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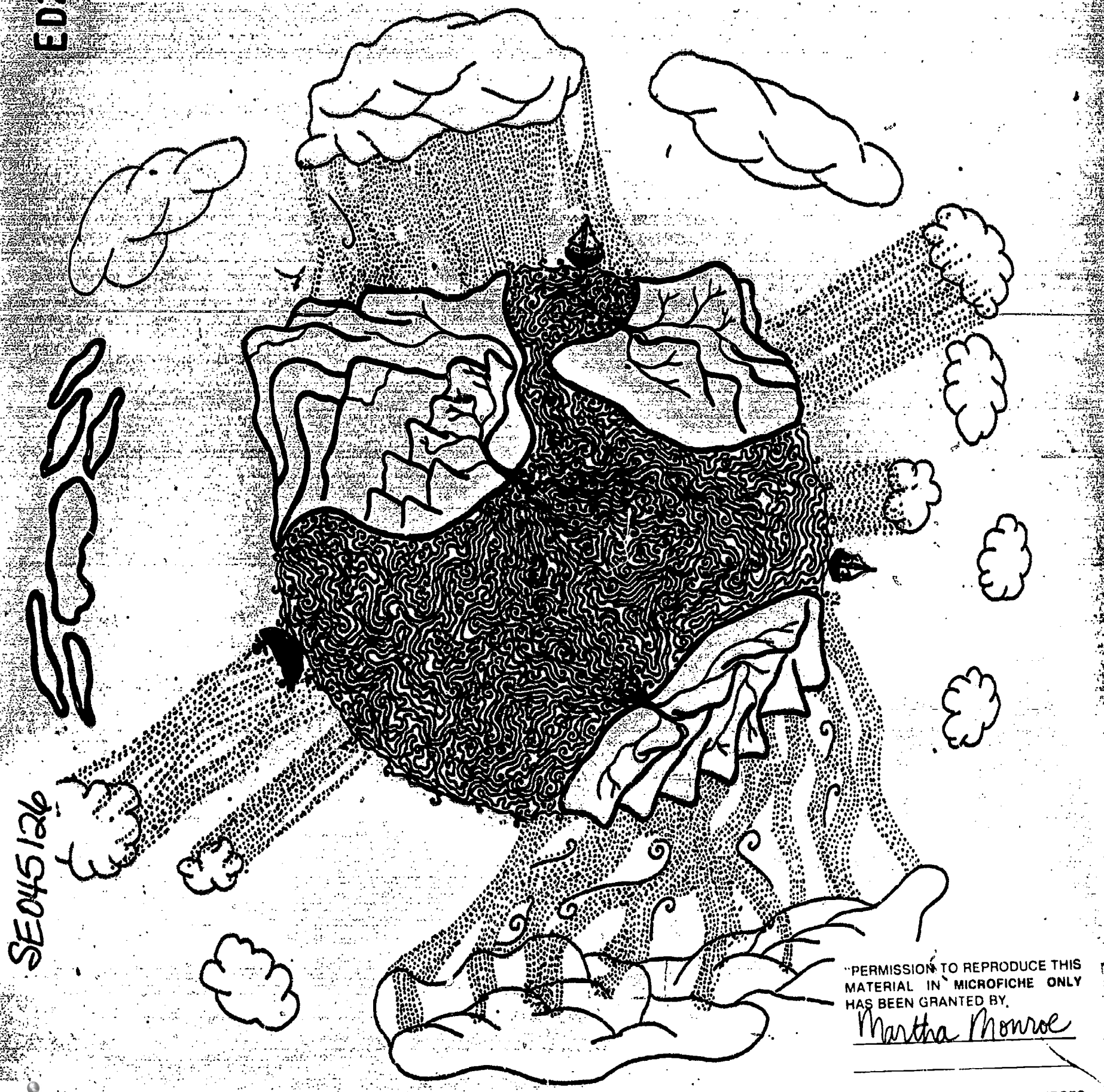
ABSTRACT

This instructional packet is one of 14 school environmental education programs developed for use in the classroom and at the Dahlem Environmental Education Center (DEEC) of the Jackson Community College (Michigan). Provided in the packet are pre-trip activities, field trip activities, and post-trip activities which focus on water in the built and natural environments. Strategies for using these activities with fifth grade students are also provided. The pre-trip activities focus on the variety and significance of water resources, the water cycle, and animals at a pond. These areas are reinforced during indoor and outdoor activities conducted during a field trip at the DEEC. These activities (and lists of formal and non-formal field trip objectives) are provided in a separate field trip guide. The post-trip activities include studies of pollution, pollution problems, and pond pollution. A simulation of a river commission and an activity designed to allow students to express their feelings for ponds are included. Because of the interdisciplinary nature of the topic, the activities can be used in science, social studies, mathematics, and language arts curricula. (JN)

Our World of Water



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"Our World of Water" is one of fourteen school environmental education programs developed by the Dahlem Environmental Education Center of the Jackson Community College. Assistance for the project was provided by the Institute of Museum Services Special Projects Grant #G008103172, of the U. S. Department of Education.

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Our World of Water

A Spring Program for Fifth Graders

Life on our earth could not exist without water. Water is the supporting medium for all cells, the transportation system within organisms, and an essential ingredient for photosynthesis. We depend upon this life-giving liquid to quench our thirst and to grow our food. But water does much more for us. Our lives are made more comfortable by the electrical power water produces, the industries it operates, the recreation it provides and of course, by its cleansing potential. What would our lives be like without water?

This program, "Our World of Water," enables fifth grade students to understand the significance of water, their water use, the water cycle, water pollution problems, and many of the animals whose lives totally depend upon water -- the pond organisms. This interdisciplinary topic lends itself to supporting science, social studies, mathematics, and language arts curriculums.

The program is highlighted with a field trip to the Dahlem Environmental Education Center. A series of pre-trip activities in this packet prepares the students for their trip by introducing several concepts. A collection of follow-up activities further these concepts in your school environment.

The experiences your students will have during this program may have a lasting impact, not only because they are enjoyable, but because they provide a basis for understanding significant and complex environmental issues. Water is a vital resource; its protection is critical to our survival. Your efforts to educate tomorrow's decision-makers will help to preserve our water resources.

Contents

Goals and Objectives

Program Goal

Fifth graders will become more aware of water in the built and natural environments.

Program Objectives

Student will:

-identify ways in which they use water and appreciate the amount of water they use by quantifying their water use for several days.

-understand the water cycle by tracing water through the built and natural environments.

-appreciate the adaptations of pond-dwelling organisms by working in small groups to capture and observe them.

-identify links in the pond food web by playing a food web game.

-appreciate how polluted water affects living organisms by empathizing with an imaginary fish.

-understand sources and causes of water pollution by polluting glasses of water and simulating eutrophication.

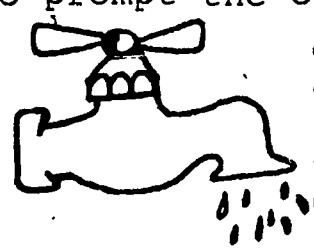
-understand water-related problems and suggest possible solutions by participating in a water management simulation.

Pre-Trip Activities

Water! It's a fascinating subject. Activities could easily branch off into a study of the human body, pollution, or even weather. For any study of water to be meaningful, your class should begin with a look at water in their lives. The following three activities examine the water we use, trace water through its cycle, and introduce students to the life in ponds.

1. Water, Water Everywhere

To introduce your class to the world of water, ask them how they use water and station several students at the board to record the responses. Here are a few questions to prompt the class:



- How do you use water in the summer?
- What in your home would be useless without water?
- What local industries use water?
- How does the food industry use water?

When the recorder runs out of board space your students may wonder if there's anything that doesn't need water!

Next, challenge the class to measure and record the amount of water they use in three days. Student Handout 1 can be used as a tally sheet. Can they think of additional ways they use water?

To measure their water use, your students will need to determine the amount of water they use for each action, and the number of times that action was performed in three days. Some standards are available (see Table 1), but in other cases, they will have to time the running water and let it flow into a measuring cup to determine the volume used. This story problem will give them practice.

> Sally brushes her teeth 2 times a day. Each time it takes her 180 seconds. By letting the water flow into a quart bottle, she determined that she uses 2 cups of water every 30 seconds. How much water does Sally use in three days for brushing her teeth?

180 seconds ÷ 30 seconds = 6
2 cups x 6 = 12 cups = 6 pints = 3 quarts per brushing
3 days x 2 times/day = 6 times/3 days
3 quarts x 6 times/3 days = 42 quarts = 10½ gallons/
3 days

Table I: Average Water Use

Washing your face	2 gallons
Brushing your teeth	¼
Flushing a toilet	5-7
Running water for a drink	¼
Taking a bath	30
Taking a shower	20
Washing dishes by hand	5
Washing dishes by machine	15
Washing a car by bucket	5
Washing a car by hose	20
Washing clothes by machine	20
Sharp Park Pool	300,090

When all the charts come back compare the "water-spenders" to the "water-savers" and determine the total amount of water the class used for that period, and then extend it to just one week. How about 1 year? Try to figure out how much water a family of four would use, and then the total population in your community. What would life be like with a limited supply of water?

Do your students know where all of our water comes from, and, after we use it, where it all goes?

2. Water Cycle Skits

All of the water we use is moving through the water cycle. Water is not destroyed, it just changes form and continues its circle. From rain and back to the clouds, water has an endless set of routes. Have you ever wondered who else drank your water?

The essence of the water cycle -- that water cannot be "thrown away" when we are done with it -- is stressed in the following role play, a parallel to "The House That Jack Built." Of the two options, City Cycle and Country Cycle, begin with the one most applicable to your students.

City Cycle

The purpose of this activity is to demonstrate to students where the water comes from when we turn on a faucet and where it goes when it is disposed of down a drain or through a toilet.

1. Cut out the cards on Student Handout 2.

2. Ask for a volunteer to come to the front of the room and give him/her the #1 (PERSON) card.

3. The student should read only the top line (A) to the class.

4. Ask for a second volunteer and give this student the #2 (PIPE) card.

5. Have the second student (PIPE) read only line A of his/her card. Have the first student (PERSON) read only the bottom line (B) of his/her card.

6. Keep adding volunteers in numerical order and repeating the entire skit. Each participant should read the A line of his/her card only when first called upon. All other times s/he should re-read the B line.

7. When you reach #9 (the SUN), tell your class that although they have reached one end, they don't have a cycle yet; they need a circle. By now it should be obvious to your class that the PERSON has been drinking to excess. S/he will need some relief!

8. Take three easy-going volunteers for the remaining three roles and station them beside the PERSON opposite the rest of the volunteers.

9. Now, begin once more with the SUN and continue past the PERSON to the WASTE WATER TREATMENT PLANT.

10. The final placement of students and cards should look like this:

12. WASTE WATER TREATMENT PLANT
11. PIPE
10. TOILET
1. PERSON
2. PIPE
3. PUMPING STATION
4. WATER TREATMENT PLANT
5. RIVER
6. LAKE
7. RAIN
8. CLOUD
9. SUN

When the giggling stops, reinforce the idea of a cycle by asking where the waste water goes. It may evaporate from a settling pond (SUN) or flow into another body of water (RIVER). Challenge your students to discover where their city water goes and then explain the following cycle for those who are not on the city water system.

