INTRODUCTION

Water is in the news every day. The issue may be a drought, flood, or transporting or sale of water to another state. Water is our most important renewable resource. We can go for days without eating food, but we can survive only a short time without drinking water. No animal or plant can survive without water. Even industry, food production, comfort and recreation are dependent upon water. Therefore, we need to understand water's characteristics to make wise decisions about its use.

THE ACTIVITIES	TIME REQUIRED
Determine Watershed Boundaries	15 to 20 minutes
Collect and Identify Aquatic Life	30 to 45 minutes
Predict Water Characteristics from Aquatic Animals	20 minutes
Measure Water Characteristics to Test Predictions	30 to 45 minutes
Measure Water Volume of a Stream or Pond	45 minutes

COMBINING THE ACTIVITIES

The activities in this chapter are displayed singly. Depending upon your time and the skill of your audience, you may choose to do only one activity or the entire series. For maximum learning, do the activities in the order listed in the unit. Other suggestions are:

Title: Collect Aquatic Life/Identify Aquatic Life/Predict Water Characteristics from Aquatic Animals /Test Predictions

Introduction: We are going to collect and identify aquatic life in a specific water environment and then use the kinds of life found to make predictions about the physical characteristics of the water. We then will use some simple testing equipment to validate our predictions.

Activity: Collect Aquatic Life

Transition Statement: Use the Pond Life books, and the drawings of aquatic life on the back of the activity sheet to identify as many of the aquatic animals collected as possible.

Activity: Identify Aquatic Life

Transition Statement: Based on the aquatic animals found and the tables on the back of the activity, predict the temperature, pH, and dissolved oxygen content of the water.

Activity: Predict Water Characteristics from Aquatic Animals

Transition Statement: Let's check out our predictions using some simple water test kits.

Activity: Measure Water Characteristics to Test Predictions

Transition Statement: What can we say about the characteristics that we did to help you discover these ideas?

CURRICULUM RELATIONSHIPS

Social Studies

1. Read and discuss how the quality of rivers and streams in your community has changed since the area was first settled. Have they remained pure or become polluted? Are they free-flowing or impounded by dams and channelization?
2. Find out your town or city's water source. Why was this source chosen? Did landforms influence the selection?
3. Find out how much it costs to have each gallon of water delivered to your home or school. How else is water used in your community? Does industry pay more or less for water than you?
4. Discuss the role that rivers and streams play in the location and settlement of your town or city.
5. Read and discuss how the political boundaries of states, counties, and cities affect rivers' management.
6. Explore a pond or lake that has died (filled up with organic and inorganic matter). Talk to long-time residents about what they remember about the lake so you can trace its history.
7. Observe the topography and steam drainage patterns on a topographic map of your area. How has the area's geology affected the stream's flow?
8. Take picnics with your family or class along a polluted, clean river, or stream. Which experience was more enjoyable? Why?
9. Find out why government agencies are concerned and involved in water quality management. Make a display about these agencies, their responsibilities and their work.

Science

1. Study how the water in your town or city is purified before you use it. What happens to water after it is used in your community?
2. Explore how water is used for cleaning purposes.
3. Study and compare how aquatic life differs in a stream environment compared to a pond or lake environment.
4. Construct a chart showing some aquatic animals that can stand various degrees of water pollution in relation to the degree of pollution.
5. Find out how rural dwellers get their water. How is it treated before and after it is used?

Mathematics

1. Calculate and compare the flow of water from different streams. Locate a stream that would support just your city?
2. Construct a graph to show your city's increase in water use over the past 50 years.
3. Read about the various units of measurement in water work.
4. Develop a pH scale range correlated with some common liquid products such as orange juice, vinegar, and bleach.

Language Arts

1. Describe the anatomy of a stream from source to mouth.
2. Write about the different ways oxygen gets into water.
3. Write about the differences between the biological, chemical and physical qualities of water.
4. Write a story about the birth or death of a pond.
5. Aquatic Wild has several good activities involving water and writing, including "Water Words."

Creative Arts

1. Construct an abstract sketch or painting of the water cycle.
2. Sketch a map of the route a stream near you takes to the ocean. Name the larger stream and watershed it joins.
3. Sketch a spot along a stream at different times of the year.
4. Draw detailed sketches of different aquatic insects collected.

DETERMINE WATERSHED BOUNDARIES

CONCEPT System, Cause/Effect, Change

PRINCIPLE Determining watershed boundaries on a map can enlarge one's understanding of watersheds, ecosystems and community. This activity takes a student from where they are standing to the concept of this particular stream and its watershed.

OBJECTIVE

- The student will be able to identify and describe a watershed for a specific stream or river.
- The student will be able to identify how certain land uses can affect the quality of water.

PREPARATION Select a study area watershed: (l) a ridge of high land dividing two areas that are drained by different river systems (2) the region draining into a river, river system, or a body of water.

MATERIALS NEEDED One for every three to four people

- Topographic maps, aerial photographs or good planimetric maps of the watershed to be studied, one for every 3-4 people
- pencils
- Activity Sheet A: Describe a Watershed, B: What is a Watershed

PROCESSES USED

- Observe
- Communicate
- Infer
- Define Operationally
- Hypothesize

TIME 15 to 20 minutes

ACTIVITY A: Describe a Watershed

15 min.
small groups

Describe what you think is meant by a watershed : _____

_____

_____

_____

_____

Find your location on the creek (pond, lake) on a map of your area.

Where does the water come from? _____

_____

Where does it go? _____

_____

Draw lines around the boundaries of our watershed. We're in the watershed. _____

What activities in this watershed might change the characteristics of this water?

Activity	Ways the activity might change the characteristics of the water

ACTIVITY B: What is a Watershed

5 min.
individual

What is a WATERSHED?

