Living Downstream:
Potable Water and Human Health

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Living Downstream: Potable Water and Human Health

INTRODUCTION:

This 8-lesson unit focuses on the human health effects of water pollution. Students learn through history, language arts, science and technology how land use, disposal of waste, household practices and lifestyle choices impact our quality of life and availability of local potable water. Students are challenged to explore the problem through an integrated interdisciplinary lens and use their knowledge to present possible solutions to the problem of water contamination via video, PowerPoint presentations, websites or brochures disseminated to their school and community.

SETTING:

The curriculum is designed for a 5th grade class at an intermediate school. However, the curriculum could be used in grades 4-8.

OBJECTIVES:

To develop students' abilities to:

- Examine an environmental health problem that has scientific, social, and political dimensions.
- Approach a complex problem through analysis of what they know and they need to know and through development of a problem statement.
- Gather, organize, and synthesize information from various sources, and identify potential ways to address a problem.
- Analyze the pros and cons of potential solutions to environmental health problems.
- Practice collaborative learning.
- Present their research and selected solutions to an audience.

INSTRUCTIONAL OVERVIEW

Day 1: Lesson 1
The historical changes in land use of your community (possible resources include the Community Historian, historical artifacts, maps, photographs, historical societies, local libraries archives)

- Worksheet 1: Focus Questions

Day 2: Lesson 2
Reviewing geographic terms and water cycle; brainstorming on the impact of land use on the environment and human health

- Worksheet 2: Geographic Water Terms
- Worksheet 3: Water Cycle: Returning Raindrop
- Worksheet 4: Potential Effects of Land Use on the Environment and Human Health

Day 3: Lesson 3
The environmental impact of chemicals (3-D Models)

- Worksheet 5: Environmental Impact of Land Usage

Days 4 and 5: Lesson 4
Making topographical relief maps from modeling clay or plasticine

Day 6: Lesson 5
The impact of land usage on environment, "What's Wrong?"

- Land Use and Water Quality handout
- Worksheet 6: "What's Wrong With This Picture?"

Day 7: Lesson 6
Planning for land use ("Utopia" maps)

- Worksheet 7: Utopia Island Map

Day 8: Lesson 7
The health effects of household chemicals (computer lab research)

- Worksheet 8: Household Chemicals and Their Effects on Human Health

Day 9 and beyond: Lesson 8
Begin language arts lessons by researching pollutants in a body of water such as a creek, stream, pond, bay, lake and/or river and reporting solutions to protect human health.

- Worksheet 9: Citizenship Skills on "How to Solve a Problem"
- Worksheet 10: Outline and Planning for Environmental Health Project
- Worksheet 11: Computer Guide

Lesson 1: Presentation by community historian

Purpose:
The historian will describe the changes in land use from the beginning of settlement in your community to the present, including changes in agricultural, residential, and industrial use. (The intent of this lesson is to provide students with an understanding of the changes in land use in the area around their school. The area of to be discussed may be a small town, suburb, and part of a metropolis, but in all cases an area in which the students have some familiarity with.

Student Objectives:

1. Students will recognize some of the social and economic factors that influenced land use within their locality.
2. Students will identify how and why land use has changed throughout the history of their community.
3. Students will draw conclusions about how the changes in land use have affected our physical and ecological environment.
4. Students will make connections between the environmental conditions and potential health issues for local residents.

Resources/Materials:

1. Historical photographic slides of your community (from your Community Historian, historical society, library archives)
2. Slide projector, if needed
3. Photo boards/captions (from Community Historian)
4. *Worksheet 1: Focus Questions* for note taking on historian's presentation

Methods:

- Lecture format (historian's presentation). Students should record at least 3 facts for each of the sections on Worksheet 1.
- Group discussion focusing on completing the questions on Worksheet 1.

Procedures:

1. As a pre-activity, assess students' current understanding of the changing land use in the community by asking them what they know. Approximately when was their home/apartment/residence built? What existed there before? When was the school built? Has the population of the community decreased or increased? By how much?
2. The community historian will present his/her lecture on the historical changes in your town or city.
3. Students will use their Worksheet 1 to answer the focus questions throughout the presentation.
4. Following the presentation, students will brainstorm on the potential environmental effects of past and current development in your town. (We will explore the connections between these environmental conditions and human health in lesson 2.)

Evaluation:

Worksheet 1

Name: _____

Worksheet 1: History of land use and development

Focus Questions:

The historian will describe how land use has changed throughout our community's history. You will take notes related to the following questions:

How would you characterize the earliest settlements in our community?
What businesses or industries existed in our community at the beginning of the 20th century?
How did land use change in our community after World War II?

New York State Social Studies Standards:

Standard 1 – History of the U.S. and N.Y.

Key Idea #2: Important ideas, social and cultural values, beliefs and traditions from NY and US history illustrate the connections and interactions of people and events across time and from a variety of perspectives.

Performance Indicators: Students will investigate key turning points in NYS history and explain why these events or developments and significant.

Key Idea #3: Study about the major social, political, economic, cultural and religious developments in NYS and US history involves learning about the important roles and contributions of individuals and groups.

Performance Indicators: Students will classify major developments into categories such as social, political, economic, geographic, technological, scientific, cultural or religious.

Standard 3 – Geography:

Key idea #1: Geography can be divided into six essential elements, which can be used to analyze important historic, geographic, economic and environmental questions and issues.

Performance Indicators:

- Students will investigate why people and places are located where they are located and what patterns can be perceived in these locations.
- Students will describe the relationships between people and environments and the connections between people and places.

Standard 4 – Economics:

Key Idea #1: The study of economics requires an understanding of major economic concepts and systems, the principles of economic decision making and the interdependence of economics and economic systems throughout the world.

Performance Indicators: Students will explain how societies attempt to satisfy their basic needs and wants by utilizing scarce capital, natural and human resources.

Lesson 2: Current land use and its impact on the environment

Purpose:
Students will review geographic water terminology and analyze the possible impacts of land usage on environmental health.

Student Objectives:
1. Students will match geographic water terms to their definitions.
2. Students will identify the components of the water cycle.
3. Students will describe current land usage within your community.
4. Students will draw connections between land usage and the impact on water quality and human health.

Resources/Materials:
1. *Worksheet 2: Vocabulary list of geographic water terms and definitions*
2. *Worksheet 3: The Returning Raindrop*
3. Also go to: http://EPA.gov/safewater/kids PDF Files on:
    - "The Case of the Disappearing Water",
    - "Deep Subjects: Wells and Ground Water"
    - "Excuse Me: Is this the Way to the Drainpipe?"
4. Current topographic and/or land use maps of your community, which can be found at http://www.topozone.com
5. Chronological series of aerial photos of the area your students will study, including streams, rivers, and other bodies of water (example: 1930, 1950, 1970, 1980, 2000)
6. *Worksheet 4: Potential Effects of Land Use on the Environment.*
7. Overhead copy or PowerPoint of Worksheet 4 (teacher made).
8. Overhead projector

Methods:
- Whole group (vocabulary and diagram)
- Small groups (brainstorming)

Procedure:
1. With the whole class, students will review the geographic water terms by matching them with their definitions. (*Worksheet #2*)
2. Students will use the terms listed on *Worksheet #3* "The Returning Raindrop" to label the water cycle diagram.
3. Students will work in small groups (4-5) to complete Worksheet #4 (Potential Effects of Land Use on the Environment). They will use their answers to Worksheet #1 and maps from the community historian's presentation and brainstorm ideas on the impact of land usage on environmental health.
4. Groups will report their results to the class ("share and compare")
5. Teacher will use an overhead copy of Worksheet #4 to record each group's ideas.
6. Students will add to their own copy of Worksheet #4 additional items from the class discussion.

