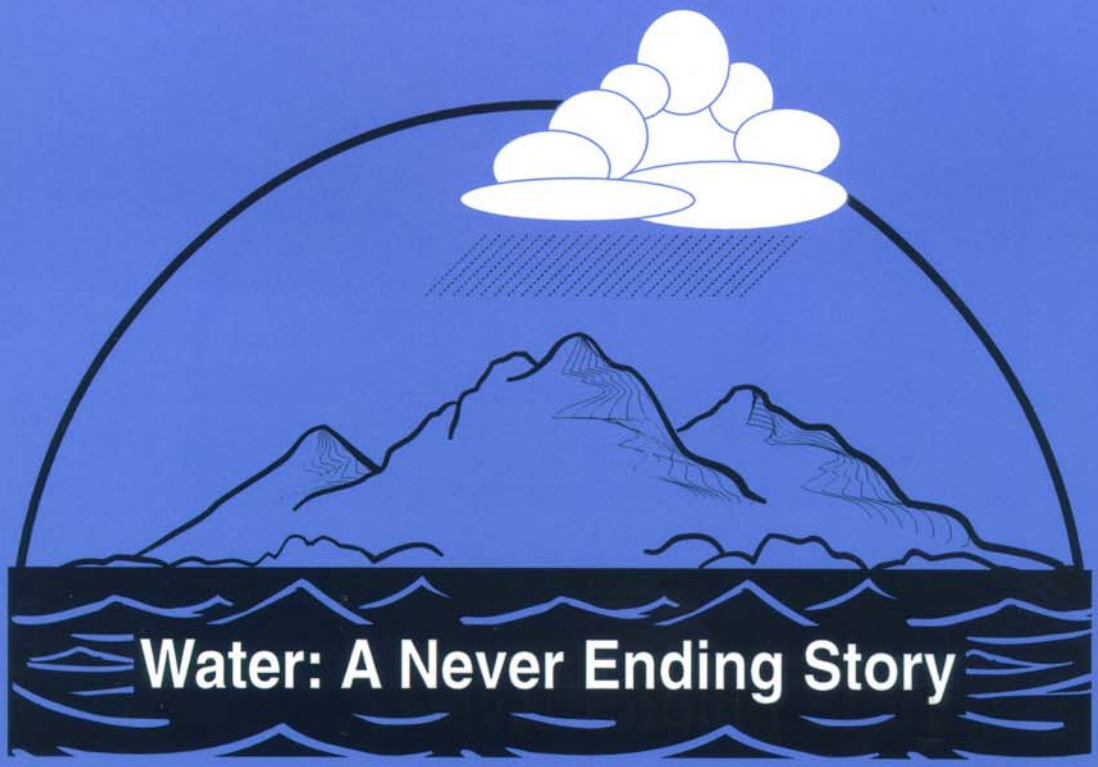

Accompanying curriculum for the *Water: A Never Ending Story* Video

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This curriculum has been sponsored in part by the following organizations:

STATE OF UTAH
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INTERNATIONAL OFFICE FOR WATER EDUCATION

ACKNOWLEDGMENTS

This document was developed through cooperative efforts of the Intermountain Section of the American Water Works Association, Utah State University Extension, Utah Division of Water Resources, and the International Office for Water Education (IOWE). Grant money was provided to develop and distribute the curricula by the Utah Section of the American Water Works Association Education Committee and the U.S. Environmental Protection Agency, Region VIII. The *Project Wet* curricula was assembled by Anne Story, *Project Wet* facilitator. The general curricula was developed by Cynthia Murdock and Geoffrey G. Smith, IOWE, at the Utah Water Research Lab.

Many thanks to the Intermountain Section of the American Water Works Association Education Committee members who provided editorial assistance and valuable input on the curriculum development:

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INTRODUCTION

By the time children enter 1st grade they are intimately acquainted with water. They can tell you it is colorless and clear, odorless and tasteless. They know that water changes form: freezing to become ice, changing from rain to snow, flowing down streets, gutters and rivers, seeping into the soil, and forming lakes, ponds and oceans. A young child knows that water quenches thirst, keeps bodies clean, and provides hours of fun and enjoyment.

However, do they know from where water comes and where it goes? Do they know that approximately the same amount of water exists on Earth today as when it first formed on the planet? Do they know the world's demand for water has tripled since 1950, and that all countries face diverse water issues as the demand for a finite resource increases? Do they know that each cell in their body depends on adequate amounts of clean water every day to survive? And do they know of the critical need for all people in all countries to be sensitive to and knowledgeable about water and water resources, ensuring responsible behavior toward this precious and finite resource?

Water education provides an excellent approach to help prepare today's children for responsible citizenship in the next century, when water-related issues will become more critical and in greater need of resolution. The Intermountain Section of the American Water Works Association (AWWA) has provided you and your students with a fun and exciting way to approach water education in the classroom.

Water: A Never Ending Story is a 20-minute video about the hydrologic (water) cycle. Its purpose is to educate students about water, helping them to cultivate a water conservation attitude, and foster a desire to wisely manage this precious resource.

The curriculum and activity guide that accompanies the video are a collection of hands-on water-related activities that are fun and easy to use. Specific activities are designed for use with each of the eight segments of the video.

Based on the assumption that students learn best by doing, the activities are designed to follow the viewing of each video segment. Also provided are activities for introducing the topic of water education as well as suggestions for follow-up activities at the conclusion of the video.

It is the AWWA's desire that through viewing ***Water: A Never Ending Story*** and experiencing the accompanying hands-on activities, today's students will become tomorrow's citizens viewing water as a shared resource and responsibility.

TEACHING STRATEGIES

Teachers will find that these hands-on activities help students better understand, remember, and utilize the information contained in the video. Activities also make water education fun and interesting.

There is one lesson for each of the eight segments found in the video, as well as an introduction and conclusion lesson. Each lesson includes a number of activities which can be used in conjunction with, or independent of, one another, depending on the ability level of students and time restraints.

A glossary of vocabulary terms and correlation of lessons to the Utah State Science Core Curriculum can be found in separate sections at the end of this guide. Other helpful sections included in the lesson plans are summaries, objectives, time required, and extension activities.

Materials necessary for the activities are clearly stated. They are usually inexpensive, easy to obtain, or frequently on hand in the average classroom.

This curriculum and activity guide has been designed for use in a fifth grade classroom. However, with a few alterations the activities can be modified to raise or lower the level of difficulty.

GETTING STARTED

For best results it is suggested that the video be shown to students in nine different "sittings." After viewing the Introductory video segment Lesson 1.0, Water on the Move, can be used to introduce the unit on water. The next day the Evaporation segment of the video would be viewed by students in conjunction with the presentation of Lesson 1.1, Evaporation. The same format would be followed for the remainder of the video presentations with the Wrap-Up Lesson (1.9) used to summarize the unit.

The entire water unit can be presented over a two week period of time, using approximately one hour of class time each day.

CROSSING THE CURRICULUM

Many of the lessons include activities which cross the curriculum to incorporate language art, math, art, and critical thinking skills, in addition to science content, thus enhancing the ease with which teachers can teach several curricula with one activity.

Further suggestions for crossing the curriculum might be to have the students:

- define vocabulary terms for each of the video segments
- use vocabulary terms as spelling words
- write vocabulary terms in sentences with correct usage and grammar
- draw/paint how they use water at home and in recreation, how water feels, where/how it is found in nature, and used in industry
- design and build water related dioramas and topographical maps
- write a skit about water and present it to another class
- research, debate, and engage in problem solving regarding water-related issues in the community
- design and make posters regarding water use and display work in the school or community library
- take field trips to water department plants, nearby streams and ponds, a waste water treatment (reclamation) plant, street department, research station, local conservation project, water conservancy district, county extension agent, or natural resource conservation office

Lessons & Video Segments

Lesson	Video Segment	Segment Length	Begin Video at Counter
1.0 Water on the Move	Introduction	2:00	0:00
1.1 Evaporation	Evaporation	0:40	2:00
1.2 Precipitation	Precipitation	2:55	2:40
1.3 Watersheds	Water Storage	1:15	5:35
1.4 Domestic Water Treatment	Water Treatment	2:20	6:50
1.5 Distribution Systems	Water Distribution	3:45	9:10
1.6 Water Use	Water Use	1:05	12:55
1.7 Nonpoint Source Pollution	Sewer Systems	1:15	14:00
1.8 Wastewater Treatment	Waste Treatment	3:45	15:15
1.9 Wrap-Up	Entire Video	20:00	0:00

If you are using a VCR with a time counter/indicator, it is easy to locate the section you desire to view. Make certain the video tape is completely rewound before beginning. Simply fast forward to the counter-time listed in the right-hand column. This will set the video at the appropriate segment.

1.0 Water on the Move

Lesson Summary:

This lesson provides an introduction to the water cycle and preparation of a student water record book which will be used throughout the unit.

Objectives:

1. Students will be introduced to the elements of the water cycle.
2. Students will create their own water record book.

Vocabulary:

water vapor
condensation
evaporation
water cycle
precipitation
sublimation
transpiration
water cycle
solid
liquid
groundwater
glacier

Materials:

Activity One

- travel cards (1 per student)
- dice (2 per group of 4 students)
- water cycle game sheet (1 per group)

Activity Two

- paper
- scissors
- glue
- card stock (for cover)
- crayons
- markers
- stapler

Video Presentation:

View the introductory video segment (~2:00 minutes) starting at minute counter 0:00.

Procedures:

Activity One: Water on the Move — 40 minutes

1. As a class brainstorm all of the places that water can be located (lakes, rainfall, clouds, underground, etc.). List responses randomly on the board. Be sure to include all of the locations found on the *Hydrologic Cycle: Water on the Move* activity sheet (page 4).

2. Have student volunteers come to the board and draw lines connecting one location of water to another. As connections are drawn discuss the process that occurs as water moves from one location to another. Processes discussed should include **evaporation**, **condensation**, **precipitation**, **sublimation**, and **transpiration**.
3. Draw out the concept of a **water cycle** in which water changes back and forth between **solid**, **liquid**, and **vapor**, as it travels in, on, and around the Earth. Point out that there many different paths water can take as it travels from one location to another in the water cycle.
4. Explain the directions and supervise students as they participate in the *Water on the Move* activity (see instructions and game pieces at the end of this lesson.)

Activity Two: Water Record Books

20 minutes

1. Explain to the students that they are about to study a unit about water, and that during this unit they will write an entry each day in a water record book.
2. Distribute materials and have each student construct their own water record book. Each book should have at least 10 pages with the student's name on the outside cover.
3. Encourage students to decide on a title or name for their book and create an attractive cover using the materials available.*
4. When students have completed their books, have them write their first entry. The entry can be structured (vocabulary words and definitions), an open-ended sentence (Today I learned . . .), the answer to a question, or any other type of writing activity related to the day's lesson.
5. Suggest that students write the date, Day One, or some other identifying notation at the top of the entry page.

