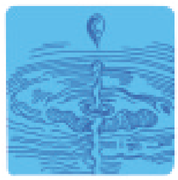
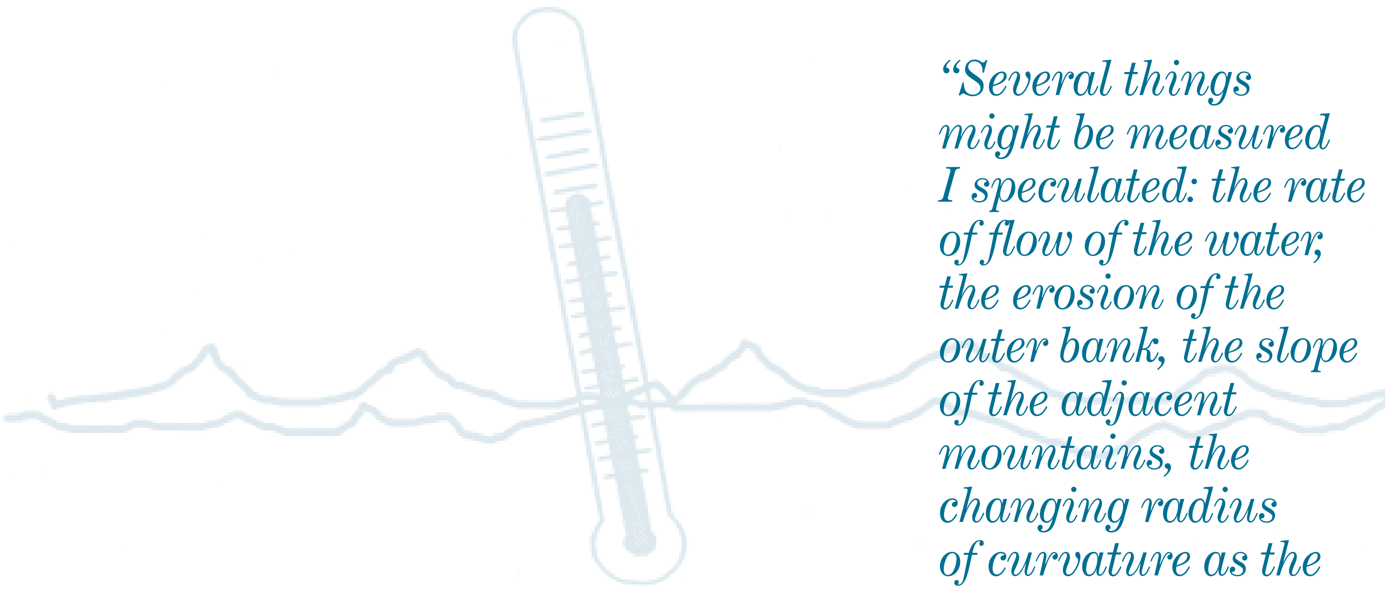
What's In That H_2O?



Introduction

This station addresses water quality and its importance for a healthy watershed. Students predict the outcome and then test the creek s chemical properties to verify their conjectures. They also enter the creek to determine its rate of flow and connect water dynamics with water quality.



"Several things might be measured I speculated: the rate of flow of the water, the erosion of the outer bank, the slope of the adjacent mountains, the changing radius of curvature as the river turned west. It could be revealed neatly, affirmed with graphic authority."

Barry Lopez

What's in that H_2O?

Teacher Section

Objectives

Students will be able to:
1) Describe the hydrologic cycle
2) List the effects of turbidity, pH, temperature, stream dynamics and dissolved oxygen (DO) on the aquatic ecosystem
3) Test Icicle Creek s health
4) Identify human activities and natural phenomena that impact water quality

WA SCIENCE Academic Learning Requirements (EALRs): 1.1, 1.2, 1.3,2.1, 2. 3.1

Concepts

- Hydrologic cycle
- The connection of water chemistry and quantity to stream health
- Human actions that influence clean water
- Point and non-point source pollution
- Ecology

Study Site Description

The meeting site will be clearly marked with a sign. Students divide into two groups to record water quality data and determine stream flow.

Vocabulary

(Descriptions may be found in the Glossary)

Aquatic	pH
Dissolved oxygen (DO)	Point Source
Erosion	Pollution
Hydrologic cycle	Sediment
Macroinvertebrate	Silt
Nephelometer	Total Suspended Solids(TSS)
Non-point source pollution	Turbidity
Parts per million	Velocity

Classroom Pre-work

MINIMUM PRE-WORK NECESSARY FOR FIELD STUDY:
60 minutes to comprehend the components of DO, temperature, flow, pH, and turbidity and how they contribute to watershed integrity.

Post-work

45 minutes for pollution study and assessment.

The Hydrologic Cycle

(20 minute activity without optional projects)

Objective

Students will be able to:

1) Discuss the components of and illustrate the hydrologic cycle (water cycle)

Materials

- ❑ Transparencies of the *Hydrologic Cycle,* Figures 1 and 1A
- ❑ Overhead projector

Background

Water is life. Without it, Earth would be a vast wasteland. Our bodies are approximately 92% water. All living things depend on it. As a result, water is a precious commodity. Wars have been fought over water rights. The water that is here now is the only water earth will ever have. It takes many forms, such as vapor, droplets, and ice. No new water is produced; it is simply recycled again and again. This process is called the hydrologic cycle. Although the surface of the earth is approximately 75% water, only about 3% of it is fresh water. Of that, about 75% is in glaciers and the polar ice caps. This leaves a limited (less than 1%) but constantly moving supply for our use. This movement can be quick and highly visible, or may take a slower path. Some water caught in deeper aquifers may have been there for hundreds of years. If we want clean water available to us and other earth dwellers, we must take care of this system.

Procedure

1. What is the hydrologic or water cycle (see Glossary)? Refer to *The Hydrologic Cycle* illustration (Figure 1). Using an overhead transparency of Figure 1, discuss the terms describing the hydrologic or water cycle.

2. Ask students to complete a research project demonstrating one facet of the cycle. They must be ready to interpret their work to peers. For example, groundwater can be shown by placing layered soil in a glass baking pan, tilting it, and pouring colored water on the higher side. Take time to watch the liquid s movement. Note and compare how it moves through the different soil types.

