8th Grade Science

Goals 1, 3
Objectives 1.01-1.10
Objectives 3.02, 3.03, 3.07, 3.08

Marine Ecosystem Health:

Water Cycle, Pollution, and the Scientific Method

National Park Service
Cape Lookout National Seashore
Harkers Island, North Carolina

Table of Contents

Overview of Pre-visit, On-site, and Post-visit Activities 2
NS Standard Course of Study Goals and Objectives Filled 6

Pre-Site Visit

A Quick Summary of the Water Cycle 7
Water Cycle Vocabulary 9

On-Site Visit

Water Infiltration and Discharge: Using the Scientific Method 10
Water Infiltration and Discharge Activity 11
Where Does Our Water Come From Activity 13
Neuse River Basin and White Oak River Basin Maps 14
What's In Our Water? 16
The Great Pacific Garbage Patch 18
Marine Habitats are Being Lost 20
Building on the Shore Activity 21

Post-Site Visit

Post-Visit Knowledge Assessment 23
How Much Water Does the Average American Use? 25
Daily Water Consumption by Activity 26
Water Consumption Journal Activity 27
Water Consumption Journal Data Sheet 28
Additional Resources 29

Marine Ecosystem Health

Overview

Description:

The learner will be able to:

- Using Cape Lookout National Seashore as an example, describe the water cycle's major elements and their roles in supporting life on earth
- Understand why the water cycle is important to us, biologically and politically
- Understand the need for conservation of water resources
- Describe the major pollutants in our water, where they come from, what they harm, and what can be done about them
- Understand the components of a healthy marine system and the need to preserve our beaches, barrier islands, wetlands, and oceans

Group Size: 5-25

Time: 45-50 minutes per class visit for on- and pre-site visit activities

On-site activity covers a five (5) day session

Location: Classroom and School Grounds

Pre-Site Visit Activities: TEACHER COMPLETED

Knowledge Assessment (in post-site materials)

Water Cycle Introduction

- Split students in groups of 2-3 and give each group a water cycle poster
- Have them reed the "Quick Summary of the Water Cycle"
- Use the discussion points below to guide students through the materials
- Have students complete the "Water Cycle Vocabulary" and review as a class

Discussion Points

- Although we depict the water cycle as a circular mechanism flowing continually from the ocean to the atmosphere to the land and back to the ocean, these elements do not follow each other in order. All of these elements are in play at the same time.

    - For example: Evaporation happens not only from the ocean, but at the same time from the land masses, and from surface runoff.
    - The water cycle is the constant movement of water on, in, and above the earth changing from liquid to vapor to ice and back again.
- The water cycle is a closed system.
    - The water contained on the earth is all the water we have. No new water is coming into the system.
- While the water cycle is a closed system, the water on Earth is all interconnected.
    - Water from Egypt may end up in England. Glacier ice from the Antarctic can find its way to the faucets of townhouses in Raleigh.
- Water originally came from superheated magma when the earth was first formed.
    - As the magma cooled, the water it contained evaporated cooling the atmosphere enough to allow water to accumulate on the surface as a liquid.

On-Site Visit Activities: RANGER COMPLETED

<u>Day 1 and Day 2</u>

Brief review of the water cycle

Will Wars of the Future be over Water?

Where in the Cycle is the Water?

The Water Cycle and Cape Lookout

Where Does Our Water Come From Activity

Water Infiltration and Discharge Activity

<u>Day 3 and Day 4</u>

Characteristics of a Healthy Marine Environment

Plastic: the Most Common Pollutant in Our Oceans

- Slide Show

Trash Movement in the Ocean

- What this Means for the Ecosystems of Cape Lookout

Day 5

Human Impacts on Barrier Islands in NC

- Cape Hatteras vs. Cape Lookout

Building on the Shore Activity

Post-Site Visit Activities: TEACHER COMPLETED

Knowledge Assessment

Water Usage and Consumption

- Have students read “How Much Water” and “Daily Water Consumption” handouts
- Use the discussion points below to guide students through the materials
- Water Consumption Journal Activity
- Draw Cape Lookout Water Cycle posters

Discussion Points

- List the top five (5) items students think we need to do to start conserving water.
- Compare the Water Consumption Journals
    - Identify the activity which uses the most water
    - Discuss ways to reduce water use
- Complete the USGS water challenge questionnaires
    - Talk about how close they came to estimating the water needed to produce different items

Marine Ecosystem Health

Goals and Objectives

NCSCOS Goal 1: The learner will design and conduct investigations to demonstrate an understanding of scientific inquiry.

Objective 1.01: Identify and create questions and hypotheses that can be answered through scientific investigations.
Objective 1.02: Develop appropriate experimental procedures for: Given questions, Student generated questions
Objective 1.03: Apply safety procedures in the laboratory and in field studies: Recognize potential hazards, Manipulate materials and equipment, Conduct appropriate procedures.
Objective 1.04: Analyze variables in scientific investigations: Identify dependent and independent, Use of a control, Manipulate, Describe relationships between, Define operationally.
Objective 1.05: Analyze evidence to: Explain observations, Make inferences and predictions, Develop the relationship between evidence and explanation.
Objective 1.06: Use mathematics to gather, organize, and present quantitative data resulting from scientific investigations: Measurement, Analysis of data, Graphing, Prediction models.
Objective 1.07: Prepare models and/or computer simulations to: Test hypotheses, Evaluate how data fit, Make predictions.
Objective 1.08: Use oral and written language to: Communicate findings, Defend conclusions of scientific investigations, Describe strengths and weaknesses of claims, arguments, and/or data
Objective 1.09: Use technologies and information systems to: Research, Gather and analyze data, Visualize data, Disseminate findings to others.
Objective 1.10: Analyze and evaluate information from a scientifically literate viewpoint by reading, hearing, and/or viewing: Scientific text, Articles, Events in the popular press.

NCSCOS Goal 3: The learner will conduct investigations and utilize appropriate technologies and information systems to build an understanding of the hydrosphere.