Evaluation:
Students will participate appropriately in the small group discussion and share their brainstorm results with the group, as observed by the teacher. Each student's Worksheet 4 should be complete after the "share and compare" session.

New York State Social Studies Standards:

Standard 3 – Geography:

Key Idea #1: Geography can be divided into six essential elements, which can be used to analyze important historic, geographic, economic, and environmental questions and issues.

Performance Indicators:

- Students will investigate why people and places are located where they are located and what patterns can be perceived in these locations.
- Students will describe the relationships between people and environments and the connections between people and places.

Key Idea #2: Geography requires the development and application of the skills of asking and answering geographic questions: analyzing theories of geography; and acquiring, organizing and analyzing geographic information.

Performance Indicators: Students will interpret geographic information by synthesizing data and developing conclusions and generalizations about geographic issues and problems.

Name_____

Worksheet 2:

GEOGRAPHIC WATER TERMS

Match the terms with their definitions: Use a globe or a world map to help you determine the answers.

____1. Bay

____2. Harbor

____3. Ocean

____4. Port

____5. Peninsula

____6. Lake

____7. River

____8. Gulf

____9. Island

___10. Coast

A. A large stream of water that flows across the land and usually empties into a lake, an ocean, or another river.

B. Land with water around it on three out of four sides.

C. A protected place where ships are safe from the ocean's waves.

D. A body of land entirely surrounded by water.

E. The largest body of water.

F. A large body of water that reaches into the land.

G. The land along a sea or ocean.

H. A small body of water reaching into the land.

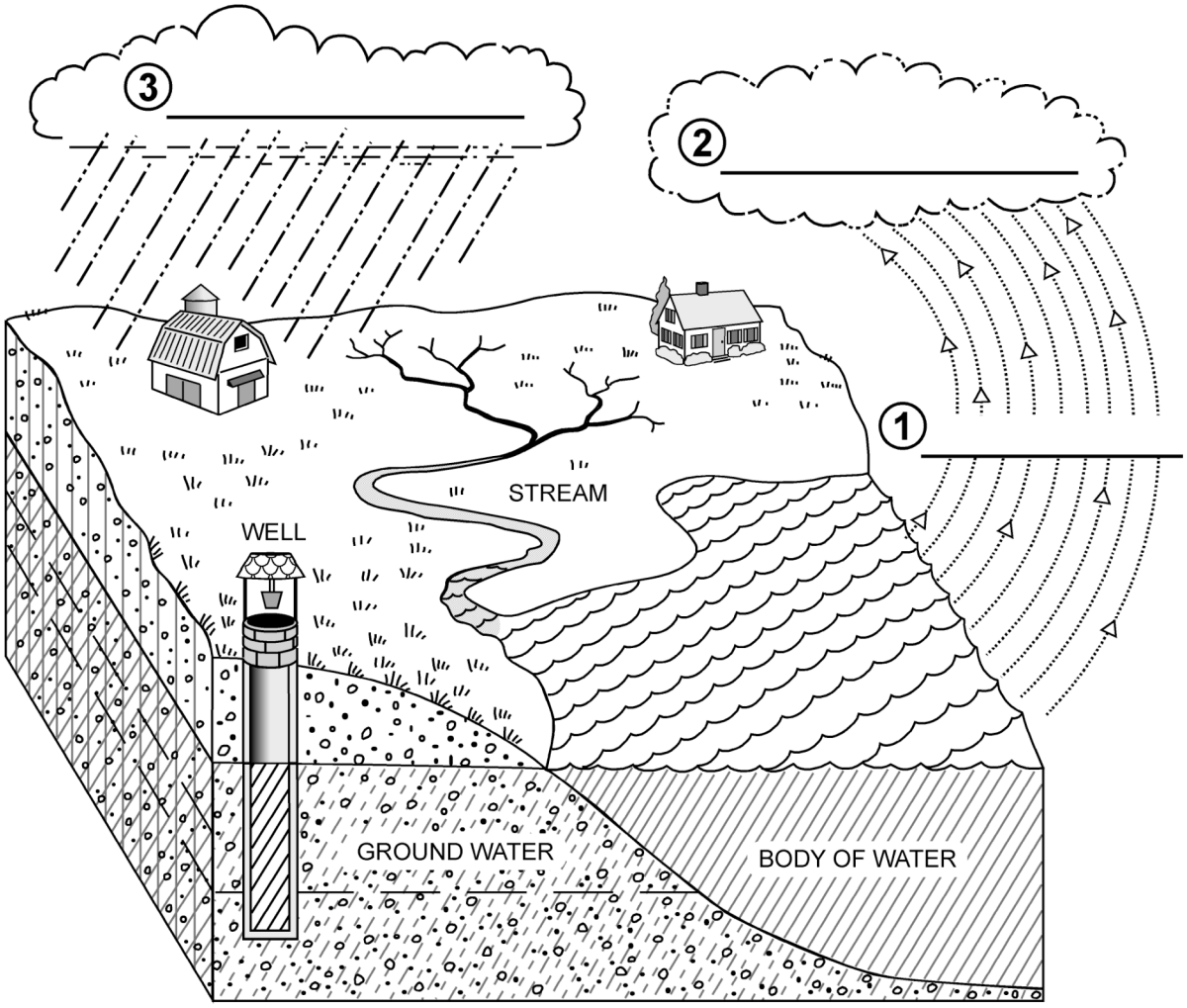
I. A place where ships load and unload goods.

J. A body of water entirely surrounded by land

Name _____ WORKSHEET 3

THE RETURNING RAINDROP

Fill in the blanks to label the picture. Use the terms at the bottom.



Terms: water cycle
evaporation
condensation
precipitation

Student sheet

Adapted from: http://epa.gov/safewater/kids/wsb/pdfs/351.pdf

Name: _____

Worksheet 4:

Potential Effects of Land Use on the Environment and Human Health

Land Use	Possible Effects on the Environment	Possible Effects on Human Health

Lesson 3: The environmental impact of chemicals and waste (3-D models)

Purpose:
Students will observe the environmental impact of chemicals and other materials used in different communities.

Student Objectives:

1. Students will identify chemicals commonly used in different parts of a community (residential, commercial, farming etc.).
2. Students will analyze the potential impact of these chemicals on the surrounding environment.
3. Student will make connections between the environmental impact and human health.