Assessment

Ask students to:

- ❑ Describe the hydrologic cycle and the dynamics of each component.
- ❑ Place water cycle terms where appropriate using the *Hydrologic Cycle* illustration (Figure 1A).
- ❑ Write a story following the journey of a water droplet that travels through at least four components of the hydrologic cycle.

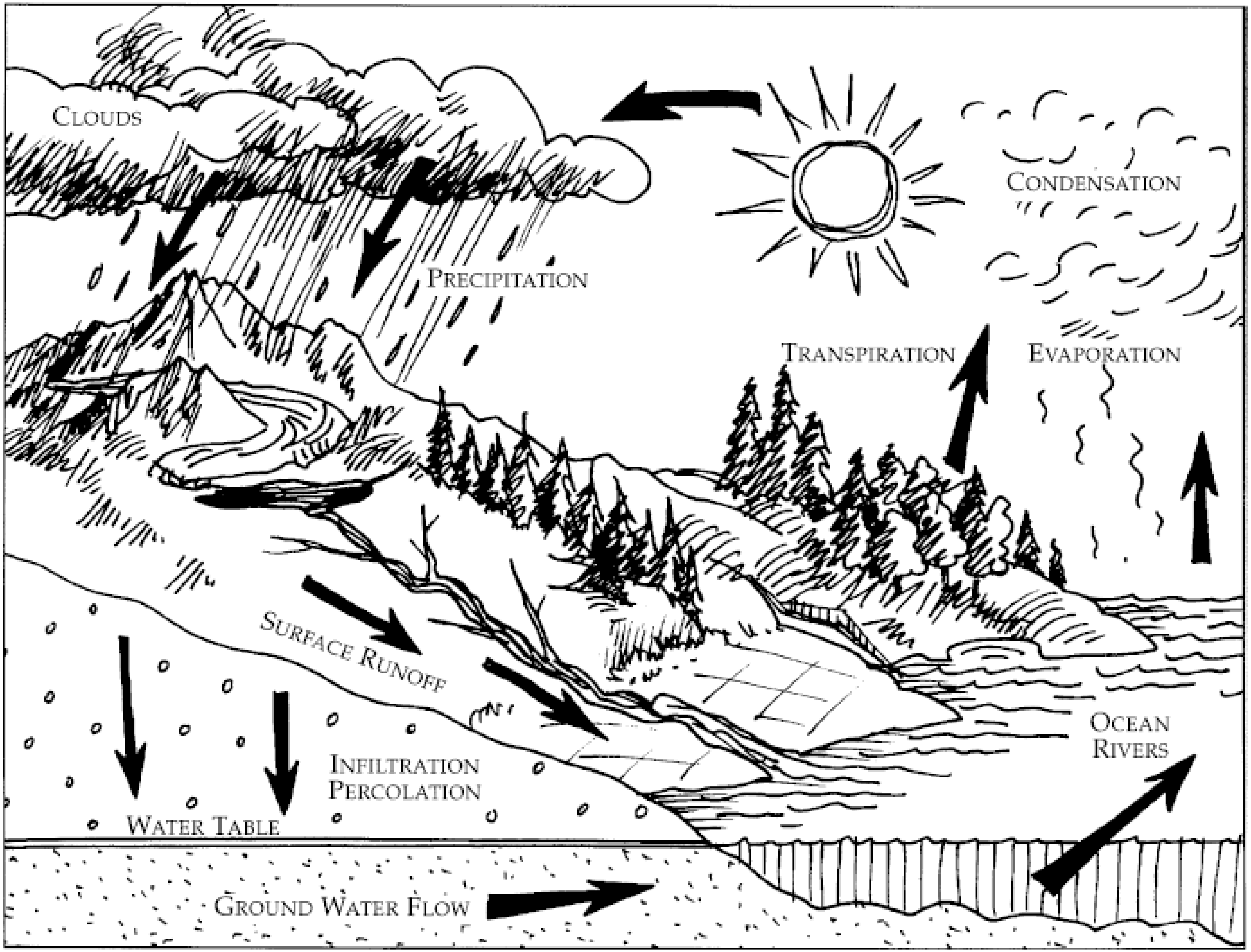


Figure 1. Hydrologic Cycle

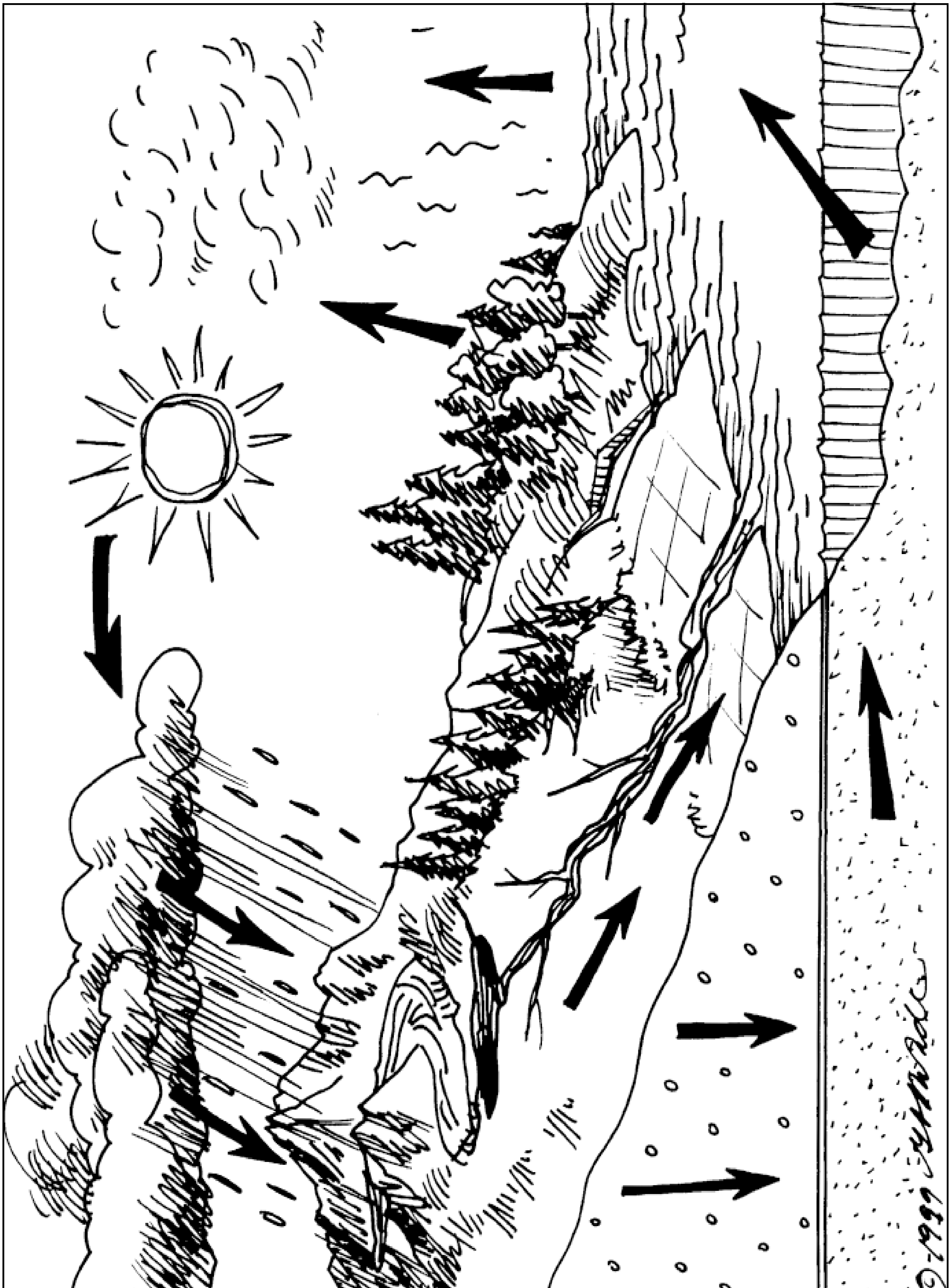


Figure 1A. Hydrologic Cycle

Let That Water Breathe and Chill!

(40 minute activity)

Objectives

The student will be able to:

1) Identify properties of dissolved oxygen (DO) and temperature
2) Test the DO and temperature of a local stream and determine its health
3) Relate the factors that can change a waterway s DO and temperature

Materials

- ❑ DO and temperature worksheets from Student Section
- ❑ DO kit
- ❑ Pencil or pen
- ❑ Thermometer

Background

Dissolved Oxygen (DO)

The presence of oxygen in water is vital to healthy aquatic ecosystems. Its absence is a sign of serious pollution. Some aquatic organisms like trout and stoneflies need higher levels of oxygen to survive. Organic wastes like animal carcasses, decaying plants, sewage (containing nitrates and phosphates), urban and agricultural run-off and other industrial sources are the major threats to oxygen availability. As those wastes decay, the microbes responsible for their breakdown consume large amounts of oxygen. Additional factors influencing water quality include: altitude, barometric pressure, plant concentrations in the area and water temperature. Oxygen is more soluble in cooler water.

The amount of oxygen found in water is called the *dissolved oxygen concentration (DO)*, and is measured in milligrams per liter of water (mg/l) or an equivalent unit, *parts per million* of oxygen to water (ppm)**.** During warm summer months, stream water temperatures go up as water and oxygen levels decline. The DO range for trout and salmon is above 6 ppm. Levels below 5 are dangerous and below 3 are lethal. Fish basically suffocate. DO levels over 9 ppm are often found in nature. In fact, some fish actually have adapted to higher amounts as evidenced by their abnormal hemoglobin configurations.

PRODUCTIVE DISSOLVED OXYGEN LEVELS

ORGANISM	DO parts per million/milligrams per liter
Cold water organisms (salmon, trout, mayfly, stonefly caddisfly)	6 ppm and above
Warm water organisms (bass, carp, catfish)	5 ppm and above

Temperature