"Watershed" is a new term to many people. The increasing use of soil and water conservation measures for watershed protection and flood prevention is bringing the term into more common use. Its definition is almost as simple as the well-known phrase "water runs downhill."

The drainboard that carries rinse water into your kitchen sink can be compared to a watershed.

On the land, water that does not evaporate or soak into the soil usually drains into ditches, streams, marshes, or lakes. The land area from which the water drains to a given point is a watershed.

When you were a small child, you probably had a favorite mud puddle in which you liked to play. The part of the yard from which the water drained into the puddle was its watershed.

Possibly a small stream ran by your house. It may have been dry most of the year or it may have flowed continuously.

Water from a few acres drained into that little stream. Those few acres were its watershed. This small stream and others like it ran into a larger one. The land areas drained by the small streams made up the watershed of the larger stream into which they flowed.

Small watersheds make up the larger ones. The Mississippi River, for example, drains a watershed of about 1,243,000 square miles.

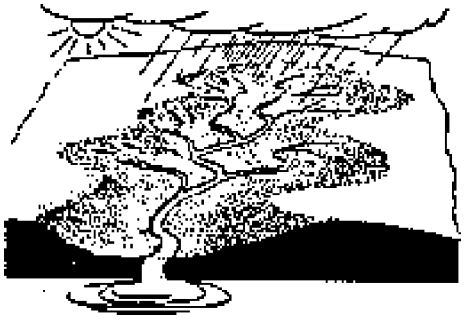


Diagram of a watershed showing the drainage pattern.

DOING THE ACTIVITY (indoors)

A. Set the Stage
In order to talk about the water in a river or stream, we also need to be able to talk about the land that affects or is affected by the water.

B. Procedure
1. Distribute the activity sheet and map.

DESCRIBE A WATERSHED Work in small groups 15 min.

Describe what you think is meant by a watershed :_____

Find your location on the creek (pond, lake) on a map of your area.

Where does the water come from? _____

Where does it go? _____

Draw lines around the boundaries of our watershed. We're in the _____ watershed.

What activities in this watershed might change the characteristics of this water?

Activity	Ways the activity might change the characteristics of the water

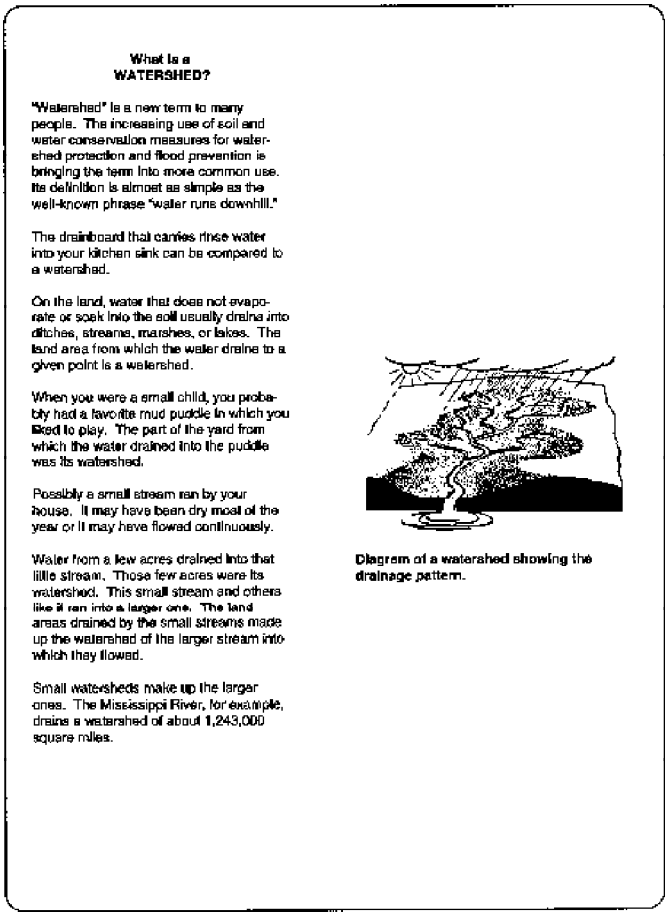
2. Tell them to work in small groups and tell them they have 15 minutes to fill out the sheet.

C. Retrieve Data

In a discussion, ask:

1. What is a watershed?
2. What are the boundaries of this watershed?
3. Where does the water come from? Where does the water go to?
4. What activities could change the characteristics of the water?
5. What would be some reasons for looking at watershed boundaries on a map?

CLOSURE Distribute "What is a watershed?" sheet and ask group to review.



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Small watersheds make up the larger ones. The Mississippi River, for example, drains a watershed of about 1,243,000 square miles.

Diagram of a watershed showing the drainage pattern.

Ask:

1. How can we summarize the concept of watersheds?
2. Can a watershed be part of a larger watershed? Explain.

TRANSITION We have used maps to understand the concept of watershed. Now let's look at a particular stream in this watershed and see what animals consider this stream home.