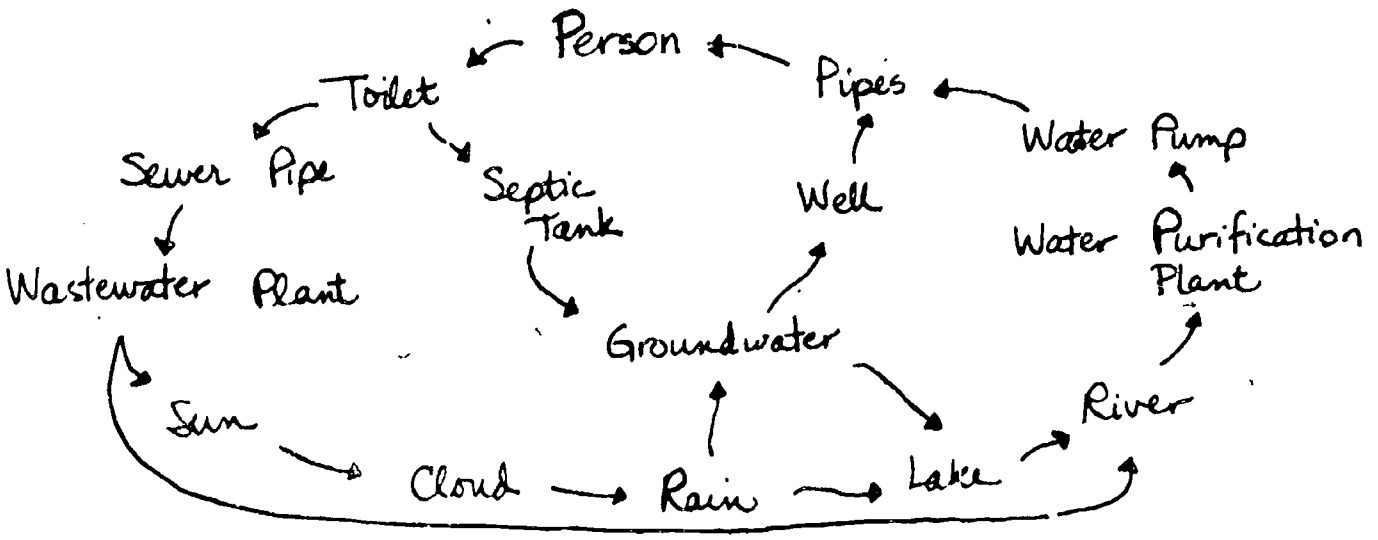
Country Cycle

Use these cards from the City Cycle -- Person, Pipe, Rain, Cloud, Sun, and Toilet -- plus the Country Cycle to quickly run through this skit with nine volunteers. The numbers will not coincide so the class will have to decide the order.

Which rural role compares to the city's waste water plant? (septic tank) How is country water purified? (the ground) Why can't everyone in a city have a well and a septic tank? (not enough space to treat the water adequately and too many people)

Thank your willing actors and continue the concept of a water cycle with additional discussion, a large chart, or by asking each student to map out a cycle on paper. The following cycle is a suggestion. What is the water cycle for a person with an outhouse? for a person washing the family car? for the space shuttle?!

City and Country Cycle



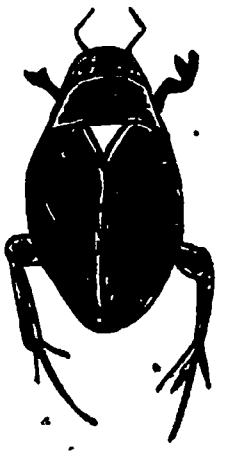
You can use Student Handout 3 to illustrate a water cycle. Ask your students to identify and label the following processes: evaporation, precipitation, transpiration, purification, and condensation, and trace water through the cycle with arrows. Each number identifies one process. Transpiration, evaporation, and purification each have more than one example in the picture.

3. Animals at a Pond

While at the Dahlem Center, your class will have the opportunity to collect aquatic organisms, and discover some creatures for whom water is everything! The experience will be enhanced with the following short introduction to these animals.

With two students at the blackboard, ask the class to list animals that may be found near a pond and the animals that live in the pond. Here are some ideas to keep them going:

Near A Pond	In a Pond
deer	snapping turtle
muskrat	fish
raccoon	frog
great blue heron	snail
duck	tadpole
goose	fisher spider
water snake	leech
frog	water strider
toad	mosquito larva
dragonfly	dragonfly larva
crayfish	whirligig beetle
redwinged blackbird	water mite
mink	diving beetles
tree swallow	water bugs
painted turtle	



It's unlikely that many students will know all of these animals, and that's why they should look forward to their field trip! Please communicate these main ideas in a discussion, lecture, research assignment, film, or reading:

1. Many animals which do not live in the pond on a permanent basis come to the area to feed, drink, or raise young.

2. Many insects live in the water. Some immature aquatic insects become aquatic adults (e.g., the water bug); others grow into non-aquatic adults (e.g., the dragonfly.)

3. Insects have two different life cycles: egg, larva, pupa, adult and egg, nymph, adult. There are aquatic insects in each of these seven stages.

4. Animals need oxygen to survive. Aquatic animals obtain oxygen either by breathing air or filtering dissolved oxygen over their gills, like fish.

5. The types of animals found in a body of water can indicate how clean the water is, since clean-water animals cannot live in polluted water. Other animals (e.g., certain worms and carp) live best in polluted water.

Vocabulary Words

These words may be helpful during this program: For teaching ideas, consult the resource section of this packet.

CONDENSATION - the process of water vapor becoming liquid

DISSOLVED OXYGEN - molecules of oxygen dissolved in water, either produced by aquatic plants or picked up from the atmosphere.

EUTROPHICATION - the process of nutrient enrichment in a body of water, and a form of water pollution (See pages 12-14.)

LARVA - an immature insect in a four step life cycle that often looks very different from the adult

NYMPH - an immature insect in a three step life cycle that often looks very much like the adult

POLLUTION - a condition that prevents water, air, or land from being used for a specific purpose

PRECIPITATION - rain, snow, hail

SUCCESSION - the sequence of natural communities in one area over time

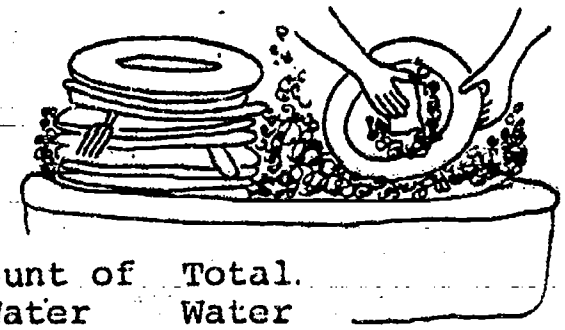
TRANSPIRATION - water vapor given off from growing plants as a result of photosynthesis

WASTE WATER TREATMENT - the process of "cleaning" waste water from homes, industries, and storm sewers

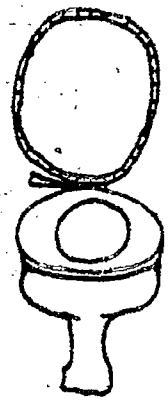
WATER CYCLE - the natural process of water use, purification, and replenishment, powered by the sun

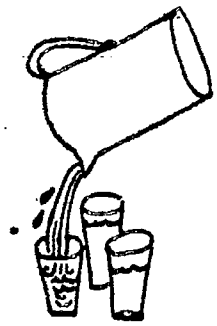
WATER PURIFICATION - the process which improves water quality for human consumption

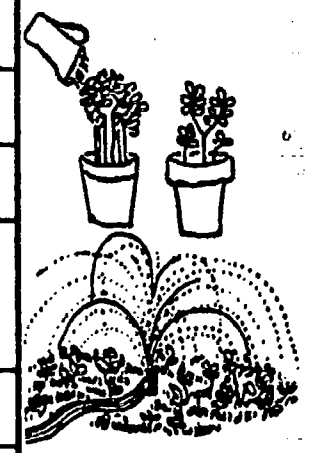
Water Use Tally Sheet

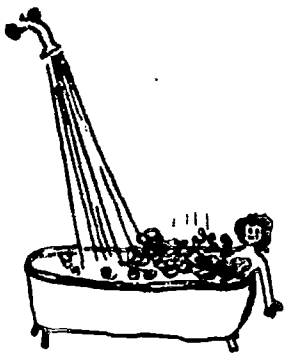


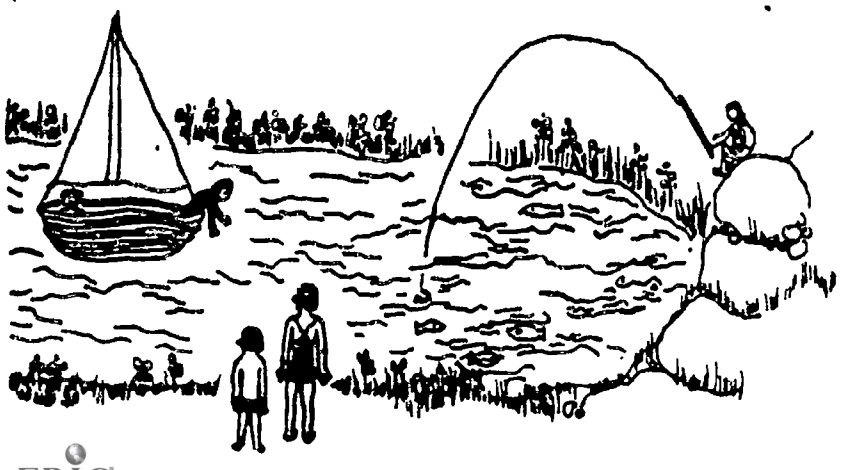
	Number of Times Each Day				Amount of Water Each Time	Total Water Use
	1	2	3	Total		
Personal						
Wash hands & face						
Brush Teeth						
Flush Toilet						
Drinking water						
Bath/Shower						
Household						
Wash dishes						
Wash clothes						
Cooking						
Water plants						
Sprinkle lawn						
Wash car						
Cleaning						
Recreational						
Swimming						
Boating						
Fishing						
Skiing						











Student Handout 1
Water, Water Everywhere

Name _____

Student Handout 2
City Cycle
Water Cycle Skits

Person **1**

A -- I am a person who turns on the faucet and gets a drink!

B -- And I turn on the faucet and get a drink!

