DOCUMENT RESUME

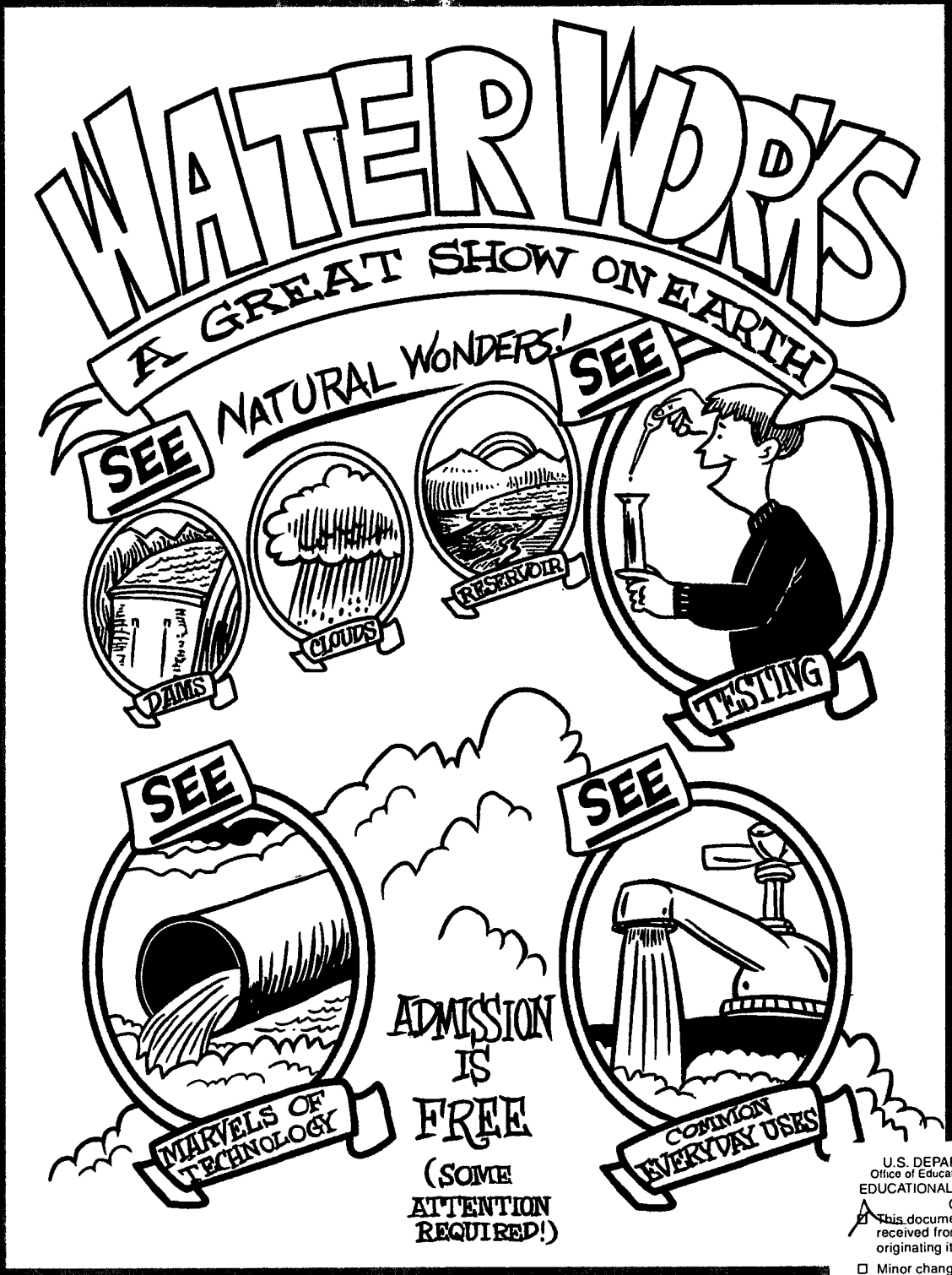
ED 433 224 SE 062 607

AUTHOR McClure, Judy; Clark, Neil
TITLE Water Works: A Great Show on Earth. Classroom Activities for Third and Fourth Grades.
INSTITUTION Massachusetts State Water Resources Authority, Boston.
PUB DATE 1999-00-00
NOTE 95p.; Title page reads "Water Works...in the Elementary Classroom." Illustrated by Leo Abbett.
PUB TYPE Guides - Classroom - Teacher (052)
EDRS PRICE MF01/PC04 Plus Postage.
DESCRIPTORS *Conservation (Environment); *Drinking Water; *Ecology; Elementary Education; Environmental Education; Inquiry; Public Health; *Science Activities; Science and Society; Science Instruction; Scientific Concepts; Scientific Methodology; Social Responsibility; Water Pollution; *Water Resources; *Water Treatment

ABSTRACT

This curriculum guide is divided into five lessons, each containing several activities that reflect the natural path of inquiry that third or fourth grade students might take in considering the water that arrives in their bathroom sinks each morning. Starting from the familiar faucet, the students are encouraged to reflect on their own habits and analyze community water use. The next lessons trace water from the faucet to the reservoir, investigating the systems that deliver water to our homes and neighborhoods. The natural systems that support not just reservoirs, but life itself are considered. Finally, students explore how water is cleaned by suppliers and how they can take simple measures to protect their own resources. (WRM)

SE



Classroom Activities for Third & Fourth Grades

Massachusetts Water Resources Authority

WATER WORKS . . .
IN THE ELEMENTARY CLASSROOM

WRITTEN BY
JUDY MCCLURE AND NEIL CLARK

Illustrated By
Leo Abbett

Design & Layout By
Jenny Seigel, Rita Berkeley and Tim Watkins

We would like to acknowledge the following teachers who piloted these activities in their classrooms. Their suggestions on implementing the curriculum were invaluable to us.

NANCY BARRON	Beechwood Knoll School, Quincy
LORRAINE EVANS	Lowell School, Watertown
MARILYN HOLLISON	Lowell School, Watertown
KAREN KELLIHER	Beechwood Knoll School, Quincy
JULIE LEWIS	Kelly School, Chelsea
COLLEEN MONAHAN-WHITE	Beechwood Knoll School, Quincy
REBEKAH RIEDER	Beechwood Knoll School, Quincy
BRENDA SHORE	Beechwood Knoll School, Quincy
CAROL SIMMONELLI	Kelly School, Chelsea
LISA VALLATINI	Beechwood Knoll School, Quincy

We especially acknowledge **Kim Piccolo** of Arlington schools and **Teresa Quinton** of Hanover schools who read, evaluated, and made suggestions in the formative stages of the project. Their guidance and expertise were extremely valuable.

Thanks also to **Carol O'Brien**, **Kathy Scanlon** and **Earl Chisholm** of Boston and **Peggy O'Kane**, Quincy, who helped us through the "rough edges" stage of kit development.

Water as a Learning Tool

Water supply is no miracle. It is the result of science and technology applied to our most fundamental needs and dedicated to community health and safety. Understanding the importance of water systems is part of modern citizenship. Water Works is intended to lay the foundation of responsible water use for elementary students, leading them to look beyond the faucet to the natural and human-made systems which support that stream of clean, reliable water.

The study of water can accomplish many things in the elementary classroom. It teaches students that if they look carefully at familiar things, there is more to learn, deeper understanding to be gained. Further, it is a rich topic for developing basic skills. As they do Water Works activities, students will predict, experiment, observe and draw conclusions. They will read, calculate, and communicate. Activities in Water Works address many of the Learning Standards set forth by the Massachusetts Curriculum Frameworks.

Water systems are an instructive example of technology for third and fourth graders. Technology, these days, conjures up "high tech," wires carrying electrical charges which no one can see. Low tech water pipes carry water, with which students are entirely familiar. Water systems are science and technology in service to families, businesses and the community. The technology is in their homes and under their streets, bringing them essential services.

Finally, water systems can help students consider distant and local human history. Not many generations have enjoyed the hot water and flush toilets that we take for granted. When and why did people decide to concentrate resources on water supply systems? What benefits did they gain? Though Water Works concentrates more on the science and technology of water supply, other areas of inquiry are readily available. Whether it's town history or the Roman Aqueducts, fruitful connections and extensions abound.

Just as we benefit today from planning done a century ago, today's young people will soon be responsible for community decisions with far reaching consequences. We hope Water Works will help build a foundation that serves the community today and tomorrow.

TEACHER'S NOTE – USING WATER WORKS

This curriculum guide is divided into five Lessons, each containing several activities, reflecting the natural path of inquiry that third or fourth graders might take in considering the water that arrives faithfully in their bathroom sink each morning. Starting from the familiar faucet, we encourage them to reflect upon their own habits and to analyze community water use. The next lessons trace water from the faucet to the reservoir, investigating the systems that deliver water to our homes and neighborhoods. Then come the natural systems and cycles that support not just reservoirs, but life itself. Finally, students explore how water is cleaned by suppliers and how they can take simple measures to protect their own resources.

At each stage we encourage students to hypothesize, to observe, to think carefully, to record and study data -- to practice good science. We also encourage them to apply other intelligences, to act out or draw pictures, to communicate. The program is designed with the Massachusetts Science and Technology Frameworks in mind, enabling teachers to accomplish those curriculum goals within a unit of study that clearly has relevance to students' daily lives.

The water cycle presents an instructive case of inquiry-based learning. Evaporation is a difficult idea, because we can't often see it. Inquiry requires us to present the phenomenon, help students observe systematically, and to support them through the disquiet of something that is both real and difficult to observe directly. We hope you will resist the temptation to answer kids' questions with the familiar mantra of the water cycle. Rather, listen to their questions, help them articulate them, and use the activities to expand the experiences they can draw upon to explain rainfall. If they are left with unanswered questions, fine. It is better to leave something for a later month or year when students can figure it out or grasp it for themselves than to provide a facile set of terms that don't have direct meaning to them. Evaporation presents you with a clear choice: do you stay with experiential education and inquiry learning, and leave some questions unanswered, or do you rush in with formulaic answers to make everyone (yourself, the kids, the school board, and parents) feel more comfortable? We strongly encourage you to stand by the first approach.

Water Works is activity based, because students remember better what they experience than what they merely read or hear about. The activities are structured and fun. Teachers in the MWRA service area can borrow activity kits from us for individual lessons in the guide. In the Teacher Pages, materials that will be included in the lending kits are designated by "(kit)."

What do teachers need to know to use Water Works? You needn't be a water professional. Knowing how to structure and manage classroom activities, and understanding the capabilities of third and fourth grade learners, are far more important skills. None of the content is sufficiently technical to put a teacher on thin ice. And if students do come up with arcane questions, MWRA School Program staff are only a phone call away.

The MWRA School Program can support Water Works in other ways. We often visit schools in our service area to make classroom presentations, doing one of the activities from Works or explaining water systems in greater detail. The Water Matters newsletter will keep you up on water issues and other environmental education resources to enrich your programs. It is our goal to form partnerships with area teachers that are mutually beneficial: MWRA's messages of conservation and stewardship reach young people, and teachers have an array of resources that help them meet their curriculum goals.

Table of Contents

LESSON 1 - HOW WE USE WATER

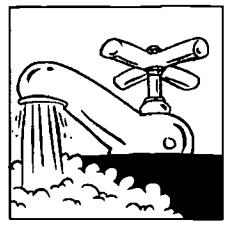
LESSON 1 - HOW WE USE WATER

Third and fourth graders have been opening faucets and flushing toilets almost all their lives. These activities draw on that experience, asking them to gather, organize and incorporate new knowledge about how people use water. Students will apply different skills (acting, counting, drawing) to broaden their water awareness.

Water Charades begins the water thinking process, as students brainstorm and act out family water use.

The Family Water Tally asks students to collect data on how much water their families use. Categorizing water use and interpreting the data may stretch some of the students, but completing the summary as a class activity should help pull it together.

The third activity extends students' water horizons beyond themselves and their families to community use, as they prepare a Water Mural. The resulting final project can be shared with the school.



ACTIVITY 1-1 WATER CHARADES

SUMMARY Working in teams, students will list individual and family uses of water. They will use the list for a game of charades.

CONTENT AREAS social studies, science, drama

GOAL to help students discover the ways that people use water and to think about individual and family uses of water

TIME one session

MATERIALS
- paper
- pencil or pen

ADVANCE PREPARATION

- Prepare small pieces of paper.
- Create student working groups.

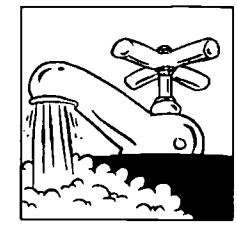
TEACHER PROCEDURE

1. Divide the class into teams of four or five students.
2. On small pieces of paper each team should write down at least five different ways that they individually use water or that their families use water. They should label the use individual or family. Here are common examples; students may think of others.

INDIVIDUAL USE	FAMILY USE
Brushing teeth	Cooking
Flushing the toilet	Cleaning
Washing hands	Washing dishes
Washing face	Doing laundry
Taking a shower	Watering the garden or lawn
Taking a bath	Filling the pool
Drinking water	Washing the car

3. One team will choose a slip of paper from another team and act out the water use to the remaining teams. Depending on the water use, one or more students can act it out.
4. The other teams will try to guess the water use the first team is acting out.
5. If you want to keep score, the team that acted out the water use and the team that guessed it will get one point. For an extra point the guessing team should say if the use is individual or family.

Lesson 1 How We Use Water



ACTIVITY 1-2 FAMILY WATER TALLY

SUMMARY Students will collect water use data at home and bring this information back to the classroom to discuss and study with classmates.

