and may indicate fecal contamination.

The coliform test in this experiment takes 30-36 hours to conduct, so it will not be conducted by the students during the activity. A sample will have been taken by the instructor prior to the activity. Students will be asked to examine the culture, compare the appearance of the tube to the picture on the coliform color chart and record the results as negative or positive.

Reactions:

Negative: Liquid above gel is clear
Gel remains at bottom of tube

Classroom Activity

Upon returning to the classroom, students should reanalyze their data, looking for patterns. They should look at each test result and determine whether it was a "good" or "bad" result, or inconclusive. If more than one of your classes went out, compare and contrast the results from each class. Ask the students whether or not they believe just one experience out in the field provides reliable testing results. Scientific investigations and experiments must be repeated to be reliable. Students now have the ingredients to create stories, poetry, research papers, etc.

If the overall data you have indicates a problem with water quality, what can you do? It's time to take action! In order to make a difference for the environment, students and teachers can take action together. Discuss the type of action you might take as a class or a school. Make sure the students look at all sides of the issues, talk to the land management agencies responsible for the water quality, determine the appropriate objectives for action and act responsibly. Here are some ideas that the students can use to increase public awareness of water quality problems and

Indicator remains red or turns yellow with no gas bubbles.
Indicates less than 200 total coliform colonies per 100 mL of water

Positive: Many gas bubbles present
Gel rises to surface
Liquid below gel is cloudy
Indicator turns yellow
Indicates more than 200 total coliform colonies per 100 mL of water

The use of these water quality testing technologies allows students to not only gather very accurate data while in the field, but to take notes while on site, draw pictures of their study site, and keep track of important results and information.

After the testing, students are asked whether the water sample is good for fish…and whether it is good for drinking. Each student determines whether the water quality is good, poor, or average, and support the conclusion.

solutions:

- write a letter to a legislator
- build a web site
- prepare a video show
- write a news release and interview with media
- build a display
- design and layout a brochure
- present findings to a city council or county commissioners

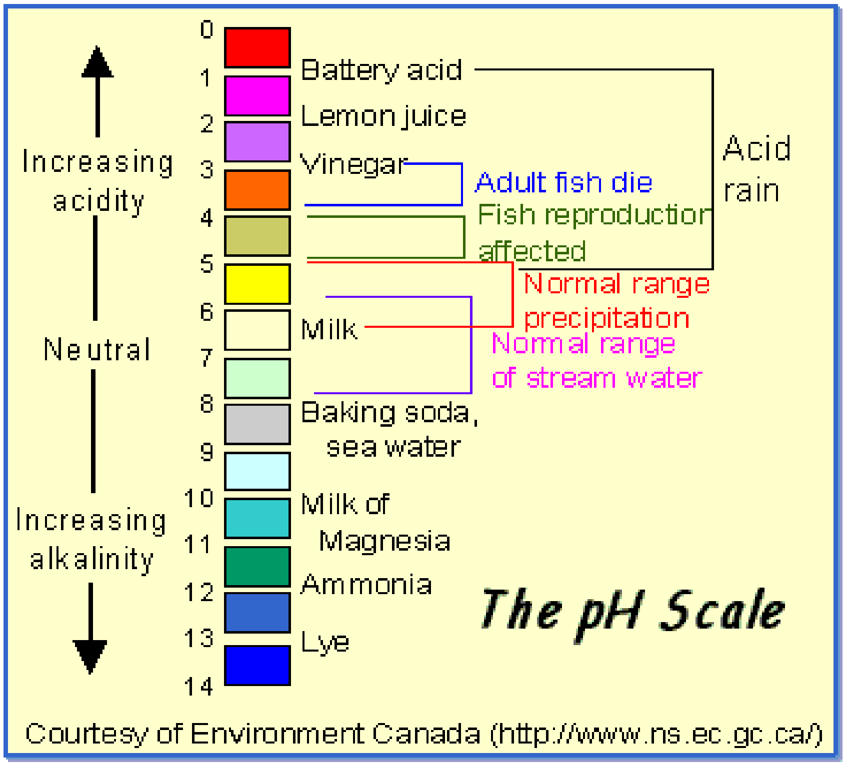
.

Background Information

We would probably not drink the water in which we swim and fish ... even though it looks clean and clear. We know that it may contain bacteria or chemicals that are harmful. Some water that we drink has bacteria and chemicals, too, but they may be present in quantities that are considered safe for drinking. When experts evaluate the quality of drinking water, they look at a number of different characteristics. These include:

- Coliform bacteria- bacteria are one-celled organisms, and coliform bacteria are unsafe in large quantities;
- Phosphate - high amounts show the presence of fertilizers;
- Hardness - high hardness shows the presence of calcium and magnesium, which is not unsafe but which may make it hard to soap in the shower;
- pH (potential of hydrogen) - this shows how acidic the water is;
- DO (dissolved oxygen) - the more oxygen, the better, especially for fish; salinity - high salinity show high amounts of salt;
- Conductivity - high conductivity shows the presence of minerals.

pH Scale



Pictures

Materials

Hach titration kit for testing hardness, nitrates
Jackson Turbidity Kit
Litmus Paper
Portable water analyzer for testing other water characteristics.
Inexpensive Fahrenheit and Celsius thermometers

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Friday, December 12, 2003

Riparian Welcome

Curriculum Objective

To teach students about riparian zones and how they affect conditions within a stream. To provide opportunities for students to observe a riparian area and learn the definition and function of the riparian zone. To teach students about runoff in a watershed by comparing runoff rates on vegetated and non-vegetated slopes and role-playing the movement of water through a watershed.

Washington State
Essential Academic Learning Requirements (EALRs)

Science: 1.1 (motion of objects BM 2&3, nature and properties of earth materials BM 1, 2 &3)
Science: 1.2 (energy transfer and transformation BM 1,2 &3, components and patterns of the earth system BM 1,2 &3, structure and organization of living systems BM 1,2&3)
Science: 1.3 (nature of forces BM 1,2 & 3, forces to explain motion BM 1,2 &3, processes and interactions in the earth system BM 1,2 & 3, environmental and resource issues BM 1, 2&3)
Science: 2.1 (questioning BM 1&2, explanation BM 1&2, modeling BM 1&2, identifying problems BM 1&2)
Science: 2.2 (identifying problems BM 1, 2 &3, evaluating potential solutions BM 1,2 &3)
Health and Fitness: 1.1 (develop fundamental and complex movement skills, as developmentally appropriate BM 1&2)

Links: functions of a riparian area | detritus and woody debris in creeks | stream erosion | role of streamside vegetation | water movement through a watershed | water quality and riparian areas |

Course Description

This course provides an opportunity for students to evaluate the stability of three portions of a riparian zone along Sherman Creek. The course also provides a role-playing opportunity for students to model the movement of water through a watershed.

Part One:
The students will then walk the shoreline of Sherman Creek, looking for shaded and non-shaded areas, eroding or undercut banks, detritus, and large woody debris in the stream. Students will discuss the effects on fish by these various components of fish habitat. They will select a vegetated and non-vegetated area within the riparian zone and predict which area water will run through the fastest and which one appears to be the most stable.

Part Two:
The students will be divided into two groups. One group will become water and the other plants.

The water group will be asked to run across an open area and the time it took will be recorded.

Next, students from the plant group will be distributed around the open area. The water group will again run through the area, this time moving around or between the plants without touching. The time it took will be recorded again and compared to the preivious time.

The students will discuss why it takes longer for water to travel through vegetated areas than it does through non-vegetated areas and how this speed can affect a stream.

Prework

Students should understand that the area surrounding a creek, lake, pond or river is called a riparian area. Discuss the types of plants and trees that can be found in these wet areas. View a video about how riparian areas function.

Classroom Activity

Introduce the importance of riparian areas, what a riparian area is, the importance and benefits of a healthy riparian area, and ways to restore riparian areas so that they help clean-up our surface and groundwater resources.

- Break the class into small groups of 3-4 students. Ask each group to think of ways that humans can harm riparian areas. Have them write down the ways on a blackboard or large poster paper. Call on 2-4 groups. Have the groups explain their ideas. Note: They should have ideas such as tree harvests, agricultural fields, dust and oil/gas spills from roads, or salt from roads in winter.
- Select two other groups to share their lists and have the class agree upon a jointly established listing of sources of cultural, horticultural and agricultural affects upon surface and ground water.
- Brainstorm ways that riparian areas can be restored or improved. Select one of the ways and elaborate on some of the details involved with restoration work.

Background Information

The riparian zone consists of the shoreline area near a stream, and can directly impact conditions within the stream. Plants and shrubs offer shade which can help to maintain cooler temperatures within the stream. Cool water contains more available oxygen for fish. In addition, shoreline vegetation promotes bank stability, leading to reduced erosion and improved water quality. Items falling into a stream from the riparian zone can also benefit things living within the stream. Many aquatic insects live in and feed on detritus made up primarily of leaves and twigs from the riparian zone. Trees and other larva items falling into streams can provide important habitat for fish.