ACTIVITY C: Observe & Collect Aquatic Life

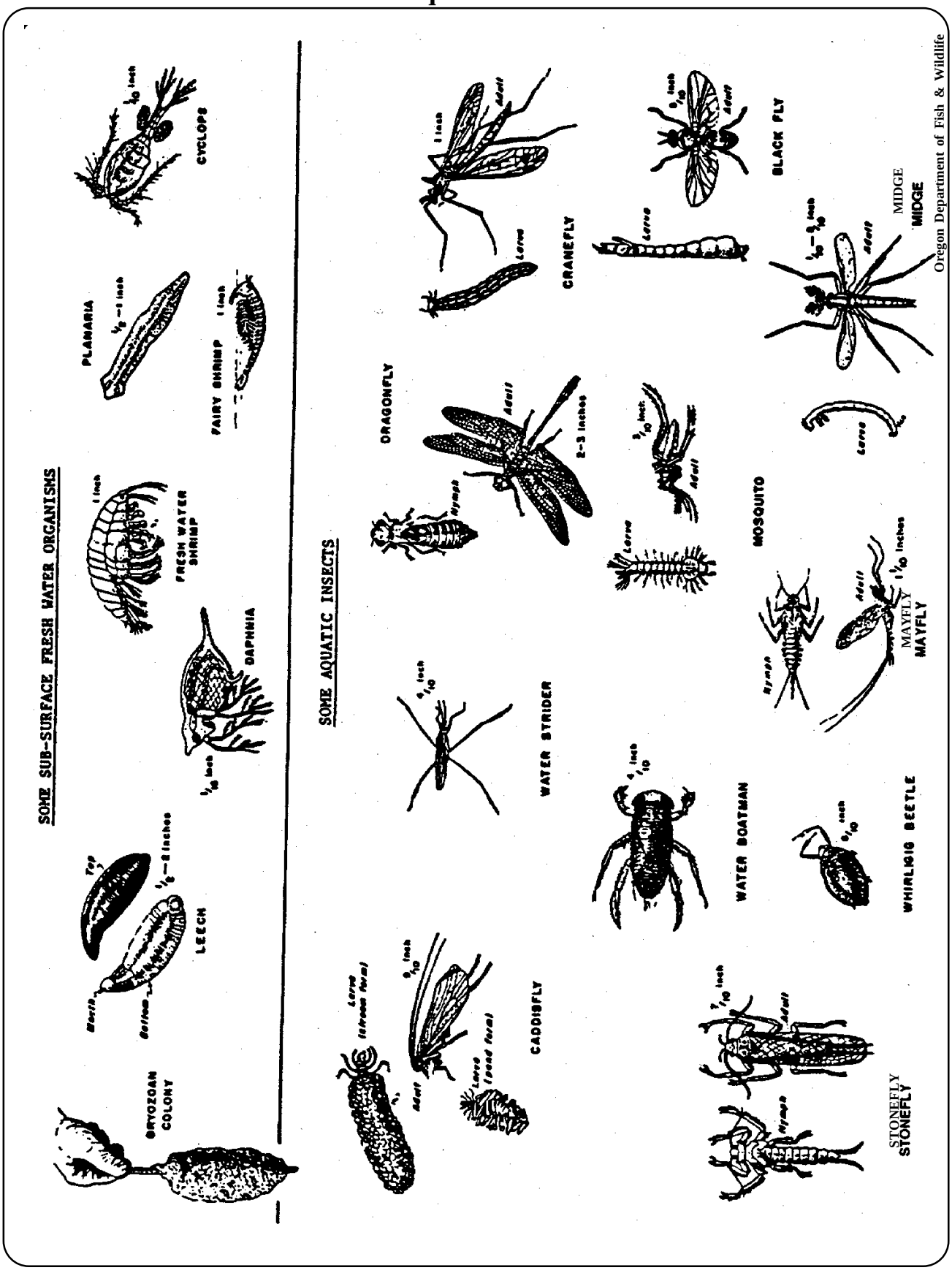
30 min.
small groups

Using the "Golden Nature Guide Pond Life" books or similar field manuals or attached picture keys, generally identify the specimens you found.

List or sketch the animals you found below. Return animals to water as soon as finished.

Type (name or sketch)	Description of where found	No.	Name

HANDOUT FOR ACTIVITY C: Aquatic Insects



COLLECT AND IDENTIFY AQUATIC LIFE

CONCEPT Aquatic animal life is not well known or studied at this age level. This activity gives participants the opportunity to look at water in any form as habitat and to identify animals found there.

PRINCIPLE Organism, Population, Interaction

OBJECTIVE
- The student will be able to collect aquatic life from a stream or pond.
- The student will be able to identify some of the aquatic life they collected from the water.

PREPARATION Locate a stream and make sure it contains some aquatic life in it.

MATERIALS NEEDED One for every four people:
- White dishpans
- Jelly cups/baby food jars/clear pill bottles
- Screens
- Dip nets
- Pond Life (Golden Nature Guide) books
- Activity Sheet C: Observe & Collect Aquatic Life with Aquatic Insect sheet on back

PROCESSES NEEDED
- Observe
- Predict
- Hypothesize
- Classify

TIME 30 to 45 minutes, depending upon how the search is going

DOING THE ACTIVITY (outdoors)

A. Set the Stage

Life in a stream can tell us many things about the water it contains. In this activity, we will be finding out what lives here. Ask questions to get participants thinking. What kind of life would you expect to find in this water environment? Where would you expect to find them?

B. Procedure

1. Hand out the activity sheet.

OBSERVE & COLLECT AQUATIC LIFE Work in small groups 30 min.

Using the "Golden Nature Guide Pond Life" books or similar field manuals or attached picture keys, generally identify the specimens you found.

List or sketch the animals you found below. Return animals to water as soon as finished.

Type (name or sketch)	Description of where found	No.	Name

2. Make sure each group has a set of equipment.
3. Tell the students:
   Using this equipment, collect as many types of aquatic animals as possible. Put them in the white pans containing water, and let the group observe them. Identify as many of the animals as possible using the "Pond Life" books and the drawings on the back of the activity sheet. Return the animals to the water as soon as you are finished. Be careful not to unduly disturb the water environment.

C. Retrieve Data

In your discussion, ask questions such as: What animals did you find? Where did you find most of them? What other life would you expect to find in this stream? What might account for the differences in the numbers from place to place?

