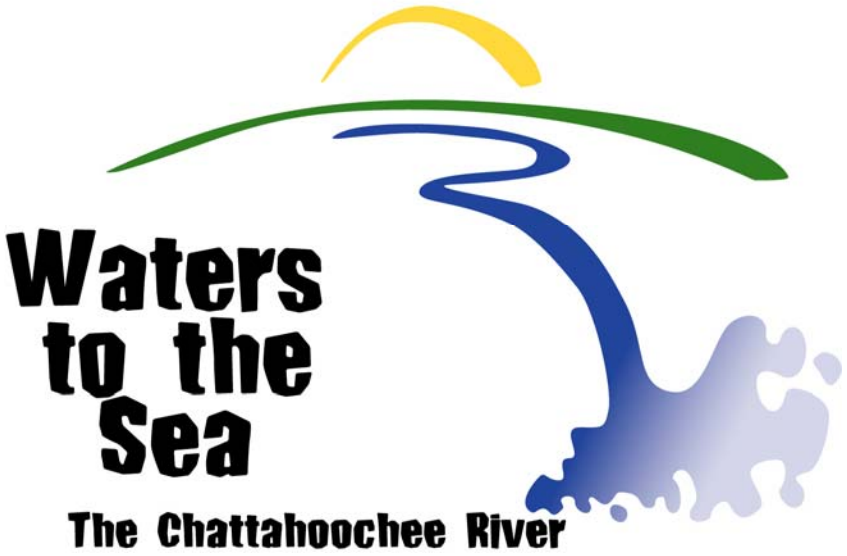

WATERS TO THE SEA
ACTIVITY AND STUDY GUIDE

VERSION 1.0
2004

CENTER FOR GLOBAL ENVIRONMENTAL EDUCATION
HAMLINE UNIVERSITY GRADUATE SCHOOL OF EDUCATION
WITH
UPPER CHATTAHOOCHEE RIVERKEEPER AND OXBOW MEADOWS
ENVIRONMENTAL LEARNING CENTER, COLUMBUS STATE UNIVERSITY

WATERS TO THE SEA
STUDY GUIDE

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Introduction

Waters to the Sea: The Chattahoochee River tells the story of how humans have lived along Georgia's greatest waterway—the Chattahoochee and Apalachicola rivers. The CD ROM's interactive multimedia experience is divided into several introductory modules and a three-part virtual river journey from the Chattahoochee's headwaters in the Blue Ridge Mountains to Apalachicola Bay in the Gulf of Mexico. The introductory segments provide background information on ecology, watersheds and the water cycle, and water quality testing. The river journey explores through a series of media-rich interative modules the human history of the watershed and the impact of the primary land use activities on terrestrial and aquatic ecosystems in the Mountains, Piedmont and Coastal Plain.

The background information in this study guide will provide a context for the content of the CD ROM and information to help you anticipate student questions. You'll find background information on each major section of *Waters to the Sea*, plus articles that provide an overview of the Chattahoochee River system.

Section 1: Understanding Watersheds

This section of the CD ROM introduces the water cycle, watersheds, and basic principals of river hydrology. These concepts will help your students understand the all-important link between the health of a river and the condition of the surrounding landscape. You can access this part of the program from the main menu screen by clicking on the watery area surrounding the canoe.

The Water Cycle

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

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

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

Watersheds

Wherever you happen to be at this or any other moment, the surface waters around you are drawn by gravity downhill toward the nearest stream. The entire area of land that drains into a stream is called its basin, or watershed. When river travel was common in America and elsewhere in the world, rivers and watersheds provided a means of orientation to the landscape much as highways and political boundaries do for us today. The perspective offered by the three historic guides in the river journeys in *Waters to the Sea* provide a glimpse into this watershed-based landscape perspective.

A stream's watershed--where it is, how big it is, and most importantly, what's happening within it--is very important. A stream's health depends a great deal on the quality of the surface waters that drain into it. Ecologically a stream is intimately tied to the surrounding landscape that makes up its watershed. This is such an important concept, that stream ecologists may define the ecosystem of a stream as its watershed. Caring properly for the land, therefore, is often the key to improving the health of the stream that winds through it.

Section 2: Ecosystem Introduction

One way to make sense of all the activity taking place in a stream is to look very carefully at who is eating whom. This view shows an interesting pattern that ecologists call a food chain. The basic idea is that energy from the sun is used by plants to make food. When they are eaten, the sun's energy is passed on to animals higher up the food chain.

At the bottom of the stream's food chain, tiny plantlike creatures called algae form a soft, slimy green layer you can see and feel on underwater rocks and logs. Algae needs direct sunlight to grow, so you'll find more of it in large unshaded streams or in smaller wooded streams during the spring. In summer, leaves overhead create too much shade for algae to grow.