CONTENT AREAS social studies, math, science

GOAL to learn the ways that a family uses water

TIME two sessions and one family assignment

MATERIALS
- home water use data page
- pencil or pen

ADVANCE PREPARATION

- Copy enough data pages for all students.
- Create a class data summary page for recording class data--on overhead, board, or flip chart.

TEACHER PROCEDURE

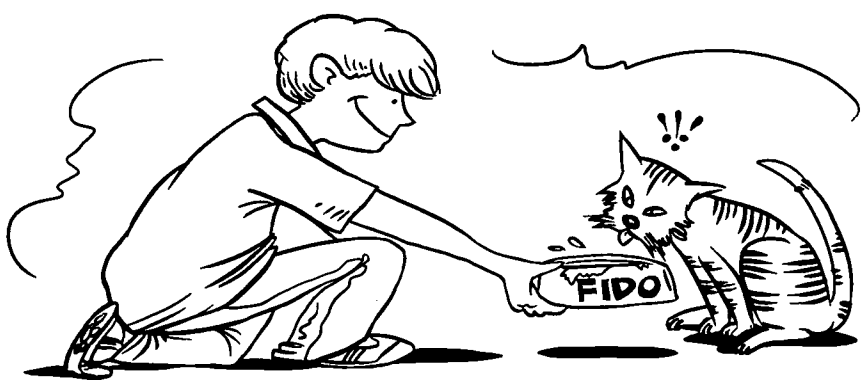
1. Collecting the Family Water Use Data
   a. Give each student one copy of each Family Data Collecting page.
   b. Explain that they should take the pages home for the weekend and post them in the correct locations. You may also want to send home the letter to families found at the end of this unit. It explains this activity to students' families.
   c. Each time a family member uses water s/he should record it on the data page in that location.
   d. After one weekend day students bring the data to the classroom.
2. Preparing Family Data Summary
   a. Each student will count the number of times the family did each water use on data collection day and record that information on the Family Data Summary Form.
3. Completing the Class Data Summary
   a. Make a list of all class water uses on the board.
   b. Distribute a Class Data Summary form to each student. Create a similar table on the board, flip chart, or overhead
   c. Complete the Class Data Summary totals for the class's water use categories. Optional: You may also want to have students figure class averages for each category (total ÷ number of students)
4. Students will answer the questions on their own or you can use them to lead a class discussion. Note that number four and number seven are optional and can only be answered if you figured the class averages.

Name _____ Date _____

Family Data Collecting Page

Location: Kitchen

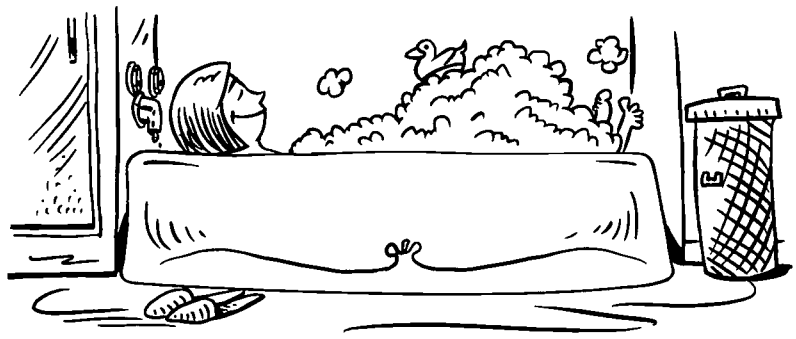
Water Use	Check off Here
washing dishes by hand	
run dishwasher	
cooking	
cleaning	
watering house plants	
water for pets	
drinking	
rinsing food	



Student Page
Activity 1 - 2

Name _____ Date _____

Family Data Collecting Page



Location: Bathroom

Water Use	Check off Here
flushing toilet	
brushing teeth	
washing hands	
washing face	
showering	
taking a bath	
drinking	
cleaning bathroom	

Name _____ Date _____

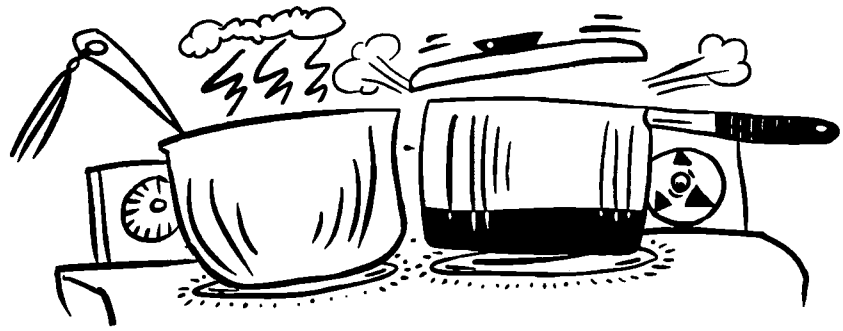
Family Data Collecting Page

Location: Laundry

Water Use	Check off Here
washing clothes by hand	
running washing machine	

Name _____ Date _____

Family Data Summary



Water Use	My Family's Total for one Day
washing dishes by hand	
run dishwasher	
cooking	
cleaning	
watering house plants	
water for pets	
drinking	
rinsing food	
flushing toilet	

Name _____ Date _____

Family Data Summary

Water Use	My Family's Total for One Day
showering	
taking a bath	
drinking	
cleaning bathroom	
washing clothes by hand	
running washing machine	
brushing teeth	
washing hands	
washing face	

16

Student Page
Activity 1 - 2

Name _____ Date_____

Class Data Summary

Water Use	Class Total	Class Average (Total divided by number of students)
washing dishes by hand		
run dishwasher		
cooking		
cleaning		
watering house plants		
water for pets		
drinking		
rinsing food		
flushing toilet		

Name _____ Date _____

Class Data Summary

Water Use	Class Total	Class Average (Total divided by number of students)
showering		
taking a bath		
drinking		
cleaning bathroom		
washing clothes by hand		
running washing machine		
brushing teeth		
washing hands		
washing face		

Name _____ Date _____

Family Water Use

1. How many different uses of water does your class have?

_____

_____

2. How was water used the most by the families in your class?

_____

_____

3. How many times was it used?

_____

_____

4. What was the class average for that use? (optional)

_____

_____

Name _____ Date _____

Family Water Use

5. Which water use did families do least often?

_____

_____

6. How many times was it done in one day for the class?

_____

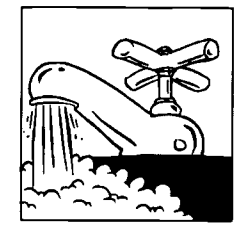
_____

7. How did the data from your family compare with the class averages? (optional)

_____

_____

Activity 1-2 Family Water Tally



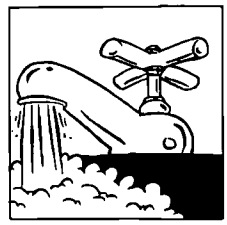
Dear Families,

In our class we are learning about the many different ways that we use water. We are trying to discover how our families use water at home. We would like each family to help us with this investigation.

Each student in the class will bring home several "Family Data Collecting Pages." These should be posted in the different rooms in your home where water is used, for example, the bathroom and the kitchen. Don't forget to include water for washing clothes, whether you do it at home or at a laundromat. When each family member uses water in the home s/he should record it on the data page. Students should bring them back to the classroom on _____.

Thank you for your help with this project. I hope that your family will enjoy learning about water with our class!

Sincerely,



ACTIVITY 1-3 COMMUNITY WATER USE MURAL

SUMMARY Students will work together to design and make a mural about community water use.

CONTENT AREAS social studies, art

GOAL to create a visual display of how a community uses water

TIME approximately three class sessions

MATERIALS
- large piece of paper for a mural (3' x 9')
- paper for design (18" x 18")
- pencils
- paint or markers

ADVANCE PREPARATION

- Prepare 3' x 9' paper.
- Create student working groups.
- Prepare 18" x 18" sketch paper for student groups.

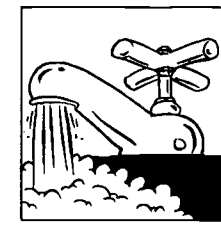
TEACHER PROCEDURE

Session One

1. Brainstorm with the class about the ways a community uses water. List their ideas on the board. (Ex: fire fighting, street cleaning, swimming pools, ice skating rinks, gardens)
2. Explain to students that they will be creating a mural that shows a community using water.
3. Develop a design for the mural. Use a large piece of paper (approximately 3' x 9') taped on a wall or board where everyone can see. Tell the students this will be the size of the mural. The class should choose 12 different "scenes" for the mural (12 is based on a class size of 24). Ideally each scene will be a part of a whole picture. Lay out the design of the mural on the piece of paper. Nothing needs to be drawn yet, just words and blocking out areas of the paper will suffice for the planning stages.
4. Assign "scenes" to pairs of students. Each pair of students should work with pencils and a 18" x 18" piece of paper to design their section of the mural.

Session Two

5. On the floor or a wall create a 3' x 9' space so that all the pieces of the mural can be fit together for a "rough draft." You can do this on a piece of paper on a wall or by making a 3' x 9' area on the floor with tape. Place the students' preliminary scenes in place. Discuss how it looks. Are there empty spaces? Do the designs look good together? Will the background need filling in? Discuss what works well and what needs changing.
6. Pairs of students redraw their pictures using suggestions from the class discussion. Students bring their pictures to the group for final discussion.



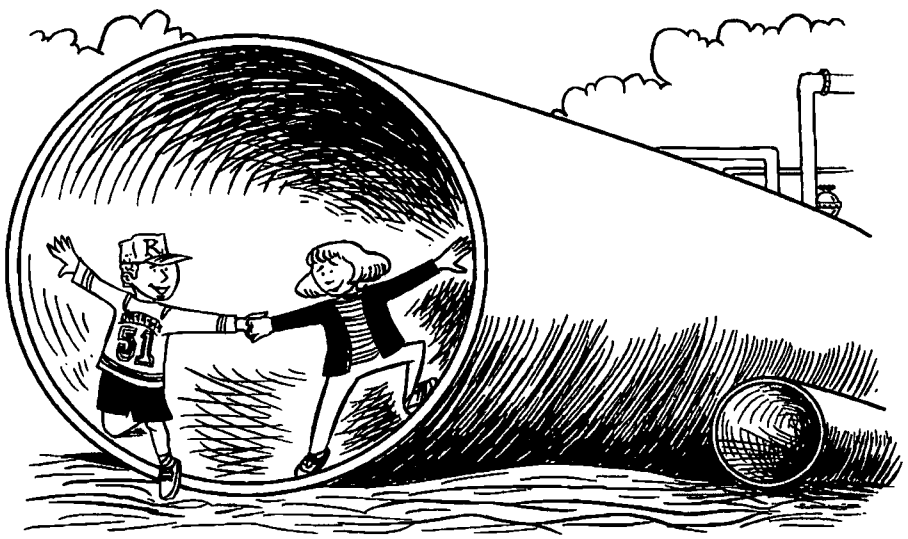
ACTIVITY 1-3 COMMUNITY WATER USE MURAL

TEACHER PROCEDURE

Session Three

7. Place a 3' x 9' piece of paper on the floor. Student pairs draw their designs on the mural in pencil. Probably no more than three pairs can work at one time.
8. When everyone has finished his/her section in pencil review the mural again. Is it ready for painting and coloring with markers or crayons? Make any necessary changes.
9. Student pairs paint or color in their portion of the mural.
10. Individual students can add background and other necessary details.
11. Hang in a prominent location and admire!

Lesson 2 - How Water is Delivered

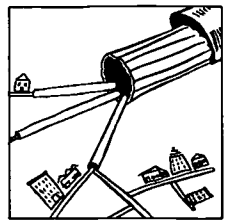


Lesson 2 - How Water is Delivered

The activities in Lesson 2 explore the systems that deliver water to families and communities. The pipes, valves and connections are mostly behind walls or under the ground, so students have little direct knowledge of them. But they are the next logical step in understanding where our water comes from.

The first two activities, How Much Water Do Containers Hold? and Which Pipe is Bigger? examine the volume of different containers and pipes. They will first estimate comparative volumes, then use water to test their predictions. The next activity, Different Diameter Pipes, combines language arts skills ("The Story of Drip and Drop") with the geometry of circles and cylinders to think about how much water different pipes can carry. Finally, using every day objects, students create a model of a water delivery system (Building a Water System).

The first two activities in Lesson 2 require water to test predictions. These activities will therefore be very engaging for students, but also potentially messy. We suggest careful preparation to control the water and a generous supply of paper towel for clean up.



ACTIVITY 2-1 HOW MUCH WATER DO CONTAINERS HOLD?

SUMMARY Students will estimate container sizes and then test their estimations using water.

CONTENT AREAS math, science

GOAL to experience different amounts of water in different size containers and to become familiar with volumes of water

TIME one session

MATERIALS for each group: about five different containers that will hold water (kit) (possibilities include: margarine tubs, yogurt containers, liquid soap containers, baby bottles)

-pitcher for water (kit)
-paper towels
-funnel
-graduated cylinder for extension activity (kit)

ADVANCE PREPARATION

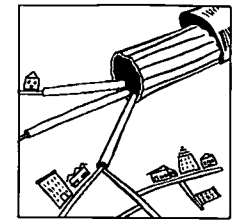
- Group containers in sets of five.
- Fill pitchers with water.
- Put materials on table available to students.
- Create student working groups.

TEACHER PROCEDURE

1. Each group of students should get a set of materials. Each group does not need an identical set of containers.
2. Students should order the containers from the one they think would hold the most water to the one they think would hold the least. (most volume to least volume)
3. Students test their predictions by using water.
4. After containers are ordered, students should explain their method for solving the problem.