Temperature affects everything that lives in water. Aquatic animals are cold blooded and adapt to the surrounding temperature. Removal of streamside vegetation can elevate temperatures along with increasing soil erosion. Suspended sediment in the water absorbs more solar energy. Industrial thermal discharge also raises water temperature. After water is used for cooling machinery, the warmed water is then recirculated back to a nearby water source. This is one example of *point source pollution.* There is a direct relationship between temperature and DO. Cooler water holds more oxygen. As temperature elevates, DO is reduced.

PRODUCTIVE TEMPERATURE RANGES

TEMPERATURE (Fahrenheit)	ORGANISM
Higher than 68°F (warm)	Many plant species, dragonfly, bass, bluegill, catfish
Middle range (55°F- 68°F)	Some plant species, salmon, trout, sculpin, mayfly, caddisfly
Less than 55°F	Some plant species, trout, salmon, sculpin, stonefly, mayfly

Procedure

1. Visit a local waterway (if this is not possible, practice with tap water).

2. Referring to the DO and temperature charts contained in this section, ask students to predict what aquatic life might be found there.

3. Practice using the worksheets. If possible, monitor water temperature and DO at various times of the day.

4. Answer the following questions:
   What are the average temperature and oxygen levels?
   What factors may have contributed to the findings?
   What can survive in this water?

Assessment

Ask students to:

- ❑ Create a chart that illustrates how DO and temperature are interrelated.
- ❑ Describe the tolerance levels various plants and wildlife have to changes in DO and temperature.
- ❑ Make a note of the factors that can alter levels of DO and temperature in fresh water.

The pH 7 Scale: Life's Good Note

(20 minute activity)

Objectives

The student will be able to:
1) Describe the pH scale
2) List the pH of common products
3) Name connections between pH and wildlife

Materials

- ❑ Common household substances representing the pH scale such as lemon, Epsom salt, milk, etc.
- ❑ pH strips
- ❑ Overhead transparency of the *pH Scale and Productivity* chart (Figure 2)

Background

Everyone has heard of acid rain. What does it really mean and what are its ramifications? All biological systems—animal, plant and microorganism—must live in an environment which supports an optimum range of *pH*. In general, they are most healthy when they are in a nearly neutral pH. pH measures the hydrogen concentration in a liquid or substance, which make it acidic, neutral, or alkaline (basic). The pH scale ranges from 0 to 14. 0 to 6 is acidic, 7 is neutral and 8 to 14 is basic. For every one unit change on the pH scale, there is approximately a tenfold change in how acidic or alkaline a sample is. Lemon is under 2 and Epsom salt is over 9 on the scale. Substances at either extreme of the pH scale tend to be very corrosive; i.e. very acidic battery acid or extremely basic lye.