Snails, clam like creatures called limpets, and some insects that begin their lives underwater consume algae. As the algae are eaten, some of the energy it received from the sun is passed on to these creatures at the next level of the food chain.

Leaves, pine needles, flower petals, and bark dropped into the stream by trees and plants form an even more important part of the bottom link of the food chain. This is especially true for small streams in wooded areas. These pieces of plant matter collect at the bottom of the stream where millions of microscopic bacteria, molds, and fungi devour them. The result is the same as what happens to a dead tree lying on the forest floor: the plant matter in the stream slowly falls to pieces, or decomposes. The bacteria, molds, and fungi that do the work are called decomposers.

A group of underwater animals called shredders, including snails and insects, help the decomposers by breaking leaves into small chunks. In the process these shredders also feed on the decomposers themselves. This places them one link up the food chain. Since they consume, or eat, the plants and decomposers, shredders are called primary (or "first-level") consumers.

Small fish and larger insects are the secondary consumers that feed on the primary consumers make up the next level of the food chain. There are also third-level consumers–larger fish, small land animals like otter and mink, waterfowl, and humans with fishing poles, all of whom feed on the secondary consumers. Again, the energy received by the third-level consumers when they eat the secondary consumers is the same energy originally provided to the algae and plants by the sun.

In a healthy stream the number of individual animals decreases as you go up the levels of a food chain. The reason has to do with the fact that most of the sun's energy is lost as it's passed from link to link. At each level of a food chain the plants and animals use 90 percent of the energy they receive simply to grow and live. Ecologists, who can actually measure the food energy available at each level of a food chain, show this flow of energy as a pyramid. The animals at each level can get only ten percent of the energy available one level down. This explains why food chains rarely have more than three or four levels. There just isn't enough energy available at the top to support another group of hungry animals.

Section 3: Testing for Water Quality

Monitoring the water in streams is detective work that helps measure the water-quality impacts of land use practices within a watershed. A water quality detective has two primary ways of going about this task. The first is to examine the small living creatures whose lives are restricted to specific areas within the stream. These benthic macroinvertebrates are good indicators of water quality because of the fact that if the stream is polluted they are unable to migrate to other locations. Different species have different levels of tolerance to pollution. Therefore, once differences in the natural conditions of streams and variations over time are taken into account, the types of macroinvertebrates found in a certain location can be good indicators of water quality.

The second kind of water quality detective work explores the chemical and physical characteristics of the stream. Nine commonly used physical-chemical tests for water quality (dissolved oxygen, fecal coliform, pH, BOD, temperature, total phosphates, nitrates, turbidity, and total solids) provide information that complements biological data in determining the health of a stream.

Taken together, water quality data from biological and chemical methods can detect four types of water pollution (the following characterizations are drawn from the Field Manual for Global

Low-Cost Water Quality Monitoring, William B. Stapp and Mark K. Mitchell, Kendall/Hunt Publishing Company, 1997, an excellent guide to water-quality monitoring):

Organic pollution occurs as living organisms decompose in a stream. The natural process that breaks down into organic elements materials like grass clippings, leaves, human sewage, and pet waste uses oxygen. If excessive amounts of organic pollutants enter a stream, oxygen levels in the aquatic ecosystem can be come depleted.

Inorganic pollution occurs when suspended or dissolved solids enter a stream. Materials like topsoil and sand and salt carried from roadways or eroded from the landscape, while not toxic, can still alter aquatic ecosystems. Impacts include reducing available sunlight for underwater plants and covering up gravel stream bottoms used by spawning fish.

Toxic pollution involves the introduction of heavy metals and other materials that are lethal to plants and animals living in the stream. This kind of pollution is often related to household and agricultural use of chemicals for pest and weed control and industrial practices. Airborne toxic pollutants can also be carried into a watershed over great distances.

Thermal pollution happens in a stream when water temperature within a stream is altered. Life cycles of aquatic species can be altered by temperature changes brought about when water is used as a coolant in industrial processes and returned to the water. Also, water entering streams from sun-warmed roadways can change stream temperatures. Changes also result due to the fact that warm water carries less oxygen than cooler water.

The Chattahoochee River: An Overview

Meet the Chattahoochee

The Chattahoochee River, the 11th largest river in the U.S., begins as a trickle from a spring in Georgia's Blue Ridge Mountains. Fed by small tributaries, the cold water travels down boulder-strewn slopes, flowing through forested banks of hardwoods and pine. From these pristine origins, the river must travel more than 500 miles to find the sea. By the time its waters mingle with saltwater in the Gulf of Mexico, the Chattahoochee River will be known by a different name: the Apalachicola, and it will have passed through parts of three states (Georgia, Alabama, and Florida).