Stream sediments

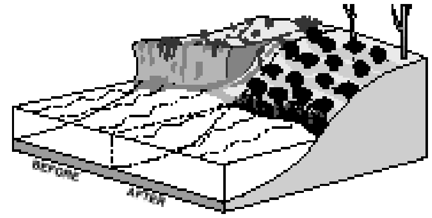
1. Solution load - dissolved rock carried in the flow; generally, this is higher where much of the flow is derived from groundwater pathways, which allow water to stay in contact with rock for long periods. It is also higher where local bedrock is prone to chemical weathering - e.g. the limestones in the southern portion of Denton Creek drainage basin (this sediment is in effect "invisible").

2. Suspended load - finer sediment (usually clay and silt) suspended by turbulence in the flow (does not contact bed).

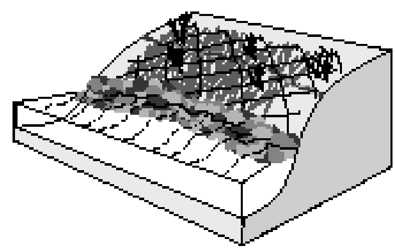
3. Bed load - coarser sediment (sand + gravel) that slides, rolls or skips along the stream bed - amount depends on the tractive force exerted by the flow + resisting force of bed material.

Riparian Restoration Methods

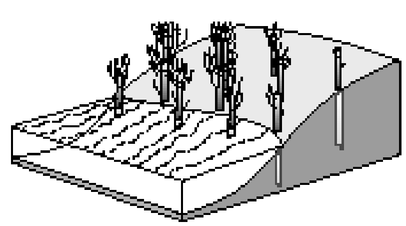
Bank Shaping and Planting
Regrading streambanks to a stable slope, placing topsoil and other materaisl needed for sustaining plant growth, and selecting, installing and establishing appropriate species.

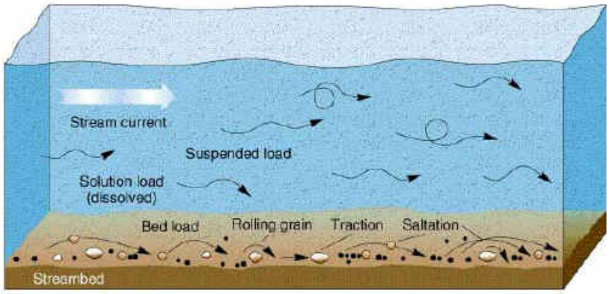


Brush Mattress
Combination of live stakes, live facines,and branch cuttings installed to cover and physically protect streambanks, eventually to sprout and establish numberous individual plants.

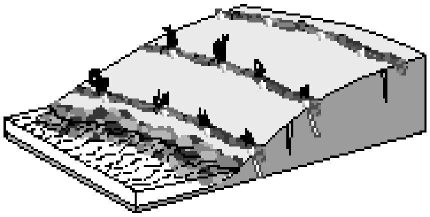


Dormant Post Plantings
Planting of cottonwood, willow, poplar, or other species embedded vertically into streambanks to increase channel roughness, reduce flow velocities near the slope face, and trap sediment





Live Facines
Dorman branch cuttings bound together into long sausage-like, cylindrical bundles and placed in shallow trenches on slopes to reduce erosion and shallow sliding.



Pictures

Materials

Riparian Zone

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Friday, December 12, 2003

Lake Roosevelt 2003 Water Festival

September 23rd and 24th 9:00a.m.-2:00p.m. at the Lake Roosevelt Day Use Area

Macroinvertebrate Mayhem

The Watercourse and Council for Environmental Education (CEE)

Curriculum Objective

To teach students how tolerance to water quality conditions varies among macroinvertebrate organisms. To teach students how population diversity provides insight into the health of an ecosystem. Students play a game of tag to simulate the effects of environmental stressors on macroinvertebrate populations. This simulation exercise helps students to understand how environmental stressors affect macroinvertebrate populations and helps the students relate the concept of biodiversity to the health of aquatic ecosystems.

Washington State
Essential Academic Learning Requirements (EALRs)

Science: 1.1 (basis of biological diversity BM 1,2 & 3)
Science: 1.2 (structure and organization of living systems BM 1,2&3)
Science: 1.3 (life processes and the flow of matter and energy BM 1& 2, biological evolution BM 1,2&3, interdependence of life BM 1,2 & 3, environmental and resource issues BM 1,2 & 3)
Science: 2.1 (questioning BM 1,2&3, explanation BM 1,2&3, communication BM 1&2)
Science: 3.1 (evaluating methods of investigation BM 1&2)
Science: 3.2: (careers and occupations using science, mathematics and technology BM 1&2)
Mathematics: 3.1 (analyze information BM 1,2&3)
Mathematics: 5.2 (relate mathematical concepts and procedures to real-life situations BM 1,2)
Health & Fitness:1.2 (safely participates in a variety of developmentally appropriate physical activities BM 1&2)

Links: macroinvertebrates | pollution | water quality testing | pollution tolerance in macroinvertebrates | adaptations to pollution | biomonitoring|

Course Description (50 minutes)

Students play a game that simulates changes in a stream when an environmental stressor, such as a pollutant, is introduced. They are shown a playing field and its boundaries.

A student volunteer is selected to become an "environmental stressor (e.g., sedimentation, sewage, or fertilizer). The group discusses ways that a stream can become polluted and how this can alter stream conditions (large groups will require more students to become stressors).

The class is divided into seven groups to play the game. Each group represents one type of macroinvertebrate species listed in Macroinvertebrate Groups. The number of members in each group is recorded, using a table as follows:

Organism	Tolerance	Numbers (at start/after each round)			
		Start	Round One	Round Two	Round Three
Caddisfly larva	Intolerant	5	2	2	2
Mayfly nymph	Intolerant	5	4	1	0
Stonefly nymph	Intolerant	4	4	4	2
Dragonfly nymph	Facultative	5	5	4	4
Damselfly nymph	Facultative	4	4	4	3
Midge larva	Tolerant	4	6	7	9
Rat-tailed maggot	Tolerant	4	6	9	11
TOTAL		31	31	31	31

Note: Have at least four students in each group; for smaller classes, reduce the number of groups. For example, eliminate the stonefly nymphs and the damselfly nymph groups.

Group members receive appropriate

Prework

Students should be familiar with the words "macroinvertebrate" and "biodiversity." They should understand that people are able to assess the water quality of a stream by its appearance and smell. Sometimes, however, a polluted stream looks and smells clean. They should understand that there are different ways to test water quality which include macroinvertebrate stream studies.

Classroom Activity

Students are introduced to the practice of sampling macroinvertebrate populations to monitor stream quality. They are shown pictures or samples of macroinvertebrates used to monitor stream quality.

Divide the class into seven groups and assign each group one macroinvertebrate (from Macroinvertebrate Groups). Ask group members to conduct library research to prepare a report for the class about their organism. The report should include the conditions (e.g., clean water, abundant oxygen supplies, cool water) the organism must have to survive.

Ask students to present their reports to the class and compare each organism's tolerance of different stream conditions.

Macroinvertebrate Groups

identification labels. The picture of each group's macroinvertebrate should face outward when labels are attached.

Students are informed that some macroinvertebrates have hindrances to crossing the field (see the following Intolerant Macroinvertebrates and Hindrances):

Intolerant Macroinvertebrates and Hindrances		
Organism	**Hindrance**	**Rational For Hindrance**
Caddisfly	Must place both feet in a bag* and hop across field, stopping to gasp for breath every five hops.	Caddisflies are intolerant of low oxygen levels.
Stonefly	Must do a push-up every ten steps.	When oxygen levels drop, stoneflies undulate their abdomens to increase the flow of water over their bodies.
Mayfly	Must flap arms and spin in circles when crossing field.	Mayflies often increase oxygen absorption by moving gills.
*Caddisfly larvae build cases and attach themselves to rocks for protection and stabilization.		

These obstacles symbolize sensitive organisms' intolerance to pollutants. Students then practice their motions.

Macroinvertebrate groups are assembled at one end of the playing field and the environmental stressor(s) at midfield. When a round starts, macroinvertebrates move toward the opposite end of the field and the stressor will try to tag them. To "survive," the macroinvertebrates must reach the opposite end of the field without being tagged by the environmental stressor. The environmental stressor can try to tag any of the macroinvertebrates, but will find it easier to catch those with hindered movements.

Begin the first round of the game. Tagged macroinvertebrates must go to the sideline and flip their identification labels to display the more tolerant species (i.e., rat-tailed maggot or midge larva). Tagged players who are already

Caddisfly larva
Mayfly nymph
Stonefly nymph
Dragonfly nymph
Damselfly nymph
Midge larva
Rat-tailed maggot

Play the Animal Game to identify these Macroinvertebrates!

Extensions

Visit a nearby stream to determine what types of macroinvertebrates live there. Have the students identify and describe the diversity of organisms. Ask the students if their findings provide insight into the quality of the stream and what other observations they may need to make to determine stream quality. They may want to report their findings to local watershed managers or water quality inspectors.

Have students analyze the stream based on a visual assessment. Have them describe macroinvertebrate organisms and identify what stream conditions they need to survive. Explain how some organisms indicate stream quality. Interpret stream quality based upon the diversity and types of organisms found there.