Pipe **2**

A -- I am the pipe that carries the water through the town into the homes

B -- Where it's carried through the town into the homes

Pumping Station **3**

A -- I am the pumping station who pumps water into pipes

B -- That's pumped into pipes

Water Treatment Plant **4**

A -- I am the water treatment plant that purifies the water

B -- Which purifies the water

River **5**

A -- I am a river that moves across the land and into a water treatment plant

B -- That moves across the land and into a water treatment plant

Lake **6**

A -- I am a lake which flows into a river

B -- Into a lake which flows into a river

Rain **7**

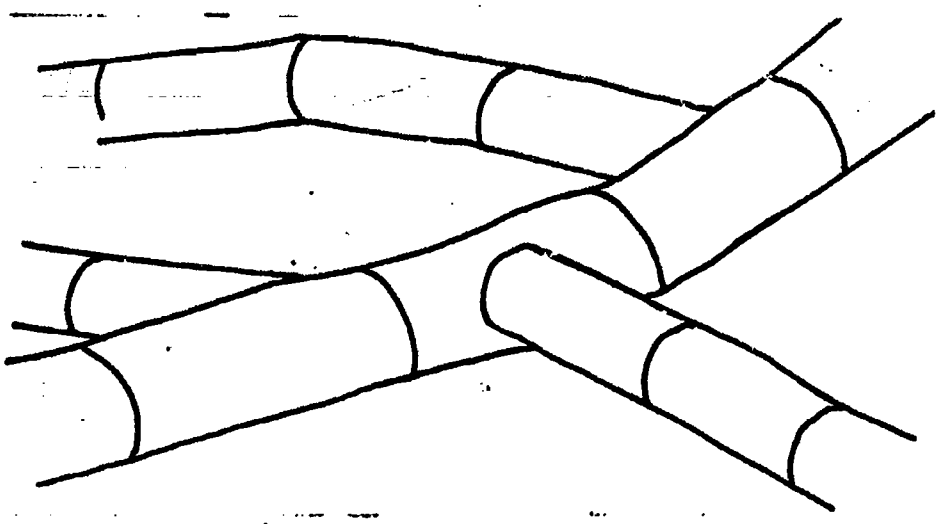
A -- I am the water that falls to the ground

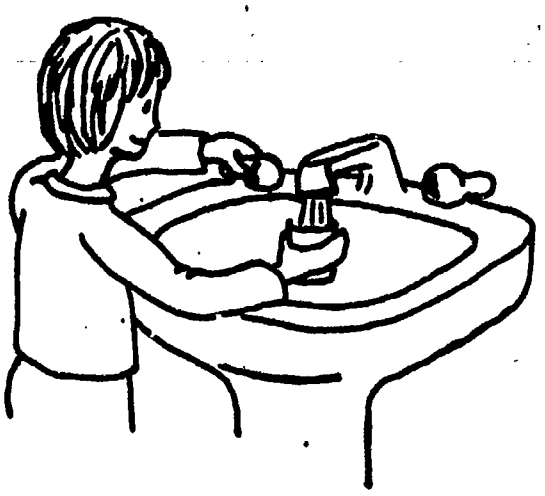
B -- Till it falls as rain to the ground

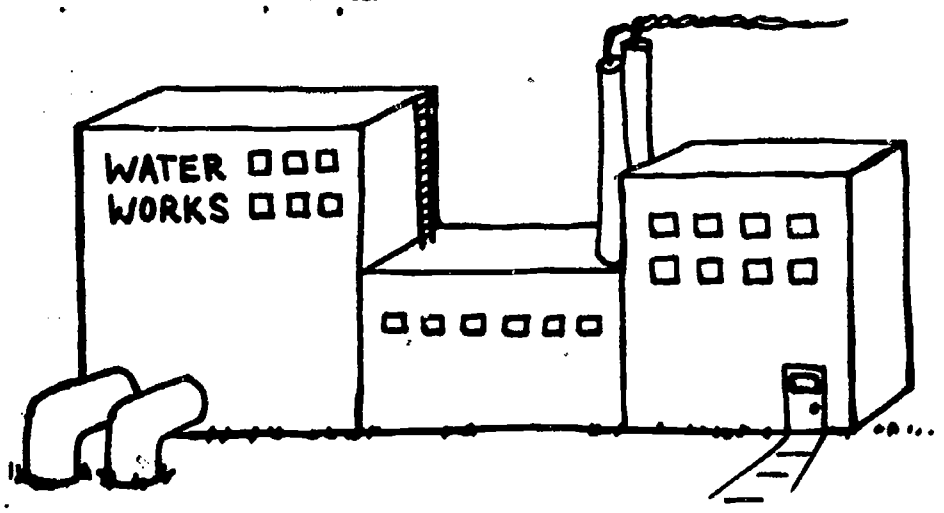
Cloud **8**

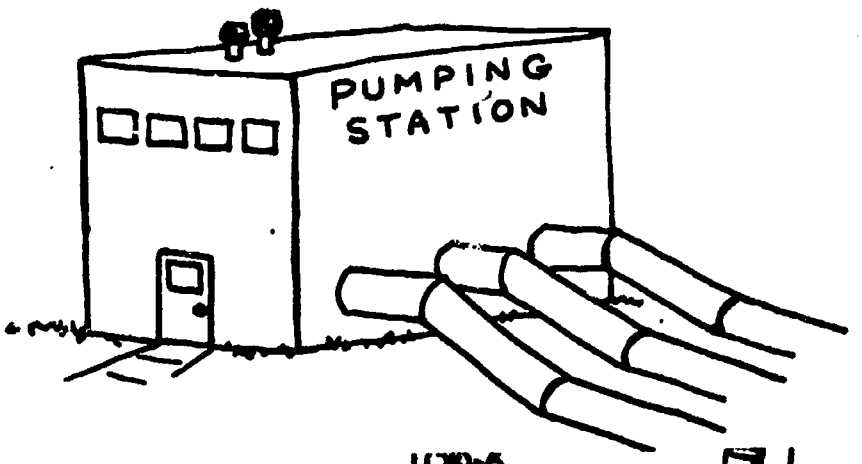
A -- I am a cloud that holds water vapor

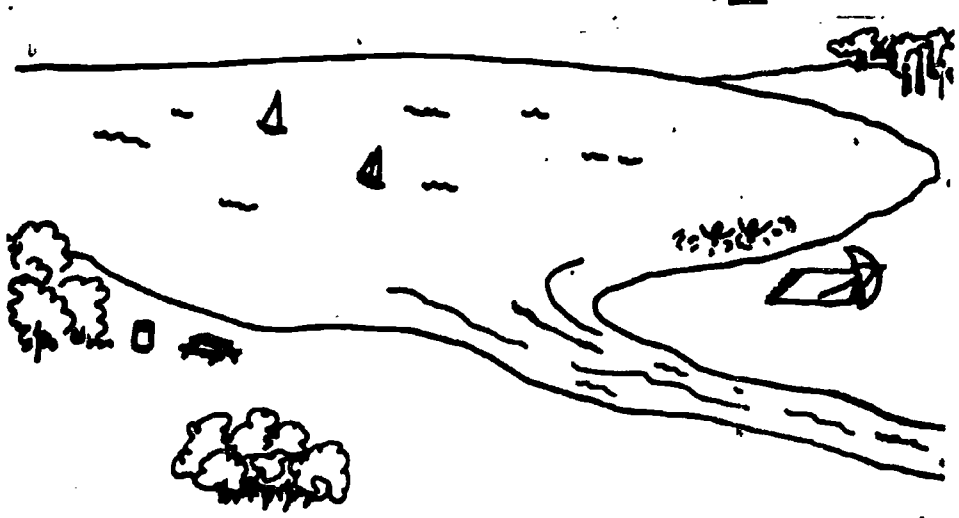
B -- That hangs in the cloud

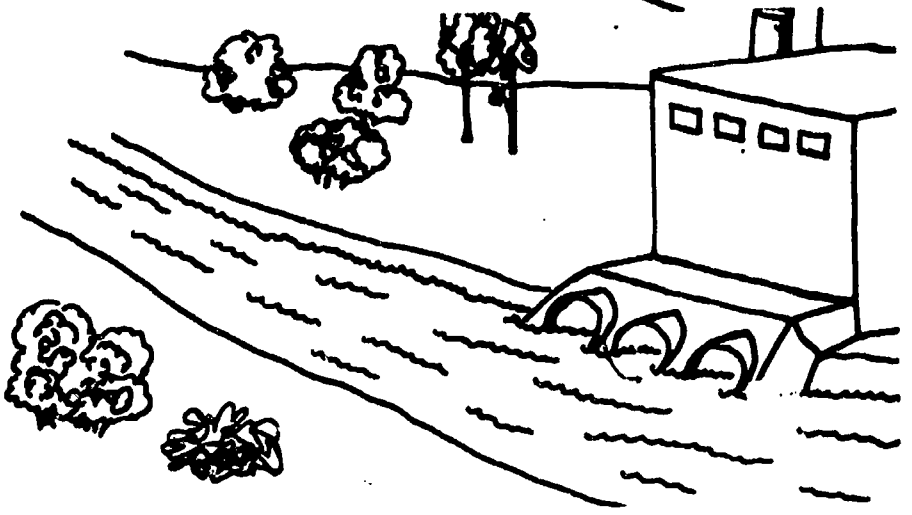


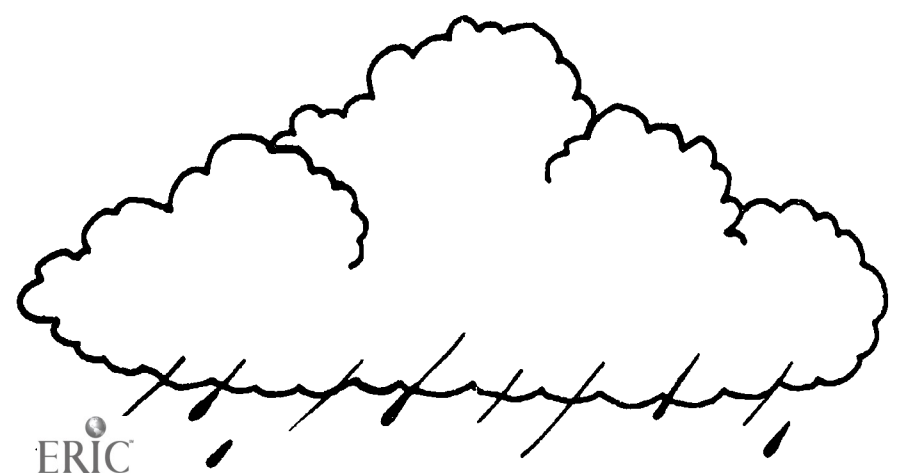


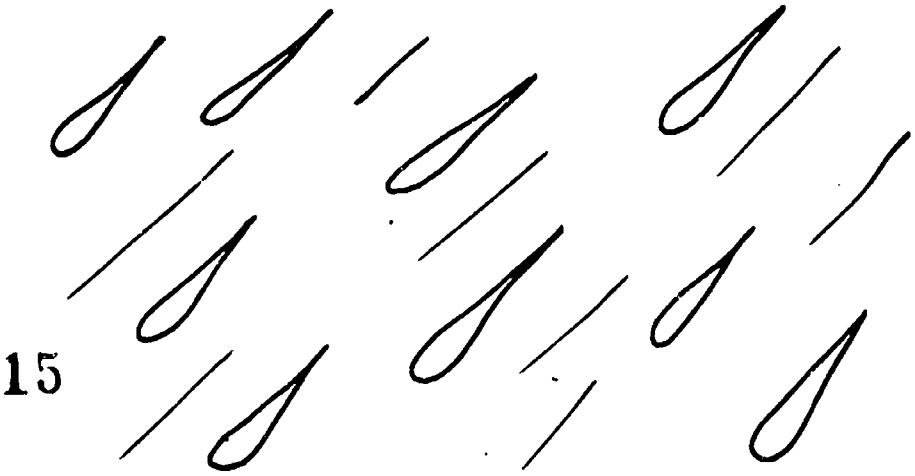

WATER
WORKS


PUMPING
STATION









Sun **9**

Read
Each Time -- I am the sun that evaporates the water

Toilet **10**

Read
Each Time -- Then, the water is flushed down the toilet

Pipe **11**

Read
Each Time -- And carried by sewer pipes

Waste Water **12**

Treatment Plant

Read
Each Time -- To the wastewater plant, where it's cleaned once again!