Like all rivers, the Chattahoochee is intimately linked to the landscapes and waterways surrounding it, and from this perspective the Apalachicola, Chattahoochee, and Flint Rivers make up one 19,600 square-mile integrated system called the "ACF Basin." This basin, which has been called a "treasure trove of biodiversity," has the greatest diversity of fish species among the Gulf Coast drainages east of the Mississippi River. Important fish include endemic species such as the grayfin redhorse and shoal bass. It is also a refuge for rare mussel species including the endangered Gulf mooccasinshell and shiny-rayed pocketbook. The protected headwaters portion of the Chattahoochee is home to more than 500 species of birds, mammals, fish and reptiles. The Apalachicola basin alone boasts more reptile and amphibian species than anywhere else on the continent north of Mexico.

In their journey to the sea, the Chattahoochee and Apalachicola Rivers pass through three major U.S. physiographic provinces: the Blue Ridge Mountain province, the Piedmont, and the Coastal Plain. Unlike the political borders that define states, these provinces reflect "natural boundaries" defined by geographers based on areas with common landforms, soils, and/or geologic history. The Blue Ridge Mountain Province is an area characterized by mountains, ridges, and basins. This province includes Georgia's highest point, 4784 ft., at Brasstown Bald. The Piedmont Province (Piedmont means "foothill") has comparatively more gentle slopes and rolling topography. Both the Blue Ridge and Piedmont provinces are underlain by hard, crystalline rocks of mostly igneous and metamorphic origin. The Coastal Plain Province was below sea level during the Cretaceous period and has relatively flat topography. It is underlain by relatively softer, sedimentary rocks.

The dividing line between the Piedmont and Coastal Plain provinces is a feature known as the "Fall Line," named for the tumble of waterfalls and rapids that occur along it as rivers flow from the Piedmont into the more erodable soils of the Coastal Plain. For the Chattahoochee, the Fall Line means a drop of more than 300 feet over a distance of 38 miles.

All along its length, the Chattahoochee River functions as a kind of scribe, recording many of the everyday activities and decisions of people who live in its watershed. Water chemistry, volume of flow, sediment load, temperature, native plant and animal communities, even the color of the water—all are subject to change in this landscape with a history of human habitation that dates back nearly 10,000 years.

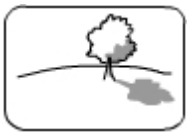
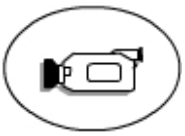
Burial mounds reflect the work of long-ago civilizations active in the riverway. These early people reshaped the landscape by moving soil one basketfull at a time. In the centuries between then and now, the scale of change has grown with rising population and advancing technology.

Farming and logging practices have replaced large areas of the watershed with ranchland, crops, pine plantation and second-growth forest. Cities along the river have grown from scattered small settlements to major urban centers. The Atlanta metropolitan area alone is home to more than 3 million people—approaching 4 million—as of the 2000 census. Highways, rail lines, and airplane routes have replaced riverboats as primary transportation. Once free flowing, the river itself has been harnessed, its flow managed by a series of dams. Water pools behind the dams to create reservoirs. These immense manmade lakes act as magnets for recreationists and shoreline development.