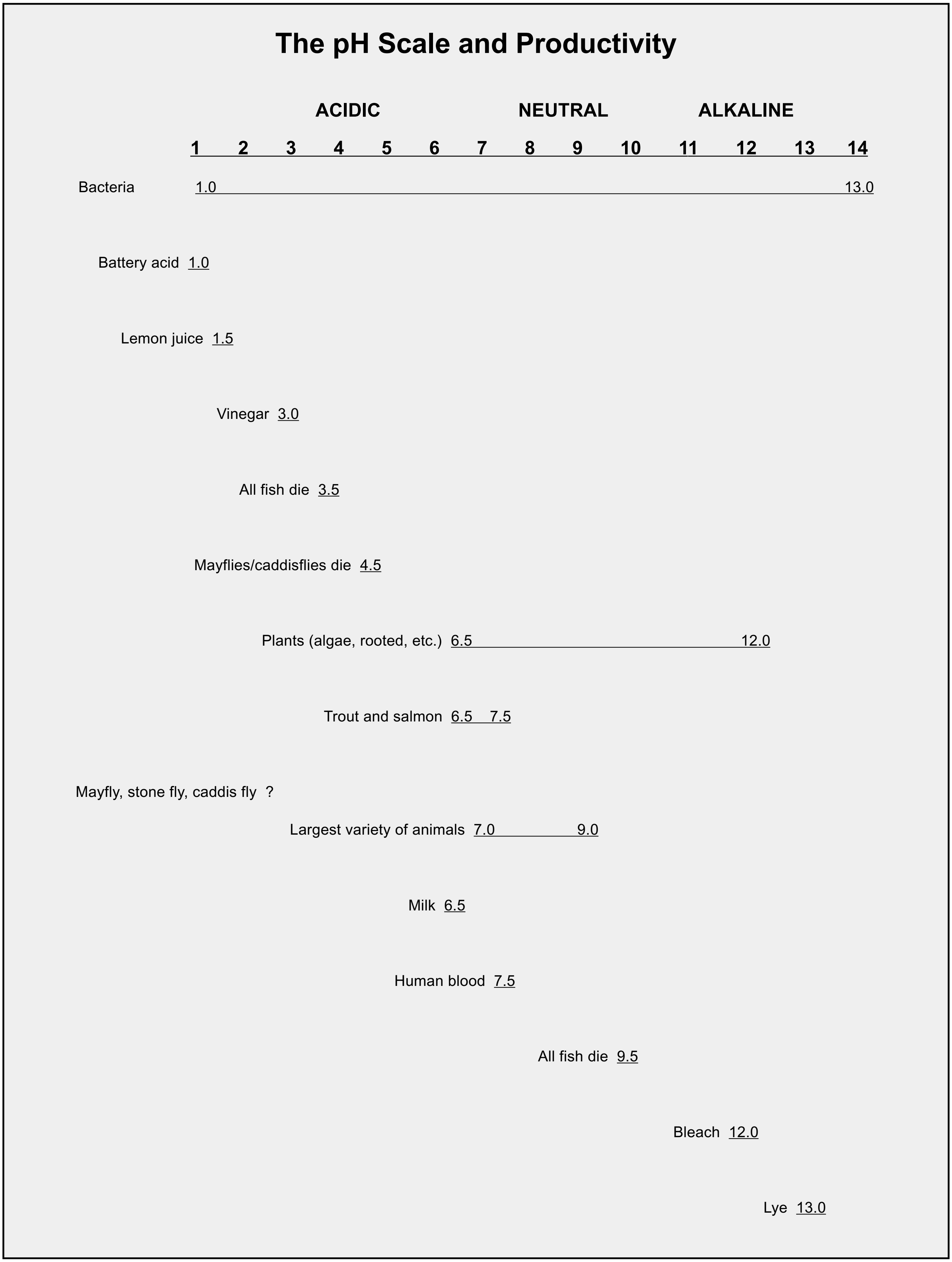


Figure 2. The pH Scale and Productivity

The largest variety of aquatic animals will exist at **pH values of >7 to <9.** Plants can range from 6.5 to 12 on the scale. pH levels in water can be affected by soils and from rain that contacts gases such as sulfur and nitrogen oxide in the atmosphere. These gases from sources such as automobile exhaust combine with water droplets and fall as acid rain.

Procedure

1. Refer to the pH scale in Figure 2. Purchase pH strips and ask students to bring common items from home like milk, vinegar, and bleach, and conduct your own experiments. Can caddisflies survive pH such as milk?

2. With the help of an overhead transparency of the pH chart, cover the answers written on the scale and ask students to fill in the blanks.

3. Research the pH tolerance levels of specific plants and animals not listed. What is their preferred water chemistry overall?

Assessment

Ask students to:
- ❑ List the pH of common products learned in the activity.
- ❑ Discuss the pH tolerances of plants and aquatic wildlife.
- ❑ Write a narrative about the items that could change pH in a stream.

Extensions

Ask students to:
- ❑ Predict the pH of substances found at home or in nature (not listed in the pH chart); test them in the classroom.
- ❑ Identify the pH tolerance range for organisms indicated on the pH scale chart.

Is There Water on Zork?

(45 minute activity)

Objectives

Students will be able to:
1) Describe qualities that distinguish water from other clear liquid
2) Design an investigation to test characteristics of water
3) Analyze the efficiency and effectiveness of the investigation

Materials

- ❑ Liquids to be tested. (Place liquids in separate beakers, numbered 1-7; label the water with a different number for each group. Depending upon the time and grade level, use seven or fewer liquids.)
  - ❑ Water
  - ❑ White vinegar
  - ❑ Hydrogen peroxide
  - ❑ Corn syrup
  - ❑ Alcohol
  - ❑ Glycerin or mineral oil
  - ❑ Clear soda

Testing materials. Possible tests are provided in parentheses for students needing more guidance. Items may be deleted or added to the list to fit the needs of the investigation.