* You may want to wait and have students complete this step at the end of the unit.

Water on the Move

1. Give each student a water *Travel Log* (page 5).
2. Divide the class into teams of four students each.
3. Give each team 2 dice and a *Hydrologic Cycle: Water on the Move Travel Key* (page 4).
4. Begin play and continue until one player on each team has traveled to all 11 destinations.

Getting Started:

Each player rolls both dice and adds the numbers together to determine their beginning location as indicated on the Water on the Move Travel Key. This location is written on line 1 of their travel log.

Playing the Game:

On their second turn to roll the dice (and each turn thereafter) students must explain how they can travel from their previous location to the one they just rolled.

They must use at least one of the hydrologic cycle words, found on the Travel Key (evaporation, condensation, sublimation, transpiration, etc.).

If a student rolls the location they are already at, they write the location again on the appropriate line of their travel log but do not have to give an explanation.

The Winner Is:

The first student in each group to travel to each of the 11 locations on the Travel Key.

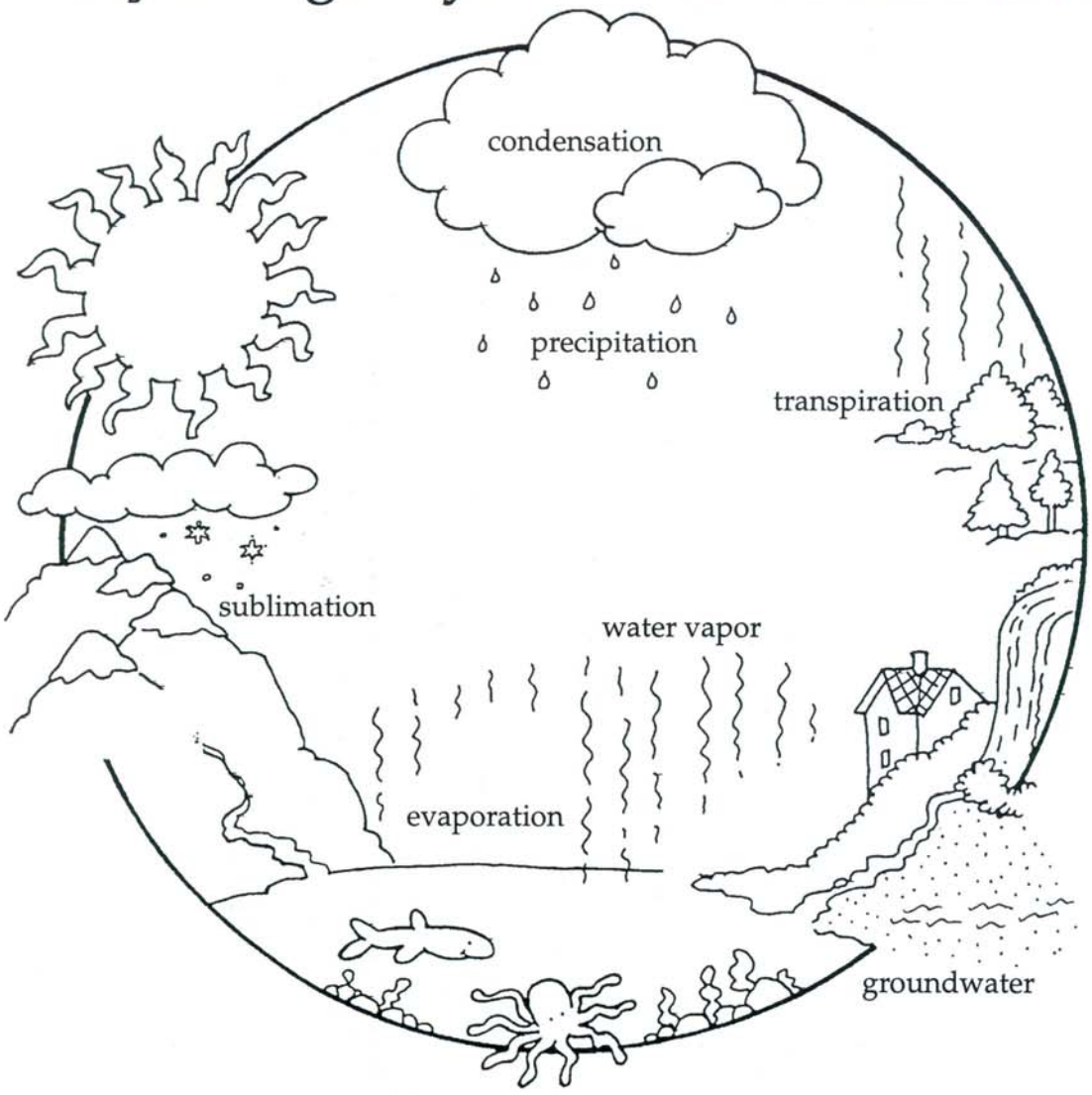
Example:

1st turn: rolls a 9 , writes down "ocean" on line one of travel log and gives dice to the next player.

2nd turn: rolls a 3 (tree); Explains: I evaporate from the ocean and become part of a cloud then condense and fall as rain onto the ground where I am absorbed by the roots of the tree. Writes down "tree" on line two of travel log and gives dice to the next player.

3rd turn: rolls a 3 again, writes down "tree" on the third line of the travel log and gives dice to the next player.

Hydrologic Cycle: Water on the Move



Travel Key

2 = water fall
3 = tree
4 = mud puddle
5 = river
6 = snowy mountain
7 = groundwater
8 = cloud
9 = ocean
10 = animal
11 = lake
12 = glacier

Name _____

Travel Log

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____
11. _____
12. _____
13. _____
14. _____
15. _____
16. _____
17. _____
18. _____
19. _____
20. _____

Name _____

Travel Log

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____
11. _____
12. _____
13. _____
14. _____
15. _____
16. _____
17. _____
18. _____
19. _____
20. _____

1.1 Evaporation

Lesson Summary:

In this lesson, students will participate in activities which demonstrate the evaporation phase of the water cycle.

Objectives:

1. Students will observe the evaporation of water.
2. Students will observe the process of transpiration.
3. Students will record what they have observed and learned.

Vocabulary:

hydrologic cycle
evaporation
transpiration
dissolve
saturation

Materials:

Activity One

- 2 petri dishes (or lids from a wide mouth jar)
- spoon
- salt
- water
- 2 clean plastic cups (clear will work best)
- labeling marker or tape and pen

Activity Two

- wet paper towels

Activity Three

- food coloring
- alum in small cups (alum can be purchased in most food stores by the spices)
- salt in small cups
- sugar in small cups
- cotton string (pre-cut in 4 inch lengths and soaked in water)
- small clear plastic cups (1 per student)
- toothpicks
- masking tape
- four large containers of water (prior to the activity, add food coloring to the containers of water)

Activity Four

- plastic tubing (1 foot for each student or group)
- leafy branches
- duct tape
- water
- marker

Activity Five

- water record books made in Lesson 1.0

Video Presentation:

View the evaporation video segment (~40 seconds) starting at minute counter 2:00.

Procedures:

Activity One: What's Left Behind

10 minutes

1. As a demonstration, spoon a small amount of salt into one of two plastic cups filled with the same amounts of water. Discuss where the salt might go. Introduce the term **dissolve**.
2. Do a magician mix-up of the two cups of water by moving them back and forth on the table. Ask the students how they could find out which cup had the salt added. Let someone taste the water to see if they are right.
3. Label the cups and two petri dishes (or lids) as "salt" and "fresh." Fill the petri dish bottoms about half full of water from the appropriate cup and then place them in a warm place. Ask students to predict what will happen.

   Results of the activity can be viewed over the next several days.

Activity Two: Feeling Evaporation

10 minutes

1. Introduce the term **evaporate**. Have three volunteers come to the front of the class. Have one person hold both arms outstretched with hands facing down. Wipe both hands with a wet paper towel. Have the other two volunteers blow on the wet hands. Describe what happens. The wet hands should dry quickly and become cooler. Students should conclude that the water evaporated into the air and that evaporating water cooled the hand. Identify wind as a form of energy.
2. Have two volunteers come to the front. One person should extend arms with hands facing down. Wet both hands. Have the other volunteer blow on only one hand. The hand not receiving wind energy should evaporate more slowly. Ask students where they think the evaporating water on the hand that is not receiving wind gets energy. They should infer that the evaporating water gets heat energy from the hand.

Activity Three: Crystal Growing

15 minutes

1. Supply each student with a small clear plastic cup. Have them place their names on strips of masking tape which they put on the cup. Each person should fill his/her cup one-half full of one of the colors of water available, slowly add **ONE** of the available chemicals (salt, sugar, or alum), and stir with a toothpick. Have the students stop adding the chemical when no more will dissolve. Introduce the term **saturation**.
2. Place the cups in a warm place where they will not be disturbed.
3. Put a toothpick over the top of the cup and lay a 4 inch string over the toothpick so that one end of the string goes to the bottom of the cup. The string may need to be weighted with a paper clip.
4. Wait for the water to evaporate (several days) then discuss the results of the crystal growing experiment. DO NOT BUMP OR MOVE THE CUPS UNTIL THE WATER HAS ALL EVAPORATED.

Activity Four: Transpiration

10 minutes

1. Distribute to each student or cooperative group a section of plastic tubing, duct tape, and two leafy branches.
2. Have students fill the tubing with water and duct tape the tubing to a window or wall near a sunny window in the shape of a "U."
3. Have students place the leafy branches into one end of the tubing and mark the water level on the other end as illustrated below. Make sure the end of the stems are submerged in water.

4. Introduce the term **transpiration** and have students predict what they think will happen.
5. Students should check the tube for changes in the water level every fifteen minutes or so and discuss the results. (While they are waiting you may wish to have them complete their water record entry for the day.)

Activity Five: Water Record Writing

15 minutes

1. Assign students to write an entry in their water record book about what they have learned about water today. The length, structure, and content of the entry is at the discretion of the teacher (see *1.0 Introductory Lesson/Activity Two*).
2. Remind students to identify the entry with a date, day number, or other distinguishing mark.

Extension Activities:

- Compare the rates of transpiration for different sizes of leaves or kinds of plants.
- Provide pails of water and paint brushes or spray bottles. Paint the outside of the building, sidewalks, etc. Watch the water evaporate. In the winter, the frozen water will sublimate (go directly from a solid to a gas).
- As part of Activity Four, have students mark the tubing in one-fourth inch segments and graph the water level at 15 minute intervals. Use the graphs to determine if the absorption rate remains the same over time. Graphs can also be used to compare the absorption rate of fresh-cut vs. day-old stem cuttings and different varieties of trees.