COUNTRY CYCLE

Well

A -- I am the well that brings the water from deep in the ground up to the house

B -- Where it's pumped inside

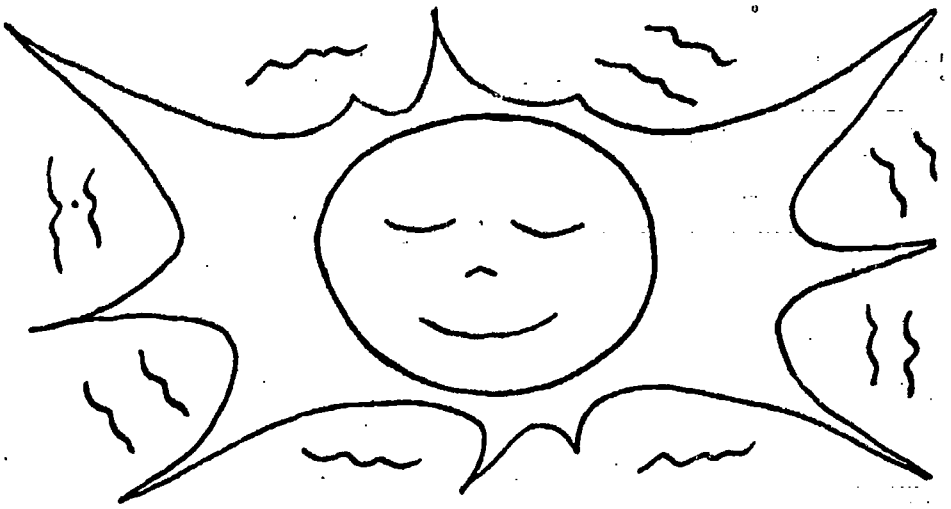
Groundwater

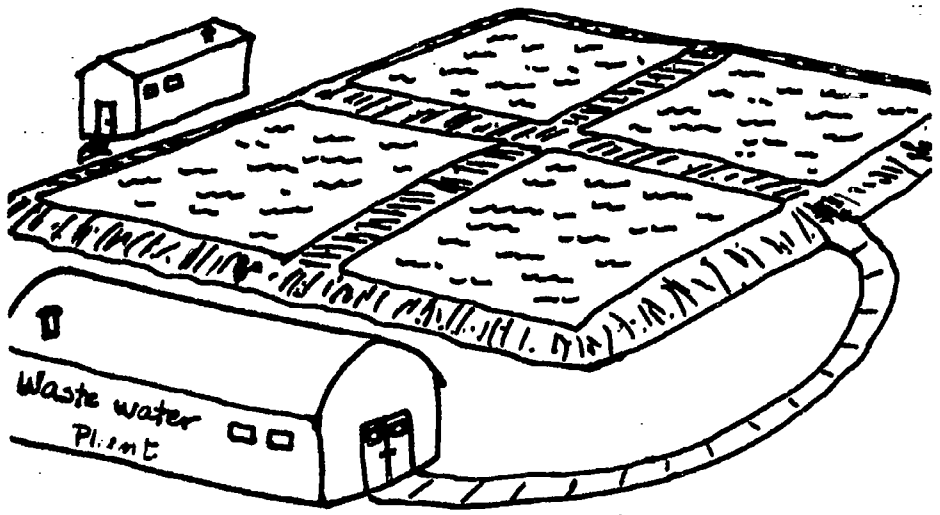
A -- I am the water deep in the ground that slowly flows to a lake or a well

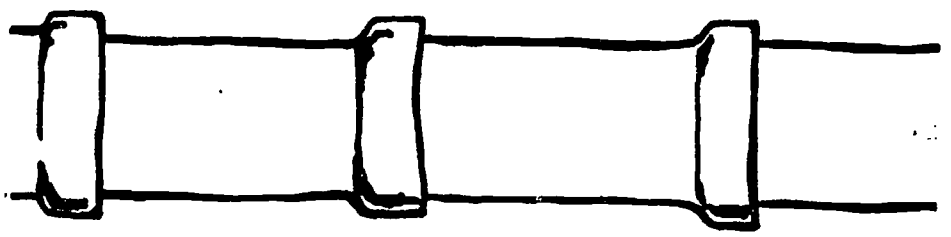
B -- Where it seeps through the dirt to a lake or a well

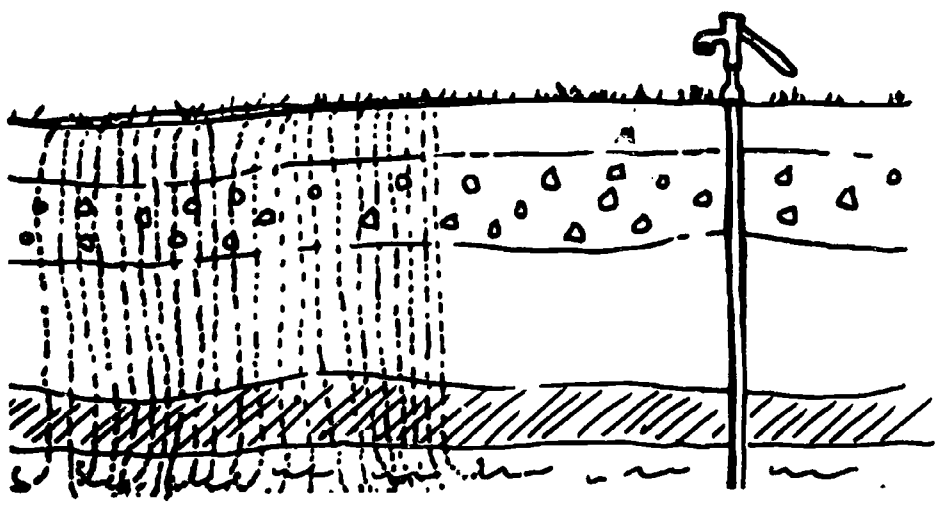
Septic Tank

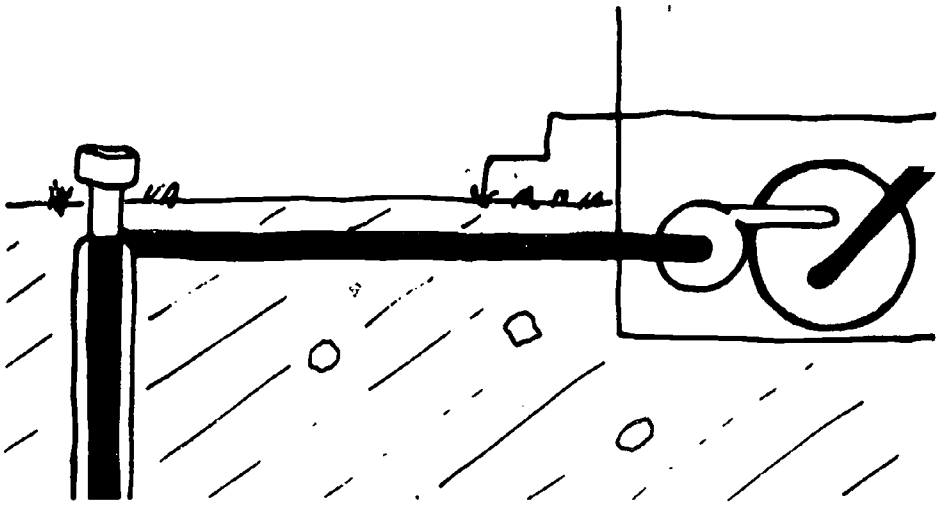
Read
Each Time -- And into a septic tank where microorganisms decompose the water products, and (return the water) to the ground

