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URBAN WATER CYCLE CURRICULUM
OVERVIEW

This curriculum is designed to support and extend the CD-ROM, The Urban Water Cycle interactive multimedia program. The activities in this curriculum and the modules on the CD ROM meet Minnesota science standards. The activities are designed to reinforce concepts introduced in the modules, giving students hands-on practice with these important ideas.

This curriculum has several goals. Students will:
• appreciate the importance of clean, safe drinking water.
• be able to identify the main parts of the urban water cycle.
• understand how the civilized water cycle fits into nature’s hydrologic cycle.
• be able to identify key wise-water-use strategies and ways of reducing non-point source pollution.
• understand the importance of the drinking water infrastructure, problems it faces, and solutions to these problems.

The curriculum is organized around a set of essential questions and concepts:
• Life as we know it would be impossible without clean, safe drinking water.
• The water that comes to us through the faucet is a “manufactured” product created and delivered in a process called the urban or “social,” water cycle.
• The urban water cycle is part of nature’s larger hydrologic cycle, in which the world’s freshwater supply is continually recycled.
• Our daily decisions to use water wisely and protect it from pollution are important to our health and the well-being of our environment.
• Maintaining the infrastructure supporting the urban water cycle is also important.

The curriculum also addresses the following benchmarks from the Benchmarks for Science Literacy, created by Project 2061, from the American Association for the Advancement of Science:
• Most things are made of parts.
• Something may not work if some of its parts are missing.
• When parts are put together, they can do things that they couldn’t do by themselves.
• In something that consists of many parts, the parts usually influence one another.
• Something may not work as well (or at all) if a part of it is missing, broken, worn out, mismatched, or misconnected.
• A system can include processes as well as things.
• Thinking about things as systems means looking for how every part relates to others. The output from one part of a system (which can include material,
energy, or information) can become the input to other parts. Such feedback can serve to control what goes on in the system as a whole.

• Any system is usually connected to other systems, both internally and externally. Thus a system may be thought of as containing subsystems and as being a subsystem of a larger system.

(From Benchmarks for Science Literacy, by the American Association for the Advancement of Science, Project 2061)

All of these concepts can be explored as you work with students on this curriculum.

Teachers can use these activities to organize a comprehensive thematic study unit on the Urban Water Cycle, or pick and choose a few activities to supplement other classroom lessons. The program can be used by individual students in a self directed way, directed by the teacher to the whole group, in small groups, or with individual students. The curriculum is flexible and adapts to a wide variety of needs and teaching styles. A pre/post test has been included for the teacher to gain an understanding of students’ prior knowledge and assess what they have learned through the use of the program.

Grade Levels

Activities in this curriculum are appropriate for students in grades 4-8. Some activities may need to be simplified for lower grades.

Standards

The Urban Water Cycle addresses the following Minnesota State Science Standards.

<table>
<thead>
<tr>
<th>I. HISTORY AND NATURE OF SCIENCE</th>
<th>A. Scientific World View</th>
<th>The student will understand how science is used to investigate interactions between people and the natural world.</th>
</tr>
</thead>
<tbody>
<tr>
<td>B. Scientific Inquiry</td>
<td>The student will participate in a controlled scientific investigation. The student will understand that scientific inquiry is used in systematic ways to investigate the natural world.</td>
<td></td>
</tr>
<tr>
<td>C. Scientific Enterprise</td>
<td>The student will recognize that science and technology involve different kinds of work and engages men and women of all backgrounds. The student will know that science and technology are human efforts that both influence and are influenced by society.</td>
<td></td>
</tr>
<tr>
<td>III EARTH AND SPACE SCIENCE</td>
<td>A. Earth Structure and Processes</td>
<td>The student will investigate the impact humans have on the environment.</td>
</tr>
<tr>
<td></td>
<td>B. The Water Cycle, Weather and Climate</td>
<td>The student will recognize that water on Earth cycles and exists in many forms.</td>
</tr>
</tbody>
</table>
EDUCATIONAL OBJECTIVES

Audience 1: students in grades 4-8 will:
1. appreciate the importance of clean, safe drinking water.
2. be able to identify the main parts of the “civilized” water cycle.
3. understand how the civilized water cycle fits into nature’s hydrologic cycle.
4. be able to identify key wise-water-use strategies and ways of reducing non-point source pollution.
5. understand the importance of the drinking water infrastructure, problems it faces, and solutions to these problems.

Audience 2: teachers will:
1. appreciate the importance of clean, safe drinking water.
2. use the module’s safe drinking water content to complement social studies and science curricula.
3. understand more about safe drinking water issues.

Audience 3: state legislators and the general public will:
1. consider and appreciate the importance of clean, safe drinking water.
2. be introduced to the main parts of the “civilized” water cycle.
3. understand how the civilized water cycle fits into nature’s hydrologic cycle.
4. be able to identify key wise-water-use strategies and ways of reducing non-point source pollution.
5. understand the importance of the drinking water infrastructure, problems it faces, and solutions to these problems.

Key Messages
1. Life as we know it would be impossible without clean, safe drinking water.
2. The water that comes to us through the faucet and goes away down the drain is a “manufactured” product created and delivered in a process called the "civilized," or "social," water cycle.
3. The civilized water cycle is part of nature’s larger hydrologic cycle, in which the world’s freshwater supply is continually recycled.
4. Our daily decisions to use water wisely and protect it from pollution are important to our health and the wellbeing of our environment.
5. Maintaining the infrastructure supporting the civilized water cycle is also important.
MODULE DESCRIPTIONS

1. Intro video: Dreaming a World Without Water

This 4-minute introductory video tells the story of three high school students preparing a multimedia presentation to be given at an elementary school. The night before the presentation, the students dream a world without water—and no life.

2. Urban Water Cycle Overview

This animated urban street grid has labeled links that illustrate the three integrated systems of the Urban Water Cycle: the Drinking Water infrastructure, the Waste Water infrastructure, and the Storm Water infrastructure.

3. Source Water: Rivers and Wells

This interactive element includes:
- A segment on the Water Cycle in nature
- A segment on groundwater
- Surface water and groundwater as a water source
- Introductions to point-source and non-point source pollution & their impacts on surface and groundwater
4. Water Conservation: Water Wisdom

This element shows how much water is used on average by American’s every day and ways of using water wisely around the home. After users have identified various residential water-conservation strategies, an interactive segment ranks different strategies according to their effectiveness.

5. Drinking Water: Water Treatment

This virtual tour of a water treatment facility follows the primary elements of the water treatment process:

- Water draw
- Disinfection
- Flocculation
- Leaves and grass-clippings
- Litter

6. Drinking Water: Pipe Game

This element introduces issues associated with the water infrastructure through a Pipe Game. Users, working against the clock, must drag and drop pipe elements to build new infrastructure in a part of town under development and replace leaking pipes in an older part of town.

7. Water Towers

This element introduces the functions of water towers and basic physics principles at work: gravity, reservoirs, water pressure, and pumps. It also identifies situations that can tax water tower reserves (fire fighting, “Super Bowl syndrome,” lawn watering, “shower syndrome,” “return from lake syndrome”). There is also a slideshow of weird and wonderful water towers of Minnesota.
8. Storm water: The Journey of a Raindrop

This element follows the journey of a raindrop from a house roof to a river, engaging users in cleaning up the following sources of non-point-source pollution around the urban residence:

<table>
<thead>
<tr>
<th>Sources</th>
<th>Sources</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pet waste</td>
<td>Litter</td>
</tr>
<tr>
<td>Oil and gas</td>
<td>Leaves &amp; grass clippings</td>
</tr>
<tr>
<td>Fertilizer &amp; pesticides</td>
<td></td>
</tr>
</tbody>
</table>

9. Wastewater Treatment

This element introduces the fundamental elements of the wastewater treatment process through a video and an exploratory interaction concerning the following topics:

<table>
<thead>
<tr>
<th>Topics</th>
<th>Topics</th>
<th>Topics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grit Chamber</td>
<td>Secondary Sedimentation</td>
<td></td>
</tr>
<tr>
<td>Disinfection</td>
<td>Solids treatment</td>
<td></td>
</tr>
<tr>
<td>Primary sedimentation</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
TECHNICAL SUPPORT: FREQUENTLY ASKED QUESTIONS

Q. How do I install and run the program?
A. If you are playing the program from a CD ROM, no installation is necessary. To play the program from the web your web browser will need the Flash 8 (or better) plug-in installed.

To run the program from disk, insert the CD ROM into your CD ROM drive. Windows users who have AutoRun active will find that the program launches automatically. If AutoRun isn't active, or you’re using a Macintosh computer, double-click the My Computer icon on your desktop and find the icon for the CD ROM. Double-click this icon and then double-click a file called "A-Start Windows.exe" or "A-Start Macintosh" among the files visible within the program window.

Q. What are the minimum system requirements for my computer?
A. A Windows computer running Vista or XP, 1 GHz processor, 500 MB available RAM or a Macintosh: 1 GHz G3, (or better) running System OS X, 500 MB available RAM.

Q. Can I run the program if my system requirements don't meet the recommended minimum?
A. The program may play on computers that don't meet the minimum system requirements, but it will probably perform poorly.

Q. How do I install the Flash browser plug-in if I'm accessing the program over the Web?
A. Go to the Adobe website for a free download of the latest Flash player: www.adobe.com.
PRE/POST TEST

Name: _________________________

Mark each statement as true or false.

1. ___ True or ___ False: A water tower holds approximately one day’s water supply for its neighborhood.

2. ___ True or ___ False: Wastewater is collected from homes and businesses through a series of pipes and pumping stations.