Objective 3.02: Explain the structure of the hydrosphere including: Water distribution on earth, Local river basin, Local water availability.
Objective 3.03: Evaluate evidence that Earth's oceans are a reservoir of nutrients, minerals, dissolved gases, and life forms: Estuaries, Marine ecosystems, Upwelling, Behavior of gases in the marine environment, Value and sustainability of marine resources, Deep ocean technology and understandings gained.
Objective 3.07: 3.07 Describe how humans affect the quality of water: Point and non-point sources of water pollution in North Carolina, Possible effects of excess nutrients in North Carolina waters, Economic trade-offs, Local water issues.
Objective 3.08: Recognize that the good health of environments and organisms requires: Monitoring of the hydrosphere, Water quality standards, Methods of water treatment, Maintaining safe water quality, Stewardship.

A Quick Summary of the Water Cycle

United States Geological Survey

What is the water cycle?

What is the water cycle? I can easily answer that—it is "me" all over! The water cycle describes the existence and movement of water on, in, and above the Earth. Earth's water is always in movement and is always changing states, from liquid to vapor to ice and back again. The water cycle has been working for billions of years and all life on Earth depends on it continuing to work; the Earth would be a pretty stale place to live without it.

Where does all the Earth's water come from? Primordial Earth was an incandescent globe made of magma, but all magmas contain water. Water set free by magma began to cool down the Earth's atmosphere, until it could stay on the surface as a liquid. Volcanic activity kept and still keeps introducing water in the atmosphere, thus increasing the surface- and ground-water volume of the Earth.

A quick summary of the water cycle

The water cycle has no starting point. But, we'll begin in the oceans, since that is where most of Earth's water exists. The sun, which drives the water cycle, heats water in the oceans. Some of it evaporates as vapor into the air. Ice and snow can sublimate directly into water vapor. Rising air currents take the vapor up into the atmosphere, along with water from evapotranspiration, which is water transpired from plants and evaporated from the soil. The vapor rises into the air where cooler temperatures cause it to condense into clouds. Air currents move clouds around the globe, cloud particles collide, grow, and fall out of the sky as precipitation. Some precipitation falls as snow and can accumulate as ice caps and glaciers, which can store frozen water for thousands of years. Snowpacks in warmer climates often thaw and melt when spring arrives, and the melted water flows overland as snowmelt. Most precipitation falls back into the oceans or onto land, where, due to gravity, the precipitation flows over the ground as surface runoff. A portion of runoff enters rivers in valleys in the landscape, with streamflow moving water towards the oceans. Runoff, and ground-water seepage, accumulate and are stored as freshwater in lakes. Not all runoff flows into rivers, though. Much of it soaks into the ground as infiltration. Some water infiltrates deep into the ground and replenishes aquifers (saturated subsurface rock), which store huge amounts of freshwater for long periods of time. Some infiltration stays close to the land surface and can seep back into surface-water bodies (and the ocean) as ground-water discharge, and some ground water finds openings in the land surface and emerges as freshwater springs. Over time, though, all of this water keeps moving, some to reenter the ocean, where the water cycle "ends" ... oops - I mean, where it "begins."

Components of the water cycle

The U.S. Geological Survey (USGS) has identified 16 components of the water cycle:

- Water storage in oceans
- Evaporation
- Sublimation
- Evapotranspiration
- Water in the atmosphere
- Condensation
- Precipitation
- Water storage in ice and snow
- Snowmelt runoff to streams
- Surface runoff
- Streamflow
- Freshwater storage
- Infiltration
- Ground-water storage
- Ground-water discharge
- Springs

Water Cycle Vocabulary

Using your Water Cycle poster and group discussion come up with a correct definition for each word. Write that definition next to the term. You'll need to have an understanding of these terms as we talk later about the Water Cycle.

- Evaporate----
- Sublimate----
- Evapo-transpiration----
- Evaporation----
- Infiltration----
- Precipitation----
- Condensation----
- Ground-water storage----
- Ground-water discharge----
- Surface runoff----

Water Infiltration and Discharge:

Using the Scientific Method

Steps of the Scientific Method:

1. **Question:** Which of 5 soils found at Cape Lookout National Seashore has the fastest rate of infiltration? Which has the fastest rate of discharge? Which has the largest amount of discharge?

2. **Research:** Go online to discover information about the 5 soils we will have in our experiment. Our soils will come from the following areas: beach sand, high dunes, grassy plain, maritime forest, saltwater marsh.

3. **Construct your hypothesis (an educated guess as to how something works):** Each group will be measuring the rate of infiltration (how long it takes for the water to pass through your soil) the rate of discharge (how long it takes for the water to stop passing through your soil), and the amount of water that discharges once water begins to pass out of your soil.

4. **Test your hypothesis with experimentation:** Everyone will follow the same experimental procedure as outlined on the following page. It is important that each soil be tested in the same manner so that we have a fair test. Because each of the soils is different we must keep all other conditions, known as variables, the same—containers filled to the same level with each soil, same amount of water used, etc. Our only variable (different condition) will be the soil type. We also will be doing 3 replications. A replication is repeating your experiment more than one time to make sure your data is as accurate as possible.

5. **Analyze and report your results and form a conclusion:** Think about what happened and why. Discuss with your partners. Come to agreement within your group, and write it down! If you disagree be prepared to make a logical, and reasoned argument for your position. This is where we will look at everyone's results, graph our rates of infiltration, rates of discharge, the amounts of water that collected in our catch beakers-actual discharge. AND THINK!

6. **Was your hypothesis true or false?**

   Write your conclusion in your lab book.

Water Infiltration and Discharge

On-Site Visit Activity

Description:
Students will identify various properties of the soil at Cape Lookout by using the scientific method to conduct an experiment.