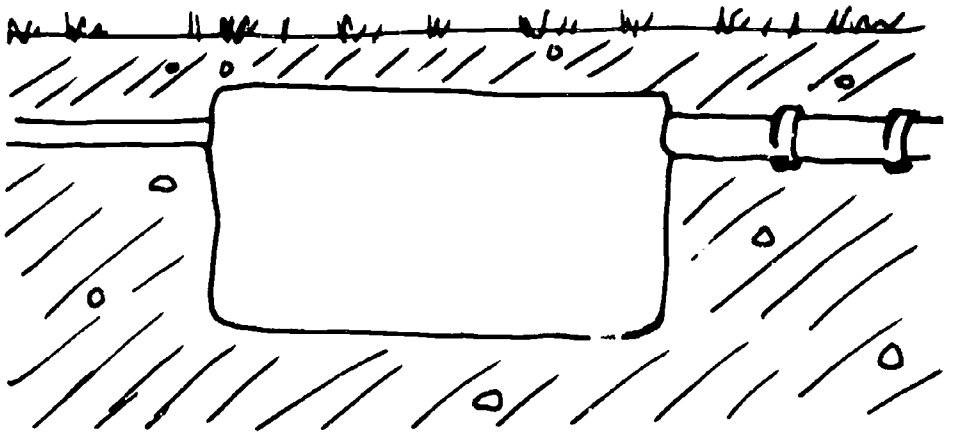



Waste water
Plant









A Water Cycle

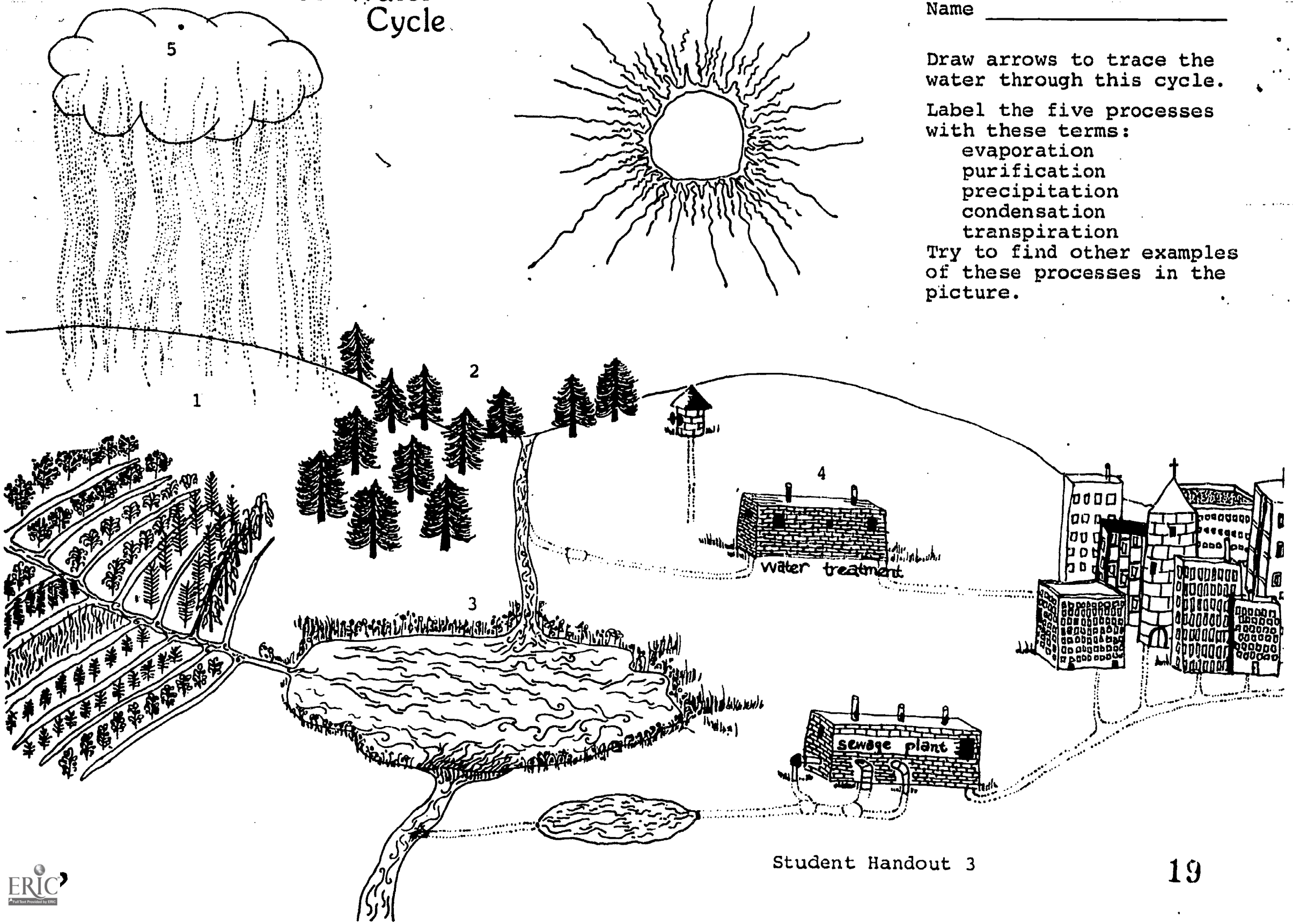
Name _____

Draw arrows to trace the water through this cycle.

Label the five processes with these terms:

- evaporation
- purification
- precipitation
- condensation
- transpiration

Try to find other examples of these processes in the picture.



Dear Parents,

Has your fifth grader recently developed a sudden interest in water? Have you noticed him/her measuring, counting, and recording your family's water usage? This water project is part of "Our World of Water," a program which will include an exploration of the ponds and pond life at the Dahlem Environmental Education Center. We will continue our water unit after the field trip with activities on pollution.

You can participate in your child's learning through the following activities:

- Help out with the Water Use Tally Sheet. Are there other ways your family uses water?
- Discover where your water comes from and how it flows through your house. How does waste water leave your home and where does it go?
- Investigate a water pollution issue in the news (TV, radio, or newspaper) or at the library.
- With a small net, a shallow container, and your family, head out to the nearest swamp and see what you can find!
- Visit the Dahlem Center so your fifth grader can show you around.

Please make sure your water-explorer is properly dressed for the weather and the water on the day of the field trip.

Sincerely,

Fifth Grade Teacher

Field Trip

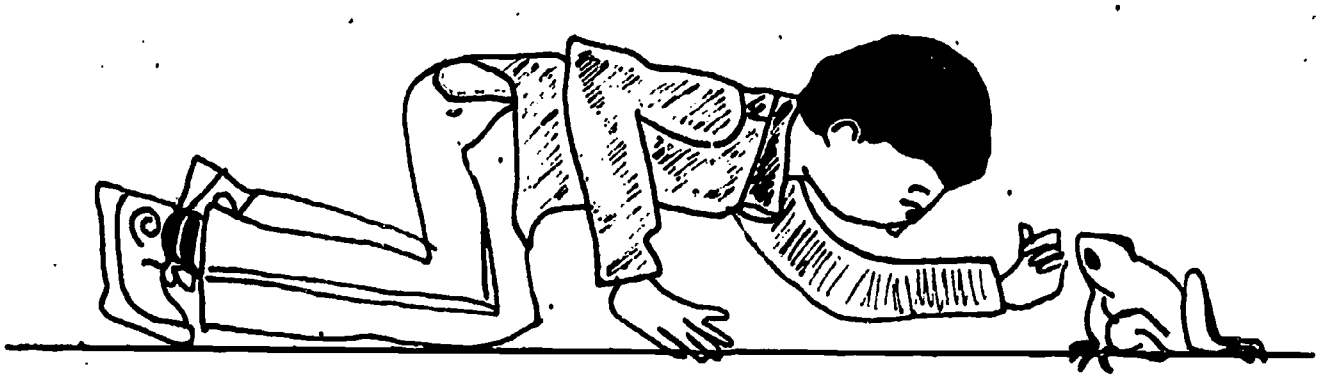
Your field trip will begin with an indoor introduction to the Dahlem Environmental Education Center and a review of the water cycle. By understanding the portion of the cycle in their community, your students will quickly comprehend the part that cycles through the Center.

Your guide will briefly describe the four bodies of water -- marsh, creek, young pond, and old pond -- you will explore at the Center, and challenge the students to imagine the "big picture" of water in our world.

At these different sites your class will:

- collect and examine aquatic organisms,
- link these organisms together in a pond web,
- observe pond succession and natural eutrophication,
- discuss the purity of the Dahlem Center's creek and potential pollution sources, and
- understand the value of wetlands in Michigan.

Your visit will conclude with review of program highlights and an introduction to some of the activities your students can do at school.



Post-Trip Activities

The following four activities will help tie together the pre-trip and field trip activities, review the basic ideas, and explore the issue of water pollution. In their lifetimes, your students may be called upon to make critical decisions regarding water resource management; this comprehensive unit will give them a start.

1. What Is Pollution?

To most people, pollution is just a dirty word. In this activity your students will improve their group skills as they think about and classify types of pollution.

Begin by asking students to arrange themselves in groups of 4-6. Give each group several clear containers and ask them to fill each with clean water. Then, challenge the groups to use all of their creativity and imagination to make this water undrinkable. Their lists could go on and on! Over the course of several days, the groups could actually carry out their plans. Encourage students to think up really different ways to make the water undrinkable. Divergent thinking is a skill that needs lots of practice.

Then ask each group to arrange their suggestions into categories with similar characteristics, and to identify each category. Some labels may change as students discuss them and shift or reclassify items. Let each group reach a consensus on their own.

Here are some sample items and categories, but do not stifle your students creativity by making suggestions early in the process. You should only say, "Make the water undrinkable."

Insoluable	Soluable	Organisms	Change in Form
rocks	salt	germs	ice
sand	acid	worms	mist
sawdust	soap	frogs	steam
glass	vinegar		
oil			

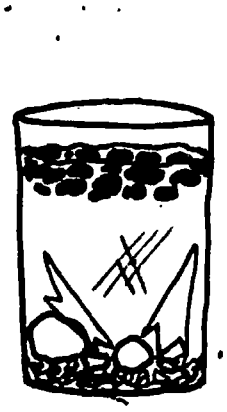
When the groups have finished, ask them to share their lists with the entire class and discuss these concepts:

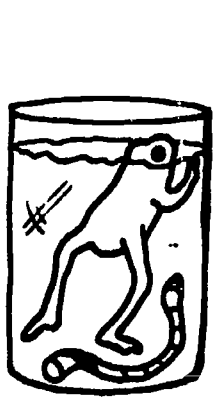
- Water can be made undrinkable in many ways.
- Some materials dissolve or disappear when added, and some do not.
- Water may look pure and clear, but still be undrinkable.
- The temperature or form of water may make it undrinkable.

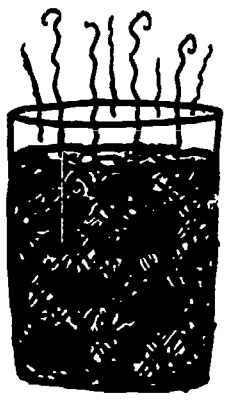
The discussion can continue with:

- How does a purification plant make water drinkable?
- How do homes and industries make water undrinkable?
- How does a city clean used water before returning it to a stream, lake, or river?
- What is pollution?
- Who polices polluted water, and who is responsible for its cleanup?*

*Adapted from "A Lesson Plan for Water Pollution Activity" by Dr. John Hug, Ohio Department of Education.







2. Pond Pollution

As you saw on your field trip, ponds and lakes go through a normal, natural aging process called succession. As aquatic plants and animals grow and die, their decomposing tissues help to slowly change the nature of the pond. Over time, nutrients build up in the water and organic matter and silt make the pond smaller and more shallow. Such conditions dictate changes in the variety of organisms that live in the pond.

Many human activities artifically speed the aging process of bodies of water. Runoff from agricultural fields which is high in fertilizers, and poorly designed septic systems add large quantities of nutrients to ponds and

lakes. The excess nutrients encourage algae blooms which result in unpopular, scummy water. When these plants die, their decomposition dramatically lowers the amount of dissolved oxygen in the pond. A decrease in the oxygen level will kill off certain fish species (e.g., trout) and encourage other populations to replace them (e.g., carp). The change may even make the area smell badly in the summer. Eutrophication, this process of nutrient enrichment, is one of the major forms of water pollution in local lakes and ponds.

An Experiment

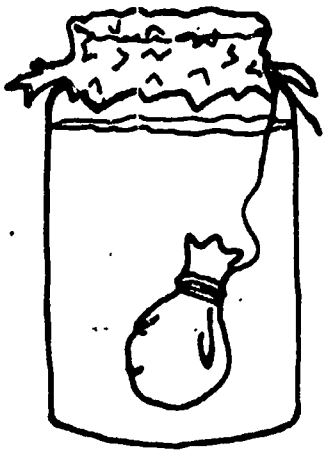
This simple experiment will help your students understand eutrophication and pollution. You will need:

- 2 clear, quart or gallon jars of the same size and shape
- 1 small vial of methylene blue solution (available at pet stores as an aquarium cleaner or at the Dahlem Center)
- a small amount of mixed organic vegetable garbage -- apple core, carrot top, orange peel, bread crust, etc.
- 1 handful of soil from outdoors
- 1 piece of cotton scrap material, the size of a handkerchief
- stone
- aluminum foil
- string

Fill both jars an inch from the top with water. While someone stirs, add the same number of drops of methylene blue to each jar, until the water is a pale light blue.