3. ___ True or ___ False: The average American uses over 190 gallons of water each day.

4. ___ True or ___ False: Water that drains into your storm sewer pipes goes to the wastewater treatment plant.

5. ___ True or ___ False: Gravity forces water to flow out of a water tower when a consumer opens a tap.

6. ___ True or ___ False: The largest amount of water consumed by Americans is used for industrial purposes (making products).

7. ___ True or ___ False: Water treatment systems are used to remove chlorine from the water.

8. ___ True or ___ False: Settling tanks provide primary treatment of wastewater.

9. ___ True or ___ False: The greater the vertical distance that water falls, the slower it flows.

10. ___ True or ___ False: Water towers are usually over 100 feet tall.

11. ___ True or ___ False: Cutting the grass in your lawn below 3 inches will save water.

12. ___ True or ___ False: Drinking water only comes from underground sources.

13. ___ True or ___ False: Water that runs off the roads, buildings, lawns, and parking lots goes to the nearest body of surface water.

14. ___ True or ___ False: Most fire hydrants stop working the moment a power outage occurs.
15. ___ True or ___ False: Natural products such as sand and gravel are used to filter our drinking water.

16. ___ True or ___ False: Microorganisms can help remove dissolved pollutants found in wastewater by using the pollutants as food.

17. ___ True or ___ False: The final treatment in most plants is not disinfection.

18. Make a list of five pollutants that could be in the water that ends up in a storm sewer.
   a. 
   b. 
   c. 
   d. 
   e. 

19. Tell me what you know about how water enters your household.

20. Tell me what you know about the treatment of wastewater leaving your home.
INTRO VIDEO: DREAMING A WORLD WITHOUT WATER

Background Information
What would the world be like without water?

This short video follows a group of high school students as they prepare for giving a presentation to a group of elementary school students about the world of water. They all have a dream the night before their presentation in which they experience a world without water. They awaken and give their presentation having all thought about the fact that virtually everything we take for granted essential to our lives—and life itself—wouldn’t be possible without water

Suggested Activity
The activity “Is There Water on Zork?” from Project Wet is an activity which could be used prior to watching the introduction video, or afterwards. This activity helps students to think about factors that make water drinkable.

Have students view the intro video.

Essential Questions
What would the world be like without water?
What does water mean to you?

Discussion Questions:
Have a discussion around the common experience of watching the video. Below you will find possible discussion questions.

• Were there any surprises?
• Name one thing for which water is not essential. For example what does an iPod have to do with water? Manufacturing of all products requires water. Food growing and processing requires water (think of beans).
• Where does the water come from, where does it go? Have students brainstorm their thoughts.
• Follow a drop of water from the faucet back to its source. How does it get back to the faucet. Where does drinking water come from?
• Where does storm water go?
• Where does wastewater go?
• Is there a difference between wastewater and storm water?
Urban Water Cycle Menu Overview

The driving point of the interactive series of menu screens that appear after the introductory video is viewed is to understand there are systems within the urban water cycle that students have never thought about. Drinking water goes through a process involving transportation, treatment, storage, and delivery. Our drinking water is a product often taken for granted. However it has a huge cost and requires a large infrastructure to create. Similar treatment processes make waste water that goes down our drains and toilets suitable for being returned to the environment.

The world’s limited supply of water perpetually moves through a process called the Water Cycle. Precipitation falls from the clouds as rain, snow, sleet, or hail and either is absorbed into the ground to become groundwater or flows across the landscape as surface water. Groundwater—underground deposits of water—replenish surface waters through springs. Small surface waterways join larger ones to become rivers that grow further still as they are carried downhill by gravity toward the sea.

Water evaporating from salt-water oceans, lakes, and rivers renews the moisture in the clouds. Water given up by trees, plants, and other living beings during a process called transpiration also renews the moisture in the clouds. Due to the water cycle, the water we drink today has been recycled for billions of years.

Though the world’s waters are cleansed by the water cycle, human water use has increased as the human population and our evolving technologies demand more and more fresh water. As a result, available clean, fresh water is increasingly scarce, and is likely to become a critical issue in the 21st century.

In the animations that play, by clicking the Drinking Water, Storm Water, and Waste Water links, you can see that there are three distinct systems of pipes beneath the streets that transport these three types of water.

Drinking water obtained from surface water requires more treatment than water from wells. Processes for treating water may differ in different communities.
Module 1: Source Water: Rivers and Wells

Essential question:
Do you know where water comes from in your community?

This section describes the difference between surface waters and underground waters (groundwater), and the processes by which the groundwater is recharged. It begins by identifying how these aspects of the Water Cycle work in nature, and then explores what happens when human activities begin to impact the natural cycle.

The following worksheet can be used by students as they go through this section of the program.
IN THIS ILLUSTRATION OF THE WATER CYCLE, YOUR JOB IS TO MATCH THE TERMS AT THE BOTTOM WITH THEIR CORRECT LOCATIONS ABOVE. FILL IN THE BLANKS BELOW WITH THE TERM THAT BELONGS IN THE LOCATION IDENTIFIED BY EACH NUMBER:

1. _______________________________________________________
2. _______________________________________________________
3. _______________________________________________________
4. _______________________________________________________
5. _______________________________________________________
6. _______________________________________________________
7. _______________________________________________________

(Copy of diagram with terms labeled 1 to 7)
Have students take the quiz in the program at the end of this module.

**Impact of human development**
After the quiz the program explores what happens to a water supply as the community grows.
What does a community need to do as the population grows to supply water?

**MODULE 1 ACTIVITY: POROSITY**

**Program Module**
Source Water: Rivers and Wells

**Essential Question:**
- What is a watershed?
- What is the water cycle?

**Overview**
- To understand the principle of porosity as it relates the water cycle
- To understand the principle of porosity as it relates to soils
- To measure the amount of water stored in the pore space of a soil sample.
- To express porosity in different forms: as a fraction, a percentage and in a graph.

**Background**
Groundwater aquifers store as much as 98 per cent of accessible freshwater supplies. They provide 50 per cent of global drinking water, 40 per cent of industrial demands and 20 per cent of water for agriculture. (Source: United Nations Environment Program, [http://www.unep.org](http://www.unep.org))

Though this water is held underground, it is still part of the water cycle.

Soils are made of particles of different types and sizes. The space between particles is called pore space. Pore space determines the amount of water that a given volume of soil can hold. Porosity is the percentage of the total volume of soil that consists of pore space. This is an important measurement in areas where drinking water is provided by groundwater reserves.

**Time:** 50 min. class period

**Materials:**
- Dry soil samples, representative of what can be found in the local area. Include several kinds to allow students to investigate the porosity of soils with different particle sizes. These should include clays, loams, gravel, sand or other types
- Two 500 ml beakers per pair of students— If you do not have beakers, substitute graduated cylinders
- Water
- Paper towels to clean up spills
Each soil type has a different porosity. For this activity, you will need to bring in several different kinds of soils and have students compare their porosity. As students pour water into their soil samples, the soil will become saturated. In an aquifer, the top surface of saturated soil is called the water table.

**Vocabulary**

**Soil**—Soil is the layer of minerals and organic matter on the land surface. Its main components are mineral matter, organic matter, moisture, and air.

**Particle**—A very small piece of something bigger.

**Pore space**—The space found between particles of soil, sand or gravel. In aquifers, pore space is filled with water.

**Porosity**—The amount of water that soil can hold in its pores.

**Saturation**—In soils, the point at which soil or an aquifer will no longer absorb any water without losing an equal amount.

**Water table**—The surface of groundwater in the soil.

**Groundwater**—Water beneath the surface of the earth that saturates the pores of sand, silt, gravel, and rock.

**Getting Started: Preparation**

This activity can be done either as a guided lab or an inquiry investigation, depending on the teacher’s time and comfort level with inquiry-based learning. For a guided lab, give students the following instructions:

Divide class into pairs of students. Distribute the materials.

Fill one beaker, up to the 500 ml mark, with dry soil or sand. Place it on a table or flat workspace.

Fill the other beaker, up to the 500 ml mark, with water.

Slowly pour the water from the second beaker into the soil sample. Stop pouring when the water level reaches the top of the soil. The soil has reached saturation and cannot hold any more water.

How much water is left in the second beaker?

**Discussion Questions:**

- Which kind of soil held the most water? Why?
- Where is the water held in the soil? (How can soil hold water?)
- Is there water in the soil outside the school? Why can’t we see it?

**To Learn More**

For definitions and distributions of the different kinds of soil types, go to this site from the University of Idaho College of Agriculture and Life Sciences [http://soils.ag.uidaho.edu/soilorders/orders.htm](http://soils.ag.uidaho.edu/soilorders/orders.htm)
Program Module
Source Water: Rivers and Wells

Essential Question
• What is the water cycle?
• What is a watershed?

Background
This activity works well when combined with the Porosity Investigation.

Permeability is the ability of a material to allow the passage of a liquid, such as water through rocks. Permeable materials, such as gravel, silt and sand, allow water to move quickly through them, whereas impermeable materials, such as clay, don't allow water to flow freely. Permeability also refers to the degree to which soils and rock are interconnected, depending upon size and shape of pores and the size and shape of their interconnections.

The coarser (containing more larger particles like sand and gravel) the soil, the more permeable it is. Water will run though more permeable soils at a faster rate than through soils with small particles. This concept (along with porosity) is important in understanding how water soaks through the ground (infiltrates) into an aquifer, a key component of the water cycle, and part of the complex relationship between surface water and groundwater.

Vocabulary
Permeable—A substance (such as sand, some types of rock) that allows water to pass through cracks and between particles.

Impermeable—A substance that does not allow water to pass through it.