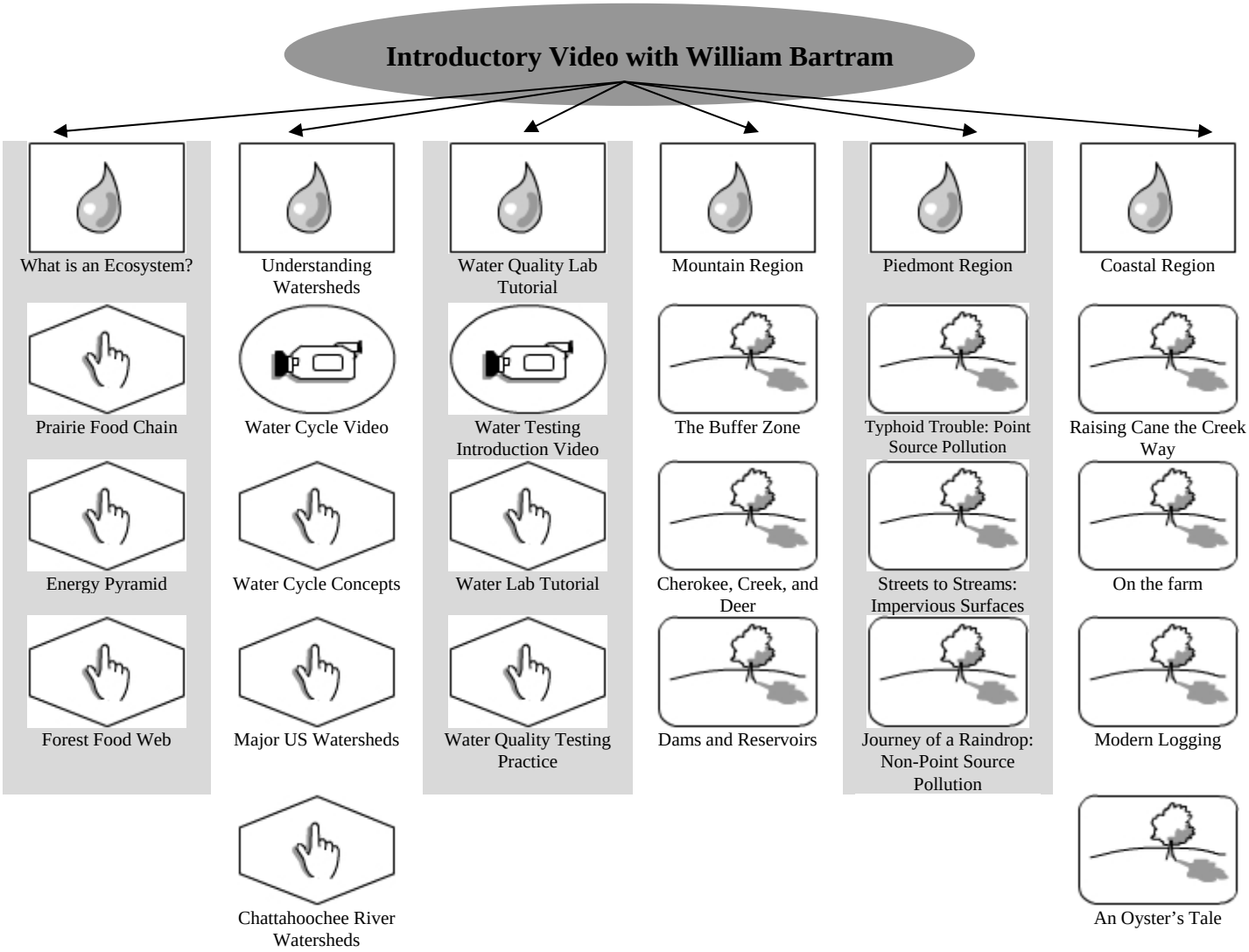
In the midst of all the changes, one thing remains the same. The Chattahoochee River system sustains life. From the Chattahoochee Wildlife Management Area in the river's headwaters area, to the International Biosphere Reserve designated by the United Nations at Apalachicola Bay, this river system offers critical habitat to a wide array of species. Trout spawn in its cold-water streams. Ospreys and bald eagles feed on its fish and nest along its banks. Alligators and dolphins swim in its tidal swamps and estuary. People depend on the riverway, too: water is needed for drinking, irrigation, hydropower, industrial cooling, and the fisheries industry. The river is a place for relaxing, for inspiration, for learning about the natural world that is our home.

This program explores the river ecosystem and the life that it makes possible. In her song, "Big Yellow Taxi," singer-songwriter Joni Mitchell writes: "…You don't know what you've got 'til it's gone." But in the case of the Chattahoochee, it's not too late. The river belongs to everyone. Take this chance to find out what you've got, so that you can be a part of making sure it's never gone.