Resources/Materials:

1. Three-dimensional landform map. In our project, we had access to the Enviroscape Watershed/Nonpoint Source Kit, which teaches students about watersheds, and the effects of point and nonpoint source pollution. The kit includes a landscape form with buildings, trees, and two waterways, which flow into a larger body of water. Drink mix powers and cocoa are used to represent chemicals. Enviroscape also offers kits that students can make and use in small groups. See website at www.Enviroscape.com for more information.
2. Powdered food products (Kool-aid, instant coffee, cocoa powder etc.), which will be used to represent different chemicals.
3. Spray water bottle.
4. *Worksheet 5: Environmental Impacts of Land Usage*

Methods:

Students will work in groups of 4 – 5 (dependent on how many models are made).

Procedure:

1. Students will sprinkle different colored powdered food products on to the 3D map to represent the different materials used on the land (ex. Pesticides, road salt, fertilizer etc.).
2. Students will spray the dry products with water to simulate rain on the landforms.
3. Students will observe the results of the dry products mixing with the water (run-off).
4. Students will complete *Worksheet 5: Environmental Impacts of Land Usage* .
5. As a class, students will discuss the potential impact of these chemicals on human health.

Evaluation:

Student Worksheets will be graded on a 4-point rubric:

4	Student has identified at least 2 chemicals, waste or materials used in each region (a total of 6 chemicals). Student has clearly explained the effect of rain on the chemicals.
3	Student has identified at least 1 chemical, waste or material used in each region. Student briefly explains the effect of rain on the chemicals.
2	Student has identified less than 3 chemicals, waste or materials total. Student has not explained the effect of rain, or the explanation is simplistic or incomplete.
1	Student has not correctly identified any of the chemicals or materials used. Student does not explain the effect of rain on the chemicals.

New York State Social Studies Standards:

Standard 3 – Geography:

Key Idea #1: Geography can be divided into six essential elements, which can be used to analyze important historic, geographic, economic and environmental question and issues.

Performance Indicator: Students will describe the relationships between people and environments and the connections between people and places.

Key Idea #2: Geography requires the development and application of the skills of asking and answering geographic questions; analyzing theories of geography; and acquiring, organizing and analyzing geographic information.

Performance Indicators:

- Students will formulate geographic question and define geographic issues and problems.
- Students will interpret geographic information by synthesizing data and developing conclusions and generalizations about geographic issues and problems.

Name: _____-

Worksheet 5:
Environmental Impacts of Land Usage

1. What types of chemicals, waste and/ or materials are often found or used around homes and residential areas?

2. What types of chemicals, waste and /or materials are often used around farms?

3. What types of chemicals, waste and/or materials are often found around roadways?

4. What happened to those chemicals, waste products and/or materials after the rainfall?

Discuss: What effect could those chemicals or waste materials have on human health?

Lesson 4: Making topographic maps

Purpose:
Students will make from modeling clay a 3-dimensional topographic map of the geographic area including bodies of water: stream, lake, bay, ocean, etc.

Student Objectives:

1. Students will examine a topographic map of the area to familiarize themselves with regional geographic features. Students will learn about elevation, how to tell whether the elevation changes gradually or quickly (elevation lines are further apart or closer, how to identify valleys and streams and rivers (the elevation lines typically make a shape similar to a tree with branches emerging from a central trunk), symbols for buildings, streets, roads, and highways, marshes, and woods.
2. Students will create a 3-dimensional map to depict the geographic features of the area surrounding your chosen water source.
3. Students will use their maps to analyze the effects of water run off and erosion within the locality.

Resources/Materials:

1. Poster size topographic map of your town, available at http://www.topozone.com/
2. Desk size copies of the topographic maps with major elevation lines color highlighted. The goal is for the student to make a clay relief map that reveals hills and valleys. Ideally, students should use three or four different colors of clay to indicate the different elevations, so which elevation lines are highlighted depends on what regular interval will provide for three or four levels. For example, changing clay colors at 50-foot intervals may work well for moderately-changing terrain.
3. Multi-colored modeling clay (such as plasticine).
4. Plastic knives, rollers or other clay modeling tools.
5. Model 3-dimensional map (teacher-made).

Methods:

- Whole group (review characteristics of topographic maps).
- Teacher demonstration (model the process of forming the map).
- Partners (create their own maps).

Procedures:

1. Teacher will use the poster size map to review the characteristics of topographic maps.
2. Using a teacher or adult made 3-dimensional map, the teacher will model how to layer different colors of clay to represent the different elevation levels outlined on the map.
3. Students will work in pairs in create their relief maps. In our project the 3-dimensional maps were about 5 inches square. We used one color for the lowest elevation, filling in the entire square. We then removed the bottom layer from the map, and placed a second layer of clay on the map ONLY within the boundaries for the next highest elevation interval. We then removed this layer from the map and placed in to top of the 5 inch square of clay to the side. We then followed the same process for the subsequent two layers. In this way we developed a multilayered relief map in which different elevations were indicate by different colors of clay.

4. Students will use their maps to discuss the effects of water runoff and erosion within the area of their water source.

Evaluation:
The teacher will assess the students' understanding through observation as they work. Students should be able to read the topographic map and use the elevation lines in order to create their own clay models. Students should work cooperatively with their partners to make their maps and actively problem solve throughout the process. Students should be able to draw connections between land elevations, water run off and water quality.

New York State Social Studies Standards:

Standard 3 – Geography

Key Idea: Geography requires the development and application of the skills of asking and answering geographic questions; analyzing theories of geography; and acquiring, organizing, and analyzing geographic information.

Performance Indicator: Students present geographic information in a variety of formats, including maps.

Lesson 5: The impact of land usage on environmental health

Purpose:
Students will examine the connection between land use, human behavior and environmental health.

Student Objectives:
1. Students will identify potential environmental hazards in a given scenario.
2. Students will recognize how human's use or misuse of land can impact the environment.
3. Students will connect the environmental impact to human health.

Resources/Materials:
1. "Land Use and Water Quality" article (source: EPA.gov website, http://EPA.gov/safewater/kids Curriculum, The Water Sourcebooks, PDF files)
2. *Worksheet 6: "What's Wrong With This Picture?"* – give 1 copy to each student
3. "What's Wrong With This Picture?" key - make an overhead transparency of this.

Methods:
- Whole Group (read article)
- Partners ("What's Wrong?")

Procedures:
1. The class will read and discuss the article "Land Use and Water Quality."
2. In pairs, students will identify the sources of water pollution on the "What's Wrong?" activity sheet.
3. Partners will return to the whole group to share and compare their responses.
4. Students will brainstorm the potential health effects of each of the identified hazards.

Evaluation:
Teacher will display the key on the overhead. Students will check their own copy to be sure they have identified all the hazards.

New York State Social Studies Standards:

Standard 3 – Geography:

Key Idea #2: Geography requires the development and application of the skills of asking and answering geographic questions; analyzing theories of geography and acquiring, organizing and analyzing geographic information.

Performance Indicators:
- Students will formulate geographic questions and define geographic issues and problems.
- Students will interpret geographic information by synthesizing data and developing conclusions and generalizations about geographic issues and problems.

Standard 5 – Civics, Citizenship and Government

Key Idea #4 The study of civics and citizenship requires the ability to probe ideas and assumptions, ask and answer analytical questions, take a skeptical attitude toward questionable arguments, evaluate evidence, formulate rational conclusions and develop and refine participatory skills.