Permeability—The rate at which water will flow through soil or rocks.

Particle—A very small piece of something bigger.

Pores—The spaces found between particles of soil, sand or gravel.

Porosity—The amount of space that is available to hold water in the soil.
Infiltrates—When a material like water passes into or through another material.

Surface water—Water that is on the Earth's surface, such as in a stream, river, lake, or reservoir

Groundwater—Water naturally stored below the surface of the earth, supplying wells and springs

Description

• Students will determine the relative permeability of several soil samples (sand, soil, and gravel).

• This investigation is designed to take students approximately one 50-minute period to complete.

General Instructions to the Teacher

Students will be working in groups of 2 or 3 during this investigation. See Permeability Investigation—Student Directions for detailed instructions on how to conduct this investigation.

Each team of students will need to weigh out a predetermined amount of each sample, depending on how much you have available. (The teacher can also do this before class if time is particularly short. Students, however, will benefit from the experience of using scales.) Once the soil, sand and gravel have been weighed out, they should be stored in a small plastic bag until needed. A central supply area, if needed, should be easily accessible.

Assessments

Students will graph the data collected from their investigations on the Permeability Activity Student Data Chart.

See also: Permeability Assessment
Permeability Investigation—
Student Directions

Task
In this investigation, you will be working in groups to determine the relative permeability of different soil samples.

Directions

1. Members of your group will measure out three samples of each soil type and put them in small plastic bags.

2. Observe each sample with the hand lens and record your observations.

3. Which sample has the largest particles? ______________________

4. Which sample has the smallest particles? ______________________

5. Predict which type of soil is the most permeable. ______________________

6. Place the funnel into the plastic bottle or small-mouthed container.

7. Fold a piece of filter paper and place a filter in the funnel.

Directions for folding: Fold paper in half, then in half again. Open to form a cone with 3 quarters on one side and one on the other (see diagram).

8. Fill the filter paper with water to wet the filter paper. As soon as the water flows out of the funnel, dump the water back into the water container. The filter paper should stick to the sides of the funnel without any air bubbles. Be sure to let all the water drip through the filter before placing the soil sample in it.

• Measure out 10 ml of water in the graduated cylinder.

9. Put one of your pre-measured soil samples into the wet filter paper and gently pack down the sample with the back of the spoon. Pour 10 ml of water on top of the soil in the funnel.

Materials

• Permeability Activity Student Data Chart—one per group
• Soil samples—3
• Sand samples—3
• Silt samples—3
• Small plastic bags—nine per group
• Hand lens
• 10 ml graduated cylinder
• Funnel
• Plastic bottle or small-mouthed container
• Filter paper—nine pieces for each group
• Spoon
• Paper towels
• Stop watch
• Water container
10. Time how long it takes for the 10 ml of water to disappear into the soil.

11. Record your time on the data chart.

12. Repeat steps #8-12 with each of the remaining samples of this same soil type.

13. Repeat steps #8-12 with each of the other soil types. (All together, you should collect data three times for each of the three soil types.)

Data Chart

Your chart will end up looking something like this.

1. Use a different color for each soil type.
2. Measure the time it takes for the water to run through the soil sample three times for each soil type.
3. Record your times on the chart below.
Student Assessment- Thinking About Permeability

Permeability is the rate at which water will flow through soil or rocks. Permeable materials, such as gravel and sand, allow water to move quickly through them. Impermeable materials, such as clay, don't allow water to flow freely. Permeable soils and rocks are interconnected by the water that flows between them.

The bigger the particles are in the soil, the more permeable it is. Water will run though soils that have large particles (like gravel) faster than it will run through soils with small particles (like sand.) This concept (along with porosity) is important in understanding how water soaks through the ground (infiltrates) into an aquifer. This is a key component of the complex relationship between surface water and groundwater.

What are the important vocabulary words in these paragraphs?

What are the main ideas in these paragraphs?

Why is permeability important in the relationship between surface water and groundwater?
**Student Background on Permeability**

Permeability is the rate at which water will flow through soil or rocks. Permeable materials, such as gravel, sand and silt allow water to move quickly through them. Impermeable materials, such as clay, don't allow water to flow freely. Permeable soils and rocks are interconnected by the water that flows between them.

The bigger the particles are in the soil, the more permeable it is. Water will run though soils that have large particles (like gravel) faster than it will run through soils with small particles (like sand and silt.) This concept (along with porosity) is important in understanding how water soaks through the ground (infiltrates) into an aquifer. This is a key component of the complex relationship between surface water and groundwater.

**Vocabulary**

**Permeable**—A substance (such as sand, some types of rock) which allows water to pass through cracks and between particles.

**Impermeable**—A substance which does not allow water to pass through it.

**Permeability**—The rate at which water will flow through soil or rocks.

**Particle**—A very small piece of something bigger.

**Pores**—The spaces found between particles of soil, sand or gravel.

**Porosity**—The amount of space that is available to hold water in the soil.

**Infiltrates**—When a material like water passes into or through another material.
Module 2: Water Conservation: Water Wisdom

Essential Questions
What are the most common wasteful water practices?
How can I be proactive in promoting water conservation practices?

Student Guide: Water Conservation: Water Wisdom

1. On average how many gallons of water are used by an American each day?
   __________

2. Which “water use” consumes the most water?
   a. Laundry
   b. Industrial purposes
   c. Watering the lawn

3. List the water “waster” items in the bathroom:
   1. 
   2. 
   3. 
   4. 
   5. Click on the lawn mower: How long should the grass be allowed to grow before mowed? __________

Play the interactive game:

4. What will save the most water in an average home?
   ________________________________

5. Describe two other ways you could save water in your home or school.
   1. 
   2. 
Module 3: Drinking Water: Water Treatment

Essential Questions:
- How have humans modified the natural water cycle for their use?
- Life as we know it would be impossible without clean water. What does it mean to have clean water?
- How can we be sure clear water means it is clean water?
- How is the water that is found in our lakes and rivers different from our drinking water?
- How can sand and gravel make water clean?

Drinking Water Discussion Questions
What does this part of the program show about drinking water?
What patterns does this show?
What questions do you have?
Describe the path of the water.
Where in the world are there drinking water issues?
Where in the world can a person safely drink the surface water without treatment?
How many people have treated drinking water?
Which step in drinking water treatment is the most important? Chlorination – chlorine has saved millions of lives.
What steps do you see for getting the drinking water to your home?
Where does water come from in your community?
Student Guide: Drinking Water

Before viewing the module, predict what you think the steps would be to clean water.

Click on the “Water Draw” and follow the pipes.

1. What are the water sources for making drinking water?

2. Describe the purpose of the flocculation process.

3. Illustrate a tank of water before and after flocculation and sedimentation has occurred.

   Before
   ![Before Image]

   After
   ![After Image]

4. True or False: When a water plant adds lime to their treated water the homeowner needs to purchase a water softener.

5. Illustrate and label the three layers used in the filtration process.

6. Why do you think there are three different layers in the filtration process?
7. Why is chlorine added to the filtered water?

8. What are the two main storage facilities used when treating water?

9. Explain which stage of the water treatment system you think is the most important step.

10. If you had to save Old Towne time and money, which stage between drawing the water and storage would you eliminate and why?
MODULE 3 ACTIVITY: WATERLOGGED

Program Module
Drinking Water: Water Treatment

Essential Questions
• Life as we know it would be impossible without clean water, what does it meant to have clean water?
• How can individuals conserve water every day?
• What are some causes and effects of excessive water use in America?

Objectives
• Students will explore their personal water use.
• Students will be able to estimate how much water they use as individuals and as a classroom.

Background
This activity helps students investigate how drinking water plays a major role in their daily lives. Students will first predict how much water they use in their daily activities. Then they will record their daily water usage. When students share with the class they can deduce patterns, note similarities, and mathematically present their data.

Method
1. As a class, discuss the ways we use water in our daily lives.
2. Show the students the "Waterlogged" worksheet. Discuss how some activities may not be on the sheet and how they should include them in the blank data spaces.
3. The following day have the students share their results.
4. Have students chart the class data using a pie chart.
5. This activity will set the stage for students to begin the discussion of water conservation found in another module found on the CD.

Time
Two class periods

Materials
• Waterlogged worksheet
STUDENTS WORKSHEET –
THE “WATER LOG”

Predict the amount of water you use on a daily basis: ________________gallons.

Actual Water Use

During the next 24 hours keep track of your water use. You can estimate the amount of water or actually measure the amount of water used.

<table>
<thead>
<tr>
<th>Water Use</th>
<th>Times per Day</th>
<th>Estimated Gallons</th>
<th>Measured Gallons</th>
<th>Total Used</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flushing Toilet</td>
<td>6</td>
<td>6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Washing face/hands</td>
<td>5</td>
<td>5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Showering</td>
<td>50</td>
<td>50</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bathing</td>
<td>30</td>
<td>30</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Brushing Teeth</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cooking</td>
<td>10</td>
<td>10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Washing Dishes</td>
<td>30 (sink)</td>
<td>10 (dishwasher)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Washing Clothes</td>
<td>60</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Getting a drink of water</td>
<td>0.25</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Questions:
1. Which activity used the most water during your “average” day?