CLOSURE You have collected and identified some aquatic insect life of this stream. What other life would you expect to find in this stream?

TRANSITION Sometimes animals in their environment tell us how healthy or unhealthy an environment is just by their presence. In the next activity, we'll look more deeply at water characteristics using the aquatic animals we found as indicators.

PREDICT WATER CHARACTERISTICS FROM AQUATIC ANIMALS FOUND

CONCEPT Cause/Effect, Change, Interaction

PRINCIPLE A healthy environment can be indicated by what animals live there. Likewise, an unhealthy environment can be indicated by what does not live there. Specific animals are often used as indicators to determine the health of a particular environment is. In this activity, participants predict the health of their aquatic environment using animal indicators.

OBJECTIVE

- The student will be able to analyze and predict water characteristics based on the life requirements of aquatic life collected from a stream or pond.

PREPARATION Completion of previous activities by participants
pH: the measure of the acidity or alkalinity of a solution (or soil). Numerically, pH equals 7 for a neutral solution; less than 7 for acid solutions and more than 7 for alkaline solutions.
Dissolved oxygen: (DO) amount of usable oxygen dissolved in a stream, lake, ocean or other body of water. DO is written as parts per million (ppm) and is essential to fish and aquatic life. Must be 4 ppm for aquatic life to live.

MATERIALS USED One for each group of three to four:

- selection of aquatic animals from previous activity if following activity
- Activity Sheet D: Predict Water Characteristics

PROCESSES USED

- Classify
- Observe
- Infer
- Hypothesize
- Interpret data
- Predict

TIME 20 minutes

DOING THE ACTIVITY (outdoors, indoors)

A. Set the Stage

Many aquatic organisms have specific needs to support their life functions. The presence or absence of various plants and animals can be used to make educated guesses about water characteristics of a stream. In this activity, we will see how well we can predict some water quality factors based on what lives there.

B. Procedure

1. Handout activity sheet

PREDICT WATER CHARACTERISTICS Work in small groups. 10 min.

Based on the aquatic animals you found, the tables below in the Aquatic Data section, and your observations, predict the following characteristics of this stream.

I predict: the water temperature will be _____ because _____
the air temperature will be _____ because _____
the pH will be _____ because _____
the dissolved O_2 count will be _____ because _____
I can see about _____ ft. down into the water.
The color of the water is _____

Keep these predictions for future use.

Table a: TEMPERATURE RANGES (APPROXIMATE) REQUIRED FOR CERTAIN ORGANISMS

Temperature (Fahrenheit)	Examples of life
Greater than 68° (warm water)	Much plant life, many fish diseases. Most bass, crappie, bluegill, carp, catfish, caddis fly.
Middle range (55-68°)	Some plant life, some fish diseases. Salmon, trout, stone fly, mayfly, caddis fly, water beetles.
Low range (cold-less than 55°)	Trout, caddis fly, stone fly, mayfly.

Table b: pH RANGES THAT SUPPORT AQUATIC LIFE

	MOST ACID 1 2 3 4 5 6	NEUTRAL 7 8 9 10 11	MOST ALKALINE 12 13 14
Bacteria	1.0		13.0
Plants (algae, rooted, etc.)		6.5	12.0
Carp, suckers, catfish, some insects		6.0 9.0	
Bass, crappie		6.5 8.5	
Snails, clams, mussels		7.0 9.0	
Largest variety of animals (trout, mayfly, stone fly, caddis fly)		6.5 7.5	

Table c: DISSOLVED OXYGEN REQUIREMENTS FOR NATIVE FISH AND OTHER AQUATIC LIFE

Examples of Life	D.O. in parts per million o/milligrams per liter
Cold-water organisms including salmon and trout (below 68° F.). Spawning, growth and well-being (caddis fly, stone fly, mayfly)	6 ppm and above
Warm-water organisms including game fish such as bass, crappie, catfish and carp (above 68° F.) Growth and well-being (some caddis fly)	5 ppm and above
Note: Pure, cold water can hold a maximum of 16 ppm under field conditions	

2. Instruct group to make predictions based on the kinds of aquatic life found. Tell them they have 10 min.

C. Retrieve Data

What were their predictions? Why?

CLOSURE None

TRANSITION Your predictions are the base data from which you will continue with the next activity--testing what you have just hypothesized.

TABLE A: Relationships of water color to productivity

The quantity of life that may be present in any given body of water at any given time is often referred to as the "productivity." A water of low productivity is a poor water, biologically speaking, but is a clean water and desirable as a water supply or for recreational use. A productive water may be either a nuisance to man or it may be highly desirable. Foul odors and weed-chocked waterways are usually branded a nuisance; however, bumper crops of bass, catfish or sunfish may be the result and are highly desirable.

Color of Water	Probable Cause	Fish Food Productivity
Clear	Absence of algae and micro-organisms	Low
Greenish hue	Blue-green algae	Moderate
Yellow to yellow-brown	Diatoms (microscopic, one-celled algae)	Moderately high
Red	Micro-crustaceans	High
Dark Brown	Peat, Humus	Low
GEOLOGICAL FACTORS HAVING BEARING ON COLOR		
In limestone geology Green	Abundant calcium	Moderate
In volcanic geology Yellow-green, Red	Abundant sulfur Abundant iron	Low Moderate

Table b: Relationships of Water Clarity to Fish Food Production and Watershed Condition

Depth you can see into water (Secchi disk reading)	Interpretations of Depth Readings		
	Fish Food Production (If reasons for degree of clarity are biological-algae, etc.)	Condition of Watershed above Water Readings (If reasons for degree of clarity are physical-soil situation, etc.)	Possibility of Dissolved Minerals
0" - 6"	Most productive waters for fish food Maximum oxygen from photo-synthesis (greatest diurnal variation) Maximum algae growth	Poor condition due to soil runoff, slides, etc.	Most
24"+	Least productive for fish food Minimum oxygen from photo-synthesis (least diurnal variation Minimal algae growth	May indicate better condition because of vegetation cover-more stable soil, etc..	Least

MEASURE WATER CHARACTERISTICS TO TEST PREDICTIONS

CONCEPTS Cause/Effect, Cycles, Change, Interaction

PRINCIPLE Predictions are often scientifically based hypotheses. Participants have the opportunity to use instruments that scientists use to evaluate a habitat. In this activity, participants will use these instruments to compare their predictions to actual measurements.