EXTENSION

Estimate the volume of the containers in milliliters. It will be helpful if students know that a 1-liter bottle holds 1,000 milliliters. They should check their estimations using a measuring cup and then a graduated cylinder. Which is more accurate?



ACTIVITY 2-2 WHICH PIPE IS BIGGER?

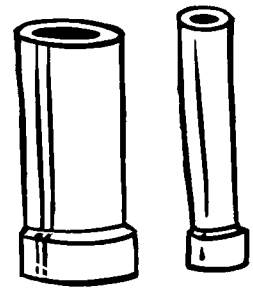
SUMMARY Students will compare pairs of pipes and predict which has the greater volume. Then they will test their predictions using water.

CONTENT AREAS math, science

GOAL to understand that volume is important in pipe size and to gain experience with measures of volume

TIME one session

MATERIALS for class:
- -10 pairs of pipes labeled A1,2 - J1,2 (kit)
- -10 pitchers of water (kit)
- -10 plastic basins or tubs
- - paper towels



ADVANCE PREPARATION

- Fill pitchers with water.
- Put pipes on materials table available to students.
- Create student working groups.
- Copy student pages.

TEACHER PROCEDURE

1. Each group of students should get one pair of pipes (ex: A1 and A2) and a pitcher of water and bring it back to their table.
2. The group should decide by looking at the pair of pipes which one they think is bigger. They should record their predictions on the data form.
3. The group will then use water to determine which pipe holds more. One student will need to hold the pipe as another is pouring water into it. Students work over plastic basins to minimize water mess.
4. Groups record their information on the data page.
5. Students trade pipes with another group.
6. They continue until they have tried at least five pairs.

Which Pipe is Bigger?

Introduction: Sometimes it is hard to tell the size of something just by looking at it. In this activity you will look at pairs of pipes and predict which one is bigger. Then you will test your prediction using water.

Materials

- 5 or more pairs of pipes
- one container of water
- plastic basin or tub
- Pipe Data Table

Procedure

1. Get one pair of pipes and bring it back to your table.

2. Look at the pair of pipes and predict which one is bigger. (Which one will hold more water.)

3. Record your prediction on the data table.

4. Test your prediction by pouring water in your pipes and seeing which holds more water. (Hint: one student should hold the pipe in the plasic tub while another student pours the water)

5. Record your results on the data table.

Which Pipe is Bigger?

6. Trade pipes with another group and repeat steps 2 through 5.

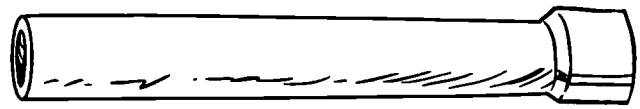
7. Continue trading with other groups until you have worked with at least five pairs of pipes.

8. Return your water container and last set of pipes to the materials table.

9. Wipe up any spilled water and dispose of towels.

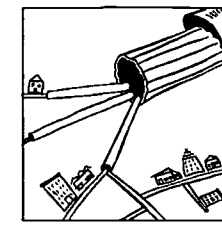
Name _____ Date _____

Pipe Data Table



Pipes	Prediction (Looks Bigger?)	Result (Holds More Water?)
A1, A2		
B1, B2		
C1, C2		
D1, D2		
E1, E2		
F1, F2		
G1, G2		
H1, H2		
I1, I2		
J1, J2		

Student Page
Activity 2 - 2



ACTIVITY 2-3 BUILDING A MODEL DELIVERY SYSTEM

SUMMARY Students will build a model of a water system using pasta to represent pipes.

CONTENT AREAS science, social studies

GOAL to understand the basic structure of a water system

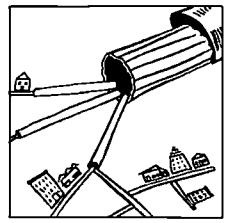
TIME one session

MATERIALS

- -large piece of paper or cardboard
- -materials bag (kit) containing:
  - -different sizes of pasta (ziti, spaghetti, etc.) to represent pipes
  - -paper towel tubes
  - -straws
  - -pictures of buildings (included in the curriculum)
- -crayons or markers
- -glue (optional-for gluing pasta on cardboard)

ADVANCE PREPARATION

- Create student working groups.
- Have large piece of cardboard for each group.
- Have materials available to students.



ACTIVITY 2-3 BUILDING A MODEL DELIVERY SYSTEM

TEACHER PROCEDURE

1. Discuss with students how water gets to the homes and buildings of a community. Emphasize that water leaves a reservoir through a tunnel (an aqueduct) and that pipes branch off and lead to the water mains in different communities. The community's smaller pipes branch off the water main.
2. Have available to each small group of students (2-4) a materials bag and a large piece of paper or cardboard.
3. Explain to students that they will use the materials in the bag to create a model of a water system. The pasta will be the pipes. They will use the drawings of buildings (school, factory) and the reservoir to represent those items in their model. Students may also want to draw apartment houses and homes for their community. They also may want to glue their pieces down on the large paper.
4. When projects are complete, students can look at other groups to see how they might have done theirs differently. Discuss some of the benefits to the different ways that students constructed their systems.
5. The questions at the end of the lesson can be used as guidelines for a class discussion or as written questions for students.

Building a Water System

Introduction: You use lots of water every day. Where does that water come from and how does it get to you? During this activity you will build a model water system using pasta and pictures of buildings.

Materials

- bag of building materials
- large piece of cardboard or paper
- crayon or marker
- glue (optional)

Building a Water System

Procedure

1. Think about how water gets to your faucet every day. You may have a class discussion on this topic.

2. Get your materials.

3. Put your buildings on your paper.

4. Draw more buildings (maybe homes) on the paper.

5. Plan with your group how this water system should be built. First decide where the reservoir will go. Then plan where the pipes should go.

7. Look at other groups' models to see what they did differently from your group.

8. Return extra pasta and buildings to the materials bag. Return those to your teacher.

9. Clean-up any glue, pasta, or scraps of paper that may have spilled.

Name _____ Date _____

Building a Water System

Conclusion

1. Why did you have different pipe sizes in your materials bag?

2. Describe the water system you created.

Name _____ Date _____

Building a Water System

Conclusion

3. Was it difficult for your group to agree on how to build the system? Explain how your group made the decision.

_____

_____

_____

_____

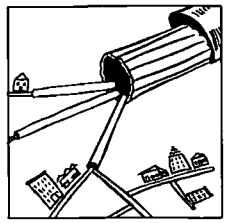
4. Describe how your system is different from those of other groups in your class.

_____

_____

_____

_____



ACTIVITY 2-4 DIFFERENT DIAMETER PIPES

SUMMARY Students will read a story and use a template to draw four different diameter pipes based on their reading. They will use construction paper to create pipes.

CONTENT AREAS reading, math

GOAL to experience the different diameters of pipes in the water system

TIME one session

MATERIALS

-Drip and Drop's Adventure (curriculum)
-pencil
-compass or 1 inch to 10 inch diameter templates (kit)
-large piece of paper-- approximately 21" x 26"
(one quarter must be big enough for a 10" diameter circle)
-ruler, crayons or graph paper
-construction paper, scissors

ADVANCE PREPARATION

- Copy story and student pages for students.
- Prepare large paper for pairs of students - exact size is not important.
- Create student working pairs.

TEACHER PROCEDURE

1. Read the story with the students. You may want students to preread the story and then have individuals read aloud with the class.
2. Working in pairs, students will complete the student pages by answering questions and drawing the correct diameter pipes.
3. Students can roll construction paper to make four pipes that have the same diameter as the ones they have drawn on the student page.
4. You may want to have students connect their construction paper pipes in the same way they are connected in the story.

EXTENSION

When they have completed the pipes they can compare the diameters in two different ways. They can see how long it takes to color each pipe. Or they can trace the pipes onto graph paper and count squares to estimate area.

Drip and Drop's Adventure

Drip and Drop lived with many other water drops in a quiet, beautiful place called Wachusett Reservoir. They played happily with their friends, watching the sea gulls, admiring an old stone church nearby, and greeting the sun and moon each day.

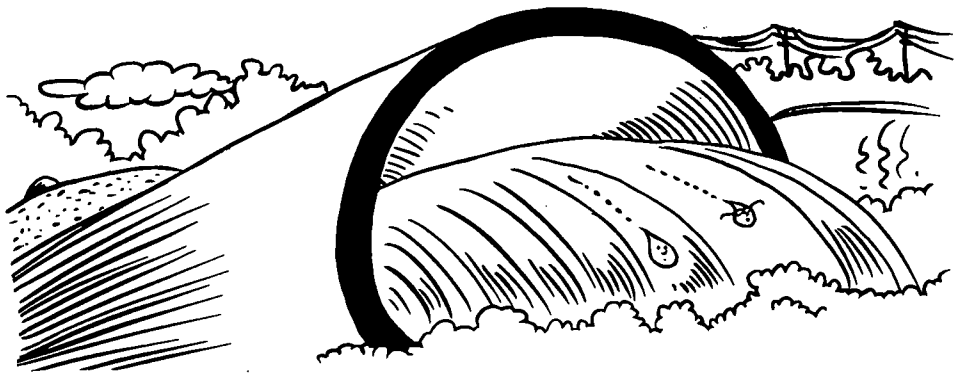
Suddenly one day, everything changed. With a big rush and whoosh, and a quick smell of chlorine, they were swept into the dark, moving very fast. Exploring by touch, they learned they were in a tunnel about fourteen feet across. After two hours, the pipe narrowed to twelve feet across.

On they rushed, hearing names like Framingham and Weston. They caught another smell of chlorine as they passed through Weston. They remembered Wachusett Reservoir and wondered when they would see the light again.

Changes came more quickly now. There were more turns and corners in the tunnel, and some of their friends were drawn off into other pipes. Drip and Drop stayed together, though, enjoying their long fast ride in the dark, wondering where it would lead.

At a fork in the tunnel, they entered a pipe just three feet across, and then one just twelve inches across! Someone said they were right beside a large hospital.

Drip and Drop's Adventure



A few blocks later they entered a six inch pipe. They learned they were under a street, in a neighborhood, right by a school.

They spent a sleepy night, moving very slowly, but then things began to quicken again. They squeezed into a one inch pipe and were carried into a three-family house. Inside the house, a 1/2 inch pipe carried them behind a wall toward a bathroom sink. At last they saw the light again, and they were very excited. They rushed happily onto a child's tooth-brush as she got ready for school.

They were so pleased to see the light that they stayed around the sink for a while. Finally they carried some tooth-paste down the drain into a new set of pipes. After a time, they began to meet more of their old friends again and hear of their adventures, but that's another story.

Student Page
Activity 2 -4

Name _____ Date _____

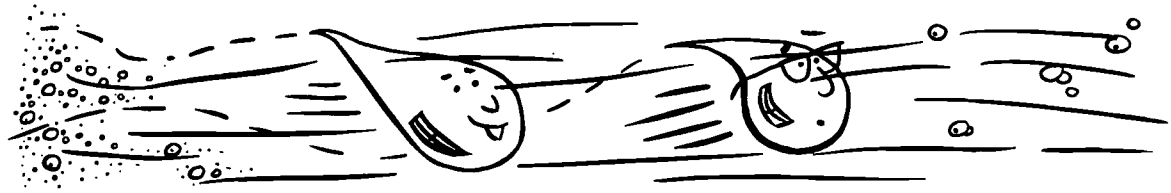
Different Diameter Pipes

1. What was the name of the reservoir where Drip and Drop lived?

2. Where did Drip and Drop smell chlorine?

3. What was the largest pipe that Drip and Drop travelled through?

4. Did the pipes get bigger or smaller as Drip and Drop travelled toward the apartment house?

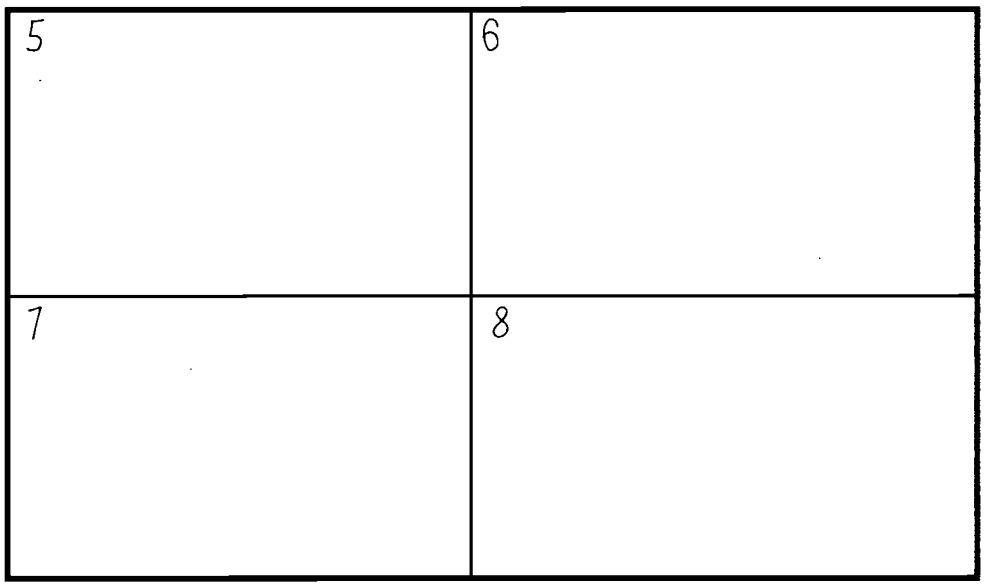


Student Page
Activity 2 - 4

Name _____ Date _____

Different Diameter Pipes

Fold the large paper your teacher has given you into fourths. Number it as shown below.