2. In which activities could you save water and how?

<table>
<thead>
<tr>
<th>Activity</th>
<th>Action: How to save water</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

3. How does your prediction compare to your estimated use?

Graphing:
Using the classroom data, graph the results in a pie chart or histogram on the backside of this worksheet.
Extension Activities:
Now that your students have had a common experience via the CD’s modules, students can start formulating their own drinking water questions. They may seek answers to questions related to the environmental impacts, conservation practices and political agendas that are involved in the most valuable resource on Earth. They will build their knowledge while doing and learning science. There are numerous drinking water activities that can be used to extend the importance of water treatment for drinking water. Try some of the suggested activities listed below:

• Taking the Swamp Out of “Swamp Water” from Wild Goose: Earth: The Water Planet.
• Waters to the Sea CD ROM series produced by Hamline University’s Center for Global Environmental Education
• Students could also obtain water samples from home and test their drinking water for hardness, chlorine, lead, etc. LaMotte Urban water test kit or one obtained from your local drinking water treatment resource would provide the chemicals and worksheets needed.
• Using a map of Minnesota, examine the cities and major rivers and think about the source of drinking water for people in different communities.
• Visit your community’s water treatment facility.
• Have students to research the differences between bottled water and tap water. Differences may include but are not limited to: cost, FDA regulation, water source, fluoride use, addition of chlorine, etc.
• Have students monitor their water consumption for a week by keeping a water usage log.
MODULE 4: DRINKING WATER: PIPE GAME

Students can play this game to see how quickly they can build a new network of pipes and still repair the old pipes. The underlying purpose of the game is to illustrate the importance of repairing and creating infrastructure to meet a growing communities needs.

MODULE 4 ACTIVITY: THE PIPESVILLE DILEMMA

CD-ROM Module
Drinking Water: Pipe Game

Objective
The purpose of this activity is for students to understand that officials are faced with difficult choices and there are no easy or right answers.

Activity Directions
This is a simple description of a scenario you could use in your classroom by assigning roles for each item and having students make their case for their cause and point of view in a debate in which groups lobby for their causes. You could also just be a facilitator in a class discussion of prioritizing. Small groups would have to prioritize their spending. This could also lead into a visit by a city official such as the mayor or city council member, a look at the structure of local, state and national government, and/or a field trip. The numbers are loose estimates and could be increased or decreased based on your expertise in these areas.

The Dilemma
Your city is growing rapidly. You live within a 45 minute commute to a large metropolitan area. Your community has growing industries, but still has a "small town" feel. Hundreds of houses are being built in or near your city limits, and the fast expansion calls for urgent decisions by the city government. You have a city budget of $30,000,000 (could be adjusted up or down) that needs to be allocated to your city's needs. (Written into these scenarios are some additional monies, if money is invested in certain projects.) Here are some examples of budget items that are on the table to be discussed.

1. A new stadium for your high school and community college has been proposed. Your high school has a long tradition of excellent football teams and has won the state championship twice in the last ten years. Your community college has a growing football program and would like to partner with the high
school on the new stadium. The varsity soccer team will also use the field for home matches. Land has been donated by a long time resident for the stadium facility, with the stipulation the stadium must be built with in the next year or the land will be forfeited back to the owner. COST $5,000,000.

2. Your school district is expanding rapidly and space is becoming an issue. You have 3 elementary schools right now and each is overcrowded. There are a total of 30 classrooms right now located in “portable classrooms” that have been built outside the three elementary buildings. The city has agreed to allow you to keep the portables for three years. You have one year remaining to decide what to do. If you spend $10,000,000 this year the state will match your funds and you will be able to build a new elementary school for $20,000,000. The cost will increase to $15,000,000 in a year with only a $5,000,000 contribution from the state if you wait. COST $10,000,000.

3. Your city has an opportunity to build a new community center that includes a new outdoor pool for summer use. The community center will be available to many groups for use and includes a small theater for plays and presentations, a fitness center, and a computer lab for student use. Your city has an indoor pool at the high school, and a room for community use at the library. A council member wrote a grant and received $4,000,000 for the city to put toward the center or other city projects. The grant could also be used for other projects within the city such as roads, bike trails, playground equipment, or youth programs. COST $7,700,000.

4. The underground water and waste water pipes in your city are getting old. There have been a few leaks and broken pipes that have needed repair. With the city expanding rapidly with new housing developments, you will also have to add new pipes. A consultant has warned you that you only have a few years before the old pipes become very risky. Pipes could break causing a shortage of water and a safety hazard with no pressure for the fire hydrants. The repair of the old pipe system has been estimated at $12,000,000. This will cover only the existing houses and businesses. You have also received bids on new pipes. You can spend $5,000,000 on pipes that will cover the projected expansion for five years, or spend $7,250,000 on a piping system that should cover your cities growth for 10 years. COSTS $12,000,000 for old pipes, $5,000,000 for new pipes for 5 years or, $7,500,000 for pipes 10 years.

5. The State Department of Transportation wants to make your city the farthest stop on a new light rail transportation system. They will build the rails and pay for the operation of the transit system but have asked you to build a parking ramp and a terminal for people to wait in. The state is investing $500,000,000 in this new line and you are only expected to invest $7,000,000 in the parking ramp and terminal. People who are commuting to the metro area are in favor of this transit system. There is one point of controversy. The path of the proposed light rail system goes through a pristine wetland area. The city can pay an additional
$3,000,000 for a bridge that will carry the train over the wetland. COST $7,000,000, or with the bridge cost an additional $10,000,000.

6. With the expansion of your city, you have also seen a rise in crime rates. A council member has proposed that you increase the police force in your city and add some new equipment such as security cameras and monitors, cars, and a K9 unit, which will make them more efficient. COST $750,000.

7. Your city has an opportunity to expand the present youth programs. A very rich community member has agreed to give the city $1,000,000 to be used over the next five years to hire teachers and coaches for a new youth program that will include athletics, arts and academics. The program is geared for elementary and Jr. High or Middle School aged kids. Besides giving training and coaching in sports, students will have opportunities in music, drama, art, science, math, industrial technology, and building trades. The one stipulation is that the city must match the $1,000,000 in order to receive it. COST $1,000,000 to receive an additional $1,000,000.

8. A new bike trail/inline skating trail connecting your city to 3 cities that lie within twenty miles of your town has been proposed by a local business group. The trail will bring many tourists into the city during the summer. The local businesses that lie near the trail have agreed to contribute $100,000 toward the cost of the trail. An old railroad bed that is no longer in use will be the main trail with some additional trail space being added in each city. A local dealer in scrap metal has agreed to remove the rails for free if he can receive the profits from selling the scrap rails. The estimated cost of the trail is $2,000,000.

9. Your school system is in need of extra buses. They have an outdated fleet that they are spending $100,000 a year to keep running. They need at least 10 new buses to allow them to maintain what they have. However they could really use 20-25 new buses to alleviate pressure and accommodate the fast growing city. A local car dealer has worked out a deal with a bus manufacturer that will allow them to purchase 1-15 buses at a cost of $65,000 a bus or if they buy 15 or more, they will pay $55,000 a bus. How many buses, if any, will you buy?

10. The city’s roads are in bad shape. Every spring there are potholes and cracks that need repair. The streets are especially in poor shape near the schools. Additional roads must also be built connecting many of the new housing developments. A local contractor has given the city a bid of $3,000,000 to fix the roads. He also has a reputation for cutting corners on some projects. Another bid was for $5,000,000 to do the same roads by a contractor who has a reputation for quality work but seems to overcharge the client. If you choose to build new roads, which contractor will you choose?
MODULE 5: STORMWATER:
THE JOURNEY OF A RAIN DROP

Essential Questions:
- Where does the water that drains into your storm sewer pipes go?
- Do you know where the storm drains are near your school?
- Do you know where the storm drains are near your home?
- Where does the water that runs off the roads, buildings, lawns, and parking lots go?
- Make a list of all the pollutants that could be in the water that end up in a storm sewer.

Extensions:
“Follow Those Pipes”, Project Wet, a short activity that looks at pipes going into and out of a house.
Student Guide: Storm Water

As you watch this module list the pollutants that end up in the storm drain. Each raindrop will give you information on a type of pollutant. Watch closely and list them below.

1. __________________________________
2. _____________________________
3. __________________________________
4. __________________________________
5. __________________________________
6. __________________________________
7. __________________________________

Match up the pollutant with the description below. Write the name of the pollutant on the blank. Go back through the storm water segment again if you need help.

1. This pollutant clouds water and makes the sunlight unable to penetrate to the underwater plants. It also makes the water warmer. ________
2. This pollutant makes the aquatic plants grow faster and causes the algae to use up needed oxygen in the water. ________
3. One quart of this pollutant can pollute a quarter of a million (250,000) gallons of water. ________
4. This pollutant is an eyesore when it is in the water. People, fish and aquatic plants can all do without it. ________
5. This pollutant can spread harmful bacteria into the water. ________
6. When this pollutant decomposes it is like a big dose of fertilizer in the water. ________
7. These pollutants are used to kill plants and insects, and when then get in the water they kill animals and plants. ________
MODULE 5 ACTIVITY: IMPERVIOUS SURFACES

Program Module
Storm Water: Journey of a Rain Drop

Essential Questions
• What are some causes and effects of water pollution?
• What should we do to protect our watershed and improve water quality?

Overview
The percentage of impervious surface covering an area has a direct impact on the water quality in surrounding streams, rivers and lakes. According to some estimates, as little as 10% impervious surface will cause a measurable change in water quality.

In this activity, students will measure an area, and calculate the percentage of pervious and impervious surfaces on a local area. Older and more advanced students will create alternative land use scenarios for the study area. If you choose to, your students will present their findings to interested local groups, extending the activity into a service learning project.

Background
When humans change the land, we also change the waters surrounding and running over that land. When land is covered with natural materials, water soaks slowly into the ground, reducing and slowing runoff to local waters. When land is paved with impervious, or non-porous, materials, water runs off more quickly, causing streams to rise and fall quickly with rainfall.