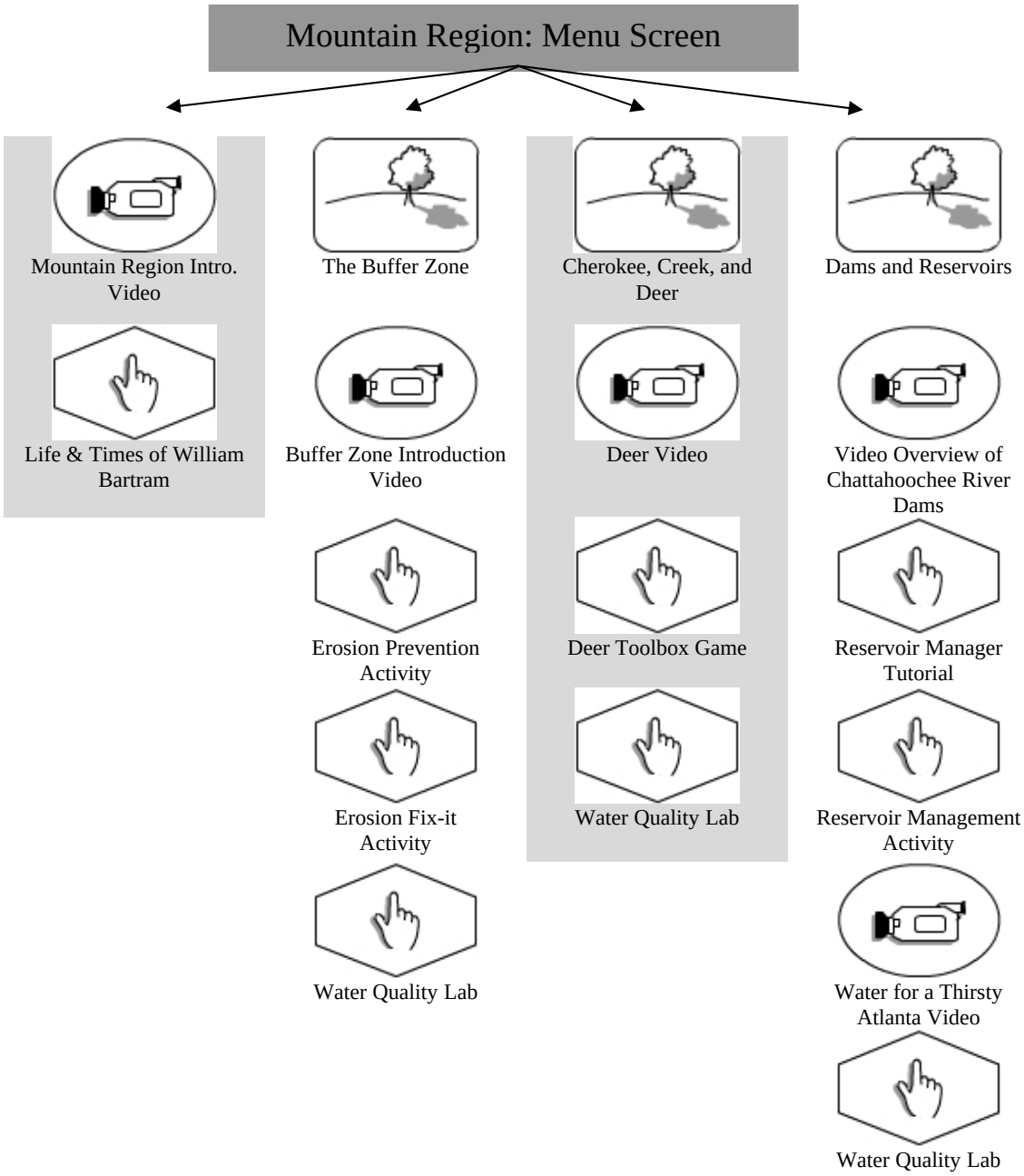
Program Overview

Shape Legend			
 Major Program Segment (Main Menu links)	 Land-Use Milestone (River Segment links)	 Video	 Multimedia Interactive