OBJECTIVE

- The student will be able to measure the physical characteristics of water in a stream or pond using scientific instruments.
- The student will be able to compare the results of scientific measuring to his/her predictions.

PREPARATION Use predictions about the physical characteristics of a stream or pond from the previous activity.

MATERIALS NEEDED One for every four people

- Thermometer
- Hach water test kit
- Activity Sheet E: Check Out Your Inferences and Table A: Relationship of Water Color to Productivity
- Secchi disk & rope

PROCESSES USED

- Measure
- Interpret data
- Use numbers
- Hypothsize
- Predict

TIME 30 to 45 minutes

DOING THE ACTIVITY (outdoors, aquatic environment)

A. Set the Stage

One way to test a prediction about water characteristics is to use a water test kit to actually measure those characteristics. That is what you are going to do in the next 45 minutes.

B Procedure

1. Hand out activity sheet and Tables A and B.
2. Make sure each group has one set of equipment.

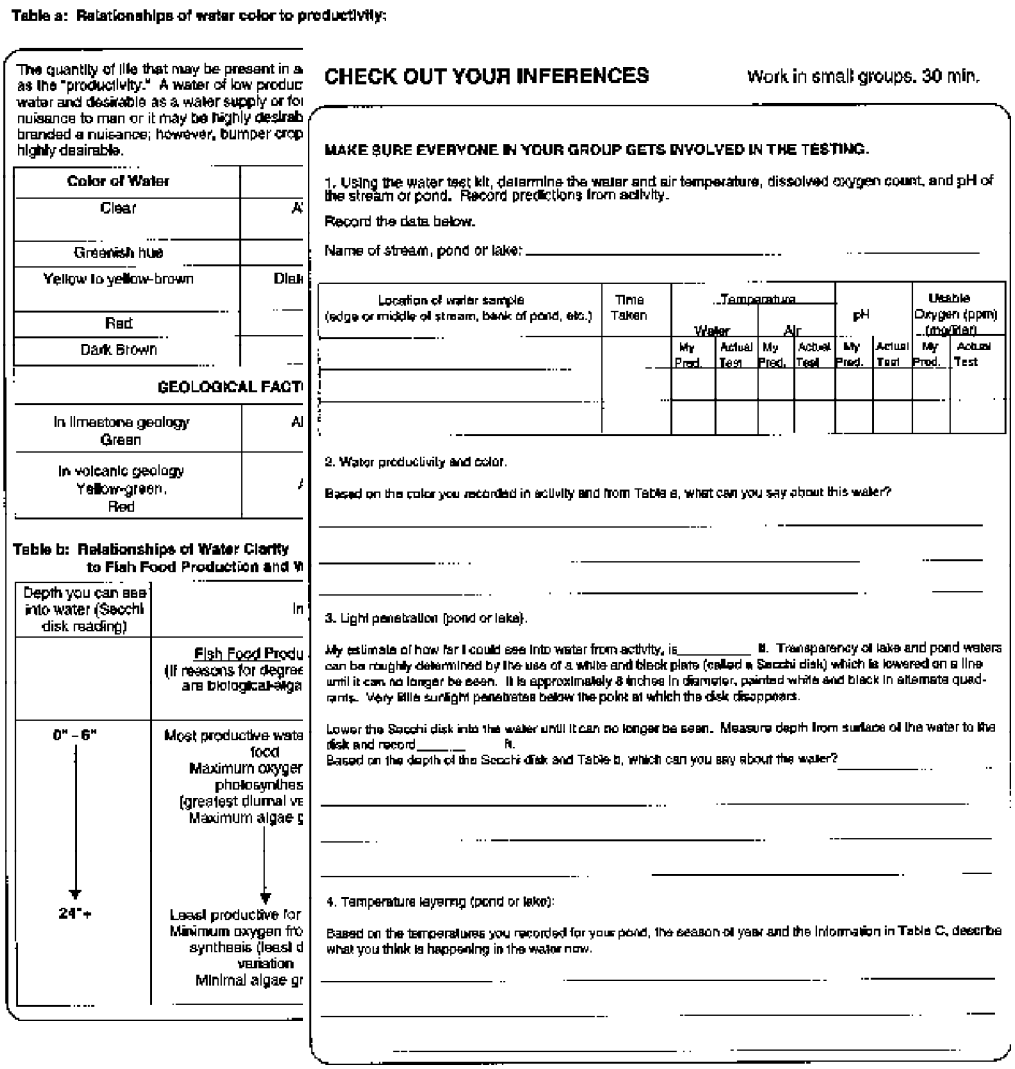


Table a: Relationships of water color to productivity:

The quantity of life that may be present in a
as the "productivity." A water of low produc
water and desirable as a water supply or fo
nuisance to man or it may be highly desirab
branded a nuisance; however, bumper crop
highly desirable.