Into one jar hang the cut-up garbage mixed with soil and wrapped in the cloth. If you weight the package with a rock and tie on a piece of string, it will sink, but still be retrievable. Cover both jars with aluminum foil.

The jar with only colored water serves as a control. By noting a difference in the color of the other water, your class can observe a change. The garbage and soil represents excess nutrients and the mud in the pond. The soil also contains bacteria and other organisms that use oxygen to decompose matter.



Methylene blue is an oxygen indicator. It is blue in the presence of oxygen. As the soil bacteria decompose the garbage, they will use dissolved oxygen. Ask your class what change they should expect to see in the jar. (water will turn light blue, then clear) If this were a pond with fish in it, what would happen to the fish? (die) How does dissolved oxygen get into a pond? (from aquatic plants and surface oxygen)*

** Adapted from "A Simple Classroom Experiment on Eutrophication" by Vivian Schatz and Albert Schatz in Science and Children 11:13, April 1974, and reprinted by permission of National Science Teachers Association.*

3. The River Commission

A simulation can be a highly effective way to teach certain objectives. By involving the students in a meaningful and realistic exercise, they will be able to appreciate the many varied viewpoints and interests that surface when water is at issue.

Here are some tricks to help the simulation run smoothly:

- Make sure everyone is involved and understands his/her position.
- Don't let arguments drag on and on, but stop the proceedings when all points have been heard and a decision reached.
- Let the students use their imaginations, but feel free to offer suggestions if they get stuck (a new solution, a compromise, etc.).
- Always wrap up a simulation with a discussion session. Evaluate what happened and why, and explore how individuals felt. Relate their thoughts to real situations.

Begin by assigning roles, or by letting each student choose a position as a member of the River Commission, or resident, industry, or government interest groups. Distribute to each person the appropriate role definition card from Activity Sheet 5.

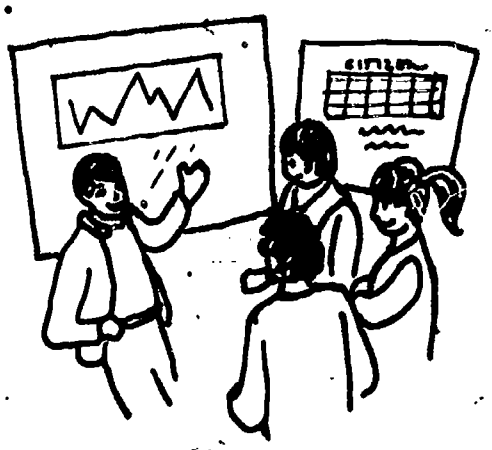
Then read the following scenario to everyone and choose one of the situations to get started. Allow each group 15-20 minutes to form its position, and 5 minutes

to present it to the commission. The commission may need your guidance to help them form a compromise. They may also want to discuss how a decision should be made -- by vote, by complete agreement, or Supreme Court-style with majority and minority opinions.

Scenario

The medium-size town of Riverside is a nice place to live. The people are friendly, businesses are doing well, and everyone is employed! A small river flows through town, providing fairly clean water to the community for drinking, cleaning, industry, recreation, and agriculture. Several parks are located at the edge of the river. One park rents canoes.

The River Commission is responsible for protecting the rights of all the users of the river. They meet periodically to hear concerns and make rulings on water rights, water use, and water pollution responsibility.



For each situation that arises, the residents, the industrial representatives, and the government make presentations to the River Commission explaining their viewpoints and interests. After hearing all presentations, the Commission will hold a public meeting to determine an appropriate action.

Situations

1. A major industry in Riverside wants to expand its operation. An additional plant would bring more jobs and more tax money, but also means less water and more pollution. Which interest groups would benefit from a new plant? Which would suffer? What information is needed to make a wise decision?

2. The Park Commission proposed to classify one of the river parks as a natural area. This change would restrict hunting and prevent future industrial development in the park, while protecting wildlife and plant species and allowing for quiet nature

observation and enjoyment. How would this proposal affect each interest group? What are the needs of your community?

3. Recent research shows that industry is polluting your section of the river with a poisonous chemical. Some fish have died and some birds have become sick. No one knows how humans have been affected. Should the pollution be stopped? cleaned up? Who should pay? The industry may have to leave town if it costs too much, which would lay off many workers. Can you work out a compromise between health and jobs?

4. An "inland" town proposes to pipe river water from Riverside to their community for irrigation. This plan would lower the river's water level, provide less water to Riverside, and force the power plants to change the dam level. Will you share, sell, or keep the water?

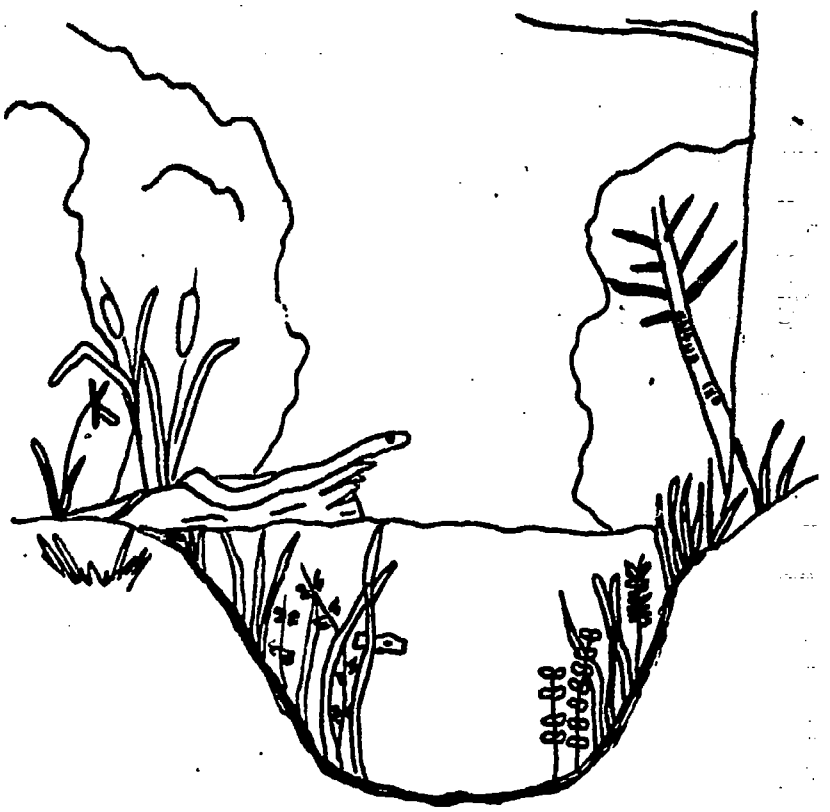
As your students work through this simulation, it is hoped they will gain a first-hand understanding of the complexity of water issues. It is very difficult to reach an acceptable balance between industrial development and nature preservation, or between economic growth and health protection. Everyone must give a little, but what is the bottom line, beyond which all is lost? Certainly a Riverside park does not need to be 1000 acres to provide habitat protection, but if it is smaller than 5 acres, it may not be worth it.

In addition, every compromise incurs a cost. Even if the cost of cleaning up an area is borne by industry, it eventually filters down to the consumer in the form of a cost increase. Ultimately, the citizens must decide what price they are willing to pay for jobs, for health, and for the environment.

4. The Life of a Pond

At the Dahlem Center your students observed several wetland areas in various stages of natural succession. They have since learned how human activity can speed up this natural aging process in ponds and lakes. Your students can use their knowledge in the following activity to creatively express their feelings for ponds.

Challenge your class to "become" a pond -- to observe the world and the things that affect wetlands through the "eyes" of a pond. Then ask your students to communicate their feelings as they "age" -- either by drawing a series of pictures or by writing a story or poem. Starting out as a very young pond is a possibility; so is describing the pond plants and animals as they change over time. What will happen to these ponds 5 or 50 years from now?



Congratulations! You've done a fine job of teaching your students about a very critical element in their life -- water. From toilet-flushing to frog-chasing and back for commission-hearing, you've led your class to a greater awareness of water resources, the life of a pond, and the conflicts around water use. Why not reward yourself -- you can "turn on the faucet and get a drink!"

ROLE DEFINITIONS

River Commission - This group of people hears complaints and concerns from residents and representatives of industry and government. Together, the members of the Commission decide upon a ruling for each concern. The Commission is made of the following people:

- 1 from city government who is interested in revenue, business, and keeping residents happy.
- 1 from county government who represents many of the farmers and small towns in outlying areas.
- 2 from industry who use lots of water, hire people, and pay taxes.
- 2 with environmental interests, (e.g., wilderness and fishing) who want to see plants, animals, and open space protected.
- 2 from the general public (e.g., teachers, store owners, or students).
- 1 from the Land Planning Agency who thinks about the other communities up and downstream from Riverside.

The remaining class members should be equally divided in these categories:

Residents - You may represent children, mothers, working parents, park enthusiasts, nature lovers, duck hunters, and people with jobs who don't want anything to change. You want clean water to drink and play in, and you want jobs. You aren't sure which you want more -- what do you think?

Industry - You represent industries such as a power plant, a flour mill, a manufacturing firm, a bakery, and a chemical factory. You require large amounts of water to run your plants, you provide lots of jobs, and you pay taxes to the City and the County Government.

City Government - You provide services to the community with the tax money you receive. You are concerned about this tax money. You are concerned with the long term future of Riverside and your children's future.

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*These books are available at the Jackson District Library. Similar titles may be found at the Library's 16 branches under the same Dewey Decimal numbers.

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AT REMC ...

The Jackson County Intermediate School District's Regional Educational Media Center has the following:

Films

"A Drop of Water"	MP 322
"The Aquatic Environment"	MP 48
"Arteries of Life"	MP 559
"Cry of the Marsh"	MP 274
"Ecology of Ponds"	MP 374
"Life in a Drop of Water"	MP 2184
"Northern Lakes"	MP 2385
"The Problem with Water is People"	MP 1331
"Water Pollution"	MP 1682
"Wise Use of Water Resources"	MP 2109
"Wonder of Water"	MP 2111
"World in a Marsh"	MP 2115

Miscellaneous

"All About Rivers"	KT 0624	Science Shelf	6
"Water Cycle Study Cards"	SE 1700.1	Science Shelf	3
"Water for Dinosaurs"	SE 3628.1	Science Shelf	22
"Water Life"	SE 3680.2	Science Shelf	3

AND ELSEWHERE ...