Performance Indicators:

- Students will participate in activities that focus on a classroom, school or community issue or problem.
- Students will suggest alternative solutions or courses of action to hypothetical or historic problems.

LAND USE AND WATER QUALITY

Land use can have a tremendous effect on water quality. Farmlands can be the source of sediment, fertilizer and animal waste pollution. Forests may not be the source of pollutants, but they can be damaged severely by water pollution. Human activities affecting forests (forestry practices such as clear cutting and road construction that cause erosion and sedimentation) can impact water quality. Cities pose numerous water quality problems due to high water demand, industrial pollutants, non-point source pollution and human wastes.

So it's important that when we decide to use land for a specific purpose, we take into account water quality, not just in the immediate area, but downstream and upstream as well. This means considering the **amount** of water available as well as how it must be processed before and after use.

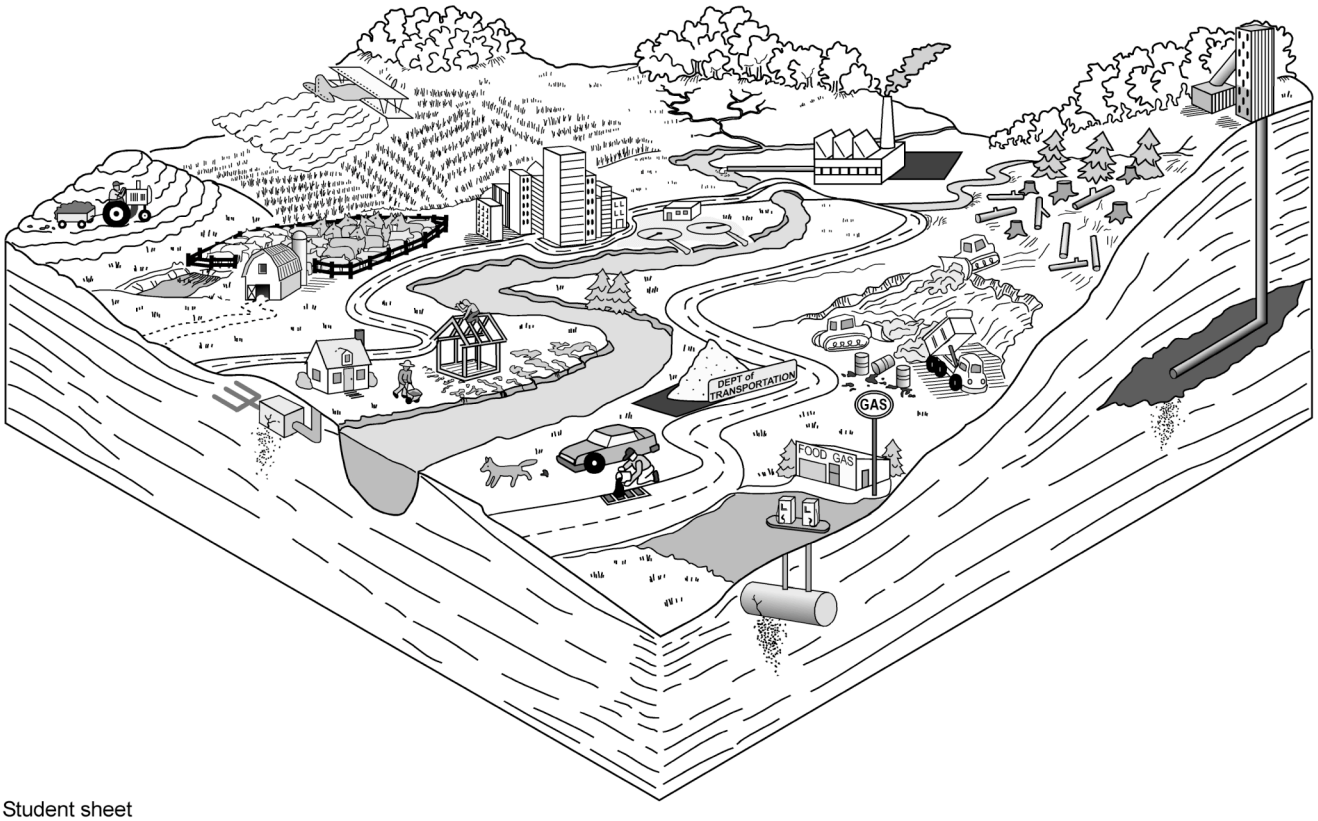
For example, crops require tremendous amounts of water. If there is not enough rainfall to support crop growth, they must be irrigated, which means transporting water from lakes, streams, or wells. Irrigation may require so much water that aquatic life in lakes and streams may be affected, or the water table may be lowered, causing wells to dry up. The complete water cycle must be considered for irrigation. Irrigation drainwater must be properly discharged or recycled to avoid causing pollution as well.

Another good example is the case of a paper mill on a small mountain river. Paper production requires lots of water, and the wastewater discharged back into the stream contains a large number of pollutants, including some toxic chemicals. A paper company might come under attack from environmental groups for this mill but receive praise for how mills are operated in other areas on larger rivers. One reason is the **amount** of water available for use. The small mountain river does not have enough flow to support the operation of the paper mill.

Name _____ WORKSHEET 6

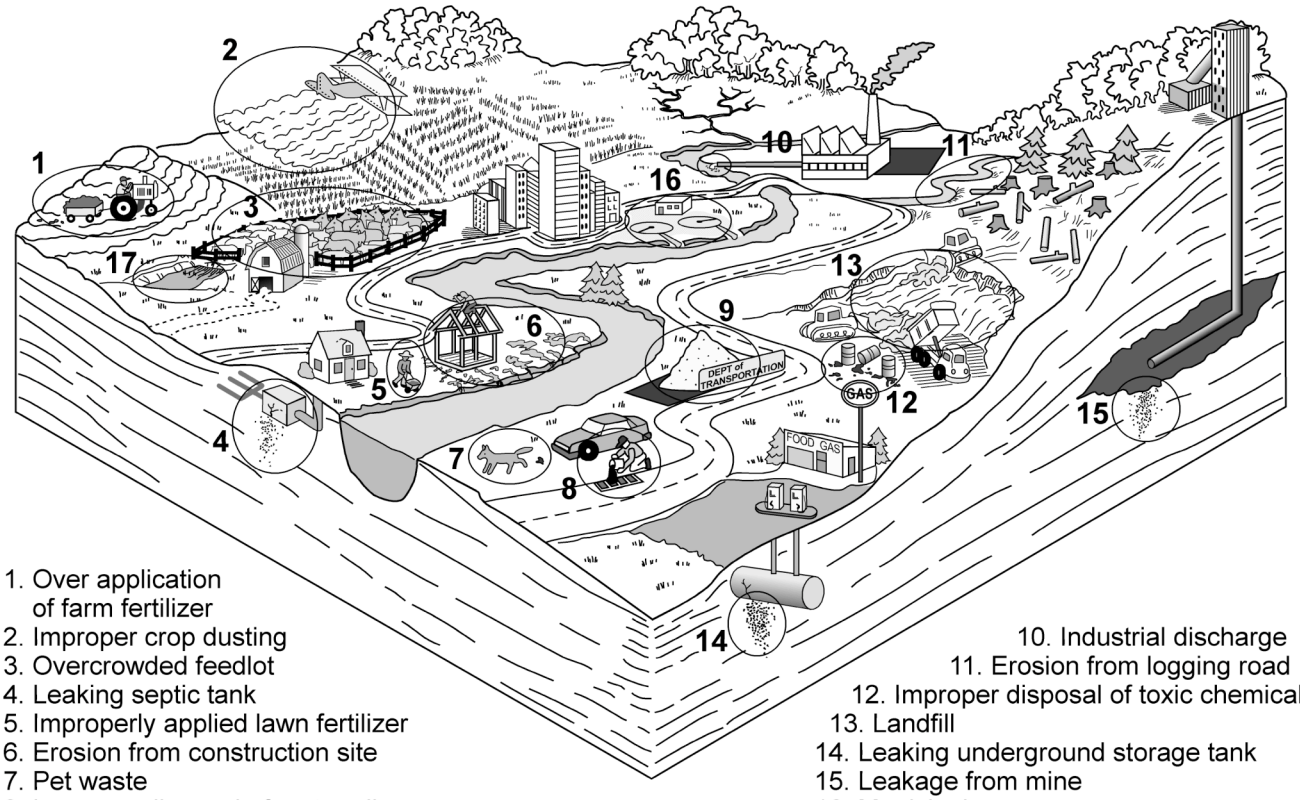
WHAT'S WRONG WITH THIS PICTURE?