Upon completing the activity, for further assessment, have students develop a matching game in which pictures of streams in varying conditions are matched with organisms that might live there.

in a tolerant species group do not flip their labels.

The round ends when all of the macroinvertebrates have either been tagged or have reached the opposite end of the playing field. The new number of members in each species is then recorded.

Students complete two more rounds, with all tagged players rejoining the macroinvertebrates who successfully survived the previous round. The numbers of members in each species of macroinvertebrates at the conclusion of each round is recorded. Because some players will have flipped their identification labels, there will be a larger number of tolerant species in each successive round.

The game is completed after three rounds. Discuss the outcome with students. Emphasize the changes in the distribution of organisms among groups. Have students compare population sizes of groups at the beginning and end of the game and provide reasons for the changes. Review why some organisms are more tolerant of poor environmental conditions than others. Have students compare the stream environment at the beginning of the game to the environment at the end.

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Orient students to stream ecology prior to this activity. The Extension of "Stream Sense" provides a variety of streamside investigations. Students can learn how nonpoint source pollutants accumulate in a stream in "Sum of the Parts." Treating polluted water is addressed in "Sparkling Water" and "Reaching your Limits."

Supplement the students' macroinvertebrate survey of a stream with chemical tests and analyses.

Have students design their own caddisfly case.

Have students study aspects of biodiversity by adding another round to the game. For example, add a fourth round in which all organisms are caddisflies. This round will demonstrate how a few intolerant species or a single species can be quickly eliminated.

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Macroinvertebrate Tolerance to Pollution

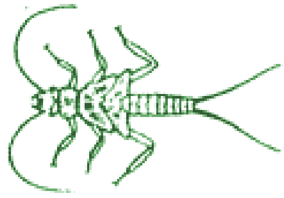
Artwork: Gould League of WA and Waterwatch SA

Sensitive Macroinvertebrates

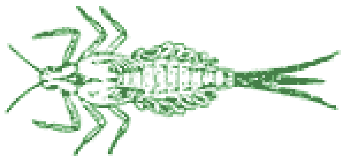
STONEFLY LARVAE
Stonefly larvae have two long tails, tubes of thread-like gills on their undersides, wing pads, antennae, and two claws on each foot. They are found among stones or plants in clear, cool, well oxygenated streams.

Background Information

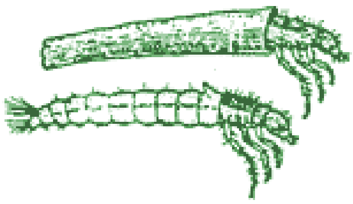
Macroinvertebrates (organisms that lack an internal skeleton and are large enough to be seen with the naked eye) are an integral part of wetland and stream ecosystems. Examples of macroinvertebrates include mayflies, stoneflies, dragonflies, rat-tailed maggots (maggot is the term used for the larva of some flies), scuds, snails, and leeches. These organisms may spend all or part of their lives in water; usually their immature



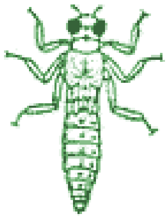
MAYFLY LARVAE
Mayfly larvae have three long filaments at the end of their abdomen, with wing pads and lateral gills along the abdomen. They have short antennae, and a single claw on each foot. They are found under stones in fast flowing water or among plants in slow flowing water.



CADDISFLY LARVAE
These are worm-like insect larvae with three pairs of legs on the first three body segments. They are usually found in cases made from rolled leaves or hollow twigs, with only their head and legs protruding when they move.



DRAGONFLY LARVAE
Dragonfly larvae are short, chunky predators with wing pads and internal gills. They are found on plants, among stones and leaf litter, or on the bottom.



phases (larvae and nymphs) are spent entirely in water. Larvae do not show wing buds and are usually very different in appearance from the adult versions of the insects. Nymphs generally resemble adults, but have no developed wings and are usually smaller.

A variety of environmental stressors can impact macroinvertebrate populations. Urban and/or agricultural runoff can produce conditions that some macroinvertebrates cannot tolerate. Sewage and fertilizers added to streams induce the growth of algae and bacteria that consume oxygen and make it unavailable for macroinvertebrates. Changes in land use from natural vegetation to a construction site or to poorly protected cropland may add sediment to the water. Sedimentation destroys habitats by smothering the rocky areas of the stream where macroinvertebrates live. The removal of trees along the banks of a river and alternation of stream velocity can both alter normal water temperature patterns in the stream. Some organisms depend on certain temperature patterns to regulate changes in their life cycles. Other stressors include the introduction of alien species and stream channelization.

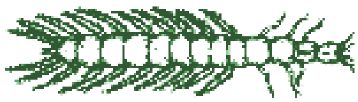
Some macroinvertebrates, such as the mayfly and stonefly nymphs and caddisfly larvae, are sensitive (intolerant) to changes in stream conditions brought about by pollutants. Some of these organisms will leave to find more favorable habitats, but others will be killed or will be unable to reproduce.

Macroinvertebrates (e.g. , rat-

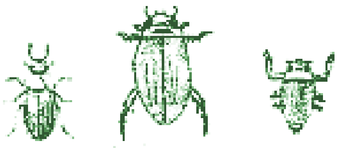
DAMSELFLY LARVAE
Damselfly larvae are more slender than dragonflies, have a distinct head section, and three gills on the tail tip. They are also found on plants, among stones and leaf litter, or on the bottom.

Tolerant Macroinvertebrates

BEETLE LARVAE
Beetle larvae may be confused with other animals. They are segmented, have three distinct pairs of legs, are never found in cases, but have a wide variety of forms. They are very active, aggressive predators with large mouth parts, and are found in all habitats.



BEETLES (COLEOPTERA)
Beetles have hard front wings folded side by side along the center of the back. From above, they have a more oval shape than bugs. Beetles have biting mouth parts They are found on plants, or swimming in or on the water at all levels.



BUGS (HEMIPTERA)
Bugs tend to be shield shaped when viewed from above. Their soft front wings are folded and overlap to leave a small triangle on the back, and they have sucking mouth parts They are found among the aquatic

tailed maggots and midge larvae) that may thrive in polluted conditions are called tolerant organisms. Other organisms, called facultative organisms (e.g., dragonfly and damselfly nymphs) prefer good stream quality but can survive polluted conditions.

Water quality researchers often sample macroinvertebrate populations to monitor changes in stream conditions over time and to assess the cumulative effects of environmental stressors. Environmental degradation will likely decrease the diversity of a community by eliminating intolerant organisms and increasing the number of tolerant organisms. If the environmental stress is severe enough, species of intolerant macroinvertebrates may disappear altogether. For example, if a sample of macroinvertebrates in a stream consists of rat-tailed maggots, snails, and dragonfly nymphs, the water-quality conditions of that stream are probably poor (i. e., low oxygen level, increased sediment, contaminants). If, on the other hand, the sample contains a diversity of organisms, the stream conditions are likely good. However, baseline data is essential because some healthy streams may contain only a few macroinvertebrate species. A variety of good sources, adequate oxygen levels, and temperatures conducive to growth all characterize a healthy stream.

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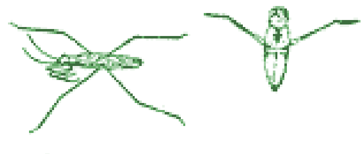
plants on the water's surface, or swimming freely at all levels of slowly flowing water. Water boatmen and backstriders are bugs.



Very Tolerant Macroinvertebrates

FLY LARVAE
There are many types of fly larvae. They are worm-like creatures with no legs, or stumpy unjointed legs, and may have a sucker on the abdomen and a brush on the head. They occur in all sorts of aquatic habitats; swimming, on rocks, or on the bottom.

MIDGE LARVAE
Midge larvae are slender worm-like creatures, sometimes red, with no legs, or stumpy unjointed legs, and bristles. They are found in all sorts of aquatic habitats; swimming, on rocks, or on the bottom.

Pictures

Materials

Samples of macroinvertebrates.
Field guides and other information resources.
Identification labels for macroinvertebrate groups, one per student [divide the number of students by 7 and make that number of copies of each macroinvertebrate picture. One side of each label should have a picture of one of the seven macroinvertebrates. The other

side of each label (except those for midge larvae and rat-tailed maggots) should have a picture of either the midge larva or rat-tailed maggot. For durability, the cards may be laminated. Use clothespins or paper clips to attach labels to students' clothing).
Pillowcases or burlap bags
Chart paper or a chalkboard

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Friday, December 12, 2003

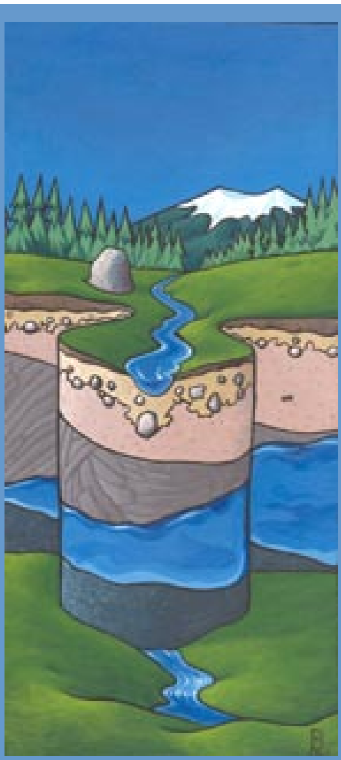
Just Passing Through?

