Lesson One: Water in Texas **Part I**
Activity One: The Water Cycle

Grade Level:
3rd, 4th, 5th

Time Frame:
1 Class Period (Fifty Minutes)

Materials:
Clear plastic jar with lid (or smaller container that fits on top of jar)
Hot water
Bag of ice
Food coloring

Overview

This activity will demonstration some of the ways water moves through natural systems, how water and the atmosphere are polluted and purified, how the water cycle purifies polluted water, and what role plants and soil have in the processes.

Objectives

1. Construct a model of the hydrologic cycle.
2. Observe that water is an element of a cycle in the natural environment and explain how the hydrologic cycle works and why it is important.
3. Identify the major rivers in Texas
4. Identify the major watersheds (basins) in Texas
5. Understand the movement of water across Texas
6. To identify a watershed and understand its processes

TEKS Correlation

Science
Grade 3 (B) 3.1, 3.2, 3.3, 3.4, 3.11
Grade 4 (B) 4.1, 4.2, 4.3, 4.4
Grade 5 (B) 5.25

Background Information

While this lesson is intended for third, fourth and fifth grade, a review of the water cycle is important for all learning levels. To understand the movement of water overland, one must first understand the hydrologic cycle. Because the Earth is essentially a closed system containing all the water we will ever have, all of this water moves in a pattern called the hydrologic or Water Cycle.

The form of water is always changing. Water moves from sky to Earth and back to the sky again. This is called the water cycle. Water falls to Earth as rain, snow, sleet, or hail. Some of the water soaks into the ground and is stored as groundwater, some water freezes and becomes part of glaciers.

The rest flows into streams, lakes, rivers, and oceans. The sun warms surface water and changes some of it into water vapor. This process is called evaporation. Plants give off water vapor in the process called transpiration. The heated water vapor rises into the sky and forms clouds. When the vapor in the clouds condenses, it falls back to the Earth as rain or snow. The water cycle has then come full circle and begins again.

Academic Questions

Where does the water on the earth's surface originate and where does it go?

Where are the major rivers and watersheds (basins) in Texas?

How does water move in and around your community?

What is a watershed?

Activity Procedures

A. Introduce and explain the new terms using the chalkboard. Give everyday examples of each term. Mention to students that the water we drink today has always been part of the earth's water cycle. The water we drink today was around during the time of the dinosaurs.

B. Build a model that will demonstrate the water cycle. Pour hot water into the plastic jar, filling it about 1/3 of the way. Add several drops of food coloring to simulate dissolved material. Place inverted lid (or smaller plastic container) on jar and fill with ice. Observe and discuss what is going on.

Things to look for:

Steam rising from warm water (clouds)

Drops forming on bottom side of lid (rain)

Product/Application

Have students discuss the demonstration of the water cycle. Discuss the following Questions.

1. What happens to the water when it gets heated up?
2. What effect does the ice have on the water?
3. Discuss the water cycle as it occurs in nature.
4. How is this demonstration similar? And how is it different?
5. How does the water cycle help to filter out impurities (food coloring)?
6. How might plants contribute to the water cycle?

Assessment

Have students label the different stages of the water cycle on the water cycle handout or have students draw their own water cycle and label the four stages: evaporation, condensation, precipitation, collection.

Resources

http://www.epa.gov/safewater/kids/tuar.html

The EPA's Web site offers a larger scale water cycle that students can build and observe over several class periods.

Lesson One: Water in Texas **Part I**
Activity Two: Rivers and Basins in Texas

Grade Level:
4-8

Timeframe:
1 Fifty Minute Class Period

Materials:
Texas River Basins Worksheet
Texas Major Rivers Worksheet
Texas State Highway Maps

Overview

This activity familiarizes students with major waterways in the state of Texas and helps students visualize that all rivers in Texas eventually flow into the Gulf of Mexico.

Objectives

- Identify the major rivers in Texas
- Identify the major watersheds (basins) in Texas
- Understand the movement of water across Texas

TEKS

Science	Social Studies
Grade 4 4.3	Grade 4 4.22
Grade 5 5, 5.3, 5.5	Grade 5 5.8, 5.25, 5.27
Grade 6 6.1,6.2	Grade 6 6.6
Grade 7 7.14	Grade 7 7.10
Grade 8 8.6	Grade 8 8.30

Background (Review pages 2 and 3 of Conducting a Watershed Survey)

The state of Texas consists of 23 major watersheds (basins) and has approximately 191, 228 miles of streams and rivers. All of these streams drain into the Gulf of Mexico. Of the total stream mileage, 144,603 miles (76 percent) have intermittent flow during some part of the year. Texas has approximately 5,700 reservoirs with a surface area of 10 acres or larger, for a total coverage estimated at 3,065, 600 acres.

The runoff from precipitation supplies and replenishes the two sources of Texas water: ground water and surface water. Underground rock formations, called aquifers, store groundwater. In Texas, nine major aquifers and 20 minor aquifers hold an estimated 3 to 4 billion acre-feet of groundwater. Annual rainfall replenishes about 5.3 million acre-feet of this amount each year. In 1990, groundwater supplied about 56 percent of total water use in Texas. The state projects a decrease in groundwater use in order to avoid depleting groundwater resources.

Of the lakes in Texas only one, Caddo Lake, is a natural lake. Texas has approximately 5,700 reservoirs, or man-made lakes, with a surface area of 10 acres or larger, for a total coverage estimated at 3,065, 600 acres and a total water supply of about 11 million acre-feet. Texans rely on 191 of these reservoirs to support about 97 percent of their surface water consumption.

Academic Question

Where are the major rivers and watersheds (basins) in Texas?

Activity Procedure

Give groups of students copies of the Texas State Highway Map, using an overhead projection of the Major Rivers, and Major Basins worksheet; have students identify the major rivers and basins in the state of Texas.

Product Application

Ask students which direction all rivers in the state flow. Have students discuss the distribution of rivers across the state.
Which areas of the state are more likely to be dry and therefore in need of more water?
Where do all the rivers in the state of Texas flow?
How does the Gulf of Mexico affect the fresh water system of Texas?

Assessment

Once students have identified rivers and basins as a group, pass out the Major Rivers Worksheet and Basin Worksheet and have students identify the basins and rivers.

Lesson One: Water in Texas **Part I**
Activity Three: The Movement of Water

Grade Level:
6th-10th

Time Frame:
One 45 minute lesson

Materials:
A roll of tin foil (each small group will work with a 15 inch long piece of tin foil)
A watering bucket with a sprinkle nozzle (one per group)

Overview

Through experimentation and cooperative group work the students will learn to identify watersheds.

See end of activity for TEKS Alignment

Objective

- To identify a watershed and understand its processes

Background

A watershed is the area of land from which precipitation drains to a single point. Watersheds are sometimes referred to as drainage basins or drainage areas.

Academic Question How does water move in and around your community? What is a watershed?

Activity Procedure

Allow students to explore the concept of watershed by conducting the following simple experiment in small groups:

a) Slightly crumple a piece of 15-inch tin foil. Spread the tin foil out on a flat surface while still preserving the folds and indentations. This tin foil represents a land surface.
b) Observe the tin foil contours. Where are the hilltops? Where are the valleys? Where is water most likely to pool? Which pathways would rain follow across the terrain of the land surface?
c) Using the definition of a watershed (under **Background**), identify how many watersheds are found on your land surface.
d) Carefully sprinkle a small amount of water over the tin foil. Watch the movement of water over the land surface. Identify the watersheds.

Product Application

Have students discuss their watershed models and simulate how water flows over their watersheds and into the waterways. Have students identify places that are most likely to be flooded. Allow students to apply their knowledge of watersheds by allowing them to observe runoff during a storm.

Assessment

Using the same piece of tin foil ask the students to create the following watershed characteristics:

1. Create a watershed that moves water quickly across the land surface.
2. Create a watershed in which the water moves slowly across the land surface.
3. Create a watershed in which the water movement gathers within the smallest land surface.
4. Create a watershed within a watershed.
5. Create two side-by-side watersheds.

Resources:

EPA's Surf Your Watershed http://cfpub1.epa.gov/surf/locate/index.cfm and
EPA's Enviromapper for watersheds (map2.epa.gov/enviromapper/). This interactive resource allows students to zoom in on their area of study, assess the water quality vulnerability, explore the different watershed tributaries, and much more. This web site can be used as a checkpoint for students to compare and contrast the boundaries of the watershed they traced to those mapped using the Enviromapper.

The Bureau of Economic Geology of the University of Texas has very inexpensive maps of Texas Geology, River Basins, Land Resources of Texas, Energy Resources, Mineral Resources, Geological Highway Map, and a Structure Map of the San Antonio Segment of the Edwards Aquifer and Balcones Fault Zone. For further information or to order, please contact the Publications Sales Office at 1-888-839-4365 or (512) 471-7144.

Watershed Education Resources on the Internet
(http://www.igc.org/green/resources.html)

This is a comprehensive list, complied by GREEN and EcoNet, of watershed and water-related resources on the Internet.

TEKS Correlation:
Science
Grade 6: 6.1, 6.2, 6.3, 6.4
Grade 7: 7.1, 7.2, 7.3, 7.4, 7.8, 7.12
Grade 8: 8.1, 8.2, 8.3, 8.4
Biology: (b)1, 12.D
Aquatic Science: (b)1, 4.B, 7B,C, 8.C,D
Environmental Science: (b)1, 5.A, B, C, E, F
Geology, Meteorology, and Oceanography: 10.C

Mathematics
Grade 6: 6.1, 6.8, 6.11, 6.12, 6.13
Grade 7: 7.3, 7.4, 7.9, 7.13, 7.14, 7.15
Grade 8: 8.5, 8.14, 8.15
Geometry: 6

Technology Applications (Computer Literacy)
Grades 6-8: 2, 4, 5, 7, 8

English
Grade 6: 6.1, 6.2, 6.5, 6.13, 6.17, 6.20, 6.22, 6/24
Grade 7: 7.1, 7.2, 7.5, 7.13, 7.17, 7.20, 7.22, 7.24
Grade 8: 8.1, 8.2, 8.5, 8.7, 8.10, 8.13, 8.17, 8.18, 8.20, 8.22, 8.24
English I: 1, 4, 6, 8, 13, 15, 16, 21
English II: 1, 4, 6, 7, 8, 13, 15, 16, 21

Lesson One: Part Two: Watersheds and Pollution
Activity One: Understanding Watershed Pollution Part II

Overview

In this lesson the students will learn to differentiate between point source and non-point source pollution and be able to identify these in real world applications.

Grade Level:
6-8

Time Frame:
1 Fifty Minute Class Period

Materials:
Conducting a Watershed Survey

Objectives

- Define point source pollution
- Identify non-point source pollution

TEKS

Science
Grade 6 6.3, 6.14
Grade 7 7.3, 7.14
Grade 8 8.14

Social Studies
Grade 6 6.6, 6.7
Grade 7 7.10

Background

The Chapter *Land and Water Uses That Affect Water Quality of Conducting a Watershed Survey* explores point and nonpoint source pollution. Point source pollution refers to water pollution that comes from an easily identifiable source such as the end of a pipe that leads from a treatment plant. Nonpoint source pollution occurs when rainfall or snowmelt runs over and through the ground, picking up pollutants and depositing them into lakes, streams, wetlands, and underground water supplies.

Academic Question

What are sources of point source pollution?
What are common sources of nonpoint source pollution?
How are point source and nonpoint source pollution different?

Activity Procedure

Have students read the chapter *Land Use and Water Uses That Affect Water Quality from Conducting a Watershed Survey.*

Product/Application

Once students have read the chapter, show slides or overheads of examples of different sources of pollution. Examples include:

Agriculture and grazing	Landfills and dumps	Lawn and garden care
Failing septic systems	Construction sites	Chemical spills
Point source discharges	Logging	Air pollution/transportation

Discuss as a class the difference between point source pollution, nonpoint source pollution. Ask students to identify examples of each source of pollution. Also discuss ways to help reduce each form of pollution.

Assessment

Once students understand the different sources of point source and nonpoint source pollution and have discussed sources of each, have the students fill out the Point and Nonpoint Source Worksheet and the Point and Nonpoint Source Pollution Study Sheet.

Lesson Two: Watersheds and Pollution
Activity Two: Build Your Own Watershed **Part II**

Grade Level
6-8

Time Frame:
With prior setup-1 class period

Materials:
1 large tupperware container (about 1.5'W x 3'L x 1'H)
2 lbs. of modeling clay
3 lbs. of sand (any type of sand will do)
2 lbs. of aquarium gravel
1 roll of wax paper (or any other impervious, water repellant surface, tin foil, plastic wrap, etc.)
1/4 cup of cocoa mix, iced tea mix, or other flavored drink mix (to represent chemicals)
1 spray bottle or bucket full of water

Overview

The teacher will construct a model to demonstrate the basic properties of a watershed, how water flows from higher elevations to lower elevations, and how watersheds are interconnected. The students will understand how the placement of buildings, roads, and parking lots can be important to watershed runoff, and how careless use and disposal of harmful contaminants can have a serious effect on downstream watershed ecology and habitat.

Objectives

- To create and study a watershed model
- To demonstrate the concept of non-point source pollution and its relationship to careless landuse practices.

TEKS

Science	Social Studies
Grade 6 6.3, 6.14	Grade 6 6.6
Grade 7 7.3, 7.14	Grade 7 7.10
Grade 8 8.14	

Background

The land we live on is divided into watersheds. A watershed is a land area whose runoff drains into any river, stream, lake, or ocean. When unobstructed, water seeps down through the soil to aquifers, which are underground rivers that slowly move water below watersheds to outlet points at springs, rivers, lakes, and oceans. Watersheds and aquifers are connected in that each can contribute to and effect the other.

Small watersheds, such as the watershed for the creek behind your house, or the watershed for the pond down the road, drain into small bodies of water, and cover small land areas. The runoff from small watersheds, join together, and their combined areas become a new, larger watershed. Large watersheds, such as the Mississippi Basin and the Chesapeake Bay

watershed, drain into large bodies of water, and cover immense land areas. Despite their differences in sizes and location, all watersheds share common properties. They all perform the same function of transporting water over the Earth's surface.

Because all land is part of a watershed, human activities can have adverse effects on them. For example, construction projects like dams can limit the flow of water while other construction projects can divert and/or increase the flow of water. Fertilizers, used in fields, golf courses, and lawns can run off and inadvertently fertilize harmful microorganisms in rivers and lakes, thus effecting water quality and marine life, irresponsibly disposed of household and industrial chemicals travel through the watershed, poisoning life and damaging natural ecosystems.

Many communities use rivers and streams as their source of drinking water. Water treatment prepares this water for human consumption, but if the watershed is contaminated or laden with chemicals and microorganisms, it can be difficult to treat effectively which, in turn, will effect the health and welfare of that community.

Floods are one of the major events in a watershed. Homes built on flood plains, low lying areas adjacent to rivers, are susceptible to flooding conditions when heavy precipitation exceeds the watershed's capacity to absorb water. Rivers, streams, and lakes overflow, threaten human lives, and damage or destroy roads, buildings, and flood control measures. On the other hand, watersheds can also become dry, causing water shortages for those who depend on their lakes and rivers for drinking water.

It is clear that humans have a close relationship with watersheds. The responsible planning of watershed use and development should include measures that sustain healthy water resources and ecosystems.

Procedure

(Note: prepare steps 1 to 4 before students are present)

1. Wash the aquarium gravel carefully to remove any powdery residue that may add cloudiness to the water. Fill the container to about 2 inches from the bottom with the gravel. Slope the gravel slightly so, that at one end (downslope), the gravel is only about ½ inch deep and, at the other end (upslope), the gravel is about 3 inches deep. This gravel layer will represent the aquifer.

2. Mix the clay and the sand. The consistency of this mix should be gritty, with slightly more clay than sand. This mixture should allow water to run freely over it, but if left standing, the water should slowly permeate the surface. Add this mixture to the container carefully, so as not to disturb the slope of the aquifer already placed. The slopes should be similar, with about 2 inches of sand/clay mix overlying the gravel already placed, and on the downhill end there should be about 3" of gravel left exposed.

3. Carve a channel in the middle of the clay/sand layer, about ½ inch deep and about 1 inch wide. This channel will represent the main river of the watershed. Near the top of the slope, split the channel into two or three separate channels to represent tributaries. You may wish to add other tributaries along the main branch of the "river" to further illustrate other watersheds.

4. With some extra clay/sand mix, build little hills between the tributaries. These hills separate the smaller watersheds, but when looked at as a whole, the entire "river" system is one watershed. You may also wish to add some small model trees or green felt to represent forests or fields. Buildings can be represented with small blocks of wood.

5. Along the main river, flatten out an area that is about 8 inches by 3 inches. Cut out a piece of wax paper to be about 4 inches by 3 inches in size. Stick this down onto the clay sand mix, sloping it slightly towards the river. If necessary, use some clay to hold the edges down. Explain to students that this wax paper represents the impervious surface of a parking lot.

6. Fill the bottom of the aquarium up to about 2 inches from the bottom with water. The water should fill all of the aquarium gravel "aquifer" area, and should just reach up to the lowest extent of the clay/sand mixture. Explain to students that the aquifer captures and transports water that seeps down through the soil.

7. Using the spray bottle, simulate rain over the flattened soil area and the parking lot. Ask the students to note that the "rain" soaks through the soil, but runs off the parking lot to the river. Ask them what the effect would be if the entire watershed was "paved".

8. Sprinkle some cocoa mix over the sides of one of the smaller watersheds. Tell the students that the cocoa represents pollution. Over one of the unpolluted "watersheds," cause some rain with the spray bottle (*it may be necessary to cause more rain by pouring water). Note that the runoff from the rain is clean. Now, make it rain over the polluted area. Ask the students to note how the pollution travels down through the watershed, contaminating all downstream areas. Discuss with the students why the pollution is a problem, and what can be done to fix the problem.

Product/Application:

1. What are some possible sources of watershed pollution in your community?
2. What other impervious surfaces besides parking lots can cause excessive runoff in a watershed?
3. What can be done to reduce our impact on watersheds and their environment?

Assessment

1. On your own paper, draw a cross-section of your watershed model. Label all areas of the model-gravel, clay, percolation, area, storage areas, rivers.
2. Write a description of how water moves through your watershed model, including all areas of the watershed caves, rivers, percolation, aquifers, etc.