Materials:
3 tin columns
3 gauze pads
3 rubber bands
1 catch collector, for water that discharges through the soil
1 soil sample
Measuring beakers
2 spoons
1 ruler
1 large sheet of white paper
2 magnifying glasses
2 pieces of graph paper
Pencil and a permanent marker
1 large plastic container

Directions: Time involved = approx. 30 minutes

1. Put your soil sample into your large plastic container.
2. Using your spoon, stir until well-mixed.
3. Put 3 spoons full of soil from 3 different parts of your container on your white sheet of paper.
4. Carefully spread your samples out with the tip of your pencil.
5. Examine the soil using the magnifying glasses.
6. Write down the physical properties of your soil—large grains or small grains; pieces of leaves, or grass, or insects; light color or dark color; feels gritty or soft, smells like pine trees etc. ANYTHING YOU CAN SEE, FEEL OR SMELL.
   - **Warning!** Do not stick your nose into the soil. See if you can smell something from about 1 foot away!
7. Using your ruler, mark a line at 5 cm. in each of your columns with a permanent marker.
8. Secure a gauze pad to the bottom of each of your columns with a rubber band
9. Carefully put your soil sample into individual columns up to the 5 cm. line
10. Slowly pour 200 ml. of water into your first column making sure to hold the column over the catch collector to collect the water. Make sure you pour on the entire top of the soil, not just in one spot!

11. Time the passage of water through your first column using a watch or the room clock—it must be able to show you seconds NOT JUST MINUTES and write down the time it takes from starting to pour to first drops of water coming out the bottom—this is your infiltration rate.
12. Also, time how long it takes for the water to stop coming out into the catch beaker—this is your discharge rate.
13. Measure the amount of water in your catch beaker—this is your actual discharge.
14. Repeat Steps 6-13 for each of your remaining columns; these are called replications
15. Your data for each measurement should be close
    - Example: all infiltration rates should be close, all discharge rates should be close, and amounts of discharge should be close. If they aren't, what could have happened?
16. Put all your data on the board. Average the data for each measurement for all 3 of your replications
17. Graph your data for each of your replications on your graph paper. Use bar graphs.
    - Write **infiltration (I)** below one bar for your first replication,
    - then **discharge (D)** below another bar for your first replication.
    - You should ultimately have 6 bars (two for each of rep. 1, rep. 2, rep. 3).
    - Graph the average of your data on a separate sheet of graph paper and mark your bars with the type of soil you had. On this same paper graph the averages of everyone else's data.
    - See example at the bottom of this page.
    - Remember this is the rate for 5 cm of soil! Note that on your graph.
18. Compare your data in groups of 3-5.

Questions: Time involved = approx. 15 minutes

- What happened?
- Which soil had the fastest infiltration rate? Which had the fastest discharge rate? Were they the same soil or different soils?
- Which were the slowest?
- Which discharged the most water, the least water? Which is a better storage of water?
- Can you rank the soils 1-5 from fastest to slowest in each category?
- Why do you think the fastest was fastest and the slowest was slowest?
- What physical properties might have contributed to fast infiltration or slow discharge, etc?
- Was your hypothesis true or false?

Report what your group thinks to the class.

Where Does Our Water Come From?

On-Site Visit Activity

Description:
Students will discover the function of river basins and discuss the effect pollutants have on the surrounding ecosystems.

Materials:
North Carolina State Transportation Map
General Map of the Neuse River Basin
General Map of the White Oak River Basin
"What's in Our Water?" Handout on the White Oak and Neuse River Basins

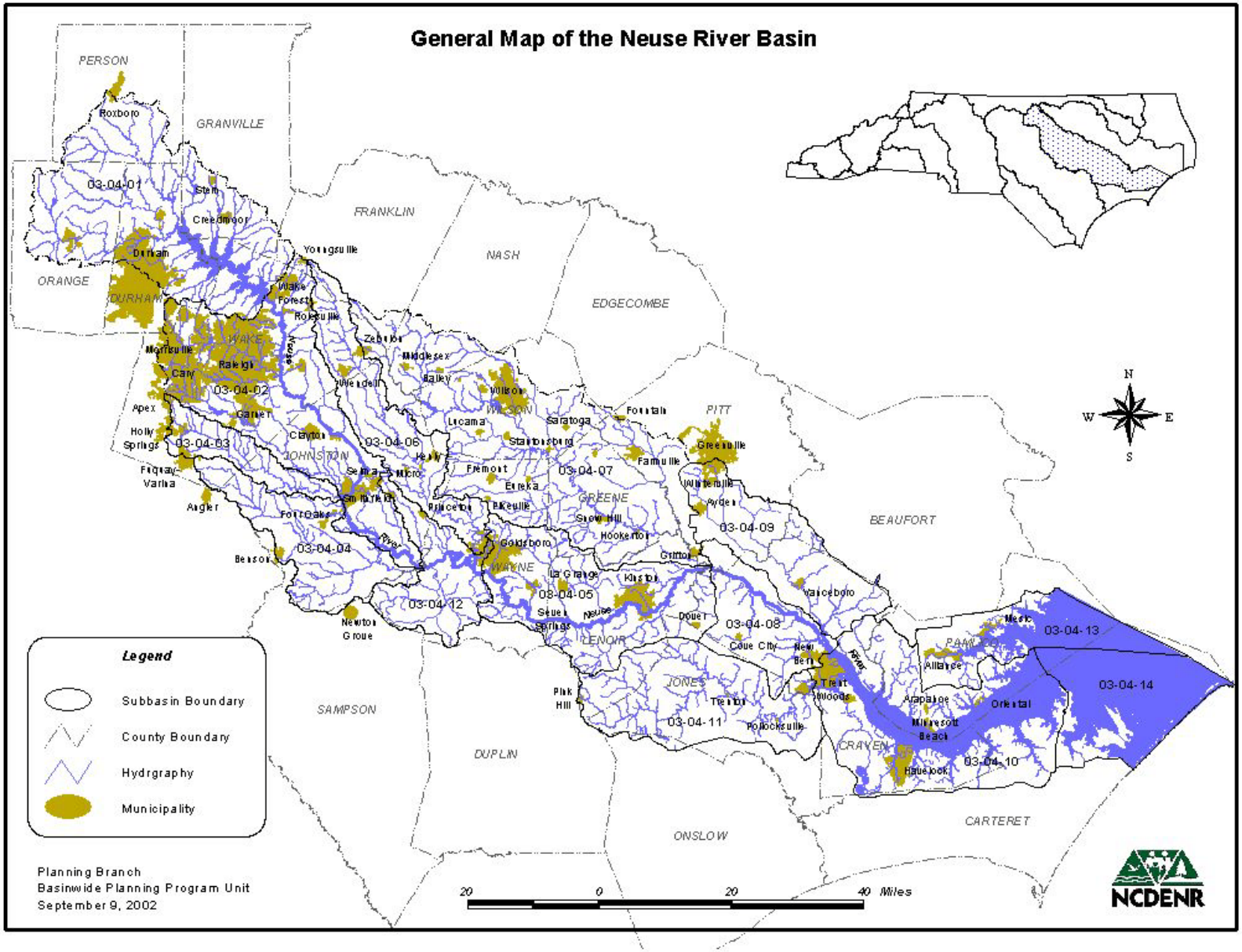
Directions:

1. Open your N.C. State Transportation Map to the large side depicting the whole state.
2. Using only your finger (please do not write on these maps) trace the Neuse River from its outlet in the Pamlico Sound back to its source.
3. Take a few minutes to study the General Maps of the Neuse and White Oak River Basins.
4. Read the "What's in Our Water?" handout

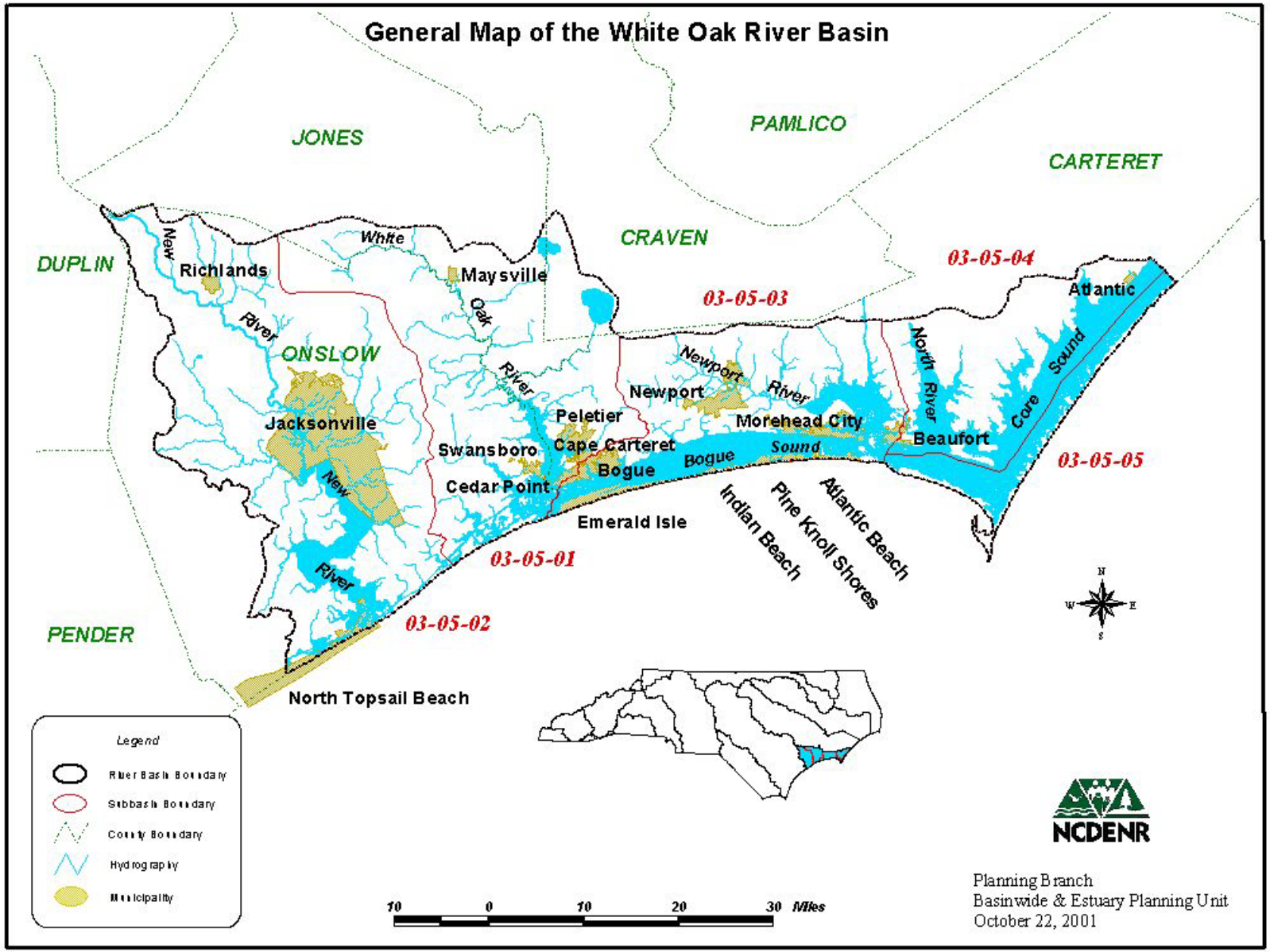
Questions:

- What counties does the Neuse River flows through?
- How many counties does the Neuse River run through?
- What major towns or cities does the Neuse River run by or through?
- What kinds of pollutants do you think the Neuse River could pick up along the way to Core and Pamlico Sounds? Ultimately, where do you think these pollutants end up?
- Did you expect these river basins to drain this amount of land area?
- Which river drains the most land?
- When we say these rivers "drain" an area what are we talking about?
- What pollutants seem to be the major problems in the White Oak River Basin? In the Neuse River Basin?
- Where do these contaminants eventually end up?
- Where is the point source pollution coming from that enters the Neuse River Basin?
- Where is the non-point source pollution coming from that enters the White Oak River Basin?
- How does this affect different plants and animals along the river basins? How will this affect be different for plants and animals in different areas of the river basin?
- How does this affect the park?
- What can people do to help reduce pollutants in the river basins?

- The Neuse River Basin drains water from Carteret, Craven, Beaufort, Jones, Pitt, Greene, Lenoir, Wayne, Pamlico, Johnston, Wilson, Nash, Wake, Durham, Orange, Person, Franklin, and Granville counties into Pamlico and Core Sounds and ultimately the Atlantic Ocean. It is the third largest river basin in N.C.



The White Oak River Basin drains water from Onslow, Jones, Craven and Carteret Counties into Bogue, Core and Back Sounds and ultimately into the Atlantic Ocean.