Procedure

5. In space # 5 of your large paper draw the pipe that Drip and Drop entered near the hospital.

6. In space #6 draw the pipe Drip and Drop were in under the street right by the school.

7. In space #7 draw the pipe that took Drip and Drop past the foundation of a three family house.

8. In space #8 draw the last pipe that Drip and Drop were in.

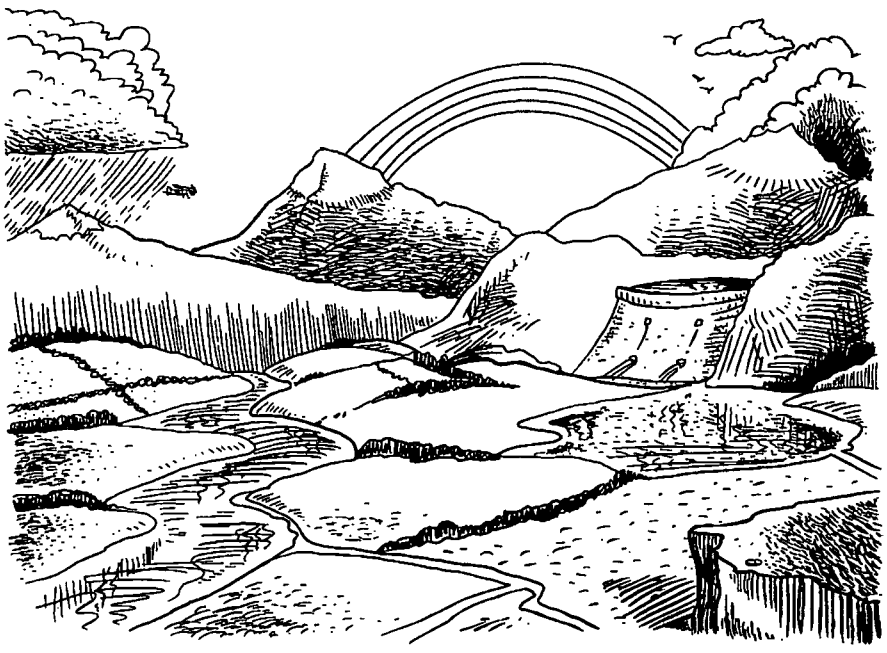
9. Roll up construction paper to create pipes with the same

   diameters as the ones you drew in spaces 5-8.

10. Connect the pipes as they are connected in the story.

Student Page
Activity 2 - 4

Lesson 3 - Reservoirs & Collecting Water

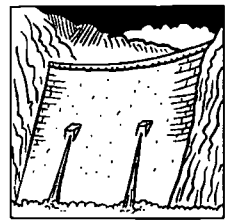


Lesson 3 - Reservoirs & Collecting Water

Where does the water in our pipes come from? In Metropolitan Boston, our water pipes are filled from two large reservoirs, Quabbin and Wachusett. Students may be familiar with the word "reservoir" or know that we depend on reservoirs. Our purpose in chapter 3 is to introduce the watershed concept at a basic level.

By building simple landscapes and raining on them (How Does Water Get Into a Reservoir?), students will reinforce a concept they already know: that water flows downhill. In the subsequent activity (Design a Reservoir), students alter their landscapes to create reservoirs to collect and store rain. Finally, in Letting Water Settle, students predict and then experiment to see what happens to materials that rain carries to the reservoir.

So far we have moved from faucets to pipes to reservoirs. The next step in the process has already been introduced: precipitation and the water cycle.



ACTIVITY 3-1 How Does Water Get into the Reservoir?

SUMMARY Students will create a model of a landscape and spray water over it to understand how water enters reservoirs. (Rain enters the reservoir by landing on the surface and through tributaries.)

CONTENT AREAS science, social studies

GOAL to use a landscape model to discover that water enters a reservoir through run-off (rivers) and rain.

TIME one session

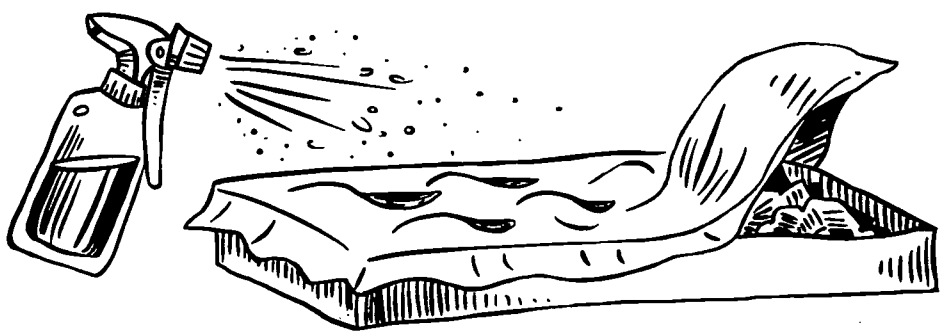
MATERIALS
- plastic box or cardboard box lid (kit)
- newspaper
- white plastic bag ("kitchen size")
- water with blue food coloring
- spray bottle (kit)

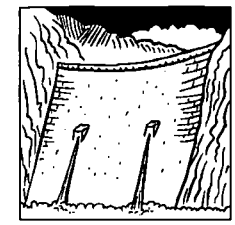
ADVANCE PREPARATION

- Fill spray bottles with blue water.
- Have materials available to students.
- Create student working groups.

TEACHER PROCEDURE

1. Discuss with students the various types of water bodies: lakes, rivers, reservoirs, oceans, etc. Talk about forms of precipitation. Distinguish between fresh and salt water. Emphasize that reservoirs are fresh water.
2. Divide students into their groups.
3. Tell the students that they are going to create a landscape using the box, newspaper, and plastic bag. The box is to hold the materials. The crumpled newspaper will be the bedrock (the rock under the soil) and the plastic bag will be the soil, so the newspaper goes in the bottom of the box and the bag goes over the top of it. Students should make sure that the edges of the bag are outside the box. Everyone's model will look different, but they should all have two or three low places.





Activity 3-1 How Does Water Get Into The Reservoir?

TEACHER PROCEDURE

4. Ask students to look at their models and describe the type of land formations they see. (Mountains, valleys and hills are the most important ones.)
5. Ask students to predict what will happen when they spray water over their landscape. They should record their predictions on the student page. (# 3)
6. Give each group a spray bottle.
7. Each member of each group should spray water over the model about ten times. Other group members should observe and record their observations. (#4)
8. Tell each group to choose one body of water in their landscape and try to determine where the water comes from that fills it. (#5)

How Does Water Get into a Reservoir?

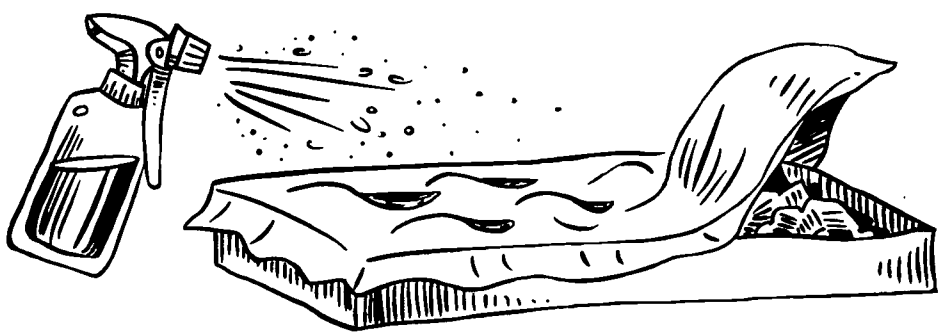
Introduction: Reservoirs store the water we will use in our communities. They are also the places where water is collected. During this activity you will investigate how water gets into reservoirs.

Materials

- plastic box or cardboard box lid
- newspaper
- white plastic bag
- spray bottle with blue water

Procedure

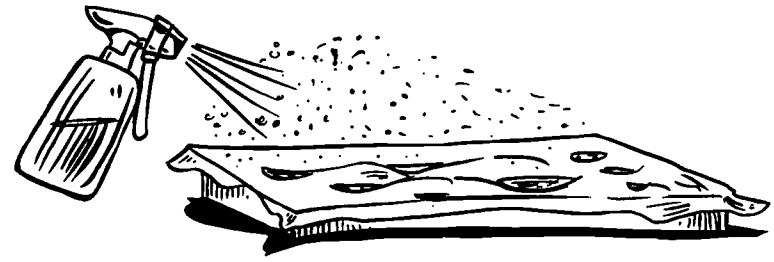
1. The group leader should get the materials and bring them to the table.
2. You are going to create a model of a land area using a box, newspaper, and a plastic bag. The box is to hold the material. The crumpled newspaper will be the bedrock (the rock under the soil) and the plastic bag will be the soil, so the newspaper goes in the bottom of the box and the bag goes over the top of it. Make sure that the edges of the bag are outside the box. Each group's model will look different.



Name _____ Date _____

How Does Water Get into a Reservoir?

3. What do you predict will happen when you spray water over your landscape?



4. Each member of your group should spray water gently over the landscape for about 10 sprays. Other group members should watch carefully as the water is sprayed. What do you observe?

5. Choose one body of water in your landscape and describe how rain is getting into that body of water.

Name _____ Date _____

How Does Water Get into a Reservoir?

6. Describe the ways that water fills reservoirs.

_____

_____

_____

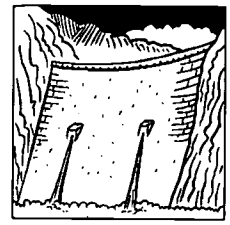
_____

7. Pick up the plastic bag with the water in it. Dispose of the water down the drain or in a bucket. Dry the plastic bag with towels and fold it neatly.

8. If the container is wet, dry it with a towel.

9. The newspaper can be used again if it is dry.

10. Return materials to your teacher.



ACTIVITY 3-2 DESIGN A RESERVOIR

SUMMARY Using simple materials, students will discover how a reservoir is formed.

CONTENT AREAS science, social studies

GOAL to help students understand that you need a valley, mountains, and a dam to collect rainwater for a reservoir; to allow students to see and experience the formation of a reservoir

TIME one session

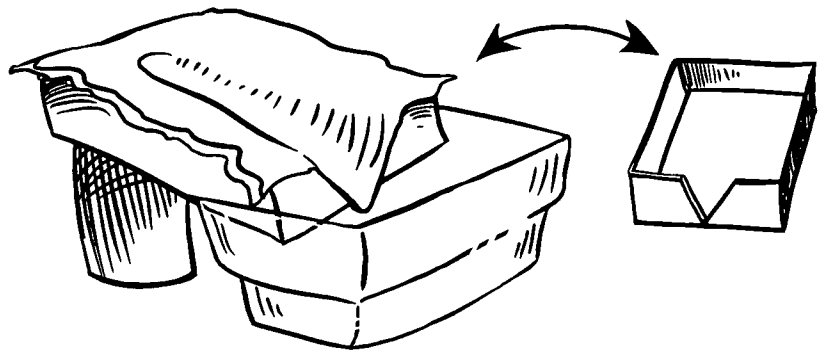
MATERIALS (for each group of 3 or 4 students)
- cardboard box lid with a notch cut out (picture)
- white plastic bag ("kitchen size")
- newspaper
- spray bottle (kit)
- water with blue food coloring
- plastic container (kit)

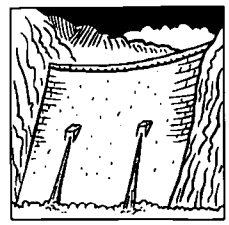
ADVANCE PREPARATION

- Prepare box lids.
- Fill spray bottles with blue water.
- Create student working groups.
- Copy student pages.

TEACHER PROCEDURE

1. Tell the students that they are going to create a landscape. It should resemble two mountains with a deep valley between them. The students will build inside a cardboard box lid with a notch cut out of the end. They will use newspaper for the bedrock and a plastic bag over the top. One end of the box should be propped up. The end with the notch should be over the plastic container. Each group should use a plastic container to collect water as it flows out of the box through the notch.





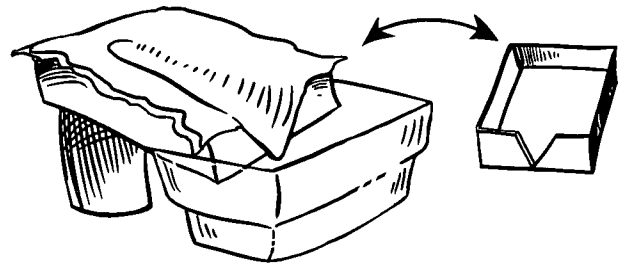
ACTIVITY 3-2 DESIGN A RESERVOIR

TEACHER PROCEDURE

2. Students should get their building materials and build their models.
3. Ask students to predict what will happen when they spray water over their landscape. They should record this prediction on the student page. (#2)
4. Give each group a spray bottle. They should spray water gently over the top and observe. They should record their observations on the student page. (#3)
5. Ask students to predict how they could change their landscape so that the rain could be collected and stored for drinking water. They should record their predictions on the student page. (#4) You may want to suggest or have materials available that the students can use to stop the flow of water.
6. Tell students to test their predictions by changing their landscape and spraying more rain. They should record their observations on the student page.(#5)

Name _____ Date _____

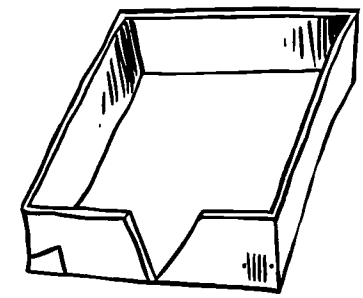
Design a Reservoir



Introduction How could you use the land to collect and store rainwater? Would you have to build anything? You will investigate these questions during this activity.