- ❑ Salt (solubility)
- ❑ Pepper (surface tension)
- ❑ Sugar (solubility)
- ❑ Baking soda (solubility, chemical reactions)
- ❑ Corn starch (solubility)
- ❑ Wax paper (surface tension)
- ❑ Aluminum foil (chemical reactions)
- ❑ Hot and cold water baths (evaporation, condensation, specific heat)
- ❑ Ice (density)
- ❑ A scale (mass)
- ❑ Objects of different density: metal to wood (density)
- ❑ Paper clips (surface tension)
- ❑ Toothpicks (density, surface tension)
- ❑ Food coloring (density)
- ❑ Graduated cylinders (volume)
- ❑ Thermometers (temperature, phase change)
- ❑ pH strips (acidity)
- ❑ Liquid soap (surface tension)

Materials *continued*

Testing equipment:

- ❑ Goggles
- ❑ Extra beakers or cups for conducting tests
- ❑ Eyedroppers
- ❑ Glass rods

Background

We all use scientific methods to answer questions about our lives and the world. Farmers study their fields, confer with agronomists, and conduct tests to learn why a certain crop is producing low yields. Teachers, when selecting an approach to best convey a concept, gather resources, attend workshops, and try out activities with their students. Consumers selecting among brands of shampoo read labels, talk with friends, listen to commercials, and test samples. All these actions are guided by questions: Why are my crops failing? What s the best way to teach this? Which shampoo should I buy?

Scientists use questions to guide their research as well. How scientists answer questions depends on current understandings, available resources, and the nature of the questions themselves. There is no one scientific method. Nonetheless, investigations are often guided by a series of questions:

1) What is the question we are trying to answer?
2) What do we know that is related to this question? (This can involve forming a hypothesis).
3) What are the procedures to answer the question?
4) What are the results of the investigation?
5) What is the value of these conclusions? (Can these conclusions be used to answer the question?)

This process facilitates thorough, organized investigations. The questions need not be followed in sequential order. Sometimes researchers first recall what they know about the problem, or they come up with a conclusion first, and then test it.

Even when these questions are used to guide an investigation, the problem may not be solved, or more questions may arise. Results may be erroneous. The farmer may not learn why the crop yields are low. The teaching strategy may reveal gaps in student knowledge requiring the teacher to develop supplementary lessons. The consumer may find that his or her choice of shampoo gives them frizzy hair. Investigations into problems are ongoing. As they learn, people continue to ask questions.

Procedure

Warm up

Present the following situation to the class. Some students are visiting planet Zork. They are running low on water. Through remote sensing techniques, they know that water exists on Zork, but they re not sure where it is. Fortunately, they encounter some friendly Zorkians who speak English; unfortunately, their words for water, clear, and liquid are different from ours. The visiting students need to explain to the Zorkians that they are looking for water.

Have several students play the visiting students and others play the Zorkians. The class can help the Zorkians think of questions they can ask about this commodity (e.g., What does it feel like? What is it used for? Why do you need it?) Mindful that the Zorkians do not understand the words clear and liquid, the visiting students must try to describe the characteristics of water.

After a few minutes, have students summarize their responses. How much do students think they know about water? Did they think it was difficult to describe water?

Ask students to list the words and phrases they use to describe water. Encourage them to use all five senses. Make a master list and post it in the classroom. This list of words and descriptions provides students with a synopsis of what they know about water. It also provides information they can use to solve the problem presented in this activity.

Procedure continued

Part 1

1. Tell students the Zorkians brought forth seven different clear liquids, based on the stranded travelers descriptions.

2. Divide the class into small groups. Provide each group with samples of clear liquids. Present students with the problem: Which of these liquids is water?

3. Based on what they know about water, have students write out several questions they have about the liquids. Ask them to brainstorm different ways to answer the questions. Display the materials they can use in the front of the room.

4. Have students develop a set of procedures to determine which liquid is water. Check the designs for safety and feasibility.

TASTE TESTS ARE NOT ALLOWED! IF STUDENTS HEAT THE LIQUIDS, THEY SHOULD USE A HOT WATER BATH, LIMIT THE HEATING TIME TO THREE MINUTES, AND BE IN A WELL-VENTILATED AREA. ANY TIME A SUBSTANCE IS HEATED, GOGGLES MUST BE WORN.

5. Have students write out the questions and procedures in a table or diagram. A suggested format is provided in this activity, but students may design their own to match the needs of their investigation. (See Problem: Which of these liquids is water?)

Part 2

1. Students can now conduct the tests to answer the questions. Make sure they record their results or answers. These can be included in the table as well.

2. At the end of their investigations, students should draw conclusions based on their findings. If they were unable to determine which liquid was water, they should still summarize the results by indicating liquids they know are not water. Explain that the investigative process is more important than determining which liquid is water. If the investigation stimulated other questions, these should be listed in the conclusion as well.

Wrap Up

Discuss the investigative process and the results with students. What was the value of the conclusions? Did the investigation solve the problem? To confirm their results, students can run identical tests on a sample of tap water. If students were to repeat the activity, would they revise their procedure or alter their conclusion? If time allows, have students conduct the investigations a second time.

What do they know about water that they didn t know before? Match these discoveries to the list of words and phrases used to describe water in the *Warm up.* Ask students if they think the list is accurate or if descriptions should be changed or added.

Have students design a poster presenting water as both a common and unique substance. Display student work in a public place such as a grocery store, library, or water treatment center.

Assessment

Ask the students to:

- ❑ Design an investigation that distinguishes water from other clear liquids (Part 1, steps 3 and 4).
- ❑ Draw conclusions to investigations based on their findings (Part 2, step 2).
- ❑ Describe the properties of water that distinguish it from other clear liquids (Wrap Up).
- ❑ Assess how effectively the investigation addressed the needs of the problem. Is there water in Zork? Is used with the permission from The Watercourse/Montana State University and the Council for Environmental Education (CEE) from the Project WET Curriculum and Activity Guide. For further information about Project WET (Water Education for Teachers), contact the national office at (406) 994-5392.

Extensions

Have students collect water samples from sources throughout the community. To compare and contrast the samples, have them design tests for smell, temperature, clarity, pH, and precipitates.