WHITE OAK RIVER BASIN

Tucked between the eastern portions of the Neuse and Cape Fear river basins, the White Oak River Basin includes coastal and freshwater wetlands, and four separate river systems, or subbasins, that feed into highly productive estuaries of Back, Core and Bogue sounds. Core Sound produces the most valuable seafood catch in the basin, followed by Bogue Sound and the Newport River.

Total miles of streams and rivers:	446
Municipalities within basin:	16
Counties within basin:	4
Size:	1,264 square miles
Population:	150,501 (2000)

The basin is named for the White Oak River, a 48-mile river that spills into Bogue Sound past Swansboro. Both privately and publicly owned wetlands cover almost half the basin. The basin contains over half of the 160,000-acre Croatan National Forest, the only coastal forest in the national forest system. It contains tidal marshes and flats and unique coastal forests along with rare plants.

Camp Lejeune has some of the highest quality longleaf pine and pocosin habitats remaining in North Carolina. Pocosins are raised bogs with a thick layer of peat. The deep soils absorb rainwater and release it slowly into adjacent estuaries. This filtering function helps preserve the correct balance of saltwater and fresh water that estuarine organisms, including fish and shellfish, need to survive.

Persistent algae blooms in subbasin rivers, caused the state to classify the headwaters of three of these rivers as “nutrient sensitive waters” and placed restrictions on nutrients in wastewater treatment plant discharges. Since 1991, wastewater treatment improvements have occurred, including eliminating Jacksonville’s discharge into the river and construction of one large, modern wastewater treatment plant at Camp Lejeune.

Many of the basin’s shellfish beds are closed to harvest due to contaminated runoff from construction sites, developed areas, streets and yards, farmland and forestry operations. After heavy rains, The estuaries contain high levels of fecal coliform, a harmful pathogen in shellfish coming from warm-blooded animals (including humans) waste. Twenty-four percent of the basin’s shellfish waters cannot completely fulfill their use as a shellfish resource because of pollution. Polluted runoff also includes nutrients like nitrogen and phosphorus (from fertilizers, detergents and animal waste) that can trigger overgrowth of algae that use up the oxygen and cause fish kills. Runoff also contains oil, grease and chemicals from surfaces like paved roads, parking lots, sidewalks and driveways. More techniques are now in place or available to reduce runoff by slowing water so it can be cleansed by plants and soil. New federal rules will require cities (based on size) to develop strategies to manage and treat stormwater runoff.

People can help prevent polluted runoff and eroded soil from entering streams and estuaries by preserving buffers of trees and shrubs along the edges of waterfront property. Such vegetation can help filter harmful substances from runoff. If landowners use paving alternatives allowing rainwater to soak into the ground (crushed stones or permeable pavers, for example), they can limit runoff from their property along with the contaminants it carries. People also can help by limiting their use of fertilizers and pesticides on landscapes and making sure septic systems are maintained and working properly.

NEUSE RIVER BASIN

The Neuse River is the longest river in North Carolina. At its mouth, it is the widest river in America—6 miles across. In the 1990s, however, floods, algae blooms, fish kills, and a toxic aquatic organism devastated the Neuse.

Total miles of streams and rivers:	3,880
Total acres of lakes:	16,414
Total acres of estuary:	369,977
Total miles of coastline:	21
Municipalities within basin:	74
Counties within basin:	18
Size:	6,235 square miles
Population:	1,320,379

The Neuse once began at the merging of the Eno and Flat rivers, but now begins at Falls Lake Reservoir Dam above Raleigh. It then flows freely as a freshwater river until it reaches New Bern where it becomes brackish, widens and travels sluggishly as it becomes a 40-mile-long tidal estuary emptying into Pamlico Sound.

It is North Carolina's third largest basin and contains one-sixth of the state's population. Water quality in the lower Neuse River is threatened by large quantities of nutrients, especially nitrogen, contributed mostly from "nonpoint" sources. Nonpoint pollution comes from a large, diffuse area. Fertilizers and animal waste washed from lawns, urban developed areas, farm fields and animal operations, particularly hog farms, contribute 60 percent of the nitrogen and phosphorus overload. The same nutrients in those wastes can be beneficial to aquatic life in small amounts, but too many nutrients can results in overgrowth of aquatic plants (like algae) and low levels of dissolved oxygen. Aquatic animals need dissolved oxygen to survive. To a lesser degree, water quality in the Neuse River Basin is affected by "point source" pollution from more than 400 sites allowed (by state permit) to discharge treated wastewater into streams and rivers. It is thought that nutrient pollution may have stimulated toxic outbreaks of *Pfiesteria piscicida*, a free-swimming, microscopic organism that was linked to major fish kills on the lower river in 1995.

The situation on the lower Neuse and other eastern North Carolina rivers spurred the N.C. Legislature in 1997 to enact a statewide moratorium on the creation of new hog farms so researchers can investigate their effect on water quality and examine alternative technologies to better handle their waste. The moratorium was extended in 2003. The crisis also prompted significant new state laws and regulations in 1998 intended to reduce nitrogen inputs to the Neuse by 30 percent within five years. The "Neuse rules" are among the first comprehensive management strategies in the country to include mandatory measures for both point and nonpoint sources of nutrients.

Although nutrient pollution has been the most publicized issue, population growth and accompanying development contribute to increased stormwater runoff throughout the basin. As pavement and lawns replace natural forests and wood lands, rain and melting snow race over land more quickly, carrying pollution and entering streams at a high speed. The Triangle (Raleigh-Durham-Chapel Hill region) was home to about 370,000 people in 1970; that population now numbers about 600,000 and is projected to reach 1 million by 2010. The population in Wake County alone is expected to grow by more than 60 percent in the next 20 years; the population in the entire basin is expected to increase by 36 percent during that time.

The Great Pacific Garbage Patch

In the broad expanse of the northern Pacific Ocean, there exists the North Pacific Subtropical Gyre, a slowly moving, clockwise spiral of currents created by a high-pressure system of air currents. The area is an **oceanic desert**, filled with tiny phytoplankton but few big fish or mammals. Due to its lack of large fish and gentle breezes, fishermen and sailors rarely travel through the gyre. But the area is filled with something besides plankton: trash, millions of pounds of it, most of it plastic. It's the largest landfill in the world—bigger than the state of Texas, and it floats in the middle of the ocean about 1000 miles from the California coast.