Materials

- cardboard box lid with a notch cut out
- white plastic bag
- newspaper
- spray bottle with water
- plastic container



Procedure

1. Use a plastic bag, newspaper, and a cardboard box to build a model of a landscape. You want your landscape to have mountains on the sides and a deep valley in the middle.
2. Prop up one end of the cardboard box. The end with the notch should be over the plastic container. Use words and pictures to predict what will happen when you spray water over your landscape.

Name _____ Date _____

Design a Reservoir

3. Spray water over your landscape to test your predictions. Describe what happens. (Use words and drawings.)

4. Describe (with words and pictures) how you might change your landscape to collect and store the rain to use for drinking water.

5. Test your predictions by changing your landscape and spraying water over it. Describe with words and pictures what you did to your model and how well it worked.

Name _____ Date _____

Design a Reservoir

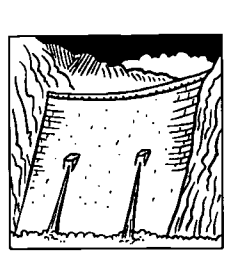
6. Draw and describe your landscape. Explain why it is a good place to collect and store drinking water.

7. Remove the water from the plastic bag and dry it with a towel.

8. Save the newspaper if it is dry.

9. Dry the box if necessary.

10. Return the materials to your teacher.



ACTIVITY 3-3 LETTING WATER SETTLE

SUMMARY Students will create model reservoirs from plastic 2-liter bottles and observe what happens to the materials they add. They will make predictions about what they think will happen as the reservoirs sit undisturbed.

CONTENT AREAS science

GOAL to help students understand that materials that do not dissolve in water settle to the bottom or float to the top

TIME one regular session and two short sessions

MATERIALS for each group of students:
- -two liter bottle with the top cut off
- -four small paper cups (kit)
- -graduated cylinder (kit)

on materials table:
- -water
- -sand (kit)
- -soil (kit)
- -pebbles (kit)
- -sticks (broken in small pieces) (kit)
- -small scoopers (coffee or smaller) for scooping dry materials (kit)

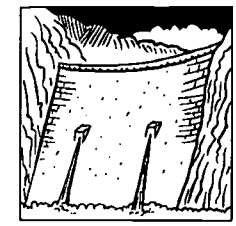
ADVANCE PREPARATION

- You may want to ask students to bring in 2-liter bottles.
- Copy student pages.
- Prepare materials table.
- Find location for reservoirs to sit for 24 hours.
- Create student working groups.

TEACHER PROCEDURE

1. Talk with students about reservoirs. (If your class has completed activities 1 and 2 in this unit review those.) Just as real reservoirs have more than just water in them, their model reservoirs will have various materials in them. Ask students how they think materials might get in reservoirs. Soil, pebbles, sticks, sand would all flow in through tributaries that help fill the reservoirs. What do students think will happen to those materials added to their reservoirs? Discuss this as a class.
2. Give each group four small paper cups and a 2-liter bottle with the top cut off. Distribute student pages.
3. Students should label their cups A, B, C, and D.

Activity 3-3 Letting Water Settle



4. Beginning with cup A each group should send one student to the materials table to create the following mixtures for their group:

   A.) Half scoop of pebbles + 25 ml of water
   B.) Half scoop of sand + 25 ml of water
   C.) Half scoop of soil + 25 ml of water
   D.) Half scoop of sticks + 25 ml of water

   They should follow all directions for mixture A before starting mixture B.

5. Remind students to make predictions on Recording Page One before they add each mixture to the reservoir. Once they have made and recorded each prediction on the recording page, they add each mixture and observe and record what happens. The mixtures are made with water to represent being brought in to the reservoir by a tributary. The amount or water is not important. They should only add a very small amount of each item to the reservoir. Don't worry if some of the material is left in the bottom of the cup.
6. Students will draw a picture of their reservoir with all of the materials added in the first space on Recording Page Two.
7. Students will predict what will happen if they leave the reservoir for one hour.
8. After one hour students will check their reservoirs. Remind students not to move the reservoirs.
9. Students draw their reservoirs in the second space.
10. The next day students should check their reservoirs again and draw them in the third space.
11. Meet with the entire class and let different groups report what they have discovered.
12. Have a class discussion about why the pipe that leaves the reservoir (the intake pipe) is located in the middle, rather than on the top or bottom. Also discuss why letting water sit in the reservoir for a long time helps to keep it cleaner.

Letting Water Settle

Introduction Reservoirs supply many people with the water they use every day. As water leaves the reservoir so that people can use it, precipitation and streams help refill the reservoir. What happens to the leaves, sticks, rocks, and soil that flow into the reservoirs with the stream water? During this activity you will find out.

Materials

- 2-liter bottle with the top cut off
- water
- 4 small cups for making mixtures
- graduated cylinder

Procedure

1. Your teacher will give you a 2-liter bottle with the top cut off and 4 small cups.

2. Label the cups a, b, c, and d. Label the bottle with your group member's initials.

3. Fill the 2-liter bottle with water. It represents a reservoir.

4. Find Recording Page One.

Letting Water Settle

5. Send one student to the materials table to get mixture A (half scoop pebbles + 25 ml water). Predict what will happen when you add mixture A to your reservoir. Record this prediction on Recording Page One.

6. Add mixture A to your reservoir and record your observations on Recording Page One.

7. Send one student to the materials table to get mixture B (half scoop of sand + 25ml water). Predict what will happen when you add mixture B to your reservoir. Record your prediction.

8. Add mixture B to your reservoir. Record your observations.

9. Send one student to the materials table to get mixture C (half scoop soil + 25 ml water). Predict what will happen when you add mixture C to your reservoir. Record your prediction.

10. Add mixture C to your reservoir. Record your observations

11. Send one student to the materials table to get mixture D (half scoop sticks + 25 ml water). Predict what will happen when you add mixture D to your reservoir. Record your prediction.

12. Add mixture D to your reservoir. Record your observations.

Name _____ Date _____

Recording Page One

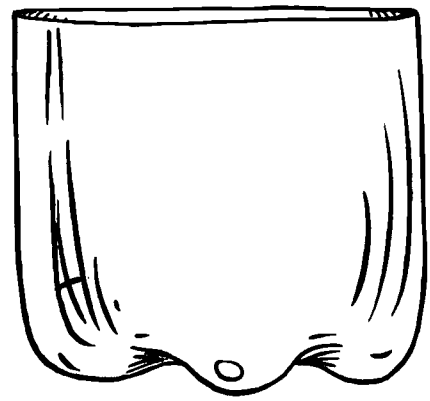
Mixture	Prediction	Observation
A pebbles + water		
B sand + water		
C soil + water		
D sticks + water		

Student Page
Activity 3 - 3

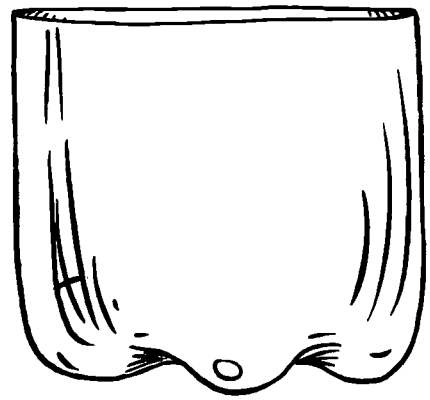
Name _____ Date _____

Recording Page Two

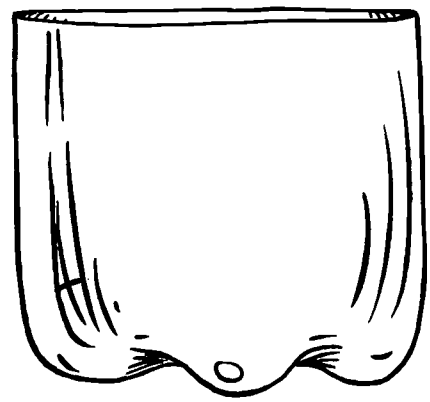
Beginning



One hour later



One day later



Name _____ Date _____

Letting Water Settle

14. Find Recording Page Two on the back of Recording Page One.

15. In the first space of Recording Page Two (beginning) draw a picture of your reservoir. Include all of the items you added.

16. What do you think will happen if you leave your reservoir for one hour?

_____

_____

_____

17. Put your reservoir in a place where it won't be disturbed. You will leave it there for one day and check it twice during that time. It is important not to move your reservoir for the rest of the activity.

18. Check your reservoir after one hour. How has it changed?

_____

_____

Name _____ Date _____

Letting Water Settle

19. Draw a picture of your reservoir in the second space of Recording Page Two (one hour later).

20. What changes do you expect to see when you observe your reservoir tomorrow?

_____

_____

_____

_____

21. Check your reservoir the next day. Describe how it has changed.

_____

_____

_____

_____

22. Draw a picture of your reservoir in the third space of Recording Page Two (one day later).

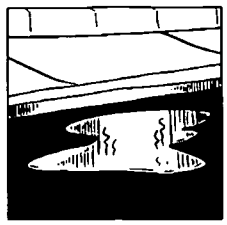
LESSON 4 - THE WATER CYCLE

LESSON 4 - THE WATER CYCLE

Water has been cycling about our planet for several billion years, shaping the land and sustaining life. Earth's most basic forces, the sun's energy and gravity, deliver fresh clean water as rain and snow to higher elevations, then pull it down hill into rivers and ultimately to the ocean. Along the way it carries waste products (autumn's leaves, for example) to serve as raw material for other processes. Sometimes water's return trip is a quick one, as mighty rivers carry spring rain to the sea. Other journeys are longer, if it finds its way to deep aquifers or is locked frozen in glaciers or ice caps. But always the sun lifts water through evaporation, and gravity reclaims it as condensation. The water cycle embodies one of nature's most enduing balances.

"Rain" and "snow" are some of the earliest words we learn. As adults we remember that rain is part of the water cycle. But how did we learn about it? Did we memorize terms such as "evaporation" and "condensation" and only later apply a more complex grasp of these phenomena? Did we see a poster in the classroom, or fill in a worksheet with those words?

Puddle Poetry asks students to consider a familiar phenomenon: puddles. They observe puddles systematically and write poetry about them. Evaporation and Condensation moves the puddles indoors into petri dishes and adds substances, salt and gravel. Our World in Two Jars demonstrates condensation by closing the system.



ACTIVITY 4-1 PUDDLE POETRY

SUMMARY Through measurement and observation, students will discover what happens to puddles on a sunny day. They will write poems to describe what they discover.

CONTENT AREAS language arts, math, science

GOAL to become familiar with evaporation and the water cycle

TIME several short sessions during the day

MATERIALS
- puddles
- measuring tape or rulers
- clipboards for students will be helpful

ADVANCE PREPARATION

- Find location to do activity. If your black top area is very new it may be too smooth. You might want to use a plastic tarp for the puddles.
- Create puddles if necessary.
- Create student working groups.
- Students may want to wear boots.

TEACHER PROCEDURE

1. Investigate the parking lot or paved play area at your school. Find several spots where puddles form when it rains. Ideally you will do this activity the morning after it has rained, but you can also create your own puddles. During the activity students will measure the length and width of a puddle. Each student can determine where to measure the length and the width because the puddles will be shaped irregularly.

2. Bring students to the puddles. Several students can work at each puddle and measure together, but everyone should complete his or her own data form and poetry.

3. Have students look at their puddle. They should measure its length and width. They can measure any part of the puddle, but they must measure the same way each time. Then they should make other observations. After making and recording observations they can write the first line of their poem.

4. After an hour, they should repeat their observations and measurements and write the second line of their poem.

5. Repeat the measurements every hour or so for as often as possible during the day. After each measurement students should write another line to their poem.

6. You might want to have students check the puddles the next day.

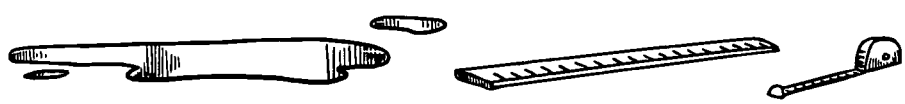
7. After completing the conclusion section students should revise and complete their poems.

8. When students have written the poems on the puddle page they can be displayed in the classroom.

Name _____ Date _____

Puddle Poetry

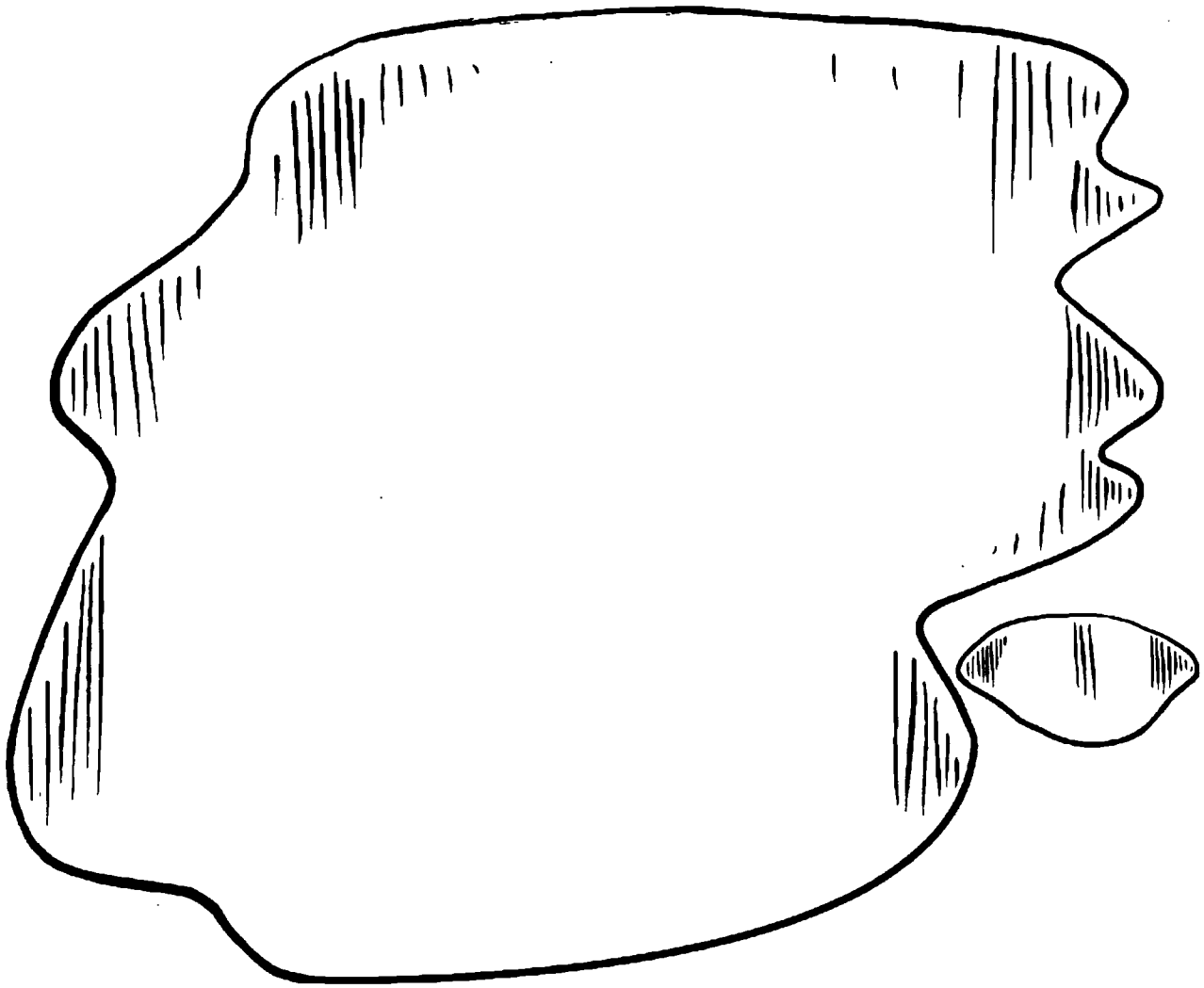
Measurement	Observation	Poem
1.		
2.		
3.		
4.		
5.		
6.		
7.		

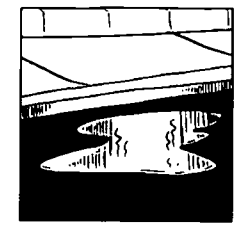


Name _____ Date _____

Puddle Poetry

Write your poem inside the puddle.





ACTIVITY 4-2 EVAPORATION AND CONDENSATION

SUMMARY Students will create two different mixtures which they will leave in the sun for five days. They will predict what they think will happen and make observations each day.

CONTENT AREAS science, language arts

GOAL to show that when water evaporates other materials are left behind

TIME one class session and four short sessions for observations and data collection

MATERIALS

- water
- salt (kit)
- gravel (kit)
- clear petri dishes -- 2 for each group (kit)
- marking pens
- ruler
- teaspoon

ADVANCE PREPARATION

- You may want to prepare petri dishes for students.
- Create student working groups.
- Arrange area in room where petri dishes can sit for 5 days.
- Copy student pages.

TEACHER PROCEDURE

1. Have the materials available to the students.
2. Give out instructions and review with students.
3. Each petri dish will need eight lines, each two millimeters apart. Demonstrate how to put the lines on the petri dishes. Some teachers may want to put the lines on for the students.
4. After setting up the experiment students should fill in "Day 1" of the data recording page.
5. Students should check their experiments and record their observations and data each day for the next four days. Some students will use the lines to quantify their data.
6. After day 5 students should complete the conclusion section.

Name _____ Date _____

Evaporation & Condensation

Introduction Why are oceans salty while rainwater isn't? What happens to the salt during the water cycle? You will investigate these questions during this activity.

Procedure

1. Send one group member to get materials. Label the two petri dishes with the initials of each group member.

2. On each of the plastic petri dishes start at the bottom and mark eight lines that are each 2 millimeters apart.

3. Fill each petri dish to the top line with a different mixture:
   petri dish 1 = half teaspoon of salt + water
   petri dish 2 = half teaspoon of gravel + water

4. Use the "Day One" section of your data recording page to draw a picture and write a description of your experiment.

5. Predict what you think will happen in each petri dish during the next four days. Will the water look different? Will the amount of water change?

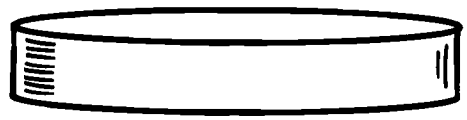
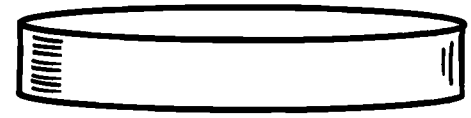
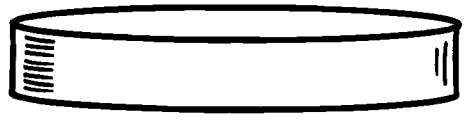
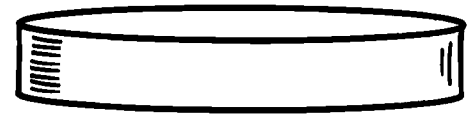
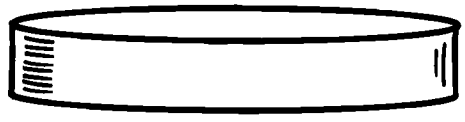
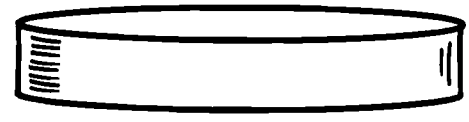
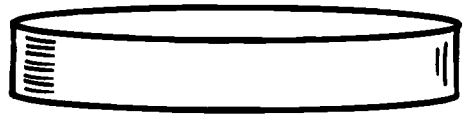
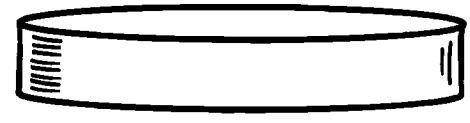
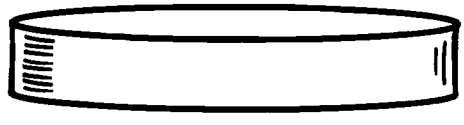
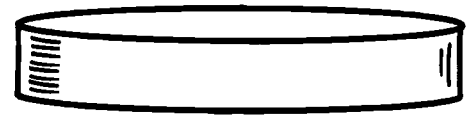
_____

_____

6. Check your experiment each day for the next four days. Use your data recording page to record what you observe each day.

Name _____ Date _____

Evaporation & Condensation

	Petri dish one	Petri dish two
Day one		
Day two		
Day three		
Day four		
Day five		

Student Page
Activity 4 - 2

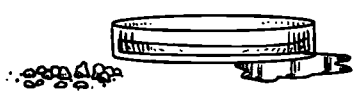
Name _____ Date _____

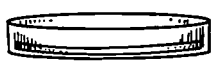
Evaporation & Condensation

1. After recording your day five results, write about what happened in your experiment and why you think it happened.

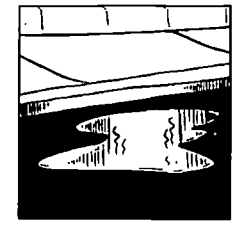
2. Compare what happened in your experiment with what happens during the water cycle.

3. If water evaporates from the ocean to create clouds and rain, why is rainwater fresh when oceans are filled with salt water?





Student Page
Activity 4 - 2



ACTIVITY 4-3 "OUR WORLD IN TWO JARS"

SUMMARY Students will set up a miniature water cycle that they will observe over several days.

CONTENT AREAS science

GOAL to understand how water changes phases through the water cycle

TIME five short sessions

MATERIALS (for each student or group of students)
- two plastic aquaria or plastic boxes or two jars (kit)
- water and food coloring (premixed by teacher)
- small rocks or gravel
- tape

ADVANCE PREPARATION

- Arrange materials for students.
- Create student working groups.
- Arrange area for models to sit for five days.

TEACHER PROCEDURE

1. Have materials ready for students on a table.
2. Put students into small groups.
3. Each group should get a set of materials. Each student should get the student pages.
4. Guide students through the setting up of their water cycle models.
5. Each group should record their observations for day one.
6. Each day students should check their models and record observations.
7. After day five, students should complete the conclusion.

Name _____ Date _____

Our World in Two Jars

Introduction During this activity you will make a water cycle in two containers. You will observe what happens during the water cycle.

Materials (for each student or group of students)

- two plastic aquaria or plastic boxes or two jars
- water and food coloring (premixed by teacher)
- small rocks or gravel
- tape
- direct sunlight

Procedure

1. Get your group materials.
2. Label your containers with the initials of your group members.
3. Put the rocks in one side of one of the containers.
4. Pour about 3 cm of water on the other side.
5. Invert the other container over the top. Tape it closed. Make sure the containers are sealed.
6. Place in a spot with direct sunlight or near a heat source.
7. In the "day one" section of your recording page describe your model.
8. Each day for the next four days check your model and record your observations.
9. After day five complete the conclusion.

Name _____ Date _____

Observation Recording Page

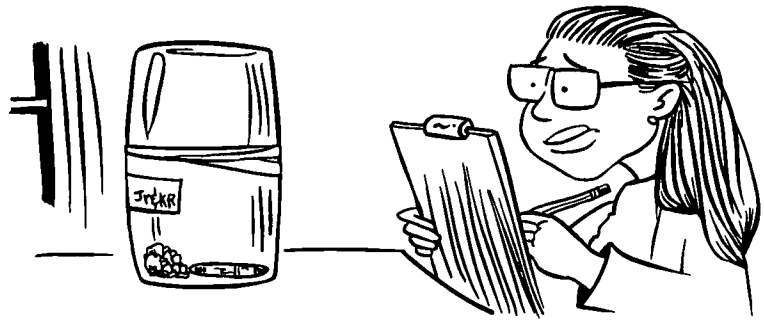
Observations

Day one: The day you set up the experiment. Describe how it looks today.
Day two
Day three
Day four
Day five

Student Page
Activity 4 - 3

Name _____ Date _____

Our World in Two Jars



1. After recording your day five results, write about what happened in your experiment and why you think it happened.

2. Compare what happened in your experiment with what happens during the water cycle.

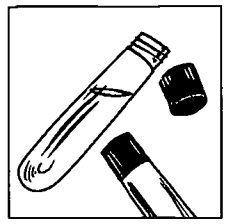
LESSON 5 - TAKING CARE OF WATER

LESSON 5 - TAKING CARE OF WATER

We look at two aspects of caring for drinking water: a) testing and treating water between its source and the consumer, which is the responsibility of the water supplier; and b) conserving water, which is the responsibility of the consumer.

Drinking water safety is a large topic, but one of its basic principles is elimination of microorganisms (germs) from water. With the first two activities, students gain some practical experience in testing and treating water. In Water Testing, students perform a basic bacteria test with two samples, a (presumable clean) tap water sample, and a second sample in which they have rinsed their hands. They observe the tests for two days, to see if a color change indicates the presence of bacteria in either tube. In Water Treatment, they use the same test procedure after disinfecting their "contaminated" sample water with a bit of chlorine bleach. Both the test and the treatment are quite true, on a smaller and simpler scale, to the methods water suppliers use every day.

Conserving water means accomplishing the same purpose with fewer drops, cups or gallons. How Much Water Does It Take to... picks up on activities in Lessons 1 and 2, helping students quantify water use through math activities.



ACTIVITY 5-1 WATER TESTING

SUMMARY Students will create a water sample with bacteria and then test water for bacteria.This activity tends to work best in warm weather when students have been outside playing.

CONTENT AREAS science

GOAL to understand that bacteria can contaminate water and that drinking water is tested for these germs

TIME one session and two short sessions

MATERIALS (for each group of students)
-two test tubes with broth (supplied with kit or order
-through biological supply company)
-large bucket
-pitcher of water
-test tube rack (kit)
-masking tape
-marker

ADVANCE PREPARATION

- Prepare water samples.
- Create student working groups.
- Arrange area in room for test tubes for 4 days.
- Copy student pages.

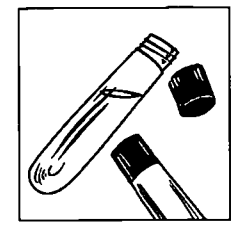
BACKGROUND

This activity helps students understand how water is tested for bacteria. There are many different types of microorganisms everywhere, including in water. Pathogens are the ones that cause diseases. Germ, in common usage, has also come to mean disease-causing microorganism. Most students will use the term in this way. Students will probably understand that bacteria (or germs) can make people sick. What they may not know is that there are federal and state regulations that require water suppliers to test for bacteria and other pathogens. There are strict rules that water suppliers must follow.

In this experiment test tubes with nutrient broth will be used to grow bacteria. The broth is the ideal environment for bacteria to grow; it is not necessary to incubate them. If there are bacteria in the water that is added to the test tubes then the broth will change to yellow after about 48 hours. If bacteria are not present, then the broth will stay purple. (A change to yellow does not necessarily mean that pathogenic bacteria are present, but that some type is in the sample.) In this activity students will compare tap water to water that they have rinsed their hands in and presumably contaminated with bacteria. There should be plenty of bacteria on the students' hands to cause a color change for the contaminated sample. It is very important to add a small amount of bleach to any sample that changes to yellow before you dispose of it down the drain.

Water suppliers are required to test their water for a variety of pathogens. They must test the water in the reservoir as well as the water at several different tap locations in the service area.

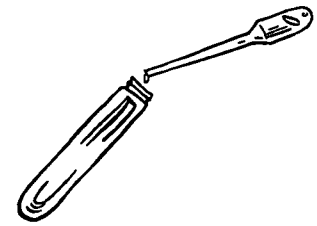
Lesson 5 Taking Care of Drinking Water



ACTIVITY 5-1 WATER TESTING

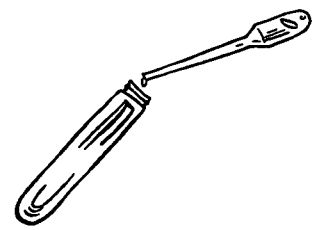
TEACHER PROCEDURE

1. Prior to class get a sample of tap water in a clean container. To clean the container wash it well with soap and water, rinse to remove soap and rinse again with boiling water. Or you can buy a bottle of water to use for the test. You must test your water sample prior to doing this activity with the students. If your tap water or bottled water turns to yellow you have probably contaminated it with bacteria from your hands or from the faucet. To solve this problem wash your hands well and clean the faucet before collecting your sample.

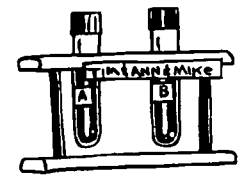


2. Each group should get a test tube rack and two test tubes with broth.
3. They should label the test tubes "A" and "B". Each test tube rack should be labeled with the names of the students in the group.
4. Water sample A will be tap water or bottled water. Use a clean dropper to fill each group's test tube close to the top.
5. Students should seal test tube A with masking tape and put it in the test tube rack.

6. Water sample B will be the contaminated sample. Create sample B by pouring water over each student's hands into the bucket.
7. Using a dropper, students should fill test tube B close to the top with water sample B. If your are going to do Activity 5-2 (Water Treatment) soon, you should save the remains of water sample B.
8. Students should seal their test tubes and return them to the test tube racks. They should record their observations for Day 1.
9. Students should check their test tubes for the next two days and record their observations.



10. Discuss with students the results of the activity. Explain that this test is similar to the ones that water suppliers use.
11. Students should complete the conclusion section.
12. Collect test tubes from the students.



13. Add a small amount of bleach to any sample that has turned to yellow.
14. Rinse all samples down the drain.

Water Testing

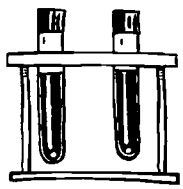
Introduction Are there germs on your hands? Can germs live in water? During this activity you will investigate both of these questions. You will test two different water samples for germs. You will use tubes with purple broth. If the water that you add to the broth has germs in it, then the liquid will turn to yellow. If there are not germs in it, the liquid will stay purple.

Materials

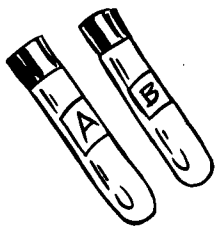
- two test tubes with broth
- large bucket
- pitcher of water
- test tube rack
- masking tape
- marker

Procedure

1. Get a test tube rack and two test tubes. Each test tube will be half filled with a purple liquid. You will be adding water to this test tube. The liquid will change to yellow if there are bacteria in the water.

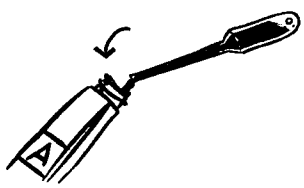


2. Label the test tubes "A" and "B".



3. Label your test tube rack with the names of the students in your group.

4. Water sample A will be water from the tap or bottled water. Go to your teacher who will put water from sample A into your test tube A.



Student Page
Activity 5 - 1

Water Testing

5. Seal test tube A with masking tape and return it to the test tube rack.

6. Go to your teacher who will pour water over your hands into a bucket. This will be water sample B.

7. Use a dropper to fill test tube B close to the top with water sample B.

8. Seal test tube B and put it in the test tube rack.

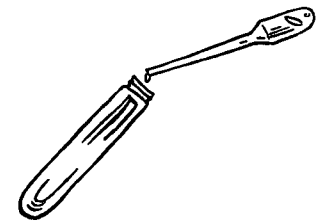
9. Draw and describe how your test tubes look in the observation section of the student page.

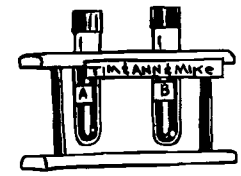
10. Check your test tubes for the next two days and record your observations.

11. Complete the conclusion section.

12. Give the test tubes to your teacher for disposal. Do not open them.

13. Remove your names from the test tube racks. Return them to your teacher.





Name _____ Date _____

Observations

	Test Tube A	Test Tube B
DAY 1		
DAY 2		
DAY 3		

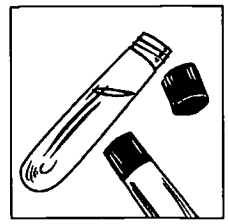
Student Page
Activity 5 - 1

Name _____ Date _____

Water Testing Conclusion

1. Describe what happened in your experiment and why you think it happened.

2. Why do you think there are rules about testing drinking water?



ACTIVITY 5-2 WATER TREATMENT

SUMMARY Students will use the water from sample B in Activity 5-1 to see how water treatment works. Water sample B will be treated with chlorine and then tested for bacteria using the test tubes with nutrient broth.

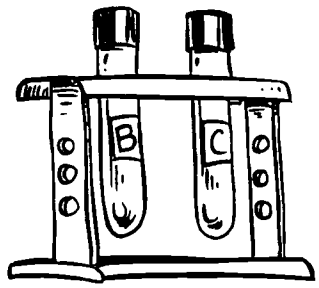
CONTENT AREAS science

GOAL to understand that drinking water is treated for bacteria

TIME one session and two short sessions

MATERIALS

- water sample B from Activity 5 - 1
- two test tubes with nutrient broth (kit)
- masking tape
- pen
- test tube racks or cups
- diluted bleach to create water sample C - 1 tablespoon of bleach + half a cup of water



ADVANCE PREPARATION

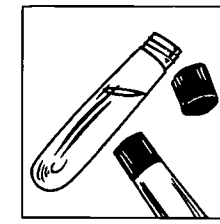
- Prepare water samples.
- Copy student pages.
- Arrange space in room for test tubes for three days.
- Create student working groups.

BACKGROUND

In this activity you will use two water samples. Water sample B can be saved from activity 5-1 or you can create a new water sample B by rinsing students' hands in water again. Water sample C will be created by adding bleach to Water sample B. This step, which you will do in front of students, will demonstrate water treatment. Water suppliers add chemicals (often a mixture of chlorine and ammonia) to the water to kill any pathogenic germs that might be present.

TEACHER PROCEDURE

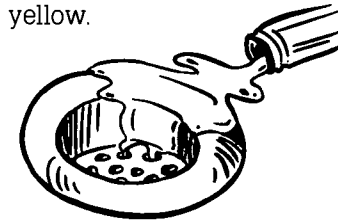
1. Explain activity to students.
2. Give each student group a test tube rack and two test tubes.
3. Students should label their test tubes B and C.
4. In test tube B they should add water sample B. Remind students that water sample B is the sample they rinsed their hands in.
5. Test tube B should be sealed and put in the test tube rack.
6. With all of the students watching add the diluted bleach to water sample B. This will now be water sample C. Explain to the students this chemical is similar to the one used to treat drinking water.
7. Students should come to you to fill test tube C with water sample C.
8. Test tube C should be sealed and put in the test tube rack.



ACTIVITY 5-2 WATER TREATMENT

TEACHER PROCEDURE

10. Students should check their test tubes after 24 and 48 hours and record their observations.
11. Discuss with students that drinking water is treated with chemicals such as chlorine which kills any bacteria that might make them sick.
12. Students complete the conclusion.
13. Collect the test tubes from the students.
14. Add a small amount of bleach to any sample that has turned yellow.
15. Rinse all samples down the drain.

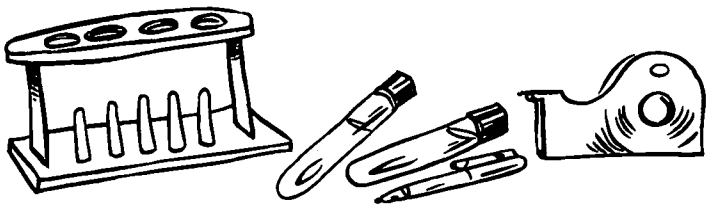


Water Treatment

Introduction It is important that there are not any germs in your drinking water. During this activity you will see how water is treated to kill germs.

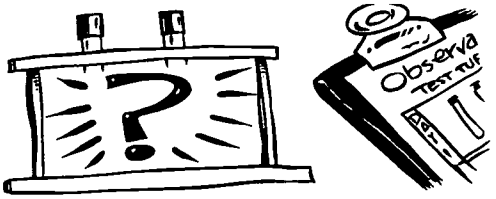
Materials

- water sample B
- water sample C
- masking tape
- pen
- two test tubes with broth
- test tube rack



Procedure

1. Get your materials
2. Label your test tubes B and C.
3. Label your test tube rack with the names of the students in your group.
4. Add water sample B to test tube B. Remember, water sample B is the water you rinsed your hands in.
5. Seal test tube B and put it in the test tube rack.
6. Fill test tube C with water sample C.
7. Seal test tube C and put in the test tube rack.
8. Record your observations in the "Day 1" space.



9. Check your test tubes on the second day and record your observations in the "Day 2" space.

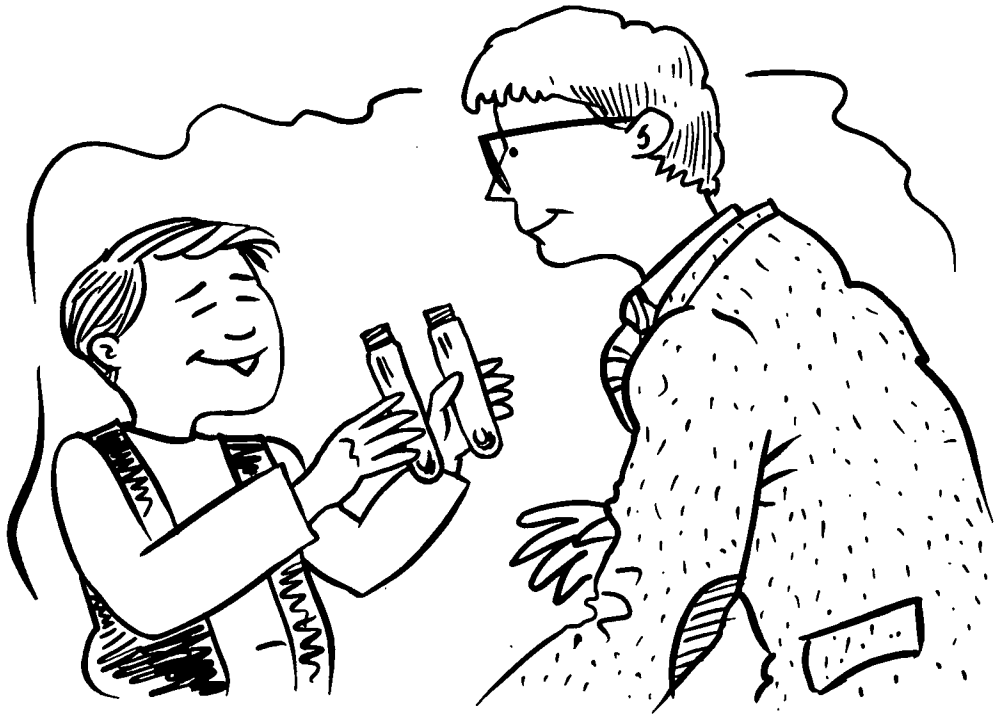
Water Treatment

10. Check your test tubes on the third day and record your observation in the "Day 3" space.

11. Complete the conclusion.

12. Give your test tubes to your teacher to be disposed of properly.

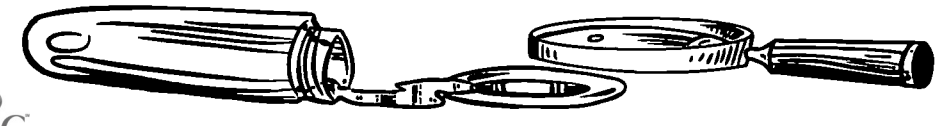
13. Remove your names from the test tube rack. Return it to your teacher.



Name _____ Date _____

Observations

	Test Tube B	Test Tube C
DAY 1		
DAY 2		
DAY 3		



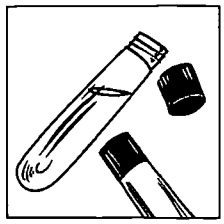
Student Page
Activity 5 - 2

Name _____ Date _____

Water Treatment Conclusion

1. Describe what happened in your experiment and why you think it happened.

2. Why do water suppliers add chemicals such as chlorine to drinking water?



ACTIVITY 5-3 HOW MUCH WATER DOES IT TAKE. . .

SUMMARY Students will calculate and compare how much water it takes to do various activities.

CONTENT AREAS math, problem solving

GOAL to encourage students to think about water conservation in their daily lives

TIME one session

MATERIALS
- paper
- pencil

ADVANCE PREPARATION

- Copy student pages, including pictures of 1/2 gallons and gallons, if necessary.

TEACHER PROCEDURE

1. Distribute the student pages.
2. Have students read the introduction.
3. You may need to explain the first example.
4. Some students may need the pictures of 1/2 gallons and gallons to solve the problem.

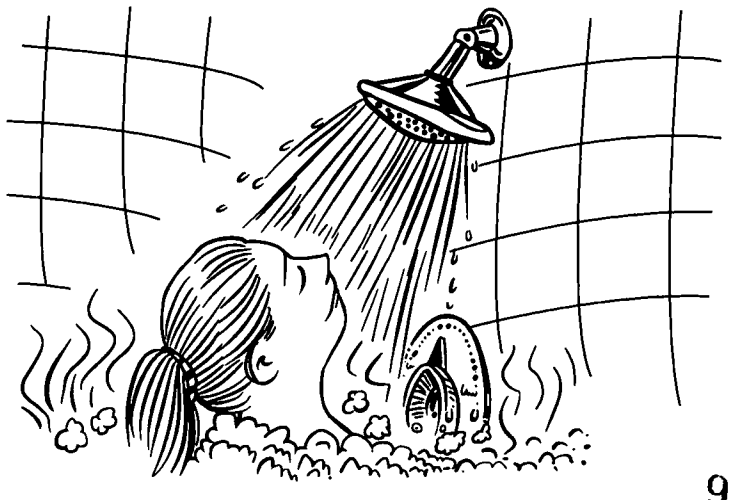
How Much Water Does it Take...

Introduction Here is a tricky question. Does it take more water to take a bath or a shower? The answer may surprise you. It depends on how long you stay in the shower and how full you fill a bath. You are going to figure out some water conservation problems by using information about showers, baths, toilets and faucets.

Water Use	Amount
toilet	2 gallons per flush
shower	3 gallons per minute
full bathtub	30 gallons
bathroom faucet	2 gallons per minute
kitchen faucet	4 gallons per minute

1. If Angie takes a fifteen minute shower, how much water does she use?

15 minutes X 3 gallons/minute = 45 gallons



Name _____ Date _____

How Much Water Does it Take...

2. How much water will she use if she takes an 8 minute shower?

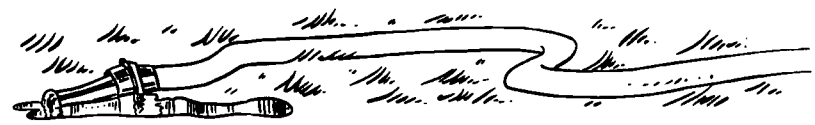
3. How much water does Angie save by taking an 8 minute shower instead of a 15 minute shower?

4. If she wanted to conserve water, should Angie take a 15 minute shower or a bath? Explain your answer.

5. Luis washes the dishes every night. One night it took him 20 minutes to wash the dishes and he left the water running the entire time. How much water did he use?

Name _____ Date _____

How Much Water Does it Take...

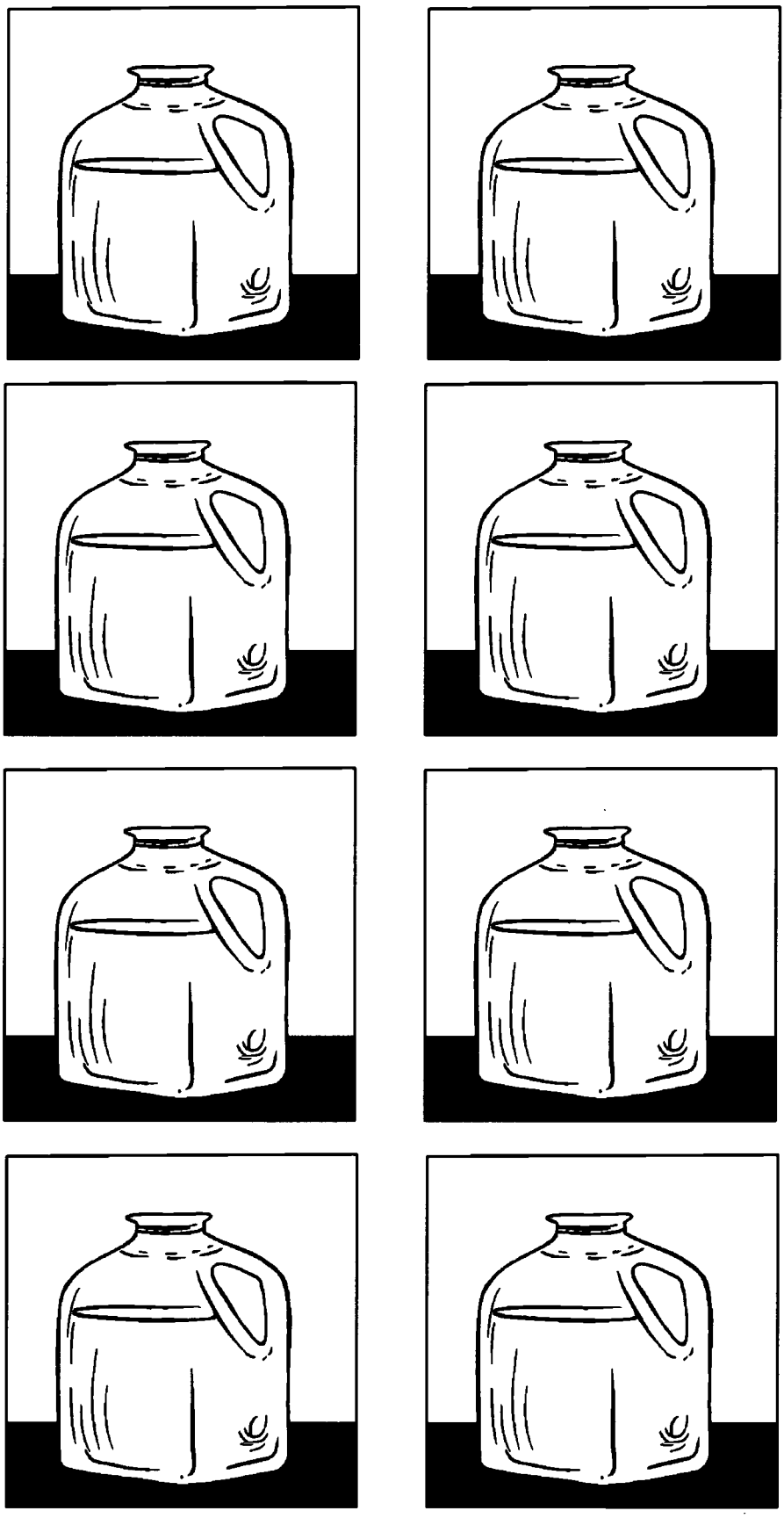


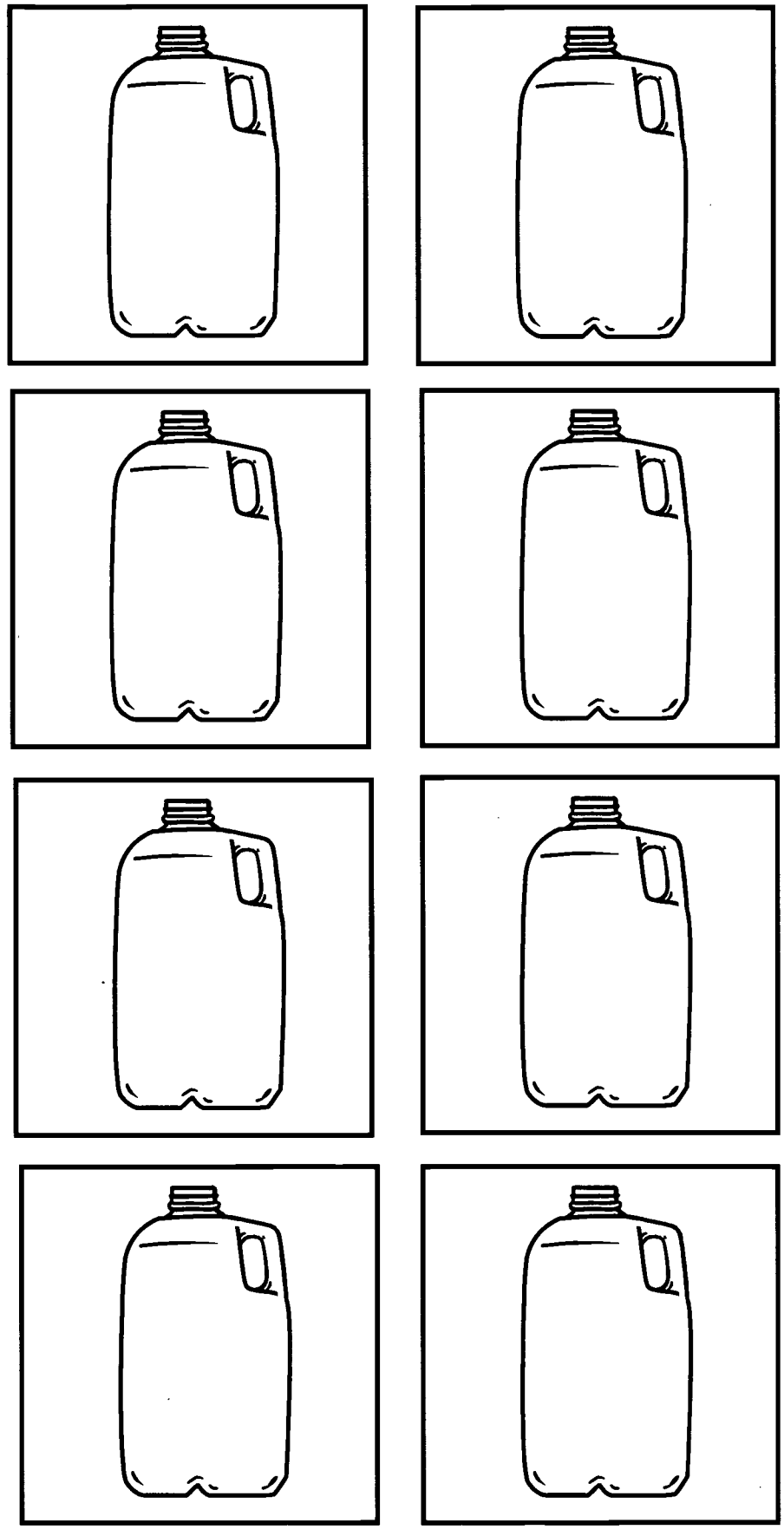
6. The next night Luis's father told him to run the water only when he was rinsing the dishes. Luis did this and the water was running for only 7 minutes. How much water did he use?

7. How much water did Luis conserve by running the water only when rinsing the dishes?

8. Anita and her mom are trying to conserve water. Their toilet uses 4 gallons every time it is flushed. They installed a new toilet that only uses 2 gallons of water per flush. How much water will they save in one day if their family flushes the toilet 10 times each day?

9. How much water will Anita's family save in one week with their new toilet?





Student Page
Activity 5 - 3

Massachusetts Water Resources Authority
Waterworks School Education Program
100 First Avenue
Charlestown Navy Yard
Boston, MA 02129
(617) 241-4662
www.mwra.com

SE029607

U.S. Department of Education
Office of Educational Research and Improvement (OERI)
National Library of Education (NLE)
Educational Resources Information Center (ERIC)

REPRODUCTION RELEASE

(Specific Document)

I. DOCUMENT IDENTIFICATION:

Title: Down The Drain Water Works . . . In the Elementary Classroom

Author(s):

Corporate Source: Massachusetts Water Resources Authority (MWRA)

Publication Date: 1999

II. REPRODUCTION RELEASE:

In order to disseminate as widely as possible timely and significant materials of interest to the educational community, documents announced in the monthly abstract journal of the ERIC system, *Resources in Education* (RIE), are usually made available to users in microfiche, reproduced paper copy, and electronic media, and sold through the ERIC Document Reproduction Service (EDRS). Credit is given to the source of each document, and, if reproduction release is granted, one of the following notices is affixed to the document.

If permission is granted to reproduce and disseminate the identified document, please CHECK ONE of the following three options and sign at the bottom of the page.

The sample sticker shown below will be affixed to all Level 1 documents

PERMISSION TO REPRODUCE AND DISSEMINATE THIS MATERIAL HAS BEEN GRANTED BY

Sample

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

1

Level 1

☑

Check here for Level 1 release, permitting reproduction and dissemination in microfiche or other ERIC archival media (e.g., electronic) and paper copy.

The sample sticker shown below will be affixed to all Level 2A documents

PERMISSION TO REPRODUCE AND DISSEMINATE THIS MATERIAL IN MICROFICHE, AND IN ELECTRONIC MEDIA FOR ERIC COLLECTION SUBSCRIBERS ONLY, HAS BEEN GRANTED BY

Sample

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

2A

Level 2A

☐

Check here for Level 2A release, permitting reproduction and dissemination in microfiche and in electronic media for ERIC archival collection subscribers only

The sample sticker shown below will be affixed to all Level 2B documents

PERMISSION TO REPRODUCE AND DISSEMINATE THIS MATERIAL IN MICROFICHE ONLY HAS BEEN GRANTED BY

Sample

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

2B

Level 2B

☐

Check here for Level 2B release, permitting reproduction and dissemination in microfiche only

Documents will be processed as indicated provided reproduction quality permits.
If permission to reproduce is granted, but no box is checked, documents will be processed at Level 1.

I hereby grant to the Educational Resources Information Center (ERIC) nonexclusive permission to reproduce and disseminate this document as indicated above. Reproduction from the ERIC microfiche or electronic media by persons other than ERIC employees and its system contractors requires permission from the copyright holder. Exception is made for non-profit reproduction by libraries and other service agencies to satisfy information needs of educators in response to discrete inquiries.

Sign here, → please

Signature: Margaret C. Tabacsko

Organization/Address: MWRA

Printed Name/Position/Title: Margaret C. Tabacsko, Manager, Watershed Education

Telephone: (617) 689-2150 FAX: (617) 689-2163

E-Mail Address: mtabacsk@aol.com Date: 8/31/99

(over)