Curriculum Objective

To teach students about how water moves through a watershed and how this movement is affected by natural and human conditions. To teach students how trees, plants and other landscape features help to modify the speed of movement and routes taken by water as it travels through a watershed. To teach students, through physical interaction with each other and role-playing, about the obstacles that divert water from flowing directly into rivers including absorption by the litter layer (humus), pooling, evaporation, plant uptake and percolation through the soil horizons into ground water reserves.

Washington State
Essential Academic Learning Requirements (EALRs)

Science: 1.1 (nature and properties of earth materials BM 1&2)
Science: 1.2 (energy sources and kinds BM 1,2&3, energy transfer and transformation BM1,2&3, physical/chemical changes BM 1&2))
Science: 1.3 (nature of forces BM 1,2&3, forces to explain motion BM 1,2&3, processes and interactions in the earth system BM 1&2), hydrosphere/atmosphere BM 1&2, environmental and resource issues BM 1,2&3)
Science: 2.1 (questioning BM 1&2, modeling BM 1,2&3, communication BM 1)
Science: 2.2 (identifying problems BM 1&2, design and test solutions BM 1&2)
Arts: 3.2 (uses the arts to communicate for a specific purpose BM 1&2)
Mathematics: 3.1 (analyze information BM 1,2&3)
Mathematics: 5.2 (relate mathematical concepts and procedures to real-life situations BM 1,2)
Health & Fitness: 1.1 (develop fundamental and complex movement skills as developmentally appropriate BM 1, 2 & 3)
Health & Fitness:1.2 (safely participates in a variety of developmentally appropriate physical activities BM 1&2)
Health & Fitness: 3.1 (understand how environmental factors affect one's health (air, water, noise, chemicals) BM 1,2&3)
Social Studies: 1.2 (recognize spatial patterns on Earth's surface and understand the processes that create these patterns BM 1,2 & 3)
Social Studies: 2.1/2 (observe and describe the natural characteristics of places and regions and explain the causes of their characteristics; describe the patterns humans make on places and regions BM 1,2 & 3)



Social Studies: 3.1 (identify and examine people's interaction with and impact on the environment BM 1)

Links: water quality game | watershed | water cycle | watershed pollution | how forests and plants absorb water | watershed restoration projects | ground water vs surface water

Course Description

Part I (5 minutes)

During this portion of the course, students will sit in a semicircle around the instructor who will show posters of the water cycle and of different watersheds. The watersheds will consist of hills, rivers and lakes with varying types of forests, plants and human developments such as houses, towns and fields. For purposes of contrast, a barren watershed will be shown to illustrate the significant difference in speed traveled by water when it is not slowed down by these "obstacles" and the impacts of erosion. Students will interact with the instructor to theorize how water travels through each watershed and how its movement will be affected or changed by humans.

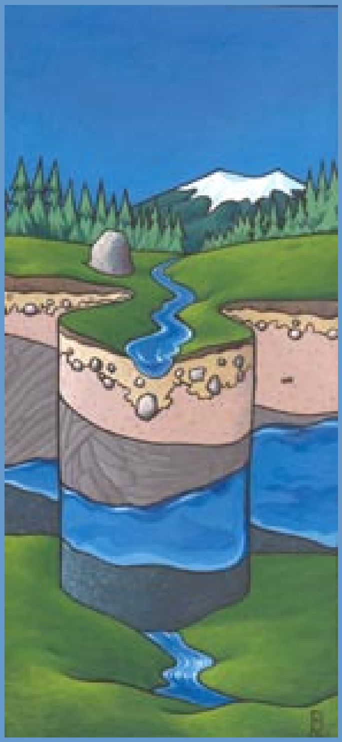
Part II Slope with Plant Cover Simulation (10 minutes)

See diagram: For this exercise, a sloping lawn will be prepared to resemble a watershed. A rope will be arranged on the lawn to represent a river (wavy) and lake. Leaves, sticks and colored styrofoam balls will be scattered near the rope. The leaves represent natural elements that can be carried by runoff and the balls represent human pollutants.

Students will be divided into two groups: Group A as raindrops and group B as trees and plants in the watershed. Students will be asked to act out the role of water as it flows through the watershed. Group B will spread out over

Prework

Students should have basic knowledge of the water cycle, erosion and pollution. Students should be led in a discussion about watersheds and how water drains through them. The discussion should highlight different types of watersheds from small areas such as the creek or lake near their homes to large watersheds that drain into large rivers and waterbodies such as Lake Roosevelt. The students should discuss the plants and animals that live in their "own" watersheds and why it is important to protect the quality of water there. They should discuss how trees and plants can protect a watershed. Finally, students should think about ways they can plant trees and vegetation to help protect their own watersheds.



the slope above and near the river with arms (branches) and legs (roots) outstretched. Group A will assemble at the top of the slope and when ready, begin a rainstorm by walking fast down the slope toward the river and lake, picking up as many leaves and balls as they can along the way. Group B, while remaining pivoted to the ground with one foot, must then try to slow down the raindrops by tagging them. If tagged, a raindrop must then drop all of its collected leaves and balls (simulating filtering properties of vegetation and soils) and walk around the tree or plant five times and crawl the rest of the way to the lake (simulating use of water by plants or water percolating into the groundwater). Raindrops that escape untagged continue down the river and through the rapids, where they can somersault and spin around, into the lake.

The time taken for all the raindrops to pass through the watershed is recorded. The entire group will then discuss how many raindrops made it all the way to the lake without being tagged, how many became groundwater and where the leaves and balls were dropped. Students will speculate whether or not the rain would speed up or slow down if there were more trees and plants. They will also speculate about the position of leaves and balls with more vegetation.

Part III Barren Slope Simulation (10 minutes)

This time, Group B will represent raindrops and Group A will represent rocks on the slope. The "rocks" are spread out over the slope, rolled up into balls or lying flat on the ground. When the rainstorm begins, the raindrops walk quickly through the watershed, picking up leaves and colored balls. When they come to a rock, they can walk around or jump over the rocks. The rocks cannot slow them down. When they come to the rapids, the raindrops can spin and somersault, and then continue walking into the lake.

Classroom Activity

Play the Watershed Game!

Students learn about and discuss the water cycle and are then provided with a diagram of a typical watershed that includes water in various forms throughout the diagram. The students are then directed to draw arrows to indicate how this water moves through the environment (a diagram showing correct water movement arrows is available for teachers reference). They may also draw plants, animals and people into their diagram. After drawing their watersheds, they may discuss how the land and everything living it constitutes a watershed and why it is important to protect their watersheds from erosion and pollution.

Present a video about protecting watersheds and how students can help.

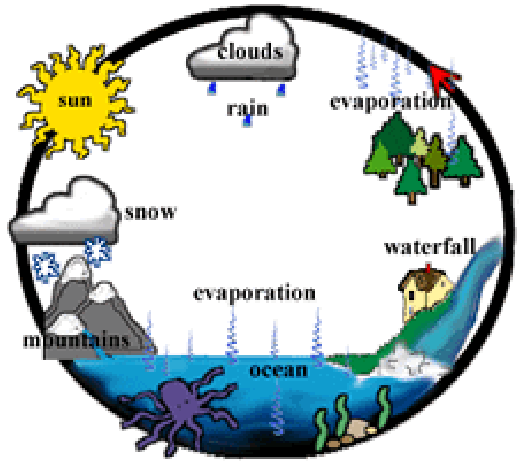
Students may plan and execute a watershed protection project for their school. For help with the project, call your local county Soil Conservation Service, extension officer, the U.S. Forest Service or Bradford Frye, education specialist for Lake Roosevelt National Recreation Area at 509-633-9192.

The time taken for raindrops to make it into the lake is recorded. This time is contrasted with the previous watershed filled with vegetation. A contrast between the movement of water through the barren watershed and the vegetated watershed is discussed. Students will discuss erosion, where it originates, how it is dispersed and how plants and trees keep it from reaching the lake. They will also discuss what happens to the lake as rain washes soil, debris and pollutants into the water.

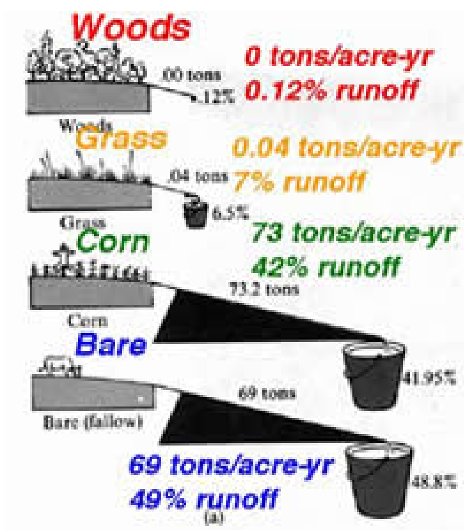
Part IV Healthy Watershed Discussion (5 minutes)

Students will again review the water cycle and watersheds on the posters and discuss why it is important to keep watersheds healthy. The discussion will include changes humans can make in a watershed and ways to make these changes less harmful. The discussion will then turn to ways the students themselves can help keep their own watersheds healthy.