Plastic constitutes 90 percent of all trash floating in the world's oceans [source: LA Times]. The United Nations Environment Program estimated in 2006 that every square mile of ocean hosts 46,000 pieces of floating plastic [source: UN Environment Program]. In some areas, the amount of plastic outweighs the amount of plankton by a ratio of six to one. Of the more than 200 billion pounds of plastic the world produces each year, about 10 percent ends up in the ocean [source: Greenpeace]. Seventy percent of that eventually sinks, damaging life on the ocean floor [source: Greenpeace]. The rest floats; much of it ends up in gyres and the massive garbage patches that form there, with some plastic eventually washing up on a distant shore.

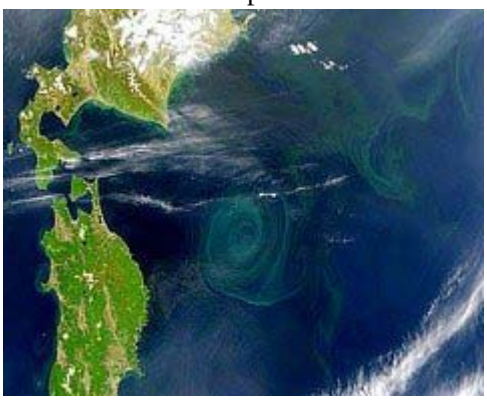
All of this plastic is killing marine life and toxic chemicals from the plastic waste have the potential to accumulate in the food chain and effect human health. Researchers plan to study and document this plastic soup, as well as test methods for removing the debris and reprocessing it into diesel fuel.

These animals which have been caught in nets and trash may lose limbs, mobility, or their lives.

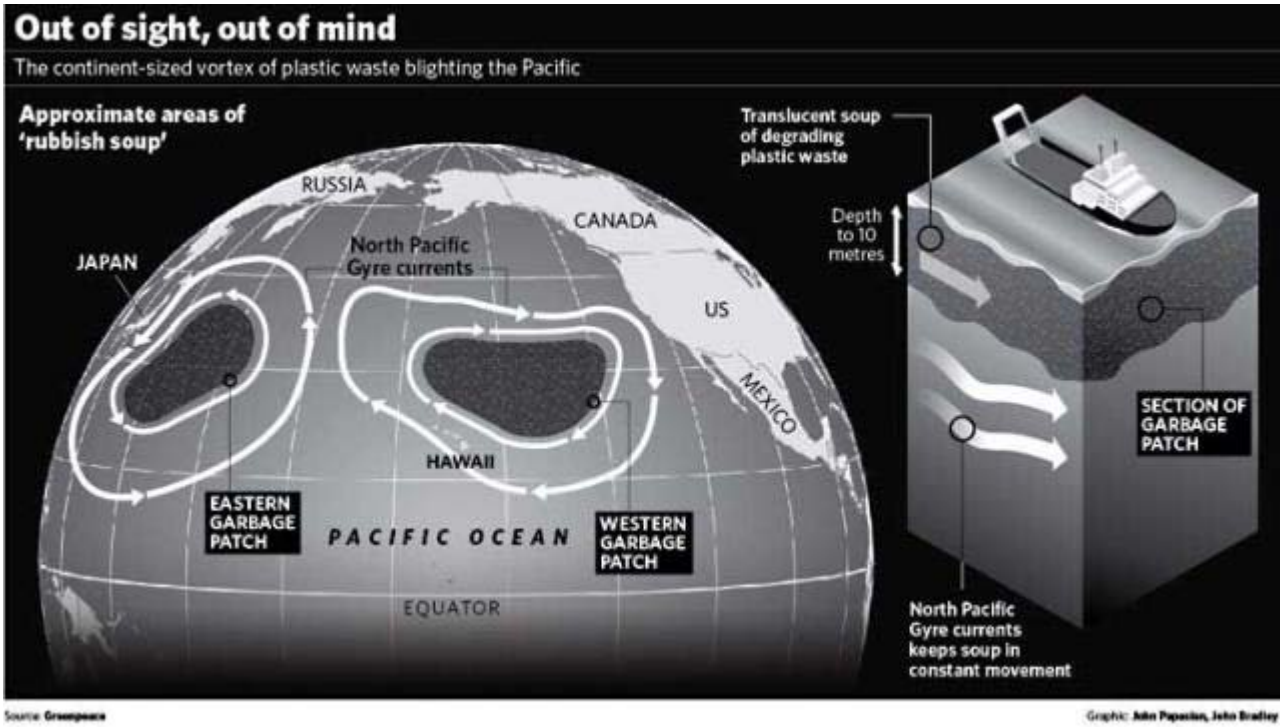
[atic

The North Pacific Gyre

As seen from outer space.



Location of the Gyre and its relative size in the Pacific.



Marine Habitats Are Being Lost

Shallow inshore waters like bays, estuaries, and rivers flowing to the seas are important for spawning grounds, nurseries, migration, and feeding areas for marine fish and shellfish.
75% - 90% of our U.S. marine fish and shellfish need these inshore waters to survive.

Coastal wetlands provide habitat for thousands of species of fish, invertebrates, amphibians, reptiles, birds, and mammals. They also provide protection from storms, reduce flooding, purify water, prevent erosion, and supply a major source of food for fish on the continental shelf.
As of 2008 the U.S. has lost more than half of its original wetlands to development.

Harbors near our most populated urban areas such as Norfolk, Miami, Boston, etc. have bottom sediments with high levels of toxic contaminants derived from burning coal and gasoline.
As many as 20% of our bottom-dwelling fish living near or in these harbors have cancerous tumors. As many as 70% of this group have other diseases that lead to cancer.

Dams and other methods of water diversion which redirect freshwater flows from rivers and streams for commercial uses such as agriculture, hydroelectric power, navigation, or water supply cause even more damage to fish, amphibians, etc. that live in them.

In the U.S. most inshore-dependent species of marine animals have decreased by up to 95% of their previous populations leaving only 5% of the populations alive and able to reproduce. The two major causes are:

- Overfishing
- Habitat loss and habitat pollution

Building on the Shore

On-Site Visit

Description:
Through observation and experimentation, students will learn how manmade structures are affected by their location on a barrier island.