It's A Dirty Water Thing

(30-60 minute activity in classroom)

Objectives

The student will be able to:

1) Identify potential sources of increased turbidity
2) Predict results and experiment on sediment levels of a nearby creek

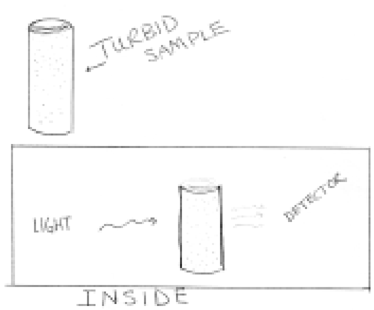
Materials

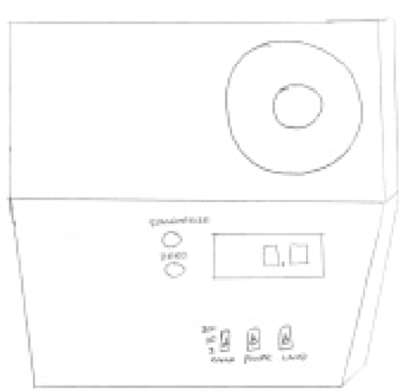
- ❑ Glass jar
- ❑ Coffee filter or cheese cloth
- ❑ Lightweight fabric
- ❑ *Kids in the Creek* student worksheet
- ❑ Pencil

Background

Turbidity and Sediment

Sediments are always present in aquatic ecosystems. This natural process introduces needed nutrients and streambed materials into the system. However, changes or disruptions to the stream bank, riparian area, and uplands can exaggerate the normal cycles. Sometimes during stormy periods, rain will release soil and pollutants from fire-scarred hillsides where vegetation has been removed. Both soil particles themselves and the *non-point source pollution* they may carry can be threats to water quality. Unless this is a frequent occurrence, aquatic wildlife can compensate. However, an overabundance of soil *erosion* can increase suspended particles, attracting heat and raising temperatures. With higher temperatures, levels of dissolved oxygen decrease. Certain fish and many *macroinvertebrates* prefer cooler water. *Silt* can settle into spawning gravel, choking eggs. Sensitive fish and insect gills inundated with silt cannot obtain needed oxygen to survive. More tolerant species may replace them over time.





Total suspended solids (TSS) measures the amount of *sediment* a stream is carrying. *Turbidity* is a measurement of how cloudy water is. TSS and turbidity are different. A stream may have a high TSS because it is carrying many large soil particles, but these particles would not necessarily make the water very turbid. On the other hand, if the stream were carrying great amounts of very small particles, the TSS would be low and the turbidity high (very cloudy). More turbidity equals less penetration of light into the stream. A turbidimeter, or *nephelometer*, measures the amount of light passing through it.

Procedure

1. Go to a nearby stream after a hard rain. Does the water look different from before the storm? A change in color or clarity may be a sign of non-point source pollution.

2. Fill two jars with water from the stream, measuring the quantity in each. If no stormwater is available, prepare two jars with water and stir a large spoonful of soil into each jar.

3. Pour the water from one jar through a coffee filter into a clear container. Were any sediments caught?

4. Measure the amount of sediment caught in the filter, if possible, or estimate its volume. How many parts of sediment per parts of water were captured in the filter?

5. Cover the opening of the second jar with one layer of lightweight cloth, then pour the water out through a clean coffee filter into a second clear container. Does the water from this jar seem cleaner? Was the amount of sediment captured in the coffee filter more or less than from the first jar? The cloth represents riparian vegetation and wetlands. They filter out some of the sediments and other pollutants carried by runoff water, helping keep the streams healthy.

Assessment

Ask students to:

- ❑ List sources of turbidity in streams
- ❑ Relate the connection between increased sediments and levels of DO and temperature
- ❑ Describe the role of riparian vegetation and wetlands in reducing sediment loading

Have Orange Will Travel

(20 minute activity)

Objectives

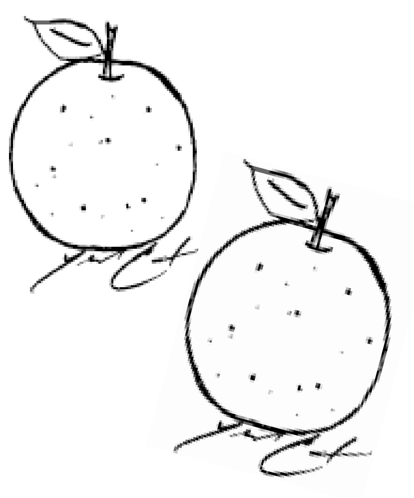
The student will able to:

1) Demonstrate the tie between water quality and dynamics
2) Measure stream flow through a classroom simulation activity

Materials

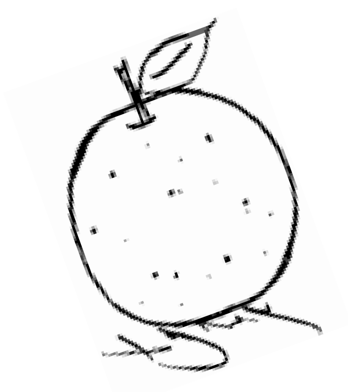
- ❑ 6 timers or watches with chronometers
- ❑ 1 measuring tape
- ❑ 3 oranges

Background



Water dynamics give a stream its character. Woody debris, boulders, slope steepness or gradient, and other factors influence velocity, or how fast a stream moves, and the volume of water. Greater *velocity* affects dissolved oxygen amounts, temperature, and nutrient levels. As flow speeds increase, so do DO amounts. When velocity decreases, there may be less erosion and sediments settle while nutrients and temperatures increase. The volume of surface water varies between watersheds because of the gradients and natural geology. Some rock formations allow water to run over surfaces in such a way that the majority of the water is visible. Other rock formations allow water to percolate through the soil and substrate to ground water. Aquifers then recharge creeks and other bodies of water. Surface water in a stream is visible and can be measured. Similarly, ground water levels can be measured in a well. The water level in a well corresponds to the surrounding water table.

Procedure



1. Since students will be measuring velocity during the field trip, practice your own stream flow determination in the halls of school! All you need are timers or watches with chronometers, a measuring tape, and oranges. Determine whatever distance you want the oranges to travel and set up three lanes.

2. Assign at least one student at the start and the finish of each orange lane equipped with timers/ watches.

3. Start the clocks, roll the oranges, and stop the time as each orange crosses the finish line.

4. Determine the velocity of each orange: **length ÷ time = velocity**.

5. Add the three results together, and divide by 3 to find the average velocity.

6. Since you are simulating measuring a stream, make up a depth and width for the calculation. Calculate the discharge or stream flow: **velocity x depth x width = stream flow^3.** The answer will be in cubic feet per second. Your students are now prepared for the real thing!

Assessment

Ask the students to:

- ❑ Determine the flow of a local waterway
- ❑ Teach *Have Orange will Travel* to younger students
- ❑ Summarize the relationship between water quantity and DO quantities

Preparing for the Field Study Station

Familiarize students with station equipment listed in the Resource Specialist section.

Copy *Water Chemistry* (DO, pH, temperature) and *Stream Flow* worksheets, one per student; use waterproof paper, if available.

Students must save worksheets for post work!

Classroom Post-work

1. Explore the EPA standards for water quality testing and compare the methods used during *What s in that $H_2$0*?

2. Go to a local creek or other water body and sample the temperature, macroinvertebrate, pH, and dissolved oxygen levels. Compare with the water quality data collected from the *Kids in the Creek* stream. Will the water quality found in the results support wildlife? Write a report on the stream s status. Include rehabilitation ideas, to benefit the situation if needed. Turn it into a class project.

3. If possible, borrow an Enviroscape* model to demonstrate non-point and point source pollution. Non-point source pollution is the more detrimental because everyone contributes to it and it cannot be traced to or controlled at a single location. What point and non-point sources of pollution might be affecting your local creek? Automobile oil leaks, fertilizers, septic leaks, animal wastes, silt from

clear cutting vegetation, soaps used in washing cars and many other factors contribute to non-point source pollution. Industrial waste emerging from a pipe is an example of point source pollution. Many inputs of pollution are triggered by rain, which releases the substances down the stream and into the hydrologic cycle.

4. Test the water above and below suspected pollution sites, remembering that due to natural geology, nutrients and other substances may be normally high or low. Note the differences and create scenarios about what and who polluted the area, and when. Study your local watershed and notice what is being swept downstream!

Wrap Up

Discussion ideas:

- Where does your drinking water come from? The majority of Washington s drinking water comes from ground water.
- Why are watershed influences so important? Refer to Watershed Wonders.
- How do changes in water quality and quantity affect stream ecology? Water temperatures and chemistry, affected by water quantity and pollution, can drastically alter stream quality.
- What changes might affect stream ecology? *Temperature, turbidity, levels of dissolved oxygen, nitrogen, phosphorous, pH*
- What aquatic species would be found in different water quality scenarios? Refer to Riparian Rx, Invert Investigator.

Assessment

Ask the students to:

- ❑ Discuss requirements of aquatic life and influences of local land use practices.
- ❑ List examples of natural and human activities that positively and negatively influence levels of turbidity, dissolved oxygen, pH, and temperature.
- ❑ Discuss answers relating to this section in the *Kids in the Creek Scavenger Hunt.*

Extension

Write a land use plan that improves the future water quality of a local stream. Contact an area conservation district, state department of fish and wildlife, or Natural Resources Conservation Service office for comparative data.

** To borrow an Enviroscape, call USFWS 509.548.7641 or to purchase one call: 703.631-8810*

Water is Used and Used!

(30 minute activity)

Objectives

Students will be able to:
1) List how water is used in their community
2) Describe water-saving conservation measures

Materials

Per table:
- ❑ 1 gallon carboy with spigot (sun tea container will work)
  - 3750 *ml* of water for 5 students
  - 3000 *ml* of water for 4 students
  - 2250 *ml* of water for 3 students
  - 1500 *ml* of water for 2 students
- ❑ 5 small containers with red and blue *ml* markings
  - red 5 *ml*, 40 *ml,* 100 *ml,* 200 *ml*
  - blue 4*ml*, 38 *ml*, 80 *ml*, 160 *ml*
- ❑ 5 one-quart bowls

Background

We unconsciously turn on the tap many times per day. How much water do we really use? Precious water will be available for people and wildlife needs if we all share. Wildlife naturally conserves. It is up to us to do the same so our wild neighbors will survive even during drought years. Conservation is easily attained and begins with each person becoming aware of how much they use on a regular basis. This activity is a step toward that realization.

Procedure

1. On a board in front of the classroom, write the following headings: home, school, farm, grocery store, and computer business.

2. Ask students how much water each of these use in gallons daily. Tell them that 5 gallons of water is used with each flush of the toilet. Most people use at least 12 gallons of water per shower. It takes about 30 gallons of water to wash the dishes.
3. Give students an assignment to go home and calculate the amount of water used for their household needs. List findings and extrapolate what that means for the entire class, for the school, and for the whole community. Have them call a local utility company to find out what the local household average truly is.

4. With a new perspective from home, write down 3 guesses per heading.

Procedure
continued

5. Ask how water is used at each of the locations. Write the following answers at the bottom of the list of guesses:
   Single family house — 250 gallons per day
   (compare to the utility company s amount)
   Elementary school — 2,100 gallons/day
   Grocery store — 5,000 gallons/day
   Farm — 100,000 gallons/day
   Computer business — 600,000 gallons/day
   Compare these numbers to actual amounts, if there is time for further research.

6. Discuss water uses for each heading.

7. At the tables...
   (This portion of the activity may be modified based on the water usage numbers the students list in the board activity. Adjust the amount of water in the carboy for the number of students and projected total usage. There should be just enough water in the carboy for the exercise. This way, if students are not precise, they will soon run out of water).

Station no more than 5 students at each table. Explain that they will simulate water usage in the activity.

The carboy at the end of the table is their reservoir. They may NOT tip it.

- ❑ Explain that 5 ml=250 gallons. Ask them to predict the amount of mls of water they will need to simulate the usage of a household.
- ❑ Give them time to work through the figures.
- ❑ To simulate use, they will have to use the small measuring containers with red marks to fill up the quart bowls to the amount needed.
- ❑ They may not share water with others.
- ❑ Once water is removed from the reservoir, it may not be put back in.
- ❑ Groups using too much water become Water Hogs.
- ❑ Was everyone able to meet the daily demand without tipping the reservoir?
- ❑ Thinking back on the water usage information on the board, how can each student cut water consumption, so the reservoir is not depleted?
- ❑ Try the experiment again with the small containers with blue marks.

Wrap Up

Discuss the importance of conserving water and the fact that it is a recycled, finite resource. Predict the amount of water used by community resources.

Assessment

Ask students to list five ways water can be conserved in their daily lives.

Extensions

- ❑ Have students monitor water usage at school. For example, how may flushes occur during a certain period of time, how long the water runs at the cafeteria, how many showers are taken at the gym, the amount of water needed for watering plants in the schoolyard, etc.

- ❑ Divide students into research groups and brainstorm local businesses they would like to learn more about. Ask them to predict the water consumption. Then learn how close the predictions are by interviewing, conducting site studies, and calling the utility companies. Local agriculturists might be included, especially for a comparison of the different water delivery systems. To calculate water usage: amount of water per hour x the amount of hours per day the irrigation system is being used x the number of days per month.

This activity was adapted for Kids in the Creek with permission from the Vancouver Water Resources Education Center, Vancouver, WA (360.696.8478)

Student Section

Water Quality Section

Name ____

River or Creek _____________________ Date ________

Temperature
My Prediction___________ Results___________

What would raise the temperature of our Creek?

Turbidity
My Prediction___________ Results___________
How is turbidity related to temperature?

pH
My Prediction___________ Results___________
What could change the pH of our creek?

Dissolved Oxygen (DO)
My Prediction___________ Results___________
What factors contribute to this level of DO?

Productive DO Levels
Cold water organisms .... 6 ppm or above
(salmon, trout, mayflies, caddisflies, stoneflies)

Warm water organisms
(bass, carp, catfish) .... 5 ppm or above

How are temperature and DO related?

How does an increase in turbidity affect DO?

Does our creek have adequate DO for salmon and trout?

At what pH do most organisms prefer to live?

Streamflow Measurements: Calculations Worksheet

Name ____

River or Creek ______________________ Date __________

Do each measurement three times

Flow _______ft. ÷______________________ = __________________ft. per second
(distance) (total seconds to float ___ft.) (distance floated per second)

Flow _______ft. ÷______________________ = __________________ft. per second
(distance) (total seconds to float ___ft.) (distance floated per second)

Flow _______ft. ÷______________________ = __________________ft. per second
(distance) (total seconds to float ___ft.) (distance floated per second)

Total _____________ft. ÷ 3 = _________________ft. per second
(ft. per second) (ft. per second average)

Width ________________ft.

________________ft.

________________ft.

Total ________________ft. ÷ 3 = _________________ft. (average width)

Depth ________________ft.

________________ft.

________________ft.

Total ________________ft. ÷ 3 = _________________ft. (average depth)

_________ft. x _________ x ____________ = __________________ft. per second
(avg. width) (avg. depth) (# ft. per second) (cubic ft. water flowing per second)

1. How does velocity affect a stream?

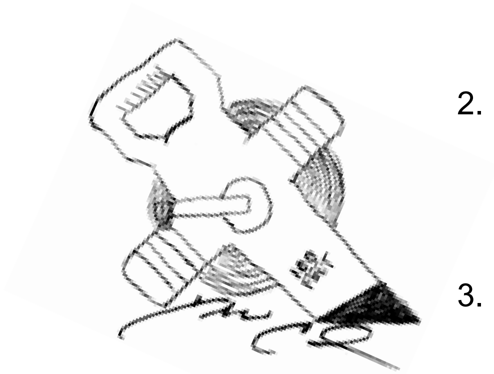
2. What influences velocity and the volume of water?

3. How is the volume of water affected by the stream s geomorphology?

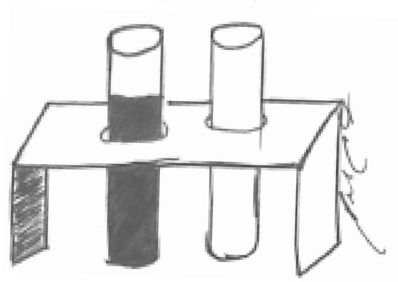
4. Give examples of how humans alter the natural flow of creeks or rivers.

Resource Specialist Section

1. Review *Tips and Tricks for Resource Specialists* in the Appendix.



2. Read the entire *What s In That H_20* section to become familiar with the pre-work. You will then have an idea of what the student knows. Always praise the classroom teacher for prepared students!



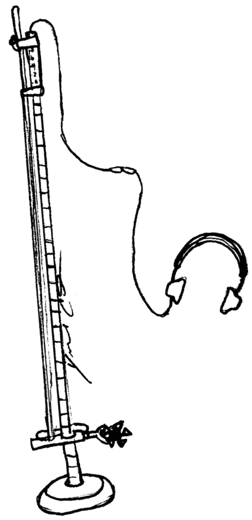
3. Checklist of equipment necessary for this station:
   - ❑ One 100 ft./meter measuring tape
   - ❑ Clear vials containing different turbidity standards (0, 5, 20)
   - ❑ pH kit
   - ❑ 8 ft. measuring stick for depth
   - ❑ Dissolved oxygen kit
   - ❑ Thermometer
   - ❑ Stopwatch and three oranges for flow measurements
   - ❑ An easel or white erasable board and marking pens to work calculations with students
   - ❑ Student field worksheets (see student section) provided by the teacher; you might have extra worksheets copied on write-in-the rain paper just in case.
   - ❑ Waders for yourself and students. (You are only responsible for providing your own.)

4. Directions to students:
   Keep on waders through the water quality station; they can rinse in the stream later.

Procedure

Gather students. Divide them into two groups. One group conducts water chemistry testing. Ask them about the river s water quality and to predict DO, temperature, pH, and turbidity levels of the stream. What organisms can tolerate that quality? Where does your drinking water come from? Have students gather samples for data on:

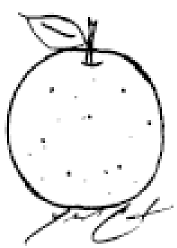
- ❑ Dissolved oxygen and temperature
- ❑ pH and turbidity



The second group measures stream flow.

- ❑ Ask students to predict the flow.
- ❑ Take 1 length, 3 width, and 3 depth measurements of the reach selected.
- ❑ Measure the reach three times in different locations in the reach, if time allows, using the worksheet provided in the Student Section.
- ❑ Begin at the top of the reach. Float the object (orange, cone, etc.) to the reach s end. Ascertain the velocity and do the calculations to derive flow.
- ❑ If possible, compare the data with a flow meter.

Students switch places after 20 - 25 minutes.
Use the student worksheets for data results.



Let students go for it!

In student directed learning, you are not the informer, but rather the guide. Be there to answer questions and help if students need it. Once each test is complete, or while they are waiting, ask them to answer questions on the worksheet.

- ❑ Watch for teachable moments connecting visible wildlife and riparian vegetation with the data results and discussing land use practices affecting water quality.
- ❑ Take the time for students to report findings. Ask if the original predictions proved correct. What are mitigations for poor water quality? Mention that the time and season could influence test results. Go over answers to the questions and relate your experiences in the field of water quality. Discuss their results, especially as they relate to fish and wildlife. Brainstorm the components of a watershed. What are its boundaries? How does geomorphology influence the watershed?