Water Cycle



Examples of Erosion Runoff



Background Information

Watersheds: Importance and Functions

A watershed is the area drained by a distinct stream or river system to ridgetop boundaries. Uplands often comprise more than 99% of the watersheds area, with the floodplain and stream channel making up the rest.

Watersheds catch and store precipitation, releasing the stored water to the stream channel. These functions are influenced by climate, elevation, the type of soil and vegetation, steepness of the slopes and their orientation to the sun, and size of the watershed.

Although climate determines the amount of precipitation entering the watershed, man can significantly influence how well or poorly the watershed functions. Land management activities impact the vegetation and soil which in turn affects the quanity and timing of water moving through the watershed.

Properly managed vegetation dissipates the energy of water, slowing the flow to the stream channel and allowing more water to enter the soil and percolate down into the aquifer. Less erosion occurs on well managed uplands.

In a healthy watershed, less sediment enters the stream to degrade water quality. More of the precipitation falling to the ground is available to contribute to late season stream flow, and high early season runoff is reduced.

Removing or altering vegetation, such that areas of bare ground are exposed, increases the potential for erosion. Water runs off the surface before it has an opportunity to soak into the soil. Its energy is concentrated, thereby accelerating erosion. Downcutting within the stream channel may occur, resulting in lowered water tables.

Runoff over bare ground carries more

Materials

Classroom Preparation:
Water cycle diagrams, crayons or coloring pencils

Water Festival Activity:
Water cycle and watershed posters
50' length of rope
Large basket of leaves
Large basket of colored styrofoam balls

soil to the stream, degrading water quality by increasing sedimentation. Less water soaks into the soil so it is not available for use by vegetation, recharging the aquifer, or groundwater storage for release later in the season.

The objective of good watershed manageement is to maintain desirable and abundant vegetative cover so that water enters the soil, can be stored with the soil, and slowly release into the stream over an extended period of time. Healthy watershed will optimize long-term benefits for all uses.

Source: The Oregon watershed Improvement Coalition

Pictures

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Friday, December 12, 2003

Hooks and Ladders

Curriculum Objective

To teach students to recognize that some fish migrate as part of their life cycle and how to identify the stages of the life cycle of one kind of fish. To teach students about the limiting factors affecting Pacific salmon as they complete their life cycle, particularly about hazards that salmon must face when they are migrating upstream to spawn. To provide an opportunity for students to simulate the Pacific salmon and the hazards the fish faces in a fun activity that portrays the life cycle of these aquatic creatures. To teach students about the survival-mortality ratio of the salmon.

Washington State
Essential Academic Learning Requirements (EALRs)

Science: 1.1 (basis of biological diversity BM 1,2 & 3)
Science: 1.2 (structure and organization of living systems BM 1,2&3)
Science: 1.3 (life processes and the flow of matter and energy BM 1& 2, biological evolution BM 1,2&3, interdependence of life BM 1,2 & 3, environmental and resource issues BM 1,2 & 3)
Science: 3.2: (careers and occupations using science, mathematics and technology BM 1&2)
Health & Fitness:1.2 (safely participates in a variety of developmentally appropriate physical activities BM 1&2)

Links: trout and salmon spawning spawning gravel suitability| water quality | salmon life cycle | salmon facts|

Course Description

This course provides a comprehensive look at the spawning requirements of salmon in the Pacific Northwest to students as they simulate the migration journey to the ocean and back by the Pacific Salmon.

The instructor first leads the students in a discussion about fish migration by first asking them what they know about the life cycle of fish that live in their area. The students are asked if they know of any local fish that migrate to spawn. If yes, which ones? The students list and discuss the types of obstacles met by the Pacific salmon as it migrates as part of its life cycle to the ocean and back to a local stream to spawn.

Prework

This activity is about the hazards that salmon must face when they are migrating upstream to spawn. The students will be more prepared for this activity if they understand the meaning of fish migration and spawning. Before the activity, students should be able to:

- list, describe and illustrate the major stages in a Pacific salmon's life cycle:
  - Alevins hatch in the spring.
  - Fry emerge from the gravel.
  - Smots migrate downstream.
  - Enter the Pacific Ocean.
  - And grow to maturity in the ocean.
  - Silvery fish enter the rivers and head for the spawning areas.
  - Change in form and color as they advance.
  - In the fall spawning salmon deposit eggs in gravel nests and die.

- list and describe some of the factors that affect salmon as they complete their life cycle. Explore ways that dams can be modified to let fish safely pass downstream and upstream. Design a perfect fish ladder.
- identify and describe some limiting factors that might affect other animal populations.

Activity

Students enact the migration of a salmon on a 60x100' playing field that includes two stream passages (one upstream and one downstream) running lengthwise of the field between the spawning grounds and the open ocean. The downstream passage includes a dam turbine and predators. The upstream passage includes a fish ladder and waterfall.

The students are then assigned roles. Some will be salmon, others will be potential hazards to the salmon:

- Choose two students to be the turbine team. These are the ones who operate the jump rope which represents the turbines in hydroelectric dams. Later in the simulation, when all the salmon have passed the turbine going down stream, these students move to the upstream side to become the waterfall-broad jump monitors.

- Choose two students to be predatory wildlife. At the start of the simulation, the predators will be below the turbines where they catch salmon headed downstream. Later in the activity when all the salmon are in the sea, these same two predators will patrol the area above the "broad jump" waterfalls. There, they will feed on salmon just before they enter the spawning ground.
- Choose two students to be humans in fishing boats catching salmon in the open ocean. These students in the fishing boats must keep one foot in a cardboard box to reduce their speed and maneuverability.
- All remaining students are salmon.

The activity begins at the spawning ground where the salmon start their journey downstream. The first major hazard is the turbines at the dam. At most dams, there are escape weirs to guide migrating salmon past the turbines. The student salmon cannot go around the jump rope swingers, but they can slip under the swingers' arms if they do not get touched while doing so. A salmon dies if it is hit by the turbine (jump rope). The turbine operators may change the speed at which they swing the jump rope.

NOTE: Any salmon that dies at any time in this activity immediately becomes part of the fish ladder. The student is no longer a fish, but becomes part of the physical structure of the human-made ladders now used by migrating salmon to get past barriers such as dams. The students who are the fish ladder kneel on the ground with a body-wide space between them.

Once past the turbines, the salmon must get past some predatory wildlife. The predators below the turbine must catch the salmon with both hands -- tagging is not enough. Dead salmon are escorted by the predator to become part of the fish ladder, which gets the predators and fishing boats off the field regularly, helping to provide a more realistic survival ratio.

Once in the open ocean, the salmon can be caught by fishing boats. The salmon must move back and forth across the ocean area in order to gather four tokens. Each token represents one year of growth. Once each fish has four tokens (four years' growth), that fish can begin migration upstream. The year tokens can only be picked up one token at a time on each crossing. Remember, the salmon must cross the entire open ocean area to get a token. The "four years" these trips take make the salmon more vulnerable and thus they are more readily caught by the fishing boats.

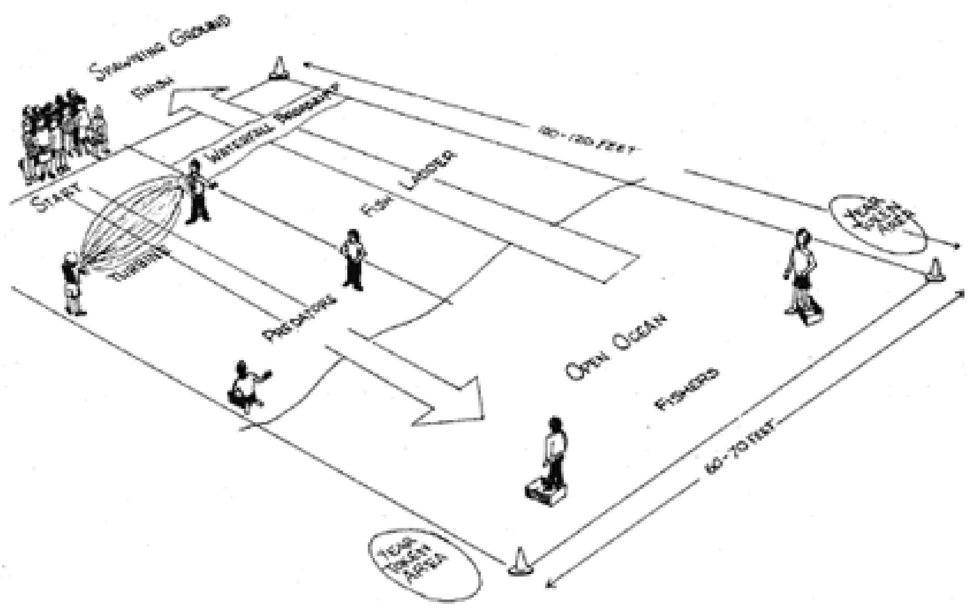
Once four of the year tokens are gathered, the salmon can begin upstream. The salmon must walk through the entire pattern of the fish ladder. This enforced trip through the fish ladder gives the students a hint of how restricting and tedious the upstream journey can be. In the fish ladder, predators may not harm the salmon.