Materials:
1 bucket of sand, per village group
7 wooden blocks in a variety of sizes to represent buildings, per village group
1 bucket of water surge (from Hurricane Barbara), per village group
Cards: King, Queen, Jack/Prince

Directions: Time involved = approximately 30 minutes

1. Split in to three village groups.
2. In a protected location in the schoolyard or beach, have each village dump their bucket of sand in a pile.
3. Shape the sand into a sand dune of the type that can be found on South Core Banks
    - About 5-6 inches high.
4. Each village should draw a card.
5. Groups which draw the Queen have chosen to build on the beach front.
    - You have a terrific view and are the envy of all your friends.
    - Your real estate values are high and "for sale" homes are snatched up within days of being put on the market.
    - The only draw-back is you have a hard time buying insurance.
6. Queen villagers should place their blocks along the ocean side in front of the dune to represent buildings along the shore.
    - In general these buildings are built on "slab" foundations, so no digging into the sand to secure your blocks.
7. Groups which draw the King card have chosen to build on the tippy-top of the dune.
    - You have a fairly good view; you can still see the ocean from where you are.
    - And the up side is, your beach front is public property with public access all the time, not like people in Queen whose beachfront is all private property in the back of a bunch of houses.
8. King villagers should place their blocks along the top of the dune to represent buildings.
    - In general these buildings are built on "slab" foundations, so no digging into the sand to secure your blocks.
9. Groups which draw the Prince card have chosen to build on the back side of the dune.
    - You don't really have much of a view.
    - No one wants to live in your town because it doesn't have a view, but your townspeople are happy with that.

    - You don't have a bunch of tourists crowding your streets all the time, and your beachfront is public property like the folks who live in King so everyone gets to enjoy the natural seascape. And, your home insurance is cheap!
10. Prince villagers should place their blocks along the back side of the dune.
    - In general, these buildings are built on "slab" foundations, so no digging into the sand to secure your blocks, either.
11. When all three towns are built, discuss the relative merits of each town's position should a nor'easter or hurricane or just a high flood tide come in.
    - What can we expect to happen to each town? Why?
12. Hurricane Barbara has come through the Caribbean and is headed straight for landfall along the coast where Queen, King, and Prince, NC are located.
    - To represent a hurricane surge with an incoming tide, toss a bucket of water toward each town.

Questions: Time involved = approx. 15 minutes

- What happened to each of these villages? Why?
- Was your hypothesis about what would happen supported (true) or disproven (false)?
- Which town had the least damage? Which had the most?
- Were any of the dunes breached in an overwash?
- If you were a town planner, where would you locate your waterfront property?
- As a voter, where would you vote to locate a housing development?
- What would the effects be on your taxes?
- What would the effects be on the price of your own home insurance?

Cape Lookout National Seashore & The Water Cycle

Circle one answer only. Name _____

- Water rises as vapor from Core Sound into the atmosphere; we call that process-----
  evaporation condensation

- Cape Lookout N.S. is next to one of the largest water storehouses on the planet.
  The Atlantic Ocean The Coastal Plain

- The water cycle continuously moves water in, on, and above the Earth.
  True False

- The water cycle is a closed system with no new water coming into it.
  False True

- The water cycle is important to us because-----
  Most of the water on Earth is stored as undrinkable salt water
  As Earth's population grows more people want fresh water
  Clean saltwater is important to the health of ocean critters
  North Americans use the largest amount of Earth's water
  All of the above

- Most of the water in Back Sound and Core Sound comes from-----
  The Neuse and White Oak River Basins
  Ground-water discharge
  Rain
  Virginia
  All of the above

- The sun is the driving force providing the energy to keep the water cycle going.
  True False

- Many cars in NC have bumper stickers reading NO WETLANDS, NO SEAFOOD. This means-----
  Destruction of wetlands destroys the habitat sea critters we like to eat use for reproducing
  If we destroy our wetlands, seafood critters will have to move farther into the ocean to live
  The water cycle is killing our seafood

- Most of the fish and shellfish we eat are dependent on a healthy estuary and wetland for their survival.
  False True

- The health of our estuaries and wetlands does not affect the health of our oceans because our oceans are so deep and far away.

True False

- Most of the pollutants in our oceans comes from-----
  Air pollutants circulating in the atmosphere falling into the sea
  Land sources

  From ground-water discharge
  Dead fish, whales, and other critters decomposing in the water

  All of the above

- The most common pollutant in our oceans is-----
  Paper and newspapers
  Floating oil patches

  Styrofoam cups, plates, etc.
  Plastic of all kinds

- In May, 2007 Cape Lookout N.S. had its own garbage crisis when shipping containers broke open and freight washed ashore off a cargo ship after it encountered heavy seas on its way to Norfolk, VA. A debris field spread from Cape Lookout to the Virginia border. This debris was-----
  Plastic
  Medical supplies

  Computers
  Styrofoam

- In our waters non-point source pollution comes from people, like us, going about our daily lives. When we do things like fertilize our lawns, wash our cars, or there is runoff from the school parking lot pollution enters the environment from a widespread land area.
  False
  True

- When a fish packing plant releases fish heads, guts, fins, etc. from the packing line of their factory into a harbor it is called point source pollution.
  True
  False

- Write down 2 things you can do to help reduce your contribution to polluting the waters in our estuaries, sounds, wetlands and oceans.

- Write down 2 things you can do to help conserve water at your house.

Average Americans Use How Much Water?

In a typical single family home . . .

- **Each person uses between 70-100 gallons each day for . . .**

A shower	**11.6 gallons**	**16.8% of their total daily water use!**
Clothes washing	**15**	**21.7%**
Dishwasher	**1**	**1.4%**
Flush the toilet	**18.5**	**26.7%**
A bath	**1.2**	**1.7%**
Water leaks	**9.5**	**13.7%**
Faucets	**10.9**	**15.7%**
Other household uses	**1.6**	**2.2%**

- **With just more efficient water fixtures and checking for water leaks a household can reduce its daily per person water use by about 35%! That's a decrease of about 45.2 gallons per person each day for . . .**

A shower	**8.8 gallons**	**19.5% of their total daily water use!**
Clothes washing	**10**	**22.1%**
Dishwasher	**.7**	**1.5%**
Flush the toilet	**8.2**	**18%**
A bath	**1.2**	**2.7%**
Water leaks	**4**	**8.8%**
Faucets	**10.8**	**23.9%**
Other household Uses	**1.6**	**3.4%**

- **If every household in the U.S. put in water-conserving fixtures . . .**

Daily water use in the U.S. would decrease by 30% saving an estimated 5.4 billion gallons! The result would be conserving a resource and saving $11.3 million each day or more than $4 billion each year in water bills!

- **Yeah, but what does an average household use in a day or a year?**

350 gallons a day!
127,400 gallons a year!

DAILY WATER CONSUMPTION AMOUNTS

IN THE U.S. BY ACTIVITY

The figures below are the average daily amounts of consumption in the United States for common uses. Data are from the Environmental Protection Agency.

ACTIVITY	AVERAGE HOUSEHOLD	HOUSEHOLD USING CONSERVATION METHODS
Bath	**36 gallons**	**15 gallons**
Brushing Teeth	Tap Running = **2 gallons**	**½ gallon**
Dishwasher	**15 gallons**	Short Cycle = **7 gallons**
Hand Washing	Tap Running = **2 gallons**	**½ gallon**
Shaving	Tap Running = **20 gallons**	Using Bowl = **1 gallon**
Shower (5 min.)	Tap Running = **25-35 gallons**	Wet, Soap, Rinse = **5 gallons**
Toilet Flush	**5-7 gallons**	Low Flush Toilet = **2 gallons**
Washing Car	Tap Running = **180 gallons**	Stopping Tap = **40-50 gallons**
Washing Dishes by Hand	Tap Running = **20-30 gallons**	Wash, Rinse in sink = **5 gallons**
Washing Machine	Top Loading = **40 gallons**	Front Loading = **25 gallons**
Watering Lawn	Tap Running = **10 gal/min**	Stopping Tap = **10 gal/min**

- The average household of four people in this country uses about **243** gallons of water per day.
- The average water use per person (including non-home water use) is over **100** gallons per day.

Water Consumption Journaling

Post-Site Visit Activity

Description:
Students will identify and graph your family's water consumption during one week.

Materials:
Pen or pencil
Notebook or notebook paper
Graph paper
Average Americans Use How Much Water? Handout
Daily Water Consumption Amounts in the U.S. by Activity Handout
Daily Water Consumption of the _____ Family Data Sheet

Directions:

1. Take materials home with you.
2. Monitor your family's water use over the next 4 days using the Data Sheet.
3. Use the water consumption handouts as reference tools to figure out your family's daily water usage.

   NOTE: Clothes washing counts in **each** person's use because usually a family's clothes are mixed together. Same with dishwashing since most people use dishwashers, even if your family hand washes dishes it will still count in each person's use because each person benefits.
4. Each day make a journal entry answering the following questions:
   - Which of your family members used the most water today? Why?
   - In which category did the most water usage occur? Why do you think this is so?
   - Was there anyway you or other family members could have cut usage and conserved water today? How?
   - Could you have saved water today by shorting the length of time you did an activity or by eliminating an activity? How and which activity?
   - Did something about your or the family's water usage surprise you? If so, what was it and why did it surprise you?
5. Use either a line graph or a bar graph to chart your family's total water usage for each of the 4 days in the following categories:
   - Showers/baths, Washing dishes, Brushing teeth, Toilet flushing, and Handwashing

Questions: Time involved = part of 1 class period

- Look at your graphs and journal answers. What happened to your water consumption throughout the week?
- Did your family use more water on some days than on others? Why?
- Did you think your family used as much water as your data showed?
- What changes could you make to save water?
- What changes could your family make to save water?
- Compare the adults' and kids' water usage. Did age make a difference in water usage?

Daily Water Consumption of the _____ Family

Date: _____

Family Member	Activity	times/today	Consumption
Name/relationship	Bath/shower	_____	_____
	Brushing teeth	_____	_____
	Toilet flush	_____	_____
Age:	Handwashing	_____	_____
	Shaving	_____	_____
Daily Total in gallons	Dishwashing-hand	_____	_____
	Dishwasher	_____	_____
_____	Clotheswasher	_____	_____
Name/relationship	Bath/shower	_____	_____
	Brushing teeth	_____	_____
	Toilet flush	_____	_____
Age:	Handwashing	_____	_____
	Shaving	_____	_____
Daily Total in gallons	Dishwashing-hand	_____	_____
	Dishwasher	_____	_____
_____	Clotheswasher	_____	_____
Name/relationship	Bath/shower	_____	_____
	Brushing teeth	_____	_____
	Toilet flush	_____	_____
Age:	Handwashing	_____	_____
	Shaving	_____	_____
Daily Total in gallons	Dishwashing-hand	_____	_____
	Dishwasher	_____	_____
_____	Clotheswasher	_____	_____
Name/relationship	Bath/shower	_____	_____
	Brushing teeth	_____	_____
	Toilet flush	_____	_____
Age:	Handwashing	_____	_____
	Shaving	_____	_____
Daily Total in gallons	Dishwashing-hand	_____	_____
	Dishwasher	_____	_____
_____	Clotheswasher	_____	_____

Additional Resources:

"The Water Cycle: Summary" from U.S. Geological Survey Water Science

http://ga.water.usgs.gov/edu/watercyclesummary.html

Includes detailed summary of the water cycle and printable diagrams

"Water Challenge Questions"

http://ga.water.usgs.gov/edu/sacsc.html

Water use questionnaires

"Water Cycle Jumble" from ATEHNA Action in Education

http://www.athena.bham.org.uk/old/WCjumbled.htm

Interactive water cycle diagram that kids unscramble

"Real Time Earth Monitors" from Geography 4 Kids

http://www.geography4kids.com/realtime.html

Current images and descriptions of water vapor and cloud patterns as well as water resource levels in the U.S. compared with the past (has links to the original cameras)

"Explore Water: Information and Data" from National Park Service

http://www.nature.nps.gov/water/infodata.cfm

Drinking water quality and regulation links