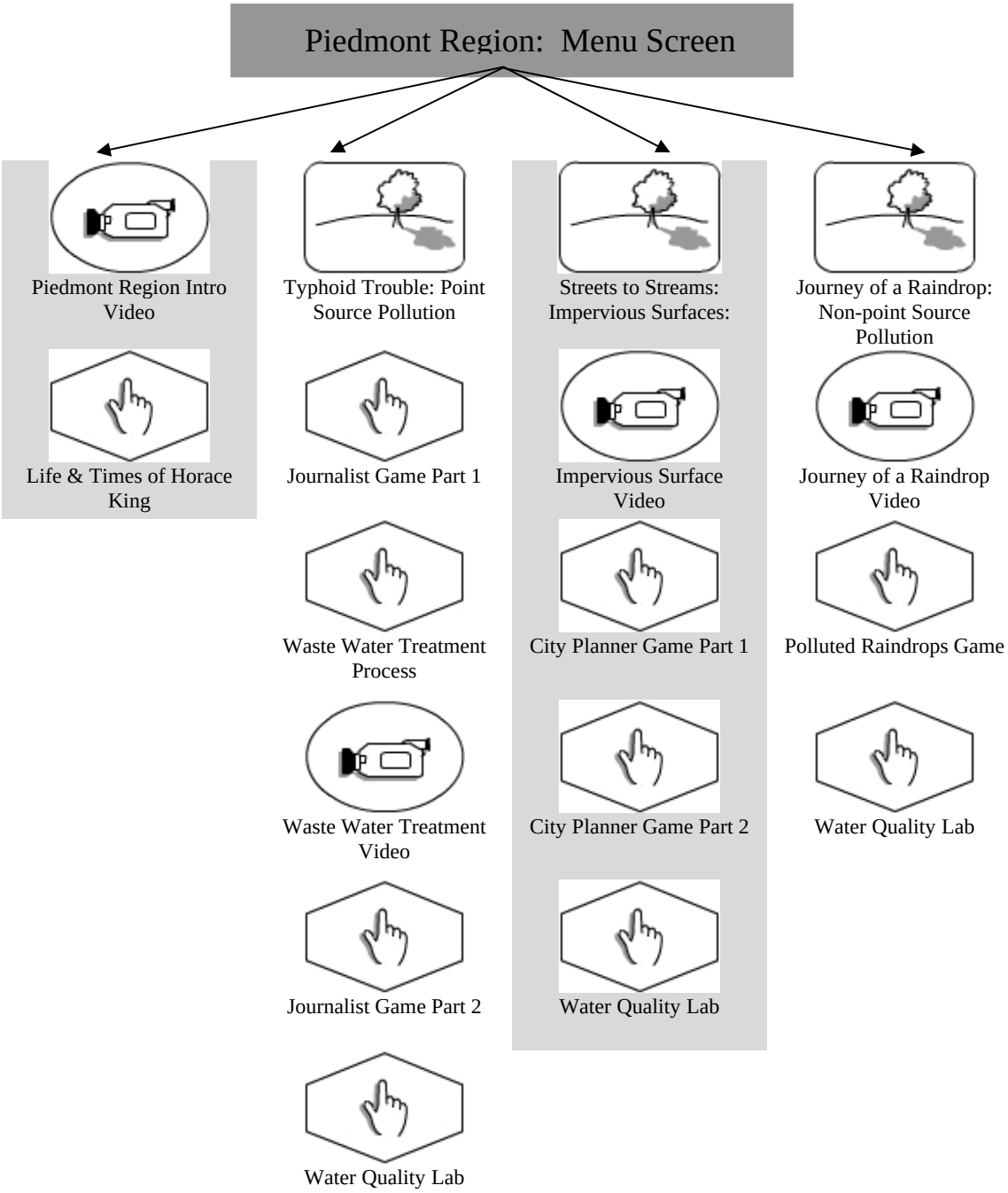
The following flow charts identify the program's main elements.