Once through the ladder, the salmon faces the broad jump waterfall. The waterfall represents one of the natural barriers the salmon must face going upstream. Be sure the jumping distance is challenging but realistic. The two former turbine students will monitor the jump. The salmon must jump the entire breath of the waterfall to be able to continue. If the salmon fails to make the jump, then it must return to the bottom of the fish ladder and come through again.

Above the falls, the two predators who started the simulation as the predators below the turbines are now the last set of limiting factors faced by the salmon. They represent bears -- one example of predatory wildlife. Again, remember that the predators must catch the salmon with both hands. If they do catch a salmon, they must then take the student they caught to become part of the structure of the fish ladder.

The activity ends when all the salmon are gone before the spawning ground is reached or when all surviving salmon reach the spawning ground. The students then discuss the activity and summarize what they have learned (the roles of predatory wildlife, barriers and people fishing, where the losses were the greatest/least and what the consequences would be if all the eggs deposited made the journey successfully).

Field Layout:



Classroom Activity

Have students cut out pictures of sand, gravel, or rock to depict the substrate, or stream bottoms preferred by salmon for spawning.

(NOTE: salmon and trout require clean, un-silted gravel beds for spawning and egg incubation. All streams naturally carry silt and other sediments suspended in the water, but too much silt can cover up gravel beds and reduce spawning habitat. When the spaces between the gravel are plugged with sediments, oxygen rich water can not flow past eggs incubating in the gravel and the eggs will suffocate and die)

Research and illustrate the life cycle of any local fish. If possible, look for one that migrates. Compare how the life cycle of a Pacific salmon is similar and different to the life cycle of one or more local fish.

Salmon Life Cycle: Spawning

When a female salmon arrives at her home stream, she chooses a nesting site with just the right combination of clean gravel, adequate depth, and good flow to provide oxygen for her eggs. She digs her nest by rolling onto her side and pumping her tail against the gravel. Stones are dislodged and carried downstream by the current. Every so often, she checks the depth of the nest by "crouching": lowering herself into the nest and inserting her anal fin into the spaces between the stones.

Males fight for access to nest-building females. The dominant male courts the female by quivering and crossing over her back.

When she is ready to lay, he moves alongside her and together they release eggs and milt. At the last moment subordinate males rush in and may manage to fertilize some of the eggs. The eggs settle into the spaces between the stones. The nest is covered with loose gravel as the female builds another nest upstream. Both male and female soon die after spawning, but females will defend the nest until they are too weak to do so.

Challenges to Spawning

- People can disrupt courtship behavior or frighten spawning salmon from their nests if they approach too closely
- Drought and water diversions lower water levels, making nests vulnerable to freezing in winter.
- Erosion, following clearcutting or fires, smothers nests with silt.
- Floods can sweep eggs out of gravel.
- Fish and birds eat salmon eggs.
- If good spawning habitat is scarce, females may dig up each others' nests.
- Clear-cutting along streams raises water temperatures and reduces oxygen in water - eggs suffocate.
- By controlling and diverting water, human activity interferes with natural cycles of flushing and gravel deposition that create new spawning habitat.

From the U.S. Fish and Wildlife Service brochure: Salmon of the Pacific Coast

Background Information

Source of Lesson Plan: Project WILD Aquatic Education activity Guide, pp. 76-81. copyright 1987, 1992 Western Regional Environmental Education Council, Inc. Reprinted with permission from Project Wild.

Many fish live part of their lives in one habitat and then migrate to another habitat. Some make their migratory journeys to mature and reproduce. Pacific salmon are an example of one of the most spectacular of the migrating species. Pacific salmon are destined to spawn only once in their lifetime. Within their genetic fiber is an encoded instinct that drives them from the time of hatching along a monumental journey from their freshwater spawning beds downstream into the sea. Once in the sea, they spend several years reaching the maturity needed for their single return journey to their original hatching ground. Once there, the salmon spawn and die.

Salmon must face a myriad of hazards that serve as limiting factors in the completion of their life cycle. Limiting factors are factors that reduce the populations of living organisms. Sometimes the limiting factors are natural and sometimes they result from human intervention with natural systems.

The female Pacific salmon deposits 1,500 to 7,000 eggs in her freshwater spawn. The eggs are deposited in a shallow gravel depression scooped out by the female. Once deposited, the eggs are fertilized by the male and then both fish nudge the gravel back over the eggs to offer as much protection as possible. Within a few days both the male and female salmon have completed their reproduction and soon die.

The eggs, before and after hatching, are susceptible to many limiting factors. Smothering silt can be washed in suddenly from watersheds damaged by a variety of land-use practices and events -- including erosion following some road building, logging, and fires. Predators can eat some of the eggs and damage hatching populations. Dropping water levels can isolate salmon offspring in streamside depressions where they will die. After hatching, the small fish -- called "alevins" -- spend their first two weeks hiding in the gravel. Gradually they absorb their yolk sac and become known as "fry." If they survive the first two weeks, they then begin their journeys. Some head directly to the sea. Depending on the species, young salmon may spend several months to as much as a year or more in the river before migrating to the estuary and then to the open ocean.

The small ocean-bound salmon, now called "smolts," are at once confronted by hazards on their downstream journey. Examples are dams; low water in streams; and predatory birds, mammals and larger fish. Up to 90 percent of the salmon that hatch never reach the sea.

Spawning is the process of fish reproduction. The male fish produces milt, or sperm, which fertilizes the female eggs, rich are deposited in the substrate, or bottom, of bodies of water. Some fish such as salmon, are born in fresh water, make a journey to the ocean and live there 1-4 years, and return to the place where they were born to spawn. Other fish, such as trout, migrate up and down the freshwater system. Although salmon used to be plentiful in northeastern Washington, dams have blocked their ability to return to the streams in this area, so they no longer exist here. However, water quality and quantity here in northeastern Washington affect salmon since the water flows downstream toward the ocean.

Pictures	Materials
	One jump rope (10-15 feet long) Traffic cones for marking boundaries Two cardboard boxes 100 tokens (poker chips) One large playing area (100 feet x 50 feet)
	
	

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Friday, December 12, 2003

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Riparian Welcome
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Water is Like?
Grounded
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Bugs on the Bottom
Habitat Haven
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Insect Discovery
Kids in the Creek
Stream Sense
Salmon

Fish Neighbors

Curriculum Objective

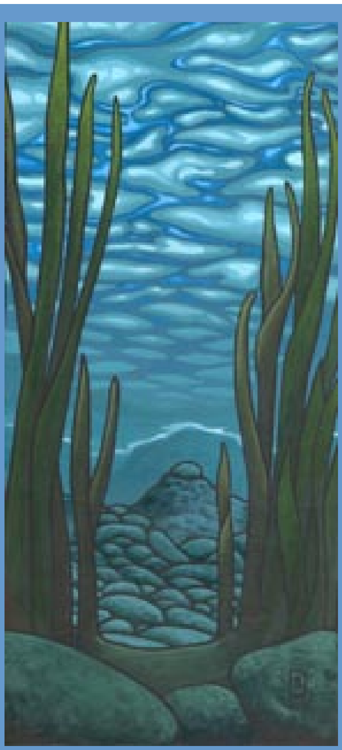
To teach students about the fish and insect species that live in Lake Roosevelt. To teach students about the anatomy and unique characteristics of each fish and insect species, how to identify organizisms by these characteristics and understand how the characteristics help them adapt to certain conditions. To teach students about the different lake niches, the conditions in these niches and what fish and insects live there. To allow students an opportunity to present a fish or insect species to the group and to explain characteristics, habits and special adaptations to the fresh water ecosystem.

Washington State
Essential Academic Learning Requirements (EALRs)

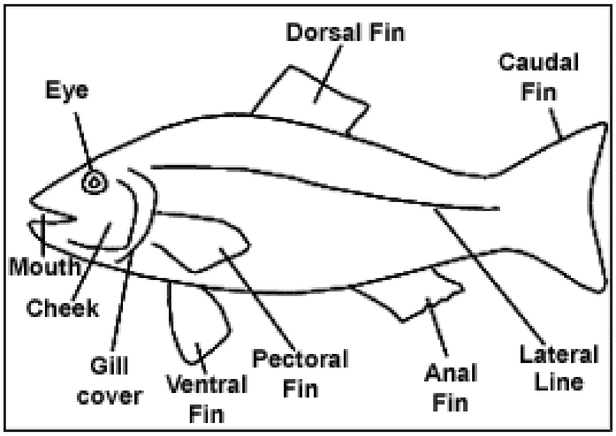
Science: 1.1 (basis of biological diversity BM 2&3)
Science: 1.2 (biological systems BM 2&3, structure and organization of living systems BM 2 &3)
Science: 1.3 (life processes and the flow of matter and energy BM 2&3, biological evolution BM2, interdependence of life BM 1,2&3)
Communication: 2.3 (use effective delivery BM 1&2)
Mathematics: 1.3 (understand and apply concepts and procedures from geometric sense - properties and relationships BM2)

Links:

fish adaptations | natural selection | niche | How fish use adaptations to survive | fish anatomy



Fish Anatomy



Course Description

This course is designed to teach students how to recognize different species of fish. It teaches them characteristics, specific adaptations and how they pertain to the survival of individual species of fish and insects that live in Lake Roosevelt.