Increasing the percentage of pervious surfaces is a promising strategy for municipalities looking for ways to reduce non-point source pollution. Students, however, will have limited influence on how developments are planned, the patterns of land use and the amount of pervious vs. impervious surface installed on an area. Because of that, this activity focuses on ways in which students can have maximum impact—by measuring, calculating percentages of various land covers, and imagining new ways to interact with the landscape.

Getting Started: Preparation
Begin by watching the “Impervious Surfaces” video on the Water Down the Drain CD-ROM. As a large group, work through the interactive module on Impervious Surfaces. Check to make sure students understand the following vocabulary words:

Pervious—materials that permit water to enter the ground. These materials may be porous or have large spaces (pores) in the material

Impervious—the ability to repel water, or not let water infiltrate

Drainage—The movement of water through the soil
Runoff—Water that falls to land as rain or snow that runs off the land in streams, rivers, oceans, inland seas or aquifers.

Non-point source pollution—Pollution that occurs when water runs over land or through the ground, picks up pollutants, and deposits them into rivers, lakes, coastal waters or into ground water.

Once waters are polluted, it is very difficult to clean them up. In a short discussion, explore students’ understanding of why fresh, clean water is so vital to human health. Issues might include:

- Drinking water
- Agriculture
- Food preparation
- Sanitation

Identify the study area
Select an area to study that is close, convenient, safe for students, and has a mix of surface materials. You might select a playground, a school common, a nearby shopping area, or other convenient area.

Measure the area
Divide students into groups of 3-5. Each group member should trade off roles in the following process, so each member has a chance to do a variety of tasks.

If you have access to 100-ft. measuring tapes, have students measure the perimeter of the area. (Note: If you do not have measuring tapes, ask students to pace off the area. Measure several paces and calculate the average length of each pace. Later, you can discuss the importance of standard measurements like meters, yards, etc.)

Transfer the area measurements to the graph paper to create a scale drawing of the study area. Each group should decide what scale they are drawing to. (For instance, one stride = one square, one stride = three squares. One foot = one square, one square = one yard, etc.)

Measure any buildings, structures or other impervious surfaces that cover the area. Plot them onto the graph paper.

Measure any green areas, or other pervious surfaces in the study area. Plot them onto the graph paper.

When they are finished, students should have a complete map plotted on the graph paper, with the perimeter of the area, and all pervious and impervious surfaces.

Once the mapping has been completed, ask students to notice where the water that drains off of roofs and parking lots goes. Does water flow to the streets, to a storm drain, or onto a field of grassy area?
Analysis

Back in the classroom, ask students to calculate the following areas:
• Total area of the study location
• Area of each individual pervious and impervious feature.
• Total areas of both pervious and impervious features
• Percentage of pervious and impervious areas relative to the overall area of the study location

Discuss students’ findings. Compare scales used by each groups, and the relative advantages and disadvantages of the different scales. If students paced off the areas, discuss the differences in results that can be traced to differences in lengths of their strides.

Compare the percentage of impervious surface in the study area to the general categories of development on your Water Down the Drain CD-ROM. Is your study area most like:
• A park
• A residential area
• An industrial area
• A retail development

Imagining Alternatives

In small groups, ask students to discuss the following questions:
• Where on their maps do they see locations or features that could be changed from impervious to pervious?
• How would those changes affect the study area? (For instance, replacing asphalt parking areas with gravel would provide more pervious surface, but would require more maintenance.)
• How could students redesign the features in the study area to include more pervious surface? (For instance, green roofs.)
• How would those changes affect the study area? (For instance, green roofs would cost more to install, but would reduce energy costs.)

Ask students to include both positive and negative consequences of any proposed changes.

Developing a Plan

After students have discussed the pros and cons of alternative design options, have each group come to agreement on one change they will make to the study area. Each member of the group will complete a Planning Sheet, describing the proposed change, the benefits, considerations and the change it will make to the impervious surface of the study area. (See Student Planning Sheet)

Once all the plans have been finalized, have students calculate the cumulative impact of their proposed changes. To what extent would the sum of their proposed changes have an impact on the impervious surfaces in the study area?

Authentic Audience

Real work deserves a real audience. Who in your community would be interested in hearing about your students’ work? Is there a neighborhood group or local business that might be interested? Who might implement your students’ plans? Make contact with local groups that share your interest in neighborhood improvement and ask for time at an upcoming meeting. Have students present their findings. Many positive changes happen when a group of interested, well-prepared students commit to improving their communities.
To Learn More

Service-learning is a promising strategy for engaging students’ interest and increasing community involvement while meeting rigorous academic standards. To learn more about service-learning, including research, resources, grants and regional support, go to:
MODULE 5 ACTIVITY: SOAK IT UP: A NON-POINT SOURCE POLLUTION PREVENTION PROJECT

Program Module
Storm Water: Journey of a Rain Drop

Essential questions

- What are some causes and effects of water pollution?
- What should we do to protect our watershed and improve water quality?

Overview

Solutions to water quality issues begin at home. In this service-learning project, students will map the immediate neighborhood around their school, identify features that contribute to non-point source pollution, single out a site for making improvements in the landscape and present the plan to an authentic audience of planners or community members.

Service-learning is an effective strategy for engaging students in solving real problems as they learn core academic content and practice the essential skills of learning. The more local the service project, the more meaningful it can be to students.

A critical element of effective service-learning is student voice— the degree to which students make decisions and direct their own learning. Seldom do we invite young people to re-imagine their environment. Giving students permission to take a lead in neighborhood improvements empowers them to become a more active, positive force in their community.

In this project, students have the opportunity to identify the site they want to “re-imagine” and create a new vision for the site they have chosen.

Background

Non-point source (NPS) pollution comes from many sources in urban and rural areas. Unlike point source pollution from industrial facilities and wastewater treatment plants, NPS is caused by all of us. We all share in the causes of this type of water pollution, and we can all be part of the solution to pollution.

The primary cause of NPS pollution is runoff from rainfall or snowmelt that picks up natural and human-made pollutants from

Time

This project can vary in length of time, depending on your schedule, size of the class, and scope of your project. Figure on at least five class periods (these can be non-consecutive,) with students doing homework and research between class periods.

Note: This activity requires a field investigation in your neighborhood.

Materials

You will need:
- Neighborhood maps for each student
- Topographical maps for each team of 3–5 students
- Map Symbols Guide for each team of students

Neighborhood maps of adequate quality are available through several free online mapping sites, including Yahoo Maps, MapQuest and others. Type in your school's address, enlarge or shrink the map to meet your needs, and select the printer-friendly version to print.

Topographical maps can be purchased locally through any one of several agencies, including the Texas Natural Resources Information Systems http://www.tnris.org and nationally, through the U.S. Geological Survey http://store.usgs.gov/

Consider giving a student or a group of students the responsibility for obtaining the necessary maps.
land surfaces and carries them into ground water, streams, rivers, lakes, and wetlands. Impervious surfaces and construction sites in urban areas, and farmland and barnyards in rural areas, also contribute to NPS.

The four major types of NPS pollution are:
- **Sediments**—Soil particles washed off the land
- **Nutrients**—Fertilizers and animal waste
- **Toxic Substances**—Pesticides, motor oil, etc.
- **Pathogens**—Such as bacteria from septic systems.

In general, NPS comes from:
- Roads and streets (stormwater runoff)
- Agriculture
- Logging
- Mining
- Construction and land development sites
- Eroding streambanks and other habitat modifications
- Septic tanks
- Animal feeding operations
- Lawns, parks and golf courses
- Boating and marine activities.

1. **Getting Started: Preparation**

Divide your class into study groups of 3–5 students. Students will work in these groups throughout the project.

**Reflecting**

Reflection is a critical element of service-learning. Ask students to keep a daily journal of their service-learning experience. Give them daily questions to which they can respond. Collect journals periodically to check in on students’ progress and thinking.

**Formative reflection questions might include:**
- What is working well, and what needs to be improved?
- What surprised me in my work today?
- What is the biggest challenge I faced today?
- What is hard for me to understand about the work I did today?
- What do I need to do next?
- Why is this work important to me and my community?
- What am I learning about myself through this project?

**Summative reflection questions might include:**
- What will I do differently next time?
- Why should my community care about non-point source pollution?
- Tell a story about your service-learning experience that is meaningful to you.
- What did you learn about your community during this project?
- How did my service project affect my community?
- What did you learn about yourself during this project?
2. Outline the Study, Identify the area

Download, or find, a map of the neighborhood around your school, and outline the boundaries of the area students will explore. Limiting the area of study gives you an important measure of control over how big the project will be. Constrain the area to make your project something you, and students, can reasonably manage. Make sure the printed map is large enough for students to mark local features on it.

3. Day One: Introducing the Project

If your students have no experience with service learning, begin by discussing the idea with them. You may want to have them talk in small groups about their neighborhood and the concerns they have.

- What aspects of their neighborhoods minimize NPS, and what do they see that could be improved? Is there litter on the streets?
- Is there a lot of automobile traffic?
- Are there enough trees to shade the buildings?
- Are there enough natural areas?
- Are there oil spots on the pavement where cars park?
- Do people sweep their yard clippings into a storm drain?

Distribute copies of the neighborhood map, the Map Symbols Guide, and the Student Overview to small groups of students. Every student in each group should read the Student Overview. Ask students to discuss the following questions in their groups:

- Why is non-point source pollution an important issue in their neighborhood?
- What kinds of non-point pollution sources do they predict they will find in their study area?
- What are their goals for the project? These might include cleaning up their neighborhood, making a difference in their community, working to solve a real problem, etc.
- Who else in the community might be interested in hearing about this service project and what students have discovered?