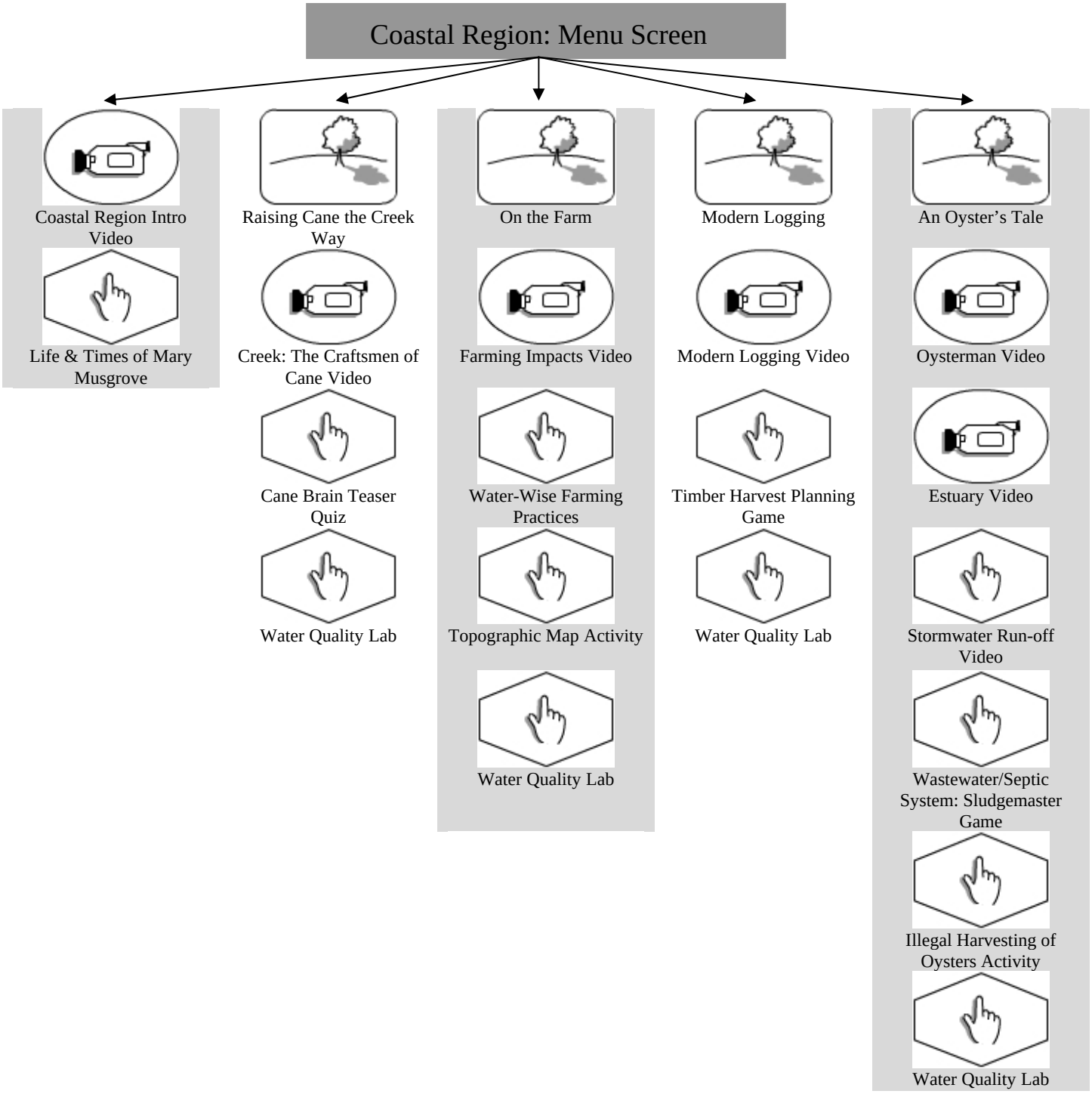
Mountain Region Journey



Piedmont Region Journey



Coastal Region Journey



Technical Support

Frequently Asked Questions

Q. How do I install and run the program?

A. If you have QuickTime 6.0 (or better) installed on your computer, no installation is necessary. To run the program, insert the CD ROM into your CD ROM drive. Windows users who have Autorun active will find that the program launches automatically. If Autorun isn't active, double-click the My Computer icon on your desktop and find the "WTTS" icon for the CD ROM. Double-click this icon and then double-click a file called "open.exe" among the files visible within the WTTS window. Macintosh users should double-click the "Waters to the Sea" icon on your desktop, then double-click the "Waters to the Sea" file. Note: If your computer doesn't have QuickTime 6.0 you will be prompted to install it from the CD ROM.

Q. What are the minimum system requirements for my computer?

A. Windows 98: ME or XP 500 MHz Pentium, 128 MB available RAM, 16-bit colors, 4X CD ROM drive, QuickTime 6.0 (or better) (QuickTime 6.0 is included on the CD ROM) Macintosh: 500 MHz Power PC, System 9.0 or OS X, 128 MB available RAM, Thousands of colors, 4X CD ROM drive, QuickTime 6.0 (or better) (QuickTime 6.0 is included on the CD ROM)

Q. Can I run the program if my system requirements don't meet the recommended minimum?

A. Yes, Waters to the Sea is programmed to play on computers that don't meet the minimum system requirements, but the program will probably perform poorly.

Q. How do I install QuickTime?

A. Windows users: With the *Waters to the Sea* (WTTS) CD ROM inserted in your CD ROM drive, click the Start button on the task bar at the bottom of your screen, then select Run from the options presented. Select Browse in the window that opens, and in the dialog box that opens find and double-click the "WTTS" icon (it should be visible after double-clicking the My Computer icon). Then double-click the "Quicktime" folder and then the "setup.exe" file (it may be called simply "setup"), which will launch the Windows installation wizard. Follow the instructions on your screen. Macintosh users: With the *Waters to the Sea* CD ROM inserted in your CD ROM drive, double-click the Waters to the Sea icon on your desktop, then double-click the "Quicktime" folder inside the window that opens. Double-click the "Installer" file and follow the installation instructions on your screen.

Q. What is QuickTime 6.0 and why is it needed to run Waters to the Sea?

A. QuickTime is software made by Apple Computer that plays multimedia files. You need to have version 6.0 installed on your computer or none of the videos and QuickTime VR panorama movies in *Waters to the Sea* will play (see next question regarding the use of newer versions of QuickTime). QuickTime provides a similar function to the Windows Media Player, which comes installed in all Windows computers. However, Windows Media Player will not play the videos and QuickTime VR movies in this program. Here's how you install it on your computer: Windows users: click the Start button on the task bar at the bottom of your screen, then select Run from the options presented. Select Browse in the window that opens, and in the dialog box that opens find and double-click the "WTTS" icon (it should be visible after double-clicking the My Computer icon). Then double-click the "Quicktime" folder and then the "setup.exe" file (it may be called simply "setup"), which will launch the Windows installation wizard. Follow the instructions on your screen. Macintosh users: double-click the Waters to the Sea icon on your desktop, then double-click the "Quicktime" folder inside the window that opens. Double-click the "Installer" file and follow the installation instructions on your screen.