Students learn about the anatomy of fish and how each role plays a different structure plan in an organisms' survival.

At the end of the presentation students take turns drawing the different parts of a fish. The presenter then discusses how the fish survives.

Prework

Students should understand the concept of adaptation and the beginning of natural selection. They should have a general understanding of basic fish anatomy (gills, fins, scales) and insect anatomy (antenae, abdomen, head, thorax) and lake conditions (deep water, slow-moving water, hydroelectric dam, reeds).

Classroom Activity

Have groups of students design (draw) one each a fish based upon certain criteria (adaptations) and a type of habitat that would be the best for their fish. After they have drawn their fish and its habitat, have the students exchange habitats with another group and explain weather or not their fish would survive in the new environment.

Background Information

Each fish and insect has a different characteristic that makes it a resident of Lake Roosevelt. These characteristics, or adaptations, include overall shape of the body, colors and markings, tail shape, and many other body features. The overall shape of a fish's body can tell a person a lot about a fish. Those with streamlined, flat bodies adapt well to fast-moving water and those with sucker-like, down-turned mouths to slow-moving water where food can filter to the bottom and be eaten. Eel-like fish can maneuver easily through matricies of rocks or vegetation. All of these shapes and adaptations influence the where fish live, travel, eat and how they escape from predators. Insects are the same way.

Colors, markings and use of natural materials are important ways that fish and insects can communicate and camouflage themselves. Male fish take on bright colors during the spawning season and that tells females that they are ready. These colors also warn off other males. Certain markings on fish help them hide from or confuse predators. Some fish have a spot on their tail that looks like an eye, sending a would-be attacker to a less vulnerable part of the body. Certain macroinvertebrates carry bits of gravel and plant material on their bodies to help them blend perfectly with the stream bottom.

Materials

Regular paper and drawing paper illustrating different niches in Lake Roosevelt.

Pens and Markers
Cloth 1-silk 1-sequined
Fish Picture Cards
Insect Picture Cards

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Friday, December 12, 2003

Lake Roosevelt 2003 Water Festival

September 23rd and 24th 9:00a.m.-2:00p.m. at the Lake Roosevelt Day Use Area

Fish Homes

Curriculum Objective

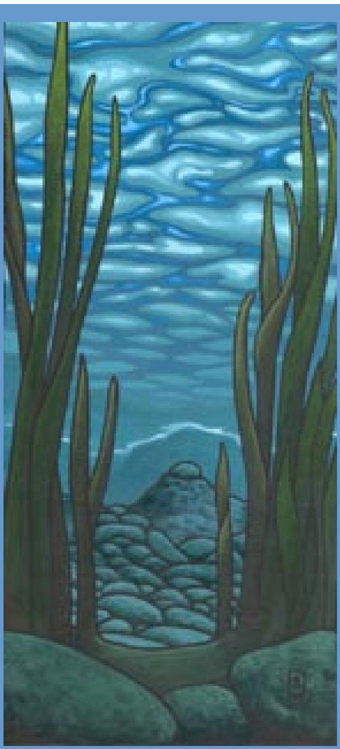
To teach students about the elements of fish habitat. Teach students where fish live, why they live there and how they use different types of cover, stream substrates and various water depths. To allow students a chance to draw their own interpretation of a stream environment with fish using the elements in the ways they learned.

Washington State
Essential Academic Learning Requirements (EALRs)

Science: 1.2 (biological systems BM 1, 2&3)
Science: 1.3 (interdependence of life BM 1&2)
Science 2.1 (modeling BM1)
The Arts: 2.1 (Applies a creative process in the arts - conceptualize/gather information, develop ideas, organize elements, reflect upon, refine and present work BM 1,2 &3)
The Arts: 2.3 (Applies a responding process to an arts presenttion - engage, describe, analyze, interpret, evaluate BM2)
The Arts: 3.2 (Uses the arts to communicate for a specific purpose BM2)

Links:

stream ecosystem | fish habitat | lake ecosystem |



Course Description

Students will learn what physical, chemical and biological features comprise fish habitat, the uses of these habitat features by fish and what roles different habitat features play in their survival. Students will study the locations of habitat features and create their own "fish home" by placing rocks, logs, plants and gravel in a pool. Students will observe fish adapt to the pool environment and reflect upon the reasons why the fish are where they are and why. Students will remove certain features, examine the fishes' response to the changes and discuss what happens to the fish. After learning about the interaction between fish and their environment, students will draw their own concept of a stream or lake environment, drawing fish where they are most likely to be located. Students will be questioned about how the fish in their drawings are using their habitat.

Prework

Students should be familiar with stream and lake shoreline environments and be able to list common components such as tree trunks, overhanging branches, bridges, gravel, sand, boulders, reeds, water lilies and waterfalls.

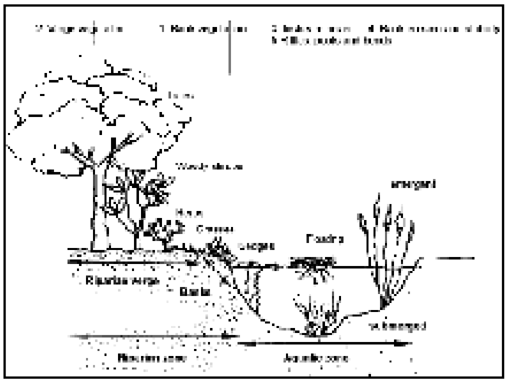
Classroom Activity

Students may discuss in small groups their own experiences near a stream or lake and recall the things they have seen or experienced. The instructor may wish to list these features as he or she encourages the students to describe them in detail.

Background Information

Each fish uses cover in different ways. One fish may use it to escape or hide from predators, while another fish may us it to feed. Cover, in the form of rocks, logs, lilypads, or overhanging vegetation, is important to fish survival

Stream Environment



Pictures

Materials

Posters of fish using habitat, fish stamps, stamp pads, flip chart, markers, baby pool, fish, rocks, logs, other habitat features, paper towels, picnic tables

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Friday, December 12, 2003


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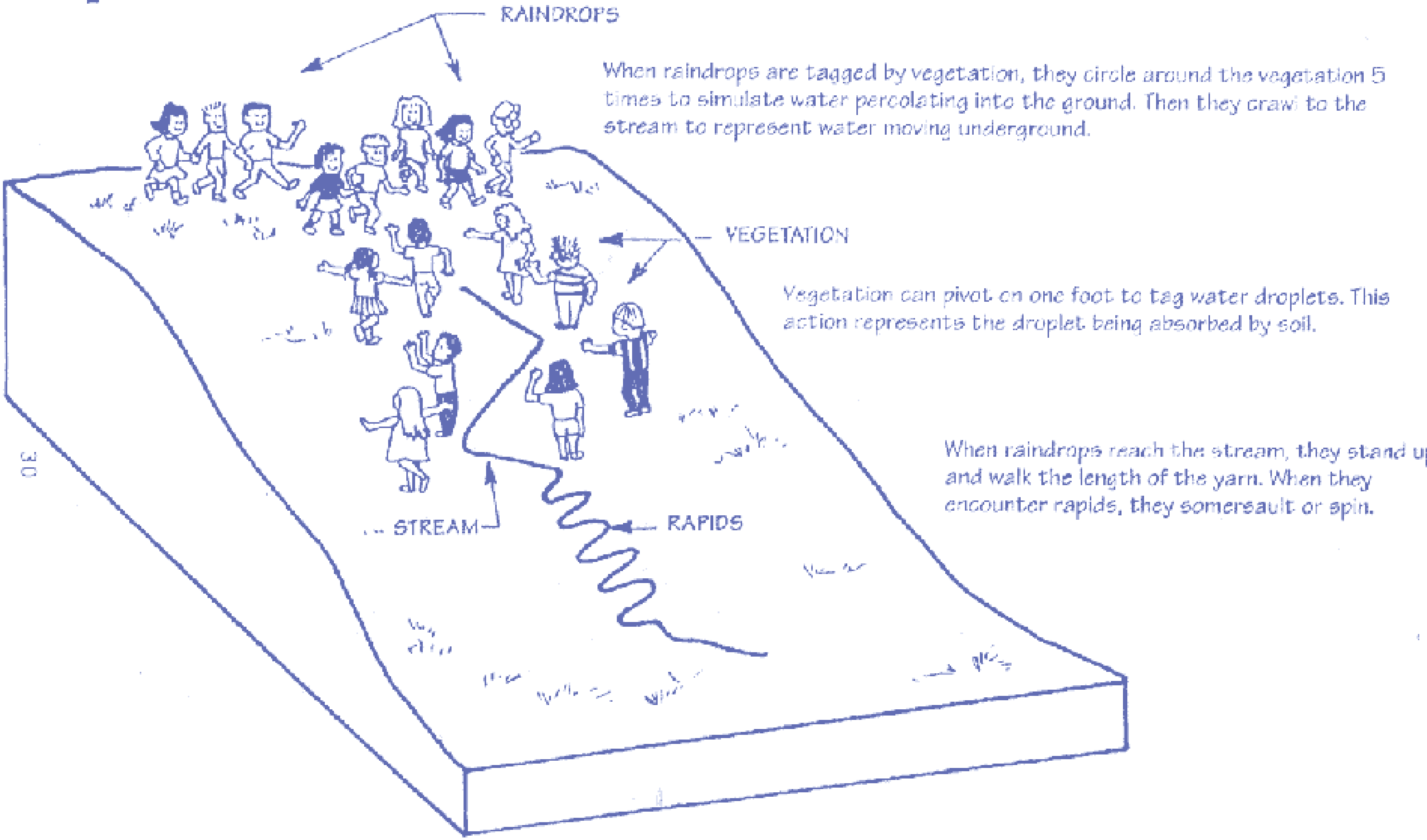
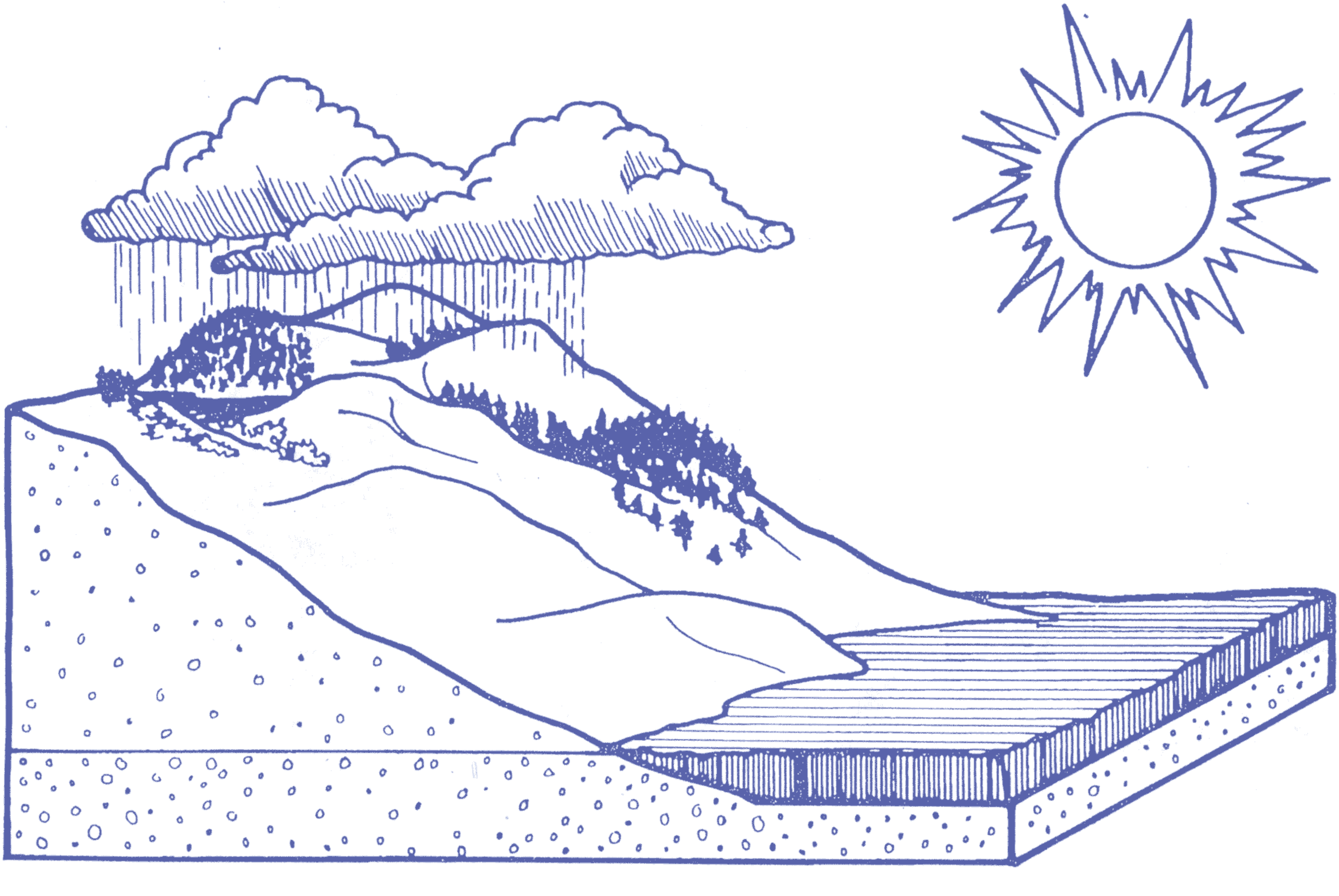
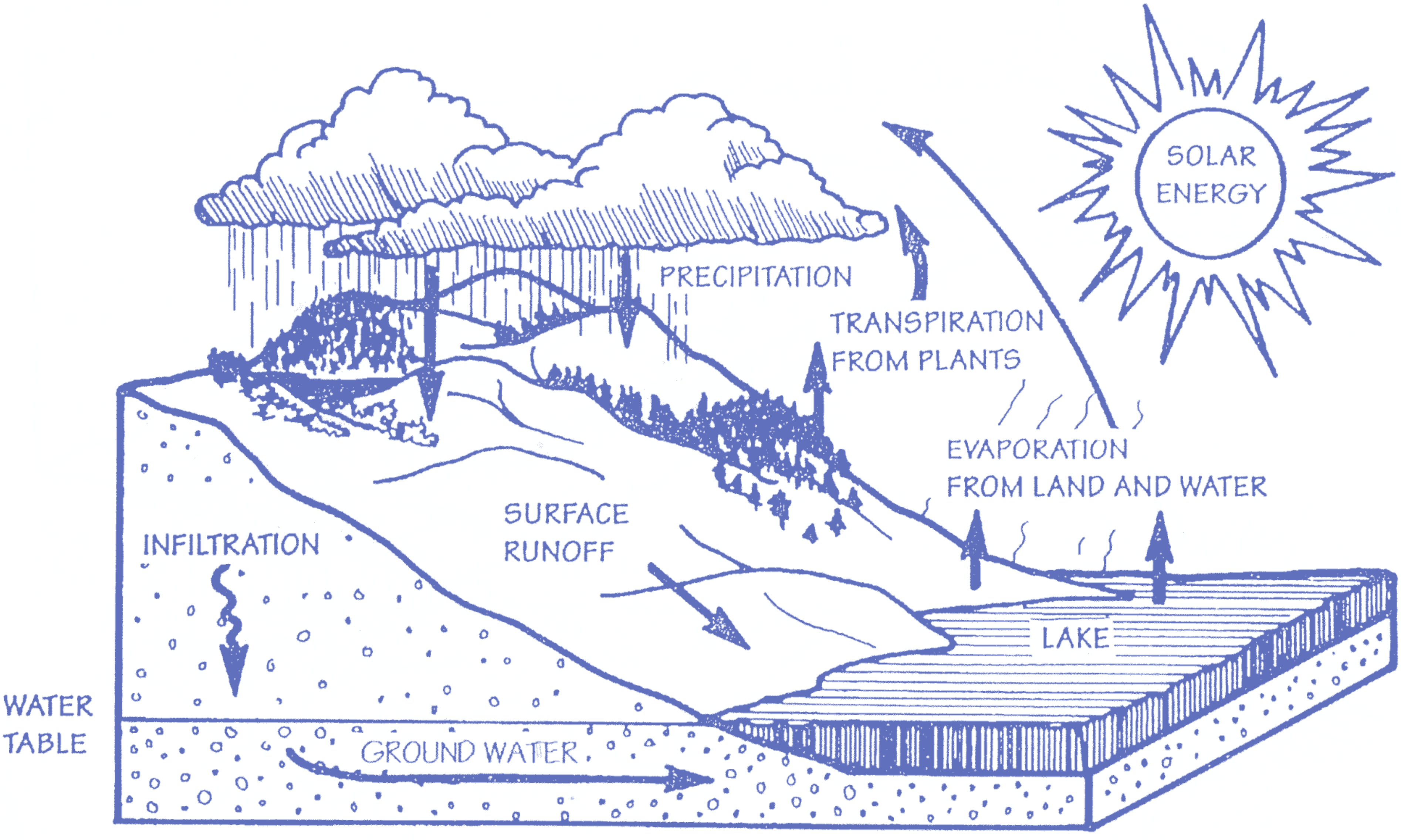
Slope With Plant Cover





Water Cycle


SOLAR ENERGY
PRECIPITATION
TRANSPIRATION FROM PLANTS
EVAPORATION FROM LAND AND WATER
SURFACE RUNOFF
INFILTRATION
LAKE
WATER TABLE
GROUND WATER


10 1 '96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