Films:

- Michigan Department of Natural Resources
  Film Service
  P.O. Box 30028
  Lansing, MI 48909
  (517) 373-1227

  "It's Your Decision -- Clean Water"
  "Rise and Fall of the Great Lakes"
  "Your Life -- Water"

- U.S. EPA Region V
  Film Comm
  108 W. Grand Avenue
  Chicago, IL 60610
  (312) 329-0185

  "A Man and a River"
  "Clean Water is Kid Stuff"
  "The Great Cleanup"
  "Is Your Drinking Water Safe"
  "Mandate for Clean Water"
  "Promises to Keep"
  "River of the Onions"
  "Water"
  "Water Follies" - wonderful cartoon on conservation
  "Water Passages"
  "Wetlands: A Case for Protection"

Teaching Aids:

- American Water Works Association
  666 W. Quincy Avenue
  Denver, CO 80235

  "The Story of the Water Supply" -- free comic book

- ECOS, Inc.
  Water/Energy Conservation Systems
  Damon Mill Square
  Concord, MA 01742

  "Water Wheel - Your Guide to Home Water Conservation" (formerly free from U.S. EPA) -- a small dial

- Gull Lake Environmental Education Project
  Kellogg Bird Sanctuary of Michigan State University
  12865 C Avenue
  Augusta, MI 49012

The Life in a Pond Chart	$1.25
Pond Life Flash Cards	$1.00, $3.75
Overhead Transparencies	$1.50 each

"Life in a Pond", "Water Cycle", "Pond Succession", "Water Cycle Profile", "Water Ecosystem"

- National Recreation and Park Association
  1601 N. Kent Street
  Arlington, VA 22209

  "Water, A Resource You Can Help Restore" -- a free poster about improving local water quality

- Reed and Sons
  Box 250 Route 2
  Perrysville, OH 44864

  "Water Pollution Chart" $3.00

WORLD OF WATER

Fifth Grade Spring Trip

Formal Objectives

Trace the water cycle in the natural environment.

Compare and contrast a stream and a pond.

Work in small groups to discover pond-dwelling organisms.

Explain several adaptions that equip aquatic organisms for underwater life.

Informal Objectives

Understand that water is used over and over again as it moves through the water cycle.

Learn about aquatic organisms.

Understand the pond food web.

Understand pond succession.

Begin to understand water pollution.

Indoor Portion

Welcome the group. Introduce yourself, other field guides, and the Dahlem Center.

Ask them what they use water for, and how much water do they think that is? Then share with them a few statistics: we use 1,800 gallons of water each day. 160 gallons is direct, home use (3 g. for flushing a toilet, 10 g. washing dishes, 20 g. taking a shower, etc.). The remainder is water we rarely think that we use -- either indirectly in the irrigation of fields, the production of meat, or the manufacturing of products. For example:

2,500 g. for 1 pound hamburger

280 g. for one Sunday newspaper

40 g. for an egg

150 g. for a loaf of bread

100,000 g. for an automobile

1,000 g. for 1 pound of aluminum

375 g. for 5 pounds of flour

35 g. for 1 pound of steel

We use an incredible amount of water every day!

So where does all that water come from, and where does it go? Start off simply, with a look at the water at the Dahlem Center. Ask them what water is here, and illustrate their answers on the board (pond, marsh, creek, trees, animals, water vapor, groundwater); how that water arrives on the scene (precipitation); and how it exits (evaporation, transpiration). Review the water in the cycle moving around and around. Then add the Arboretum Building, a well and a toilet. Tell them <u>they</u> are a part of the Dahlem cycle, too, as they might get a drink or go to the bathroom. What happens when they flush the toilet? Yep, the water returns to the ground via the septic tank, and the water continues to cycle around. Reassure them that the soil is an excellent cleaner for small quantities of wastewater -- we run into water pollution problems when the pollutants are toxic chemicals or the quantity of wastewater is much too large for the environment to handle (ergo -- wastewater treatment plants).

"And that's part of the reason people are concerned about clean water -- in some places of the world there's not enough to go around." Use the gallon jar and measuring implements to demonstrate the world's water supply. If 1 gallon is all the water in the world, ½ cup is all the freshwater, the rest is salt. Most of the freshwater is tied up in glaciers and ice, very deep underground, or in the atmosphere (i.e. unavailable). That leaves us with 1 Tablespoon of available surface and ground water. Of this amount, most is either not in the right place (Amazon basin), or too polluted to use. So all the water that we <u>use</u> is actually one drop, if all the water in the world is <u>one</u> gallon. (0.003% of the total supply)

Then switch back to the board and tell them that while they are here today they'll be exploring the ponds for aquatic life -- what lives there? Draw their answers in your "pond", and use the aquatic critter posters to explain insect larvae and nymphs, etc.

"Over time, what happens to a pond?" Dead plants and animals slowly decay, filling the pond with muck and actually making it smaller. If we wait long enough we may see a pond turn into a marsh, and eventually firm ground where a forest may grow. This process is called succession, where one community of plants and animals succeeds another until a stable balance is maintained. Outside influence may slow this process, such as fire, dredging, chemically treating a lake, etc.

Divide the group into trail groups -- one for each guide, and equip each pair with a net, a bucket, and a clipboard with checklist. Larger groups may need to be broken into groups of four to share bucket and clipboard. You may wish to take a thermometer and/or water treating equipment. Arrange your stations with the other guides to give each group 10-15 minutes at the ponds.

Trailside Stations

Arboretum Boardwalk: The marsh. Your group can look for aquatic life, but even more important here is the great value of the wetlands. Measure the temperature. Talk about the great variety of animals and plants and the rich nutrient supply in wetland area.

Creek at the bridge: "What kinds of critters live in fast running water?" (Animals that adapt to movement by clinging to the rock or staying near the banks.) Take its temperature, and if possible, carefully grab a rock and look for a clinger. "Would you drink this water" (probably could, but it comes from a cow field and near several houses -- discuss pollution). Polluted water is unfit for a specific purpose, so water maybe too polluted to drink, but may not be too polluted for industrial purposes. A bank full of bottles and cans may look bad - but it wouldn't hurt the quality of the water. Crystal clear water in New England can be so polluted not a thing can survive. Kids often think polluted water looks nasty, and that's it!

Dug Pond Boardwalk or Spring Pond Boardwalk: Spend some time collecting and looking at the acquatic organism. Use the aquatic organism I.D. Sheet and encourage the kids to identify their discoveries. Use the laminated pond cards if there's time or interest. Measure the temperature and compare it to the creek and the marsh. Would they drink the water? Tie in natural pond eutrophication. Talk about the animals in terms of the pond food webs. Who eats this, that?

Natural pond: Here is the perfect place to point out pond succession. Show your group the original size of the pond and have them explain what has happened over the years. What will happen to the other ponds they have been to?

Returning, review the main ideas of the program:

Differences and similarities between bodies of water: Marsh, creek, pond.

Aquatic organisms, their adaptions and food web.

Pond succession

Water pollution and eutrophication

Water cycle with and without humans.

And mention some they may do at school:

Make a food web with aquatic organisms.

Water pollution activity.

Discuss who is responsible for pollution and who should clean it up.

Back at the Building

Make sure you leave enough time in your program for a ten minute fish story at the end of the jaunt. You will need:

1 gallon jar, 3/4 filled with water

a plastic fish suspended on a wire

handful of soil

handful of paper scraps

a film cannister of pancake syrup
salt
detergent

cup of hot water

few drops of red food coloring

Tell the students to imagine the jar is a river, and the river is a home for this fish. The fish swims happily in the river, under the trees, passed the fields, and all around. How does it feel to be this fish?

The fish swims by a steep bank where loose soil washes into the river when it rains. What happens to the water? (Put the soil in the jar.) How does it feel to be this fish?

The river enters the edge of town at a park where litter from lunch boxes and newspapers blow around. (Put paper in the jar.) How does it feel to be this fish?

Near the park several cars have been dumped on the river bank. The oil from the engin is leaking out into the water. (Put the syrup in the water.) How would you like to live in this river?

The river passes several houses where the detergent from the kitchens and bathrooms leaks into the river through a faulty septic tank. This adds soap and sewage to the river. (Add detergent). How do you think this fish feels now?

In the winter, the salt from the ice-covered road is washed into the river with the melting slush. (Add salt to water.) Can this fish get fresh water to drink?

As the river leaves the town, a large power plant dumps hot water and some chemicals into the river. There aren't very many chemicals in their effluent -- but they are dangerous. (Add the hot water and 1 drop of food coloring.) Would <u>you</u> like to live in this river?

When the water gets pretty murky, the kids have a fairly good idea of what's going on, you can stop the story, and let them sum it up. We all contribute to water pollution, and since we all use the water, we need to pay attention to pollution problems and water quality. We need to remember the fish!

As the kids begin to get up to leave -- ask them to be patient a little longer, and ask them where we should dump this water. After all -- if we put it down the drain, it will end up polluting the soil . . . Help them figure out that the parking lot would be the best filter without killing plants.

Encourage them to come back with their families, and thank them for coming!

GIANT WATER BUG

This large insect can reach 3 inches in length! It usually lives near the bottom of ponds, breathing air trapped in a silver bubble under it's wings. The female water bugs cement their eggs to the back of the male. He carries them around for a week. Adults often fly into lights at night.

Food: Giant water bugs are fierce predators. They eat insects, small water animals, tadpoles and fish. They bite and sting their prey with a poison.

WATER BOATMAN

This adult insect has very long middle legs and flattened hind legs that propel it through the water like the oars of a boat. It is often confused with the backswimmer because of its similiar shape, but it can be identified by its dark back and white belly. The water boatman breathes air from the pond's surface, and while underwater, breathes air from a silvery envelope that surrounds its body. Because it floats, the boatman must hang on to vegetation to stay under water.

Food: Water boatman feed upon Algae, vegetation, decaying plants and animals, and microscopic animals. Its the only aquatic bug that eats plants.

DIVING BEETLE

These beetles are very common in ponds. They have a dark shiny back and flat, fringed hind legs that allow them to quickly dart through the water. Upon reaching the pond's surface, they store air under their wings to breathe while underwater.

Food: Sometimes called "dragons of the pond", the diving beetles are fierce predators. They attack insects, leeches, snails, tadpoles, and even small fish.

They are eaten by turtles, frogs, fish, birds, raccoons, and skunks.

MOSQUITO LARVA AND PUPAE

Mosquito larvae are between ¼ - ½ inch long. Unlike other fly larva, a mosquito larva's head and mid-section is fatter than the rest of its body. It breathes through gills at the end of its body. Mosquito pupae are also different than other fly pupae -- they can swim. They breathe through tubes from the middle of their bodies.

Mosquito larvae usually rest at the surface, and with violent wiggling motions, swim downward when disturbed. Thats how they get their nickname, the "wigglers". Can you guess why the pupae are also called the "Tumblers"?

Food: Mosquito larvae eat microscopic plants and animals or dead stuff which they filter through brushes surrounding their mouths.

LEECHES

Leeches look like flat worms with lots of segments. They often live in fresh water and are usually bright colored. A leech has a sucker at either end of its body. It uses its suckers to hold onto plants and creep along, inch worm style.

Food: Most leeches eat insect larvae, snails, and worms. Only a few kinds feed on worms blood.

DRAGONFLY NYMPH AND ADULT

The dragonfly nymph hatches from an egg on the bottom of a muddy pond. For several years the nymph stays in the water gobbling up insect larva (especially mosquitoes), worms, tadpoles, and small fish with its powerful shooting jaw. The nymph uses a jet-propulsion squirt of water to

scoot quickly out of the path of a predator, usually fish and turtles. A set of gills line the inside of an abdominal tract, enabling the nymph to absorb oxygen from the water. During the winter the nymph hibernates in the mud.