Share the results of students’ discussions in the large group. Gather students’ ideas onto one comprehensive list.

Discuss the audience to whom your students will present their findings: neighbors, planners or other policy makers. Remind students: They will need to take their study seriously if they want their audience to take their findings and recommendations seriously.

Discuss the students’ goals for the project. Narrow the list of goals to a reasonable number. Don’t try to do too much.

Consider how you and your students will assess how well they did on the project. How will they know if they succeeded? Ask them to think about how to evaluate their project. There are assessment ideas included with this activity.

See:

- Improvement Plan Rubric
- Oral Presentation Rubric
4. Day Two: Survey the Area

Each team will walk the boundaries of the study area, marking likely sources of non-point source pollution, and the types of pollution generated. These include:

**Types of NPS pollution:**
- Sediments—Soil particles washed off the land
- Nutrients—fertilizers and animal waste
- Toxic Substances — pesticides, motor oil, etc.
- Pathogens—such as bacteria from septic systems.

**Sources of NPS pollution:**
- Parking lots, driveways, roads and streets (stormwater runoff)
- Agriculture
- Logging
- Mining
- Construction and land development sites
- Eroding streambanks and other habitat modifications
- Septic tanks
- Animal feeding operations
- Lawns, parks and golf courses
- Boating and marine activities.

Once students have walked the boundaries of the area, have them walk through the entire area, in a grid pattern if possible, noting any additional sources of non-point source pollution.

**For each likely source that teams mark on their maps, they should also include:**
- Measurements of the site, where appropriate (for paved areas, lawns, etc.)
- Observations and descriptions of the source—a gas station might have spilled oil or solvents on the ground, streets may have litter, etc.
- Any appropriate information about the ownership of the site, including contact information.

Student teams should also make note of the natural areas, habitats, gardens and other places that make their community a “greener” place to live.

Students may not have a second chance to survey the neighborhood in their group, so make the most of this survey. Each student in the group should take notes, make observations, offer ideas and record information.

5. Day Three–Five: Identify Your Site, Identify Your Strategy

After students have surveyed the neighborhood, ask students to make two pie charts showing:

- The different categories of contributing sources of pollution, and
- The number of examples of each of the major categories of pollution they found.

Once you have your maps marked with contributors to non-point source pollution in your neighborhood, the next step is to choose the contributing feature your team will focus on, and a strategy for the improvement you will recommend.

**Analysis of Survey Maps**

Examine the street surveys and look for two trends:
• The source of the most visible sources of pollution
• The source of the most easily remedied pollution.

Your Strategy: Developing a Plan
Develop an action plan to remove the most easily remedied pollution. The action plan should:

• Identify the exact source of the pollution.
• Identify the impact the source is having on the stream. (Use a topographical map to determine where the pollutant might enter a waterway.)
• Decide what can reasonably be done to remove or reduce the source.
• Create all the steps necessary to remove or reduce the pollution.
• Decide who will do each step.
• Create a poster to display this information.
• Develop an oral presentation to communicate this information.

Authentic Audience
Real work deserves a real audience. Who in your community would be interested in hearing about your students’ work? Is there a neighborhood group that might be interested? Who might implement your students’ plans? Make contact with local groups that share your interest in neighborhood improvement and ask for time at an upcoming meeting. Have students present their findings.

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To Learn More
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The National Youth Leadership Council at: http://www.nylc.org
## Soak It Up Improvement Plan Rubric

<table>
<thead>
<tr>
<th></th>
<th>Exceptional 4</th>
<th>Admirable 3</th>
<th>Acceptable 2</th>
<th>Amateur 1</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Identifying a site for improvement</strong></td>
<td>Students have accurately identified a site, and how the improvement plan or service will address the need, including expected outcomes</td>
<td>Students have identified a site, and how the improvement plan will address the need, but outcomes are not clearly defined</td>
<td>Students have not identified an appropriate site. Improvement plan doesn't clearly address issue. Outcomes are not clearly defined.</td>
<td>Students have not identified an appropriate site. Improvement plan doesn't clearly address issue. Outcomes are not defined, or unlikely.</td>
<td></td>
</tr>
<tr>
<td><strong>Articulating the improvement plan</strong></td>
<td>Improvement plan is clearly defined, practical and effective. Student capacities are clearly considered, and the plan is realistic and practical.</td>
<td>Improvement plan is clearly defined, reasonably practical and effective. Student capacities may have been over- or under-estimated. The plan is reasonable and practical.</td>
<td>Improvement plan is vague or unfocused. Student capacities have been over- or under-estimated. The plan is somewhat practical.</td>
<td>Plan is unfocused or ineffective. Student capacities have been over- or under-estimated. The plan is not practical.</td>
<td></td>
</tr>
<tr>
<td><strong>Resources of the team</strong></td>
<td>The resources of the team have been accurately identified. Student team members have creatively offered skills and interest areas, as contributions to the team effort.</td>
<td>The resources of the team have been identified. Student team members have offered skills and interest areas as contributions to the team effort.</td>
<td>The resources of the team have been identified, but not clearly or comprehensively. Team members have offered some skills and interests to the team.</td>
<td>The resources of the team have not been identified. Team members have been reticent to offer skills as a contribution to the group effort.</td>
<td></td>
</tr>
<tr>
<td><strong>Student participation</strong></td>
<td>All students enthusiastically participate</td>
<td>At least 3/4 of students actively participate</td>
<td>At least half the students confer or present ideas</td>
<td>Only one or two persons actively participate</td>
<td></td>
</tr>
<tr>
<td><strong>Responsibility</strong></td>
<td>Responsibility for task is shared evenly</td>
<td>Responsibility is shared by most group members</td>
<td>Responsibility is shared by 1/2 the group members</td>
<td>Exclusive reliance on one person</td>
<td></td>
</tr>
<tr>
<td><strong>Listening and leadership</strong></td>
<td>Excellent listening and leadership skills exhibited; students reflect awareness of others' views and opinions in their discussions</td>
<td>Students show adeptness in interacting; lively discussion centers on the task</td>
<td>Some ability to interact; attentive listening; some evidence of discussion of alternatives</td>
<td>Little interaction; very brief conversations; some students were disinterested or distracted</td>
<td></td>
</tr>
<tr>
<td><strong>Student roles</strong></td>
<td>Each student assigned a clearly defined role; group members perform roles effectively</td>
<td>Each student assigned a role but roles not clearly defined or consistently adhered to</td>
<td>Students assigned roles but roles were not consistently adhered to</td>
<td>No effort made to assign roles to group members</td>
<td></td>
</tr>
<tr>
<td><strong>Identifying resources</strong></td>
<td>Other resources have been thoroughly and accurately identified, including information, materials, community members and partnerships, and necessary funding.</td>
<td>Most, but not all, of the other resources have been identified, including information, materials, community members and partnerships, and necessary funding.</td>
<td>Some, but not most, of the other resources have been identified, including information, materials, community members and partnerships, and necessary funding.</td>
<td>Few of the necessary resources available have been identified. Efforts seem perfunctory.</td>
<td></td>
</tr>
<tr>
<td><strong>Comparing resources to project needs</strong></td>
<td>Students have thoughtfully compared resources with needs. The results show an exceptional level of understanding of the issues and processes involved.</td>
<td>Students have compared resources with needs. The results show a thorough understanding of the issues and processes involved.</td>
<td>Students have compared resources with needs, but the results show an incomplete understanding of either the issues or processes.</td>
<td>Students have not mastered the concepts needed to compare resources with needs. Results show a lack of understanding of either the issues, or the processes.</td>
<td></td>
</tr>
<tr>
<td>Getting resources</td>
<td>Students have precisely identified how to get needed resources. Results demonstrate a thorough familiarity with both their community, and their needs.</td>
<td>Students have determined how to get needed resources. Results demonstrate a familiarity with both community and needs.</td>
<td>Students have determined how to get needed resources, but the results show a lack of familiarity with either their community, or their needs.</td>
<td>Students have not determined how to get needed resources. Results show a lack of familiarity with both community and needs.</td>
<td></td>
</tr>
<tr>
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<td>-------------------------------------------------------------------------------------------------------------------------------------</td>
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<td></td>
</tr>
<tr>
<td>Flow chart</td>
<td>Flow chart precisely maps the task. Great care and thought is evident in both design and execution.</td>
<td>Flow chart accurately maps the tasks. Care and thought are evident in both design and execution.</td>
<td>Flow chart maps the task, but is unclear, or confusing. Some care and thought are evident in either design or execution.</td>
<td>Flow chart does not accurately chart task. Flow is confusing. Little care or thought is evident in either design or execution.</td>
<td></td>
</tr>
<tr>
<td>Teamwork</td>
<td>Plan was fully implemented. Work was shared equally. All members of the team were fully engaged and responsible.</td>
<td>Plan was fully implemented. Work was shared, not always equally. Most team members were fully engaged and responsible.</td>
<td>Plan was mostly implemented. Work was not equally shared. Some team members were engaged and responsible.</td>
<td>Plan was not fully implemented. Work was not fully shared. Most team members were not engaged or responsible.</td>
<td></td>
</tr>
</tbody>
</table>
# Soak It Up Oral Presentation Rubric