1.2 Precipitation

Lesson Summary:

In this lesson students will observe the change of water vapor to liquid water and will learn how rain is formed.

Objective:

1. Students will facilitate and observe the condensation of water vapor.

Vocabulary:

precipitation
condensation
evaporate
water vapor

Materials:

Activity One

- drinking glasses
- ice cubes
- water
- small mirrors

Activity Two

- piece of glass
- pan
- water
- hot plate

Activity Three

- light source
- clear plastic cups
- masking or electrical tape
- water

Activity Four

- water record books

Video Presentation:

View the precipitation video segment (~2:55 minutes) starting at minute counter 2:40.

Procedures:

Activity One: Condensation — **15 minutes**

1. Form students into cooperative learning groups. Have one student from each group obtain a glass of water with ice cubes and a small mirror.

2. Have students observe and describe what happens to the outside of the glass of water as it sits on the desk.
3. Assign one student from each group to breathe onto the surface of the mirror. Make sure he or she blows out hot air several times.
4. Have students observe and describe what they see on the mirror.
5. Discuss the activity with the students using the terms **water vapor, condensation,** and **precipitation.**

Activity Two: Evaporate / Precipitate

10 minutes

DO THIS ACTIVITY AS A TEACHER DEMONSTRATION

1. Hold a piece of glass over a pan of boiling water.
2. Ask students to predict what will happen.
3. Drops of water will soon form on the glass. When there are enough droplets, they will combine to form larger drops which will drip off the glass.
4. Ask students to indicate what the large drops of water represent in the water cycle.
5. Discuss the activity using the terms **evaporate, water vapor, condensation,** and **precipitation.**
6. Remind students that water droplets form in the air when moist air cools. The droplets form on tiny pieces of dirt, dust, salt, or other small particles.

Activity Three: Rain-Makers

20 minutes

1. Form students into cooperative learning groups. Have one student from each group pick up two clear plastic cups, masking or electrical tape, and water.
2. Have each group place about one inch of water into one cup, turn the other cup upside down, and tape the cups together mouth-to-mouth.
3. Place the "rain-makers" in a warm sunny location or under a strong light source.
4. Ask students to predict what they believe will happen.

5. Have students observe and record the changes occurring in the cups over a period of several hours.
6. Discuss student observations. Ask students to relate the experiment to the water cycle. Students may conclude that the top cup relates to the air, the bottom cup relates to the earth, the water relates to the oceans, the light source relates to the sun's energy, and that the water on the sides of the top cup relates to precipitation.
7. Have students remove the rain-makers from the light source and observe what happens.
8. Discuss observations and conclusions, review terms.

Activity Four: Water Record Writing

 15 minutes

1. Assign students to write an entry in their water record books about what they have learned from today's activities.
2. Remind students to identify the entry with the date, a title, or day number.

Extension Activities:

- Use a saturated sponge to demonstrate that it is like a cloud that has more water than it can hold. They both drip water. The drops look like rain.
- Discuss the different forms of precipitation (rain, snow, sleet, and hail) and study how they are formed.

1.3 Watersheds

Lesson Summary:

In this lesson, students construct aluminum foil watersheds to demonstrate the flow of surface water and how it can be polluted.

Objectives:

1. Students will construct aluminum foil watershed models and observe the flow of polluted groundwater.
2. Students will survey the school grounds to identify drainage patterns and possible sources of pollution.

Vocabulary:

watershed
surface water
runoff
groundwater
dam
reservoir
pollution

Activity One

- water
- plastic cups
- medicine droppers or plastic pipettes
- aluminum foil
- powdered punch (instant drink mix)
- paper towels

Activity Two

- rough sketch map of the school grounds
- pencils

Activity Three

- water record books

Video Presentation:

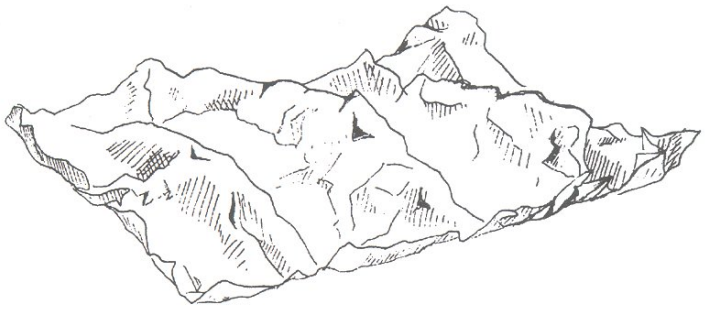
View the water storage video segment (~1:15 minutes) starting at minute counter 5:35.

Procedures:

Activity One: Making a Watershed — 15 minutes

1. Distribute materials to cooperative student learning groups.

2. Explain that each group is going to create their own "country." Demonstrate the process by creating wrinkles and folds in a piece of aluminum foil so that there are mountains, valleys, and plains. All areas should feed into a central low area.



3. Introduce the term **watershed** to the students.
4. Instruct each group to make their own watershed.
5. Give each group a measured amount of water to use as rain water.
6. When each watershed is complete, have students simulate rain by using the medicine dropper, or pipette, to drop water on the model.
7. Relate the terms surface water, streams, rivers, lakes, and oceans to their models.
8. Have students add small strips and pieces of paper towel to show how water is absorbed by the ground to become **groundwater**.
9. Have students place punch powder on the model to illustrate types of **pollution** that could be found in a watershed.
10. Begin the rain process again and have students observe the effects of the paper towels and the spread of pollution. Compare the runoff collected with the original rain water.
11. Discuss the effect that a little bit of punch powder can have on an entire lake in the model. Relate this to the effects of pollutants such as motor oil and paint which are sometimes introduced to the watershed, **surface water**, and groundwater supply.

Activity Two: School-Ground Watershed

30 minutes

1. Equip each student with a school-ground map and pencil, and then arrange students into cooperative learning groups.
2. Ask them to assume that the school ground is a watershed and that their task is to identify on their map where the water will flow when it rains. They should also look for, and mark on their map, possible sources of pollution that the water may encounter as it travels over the school property.
3. Discuss with students the following points:
   - What is a watershed?
   - Can you trace the path of a drop of water falling on the school roof until it leaves the school property?
   - Do you know where water from the school property will ultimately end up?
   - Could we build a dam on the school grounds to capture rainfall runoff water?
   - Where would be the most effective place to build a dam?
   - Possible uses for the water collected in the reservoir created by the **dam**?
   - What steps could be taken to keep the **reservoir** water clean?

Activity Three: Water Record Writing

15 minutes

1. Assign students to write an entry in their water record book, they may wish to attach their copy of the school-grounds map as an illustration for the entry.
2. Remind students to identify the entry by name, date, or number.

Extension Activities:

- Collect student school-ground maps. On the next rainy day, distribute maps and have students compare their water flow maps with the actual runoff patterns on the school grounds.
- Study the watershed for your community. Find out and discuss where and how the water supply is stored before being distributed to homes, schools, and businesses.

1.4 Domestic Water Treatment

Lesson Summary:

In this lesson, the teacher will demonstrate the generalized steps to prepare water for domestic use.

Objective:

1. Students will observe the generalized steps of water treatment and compare the beginning and end water quality.

Vocabulary:

filtration	sedimentation	coalesce	water treatment
flocculation	effluent	floc	
coagulation	chlorine	polishing	

Materials:

Activity One

none

Activity Two

- plastic spoons
- 3 one-quart jars
- aluminum sulfate (alum) — found in most grocery stores near the spices
- sand filter (see diagram)
- water
- pollutants (food coloring, cooking oil, motor oil, dirt, twigs, etc.)
- chlorine bleach

Activity Three

- water record books

Video Presentation:

View the water treatment video segment (~2:20 minutes) starting at minute counter 6:50.

Procedures:

Activity One: Water in the Wild — 15 minutes

1. Teacher / Student Dialogue

   Teacher: Suppose you were hiking with some friends and you came upon a small stream. It's hot and you are thirsty, should you drink the water?

   Students: NO!

   Teacher: Why not?

   Students: It could make you sick.

   Teacher: What things might be in the water that could be harmful to you?

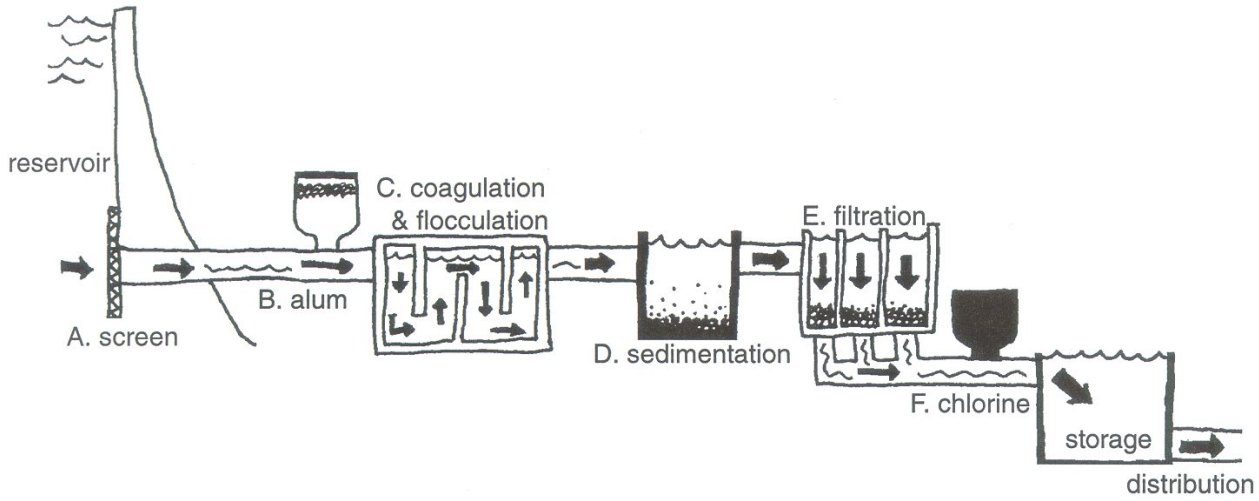
   Students: Dirt, oil, paint, bacteria, etc.

   Teacher: Eventually some of that water in the stream will end up in someone's home. Will it be safe to drink then?

   Students: Yes.

   Teacher: What will have happened to the water between the stream and the tap in someone's home to make it safe? (Encourage discussion until **water treatment** is brought up.)

2. Review the steps in the water treatment process discussed in today's video segment and illustrated on page 18.



Adapted from *Utah Water: A Precious Resource* Utah Department of Natural Resources, Division of Water Resources, 1990.

A. Water taken from a source is screened to remove plants, fish, and other debris.

B. Chemicals such as alum (aluminum sulfate) are added to the water to remove the tiny clay and silt particles remaining in the water. The alum neutralizes the negative charges on the soil particles and makes them "sticky" so that they can **coalesce**.

C. As the particles coalesce they begin to stick together and form larger particles called **floc**. These processes are often referred to as **coagulation** and **flocculation**.

D. The water and floc particles travel to a **sedimentation** tank where the large floc particles settle to the bottom and are removed.

E. With the floc particles removed, the water flows through filters of sand and gravel to remove any particles still left in the water. This **filtration** step is often referred to as **polishing**.

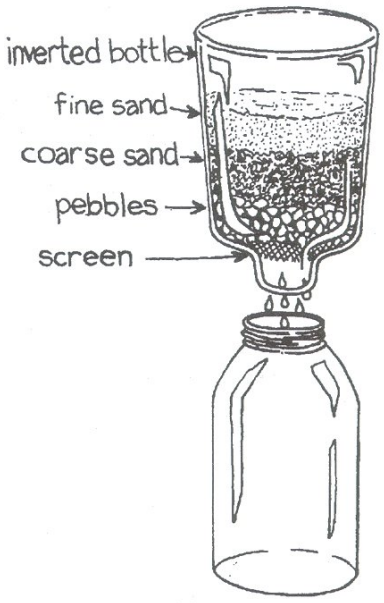
F. After filtration, the finished water is often disinfected with **chlorine** to kill any remaining bacteria and keep it safe as it is stored and distributed to the public. Some communities also add fluoride at this point to prevent dental decay in children and young adults.

Activity Two: Water Treatment

30 minutes

1. Partially fill two one-quart jars with water. Discuss and add various pollutants to the water in the jars. Pollutants you might want to consider adding include soil, fertilizer, detergent, and paint.

2. Place one teaspoon of granulated alum in one jar and stir for 3-5 minutes. Look for the formation of floc particles.
3. Let the jar settle for 10-15 minutes. Observe the difference between the water in the jar treated with alum and the one without the alum. Point out that so far you have demonstrated **coagulation**, **flocculation**, and **sedimentation**.
4. Construct a filter from the top of a two liter pop bottle with its bottom cut off. See illustration below.



   A. Attach a nylon screen to the outside neck of the bottle with a rubber band. Turn the bottle upside-down and pour a layer of pebbles or gravel into the bottle, the screen will prevent the pebbles from falling out of the neck of the bottle.
   B. Pour coarse sand on top of the pebbles.
   C. Pour fine sand on top of the coarse sand.
   D. Condition the filter by slowly and carefully pouring clean tap water through the filter until it drains clean from the bottom. Try not to disturb the top layer of sand as you pour the water. Conditioning the filter cleans out the fine particles and prepares it for filtration.

   A nylon stocking placed over the mouth of the bottle can be used in place of, or in conjunction with, the screen.
5. Carefully pour a portion of the coagulated and settled water through the filter. If some of the alum floc goes over into the sand filter, it will increase the effectiveness of the filter.
6. Observe the water that has passed through the filter. Discuss the term **effluent**.
7. Add one drop of chlorine bleach to the filtered water to complete the treatment process.

NOTE: Students may ask if the treated water is safe to drink and will probably want someone to taste it. Since controls and tests available at modern water plants are not available in the classroom, students should not take the chance of drinking contaminated water and becoming ill.

8. Discuss which pollutants were removed and which may still be in the water after treatment.

Activity Three: Water Record Writing

 15 minutes

1. Assign students to write an entry in their water books.
2. Remind them to identify the entry by name, date, or number.

Extension Activities:

- Visit a local water treatment facility.
- Have students illustrate or construct models of a treatment plant.
- Research waterborne diseases such as the 1854 cholera epidemic in London or the giardia outbreak in Minneapolis.
- Discuss the need for disinfecting drinking water by looking up typhoid, cholera, diphtheria, and other waterborne diseases to determine the microorganism which causes the disease, how it is transmitted, and how it can be removed.

1.5 Distribution Systems

Lesson Summary:

In this activity, students discover what a bargain water is and gain an appreciation for modern water distribution systems.

Objectives:

1. Students will compare the cost of water to the cost of milk and soda pop.
2. Students will transport water in buckets to gain an appreciation for the convenience of modern water distribution systems.

Vocabulary:

bargain
cost
inconvenient
convenient

Materials:

Activity One

- 1 can of soda pop
- 1 gallon of water
- 1 gallon of milk
- paper
- pencils

Activity Two

- buckets
- wading pool
- access to faucet or other outside water source

Activity Three

- paper
- pencils

Activity Four

- water record books

Video Presentation:

View the water distribution video segment (~3:45 minutes) starting at minute counter 9:10.

Procedures:

Activity One: The Cost of Water — 15 minutes

1. Display the gallon of water, gallon of milk, and can of soda pop.
2. Ask students to guess the cost of each liquid.

3. Share the actual cost of each item. The cost of a gallon of water from a household faucet can be determined using the information on a water bill (usually about 1¢ per gallon.) You may want to compare and contrast this price with the current price of a gallon of water purchased at a store.
4. Calculate the **cost** of . . .

   using milk to wash a car. (approximately 30 gallons)

   running the dishwasher with soda pop. (approximately 16 gallons)

   taking a 10-minute milk shower. (approximately 47 gallons)

   brushing your teeth using soda pop. (approximately 7 gallons)

   watering the lawn with milk. (approximately 180 gallons)
5. Compare the costs calculated in step number four, with the cost of completing the same activities using water.
6. Discuss what a **bargain** water really is.

Activity Two: The Long Haul

20 minutes

1. Discuss with students the following:

   As recently as 100 years ago, nearly everyone had to depend on wells, springs, or rivers for water supplies. Water for drinking, washing, cleaning, and livestock had to be carried by hand.
2. Have students calculate the amount of water needed to supply the daily drinking water for the entire class (at least 1/2 gallon is required per person each day).
3. Use a faucet or garden hose to simulate a spring and a wading pool to serve as the collection container.
4. Have students measure and carry water from the "spring" to the pool, placed an appropriate distance away. Use small enough containers so that students do not hurt themselves, but large enough containers to demonstrate the difficulty of the job (2.5 gallon buckets are about the right size).
5. Identify other uses for water besides drinking.

6. Share with students that the average person uses about 176 gallons of water each day for drinking, cleaning, preparing meals, etc. Ask students to estimate the time involved in carrying that much water in a manner similar to the bucket/wading pool activity.
7. Discuss and relate the time and **inconvenience** of supplying water 100 years ago to the **convenience** and low cost of today's water supply.

Activity Three: Water Use Log

10 minutes

NOTE: This assignment will provide information necessary for completing tomorrow's water use lesson.

1. Have students create a water use log similar to the one below.

Water Usage	Number
Number of toilet flushes	
Number of washing machine loads	
Number of minutes in the shower	
Number of meals	
Number of baths	
Number of dishwasher loads	
Number of minutes watering the lawn	
Number of times washing the car	
Number of hours house cleaning	
Number of times brushing teeth	
Other	
Other	
Other	
Other	

2. Assign students to keep a log of every time they use water during the next twenty-four hours. Explain that without the completed log they will be unprepared to participate in tomorrow's activities.

Activity Four: Water Record Writing

 15 minutes

1. Assign students to write an entry in their water books.
2. Remind students to identify the entry by name, date, or number.

Extension Activities:

- Form cooperative learning groups and have each group brainstorm ideas for a "wet party" (one that involves water) which would cost no more than fifty cents. Party ideas might include a wading pool beach party, tablespoon relay races, or water-balloon volleyball.
- Write about how life-styles might change if society had to go back to carrying their own water supply on a daily basis.

1.6 Water Use

Lesson Summary:

This lesson provides a visual representation of the distribution of water on the earth followed by activities to increase awareness of the amount of water used in daily activities.

Objectives:

1. Students will learn the ratios of salt water to fresh water on the earth.
2. Students will become more aware of the amount of water used in daily activities.

Vocabulary:

salt water	glaciers
fresh water	ice-caps

Materials:

Activity One

- colored water (because it is easier to see)
- equipment for measuring volume
  (liter & milliliter or gallon & tablespoon)
- clear water display containers

Activity Two

- Water Use Logs (from previous lesson)
- calculators (optional)
- pencils

Activity Three

- water trivia questions and answers
- answer cards (one set for each group)

Activity Four

- water record books

Video Presentation:

View the water use video segment (~1:05 minutes) starting at minute counter 12.55.

Procedures:

***Activity One: Where is the water?** — 10 minutes

1. Display one liter of colored water.
2. Tell the students that this water represents all of the water on the earth. Explain that you are going to pour some of the water into another container to represent the amount of water on the earth that is **fresh water**.

3. Ask students to guess how much water they think this will be and to tell you to stop when they think you have poured enough out. Pour until they say to stop.
4. Explain that you are now going to demonstrate the actual ratios.
5. Using another liter of water pour 30 mL into a container. Explain that this represents the amount of **fresh water** on the earth. Compare the student's guess with the measured amount and discuss the differences.
6. Pour 10 mL of the 30 mL into another container, explaining that only one-third of all fresh water is actually available for use. The other two-thirds is in the form of **glaciers** and **ice-caps**.
7. Review the following ratios of water on the Earth:
   - 97% is **salt water**
   - 2% is fresh water in glaciers and ice-caps
   - 1% is fresh water available for use
8. Ask students to take out their Water Use Logs from the previous lesson which will identify some of the ways which they use the 1% of fresh water that is available.

*Alternate Activity Using Standard Measures
1 gallon = all of the water on the Earth (256 Tablespoons)
7 1/2 Tablespoons = fresh water
5 Tablespoons = glaciers and ice-caps
2 1/2 Tablespoons = fresh water available for use

Activity Two: Water Use Logs

 **15 minutes**

1. Have students use the information on page 27 to compute the gallons of water they have used in the past 24 hours.

Water Usage	Number	x gallons of water*	Water Used
Number of toilet flushes		x 3 gallons per flush =	
Number of washing machine loads		x 32 gallons per load =	
Number of minutes in the shower		x 5 gallons per minute =	
Number of meals		x 5 gallons per meal =	
Number of baths		x 35 gallons per bath =	
Number of dishwasher loads		x 10 gallons per load =	
Number of minutes watering the lawn		x 60 gallons per hour =	
Number of times washing the car		x 40 gallons per time =	
Number of hours house cleaning		x 8 gallons per hour =	
Number of times brushing teeth		x 2 gallons per time =	
Other			
Total Number of Gallons of Water Used			

* Values obtained from *The Comprehensive Water Education Book,* Utah State University, 1994.

2. Compare totals and discuss possible uses of water that students may have overlooked.

Activity Three : Water Trivia

20 minutes

1. Form cooperative learning groups and distribute answer cards to each group.
2. Explain the procedures for the Water Trivia Game.
   - The teacher asks how many gallons of water are used for various activities.
   - Each group has 10 seconds of "think and discussion" time to decide which answer card is correct.

- The teacher signals when time is up and the team captain raises the selected card.
- Scoring:
  - First group with card up and correct answer = 3 points
  - All other correct answers = 2 points
  - If no correct answers, the closest = 1 point

3. Begin all questions by asking, "How many gallons of water are used in . . ."

Use	Number of Gallons Used
1. refining one barrel of oil	770 gallons
2. taking a bath	30 gallons
3. taking a shower	20 gallons
4. flushing a toilet	3 gallons
5. washing hands or face	2 gallons
6. getting a drink	1/4 gallon
7. brushing teeth	2 gallons
8. washing dishes	8 gallons
9. cooking a meal	5 gallons
10. using a washing machine	32 gallons
11. producing a loaf of bread	136 gallons
12. going water-skiing	400,000,000 gallons

4. Award a "wet" prize (such as drinking fountain passes) to the winning team.

Activity Four: Water Record Writing

 **15 minutes**

1. Assign students to write an entry in their water record book.
2. Remind students to identify the entry by name, date, or number.

Extension Activities:

- Keep water use logs for several days or an entire week.
- Challenge students to find additional water facts and develop their own trivia game.
- Discuss situations when demand for water may be greater than the supply. Ask students to devise plans for using as little water as possible during one day.

Water Use Trivia Answer Cards for Students

770 gallons	**30 gallons**	**20 gallons**
3 gallons	**2 gallons**	**1/4 gallon**
2 gallons	**8 gallons**	**5 gallons**
32 gallons	**136 gallons**	**400,000,000 gallons**

Water Use Trivia Question Cards for Teacher

How many gallons of water are used in: **refining 1 barrel of oil?** (770 gallons)	How many gallons of water are used in: **taking a bath?** (30 gallons)	How many gallons of water are used in: **taking a shower?** (20 gallons)
How many gallons of water are used in: **flushing a toilet?** (3 gallons)	How many gallons of water are used in: **washing hands or face?** (2 gallons)	How many gallons of water are used in: **getting a drink?** (1/4 gallon)
How many gallons of water are used in: **brushing teeth?** (2 gallons)	How many gallons of water are used in: **washing dishes?** (8 gallons)	How many gallons of water are used in: **cooking a meal?** (5 gallons)
How many gallons of water are used in: **using a washing machine?** (32 gallons)	How many gallons of water are used in: **producing a loaf of bread?** (136 gallons)	How many gallons of water are used in: **going water-skiing?** (400,000,000 gallons)

1.7 Nonpoint Source Pollution

Lesson Summary:

This lesson is an interactive activity in which students are introduced to nonpoint source pollution.

Objective:

1. Students will be able to define and give examples of nonpoint source pollution.

Vocabulary:

point source pollution
nonpoint source pollution
pollutant
contamination

Materials:

Activity One

broom
paper (3 sheets per student)
role cards (duplicate and cut out so that each student has one)

Activity Two

water record books

Video Presentation:

View the sewer systems video segment (~1:15 minutes) starting at minute counter 14:00.

Procedures:

Activity One: Knowing Nonpoint — 45 minutes

1. Write the term "nonpoint source pollution" on the board. Ask students what they think the term means. Accept all answers, but do not define the term. Indicate that they will participate in an activity which will demonstrate nonpoint source pollution.
2. Distribute one role card to each student.
3. Discuss how different groups represented on the cards could pollute the water.
4. Distribute three sheets of paper to each student. (The back of old assignments will work great.) Instruct students to list a different **pollutant** that could come from the source on their role card on each of the three papers.

5. Have students wad up each paper and throw it on the floor.

> EXAMPLE: If a student were given a role card that says: "You like to work on your car at home," the student might write on their three pieces of paper:
> A. Oil from my car dumped on the ground.
> B. Spilled antifreeze.
> C. Poured cleaning solution onto the lawn after washing the car windows.

6. Assign a student to be the "rain person" who uses a broom to sweep the pollutant papers into a pile.
7. Place the following headings on the board: Agriculture, Mining/Logging, Urban (business/home), Waste Disposal, and Construction. Unfold each paper and list pollutants under the appropriate heading.
8. Define the terms **point source pollution** and **nonpoint source pollution**. As a class, identify the pollutants listed on the board as point source pollution or nonpoint source pollution.
9. Once the list and identification are completed discuss the results with the class. Was the oil from just one car harmful? Discuss the cumulative effect of each student dropping just three pieces of paper.
10. Discuss your community's water supply. Where does it come from? What might **contaminate** it?

Activity Two: Water Record Writing

15 minutes

1. Assign students to write an entry in their water books.
2. Remind students to identify the entry by name, date, or number.

Extension Activities:

- Identify all of the sources at home or school that drain into a sewer system.
- Research and develop a list of hazardous materials that should never be poured down the drain or onto the ground. Identify places in your community where they can be disposed of properly.

You are a farmer who grows wheat and corn.	You are a farmer who grows apples and grapes.	You are a rancher who raises sheep.
You are a farmer who raises pigs.	You drive five miles to work every day.	You are in charge of an airport.
You are a farmer who raises cattle.	You operate a large grocery store.	You operate a zoo.
You like to work on your car at home.	You own a gas station with large underground tanks.	You are a homemaker who likes to keep her house clean.
You are a principal of a large school.	You are in charge of your city streets.	You own a large logging company.
You produce coal from your mine.	You produce copper from your mine.	You are in charge of a landfill.
You have a large lawn.	You are in charge of building new roads in your town.	You are a major contractor in your community.

1.8 Wastewater Treatment

Lesson Summary:

In this lesson, students will study the process of wastewater treatment.

Objectives:

1. Students will identify materials often found in wastewater.
2. Students will review the steps involved in wastewater treatment.
3. Students will devise a plan for treating wastewater.

Vocabulary:

water treatment facility
primary treatment
secondary treatment
tertiary treatment
chlorine
sludge
wastewater
aeration

Materials:

Activity One

jar with lids
water
sand
cooking oil
silt
grass
leaves
paint
liquid soap
small sticks
tissue paper
candy wrappers

Activity Two

Wastewater Treatment Handout

Activity Three

wastewater sample jars from Activity One

Activity Four

water record books

Video Presentation:

View the waste treatment video segment (~3:45 minutes) starting at minute counter 15:15.

Procedures:

Activity One: The Making of Wastewater

15 minutes

1. Ask students to name ways they use water in their homes. Ask them to name materials that end up going down the drain with the used water. List student answers on the board. Be sure to include cooking oil, dirt, and soap.
2. Add cooking oil, liquid soap, soil, and tissue paper to a demonstration jar of water to represent the materials students named.
3. Ask students to name other materials that accumulate in the water as it passes through drainage pipes, gutters, and storm drains. Encourage them to think of materials which come from their own home as well as the community.
4. Add materials such as sand, sticks, grass, and candy wrappers.
5. Screw on the lid and shake the jar. Explain that this water represents the **wastewater** that ends up in **wastewater treatment facilities** by way of sewers (not storm drains.)

Activity Two: Wastewater Treatment

10 minutes

1. Ask students where water goes after it flows down the drain.
2. Use the *Wastewater Treatment Handout* to help review/explain the treatment procedure illustrated in the video and explained below.

The major components in wastewater treatment are primary, secondary, and tertiary treatment.

Primary Treatment: The purpose of primary treatment is to remove solids. This is accomplished through physical processes (as opposed to biological or chemical) such as screening large floating materials, grinding solids into pieces about 2 inches or smaller, removing grit and sand with a grit chamber, and removing the remaining solids through sedimentation tanks (also known as clarifiers).

Secondary Treatment: The purpose of secondary treatment is to remove the demand for oxygen. This is usually accomplished through biological processes such as microbial decomposition and aeration. The microbes decompose organic materials in the water and in the process use up the available oxygen found in the water. Examples of secondary systems include trickling filters, activated sludge systems, aerobic lagoons, and anaerobic digesters.

Tertiary Treatment: The purpose of tertiary treatment is to "polish" the effluent from the secondary treatment by removing excess suspended solids, nutrients (primarily nitrogen and phosphorus), and/or heavy metals. This is accomplished through physical (filters), biological (oxidation ponds), or chemical (precipitation of heavy metals) processes depending on the pollutant to be removed. Tertiary treatment is used only when the first two treatment systems cannot remove the pollutants to the level required by the discharge permit granted by the Utah Department of Environmental Quality.

Activity Three: A Wastewater Treatment Plan

20 minutes

1. Shake the demonstration jar used in Activity One. Ask students to observe what happens.
2. Explain to students that the material at the bottom of the jar is called **sludge**.
3. Challenge students to devise a plan using materials found in the classroom to separate the sludge and floating materials from the water.
4. Discuss proposed treatment plans. Select and implement one plan to see how effectively it works.

Activity Four: Water Record Writing

15 minutes

1. Assign students to write an entry in their water record books.
2. Remind students to identify the entry by name, date, or number.

Extension Activities:

- Assign students to research their community wastewater treatment facility. Have them answer the following questions:

  A. What type of facility does your community use?

  B. Where is the facility located?

  C. How much wastewater is treated there each day?

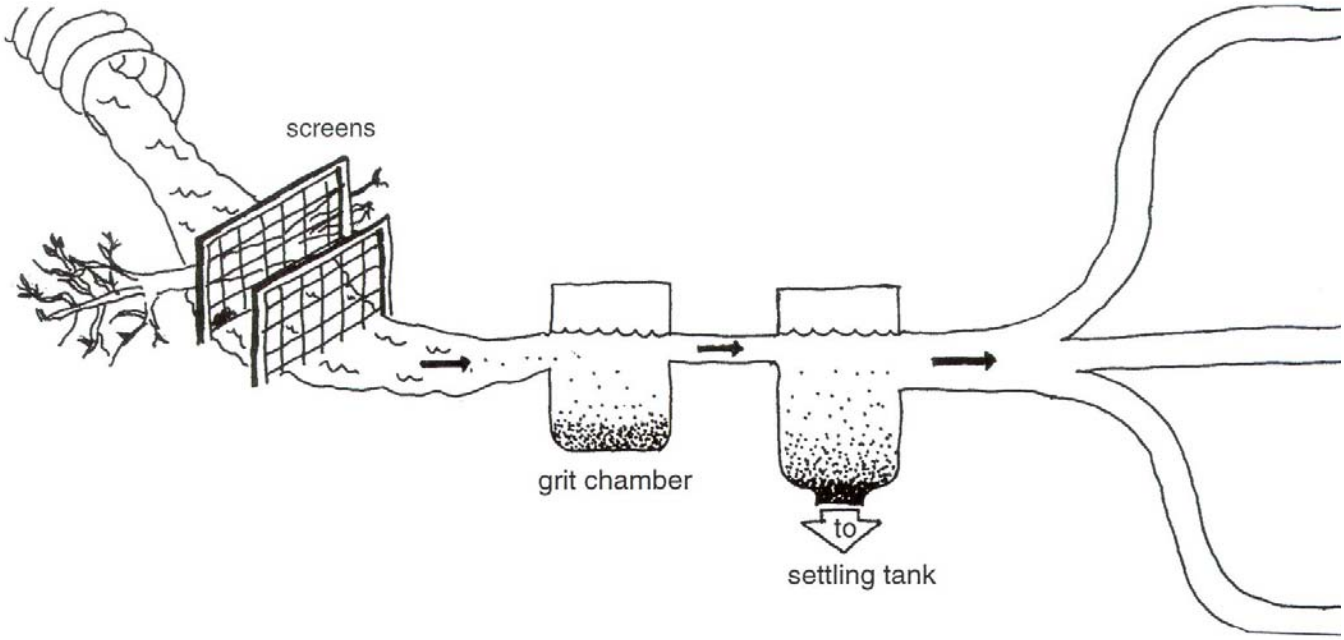
  D. How much water is the facility designed to treat?

  E. Where is the treated water discharged?

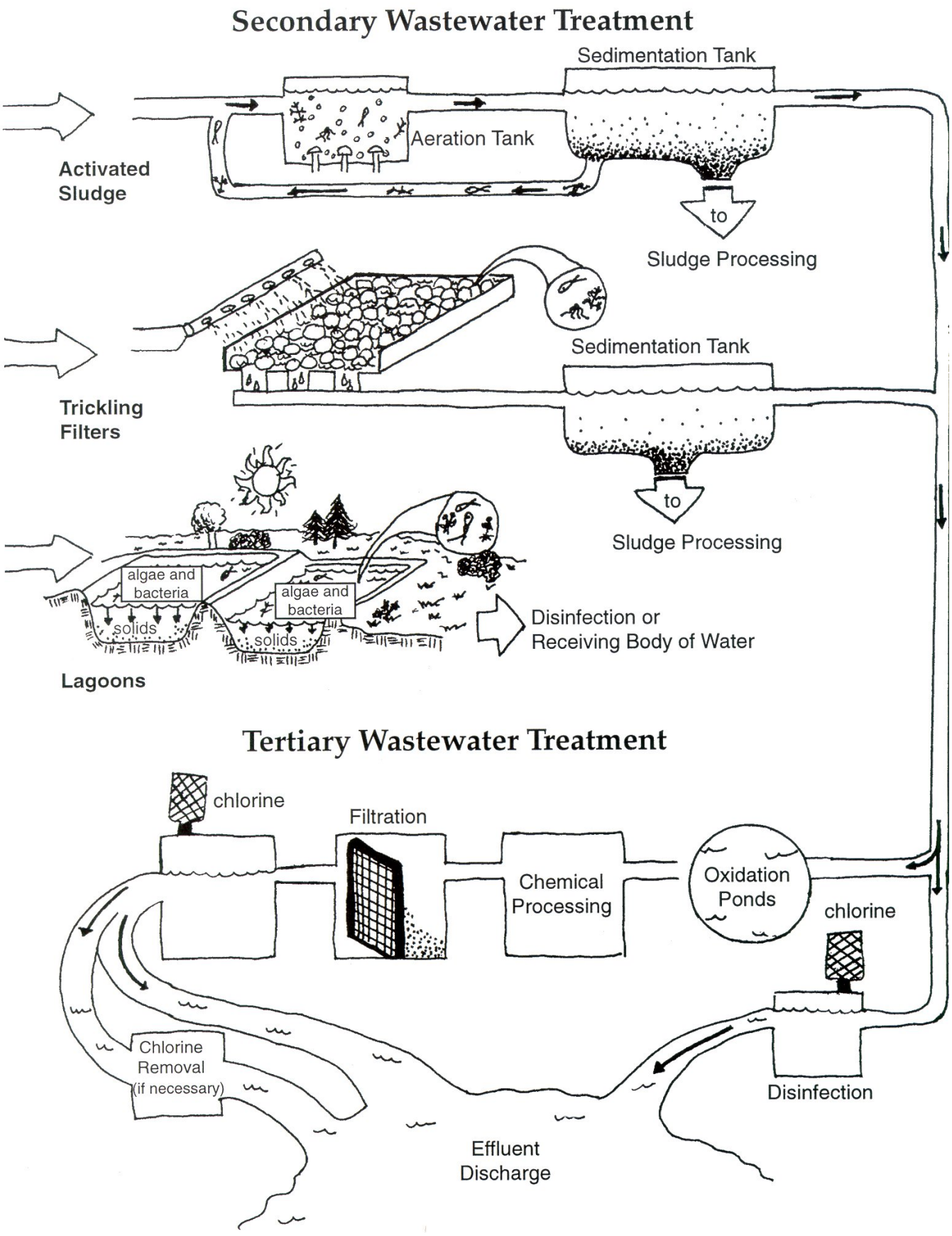
  F. What are problems the treatment facility is facing or has faced in the past?

- Visit a local wastewater treatment facility.
- Study the use of septic tanks.
- Invent a sewage system that does not use water.

Primary Wastewater Treatment



Adapted from *Wastewater Treatment: The Student's Resource Guide* Water Pollution Control Federation, 1987.


Secondary Wastewater Treatment
Sedimentation Tank
Aeration Tank
Activated Sludge
to
Sludge Processing
Sedimentation Tank
Trickling Filters
to
Sludge Processing
algae and bacteria
solids
algae and bacteria
solids
Disinfection or Receiving Body of Water
Lagoons
Tertiary Wastewater Treatment
chlorine
Filtration
Chemical Processing
Oxidation Ponds
chlorine
Chlorine Removal (if necessary)
Disinfection
Effluent Discharge

1.9 Wrap-Up

Lesson Summary:

In this lesson, the students create a visual representation of the eight components of the hydrologic cycle as presented in this unit.

Objective:

1. Students will create an illustration representative of their understanding of the parts and interconnections of the hydrologic cycle.

Vocabulary:

none

Materials:

Activity One

Water: The Never Ending Story video

Activity Two

art paper (11x17 or larger)
art supplies (colored pencils, markers, scissors, glue, etc.)
water record books

Procedures:

Activity One: Putting It All Together

 **30 minutes**

1. Before viewing *Water: A Never Ending Story*, challenge students to learn at least one new thing they as they watch the video for a second time.
2. View the video from beginning to end without interruption.
3. Share new information that students learned from watching the presentation a second time.

Activity Two: Illustrating What I've Learned

 **30 minutes**

1. Review with the students the eight components of the hydrologic cycle as presented in this unit.

A. Evaporation

B. Precipitation

C. Watersheds

D. Water Treatment

E. Distribution Systems

F. Water Use

G. Nonpoint Source Pollution

H. Wastewater Treatment

2. Option A: Have students create a poster which depicts these eight components and how they are connected to one another. Suggest that they include some of the interesting facts that they learned on the poster. Encourage students to refer to the water record books they have kept throughout the unit for information which will help them complete this project.

   Option B: Arrange students in 8 cooperative learning groups and assign each group to create a poster or diagram of one of the 8 segments of the video in such a way that the eight group projects can be displayed together as a class collage of the hydrologic cycle.

3. Display completed posters and diagrams.

Extension Activities:

- Assign students to do research and present a report about one part of the hydrologic cycle.
- Invite a guest speaker whose career is associated with the community's water supply.
- Have a "Water Party" where all games, activities, and refreshments use, or are associated with, water.

CORRELATION TO THE UTAH CORE CURRICULUM FOR SCIENCE--1994

The following is a correlation between the lessons found in this curriculum and activity guide with the Utah State Science Core Curriculum Standards. A lesson denoted in conjunction with a particular standard indicates that one or more of the activities which comprise the lesson can be used to teach, enhance comprehension, or provide an extended application of the science principles outlined in the objectives for the achievement of the science standard.

LEVEL 1 - FIRST GRADE

STANDARD 3010-01	Students will describe the characteristics and uses of air.

OBJECTIVE		Water: A Never Ending Story
3010-0103	Explain the effects and uses of wind on people.	Lesson 1.1: Evaporation

STANDARD 3010-02	Students will describe the characteristics and uses of water.

OBJECTIVE		Water: A Never Ending Story
3010-0201	Observe and measure the characteristics of water.	Lesson 1.1: Evaporation Lesson 1.2: Precipitation Lesson 1.4: Water Treatment
3010-0202	Demonstrate the effects of water on plants, animals, and people.	Lesson 1.1: Evaporation Lesson 1.5: Water Distribution Lesson 1.6: Water Use Lesson 1.9: Wrap-Up

STANDARD 3010-03	Students will recognize various geological features and investigate geological processes.

OBJECTIVE		Water: A Never Ending Story
3010-0301	Compare the physical properties of ice liquid water, and water vapor.	Lesson 1.0: Water on the Move Lesson 1.1: Evaporation Lesson 1.2: Precipitation Lesson 1.6: Water Use Lesson 1.9: Wrap-Up
3010-0302	Describe the relationships between the three states of water.	Lesson 1.0: Water on the Move Lesson 1.1: Evaporation Lesson 1.2: Precipitation Lesson 1.9: Wrap-Up

LEVEL 2 - SECOND GRADE

STANDARD 3020-02	Students will gather data about properties of heat and communicate observations.

OBJECTIVE		
3020-0202	Observe and describe the flow of heat.	Water: A Never Ending Story Lesson 1.2: Precipitation

STANDARD 3020-05	Students will analyze objects in terms of the materials of which they are made.

OBJECTIVE		
3020-0502	Compare and contrast objects that are made of more than one kind of material.	Water: A Never Ending Story Lesson 1.1: Evaporation

LEVEL 3 - THIRD GRADE

STANDARD 3030-02	Students will analyze the influence of people in ecosystems.

OBJECTIVE		
3030-0201	Relate effects of technology on local ecosystems.	Water: A Never Ending Story Lesson 1.5: Water Distribution Lesson 1.7: Nonpoint Source Pollution
3030-0202	Investigate the impact of technology on resources.	Lesson 1.3: Watersheds Lesson 1.5: Water Distribution Lesson 1.6: Water Use Lesson 1.7: Nonpoint Source Pollution Lesson 1.8: Wastewater Treatment

LEVEL 3 - THIRD GRADE, continued

STANDARD 3030-03	Students will recognize various geological features and investigate geological processes.

OBJECTIVE		Water: A Never Ending Story
3030-0301	Relate effects of technology on local ecosystems.	Lesson 1.0: Water on the Move Lesson 1.3: Watersheds
3030-0302	Identify various geological features such as mesa, mountains, streams, oceans, and islands	Lesson 1.3: Watersheds Lesson 1.9: Wrap-Up

LEVEL 4 - FOURTH GRADE

STANDARD 3040-03	Students will explain the water cycle.

OBJECTIVE		Water: A Never Ending Story
3040-0301	Explain the processes of melting, precipitation, evaporation, condensation, percolation, and erosion.	Lesson 1.0: Water on the Move Lesson 1.1: Evaporation Lesson 1.2: Precipitation Lesson 1.9: Wrap-Up
3040-0302	Construct a chart or drawing of the water cycle.	Lesson 1.0: Water on the Move Lesson 1.1: Evaporation Lesson 1.2: Precipitation Lesson 1.9: Wrap-Up

STANDARD 3040-04	Students will examine and categorize a variety of Utah rocks and minerals

OBJECTIVE		Water: A Never Ending Story
3040-0401	Identify properties of rocks and minerals.	Lesson 1.1: Evaporation

STANDARD 3040-06	Students will observe, record, analyze, and predict weather.

OBJECTIVE		Water: A Never Ending Story
3040-0601	Identify the elements of weather.	Lesson 1.0: Water on the Move Lesson 1.1: Evaporation Lesson 1.2: Precipitation Lesson 1.9: Wrap-Up

LEVEL 5 - FIFTH GRADE

STANDARD 3050-01	Students will compare and contrast changes in physical features of Earth over time.

OBJECTIVE		Water: A Never Ending Story
3050-0102	Cite and categorize examples of Earth's natural resources.	Lesson 1.6: Water Use

STANDARD 3050-02	Students will evaluate conservation practices in relation to natural resources

OBJECTIVE		Water: A Never Ending Story
3050-0201	Identify available natural resources.	Lesson 1.3: Watersheds Lesson 1.5: Water Distribution
3050-0202	Analyze conservation practices and pollution problems.	Lesson 1.3: Watersheds Lesson 1.6: Water Use Lesson 1.7: Nonpoint Source Pollution Lesson 1.9: Wrap-Up
3050-0204	Accept the responsibility to become aware of ecological and social issues related to natural resources.	Lesson 1.3: Watersheds Lesson 1.6: Water Use Lesson 1.7: Nonpoint Source Pollution Lesson 1.8: Wastewater Treatment Lesson 1.9: Wrap-Up

LEVEL 5 - FIFTH GRADE, continued

STANDARD 3050-03	Students will understand the characteristics and management of water.

OBJECTIVE		Water: A Never Ending Story
3050-0301	Understand the properties of water.	Lesson 1.1: Evaporation Lesson 1.2: Precipitation Lesson 1.4: Water Treatment Lesson 1.8: Wastewater Treatment Lesson 1.9: Wrap-Up
3050-0302	Cite examples of personal, recreational, industrial, and biological uses of water.	Lesson 1.5: Water Distribution Lesson 1.6: Water Use Lesson 1.9: Wrap-Up
3050-0303	Estimate amounts of water used daily by individuals, families, and communities.	Lesson 1.5: Water Distribution Lesson 1.6: Water Use Lesson 1.9: Wrap-Up
3050-0304	Based on gathered information, form an opinion and defend it regarding management of water resources.	Lesson 1.3: Watersheds Lesson 1.4: Water Treatment Lesson 1.5: Water Distribution Lesson 1.6: Water Use Lesson 1.8: Wastewater Treatment Lesson 1.9: Wrap-Up

STANDARD 3050-04	Students will compare and contrast physical changes and chemical reactions.

OBJECTIVE		Water: A Never Ending Story
3050-0401	Identify physical properties of matter.	Lesson 1.0: Water on the Move Lesson 1.2: Precipitation Lesson 1.8: Wastewater Treatment
3050-0403	Give examples of physical changes and chemical reactions that take place in the environment.	Lesson 1.1: Evaporation Lesson 1.2: Precipitation Lesson 1.4: Water Treatment Lesson 1.8: Wastewater Treatment Lesson 1.9: Wrap-Up

LEVEL 6 - SIXTH GRADE

STANDARD 3060-01	Students will compare the production of heat, light, and sound.

OBJECTIVE		Water: A Never Ending Story
3060-0101	Identify sources of heat.	Lesson 1.2: Precipitation

STANDARD 3060-07	Students will describe the growth, function, and significance of microorganisms in the environment.

OBJECTIVE		Water: A Never Ending Story
3060-0701	Identify helpful and harmful aspects of microorganisms such as viruses, bacteria, fungi, algae, and protozoa.	Lesson 1.8: Wastewater Treatment
3060-0702	Describe the interaction of microorganisms within an ecoysystem.	Lesson 1.8: Wastewater Treatment

LEVEL 7 - SEVENTH GRADE

STANDARD 3200-01	Students will evaluate the particulate nature of matter.

OBJECTIVE		Water: A Never Ending Story
3200-0101	Analyze evidence about particles of matter.	Lesson 1.2: Precipitation

STANDARD 3200-05	Students will create, use and understand the application of classification schemes.

OBJECTIVE		Water: A Never Ending Story
3200-0501	Classify matter based upon observable properties.	Lesson 1.0: Water on the Move Lesson 1.1: Evaporation Lesson 1.2: Precipitation Lesson 1.9: Wrap-Up

LEVEL 8 - EIGHTH GRADE

STANDARD 3240-01	Students will observe and describe physical and chemical change.

OBJECTIVE		Water: A Never Ending Story
3240-0101	Differentiate between common chemical and physical changes.	Lesson 1.0: Water on the Move Lesson 1.1: Evaporation Lesson 1.2: Precipitation Lesson 1.4: Water Treatment Lesson 1.8: Wastewater Treatment Lesson 1.9: Wrap-Up
3240-0102	Analyze factors that influence chemical and physical change.	Lesson 1.1: Evaporation Lesson 1.2: Precipitation Lesson 1.4: Water Treatment
3240-0103	Research technological innovations related to chemical and physical processes.	Lesson 1.4: Water Treatment Lesson 1.8: Wastewater Treatment Lesson 1.9: Wrap-Up

STANDARD 3240-02	Students will investigate changes in biological energy.

OBJECTIVE		Water: A Never Ending Story
3240-0201	Relate energy requirements of plants and animals to physical and chemical changes.	Lesson 1.1: Evaporation

STANDARD 3240-03	Students will relate forces and energy to motion.

OBJECTIVE		Water: A Never Ending Story
3240-0304	Explain the energy implications of technology in society.	Lesson 1.8: Wastewater Treatment Lesson 1.9: Wrap-Up

STANDARD 3240-05	Students will investigate changes in Earth's crust and climate.

OBJECTIVE		Water: A Never Ending Story
3240-0501	Model changes in Earth's surface.	Lesson 1.3: Watersheds

LEVEL 9-12 - Biology

STANDARD 3520-0 1	Summarize the function of atoms and molecules in the chemistry of cells.

OBJECTIVE		Water: A Never Ending Story
3520-0102	Investigate and explain the relation of water to organisms.	Lesson 1.1: Evaporation

STANDARD 3520-0 7	Students will analyze characteristics of ecosystems.

OBJECTIVE		Water: A Never Ending Story
3520-0701	Investigate an ecosystem using the tools of an ecologist.	Lesson 1.3: Watersheds

STANDARD 3520-0 8	Students will investigate the interdependence of organisms with each other and with their environment.

3520-0802	Analyze the effects of human activities on matter cycles and energy flow.	Lesson 1.3: Watersheds Lesson 1.7: Nonpoint Source Pollution Lesson 1.9: Wrap-Up
3520-0803	Analyze the influence of humans in an ecosystem.	Lesson 1.3: Watersheds Lesson 1.4: Water Treatment Lesson 1.5: Water Distribution Lesson 1.6: Water Use Lesson 1.7: Nonpoint Source Pollution Lesson 1.8: Wastewater Treatment Lesson 1.9: Wrap-Up

LEVEL 9-12 - Biology: Agricultural Biology

STANDARD 3560-0 1	Students will investigate and describe the chemistry of cells.

OBJECTIVE		Water: A Never Ending Story
3560-0102	Investigate and explain the relationship of water to organisms.	Lesson 1.1: Evaporation

LEVEL 9-12 - Biology: Agricultural Biology, continued

STANDARD 3560-07	Students will investigate the interdependence of organisms with each other and with their environment.

OBJECTIVE		Water: A Never Ending Story
3560-0701	Analyze an agricultural ecosystem.	Lesson 1.3: Watersheds Lesson 1.8: Wastewater Treatment
3560-0703	Analyze the impact of agriculture in ecosystems.	Lesson 1.3: Watersheds Lesson 1.4: Water Treatment Lesson 1.5: Water Distribution Lesson 1.6: Water Use Lesson 1.7: Nonpoint Source Pollution Lesson 1.8: Wastewater Treatment Lesson 1.9: Wrap-Up

LEVEL 9-12 - Biology: Human Biology

STANDARD 3580-06	Students will investigate the impact of humans in ecosystems.

OBJECTIVE		Water: A Never Ending Story
3580-0601	Analyze an ecosystem in relation to matter cycles and energy flow.	Lesson 1.3: Watersheds Lesson 1.7: Nonpoint Source Pollution Lesson 1.9: Wrap-Up
3580-0602	Investigate the interdependence of organisms with each other and with their environment.	Lesson 1.6: Water Use Lesson 1.7: Nonpoint Source Pollution Lesson 1.9: Wrap-Up

LEVEL 9-12 - Chemistry

STANDARD 3620-03	Students will investigate and infer physical and chemical properties of substances based on chemical bonding and periodic tendencies.

OBJECTIVE		Water: A Never Ending Story
3620-0301	Examine and identify physical and chemical properties of molecules related to bond types.	Lesson 1.4: Water Treatment Lesson 1.7: Nonpoint Source Pollution Lesson 1.9: Wrap-Up

LEVEL 9-12 - Chemistry, continued

STANDARD 3620-05	Students will determine and quantify regulating factors in chemical systems.

OBJECTIVE		Water: A Never Ending Story
3620-0501	Identify variables and predict relative changes in equilibrium of chemical reaction.	Lesson 1.3: Watersheds Lesson 1.7: Nonpoint Source Pollution Lesson 1.9: Wrap-Up

STANDARD 3620-06	Students will apply concepts of concentration to analyze solutions.

OBJECTIVE		Water: A Never Ending Story
3620-0601	Determine concentration of solutions and express in units of molarity, percentage and parts per million.	Lesson 1.1: Evaporation Lesson 1.4: Water Treatment Lesson 1.7: Nonpoint Source Pollution

LEVEL 9-12 - Earth Systems

STANDARD 3600-01	Students will investigate biological systems and summarize relationships between systems.

OBJECTIVE		Water: A Never Ending Story
3600-0101	Analyze the functioning of a biological system.	Lesson 1.8: Wastewater Treatment
3600-0102	Determine how systems relate within the biosphere.	Lesson 1.0: Water on the Move Lesson 1.1: Evaporation Lesson 1.2: Precipitation Lesson 1.4: Water Treatment Lesson 1.8: Wastewater Treatment Lesson 1.9: Wrap-Up
3600-0104	Evaluate the influence of people on the biosphere.	Lesson 1.4: Water Treatment Lesson 1.7: Nonpoint Source Pollution Lesson 1.8: Wastewater Treatment Lesson 1.9: Wrap-Up

STANDARD 3600-02	Students will analyze the relationship between the sun's energy, the atmosphere, and Earth.

OBJECTIVE		Water: A Never Ending Story
3600-0201	Analyze the influence of the sun's energy on the atmosphere.	Lesson 1.1: Evaporation Lesson 1.2: Precipitation

LEVEL 9-12 - Earth Systems, continued

STANDARD 3600-0 4	Students will determine the importance of water to Earth systems.

OBJECTIVE		Water: A Never Ending Story
3600-0401	Relate the properties of water to Earth systems.	Lesson 1.0: Water on the Move Lesson 1.1: Evaporation Lesson 1.2: Precipitation Lesson 1.3: Watersheds Lesson 1.4: Water Treatment Lesson 1.9: Wrap-Up
3600-0402	Relate the importance of water resources to Earth systems.	Lesson 1.0: Water on the Move Lesson 1.1: Evaporation Lesson 1.3: Watersheds Lesson 1.6: Water Use Lesson 1.9: Wrap-Up

STANDARD 3600-0 7	Students will understand the flow of energy into and out of Earth systems.

OBJECTIVE		Water: A Never Ending Story
3600-0701	Compare and contrast internal and external sources of energy.	Lesson 1.1: Evaporation Lesson 1.2: Precipitation
3600-0702	Analyze the transfer of energy within Earth systems.	Lesson 1.1: Evaporation Lesson 1.2: Precipitation

LEVEL 9-12 - Physics

STANDARD 3640-0 1	Students will analyze properties of matter.

OBJECTIVE		Water: A Never Ending Story
3640-0101	Collect and report data on the properties of matter.	Lesson 1.1: Evaporation Lesson 1.3: Watersheds
3640-0102	Explain and predict the behavior of matter in terms of energy changes.	Lesson 1.1: Evaporation Lesson 1.2: Precipitation

Glossary of Vocabulary Terms

Activated Sludge: Wastewater is mixed with air and the microorganisms break down organic matter. From the aeration tank the wastewater is piped to another sedimentation tank to remove remaining suspended solids. The treated wastewater or effluent may be disinfected by chlorine before being released to the environment.

Aeration: The process of bubbling air through water or wastewater to remove impurities.

Bargain: When the amount paid is relatively small in relation to the value of the goods received.

Chlorine: A chemical capable of killing many microorganisms, often used in the disinfection of water.

Coagulation: The clumping together of particles in the water and wastewater treatment processes prior to the formation of floc.

Coalesce: To stick together, as in particles which have been treated with alum in a water treatment process.

Condensation: The process by which a vapor becomes a liquid; the opposite of evaporation.

Contamination: The adding of any substance to water which makes it unfit for use.

Convenient: Located near at hand or easily acquired.

Cost: The amount that must be paid in order to purchase an item or service.

Dam: A barrier built across a course of water to prevent its flow.

Dissolve: The physical process in which one substance mixes with another substance to form a solution in which the physical properties of both substances have been changed but can be recovered.

Effluent: Water discharged or flowing out of a water treatment facility.

Evaporation: The process by which a liquid becomes a vapor (gas) usually through the application of heat energy, the opposite of condensation.

Filtration: In water and wastewater treatment, it is the process which involves moving water through a material, usually sand, designed to catch and remove unwanted particles.

Floc: The large particles formed in water and wastewater treatment processes when small particles begin to coalesce.

Flocculation: The formation of floc particles in the water and waste water treatment processes.

Fresh Water: Water with less than 0.5 parts per thousand dissolved salts.

Glacier: A large body of ice moving slowly down a slope or valley or spreading outward across a land surface.

Groundwater: Water found under the ground, in aquifers and between soil particles.

Grit Chamber: The initial step for raw sewage where heavy materials that might damage equipment or interfere with later processes are removed from raw sewage.

Hail: Precipitation in the form of small balls or lumps made up of layers of ice.

Hydrologic Cycle: The cycle of water movement from the atmosphere to the earth and act to the atmosphere through condensation, precipitation, evaporation, and transpiration.

Ice Caps: A perennial cover of ice and snow covering an area of land, can also be the beginning of a glacier.

Inconvenient: Difficult or troublesome to obtain or accomplish.

Lagoon: A treatment pond, usually 1 to 1.5 meters deep, that uses sunlight, algae, microorganisms, and oxygen to remove organic matter and nutrients from wastewater. The resultant wastewater may be disinfected with chlorine before being reused or released into the environment.

Leach Field: Wastewater from a septic tank is piped to the leach field or absorption field and seeps through the soil. The soil serves as a filter, removing bacteria and nutrients from the wastewater. The wastewater is purified by the microorganisms that live in the soil.

Liquid: The state on water in which it can be poured, and takes the shape of its container. Molecules move freely among themselves but do not separate as in the water vapor state.

Nonpoint Source Pollution: Wide-spread, overland runoff containing pollutants. The contamination does not originate from one specific source or location and the pollution discharges over a wide land area.

Point Source Pollution: Pollutants discharged from any identifiable point, including pipes, ditches, channels, sewers, tunnels and containers of various types.

Polishing: In water treatment it is the removal of floc particles from water by allowing the water to flow through filters of sand and gravel.

Pollutant: Anything which alters the physical, chemical or biological properties of water making it harmful or undesirable for use.

Precipitation: Water falling in a liquid or solid state from the atmosphere to the Earth, such as rain, snow, sleet, and hail.

Primary Treatment: The first state of the waste water treatment process, usually utilizes mechanical methods such as screening and sedimentation to remove pollutants. See also Secondary and Tertiary Treatment.

Reservoir: An artificial lake where water is collected and stored, often accomplished by the building of a dam.

Runoff: Precipitation that flows overland to surface streams, rivers, and lakes.

Salt Water: Water which contains a relatively high percentage of salt minerals (over 0.5 parts per thousand).

Sand Filter: A system used in areas with high water tables, shallow soils, or soils that water cannot flow through easily. Sand and gravel are mounded on top of natural soil to filter wastewater received from the septic tank before the wastewater reaches natural soil.

Saturation: To dissolve one substance in another to a point where no more will dissolve.

Secondary Treatment: The second stage of a waste water treatment process, often using biological methods to consume and destroy pollutants.

Sedimentation: The action or process of matter settling or moving from one place to another.

Sedimentation Tank: A structure designed to remove suspended solids. The speed of flow is decreased as wastewater moves through this tank, and suspended solids sink to the bottom and are removed. This mass of solids is called raw sludge.

Septic Tank: The septic tank separates solids from liquids. The solids (sludge) collect on the bottom of the tank and are periodically pumped out and disposed of at a community treatment facility or an approved disposal site. The partially treated wastewater is piped to a leach field.

Sleet: Precipitation in the form of frozen or partly frozen rain.

Sludge: The solids (heavy organic waste matter) resulting from the wastewater treatment processes.

Sludge Composting: Composting uses biological processes to generate heat to kill disease-causing organisms. By forcing air into the compost pile, more oxygen is available to the biological organisms that decompose the sludge. The treated sludge can be used as fertilizer, burned, or placed in a landfill.

Sludge Treatment: Sludge is that part of wastewater that settles to the bottom. Sludge is removed from the bottom of tanks and filters. Prior to use or disposal, sludge is treated with chemicals and heat to kill disease-causing organisms and decrease the water content.

Solid: The state of matter in which a substance has a definite shape, can not be poured, and its molecules are limited in their movement.

Sublimation: The transition of a substance from a solid phase to a vapor phase, or vice versa, without going through the liquid phase, such as snow or ice sublimating to water vapor.

Surface Water: Water above the surface of the land including lakes, rivers, streams, ponds, flood water, and runoff.

Tertiary Treatment: The third phase of water treatment, utilizing a physical, chemical, or biological treatment process that removes specific and/or additional contaminants not removed in the primary or secondary water treatment phases.

Transpiration: The process by which water that has been absorbed by a plant is evaporated into the air from a plant surface, usually through a leaf.

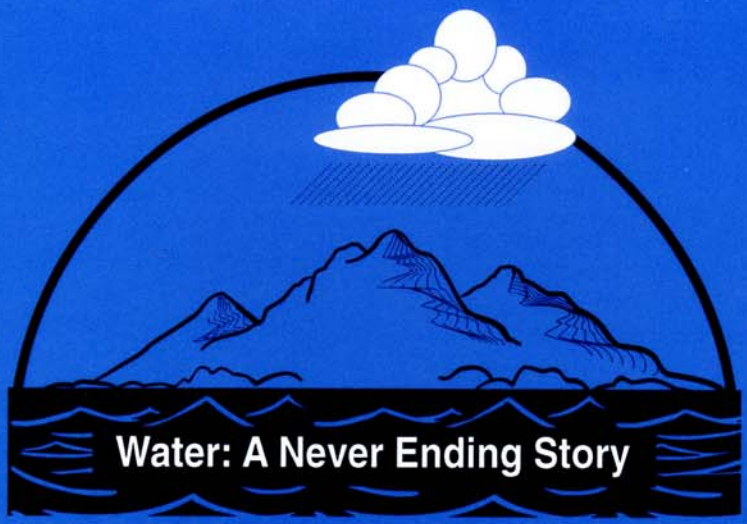
Wastewater: Water that contains unwanted materials from homes, businesses, and industry; a mixture of water and dissolved or suspended substances.

Wastewater Treatment Plant: A facility that receives wastewater (and sometimes runoff) from domestic and/or industrial sources, and by a combination of physical, chemical, and biological processes reduces (treats) the wastewater to less harmful by-products; also know by the acronyms WWTP, STP (sewage treatment plant), and POTW (publicly owned treatment works).

Water Cycle: The path which water takes through its various states as it move throughout the Earth's systems, also called the Hydrologic Cycle.

Water Vapor: The state of water in which individual molecules are highly energized and move about freely, also know as a gaseous state.

Watershed: The land area from which surface runoff drains into a stream, channel, lake, reservoir, or other body of water; also called a drainage basin.



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