When the nymph is ready to transform into an adult, it crawls out of the water on a branch or a bridge. The outer skin splits and the soft, crumpled dragonfly emerges. After several hours the adult dragonfly is capable of flying.

The adult dragonfly swoops lightly around the pond, spying prey with huge compound eyes (each had 10,000 to 20,000 lenses). When at rest, its wings lay outstretched on either side of its body.

Food: Nymph eat aquatic insect larva, tadpoles, and fish. Adults eat flying insects, especially mosquitoes.

WATER STRIDER

Water Striders live on the surface of the water, skating across the surface film. The adults are wingless. Their two back pair of legs are 2-3 times as long as their dark bodies. The legs are spread far apart, allowing the strider to rest on the top of the water.

Food: Water Striders eat insects that fall into the water or drift too close to the surface of the water, by capturing them with their short front legs.

FISHER SPIDER

This is the only spider commonly found near and in ponds. It can dive and stay underwater for long periods of time, after trapping a layer of air in the hairs around its body. Fisher spiders are good-sized (body length is ½ - 1 inch), and they have a dark body with 3 light lines.

Food: Fisher Spiders usually eat insects, but may also catch small fish and tadpoles.

WHIRLIGIG BEETLE

Spinning and whirling groups of whirligig beetles decorate the surface of many ponds. Occasionally they dive beneath the surface of the water with a bubble of air attached to the end of each beetle's body. Their bodies are steamlined for swimming and they have two sets of eyes which allow them to see above and below the water surface at the same time.

Food: Primarily they eat insects caught on the surface of the water.

CADDISFLY LARVA

Caddisfly larva builds small tube-shaped houses to live in. Usually, it's this collection of branches and bits of vegetation, slowly moving along the pond bottom that is first seen. You have to look closely to see the small head and waving front feet of the larva poking out. The larva breathes through gills along the outside of its abdomen. Small hairs keep the water moving in and out of the case, supplying it with fresh oxygen.

The case is held together with a type of silk, and in addition to sheltering the larva, protects the caddisfly pupa, too.

The adult caddisfly resembles a moth, with narrow antennae and brown wings. It is small, less than 1 inch long.

Food: Larva eat small plants, small animals, bits of plants, insects and worms. Adults suck sweet liquids; they don't eat much, as they only live one month.

Larva are an important food for fish.

BACKSWIMMER

These bugs are often seen on the surface of the water. Their strong hind legs are fringed for swimming, and their body is keeled like the bottom of a boat. The backswimmer swims on its back with its dark belly facing up. It can breathe underwater from air stored in grooves along the sides of its body.

Food: Backswimmers are predators. They eat small animals and even attack fish. They can sting.

DAMSELFLY NYMPH AND ADULT

The Damselfly completes its life cycle within one year. After hatching from an egg in the spring, the young nymph crawls through the pond bottom in search of small insect larva to eat. It breathes dissolved oxygen which it absorbs from the water through three gill plates extending from it tail. Although similar, the damselfly nymph is more slender than the dragonfly nymph.

After emerging as an adult, a damselfly flies near the edge of ponds in search of flying insects to eat. Its compound eyes bulge from the side of its head. When resting, the damselfly holds its wings together above its body. Damselflies tend to be bright blue, green, and black.

Food: Nymphs eat aquatic insects. The adults eat flying insects.

TADPOLES AND EGGS

Amphibian eggs look like clear, round globes of jello with black dots inside. Toad eggs usually appear in strings and frog eggs in masses. The black dots inside the eggs hatch into legless tadpoles. A tadpole has gills at the sides of its head and a long tail. First the hind legs grow and then the front legs. Finally the tail disappears and lungs develop. The tadpole has turned into an adult frog or toad!

Food: Tadpoles eat plants. Adult frogs and toads eat live animals, especially insects and worms.

WATER MITE

Water mites are usually small, red, and round. They have 8 legs and 1 body section, spiders are different, they have 8 legs and 2 body sections. They absorb oxygen through their body wall, and rarely come to the surface for air. When they stop swimming the mites sink to the bottom, which is probably why they seem to hurry when they swim!

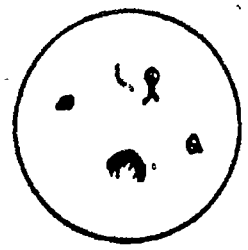
Food: Mites feed on insects and worms, piercing them and drawing out their juices. Some are parasitic.

Water mites are eaten by insects and fish.

Name _____

Pond Life Checklist

Many animals can be found in a spring pond, and a few are pictured below. Please check the animals you find while collecting.



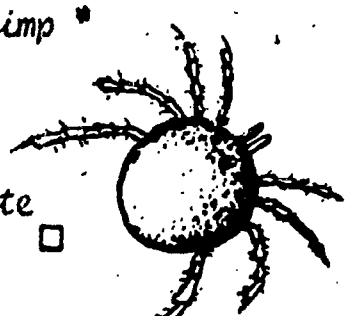
☐ zooplankton

☐ leech

☐ horsehair worm

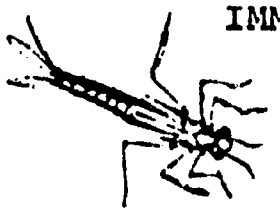
☐ fairy shrimp *

☐ clam shrimp



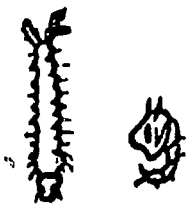
☐ water mite

IMMATURE INSECTS



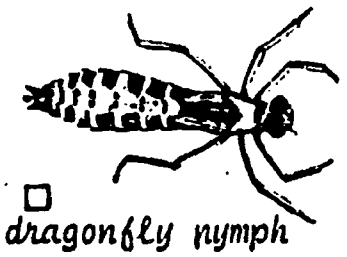
☐ damselfly nymph

☐ caddisfly larva *

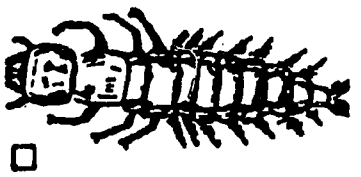


☐ mosquito larva and pupa

☐ mayfly nymph *



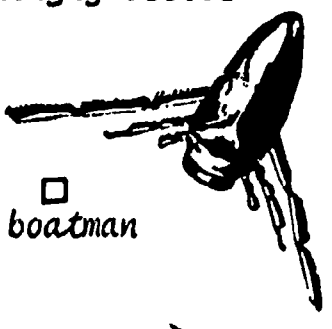
☐ dragonfly nymph



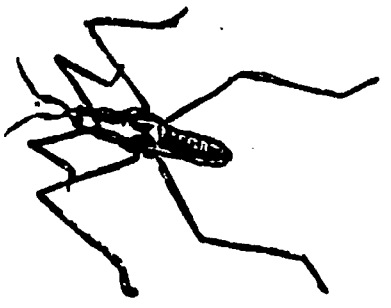
☐ hellgrammite

MATURE INSECTS

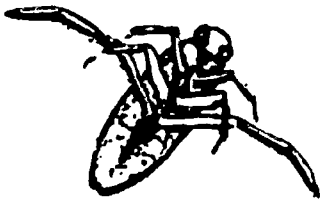
☐ whirligig beetle



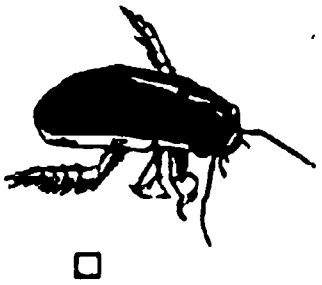
☐ water boatman



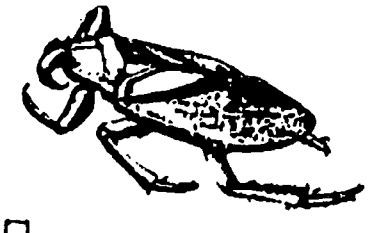
☐ water strider



☐ backswimmer



☐ diving beetle



☐ giant water bug

Other Critters

- ☐ crayfish
- ☐ fisher spider
- ☐ stickleback fish*
- ☐ frog
- ☐ tadpole
- ☐ turtle
- ☐ snail

A large number of different organisms (10-20) and the presence of any starred animal (*) indicates a high quality of water.

Name _____

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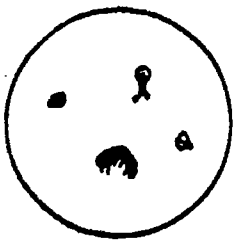

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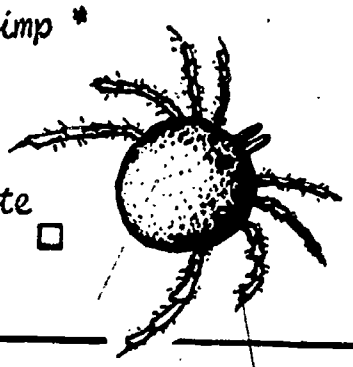
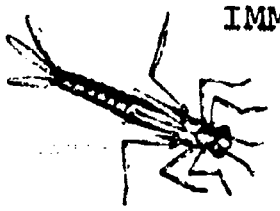


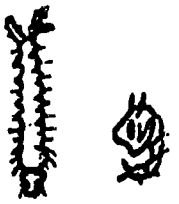
☐ water mite

IMMATURE INSECTS



☐ damselfly nymph

☐ caddisfly larva *



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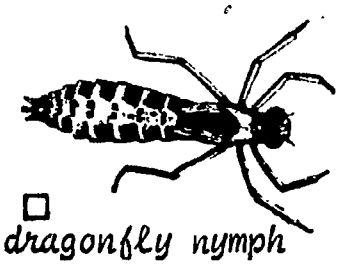
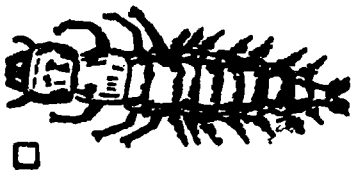


☐ dragonfly nymph



☐ hellgrammite

MATURE INSECTS

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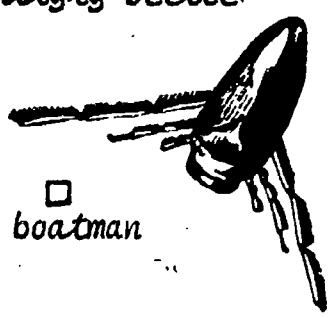
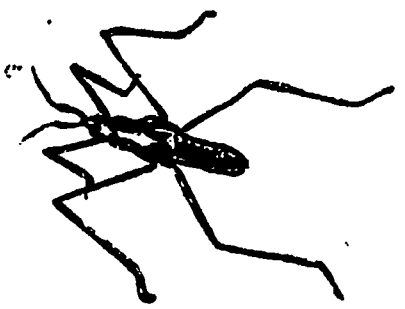


☐ water boatman



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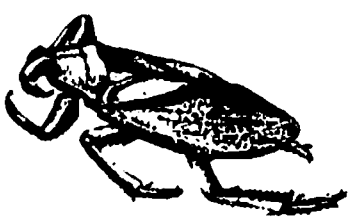
☐ diving beetle



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