There are 13 potential sources of water pollution in this diagram. Circle them and label each one.



Student sheet

WHAT'S WRONG WITH THIS PICTURE? TEACHER KEY



1. Over application of farm fertilizer
2. Improper crop dusting
3. Overcrowded feedlot
4. Leaking septic tank
5. Improperly applied lawn fertilizer
6. Erosion from construction site
7. Pet waste
8. Improper disposal of motor oil
9. Road salt
10. Industrial discharge
11. Erosion from logging road
12. Improper disposal of toxic chemicals
13. Landfill
14. Leaking underground storage tank
15. Leakage from mine
16. Municipal sewage
17. Leaking animal waste storage lagoon

Lesson 6: Planning for Land Use

Purpose:
Students will explore the many factors, including environmental, that influence land use decisions within a community.

Student Objectives:
1. Students will identify the necessary components of a typical community: residential needs, business needs, recreational needs, etc.
2. Students will design a fictitious community to include the necessary components.
3. Students will consider the environmental impacts of their community design.
4. Students will justify their reasoning for their land use decisions.

Resources/Materials:
1. Fictitious Island "Utopia" maps (Worksheet 7 - give one copy to each student)
2. Overhead transparency of "Utopia" (teacher made)
3. Colored pencils (or other drawing materials)
4. Writing journals

Methods:
- Whole group (brainstorming)
- Independent (maps and writing)

Procedures:
1. As a class, students will brainstorm and list on board the different elements necessary for most communities, for example: housing, retail stores, industries, forests and agricultural, recreational areas, airports, streets and highways. Students will also develop a legend to indicate each of the elements.
2. In pairs, students will place the different identified elements on the map, and consider how the different elements might impact the environment and surrounding elements.
3. Students will write a justification for their decisions reflecting the environmental impact of the different elements.
4. Students will share and compare their maps with the whole group.

Evaluation:
Students' maps and writing will be scored on a 4-point rubric.

4	The student's writing clearly explains 5 decisions. Much of the reasoning reflects an awareness of environmental issues, including environmental health. The map includes most of the necessary elements of a community as discussed in the brainstorming session. The map and its key are legible and logical.
3	The student's writing explains at least 4 decisions, with some connections to environmental issues. The map includes some of the necessary elements as discussed in the brainstorming session. The map and its key are legible.
2	The student's writing attempts to explain at least 3 decisions. The reasoning, however, does not appear to be based on issues of environmental concern. The map includes some necessary components, but may be missing some major elements. The map or key may be hard to read or understand.
1	The student's writing makes vague or irrelevant explanations for the decisions. The reasoning does not make any connections to environmental issues. The map is lacking in the major elements discussed within the brainstorming session. The map or key may be illegible or illogical.

New York State Social Studies Standards:

Standard 3 – Geography

Key Idea #1: Geography can be divided into six essential elements, which can be used to analyze important historic, geographic, economic and environmental questions and issues.

Performance Indicator: Students will map information about people, places and environments.

Standard 4 – Economics

Key Idea #1: The study of economics requires and understanding of major economic concepts and systems, the principles of economic decision making and the interdependence of economics and economic systems throughout the world.

Performance Indicator: Students will explain how societies and nations attempt to satisfy their basic needs and wants by utilizing scarce capital, natural and human resources.

Name _____ WORKSHEET 8

UTOPIA (GREEK FOR "NO PLACE")

SCALE 0 5 10 MILES
1 INCH

SYMBOLS:

- HILLS
- MOUNTAINS
- SANDY BEACH
- MARSH
- OCEAN

N

THE OCEAN MAR

Lesson 7: Researching chemical hazards

Purpose:
Students will identify the chemicals within common household products and research the effects of those chemicals on human health.

Student Objectives:
1. Students will independently utilize the EPA website to locate common household products.
2. Students will identify the chemicals within household products that end up in the water supply.
3. Students will describe the effects each chemical may have on human health.
4. Students will record their findings on a graphic organizer (Worksheet #7) that will be used as a reference for future activities.

Resources/Materials:
1. *Worksheet 8: Household Chemicals and Their Effects on Human Health*
2. Computers/Internet

Method:
After a brief review of the written directions with the teacher, students work independently (45 minutes in computer lab)

Procedures:
1. Teacher will read through the written directions on Worksheet 8 with the whole group.
2. Students will work independently to follow directions, locate the EPA web site and complete the chart.

Evaluation:
Student work will be assessed using a 4-point rubric:

4	The student identifies 6 chemicals on the chart. The student lists the products in which each chemical can be found. The student describes at least one health effect for all of the 6 chemicals. The chart is neat and is completed within the lesson period.
3	The student identifies at least 5 chemicals on the chart. The student lists the products in which each chemical can be found. The student describes at least one health effect for most of the chemicals. The chart is neat and is completed within the lesson period.
2	The student identifies 3-4 chemicals. The student lists the products in which some of the chemicals can be found. The student describes a few health effects, but the connections may be unclear or incomplete.
1	The student identifies less than 3 chemicals. The student does not clearly identify the products or describe the connections to human health.

New York State Language Arts Standards:

Standard 1 – Language for Information and Understanding

Key Idea #1: Listening and reading to acquire information and understanding involves collecting data, facts and ideas; discovering relationships, concepts and generalization; and using knowledge from oral, written, and electronic sources.

Performance Indicator:

- Students will distinguish between relevant and irrelevant information and between fact and opinion.
- Students will compare and synthesize information from different sources.

Name: _____

Worksheet 8: Household Chemicals and Their Effects on Human Health

You will use information from the Environmental Protection Agency (EPA) website to identify common household chemicals and their effects on human health. Follow these directions to get to the website:

1. Type in the web address, www.epa.gov/kidshometour
2. Click on "Join us for a House Tour."

Once you have reached the "House Tour" site, follow the directions for locating potential environmental hazards in the pictures. You must identify at least six (6) chemicals and list their potential effects on human health. Use the chart below to organize your information. Remember that our focus is on water quality. Try to find chemicals that could realistically end up in the water supply.

Substances in which this chemical can be found	Chemical name	Possible health effects on humans

Lesson 8: Day 9 and beyond

Begin language arts lessons by researching pollutants in a body of water such as a creek, stream, pond, bay, lake and/or river and reporting solutions to protect human health.

Purpose:
Students will research the sources, problems and solutions associated with different contaminants in our environment ad their effect on human health.

Student Objectives:

1. Students will identify a contaminant to research on the web. These might include pesticides, herbicides, or (a favorite of our students) pet waste.
2. Students will design or create a website, brochure, iMovie, PowerPoint presentation on a water contaminant.
3. Students will consider the environmental impacts of the contaminant on human health and their community.
4. Students will include good land use practices and propose possible solutions to the remediate the problem at a community and individual level.

Resources/Materials:

1. *Worksheet 9: Citizenship Skills on "How to Solve a Problem"*
2. *Worksheet 10: Outline and Planning for Environmental Health Project*
3. *Worksheet 11: Computer Guide*
4. Access to the internet, technology necessary to create websites, brochures, iMovies, and Power Points.

Methods:

- Whole group (brainstorming). The teacher and the students will discuss possible contaminants to research based on what they have discussed to date in the unit.
- Independent collaborative work by topic ad presentation.

Procedures:

1. Students will divide into groups of 2-4 to research a topic and develop a media presentation. Students research on the internet the consequences of different contaminants and what might be done to lessen or eliminate the problem. Use Worksheet 9 as a guideline for this process. Worksheet 10 provides specific questions to be used in answering questions. Worksheet 11 provides suggested internet resources.
2. Students develop a media presentation to present to their class and/or school.
3. Students present.

Worksheet 9: Citizenship Skills on "How to Solve a Problem"

Step 1: Identify the problem

Step 2: Gather information and facts

Step 3: Think of and list ALL possible options

Step 4: Consider advantages and disadvantages of possible options

Step 5: Choose the best solution

Step 6: Try your solution

Step 7: Think about how well your solution helps solve the problem

Worksheet 10: Outline and Planning for Environmental Health Project

The answers to these guiding questions should be present in your presentation and document.

Project Outline Questions

1. Where is your water source geographically located?

2. What pollutant are you researching?

3. How does this pollutant get into your water source?

4. How does this pollutant affect human health? (Be specific and provide details.)

5. What solutions can keep this pollutant out of your water source?

Worksheet 11: Computer Guide

For your research, you can use the following websites:

1. US Environmental Protection Agency:
   Environmental Kids Club: www.epa.gov/kids/

   - Find the left margin of the main page. Scroll down until you see "For Kids."
   - Click on "For Kids."
   - Read through all of your activity choices looking for key words like…Water…water cycle…water pollution…litter…waste…pesticides etc.
   - Click on any activity listings that seem related to your topic.
   - Read the activity listings to find any information that might be related to your problem or solution.
   - Write down any information that you think you can include in your project (take notes).

2. Google search

   - Enter www.google.com in the web address space.
   - Enter your topic in the search space.
   - Read the website choices that are listed.
   - Click on any sites that seem to be related to your topic.
   - Read and take notes.

Glossary of terms

adapted from: http://epa.gov/safewater/kids/wsb/pdfs/35gloss.pdf

A

Abandoned well: any well (drinking water, oil and gas, etc.) which is not used for a long period of time, is not properly maintained, and/or is not properly sealed when its useful life is over.

Acidity: the strength (concentration of hydrogen [H*] ions) of an acidic substance; measured pH.

Aeration: to expose to circulating air.

Ariel photography: high altitude pictures taken from an aircraft or satellite.

Aerobic: living or occurring in the presence of oxygen

Agriculture: the science, art and business of cultivating the soil, producing crops, and raising livestock.

Algal bloom: a heavy growth of algae in and on a body of water; usually results from high nitrate and phosphate concentrations entering bodies of water from farm fertilizers and detergents; phosphates also occur naturally under certain conditions.

Anaerobic bacteria: any bacteria that can survive in complete or partial absence of air.

Anthracite: the hardest grade of coal, having a very high carbon content: may be used as a filter medium in drinking water treatment.

Artesian well: well in which the water comes from a confined aquifer and is under pressure.

Aquatic life: plants, animals, and microorganisms that spend all or part of their lives in water.

Aquifer: an underground layer of unconsolidated rock or soil that is saturated with usable amounts water (a saturation zone).

Atmospheric transport: the movement of pollutants from one region to another by wind; may be hundred of miles.

B

Bacterial water pollution: the introduction of unwanted bacteria into a water body.

Bay: a large estuarine system (e.g. Chesapeake bay).

Biocontrol agent: an organism used to control pests (e.g. ladybugs used to control aphids in the garden).

Biosolids: solid materials resulting from wastewater containing human wastes.

Blackwater: domestic wastewater containing human waste.

Bog: poorly drained fresh water wetland that is characterized by a build up of peat.

Bottom lands: low lying land along a waterway.

C

Catch basin: a sedimentation area designed to remove pollutants from runoff before being discharged into a stream or pond.

Centrifugal force: the force that causes something to move outward from the center of rotation.

Cesspool: a covered hole or pit fro receiving untreated sewage.

Chemical: related to the science of chemistry; a substance characterized by a definite chemical molecular composition.

Chlorination: water disinfection by chlorine gas or hypochlorite.

Chlorine: a chemical element, symbol Cl, atomic number 17, atomic weight 35.453; used as a disinfectant in drinking water and wastewater treatment processes.

Cholera: an acute, often fatal, infectious epidemic disease caused by the microorganism *Vibrio comma*, that is characterized by watery diarrhea, vomiting, cramps, suppression of urine, and collapse.

Clean Water Act: water pollution control laws based upon the Federal Water Pollution Control Act of 1972 with amendments passed in 1977, 1981, and 1987; main objective is to restore and maintain the "chemical, physical, and biological integrity of the `nation's water.

Coliforms: bacteria found in the intestines of warm-blooded animals: used as indicators of fecal contamination in water.

Compost: an aerobic mixture of decaying organic matter, such as leaves and manure, used as fertilizer/

Confined aquifer (artesian aquifer): an aquifer with a dense layer of compacted earth material over it that blocks easy passage of water.

Conservation farming: the management of farm activities and structures to eliminate or reduce adverse environmental effects of pollutants and conserve soil, water, plant, and animal resources.

Constructed wetlands: wetlands that are designed and built similar to natural wetlands; some are used to treat waste-water.

Contaminate: to make impure (not pure) by contact or mixture; to introduce a substance into the air, water, or soil that reduces its usefulness to humans and other organisms in nature.

Contaminant: an impurity that causes air, soil, or water to be harmful to human health or the environment.

Corrosivity: ability to dissolve or break down certain substances, particularly metals.

Cumulative: increasing or enlarging by successive addition; acquired by or resulting from accumulation.

D

Debris: dead organic material (leaves, twigs, etc.) and sediment.

Decompose: to decay or rot; a result of microbial action.

De-foaming agents: chemicals that are added to wastewater discharges to prevent the water from foaming when discharged into a body of water.

Degradable: capable of decomposition; chemical or biological.

Desalination: the purification of salt or brackish water by removing dissolved salts.

Detergent: a synthetic cleansing agent resembling soap; has the ability to emulsify (break-up) oil and remove dirt.

Digestion: decomposition of organic waste materials by the action of microbes; the process of sewage treatment by the decomposition of organic matter.

Discharged: released into a body of water.

Disinfect (disinfected): to cleanse of harmful microorganisms.

Dissolved oxygen (DO): oxygen gas dissolved in water.

Dissolved solids: materials that enter a wave body in a solid phase in water.

Downstream: in the direction of a stream's current.

Drainage basin: an area drained by a main river and its tributaries.

Drainage system: a network formed by a main river and its tributaries.

Drainfield: the part of a septic system where the wastewater is released into the soil for absorption and filtration.

Dredging: the cleaning, deepening, or widening of a waterway using a machine (dredge) that removes materials using a scoop or suction device.

E

Evaporate: to convert or change into a vapor with application of heat.

Evapotranspiration: combination of evaporation and transpiration of water into the atmosphere from living plants and soil.

F

Feedlots: confined areas where livestock (cows, pigs, sheep, etc.) are kept. Often holding areas where animals a "fattened-up" prior to slaughter for the market.

Fertilizer: anyone of the natural or synthetic materials, including manure (animal fecal waste) and nitrogen, phosphorus, and potassium compounds, spread or worked into the soil to increase its fertility.

Fill: material added to wetland area to make it suitable for building.

Filtration: the process of passing a liquid or gas through porous article or mass (paper, membrane, sand, etc.) to separate out matter in suspension.

Fish kill: the sudden death of fish due to the introduction of pollutants or reduction of the dissolved oxygen concentration in a water body.

Flood conveyance: the transportation of floodwaters downstream with minimal, if any, damage.

Food chain: a succession of organisms in a community that constitute a feeding order in which food energy is transferred from one organism to another as each consumes a lower member and in turn is preyed upon by a higher member.

Fossil fuel: a hydrocarbon fuel, such as petroleum, derived from living matter of a previous geologic time.

Fresh water: water containing an insignificant amount of salts, such as inland rivers and lakes.

G

Gaining streams: streams that appear from the ground or cracks in rocks because they are flowing directly out of an aquifer.

Grade: the slope of the surface of the earth.

Green zones: areas along the river and stream banks, wetlands, lakes, and ponds where there is high productivity and diversity.

Grey water: domestic wastewater that <u>does not</u> contain human wastes such as tub, shower, or washing machine water.

Ground water: water that infiltrates into the earth and is stored in usable amounts in the soil and rock below the earth's surface; water within the zone of saturation.

H

Hardness: the amount of calcium carbonate dissolved in water.

Hazardous chemicals: chemical compounds that are dangerous to human health and/or the environment.

Heavy metals: metallic elements (e.g. cadium, chromium, cooper, lead, mercury, nickel, and zinc) which are to manufacture products; they are present in some industrial, municipal, and urban runoff.

Holding ponds: an animal waste treatment method, which uses a shallow pond to temporarily store animal wastes for land application at a later time.

Hydroelectric: that generation of electricity, which conveys the energy of running water into electric power.

I

Induced recharge: replenishing a body of water or aquifer by transporting water from somewhere else and putting it into an aquifer or body of water.

Industrial pollution: pollution cause by industry.

Infiltration: the gradual downward flow of water from the surface of the earth into the soil.

Injection wells: a well which fluids (such as wastewater, saltwater, natural gas, or used chemicals) are injected deep in the ground for the purpose of disposal or to force adjacent fluids like oil into the vicinity of oil producing wells.

Irrigation: to supply (dry land) with water by means of ditches, pipes or streams.

K

Karst: a topography formed over limestone, dolomite or gypsum and characterized by sinkhole, caves and underground drainage.

L

Lagoon: as a wastewater treatment method, an animal waste treatment methods which uses a pond to treat manure and other runoff from livestock operation, may be aerobic or anaerobic (both use bacteria to break down wastes).

Landfill: a large, outdoor area for waste disposal; landfills where waste is exposed to the atmosphere (open dumps) are now illegal; in “sanitary” landfills, a waste is layered and covered with soil.

Land use: how a certain area of land is utilized (e.g., forestry, agriculture, urban, industry).

Leachate: the liquid formed when water (from precipitation) soaks into and through a landfill, picking up a variety of suspended and dissolved materials from the waste.

Leaking underground storage tank (LUST): an underground container used to store gasoline, diesel fuel, home heating oil, or other chemicals that is damaged in some way and is leaking its contents into the ground; may contaminate groundwater.

Legislation: a proposed or enacted law or group of laws.

Losing streams: streams, which seem to disappear because they flow into an aquifer.

M

Marsh: low lying wetland.

Maximum contaminant levels: the highest level of certain substances allowable by law for a water source to be considered safe.

Membrane: a soft pliable sheet of layer, often of plant or animal origin.

Microbial digestion: breakdown and use of a substance by microorganisms.

Microorganism: organisms that are too small to be seen by an unaided eye (without a microscope). These include bacteria, protozoa, algae, fungi, and viruses.

Midnight dumping: a term used for illegal dumping of hazardous wastes in remote locations often at night, hence the term “midnight.”

Mill tailings: rock and other materials removed when minerals are mined; usually dumped onto the ground or deposited into ponds.

Monitoring: scrutinizing and checking systematically with a view to collecting data.

Mulch: a protective covering of various substances, especially organic; placed around plants to prevent evaporation of moisture and freezing of roots and to control weeds.

Municipality: a political unit, such as a town, incorporated for local self-government.

Municipal sewage: sewage originating from urban areas (not industrial).

N

National water quality standards: maximum contaminant levels for a variety of chemicals, metals, and bacteria set by Safe Drinking water Act.

Nitrates: used generically for materials made of nitrogen and oxygen.

Nitric acid: a component of acid rain; corrosive; damages buildings, vehicle surfaces, crops, forests, aquatic life.

Nonbiogradable: not biodegradable.

Non-compliance: no obeying all the federal and state regulations that apply.

Non-permeable surfaces: surfaces, which will not allow water to penetrate, such as sidewalks and parking lots.

Non-point source pollution (NPS): pollution that cannot be traced to a single point, because it comes from many individual places or a widespread area (eg., urban and agriculture runoff).

Nutrient: an element or compound, such as nitrogen, phosphorus, and potassium, that is necessary for plant growth.

O

Organism: any living being: plant or animals

Oxygen depletion: the reduction of dissolved oxygen level in a water body.

P

Percolate: to drain or seep through a porous substance.

Permeability: the property of a membrane or other material that permits a substance to pass through.

Pesticide: any chemical or biological agent that kills plant or animal pests; herbicides, insecticides, fungicides, rodentcides, etc., are all pesticides.

Petroleum products: products derived from petroleum or natural gas.

pH: a measure of the concentration of hydrogen ions in a solution; the pH scale ranges from 0-14, where 7 is neutral and values less than 7 are acidic and values greater than 7 are basic or alkaline.

Phosphate: used generically for materials containing a phosphates. Sources include fertilizers and detergents when phosphates enter surface water these chemical act as nutrient pollutants (causing over growth of aquatic plants).

Plankton: minute animal and plant life in a body of water.

Point source pollution: contaminants in the air, water, or soil that cause harm to human health or the environment.

Pollutant: an impurity (contaminants) that causes an undesirable change in the physical, chemical, or biological characteristics of the air, water, or land that may be harmful to or affect health, survival or activities of humans or other living organisms.

Pollution: contaminants in the air, water, or soil that use harm to human health or the environment.

Porosity: the property of being porous, having pores; the ratio of minute channels or open space (pores) to the volume of solid matter.

Precipitation: water droplets or ice particles condensed from atmospheric water vapor and sufficiently massive to fall to earth's surface, such as rain or snow.

Primary treatment: the first process in wastewater treatment, which removes settled or floating solids.

Pristine: describes a landscape and/or a water body remaining in pure state.

R

Radon: a colorless, radioactive, inert gaseous element (atomic number 86) formed by the radioactive decay of radium; exposure to high levels causes cancer.

Reclaim: to return to original condition.

Red tide: a reddish discoloration of coastal surface waters due to concentrations of certain toxin producing algae.

Reforestation: replanting trees and establishing a forest harvesting or destruction.

Regulation: a governmental order having the force of law.

Reverse osmosis: a process where water is cleaned by forcing water through an ultra-fine semi-permeable membrane which allows only the water to pass through and retains the contaminants.

River: a large natural stream emptying into a ocean, lake, or other body.

Riprap: large rocks placed along a bank of a waterway to prevent erosion.

Riverine habitats: tidal and non-tidal river systems that feed into wetlands.

Runoff: water (originating as precipitation) that flows across surfaces rather than soaking in; eventually enters a water body; may pick up and carry a variety of pollutants.

S

Safe Drinking Water Act: a regulatory program passed by the U.S. Congress in 1974 to help ensure safe drinking water in the United States; sets maximum contaminants levels for a variety of chemicals, metals and bacteria in public water supplies.

Saline intrusion: the saltwater infiltration of freshwater aquifers in coastal areas, when ground water is withdrawn faster than can be recharged.

Salt water: water associated with the seas distinguished by high salinity.

Saturated zone: underground layer in which every available space is filled with water.

Secondary treatment: the wastewater process where bacteria are used to digest organic matter in the wastewater.

Sediment: insoluble material suspended in water that consists mainly of particles derived from rocks, soil, and organic materials; a major non-point source pollutant to which other pollutants may attach.

Sediment pollution: the introduction of sediment into a water body.

Sediment pond: a natural or artificial pond fro recovering solids from effluent.

Septic system: a domestic wastewater treatment system (consisting of a septic tank and a soil absorption system) into which wastes are piped directly from the home; bacteria decompose the wastewater, sludge settles to the bottom of the tank, and the treated water flows out onto the ground through drainage pipes.

Settling tank: a vessel in which solids settle out of the water by gravity during drinking and wastewater treatment processes.

Sewage contamination: the introduction of untreated sewage into a water body.

Silage: livestock food prepared by storing and fermenting green forage plants in a silo.

Slough: a stagnant swamp, marsh, bog, or pond, or part of an inlet or backwater.

Sludge: solid matter that settles to the bottom of septic tanks or wastewater treatment sedimentation; deposed of by bacterial digestion or other methods or pumped out of land disposal or incineration.

Solar radiation: radiation emitted by the sun.

Solvent: a liquid capable of dissolving another substance (e.g., painter thinner, mineral spirits, and water).

Storm runoff: surface water runoff that flows into storm sewers.

Strip mine: an open mineral mine (e.g., coal, cooper, zinc, etc.) where the topsoil and overburden is removed to expose and extract the mineral.

Substance: a material of a particular kind.

Suffocate: to die due to lack of oxygen.

Sulfuric acid: an acid forms when sulfur oxides combine with atmospheric moisture; a major component of acid rain.

Surface water: precipitation that does not soak into the ground or return to the atmosphere by evaporation or transpiration, and is stored in streams, lakes, wetlands, reservoirs, and oceans.

Swamp: land having soils saturated with water for at least part of the year and supporting natural vegetation of mostly trees and shrubs.

T

Temperate climate: climates that are neither hot nor cold; mild.

Terrain: the characteristic features of a tract of land's surface; topography.

Thermal pollution: the increase in temperature of a body of water due to the discharge of water used as a coolant in industrial processes or power production; can cause serious damage to aquatic life.

Toilet dam: a device that is placed inside the tank portion of the toilet to reduce the amount the amount of water the tank will hold by partitioning off a part of the tank.

Toxic: having characteristic of causing death or damage to humans, animals, plants; poisonous.

Toxic chemical: a chemical with the potential of causing death or damage to humans, animals, or plants; poison.

Toxin: any of various poisonous substances produced by certain plant and animal cells, including bacterial toxins, phytotoxins, and zootoxins.

Transpiration: direct transfer of water from the leaves of living plants or the skins of animals into the atmosphere.

Treatment plant: facility for cleaning and treating fresh drinking water for drinking, or cleaning and treating wastewater before discharging into a water body.

Turbidity: the cloudy or muddy appearance of a naturally clear liquid caused by the suspension of particulate matter.

Turbine: a device in which a bladed wheel is turned by the force of moving water or stream; connected by a shaft to a generator to produce electricity.

Typhoid (fever): an acute, highly infectious disease caused by the typhoid bacillus, *Salmonella typhosa* transmitted by contaminated food or water and characterized by bad rashes, high fever, bronchitis and intestinal hemorrhaging.

U

Unconfined aquifer: an aquifer without a confining layer above it; the top surface of water in an unconfined aquifer is the water table.

Unsaturated zone: an area underground between the ground surface and the water table where the pore spaces are not filled with water, also known as zone of aeration.

W

Wastewater: water that has been used for domestic industrial purposes.

Wastewater treatment: physical, chemical, and biological processes used to remove pollutants from wastewater before discharging into a body of water.

Waterborne disease: a disease spread by contaminated water.

Water conservation: practices which reduce water use.

Water criteria: the degree of water quality needed to support a designated use for a body of water.

Watershed: land area from which water drains to a particular.

Well: a deep hole or shaft dug or drilled in the ground to obtain water, oil, gas, or brine.

Wellhead: the area of land surrounding drinking water wells which contributes water to the aquifer supplying the well.

Wellhead contamination: the addition of substances to the area of land surrounding a water well which reduces the well's water quality and prevents its use unless the water is treated.

Wellhead protection area: the surface and subsurface areas surrounding a water well or well filled supplying a water system.

Wetlands: areas that at least periodically have water logged soils or are covered with a relatively shallow layer of water.

X

Xeriscaping: landscaping technique designed to minimize the need for watering.