Color of Water	
Clear	A
Greenish hue	
Yellow to yellow-brown	Diat
Red	
Dark Brown	
GEOLOGICAL FACT	
In limestone geology Green	Al
In volcanic geology Yellow-green, Red	

Table b: Relationships of Water Clarity to Fish Food Production and W

Depth you can see into water (Secchi disk reading)	In
	Fish Food Produ (If reasons for degree are biological-lega
0" - 6"	Most productive wate food Maximum oxyger photosynthes (greatest diurnal ve Maximum algae g
24"+	Least productive for Minimum oxygen fro synthesis (least d variation Minimal algae gr

CHECK OUT YOUR INFERENCES Work in small groups. 30 min.

MAKE SURE EVERYONE IN YOUR GROUP GETS INVOLVED IN THE TESTING.

1. Using the water test kit, determine the water and air temperature, dissolved oxygen count, and pH of the stream or pond. Record predictions from activity.

Record the data below.

Name of stream, pond or lake: _____

Location of water sample (edge or middle of stream, bank of pond, etc.)	Time Taken	Temperature				pH		Usable Oxygen (ppm) (mg/liter)	
		Water		Air					
		My Pred.	Actual Test	My Pred.	Actual Test	My Pred.	Actual Test	My Pred.	Actual Test

2. Water productivity and color.

Based on the color you recorded in activity and from Table a, what can you say about this water?

_____

_____

_____

3. Light penetration (pond or lake).

My estimate of how far I could see into water from activity, is_____ ft. Transparency of lake and pond waters can be roughly determined by the use of a white and black plate (called a Secchi disk) which is lowered on a line until it can no longer be seen. It is approximately 8 inches in diameter, painted white and black in alternate quadrants. Very little sunlight penetrates below the point at which the disk disappears.

Lower the Secchi disk into the water until it can no longer be seen. Measure depth from surface of the water to the disk and record_____ ft.
Based on the depth of the Secchi disk and Table b, which can you say about the water?_____

_____

_____

_____

4. Temperature layering (pond or lake):

Based on the temperatures you recorded for your pond, the season of year and the information in Table C, describe what you think is happening in the water now.

_____

_____

_____

3. Tell the group they have 30 minutes to do the testing.
4. Instructions are on the inside of the test kit lid.

There are lots of jobs to be done — clipping, squirting, dipping, counting, and reading. Every one should participate in the testing. Record the test measurements beside the predictions. Spread out along the edge of the water so that each group is testing from a different location.

C. Retrieve Data

Compare test data with predictions.

1. What did we find out?
2. How did the test results compare with the predictions?
3. Under what conditions might you expect to get different results than you did today?
4. What can you say about the water quality of this stream or pond based on your test results?

CLOSURE

1. What have we found out about this stream so far?
2. What else would you need to know to decide whether or not to drink this water?

TRANSITION

We have collected aquatic organsims, used them to predict the quality of water, and tested the physical characteristics of this water. Have you ever stood on the edge of a river or stream and wondered how much water was there? Have you stood on a bridge, tossed in a stick, and rushed to the other side to see your boat float on by? If you have, then you have wondered about the volume of that body of water. In the next activity, you will have the opportunity to measure water volume.

MEASURE WATER VOLUME OF A STREAM OR POND

CONCEPT Quantification, Interaction

PRINCIPLE Using mathematical skills, participants measure the volume of their body of water and then calculate how many people could live off that water volume.

OBJECTIVE

- The student will be able to measure and calculate water volume for a stream.
- The student will be able to determine how many people could live off the water volume for one day.
- The student will be able to identify the environmental effects of diverting the water for domestic use.

PREPARATION Locate the study site. You may want more than one site.

MATERIALS NEEDED One for each group of three to four:

- String and other materials for group to problem solve with
- 50 foot or 100 foot measuring tape
- Watch with second hand
- Activity Sheet F: Determine Streamflow, G: Determine Stream Volume
- Pencil
- Calculator (optional)

PROCESSES USED

- Measure
- Use numbers
- Communicate
- Design experiments
- Interpret data

TIME 45 minutes

DOING THE ACTIVITY (outdoors)

A. Set the Stage

We have investigated some factors that relate to the quality of water of a stream. In this activity, we will be considering the quantity of water.

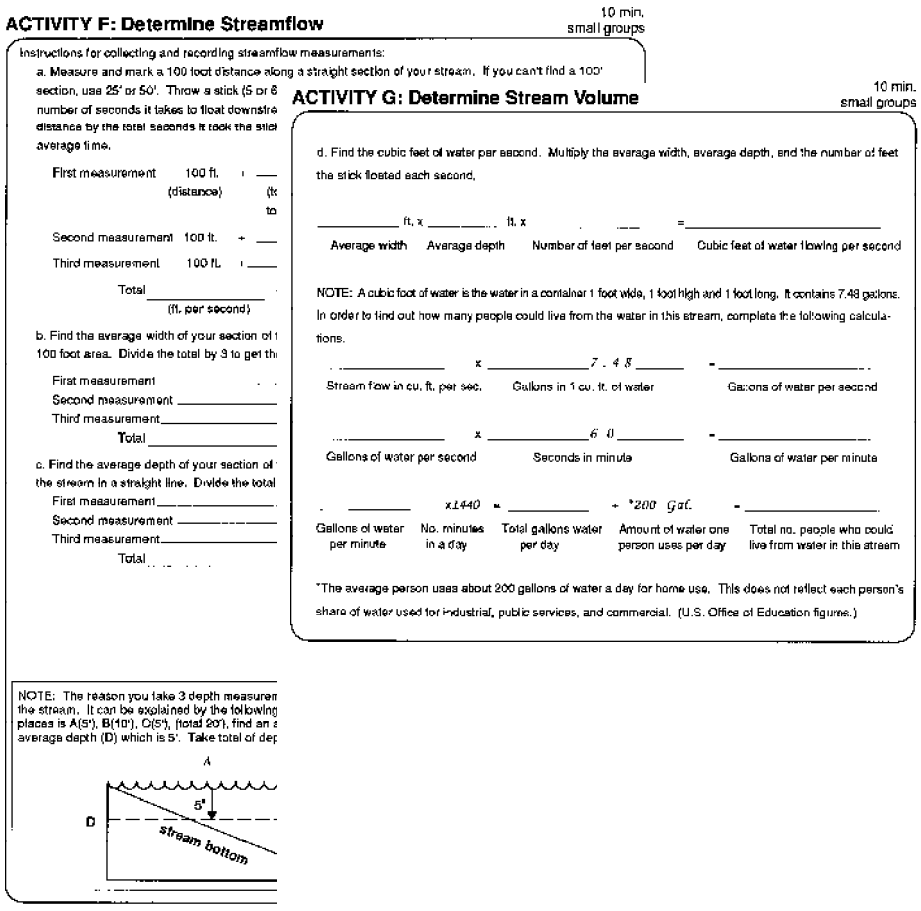
Ask:

How many people do you think could live off the water in this stream?

This prediction should be only domestic water use. What measurements do you need to know in order to determine the amount of water in this stream so you can validate your prediction? How can you make the measurements?

B. Procedure

Working in groups of three to four, follow the instructions on the activity sheet and calculate how many people could live off the water here.



ACTIVITY F: Determine Streamflow

10 min.
small groups

Instructions for collecting and recording streamflow measurements:

a. Measure and mark a 100 foot distance along a straight section of your stream. If you can't find a 100' section, use 25' or 50'. Throw a stick (5 or 6
number of seconds it takes to float downstre
distance by the total seconds it took the stick
average time.

First measurement 100 ft. ÷ ___ (distance) (ti
to
Second measurement 100 ft. ÷ ___
Third measurement 100 ft. ÷ ___
Total _____ (ft. per second)

b. Find the average width of your section of
100 foot area. Divide the total by 3 to get th

First measurement
Second measurement _____
Third measurement _____
Total _____

c. Find the average depth of your section of
the stream in a straight line. Divide the total

First measurement _____
Second measurement _____
Third measurement _____
Total

NOTE: The reason you take 3 depth measurem
the stream. It can be explained by the following
places is A(5'), B(10'), C(5'), (total 20'), find an
average depth (D) which is 5'. Take total of dep

A
D
5'
stream bottom

ACTIVITY G: Determine Stream Volume

10 min.
small groups

d. Find the cubic feet of water per second. Multiply the average width, average depth, and the number of feet the stick floated each second.

_____ ft. x _____ ft. x _____ = _____

Average width | Average depth | Number of feet per second | Cubic feet of water flowing per second

NOTE: A cubic foot of water is the water in a container 1 foot wide, 1 foot high and 1 foot long. It contains 7.48 gallons. In order to find out how many people could live from the water in this stream, complete the following calculations.

_____ x 7.48 = _____

Stream flow in cu. ft. per sec. | Gallons in 1 cu. ft. of water | Gallons of water per second

_____ x 60 = _____

Gallons of water per second | Seconds in minute | Gallons of water per minute

_____ x 1440 = _____ ÷ *200 Gal. = _____

Gallons of water per minute | No. minutes in a day | Total gallons water per day | Amount of water one person uses per day | Total no. people who could live from water in this stream

*The average person uses about 200 gallons of water a day for home use. This does not reflect each person's share of water used for industrial, public services, and commercial. (U.S. Office of Education figures.)

C. Retrieve Data

Conduct a discussion using the following questions:

1. How many people could live off this water for one day? (Have groups compare their results).
2. How did your predictions compare with your calculations?
3. What would happen to this environment if we piped all the water at this point to a community?
4. If we decided to use some of this water to support a community, how would we determine the amount to be left to maintain the environment?
5. What might affect the amount of water?
6. What else would we need to do if we wanted a more accurate result to determine the adequacy of this water for a community supply.

CLOSURE In this unit we have explored many different aspects of water. Share within your work group at least two new concepts or ideas you have learned. Look back at your original definitions of watershed. Can you expand upon that definition? How?

ACTIVITY F: Determine Streamflow

10 min.
small groups

Instructions for collecting and recording streamflow measurements:

a. Measure and mark a 100 foot distance along a straight section of your stream. If you can't find a 100' section, use 25' or 50'. Throw a stick (5 or 6 inches long) in the water above the upstream marker. Record the number of seconds it takes to float downstream between the markers. Record below. Now divide the 100 foot distance by the total seconds it took the stick to float between the stakes. Do this three times and use the average time.

First measurement 100 ft. " = ft. per second
(distance) (total seconds to float 100 ft.) (number of feet stick floated each second)

Second measurement 100 ft. " = ft. per second

Third measurement 100 ft. " = ft. per second

Total " 3 =
(ft. per second) (ft. per second average)

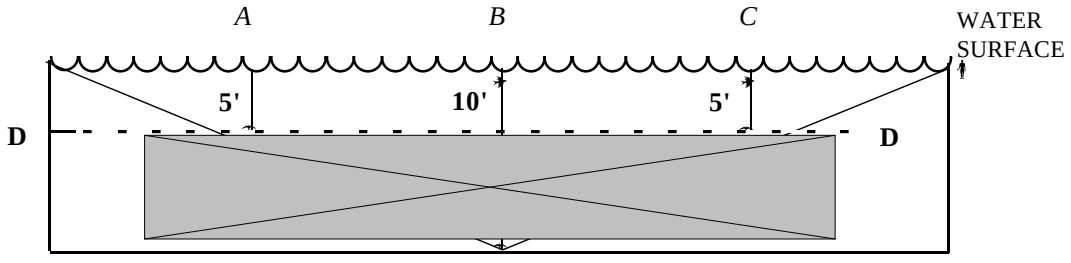
b. Find the average width of your section of the stream. Measure the width of the stream at 3 places within the 100 foot area. Divide the total by 3 to get the average width of the stream.

First measurement feet.
Second measurement feet.
Third measurement feet.
Total feet " 3 = ft. (average width)

c. Find the average depth of your section of the stream. Measure the depth of the stream in 3 places across the stream in a straight line. Divide the total by 4 to get the average depth of the stream.

First measurement feet.
Second measurement feet.
Third measurement feet.
Total feet " 4= ft. (average depth).

NOTE: The reason you take 3 depth measurements then divide by 4 is to take into account the shallow areas of the stream. It can be explained by the following example of a drawing of a stream cross-section. If depth in 3 places is A(5'), B(10'), C(5'), (total 20'), find an average by dividing by 3 (20'"3 = 6 2/3'). Now look at the mean or average depth (D) which is 5'. Take total of depths and divide by 4 (20'"4 = 5'), the correct average depth.



ACTIVITY D: Predict Water Characteristics

10 min.
small groups

Based on the aquatic animals you found, the tables below in the Aquatic Data section, and your observations, predict the following characteristics of this stream.

I predict: the water temperature will be _____ because _____
the air temperature will be _____ because _____
the pH will be _____ because _____
the dissolved O_2 count will be _____ because _____
I can see about _____ ft. down into the water.
The color of the water is _____

Keep these predictions for future use.

Table a: TEMPERATURE RANGES (APPROXIMATE) REQUIRED FOR CERTAIN ORGANISMS

Temperature (Fahrenheit)	Examples of life
Greater than 68° (warm water)	Much plant life, many fish diseases. Most bass, crappie, bluegill, carp, catfish, caddis fly.
Middle range (55-68°)	Some plant life, some fish diseases. Salmon, trout, stone fly, mayfly, caddis fly, water beetles.
Low range (cold-less than 55°)	Trout, caddis fly, stone fly, mayfly.

Table b: pH RANGES THAT SUPPORT AQUATIC LIFE

	MOST ACID					NEUTRAL					MOST ALKALINE			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Bacteria	1.0											13.0		
Plants (algae, rooted, etc.)						6.5						12.0		
Carp, suckers, catfish, some insects					6.0			9.0						
Bass, crappie						6.5		8.5						
Snails, clams, mussels							7.0		9.0					
Largest variety of animals (trout, mayfly, stone fly, caddis fly)						6.5	7.5							

Table c: DISSOLVED OXYGEN REQUIREMENTS FOR NATIVE FISH AND OTHER AQUATIC LIFE

Examples of Life	D.O. in parts per million or/milligrams per liter
Cold-water organisms including salmon and trout (below 68° F.). Spawning, growth and well-being (caddis fly, stone fly, mayfly)	6 ppm and above
Warm-water organisms including game fish such as bass, crappie, catfish and carp (above 68° F.) Growth and well-being (some caddis fly)	5 ppm and above

Note: Pure, cold water can hold a maximum of 16 ppm under field conditions

ACTIVITY G: Determine Stream Volume

10 min.
small groups

d. Find the cubic feet of water per second. Multiply the average width, average depth, and the number of feet the stick floated each second.

_____ ft. x _____ ft. x_____ = _____

Average width | Average depth | Number of feet per second | Cubic feet of water flowing per second

NOTE: A cubic foot of water is the water in a container 1 foot wide, 1 foot high and 1 foot long. It contains 7.48 gallons. In order to find out how many people could live from the water in this stream, complete the following calculations.

_____ x _____7.48 _____ = _____

Stream flow in cu. ft. per sec. | Gallons in 1 cu. ft. of water | Gallons of water per second

_____ x _____60 _____ = _____

Gallons of water per second | Seconds in minute_____ | Gallons of water per minute

____ _____ x1440 = _____ "*200 Gal. = _____

Gallons of water per minute | No. minutes in a day | Total gallons water per day | Amount of water one person uses per day | Total no. people who could live from water in this stream

*The average person uses about 200 gallons of water a day for home use. This does not reflect each person's share of water used for industrial, public services, and commercial. (U.S. Office of Education figures.)

30 min.

ACTIVITY E: Check Out Your Inferences

small groups.

MAKE SURE EVERYONE IN YOUR GROUP GETS INVOLVED IN THE TESTING.

1. Using the water test kit, determine the water and air temperature, dissolved oxygen count, and pH of the stream or pond. Record predictions from activity.

Record the data below.

Name of stream, pond or lake: _____

Location of water sample (edge or middle of stream, bank of pond, etc.)	Time Taken	Temperature				pH		Usable Oxygen (ppm) (mg/liter)			
		Water				Air					
		My Pred.	Actual Test	My Pred.	Actual Test	My Pred.	Actual Test	My Pred.	Actual Test	My Pred.	Actual Test

2. Water productivity and color.

Based on the color you recorded in activity and from Table a, what can you say about this water?

_____

_____

_____

3. Light penetration (pond or lake).

My estimate of how far I could see into water from activity, is_____ ft. Transparency of lake and pond waters can be roughly determined by the use of a white and black plate (called a Secchi disk) which is lowered on a line until it can no longer be seen. It is approximately 8 inches in diameter, painted white and black in alternate quadrants. Very little sunlight penetrates below the point at which the disk disappears.

Lower the Secchi disk into the water until it can no longer be seen. Measure depth from surface of the water to the disk and record_____ ft.
Based on the depth of the Secchi disk and Table b, which can you say about the water? _____

_____

_____

_____

4. Temperature layering (pond or lake):

Based on the temperatures you recorded for your pond, the season of year and the information in Table C, describe what you think is happening in the water now.

_____

_____

_____