<table>
<thead>
<tr>
<th></th>
<th>Superior</th>
<th>Adequate</th>
<th>Minimal</th>
<th>Inadequate</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Content</strong></td>
<td>The speaker provides a variety of types of content appropriate for the task, such as generalizations, details, examples and various forms of evidence. The speaker adapts the content in a specific way to the listener and situation. Solutions proposed are creative, reasonable, and are well supported by research.</td>
<td>The speaker focuses primarily on relevant content. The speaker sticks to the topic. The speaker adapts the content in a general way to the listener and the situation. Solutions proposed are reasonable, and are supported by research.</td>
<td>The speaker includes some irrelevant content. The speaker wanders off the topic. The speaker uses words and concepts that are inappropriate for the knowledge and experiences of the listener (e.g., slang, jargon, technical language). Solutions proposed are not reasonable, or are not supported by research.</td>
<td>The speaker says practically nothing. The speaker focuses primarily on irrelevant content. The speaker appears to ignore the listener and the situation. Solutions proposed are not reasonable, and are not supported by research.</td>
</tr>
<tr>
<td><strong>Delivery</strong></td>
<td>The speaker delivers the message in a confident, poised, enthusiastic fashion. The volume and rate varies to add emphasis and interest. Pronunciation and enunciation are very clear. The speaker pauses very infrequently and has no interruptions, such as 'ahs,' 'uhms,' or 'you knows.'</td>
<td>The volume is not too low or too loud and the rate is not too fast or too slow. The pronunciation and enunciation are clear. The speaker pauses infrequently and has few interruptions, such as 'ahs,' 'uhms,' or 'you knows.'</td>
<td>The volume is too low or too loud and the rate is too fast or too slow. The pronunciation and enunciation are unclear. The speaker pauses frequently and has some interruptions, such as 'ahs,' 'uhms,' or 'you knows.' The listener is distracted by problems in the delivery of the message and has difficulty understanding the words in the message.</td>
<td>The volume is so low and the rate is so fast that you cannot understand most of the message. The pronunciation and enunciation are very unclear. The speaker appears uninterested.</td>
</tr>
<tr>
<td><strong>Organization</strong></td>
<td>The message is clearly well organized. The speaker helps the listener understand the sequence and relationships of ideas by using organizational aids such as announcing the topic, previewing the organization, using transitions, and summarizing.</td>
<td>The message is organized. The listener has no difficulty understanding the sequence and relationships among the ideas in the message. The ideas in the message can outlined easily.</td>
<td>The organization of the message is confusing. The listener must make some assumptions about the sequence and relationship of ideas.</td>
<td>The message is so disorganized you cannot understand most of the message.</td>
</tr>
<tr>
<td><strong>Creativity</strong></td>
<td>Very original presentation of material; captures the audience’s attention.</td>
<td>Some originality apparent; good variety and blending of materials / media.</td>
<td>Little or no variation; material presented with little originality or interpretation.</td>
<td>Repetitive with little or no variety; insufficient use of materials / media.</td>
</tr>
<tr>
<td><strong>Length of Presentation</strong></td>
<td>Within two minutes of allotted time</td>
<td>Within four minutes of allotted time</td>
<td>Within six minutes of allotted time</td>
<td>Too long or too short; ten or more minutes above or below the allotted time.</td>
</tr>
</tbody>
</table>
Soak It Up Map Icons

- Mining
- Roads & Streets
- Septic Tanks
- Natural Areas
- Agriculture
- Animal Feeding Operations
- Boating and Marine Activities
- Eroding Stream banks & Other Habitat Modifications
- Logging
- Habitats
- Lawns Parks & Golf Courses
- Gardens
- Construction & Land Development Sites
Design Alternative Description:

Benefits:
(How will this improve water quality, save energy, etc?)

Considerations:
(How will this change the maintenance of the area, what costs will this incur, who will pay for this etc.?)

To what extent will this change reduce the impervious surface of the study area?
(Write down the mathematical equation you used to calculate the change in impervious surface.)
MODULE 6: WATER TOWERS

Essential Questions
What are some ways that water towers are useful?
What influences water tower design and placement?

ACTIVITY: WATER TOWER FLOW RATES

Program Module
Water Tower

Essential Questions:
• What are some ways that water towers are useful?
• What influences water tower design and placement?

Overview
• Water flows out of water towers due to gravity.
• The flow rate depends on the elevation difference between the tower and the consumer.
• An adequate flow rate for fire fighting is a consideration in water tower design.

Background
Water towers typically store a one day supply of water for the areas they serve. Pumps are used to refill water towers to maintain an adequate and fresh water supply for consumers. Water towers are very reliable because gravity draws the water out of water towers. They are able to supply water during power outages and rapidly provide large volumes of water to fight fires. The flow rate is a measure of the volume of water that moves out of a water tower in a fixed period of time. Examples of units for flow rates include cubic feet per second and milliliters per second.

Pre-Assessment
Ask students what they know about water towers. What are some uses of water towers? How does the water get into the tower? How does it get out of the tower? What force brings the water to the consumer? Why are water towers in high places? Another approach is to give students a pre and post quiz.

Activities
After the pre-quiz and discussion, students view and discuss the water tower section of the Urban Water Cycle program drinking water module. Later they conduct a lab to simulate the flow of water out of water towers and compare flow rates. After a post lab discussion, students take the post quiz to see how their knowledge of water towers has changed.
Extensions/Alternatives:

1. Design your own water tower: After viewing the Weird and Wonderful Water Towers CD section, students draw their own water towers. They could include designs that draw the attention of a visitor or relate to the community's identity.

2. Water tower in a bag: Demonstrate water pressure by filling a one gallon transparent plastic bag with water. Poke holes in the bag at different depths and watch the water flow at different rates.

3. Water tower labs: Modify the water tower lab investigation to compare flow rates for different levels of water in the bucket or different tubing diameters. Students could also design inquiry based investigations.

4. Siphoning chain: Water flowing in the flexible siphon hose during lab is somewhat like a chain draped over a pulley. Demonstrate how unequal lengths of chain over a pulley (or teacher's arm) cause the chain to accelerate with gravity down the longer side.

5. Water tower locations: Use topographic maps to find potential water tower sites with appropriate elevation and proximity to future development.
Water Tower Lab Investigation—
Student Directions

Purpose
In this investigation you will determine how the elevation
difference between the water tower and consumer relates to the
flow rate. Flow rate is the volume of water that travels past a
point in a specific period of time. You will measure the flow rate
in milliliters per second.

Directions
1. Add water to the 5 gallon bucket until it is approximately \( \frac{3}{4} \)
full. Place the bucket on the top of your lab table. The bucket
represents a water tower, and your lab table represents a hill
where the water tower is located. Measure the depth of the water
in centimeters and record the depth here: ______.

2. Select four points below your lab table to represent buildings that use water. Use the meter stick
to measure in centimeters how far each location is below the top of the lab table. Record these
distances in the column of the data table labeled “elevation difference.” The lowest building
should have the largest number. Make a prediction of which building will have the greatest flow
rate. Circle that building on the data table.

3. The flexible hose represents pipes that carry water from a water tower to a building. Feed one
end of the flexible hose into the five gallon bucket. Keep this end under water, and keep feeding
hose into the bucket until both ends are completely under water. If there are any air bubbles in
the hose you will need to remove it from the bucket and start over.

4. Place the graduated cylinder at the elevation of building 1. You will use the graduated cylinder to
measure the volume of water that reaches each building.

5. Check that both ends of the hose are underwater, then seal one end with your thumb. Leave the
other end underwater. Keep your thumb tight on the end of the hose, and pull that end to the
mouth of the graduated cylinder.

6. Remove your thumb, and allow water to flow from the hose into the graduated cylinder for 10
seconds. Stop the flow. Record the volume of water in the graduated cylinder in the data table.

7. Pour the water from the graduated cylinder and hose back into the bucket. Add water as
necessary to bring the water in the bucket back to its depth in step 1.

8. Repeat steps 1-7 for the other buildings. Record your data in the data table. To find the flow rate
divide volume by time. For example 50mL divided by 10 seconds equals a flow rate of 5mL per
second (5mL/s.) Use the data table to record flow rates for each building.

Materials
- 5 gallon bucket
- 600 mL or larger
  graduated cylinder or
  beaker
- meter stick
- 10 foot, 3/8” inner
diameter flexible hose
- stopwatch or clock
  with second hand
- water
- graph paper
9. Construct a graph that relates elevation change to flow rate.

Questions:

1. Examine your data table and graph. How did the flow rate change as the elevation difference increased?

2. Before you conducted the lab you predicted which building would have the greatest flow rate. Did your data match your prediction?

3. Why are water towers often located on hills?

4. Which building would have a higher flow rate: one at the elevation of a water tower or one down the hill from the water tower? Why?

5. What natural force allows water to flow out of the water tower?

6. Will a fire hydrant connected to a water tower stop working the moment a power outage begins? Why or why not?
Water Tower Quiz

Mark each statement as true or false

1. ____ A water tower holds approximately one day’s water supply for its neighborhood.

2. ____ Gravity forces water to flow out of a water tower when a consumer opens a tap.

3. ____ The greater the vertical distance that water falls, the slower it flows.

4. ____ Most fire hydrants stop working the moment a power outage occurs.

5. ____ Water towers are usually over 100 feet tall.
MODULE 7: WASTE WATER TREATMENT

ESSENTIAL QUESTIONS

• Why treat wastewater?
• How does the wastewater treatment system compare to the drinking water treatment system?
• What are the similarities, what are the differences?
• How does treating wastewater benefit surface water?

Guided Worksheet: Wastewater

Name: _______________

How are businesses and homes connected to a treatment plant?

Why is it important to remove large trash from the wastewater once it reaches the treatment plant?

How do settling tanks work?

What is secondary treatment of wastewater?

What do microorganisms do in secondary treatment of wastewater?

What is the final treatment process in most wastewater treatment plants?

Where does the treated water end up?
MODULE 7 ACTIVITY: WASTEWATER

Program Module
Wastewater

Essential Questions:
• Why treat wastewater?
• How does the wastewater treatment system compare to the drinking water treatment system?
• How does treating wastewater benefit surface water?