Q. The program doesn't play smoothly. Transitions between segments last a long time; movies take a long time to load and/or are choppy when they play. What do I do about it?

A. The most likely causes of this problem are either that you are using a computer that doesn't meet the minimum system requirements or that your computer's hard drive is full and/or fragmented. Increasing the amount of available disk space on your hard drive by eliminating unneeded files may improve performance. Software such as Norton's Utilities, which includes a program called Speed Disk, is available that will "defragment" your hard drive (rearrange the way files are stored so enhance performance).

Q. Occasionally the program's drag-and-drop activities or other interactive features don't work. What can I do about this?

A. In some of the program's interactive segments if you use the left arrow button to return to a previous screen, the interactive features on that screen won't work. If this happens, you can regain the interactivity for the screen in question by returning to the main menu and beginning the program segment again.

Q. Images look pixilated or splotchy. Can I improve their quality?

A. The most likely cause of poor image quality relates to the color settings of your monitor. For optimal image quality, your monitor should be set for 16-bit colors (Windows), or Thousands of colors (Macintosh). Here's how to check and change this setting: Windows: from the Start

menu, select Settings, then Control Panel from the list of choices. Double-click the Displays icon in the Control Panel window. In the Displays window, select the "Settings" tab. In the drop-down menu under "Color Pallet" select the highest available color setting (at least 16-bit colors). Macintosh: In the Apple menu (accessed by clicking and holding on the colored Apple icon in the top left corner of your screen), select the "Control Panel" option. In the Control Panel window, double click the Monitors icon and the Monitors control panel will open. In the area designating number of colors (the appearance of this window varies with different versions of the Macintosh operating system), select the highest available setting (at least Thousands of colors).

Exploring Experts
(for grades 4 - 5)

Grad Standard:
Technology: basic operations and concepts

Activity Type:
_X__ individual
_X__ small group
____ class

Discipline:
Technology
Water (Earth Science)

CD Section:
Main Screen

Introduction

In this activity, students will explore the main screen of the CD, the picture with the canoe, the bear and the lake. This is an orientation activity, to allow familiarization with the main menu.

Materials

- CD
- Computer with CD player
- Paper
- Pen/pencil

Preparation

Make sure that all the CDs are loaded and ready to be viewed.

Activity

While the students are looking at the main screen of the CD, the picture with the canoe, the bear and the lake, have them answer the following questions:

- Which picture do you click on to explore water testing on the computer?
- Which picture do you click on to learn about watersheds on the computer?
- Which picture do you click on to learn about ecosystems on the computer?
- Which picture do you click on to explore one of the regions on the computer?
- What are the three regions that this CD explores?

Once these questions are completed, ask the students to examine the watershed section of the CD in greater detail. Ask them to complete the following questions on the watershed section:

- Name three of the North American watersheds.

	• In which watershed would you find each of the following states? California. Minnesota. Texas. Georgia. • Into what two oceans do rivers from Georgia flow? **Assessment** Check the students' answers to see if they are correct. **Extensions** Ask the students to look for other large rivers in the US and to find the watersheds they are located in and the oceans the rivers flow into. Ask the students to examine where their own water comes from, what watershed they are located in and the history (geological, ecological and cultural) of their watershed.

River Work—River Play
(for grades 4 -5)

Grad Standard:
Science:
Physical Science

Activity Type:
___ individual
_X_ small group
_X_ class

Discipline:
Water (Earth Science)

This activity is adapted from an activity of the same name by Joe Riederer, a science teacher in Wisconsin Rapids, WI.

Introduction

One way for students to appreciate the work of a river is to play with water. I know what you're thinking-the word "play" is not found in the State Academic Standards and will not look good in your lesson plans. Just substitute "kinesthetic inquiry" for the word "play" and you're home free. If you can find a way to use "metacognition" or "paradigm shift," it would make it sound even more impressive. The truth is that kids will be playing with water and learning about rivers.

Materials

- Twelve foot long rulers or 12 meter sticks
- Tape
- Rope (for hanging model from ceiling)
- 100 plastic 1 gallon milk jugs (Don't forget to recycle them at the end of the activity)
- Water
- Sidewalk chalk or rope
- Watches

Preparation

Finding Flow Rate: The flow rate of a river is the amount of water that passes a given point in a given amount of time. Imagine looking at a cross section of a river. This slice has an area that can be measured in square feet (Depth x Width). