# Clean Water Curriculum

## A Wastewater Teaching Unit for Fourth Graders

Developed through a grant from the
HRSD Environmental Improvement Fund

# Clean Water Curriculum Contents




## Acknowledgments

Authors: Deborah W. West and Ruth Kavanaugh created these easy-to-use lessons for Hampton Roads Sanitation District (HRSD) to help educators teach the importance of clean water and environmental protection.

We would also like to thank the following teachers and classrooms for helping pilot this unit: Shannon Bowman, Hidenwood Elementary School; Lauren Pemberton, Newsome Park Elementary School; Deborah Clevenger, Epes Elementary School; Marsha White, Newsome Park Elementary School; and Maria Perry, Newsome Park Elementary School.

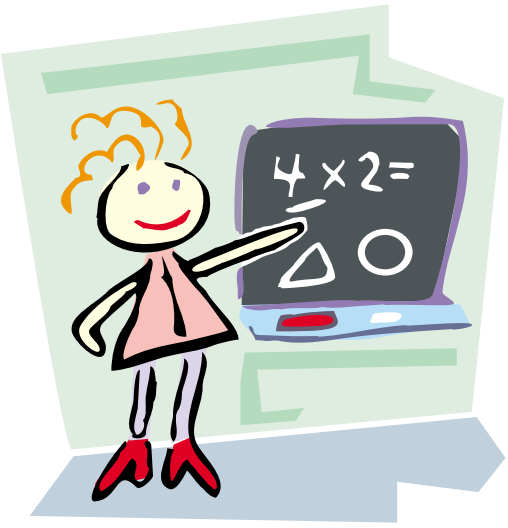
# Work Smarter, Not Harder!!

## How Can This Teaching Unit Help You?

- Reviews six of the eight fourth grade science SOLs.
- Uses an easy-to-teach format that ties together Virginia history, geography, government, and economics. Many math, English, and health objectives are also reinforced through this curriculum.
- Is tailor-made for the Hampton Roads area.
- Is as teacher-friendly as possible. Lessons include everything you need but the pipes!

## How Does This Teaching Unit Help Your Students?

- Raises real-world issues and concerns.
- Helps students become better stewards of the planet.
- Gives students a thorough dose of science, math, geography, and history.
- Enhances awareness of their community and how it functions.
- Provides hands-on activities designed for small groups.



# Background Information For Teachers

## HRSD History

(from www.hrsd.com)

### Environmental Protection – Its Heritage

Hampton Roads Sanitation District (HRSD), a political subdivision of the Commonwealth of Virginia, was created by public referendum in 1940 to eliminate sewage pollution in the tidal waters of the Chesapeake Bay.

HRSD owes its creation to oysters, a robust seafood industry in the early 1900s. The Virginia Department of Health condemned a large oyster-producing area in 1925, bringing the question of sewage pollution to light.

Today HRSD treats the wastewater of approximately 1.6 million people living in 17 cities and counties.

As the region has grown and its needs expanded, HRSD has remained dedicated to protecting and enhancing the environment. It has attained an environmental record that is the envy of the wastewater industry, where it is recognized as an industry leader. Because of this high level of commitment, the residents of the communities it serves are able to enjoy fully the benefits of local waterways.

## Water

### EPA Fact Sheet:

Nearly 80 percent of the Earth's surface is water, yet only 1 percent is available for drinking. Unfortunately, many of us take this water for granted. The average adult needs only 2.5 quarts of water per day to maintain health, but in the United States, we each use 125 to 150 gallons per day for cooking, washing, flushing, and outdoor watering.

The Earth's water is an extremely valuable natural resource that should be used wisely.

# Wastewater

## What Is Wastewater?

- Wastewater is water that goes down drains in industries, homes, and public buildings.
- Less than 1 percent of wastewater is waste; more than 99 percent is water.
- Wastewater in the HRSD service area is returned to local waterways after it is treated.
- In our area, treated wastewater is not returned to reservoirs used for drinking water.
- The United States and other developed countries use advanced wastewater treatment systems. More than 1 billion of the world's population live in areas with inadequate (or no) sewage collection or treatment, including parts of Mexico, Russia, and Thailand.

## Why Do We Clean It?

- Cleaning wastewater has environmental, public health, and economic benefits.
- Every day, HRSD plants treat over 150 million gallons of wastewater.
- Without adequate wastewater treatment, waterborne diseases (cholera, dysentery, and typhoid) would be more prevalent.

# Wastewater

## How Is It Cleaned?

- HRSD relies on both gravity and pumps to move wastewater from homes, public buildings, and industries through underground pipelines to treatment plants.
- The HRSD system is not a combined system. It treats wastewater from drains but not storm water (water collected in storm drains).
- There are various levels of treatment for wastewater:
  - Preliminary treatment removes sand, debris, and human-made objects.
  - Primary treatment physically removes solids by screening, settling, or floating.
  - Secondary treatment biologically removes pollutants that are dissolved in wastewater.
  - Tertiary treatment removes additional dissolved pollutants from the wastewater.
- Disinfection destroys any harmful bacteria present prior to releasing treated wastewater to waterways.
- Wastewater takes approximately eight to ten hours to move through a treatment plant.
- Treatment plant staff conduct hourly testing. Samples are also sent to a central lab in Virginia Beach for more extensive tests.

## What Is Your Role?

- An individual can profoundly affect the amount and make-up of wastewater.
- The demands on the wastewater treatment system have never been greater.
- Individuals can take many simple steps at home, school, and work to reduce the amount of wastewater produced each day.
- Understanding how wastewater is created and treated is the first step towards becoming a more responsible citizen.

## Notes

# What Is Wastewater?

# What's In The River? What's In The Pipes?

## Overview

In this introductory lesson, students learn that wastewater is produced in homes, public buildings, and industries. Wastewater is treated before it reaches the environment. Students also will learn how a wastewater treatment plant works and what they can do to help manage what is in wastewater.

## Related Standards of Learning

| | |
|---|---|
| Science 4.1 | Process Skills |
| Science 4.5 | Living Systems |
| Virginia Studies 10b | Industries of Geographic Regions |
| English 4.7 | Writing |

## Teacher Notes

Many students may not understand that the water (and everything in it) that flows in drains and pipes from houses, public buildings, and industries must be treated before it is returned to the environment. Through HRSD, treated water is returned to local waterways. The Hampton Roads Sanitation District includes 17 cities and counties and serves 1.6 million people. The treatment plants can clean up to 231 million gallons of wastewater each day.

The goal of wastewater treatment in our area is to protect the environment and public health by removing solids and potentially harmful substances from wastewater.

## VOCABULARY

Wastewater

Wastewater treatment

## MATERIALS

- ✔ Chart paper
- ✔ Markers

## Teaching Points

- In Hampton Roads, treated wastewater is returned to local waterways, not to the drinking water supply.
- Our wastewater system treats used water from buildings, not rain, groundwater, or drinking water.
- Each person is responsible for managing what is added to the wastewater treatment system.
- Dire environment consequences would result if wastewater entered the waterways without treatment.

## Procedures

1. On one piece of chart paper draw two blue lines that represent a river. Ask students what kinds of plants and animals live in and around our rivers. As students give answers, write the words in and around around the river.
2. On a second piece of chart paper draw a simple house with a series of pipes that come out towards the river. Ask students where the wastewater leaving the house comes from (e.g., toilet, sink, tub, washing machine, etc.) Ask students what kinds of things would be in the wastewater (e.g., human wastes, soap, food, paper, cigarettes, cleansers, grease, etc.). As students give answers, write the words along the pipes.
3. Ask students what would happen if the wastewater coming from the house went directly into the river.
4. On the edge of the house paper draw a large circle. Tell students this circle represents a wastewater treatment plant – a place where wastewater is cleaned before it reaches the river.
5. Ask students where else wastewater might come from. As students name buildings or businesses draw and label small squares around the house. The paper should look crowded to reflect the demands on the wastewater treatment system.
6. If students mention drinking water, rain, or groundwater, explain that our system only treats water that comes through pipes from buildings. If students do not mention these sources, bring them up yourself.

## Assessment

- Individually or in pairs, ask students to write about or illustrate what might happen to the river if wastewater flowed there directly and was not treated first. Have students share their responses.

*Adapted from materials from the City of San Diego Metropolitan Wastewater Department*

# Back In The Day

## Overview

Students compare the quantities of water used by a modern family to a family in the late 1800s and investigate changes in water use habits.

## Teacher Notes

In modern society we take water very much for granted. We expect to turn on the faucet and have an unlimited supply of clean water for our use. This has not always been the case in the United States. About 120 years ago, most people had to pump their own water for washing, cooking, bathing, and other needs. Families relied on wells that were dug on their property or a nearby spring. In many parts of the world this is still the case; hauling water is a very big part of a family's day. Imagine how differently we would feel about water if we had to pump and haul it by hand. Imagine, also, the effects of drought or pollution on that water supply.

## Teaching Points

- Before beginning this lesson, show the students the pictures of the wells and hand water pumps provided. Explain that before tap water, this was the standard way to get water.
- In this activity students will discover that water use has changed over the course of 120 years.