Objective
Students will understand that cleaning water requires many steps and it may not end up as clean as they would like.

Background Information
Overview: Wastewater is first collected from homes and businesses through a series of pipes and pumping stations. When it arrives at the treatment plant it first undergoes preliminary treatment where large objects are removed from the water. The wastewater then goes through roughly three steps: primary treatment, secondary treatment and tertiary treatment. Other processes may be used to take care of solids and provide other means of treatment. Primary treatment involves settling tanks. The flow of the water is slowed to allow particles to settle out of the water, while grease and oil float to the surface. The sludge, which settles, and the grease, which floats, are removed by skimming. Secondary treatment involves the addition of microorganisms and oxygen to the wastewater. The organisms use the oxygen to decompose the remaining dissolved pollutants. Tertiary treatment is disinfecting the water; chlorine or ultraviolet light may be used.

Pre-Assessment
Discuss with the students:
• What goes down the drain at their house?
• Is there anything that goes down the drain that shouldn’t?
• Is there anything that could be composted instead?

Activity Directions
Either the students bring something from breakfast that would have gone down the drain (cereal, milk, a bit of orange juice, coffee grounds etc) or the teacher provides materials for the class. Mix the materials with a couple of liters of water.

Materials
• Several liters of water
• Filters of various sizes
• Sieves/strainers
• beakers
• various food stuffs/beverages

Time
One-two class periods
Divide the “wastewater” among groups of students, and ask them to “treat” the water so that it can be as clean as possible. Provide the students with several beakers and the following: screening/ kitchen strainer, filters in various sizes, charcoal, sand, and gravel.

Have students record their observations in their science journals.

- Describe their wastewater before treatment.
- What steps did they take to clean the water?
- Describe their wastewater after treatment.
- What would they do differently next time?

**Post-Activity Assessment:**
What worked? What didn’t? What could they do better or differently next time? Is the treated water as clean as they would like it to be? How did the student activity compare with treating wastewater at a treatment plant? Why is wastewater treated before being sent to surface water? Why should we care?

**Extensions:**
“Dilemma Derby’ and “Sum of the Parts”, Project Wet, 2005.
Overview Worksheet 1

Name________________________

Introduction = movie clip

A. Drinking Water:

1. Source Water: Rivers and Wells

   a. Gravity slowly forces water to seep through spaces between rocks and sand in a process called ________________.
   b. Water flowing underground is called ________________.
   c. Underground soil and rocks that allow water to pass through are called ________________.
   d. Underground areas where water collects are called ________________.

Click through the water cycle “quiz” and the growing town information

e. Non-point pollutants come from ________________ and aren’t easily traced.

f. Point source pollutants are caused by waste dumped directly into ________________ or dumped on ________________.
g. Just like water can seep through porous soils, _________________ can also creep down through soils.

2. Treatment Plant:
   a. **Water draw**: Water is drawn from the surface or _________________.
   
   b. **Flocculation**: Particles of _________________ stick to chemicals and form clumps called floc.
   
   c. **Sedimentation**: After the clumps form they settle to the bottom and are _________________ away.
   
   d. **Filtration**: During filtration water flows through layers of _________________, _________________, and _________________.
   
   e. **Disinfection**: Adding _________________ to water kills biological organisms in the water.
   
   f. **Storage**: After treatment water goes into towers or underground tanks that hold _________________ of gallons of water.

3. Drinking Water Pipes:
   a. Write two facts about water pipes:
      
      •
      •
   
   b. Play the water race game
4. Water Tower:
   a. Water towers are usually over ____________________ tall
      and often located on ____________________.
   b. Gravity forces water in the tower toward Earth creating
      ____________________.
   c. An average tower can hold ____________________
      swimming pools full of water.
   d. A water tower tank is large enough to hold
      ____________________ worth of water.

Back to Main Menu:

B. Storm Water:

   1. Watch the storm water video clip.
   2. Click on the raindrops to learn how to prevent pollution run-off
      around your yard.
   3. List four ways you can prevent pollution run-off:
      •
      •
      •
      •

Back to Main Menu:

C. Waste Water:

   1. On average people add about ____________________ of waste
      water to a community’s waste water system.
   2. Pumping systems: move waste water to
      ____________________ facilities.
3. Preliminary treatment: a ____________________ removes large trash items from waste water.

4. Primary treatment: while in sitting tanks, heavy solids fall to the bottom of the tank and become a slurry called ____________________.

5. Secondary treatment:
   a. ____________________ use the remaining organic material as food.
   b. The solids in the waste water plant are mostly ____________________.

6. Solids processing: microorganisms in the waste solids convert the organic material into ____________________. This gas can be used as an ____________________.

7. Solids dewatering: filter presses and centrifuges are used to squeeze ____________________ from the biosolids to reduce their volume.

8. Final treatment: biosolids produced at waste water treatment plants can be applied to land as ____________________ after they have been assured to be safe.

Back to Main Menu:

D. Conservation:

1. Click through this section and write four facts you learned:
   •
   •
   •
   •
Overview Worksheet 2  Name________________________

Below you will find questions for the different modules found on the Urban Water Cycle program. Answer the following questions as you navigate through the modules.

Conservation: Click on the “Conservation” Icon

Water Wisdom

1. On average how many gallons of water are used by an American each day? ________

2. Which “water use” consumes the most water?
   a. Laundry
   b. Industrial purposes
   c. Watering the lawn

3. List the water “waster” items in the bathroom:
   1. 
   2. 
   3. 
   4. 
   5. Click on the lawn mower: How long should the grass be allowed to grow before mowed? ________

Play the interactive game:

4. What will save the most water in an average home?  __________________________

5. Describe two other ways you could save water in your home or school
   1. 
   2. 
Drinking Water: Click on the Drinking Water Icon
Source Water: Rivers and Wells

Click on “Source water: Rivers and Wells.” As you follow through the module fill in the missing vocabulary words on the following picture.

1. Substances like sand and rock that can hold water in cracks and spaces between particles are: ____________________________.

2. The process of water seeping below ground is called: ____________________________.

3. The area above the aquifer is called the: ____________________________.

4. The aquifer itself is also called the: ____________________________.

5. The top of the aquifer is called the: ____________________________.
6. The solid rock below the aquifer is ______________________, but can be fractured in some places.

7. An area of underground water is an: ________________________________.

8. Particles such as ___________________ can be left over in a: ____________________.

There are two kinds of pollution, point and non point pollution. Make a list of pollution examples from the Urban Water Cycle program.

<table>
<thead>
<tr>
<th>Non-Point Pollution</th>
<th>Point Pollution</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Describe how oil spilled on the ground can get into our drinking water.

**Water Treatment**

**Click on “Water Treatment”**

Before viewing the module predict which stage you think is the most important step in the treatment of water?

Prediction:

Click on the “Water Draw” and follow the pipes.

1. What are the water sources for drinking water?

2. Describe the purpose of the flocculation process.

3. Illustrate a tank of water before and after flocculation and sedimentation has occurred.
4. True or False: When a water plant adds lime to their treated water the homeowner needs to purchase a water softener.

5. Illustrate and label the three layers used in the filtration process.

6. Why do you think there are three different layers in the filtration process?

7. Why is chlorine added to the filtered water?

8. What are the two main storage facilities that are used when treating water?

9. Explain which stage of the water treatment system you think is the most important step.

10. If you had to save Old Towne time and money, which stage between drawing the water and storage would you eliminate and why?
Water Treatment
Click on “Water Pipes”
Click on the “Water Pipes”
Play the interactive game.

What were the two causes for leaking pipes in the game?

How do you think this game could be like real life?

How many times did it take you to be successful?

Water Tower
Click on “Water Tower.” View the module and answer the following questions.

1. Where are water towers often located?

2. What natural force creates water pressure from water towers?

3. How many swimming pools would it take to fill an average size water tower?

4. Why do you think a pump is needed to replace water in the water tower?

5. Why is it important for some communities to have water towers?

6. View the water tower slide show. Do you have any favorites?
Storm Water
On the main menu, click on “Storm Water”

As you watch this section of the video list the pollutants that end up in the storm drain. Each raindrop will give you information on a type of pollutant. Watch closely and list them below.

1. __________________________________
2. __________________________________
3. __________________________________
4. __________________________________
5. __________________________________
6. __________________________________
7. __________________________________

Match up the above pollutants with the description below. Write the name of the pollutant on the blank. Go back through the storm water segment again if you need help.

1. This pollutant clouds water and makes the sunlight unable to penetrate to the underwater plants. It also makes the water warmer. ________
2. This pollutant makes the aquatic plants grow faster and causes the algae to use up needed oxygen in the water. ________
3. One quart of this pollutant can pollute a quarter of a million (250,000) gallons of water. ________
4. This pollutant is an eyesore when it is in the water. People, fish and aquatic plants can all do without it. ________
5. This pollutant can spread harmful bacteria into the water. ________
6. When this pollutant decomposes it is like a big dose of fertilizer in the water. ________
7. These pollutants are used to kill plants and insects and when then get in the water they kill animals and plants. ________
Wastewater

On the main menu, click on “Wastewater”
Answer the following questions as you work through the module.

1. How are businesses and homes connected to a treatment plant?

2. Why is it important to remove large trash from the wastewater once it reaches the treatment plant?

3. How do settling tanks work?

4. What is secondary treatment of wastewater?

5. What do microorganisms do in secondary treatment of wastewater?

6. What is the final treatment process in most wastewater treatment plants?

7. Where does the treated water end up?

List 2 questions that you still have about the “Urban Water Cycle”.

1.

2.