## Related Standards of Learning

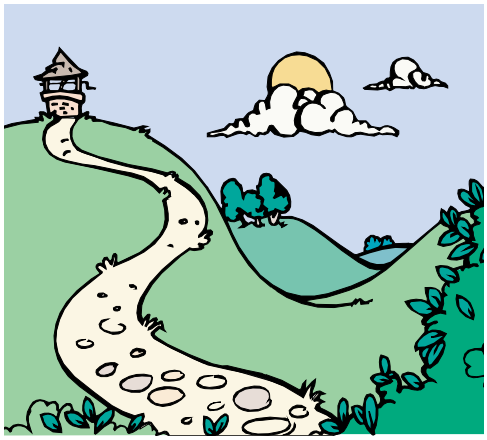
| | |
|---|---|
| Science 4.1 | Process Skills |
| Math 4.6 | Add/Subtract |
| Math 4.20 | Collect Data |
| English 4.7 | Writing |

### VOCABULARY

Drought

### MATERIALS

- ✔ Transparency of Then And Now chart
- ✔ Copies of The Bucket and The Bath
- ✔ Calculators
- ✔ Copies of Wastewater Wise sheet (one per student)
- ✔ Bucket of water

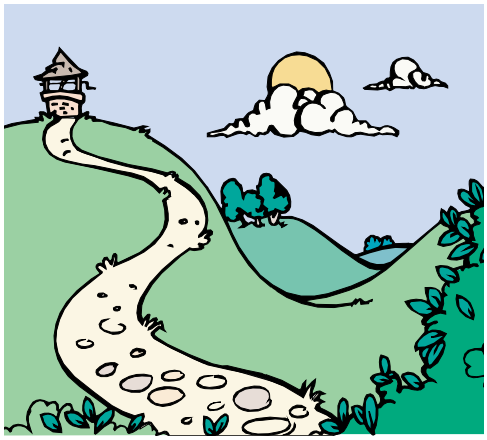


## Procedures

1. Ask the class to calculate the date it would be 120 years ago. You may want to put the date into historical perspective by showing the date on a timeline.
2. Before reading the story selections, ask the students to listen carefully to the story and find three or more differences from the 1800s and modern times.
3. Read The Bucket or The Bath (or both) to the class.
4. Ask the children to share the differences they found.
5. Tell the students they will compare the average family's water use of 120 years ago to a family in modern times.
6. Have the children pick up the bucket of water and carry it across the room to discover how hard hauling water was. Explain that this chore was generally given to the children in the family.
7. Show the class the transparency comparing modern water use with water use in the 1880s. Discuss how times have changed and remind them that all of that water had to be hauled to the house or barn from the well or spring.
8. Find the differences in water use on the Then and Now chart. This can be done together by using the overhead projector.
9. Ask the class to look at the modern water list and find ways to eliminate some of the unnecessary water use. List their suggestions on the board and discuss.

## Assessment

- Ask the students to interview a grandparent or older adult to find out how water use has changed in his or her lifetime. Write a paragraph describing the interview.
- Have the students take home the Wastewater Wise sheet and log their water use both at school and at home in a 24-hour period.



# Then And Now

## 1880s

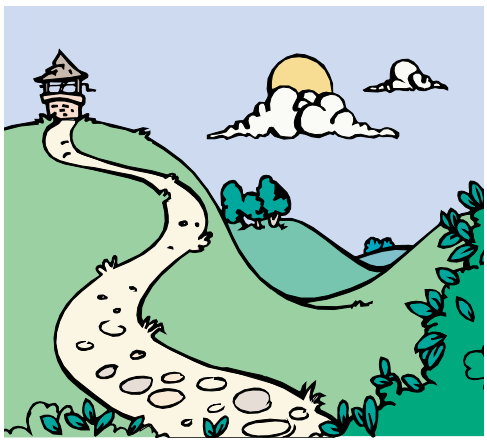
| WATER USE ACTIVITY (use per day for family of 2 adults and 3 children) | gallons | liters |
|---|---|---|
| Toilet (outhouse) | 0 | 0 |
| Wash basin (for morning sponge bath) | 1 | 3.8 |
| Washing dishes (by hand) | 2 | 7.6 |
| Drinking water (mother, father, three children*) | 25 | 95 |
| Washing clothes (by hand) | 5 | 19 |
| Watering the garden | 20 | 76 |
| Watering the livestock | 114 | 282 |

## Modern Times

| WATER USE ACTIVITY (use per day for family of 2 adults and 3 children) | gallons | liters |
|---|---|---|
| Toilet | 15 | 70 |
| Bath | 175 | 679 |
| Washing dishes (by hand with water running) | 30 | 11.4 |
| Drinking water (mother, father, three children*) | 25 | 95 |
| Washing machine (large load) | 60 | 228 |
| Watering the lawn | 75 | 285 |
| Washing the car (hose running) (similar to watering livestock) | 180 | 684 |

## Now And Then

| WATER USE ACTIVITY (per day use for family of 2 adults and 3 children) | Now | Then | Difference |
|---|---|---|---|
| Toilet | 15 | 0 | |
| Bath | 175 | 1 | |
| Washing dishes | 30 | 2 | |
| Drinking water (mother, father, three children) | 25 | 25 | |
| Washing clothes | 60 | 5 | |
| Watering the garden or lawn | 75 | 20 | |
| Watering livestock or washing car | 180 | 114 | |



*based on 5 gallons per person

## Wastewater Wise

DIRECTIONS: Each time you perform one of the activities on the sheet, or the activity occurs in your home, place a check beside that activity. Log your wastewater use for a full 24-hour period.

| ✔ Activity | | 24-hour total |
|---|---|---|
| | **Brushed my teeth**<br>1 gallon | 1 gallon X _____=_____ |
| | **Flushed the toilet**<br>2 gallons | 2 gallons X _____=_____ |
| | **Washed hands**<br>2 gallons | 2 gallons X _____=_____ |
| | **Took a bath**<br>35 gallons | 35 gallons X _____=_____ |
| | **Took a 5-minute shower**<br>20 gallons | 20 gallons X _____=_____ |
| | **Washed dishes in the sink**<br>(water left running)<br>30 gallons | 30 gallons X _____=_____ |
| | **Ran the dishwasher**<br>15 gallons | 15 gallons X _____=_____ |
| | **Washed clothes in machine**<br>40 gallons | 40 gallons X _____=_____ |
| | **Other uses**<br>Estimate gallons | ___ gallons X _____=_____ |
| | **Total gallons of wastewater** | |

## Wastewater Wise

1) List three ways you could reduce wastewater:

_____

_____

_____

_____

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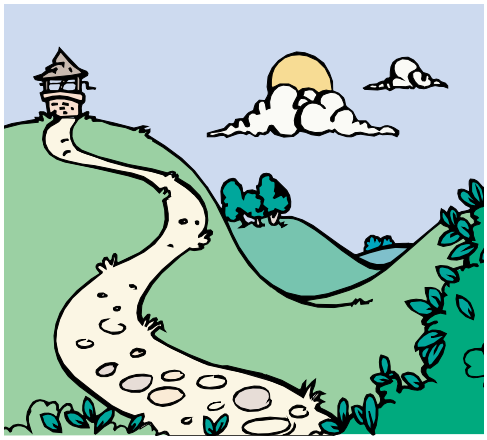


## The Bucket

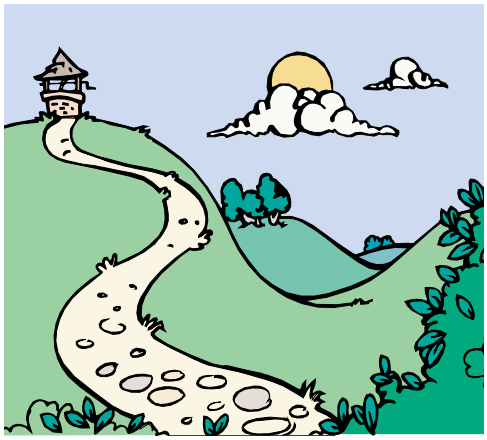
If you need water to wash dishes, fill your puppy's bowl, or take a bath, you simply turn a faucet and watch the water flow. If you had lived 120 years ago you would have had a very different experience. When you and your family needed water, someone had to carry it in a bucket. Often, it was a job for the children.

How much water could a child haul? It would depend on age and size. You would start out small, but as you grew you could manage larger and larger buckets and eventually one in each hand. Every change, every effort was a source of great pride. You were proving your worth to yourself and helping your family.

Where did you find the water? If your farm was new and no well had been dug, you would walk to a spring or river. Imagine all the trips you would need to make in one day and you can understand how important a well would be for your family. A well made your chores so much easier. Many wells even had a windmill that helped pump the water. Thank goodness for wind power because there was no electric power yet. You would also have a hand pump to get water on calm days when the wind could not lift the pump, but pumping added to your workload.

As much as your family needed water for themselves, your livestock would need it even more. Thirsty chickens, pigs, cows, oxen, or horses needed your help. Day in and day out you needed to bring water, and lots of it, to your animals. Where would you dig your well if you had a choice? Would you place it closer to the house or the barnyard? Think of the buckets you must carry before you decide.

Buckets full of fresh, cool water were essential 120 years ago. The children who helped carry them were just as important. Remember those buckets the next time you turn on your faucet and see clean water flowing out.



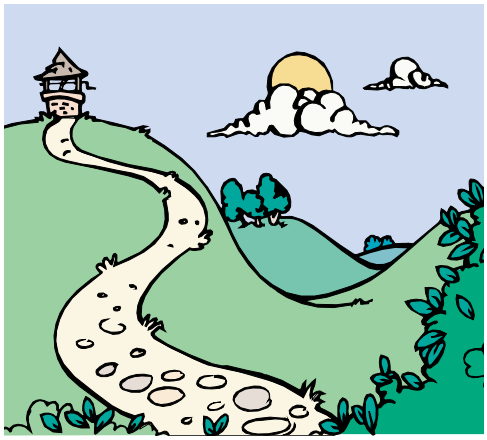
## The Bath

Before indoor plumbing, baths were usually a once a week event. On weekday mornings everyone in the family took a "bird bath" before they started their day. A bird bath consisted of a large bowl (called a basin) placed on a table and filled with water that had been carried into the house. This cold water was used to rinse off quickly from head to toe as well as to brush your teeth. Several people probably used the same basin water before it was replaced because it was a lot of work to carry buckets of water to the house.

Saturdays were a different story! After all the chores were finished, a large wash tub was taken down from the back porch and placed in the middle of the living room in front of the fireplace. The young children all grabbed buckets and marched to the pump to begin the process of hauling the water to the kitchen so it could be heated and used to fill the wash tub. As the children hauled the buckets of water into the house, momma would pour each bucketful into a huge boiler pan that she had put on the wood-burning stove. As the water warmed, the children would then carry it to the living room, bucket by bucket, to fill the wash tub. It took many gallons of water to fill the tub because it was large enough for a full-grown man to sit in!

Usually the children went first and were quickly scrubbed from top to bottom by their mother. Once the small children were squeaky clean and put to bed, the older children bathed. Privacy was honored and no one interfered as one by one each family member took his or her turn enjoying the nice hot bath water. In between each bather, fresh hot water could be added but the wash tub wasn't emptied until everyone was clean.

After all the baths, the wash tub had to be emptied one bucket at a time. Even then the bath water was not wasted – it was taken outside to water the family vegetable garden.



# Just Throw It Away!

## Overview

Students find out what happens to the substances that we "just throw away" in our daily water use. The wastewater that is made during this activity can be used for the activity in Lesson 19. This activity challenges the students' understanding of metric volume, length, temperature, and mass.

## Teacher Notes

Our society often "throws away" waste and trash when, in reality, it must go somewhere and be dealt with. In the United States, some streams and rivers were once so polluted that one of them even burned. So much oil and chemical waste was in the Cuyahoga River outside Cleveland, Ohio, that it caught fire in 1969. Our rivers, lakes, and even oceans were once thought to be capable of carrying off and naturally treating our liquid wastes. Cities pumped raw sewage from homes and businesses directly into rivers. Factories sent water that had been used in manufacturing processes, untreated, into streams, rivers, and oceans. As this practice continued and populations expanded, water supplies degraded to the point of posing serious health and environmental hazards. The 1972 federal Clean Water Act began the process of cleaning our waterways and establishing guidelines to ensure that all cities have wastewater treatment facilities.

## Related Standards of Learning

| | |
|---|---|
| Science 4.1 | Process Skills |
| Math 4.12 | Liquid Measurement |
| English 4.1 | Group Discussion |

## VOCABULARY

Wastewater
Pollutants

continued on next page

## Teaching Points

- Make sure that the students wear their goggles during the entire activity.
- Some measuring devices will not be used but are given to all groups so students must make an appropriate choice.
- Allow the students to discuss, disagree, and make mistakes in their measurements. If a group makes a mistake in measuring, ask the class if it agrees with its measurement method and have the students correct it before adding it to the wastewater.
- Within the next couple of days, use the class-created wastewater for the Washing Water activity, as the water will become unpleasant.

## MATERIALS

- ✔ 1 Bucket half filled with water
- ✔ 1 Large mixing spoon
- ✔ Water Users cards
- ✔ Warm water

POLLUTANTS

- ✔ Group 1 – coffee grounds
- ✔ Group 2 – vegetable oil
- ✔ Group 3 – laundry detergent (powdered or liquid)
- ✔ Group 4 – food scraps (orange or apple peels – avoid meat)
- ✔ Group 5 – vinegar
- ✔ Group 6 – liquid soap
- ✔ Group 7 – toilet tissue
- ✔ Group 8 – soil
- ✔ Group 9 – ten plastic drinking straws (this group will need scissors)
- ✔ Group 10 – yeast[1]

PER GROUP

- ✔ Safety goggles for each student
- ✔ Paper towels
- ✔ 3 Spoons
- ✔ (1) 1000-ml beaker
- ✔ (1) 100-ml graduated cylinder
- ✔ Balance scales
- ✔ Metric ruler and meter stick
- ✔ Metric thermometer

[1]*Activated dry yeast is a dormant organism that will begin reproducing rapidly when mixed with warm water and sugar. This will represent the living organisms that are found in wastewater.*

## Procedures

Divide the class into groups of three students.

1. Explain to the class that they are going to represent HRSD customers. Show the students the clean water in the bucket and explain that the water that enters each house and business is as clean as the water in the bucket; however, the water that leaves the house is quite a different story.
2. Give each group one of the Water Users cards and ask them to read the card together as a group. Each card gives a short scenario and tells the group which waste they are to put into the water.
3. Give the groups a few minutes to discuss which measuring device they will use (beaker, graduated cylinder, metric ruler, or thermometer) to measure the pollutant assigned to them.
4. Circulate among the groups to make sure they are on the right track with their measurements and to answer any questions that arise.
5. One at a time, have each group read the information aloud on their Water Users card, explain how they measured their substance, and dump the pollutant into the wastewater pipe (bucket).
6. Before each group adds their substance to the wastewater, ask the class if they agree with their measurement method.
7. After each group adds its pollutant, use the large spoon to stir the bucket contents.
8. When all the pollutants are added, stir the wastewater well to allow the pollutants to mix together and the tissue to liquefy. Explain that this represents the wastewater that enters the HRSD wastewater treatment plants. Allow the entire class to see the final wastewater.
9. Ask the class if they think the wastewater could ever be clean enough to be discharged into a lake, stream, or river. That is the problem that HRSD faces every day.
10. Save the wastewater and use it in the water cleaning activity Washing Water.

**Water User Card** **Group 1 – coffee grounds**

The day began at the Wilkins house as it did every day. Mom was up early getting the coffee started. Oops! Mom accidentally dropped the coffee grounds on the kitchen counter. No problem – she just wiped them off of the counter into the sink. Once the faucet was turned on and Mom ran the garbage disposal, they were gone!

**Pour 50 ml of coffee grounds into the bucket.**

**Water User Card** **Group 2 – vegetable oil**

Dad came into the kitchen ready to cook breakfast. Before long the whole house was filled with the smell of frying bacon and Dad's famous pancakes. These pancakes were the standard breakfast every Saturday morning at the Wilkins' house. Dad, Mom, and the three children ate, talked, and laughed as they ate. Time to clean up the mess! Dad plunged the pancake pan into the hot water in the sink.

**Pour 25 ml of vegetable oil into the bucket.**

**Water User Card** **Group 3 – dishwashing detergent**

The breakfast dishes were set on the counter ready to be washed. It was Janna's turn to wash dishes that Saturday. Her two younger brothers ran upstairs to brush their teeth and get dressed. Janna put a generous squirt of dishwashing detergent into the full sink of dishes. She sure wished that the family would get a dishwasher soon.

**Pour 1 ml of dishwashing detergent into the bucket.**

**Water User Card** **Group 4 – food scraps**

After Janna finished the dishes and wiped off the table, she scraped the leftover food into the sink and turned on the garbage disposal. The food was ground into tiny pieces and away it went.

**Add 30 g of chopped food**

**Water User Card** **Group 5 – vinegar**

While the dishes were being washed in the kitchen, the youngest Wilkins son, Charlie, was proudly showing his mom how he could now use the potty like a big kid. He was a proud 3 year old.

**Pour 35 ml of vinegar into the bucket.**

**Water User Card** **Group 6 – liquid soap**

Mom reminded little Charlie that big boys also wash their hands every time they use the potty. Charlie squirted a blob of liquid soap on his little hands and rubbed until they were covered in lather. Charlie thought it was fun being a big boy!

**Pour 1 ml of liquid soap into the bucket.**

**Water User Card** **Group 7 – toilet tissue**

Carl, the Wilkins' middle child, had a cold all week. He was tired of watery eyes and a constantly runny nose. Carl stepped into the bathroom, pulled off some toilet tissue, blew his nose, dropped the tissue into the toilet, and flushed.

**Add 2 cm of toilet tissue to the bucket.**

**Water User Card** **Group 8 – soil**

Back in the kitchen, Dad held his Nikes over the sink and scraped off the dried mud that had caked all over them the night before. Once he removed all the mud, he cleaned the sink by turning on the faucet. The sink was spotless again!

**Add 5 g of soil to the bucket.**

**Water User Card** **Group 9 – plastic straws**

Charlie was still playing in the bathroom. He loved watching the water whirl around and listening to the water gurgle down the hole when he flushed the toilet. He found some pieces of plastic in the wastepaper basket and giggled as he dropped them into the swirling water. Boy was this fun!

**Add 10 2cm pieces of plastic straw to the bucket.**

**Water User Card** **Group 10 – yeast**

Deep underground the wastewater pipes from the Wilkins house (along with all the hundreds of pipes in the neighborhood) moved the wastewater away from the house and toward the treatment plant. The water that had come into the house clear and clean was now filled with many different substances. Now the water was full of billions of living organisms. The bacteria, viruses, and other microscopic organisms love their new home.

**Add 10 g of yeast to the bucket.**

## Assessment

- Have each group explain a way to prevent or reduce their type of pollution in our wastewater.
- Make sure the students explain the measurement method and the metric instrument their group used. Ask why they used that instrument. For example: We measured the 150ml of vinegar with the 1000-ml beaker because this liquid measurement would have been more difficult with the smaller 100-ml graduated cylinder.
- Ask students to explain what wastewater is and who produces it. Must we have wastewater in our society? (yes) Should we try to produce less wastewater with fewer pollutants? (yes)

## Notes

# Business And Domestic Use Pie Chart

## Overview

In this lesson students learn to read a pie chart and make decisions using the information from the pie chart.

## Teacher Notes

Fourth grade students have limited experience with pie charts. This simple example gives students a chance to look at the parts of a pie chart and interpret its information. Fourth graders may not have worked with percentages, but they can identify which parts of the pie chart are larger or smaller. They can also learn that the slices of the pie chart will total 100.

## Teaching Points

- Pie charts have a title and key that are necessary for interpretation.
- Pie chart information is in percentages of the whole.
- The majority of wastewater treated by HRSD comes from domestic use.

## Procedures

Lead a discussion of the pie chart using questions such as those listed below:

1. What does the pie chart show?
2. Does domestic use or business use create more wastewater? What are the percentages?
3. If you wanted to reduce the amount of wastewater, would you start with business or domestic users? Why?
4. What suggestions would you give to reduce the amount of wastewater created?

## Related Standards of Learning

| | |
|---|---|
| Science 4.1 | Process Skills |
| Math 4.20 | Collect Data |

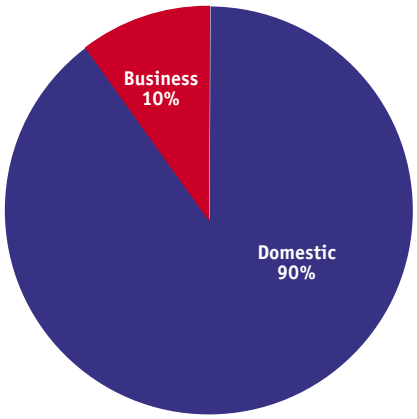
### VOCABULARY

Domestic

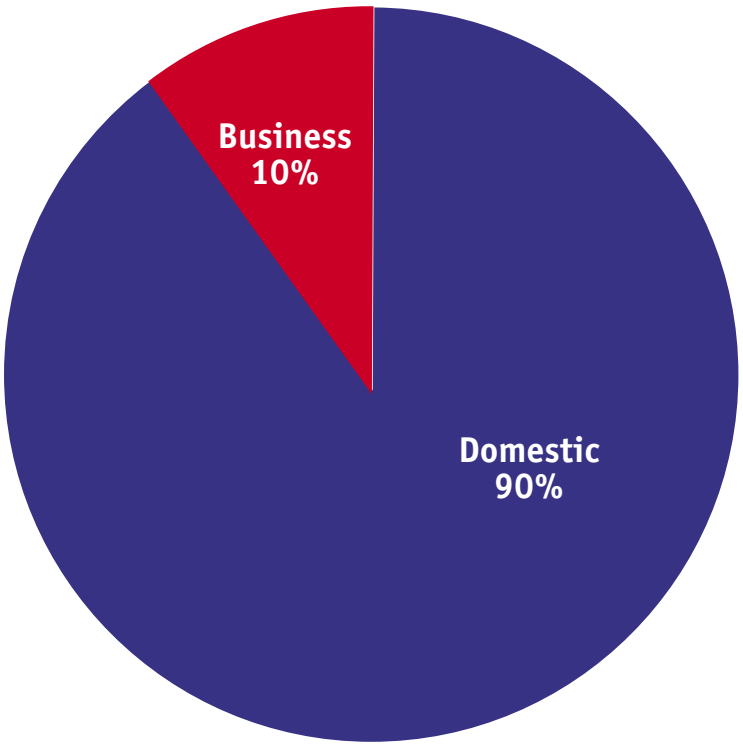
### MATERIALS

- ✔ Pie chart for each student or group of students
- ✔ Overhead transparency of pie chart

**Sources of Wastewater Sent To HRSD**

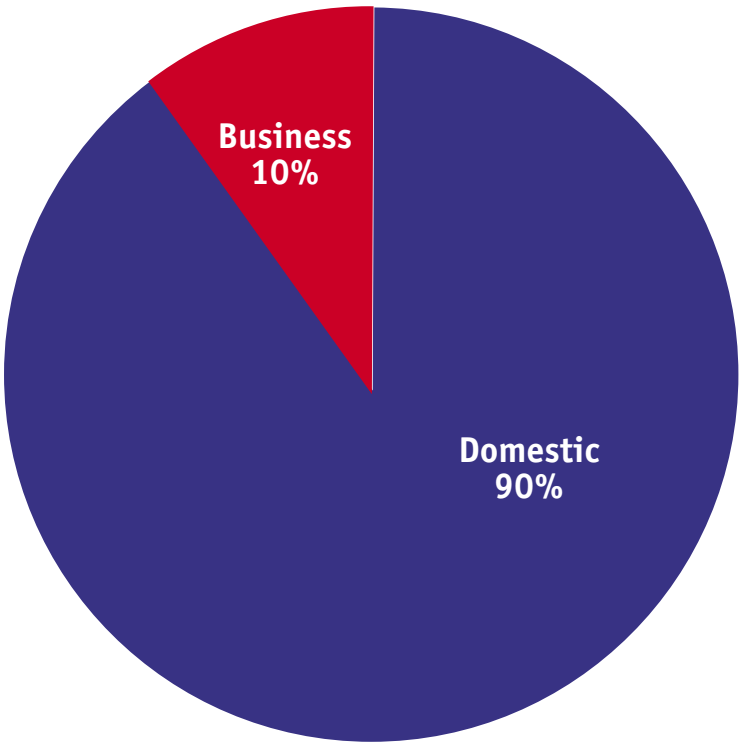


# Sources of Wastewater Sent To HRSD




*Lesson 4 – Business And Domestic Use Pie Chart*

# Sources of Wastewater Sent To HRSD




*Lesson 4 – Business And Domestic Use Pie Chart*

## Assessment

- While reading the pie chart, you will want to informally check that students can answer questions using the information from the chart. You may want to have the students write questions for each other.
- You may also want to have students record their suggestions to decrease the amount of wastewater created. These records can be the basis for a longer writing assignment, posters, or public service announcements.

## Notes

# How Much Is That?

## Overview

To visualize the concept of extremely small numbers.

## Teacher Notes

Often in newspapers, television, or magazines we find references to parts per million (ppm), parts per billion (ppb), and even parts per trillion (ppt). This type of measurement is a difficult concept for all of us to imagine. Many people have the misconception that if water looks clear and clean then it is clean. This activity helps students understand the important concept of contamination levels and how a very small concentration of pollutants can affect a much greater amount of clean water.

## Teaching Points

This activity works best as a teacher demonstration. An excellent way to demonstrate this to the whole class is to use clear plastic or glass cups and perform the entire activity on the surface of the overhead projector. This allows the solutions to be seen on the AV screen by the whole class. Selecting students to add the drops tends to keep the class attentive.

## Related Standards of Learning

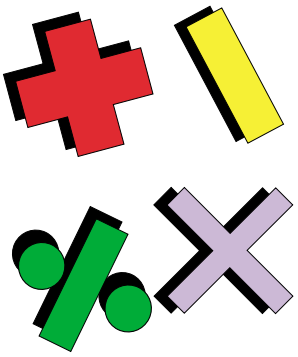
| | |
|---|---|
| Science 4.1 | Process Skills |
| Math 4.12 | Liquid Measurement |

## VOCABULARY

ppm
ppb
ppt
Contaminate
Solution
Concentration

## MATERIALS

- ✔ 1 bottle of food coloring (red, green, or blue show up best)
- ✔ 1 medicine dropper
- ✔ Six small clear plastic cups labeled A,B,C,D,E, and F



## Procedures

* For this age level emphasize the numbers and fraction less and focus on the concept that even if you dilute a solution, the contaminant is still present and even that low level of contamination can be dangerous to your health. Water that looks clear is not always safe to drink or be released into our waterways.

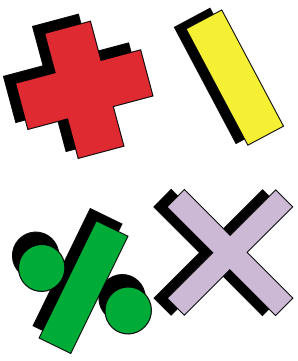
1. Put one drop of food coloring into plastic cup A.
2. Add 9 drops of water to cup A and stir. The food coloring solution began as a 1/10 concentration, and now you have changed the solution to a concentration of 1/100.
3. Use the medicine dropper to transfer 1 drop of the solution in cup A to clean cup B. Add 9 drops of water to form a new solution. The concentration is now 1/1000.
4. Continue to dilute 1 drop of each solution by adding 9 drops of water to obtain cup C (1/10,000), cup D (1/100,000), and cup F (1,000,000).
5. Your final solution in cup F is one part per million: 1/1,000,000 or 1ppm.

## Assessment

- In which cup do you first observe no visible evidence of food coloring? (It is present in all cups to some degree but usually is the least visible in cup F, where the food coloring is 1ppm.)
- Since you can't see any color present in cup F, how do you know it is present? (You observed the food coloring being put in the solution at the beginning in cup A.)
- Can you think of an experiment that you could perform to prove there is food coloring present in each cup? (One possibility is to place a drop of each cup's solution into a petri dish and allow the water to evaporate. The food coloring will be left behind and can be observed easily when the petri dish is held against white paper.)

*Before beginning the activity, ask the children the following:

1. What is the largest number of things you can clearly visualize? (Most of us can clearly visualize 5, 10, or 20 items.)
2. Can you visualize a group of 100 people? (Many people think they can by describing a party or a room full of people. If you try to visualize a group of 80 or 120 differently from 100, it soon becomes apparent that our visualization is not that clear. A large professional football stadium filled to capacity represents about 100,000. Trying to pick out one individual in that crowd would be finding 1 in 100,000.)
3. Food coloring from the store is usually a 10% solution. What does 10% mean? (It means 10 parts {by weight} of solid food coloring is dissolved in 100 parts {by weight} of solution. For example, 10 grams of food coloring dissolved in 90 grams of water total 100 grams of 10% solution.)



# Why Do We Clean Wastewater?

# A Drop In The Bucket

## Overview

Students may know Earth is covered mainly by water, but they may not realize that only a small amount is available for human consumption. Learning that water is a limited resource helps students appreciate the need to use water resources wisely.

## Teacher Notes

Ironically, on a planet extensively covered by water (71 percent), this resource is one of the main limiting factors for life on Earth. On a global scale, only a small percentage of water is available. Water may appear plentiful, but for many it is a scarce commodity. This scarcity is due to geography, climate, and weather, which affect water distribution. For example, Death Valley receives as little as 2 to 5 inches of rain per year, yet 100 miles away, mountain ranges receive more than 30 inches per year. Agriculture, industry, and domestic use also affect availability.

## Teaching Points

- Tell students they will estimate how much water on Earth is available for humans to use.
- Give each group two 1000-ml beakers (one filled with water and the other empty).
- Tell the students to imagine that the 1000-ml beaker of water represents all the water on Earth. In the second beaker, they are to put the amount of water that represents water available for human use.
- When all groups are finished, let each group quickly show its prediction.
- Tell the students you are about to show them the answer to the question.

## Related Standards of Learning

| | |
|---|---|
| Science 4.1 | Process Skills |
| Science 4.5 | Living Systems |
| Math 4.12 | Measurement |
| English 4.1 | Group Discussion |
| English 4.2 | Oral Presentation |

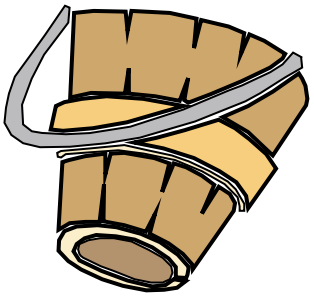
## VOCABULARY

Resources
Glaciers
Ice caps

## MATERIALS

(Per Group)

- ✔ 1000-ml beaker
- ✔ 100-ml graduated cylinder
- ✔ 10-ml graduated cylinder
- ✔ Dropper
- ✔ Water
- ✔ Empty ice tray
- ✔ Salt
- ✔ Globe
- ✔ Cup of soil



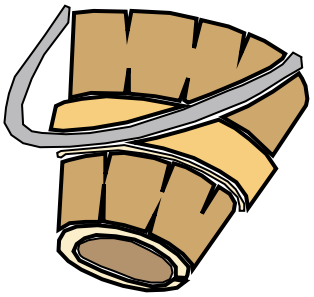
## Procedures

This procedure works best as a teacher demonstration.

1. Pour about 970ml of tap water into the 1000ml beaker. This represents all the water on Earth.
2. Pour 30ml of the water out of the beaker into the 100ml graduated cylinder. This 30ml of water represents the available fresh water on Earth.
3. Put salt in the water remaining in the 1000ml beaker; this simulates the water found in the oceans that is unsuitable for consumption. Ask students what is at the Earth's poles. Almost 80% of the fresh water on Earth is frozen in ice caps and glaciers.
4. Pour 6ml of the water in the 100ml graduated cylinder into the 10 ml graduated cylinder. Pour the rest of the large cylinder water into an ice tray.
5. The 6ml of water represents the nonfrozen fresh water. Take one dropper full of water out of the small cylinder and pour the other water into the cup of soil. The water in the cup of soil represents all the water underground (groundwater). The one drop of water left in the dropper represents the water available as clean, fresh water that we can use.
6. Discuss how important it is to manage this water resource properly.

## Assessment

- Students can convert percentages into a pie chart.
- Ask each group to write one sentence that summarizes the exercise they saw today.



# It's A Never-Ending Cycle

## Overview

In this activity students are able to see the "big picture" of the cycle: nature's source of water → water treatment → homes and businesses → wastewater treatment → nature's source of water

## Teacher Notes

The amount of water on Earth has always remained basically the same. The water used today is the same water that dinosaurs drank and bathed in millions of years ago! Water is constantly moving through the water cycle, and in this natural cycle, the water is cleaned. This cleaning occurs as water is evaporated, leaving behind solids as water percolates through layers of soil, sand, and rock and as water passes through wetland areas such as marshes. Thousands of years ago this filtration process could keep waterways clean and provide clean water for all life on Earth. With the booming human population and their ever-increasing water needs, it became necessary to take this natural cleaning process and speed it up. The accelerated processes of the municipal drinking water treatment and wastewater treatment systems simulate natural processes.

## Teaching Points

- Students will see a demonstration of how contaminants are removed during the water cycle.
- You will need copies of the Water Cycle Observation Sheet.

## Related Standards of Learning

| | |
|---|---|
| Science 4.1 | Process Skills |
| Science 4.5 | Living Systems |
| Math 4.12 | Measurement |
| English 4.1 | Group Discussion |
| English 4.2 | Oral Presentation |

## VOCABULARY

Cycle
Wastewater
Evaporation
Dissolve

## MATERIALS

- ✔ Clear plastic cup
- ✔ Salt
- ✔ Water
- ✔ Graduated cylinder (10ml)
- ✔ Spoon

## Procedures

Divide the class into small groups.

1. Have each group pour 10ml of water into a plastic cup.
2. Have each group add about 2ml of salt to the water and stir until the salt is completely dissolved.
3. Ask the class how they could remove the salt back from the water.
4. Allow time for students to discuss different options within the group.
5. Give each group a turn to explain the procedure it would use.
6. If no group comes up with the answer, give them the clue of "evaporation."
7. Tell the students to put the cups on the counter in direct sunlight.
8. Leave the cups, undisturbed, for at least 5 days. Students can make informal observations daily.
9. Within a day or two, the water will completely evaporate, leaving behind all the salt. The salt will appear as a white film at the bottom of the cup.

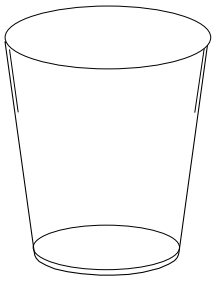
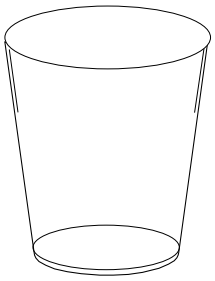
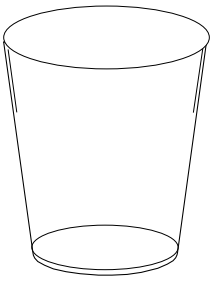
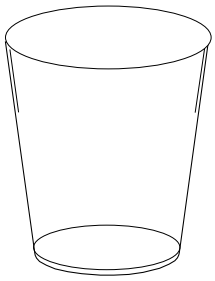
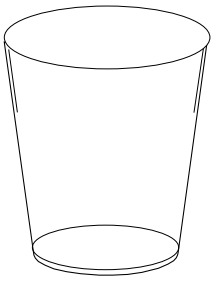
## Assessment

- Ask the students to explain what happened to the water.
- Have the students explain how this exercise shows how the water cycle helps clean the water on Earth.
- Ask the students if the water evaporated from the oceans is salty. (No, because the salts are left behind in the evaporation process.)

## Notes

# Water Cycle Observation Sheet

Each day make an observation of the water cycle cup.
Draw what you see happening in the cups and write a brief description of what you observe each day.

| | DAY 1 | DAY 2 | DAY 3 | DAY 4 | DAY 5 |
|---|---|---|---|---|---|
| VISUAL OBSERVATION |  |  |  |  |  |
| WRITTEN DESCRIPTION | | | | | |



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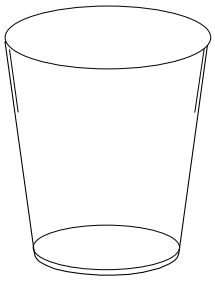
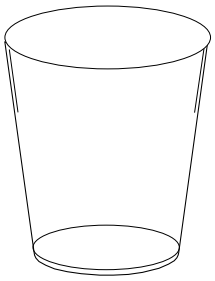
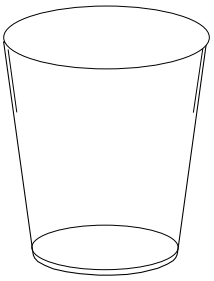
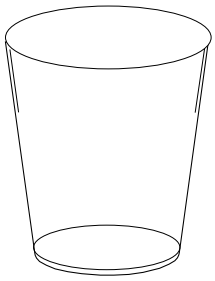
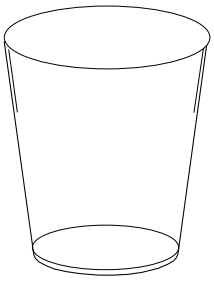
| VISUAL OBSERVATION |  |  |  |  |  |
| WRITTEN DESCRIPTION | | | | | |

# Down-The-Drain Dilemmas

## Overview

Student groups are each given a Down-the-Drain Dilemma card. After reading the card, the groups discuss the wastewater problem presented and decide on a solution to the problem.

## Teacher Notes

Xerox and laminate the Dilemma cards for durability. If each group is to be given more than one card, copy and laminate several sets of the cards.

## Teaching Points

Begin this activity by defining the word "dilemma" as a problem requiring a person to choose from two or more alternatives, each of which can produce desirable or undesirable effects. Managing water resources often creates dilemmas as it involves conflicts between what one is used to doing (or wants to do) versus what one believes should be done. Give the following dilemma as an example:

> *Laura has a dilemma. She knows that all the water that flows down the drains in her house goes to the wastewater treatment plant and that using water unwisely wastes this valuable resource and money. Her grandmother lives with her family and does all the laundry. Laura has noticed that granny only fills the washing machine half full and then washes on the full-load cycle. When she asked granny why she did this, granny told her she liked the clothes to have plenty of water around them. What is the problem with granny's washing habits and what can granny do to create less wastewater?*

## Related Standards of Learning

| | |
|---|---|
| Science 4.1 | Process Skills |
| Science 4.5 | Living Systems |
| English 4.1 | Group Discussion |
| English 4.2 | Oral Presentation |

### VOCABULARY

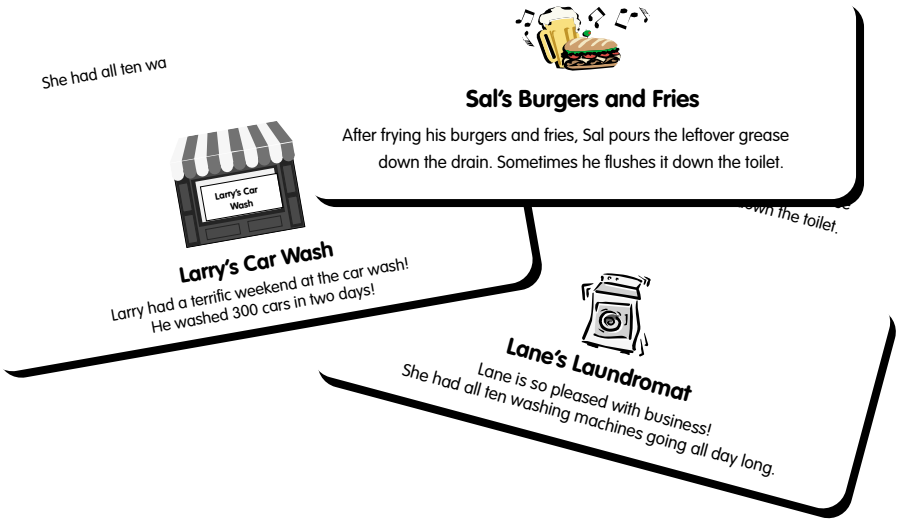
Dilemma

### MATERIALS

- ✔ Dilemma cards
- ✔ Response sheets

## Procedures

1. Review the information given in "Teaching Points" with the class.
2. Divide the class into groups of three students. Designate one student in each group as reader, one as recorder, and one as reporter.
   - Readers hold the card and read the dilemma to the group and again to the class when presenting.
   - Recorders write the team's response on the sheet.
   - Reporters explain (or read) the group's answer to the dilemma to the class.
3. Give each group a Dilemma card and a response sheet. Allow a few minutes for discussion within the group.
4. When all groups have finished, allow one group at a time to read and discuss the dilemma it was given.



## Assessment

- Circulate among the groups to guide their discussion, when necessary.
- As each group presents its dilemma and solution, check to make sure the students have identified the correct problem on each card and have given an appropriate solution.
- During the classroom discussion for each dilemma, ask other students to comment on the decision made by each group.
- Instead of reading and discussing only one dilemma, give each group several (or all) dilemma cards and additional response sheets to record and discuss more than one dilemma. The groups can then compare their responses to each card with the other groups.
- Ask the class if it can generalize the answers given into main areas describing the best practices for using wastewater. These main areas might be:
  - Businesses that use a great deal of water can recycle water.
  - Do not put anything down a drain that is not supposed to be there.
  - Turn the water off when you are not using it.

  Student groups can decide under which heading each dilemma would fit.

## Notes

## Sal's Burgers and Fries

After frying his burgers and fries, Sal pours the leftover grease down the drain. Sometimes he flushes it down the toilet.

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## Lane's Laundromat

Lane is so pleased with business!
She had all ten washing machines going all day long.

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## Larry's Car Wash

Larry had a terrific weekend at the car wash!
He washed 300 cars in two days!

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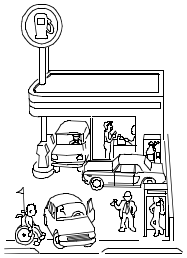
## 323 Newsome Ave.

Mrs. Lawson needed to throw away an old can of paint thinner that she found in her basement. She was afraid to put it in her garbage can because it is flammable, and she knew it would kill her grass if she poured it outside. Luckily she had a sink down in her basement so she poured it down the drain.



## Gina's Garage

Gina changed the oil in seven cars today. Her container for recycling oil was full so she had to pour the old oil from the last two cars down the drain in the garage floor.

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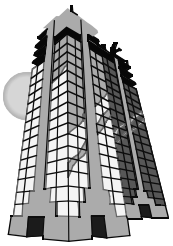

## Starlight Apartment Building

**Apartment 5A**

Loletta has flushed her toilet 14 times today! She has a bad cold and flushes the tissues she uses down the toilet so the germs aren't in her trash can.

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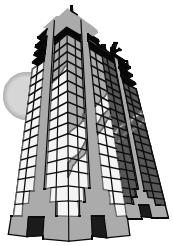

## Starlight Apartment Building

**Apartment 3G**

Mason finally cleaned out his kitchen cabinets. He dumped some old vegetable oil, and old bottle of floor cleaner, and a jar of pickles into the garbage disposal and away it went!

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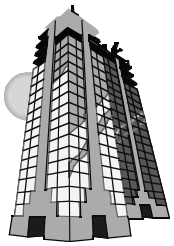
## Starlight Apartment Building

**Apartment 24C**

The Roberts family just got back from Grandma's house. She sent three jars of pickled cabbage home with them! They all hate pickled cabbage so Mrs. Roberts put all three jarsful down the garbage disposal. Goodbye stinky cabbage!



## Starlight Apartment Building

**Apartment 6D**

Every morning Marcus turns the hot water on in the shower, closes the bathroom door, and waits a few minutes sow the shower water and bathrooom will be toasty warm.

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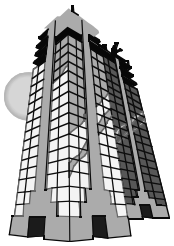

## Starlight Apartment Building

**Apartment 12B**

Mr. Klink is very proud that he brushes his teeth four times a day.
He likes to run the water the whole time he brushes so that he can rinse his toothbrush.

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# DOWN-THE-DRAIN DILEMMA RESPONSE SHEET

After reading the card, record the wastewater problem you found and the solution to the problem on the response sheet.

GROUP MEMBERS _____

| Dilemma | Dilemma Solution |
|---|---|
| | |



# DOWN-THE-DRAIN DILEMMA RESPONSE SHEET

After reading the card, record the wastewater problem you found and the solution to the problem on the response sheet.

GROUP MEMBERS _____

| Dilemma | Dilemma Solution |
|---|---|
| | |

# How Do We Clean Wastewater?

# How Is Wastewater Treated?

## Overview

Students use a flow map of the wastewater treatment process to learn how HRSD cleans water. Students match a description to each step so they can visualize the process.

## Teacher Notes

Wastewater treatment has three levels of treatment that involve physical, biological, and chemical processes. At the first level of treatment, solids and floating materials are physically removed by screens and skimming. At the secondary level, microorganisms that digest remaining solids are added to the water. Later, disinfection further kills harmful organisms or removes harmful substances.

## Teaching Points

- Wastewater treatment is a sequence of processes.

## Procedures

Have students work in pairs.

1. Give each student the wastewater treatment process flow map and the description squares.
2. Have the students cut apart the description squares. (Students should initial the back of the squares to make sure they keep a complete set.)
3. Through discussion, the students should match the descriptions to the flow map steps. If it seems that students are having difficulty, lead a class discussion so that each pair has a better sense of how to look for clues to match.

## Assessment

- Check to see that all students have correctly matched flow map and description squares.
- Students can also use the squares as a match game or to play Concentration once they have correctly identified the matches.

## Related Standards of Learning

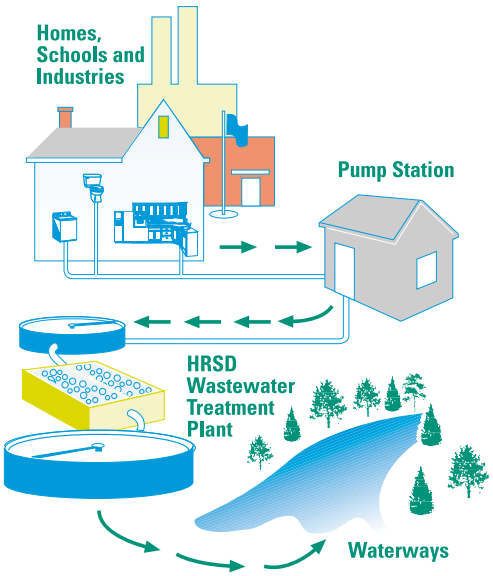
| | |
|---|---|
| Science 4.1 | Process Skills |
| English 4.5 | Comprehension of Nonfiction |

## VOCABULARY

Grit
Aeration
Scum
Micro-organisms
Dissolved

## MATERIALS

- ✔ Flow map for each student
- ✔ Description of steps for each student
- ✔ Overhead transparency of flow map and descriptions



| | |
|---|---|
| As wastewater enters into the wastewater treatment plant it is called influent.<br><br>INFLUENT | Visualize Packman gobbling up dots and you will have an idea of what happens in this step. |
| If you picture pouring wastewater through a filter or colander, you will understand this step. | Even organisms that we cannot see with our eyes produce waste. This waste sinks and can also be removed. |
| If the movement of the wastewater slows down a little, gravity will cause bits of solids to sink so that they can be removed. | Even water that looks clear may not be healthy. Sometimes chemicals can help destroy unhealthy substances. |
| Have you ever blown into a drink with a straw? In this step air bubbles into the wastewater to push out other gases that do not smell so good. | As wastewater leaves the wastewater treatment plant it is called effluent.<br><br>EFFLUENT |
| The wastewater flow slows, giving solids time to settle. Some substances such as oil or grease float to the top so they are easy to remove. | |

## PRIMARY TREATMENT

- Wastewater enters the treatment plant
- Wastewater flows through screens that catch solids
- Wastewater flow slows so that grit settles
- Wastewater undergoes pre-aeration to remove some odors
- Wastewater goes to tanks where solids sink and scum floats

## SECONDARY TREATMENT

- Micro-organisms consume dissolved solids still in wastewater
- Solids and microorganisms settle out for removal

## TERTIARY TREATMENT

- Additional physical, chemical, or biological processes can be used to further clean wastewater
- Clear wastewater leaves the treatment plant

# Can You Design A Wastewater Treatment System?

## Overview

In this activity students will have an opportunity to design a simple wastewater treatment system using pipes, screens, and buckets.

## Teacher Notes

The first stage of wastewater treatment is physical removal of solids. This stage relies on screens and the effects of gravity. Without gravity, solids would not settle out of the wastewater. These aspects of wastewater treatment will become clearer to students after they have a chance to work with simple systems that they create themselves.

## Teaching Points

- The first stage of wastewater treatment is physical removal of solids.
- Primary treatment uses screens and settling to remove solids.
- Primary treatment speeds up the natural cleaning that occurs as water travels through soil or natural features such as wetlands.

## Related Standards of Learning

| | |
|---|---|
| Science 4.1 | Process Skills |
| English 4.7 | Writing |

## VOCABULARY

Screen
Gravity

## MATERIALS

- ✔ Plastic pipes
- ✔ Tape
- ✔ Buckets
- ✔ Water
- ✔ Plastic filters, colanders, screen
- ✔ Water
- ✔ Sand, gravel, rocks, tissue
- ✔ Pencils, paper
- ✔ Jars

## Procedures

1. This is an outside activity, although some of the planning could be done inside. Students should work in teams and have plenty of time to examine their materials and plan their design. They should produce a sketch or written plan before they try to clean any water. Help the students understand that their system must have higher and lower points so that the water will flow.
2. Give students pipes, screens, and collection buckets. When their wastewater treatment system is ready, give them a bucket of water that has sand, gravel, and tissues mixed in it. Make sure that the students stir the bucket well and save some of the water for a final comparison with water they have "treated."
3. Have students pour dirty water into their system and collect clean water at its end.

## Assessment

- Check that students have a sketch or written plan before letting them build a model.
- Have students collect water in a jar at the end of their "treatment." Have the students compare the clarity of this sample against the dirty water they started with to see if the water is noticeably clearer.
- Have the students write about the experience, focusing on what they attempted to do and why they were successful or not. Student photographs or video make an excellent addition to the activity.

*Adapted from a lesson from the Texas Natural Resource Conservation Commission*

## Notes

# How Do You Wash Water?

## Overview

Generally when we have something that needs to be cleaned, our first thought is to use water. What if the substance you want to clean is water? In this activity, students develop strategies to remove contaminants from wastewater.

## Teacher Notes

- Have the cleaning materials on a table at the front of the room under your supervision and control.
- Dispose of the wastewater by first straining all solids out of the water and throwing the solids in the trash. The liquid wastewater can be poured on the ground away from streams and other water sources.
- Only the teacher is allowed to handle the bleach. Allow students to bring their wastewater samples up to have the bleach added by the teacher.
- You will need copies of the Cleaning Procedures Sheet and the Washing Water Data Sheet.

## Related Standards of Learning

| | |
|---|---|
| Science 4.1 | Process Skills |
| Math 4.12 | Liquid Measurement |
| Math 4.20 | Collect Data |

### VOCABULARY

Wastewater

### MATERIALS

*Per Group*

- ✔ Wastewater (Use the wastewater created in the activity Just Throw It Away! or use the wastewater materials listed on the next page to make a bucket of wastewater.)
- ✔ Safety goggles
- ✔ One gallon-sized (3.8 l) container
- ✔ Plastic cups or bowls
- ✔ Paper towels

*Possible water cleaning materials*

- ✔ Screens to use as filters
- ✔ Coffee filters
- ✔ Alum (available at grocery stores in the baking section) – see safety alert in this section
- ✔ Straws or pipettes
- ✔ Spoons
- ✔ Baking soda
- ✔ Charcoal (aquarium type)
- ✔ Rocks, pebbles, and sand

*continued on next page*

## Teaching Points

- Modern wastewater treatment plants use a process similar to nature's cleaning. As water moves through the water cycle, it is cleaned in many different ways. For example, when water flows from a river into a lake the contaminants in the water tend to settle to the bottom of the calm lake water. This action is called settling. As water percolates through soil, the soil acts as a natural filter, removing substances from the water. During evaporation, water is purified when the water molecules leave the liquid water, leaving other materials behind. This action is called distillation.
- As human populations grew, the demand for clean water exceeded the rate at which it could be naturally purified. This is when wastewater treatment plants became necessary. The addition of more complex materials has required more complex treatment processes.
- The simplest form of wastewater treatment (primary treatment) involves filtration and settling. In addition, waste materials that float are skimmed from the top. About 40 to 50 percent of the pollutants are removed utilizing primary treatment. Most developed countries have a secondary process of wastewater treatment.
- Secondary treatment, mainly a biological process, removes 85 to 90 percent of the remaining pollutants. In secondary treatment, helpful micro-organisms consume most of the waste material in aeration tanks. Solids and microorganisms are separated from the wastewater in secondary settling tanks.
- Adding a disinfectant (such as chlorine) kills any remaining disease-causing organisms. The water leaves the treatment plant to be released into nearby waterways.
- Because some pollutants are extremely difficult to remove from wastewater, the best solution is to avoid putting them in water in the first place!

## MATERIALS

*continued*

Possible testing materials

- ✔ pH paper
- ✔ Brown paper bag

*Making wastewater*

- ✔ Half fill a bucket with clean water.
- ✔ Add soil, coffee grounds, vegetable oil, soap, vinegar, yeast, sugar, and food scraps (fruit peels are best). Stir well.

## Safety Alert

Make sure that the alum to be used in this activity is PURE ALUM. Some alum may be ammoniated. Mixing ammonia with bleach creates harmful fumes.

## Procedures

1. Ask the class to explain the water cycle. Within the water cycle, when do students think water can be cleaned naturally? Discuss filtering, settling, and distillation processes. Why must we treat wastewater instead of leaving it to nature?
2. When making wastewater, mix it in front of the class. Ask the students to list the contaminants that were added.
3. Tell students their mission is to try to clean this water.
4. Show the students the materials that can be used and instruct the students on necessary safety procedures.
   - No more than 1/2 teaspoon (2ml) of bleach, alum, or baking soda can be used.
   - Always wear your safety goggles.
   - Never taste the water.
   - Wash your hands after the activity.
5. Give each group about 1/2 gallon (1.9l) of the wastewater.
6. Ask the students to examine the water and record their observations on their Washing Water Data Sheet.
7. After all groups are finished with their observations, have students share some of their observations with the class.
8. Have the students write down the procedures that they plan to use to clean the water. Encourage the students to use a series of steps to allow each step to be evaluated for its effectiveness. Check each plan before the group proceeds.
9. Each group must list on their data sheet the materials needed to carry out the plan. One student from each group can go to the materials table to collect the materials they need from the teacher.
10. After they have attempted to clean their water, have the groups evaluate their results.

## Assessment

- Have the students compare their process with the process of a real wastewater treatment plant and nature's method of cleaning water.
- Discuss "Does clear water = clean water?"
- Have students list five ways to prevent contamination.

# Cleaning Procedures

| Purpose | Steps | Results |
|---|---|---|
| What in the water do you want to clean? | How do you plan to clean it? | How well did it work? |
| | | |
| | | |
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# Cleaning Procedures

| Purpose | Steps | Results |
|---|---|---|
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| | | |
| | | |
| | | |
| | | |
| | | |

# Washing Water Data Sheet

| OBSERVATION | DESCRIPTION |
|---|---|
| Sight | |
| Smell | |
| pH | |
| Color | |
| Presence of oil* | |

**Put a drop of water on brown paper and see if an oil smear forms when dry.*



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*Lesson 11 – How Do You Wash Water?*

# What Is Your Role?

# Be A Leak Detective

## Overview

In this activity, students check their homes for leaking toilets and faucets by using very simple tests. If the students find leaks, they can then determine approximately how many gallons of water are wasted each day.

## Related Standards of Learning

| | |
|---|---|
| Science 4.1 | Process Skills |
| Math 4.2 | Liquid Measurement |

## Teacher Notes

The children in our classrooms today have been raised on a steady diet of everything's wrong with the world syndrome. Television, magazines, and even our textbooks tend to paint a pretty bleak picture of our global environmental situation. Many children become jaded to the whole environmental issue after years of being bombarded with all the problems we have with endangered species, pollution, and the population explosion. As teachers, our job is to show them the problems that exist, yet also show them how much progress has been made and how they can impact the Earth in small but important ways. None of us can be perfect ecological stewards, but if we all make just a few simple changes, we can improve our environment. Empowering students is one of the most important environmental differences we can make.
BE POSITIVE – KIDS CAN CHANGE THE WORLD!

## MATERIALS

- ✔ Color tablets
- ✔ 1 Paper or plastic cup per student (small bathroom cups work best)
- ✔ Graduated cylinders/ measuring cups
- ✔ Water
- ✔ Permanent markers
- ✔ Leak Detective assignment sheets

## Teaching Points

- Explain that the tablet you will give them are very much like the dye tablets they may have used to dye Easter eggs.
- They should keep their dye tablet in the Ziplock bag provided until time to use it. Tablets should not be put in their mouths.
- Drop a tablet into a container of water to demonstrate how the tablet will dissolve and color the water.
- The Leak Detector assignment sheets can be laminated and used year after year.

## Procedures

1. Tell the students they are going to have a fun homework assignment as a water leak detective.
2. Pass out the Leak Detective assignment sheet and go over the information and directions on the sheet with the children.
3. Have the children make a simple leak-measuring device. Using a graduated cylinder or measuring cup, measure 1 ounce (25ml) of water and pour it into the plastic/paper cup. Looking from the side have the students mark the 2 ounce (50ml) level on the cup.
4. Repeat this procedure to mark the 3 ounce (75ml) and 4 ounce (100ml level).
5. Send the materials home for homework.

**Film canisters are often available free if you ask at any film-processing store.*

## Assessment

- Have students share their findings with the class.
- Take one example and do the math together as a class. Use a calculator!
- Share some of the water trivia facts with the class.
- Have the students do a think/pair/share describing why it is important to stop leaks at home.

## Water Trivia Facts

- ✔ The water we flush down the toilet starts out as fresh drinking water.
- ✔ Even a tiny leak can waste a lot of water. A leak that can fill an average size coffee cup in 10 minutes will waste more than 3,000 gallons of water in a year.
- ✔ How much water is that? You'd have to drink 65 glasses of water every day for a year to get that much water.
- ✔ Twenty percent of all the toilets in American homes are leaking right now...and usually people do not even know it.
- ✔ In one year, a leaky toilet can waste more than 7,200 gallons of water. That's enough to take 3 baths every day!

# Be A Leak Detective

Tonight you have two assignments: check all your home toilets for leaks and check all your home faucets for leaks. By doing these checks, you can save your parents money on their water bill as well as reduce the amount of wastewater that must be cleaned. That's a win/win situation! Let's get started!

## TOILET TEST

- Get an adult to take the top off the toilet tank. Then drop one dye tablet in the tank.
- Wait about 15 minutes. Make sure no one uses the toilet while you wait.
- Check the toilet after 15 minutes. If colored water shows up in the bowl, you have found a leak! Share your findings with your parents.

## FAUCET TEST

- Put your leak detector under the faucet and measure how much water leaks from a faucet in one minute.
- Figure out how much water you would lose if the faucet dripped for one hour (60 minutes), one day (1,440 minutes), and one year (525,600 minutes).
- If you find a leak, share your findings with your parents.



# Be A Leak Detective

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- If you find a leak, share your findings with your parents.

*Lesson 12 – Be A Leak Detective*

# What's The Story?

## Wastewater Treatment In The News

## Overview

Stories about wastewater issues are common in the news. In this activity, the class will collect articles and then analyze the information in the articles.

## Teacher Notes

Articles on the topic of wastewater treatment are published frequently in newspapers and magazines. Students benefit from looking at both to get a local perspective and to see that wastewater treatment is an important service in all communities. Once they start looking, students may be surprised to find so many articles. If they start collecting articles at the beginning of the unit, they will have many examples at the end.

## Teaching Points

- Articles are often a combination of facts and opinions.
- Articles often identify issues that affect a community.
- Understanding the author's purpose helps the reader interpret an article.
- Good readers look for personal connections when they read.

## Related Standards of Learning

| | |
|---|---|
| Science 4.1 | Process Skills |
| Science 4.5 | Living Systems |
| Science 4.8 | Virginia Resources |
| English 4.5 | Comprehend Nonfiction |
| English 4.7 | Writing |

## VOCABULARY

Perspective
Fact
Opinion

## MATERIALS

- ✔ Newspaper and magazine clippings
- ✔ Bulletin board

## Procedures

1. Have students bring in articles from home about wastewater issues. Have newspapers and magazines available in class so students can search for articles. Discuss and put articles on a bulletin board so students have a better sense of what they are looking for, and can create a shared store of information.
2. Select or let students select an article for analysis. The analysis might include:
    - A brief summary of the article
    - Why the article was written (to highlight a success, to highlight a community concern, to raise an issue, etc.)
    - Examples of facts and opinions in the article
    - If an issue, whether the issue mostly affects individuals, neighborhoods, larger communities, regions, states, larger regions, the Earth
    - The nature of the issue
    - Who is responsible for a solution
    - How kids connect to the article and what role they can play

    Share and/or post the analyses on the bulletin board.

If desired, compile the analyses into a "wastewater news" fact sheet or newsletter.

## Assessment

- Assessment can take several directions depending on the types of articles selected.
- In all cases, students should write a summary, not a retelling of the article.
- Other areas for assessment include whether the student could identify facts and opinions. If the article identified an issue, did a the student correctly determine whom the issue would affect, and who would be responsible for a solution?
- Especially if the analysis is near the end of the unit, there is an expectation that the student can identify a personal connection to the article and identify a way for kids to play a role.

## Notes

# Friendly Products

## What do you put down the drain?

## Overview

In this activity students will use a common nontoxic cleaning solution to shine pennies. They will then research and compile a list of other nontoxic cleaning products to share in brochures or posters.

## Teacher Notes

Many of the products that we commonly use for cleaning our homes can be harmful to the environment. It makes sense to use nontoxic products when they are available. Consumers need to know some of these alternatives and how to use them. In this activity students shine pennies with vinegar and salt. This process can be a springboard to learning about other common cleaning alternatives.

## Teaching points

- Many cleaning products are potentially dangerous for the environment.
- Common alternative products are available.
- Often consumers are not aware of the alternative products.

## Related Standards of Learning

| | |
|---|---|
| Science 4.1 | Process Skills |
| Science 4.5 | Living Systems |
| Math 4.12 | Liquid Measurement |
| English 4.6 | Research |
| English 4.7 | Writing |

## VOCABULARY

Toxic
Nontoxic
Prediction
Observation

## MATERIALS

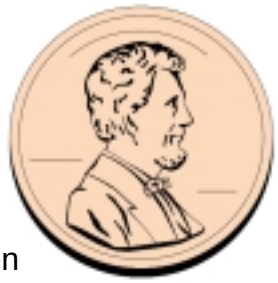
- ✔ Tarnished pennies
- ✔ Vinegar
- ✔ Salt
- ✔ Graduated cylinder
- ✔ Small cups

# Procedures

## PENNY CLEANING

Have students work in pairs or small groups.

1. Give each group a graduated cylinder and a small cup.
2. Have students predict what will happen when they add the salt to the vinegar.
3. Have students measure 1ml of salt into the cup. Have students measure and add 10ml of vinegar. Students should record their observations and reflect on their predictions.



4. Have students predict what will happen when they add a penny to the cup. Put a penny into the cup and record observations each minute for 3 minutes. Reflect on predictions.
5. Help students make the connection between cleaning the pennies and cleaning similar surfaces in their homes.

## RESEARCH

Have students research other simple alternative cleaning products. Some of the products they might choose include vinegar, baking soda, lemon juice, and salt. The students might research uses of the product, directions for using the product, and benefits to the environment. For comparison, the teacher may also want to bring in some harsher products so students can read the labels and note any warnings on the labels. It is important that the students do not open or use these products.

Have students design a brochure or poster to summarize their learning about simple, effective cleaning products. Their work should include benefits to the environment.

## Assessment

- If desired this is an easy time to check on students' ability to measure accurately with a graduated cylinder.
- Assess students' research skills – especially what sources of information they found and whether they answered the research questions.
- Assess the quality of the brochure or poster and whether its information is based on student research findings.

**Be Enviro-Smart from the start.**



Buy environmentally friendly products, rather than household hazardous products, when possible. "Green" products have minimal impact on the environment. The product label is your best source of information. Look for the signal words Caution, Warning, or Danger/Poison, which could indicate a toxic product (harmful upon contact, ingestion, or inhalation):

- Caution indicates the product is relatively nontoxic or slightly toxic.
- Warning means it is moderately toxic.
- Danger/Poison indicates it is highly toxic.

# Sources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"CLEAN WATER FOR TODAY: What is Wastewater Treatment?," Water Environment Federation, Alexandria, VA

Discover Wetlands, Publications Office, Washington State Department of Ecology, Mail Stop PV-ll, Olympia, WA 98504

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The Project WET Curriculum and Activity Guide, Project WET and the Western Regional Environmental Education Council, 201 Culbertson Hall, Montana State University, Bozeman, MT 59717

Wow! The Wonders of Wetland by Environmental Concerns, Inc., P.O. Box P, St. Michaels, MD 21663. The Watercourse, 201 Culbertson Hall, Montana State University, Bozeman, MT 59717

# Web Sites

Watershed Ecology Center, University of South Carolina, Spartanburg
http://www.uscupstate.edu/academics/arts_sciences/watershed/Default.apsx?id=1911

Fun Water Activities
http://www.shoalwater.nsw.gov.au/education/tapstar_home.htm

Drinking Water 101, A presentation on the EPA's Website (Operation of a Conventional Water Treatment Plant)
http://www.drinkingh2o.com/html/slides/d101-1.htm

Water Science of Schools
http://ga.usgs.gov/edu/msac.html

EPA Office of Water Kid's Stuff Page (Games, activities, health, Spanish)
http://www.epa.gov/ogwdw/kids/

Illinois American Water Company, H2O Learning Center Water Activities for Grades K-3
http://www.amwater.com/ilaw/Learning-Center

National Drinking Water Week (May)
http://www.awwa.org/Government/content.cfm?ItemNumber=3862&navItemNumber=3863

Learning to be Water Wise (Developed by National Energy Foundation, kits available on for purchase)
http://www.getwise.org/lounge.htm

Scholastic The Magic School Bus, Science Fun Activities
http://www.scholastic.com/magicschoolbus/games/teacher/index/htm

Educating Young People About Water
(Download files or purchase publications)
http://www.uwex.edu/erc/eypaw/

EPA Water Source Books (Downloadable info on water and wastewater including lesson plans for grades K-12)
http://www.epa.gov/safewater/kids/wsb/

Monroe County Water Authority (Kids water fun activities)
http://www.mcwa.com/kids.htm

Water Environment Federation (Lesson plans for grades K-12, lesson plans in Spanish)
http://www.wef.org/AboutWater/ForEducators/CurriculumMaterials

Wofford College, "The Nature and Culture of Water"
http://webs.wofford.edu/goldeyes/WaterWWW/Waterhome.html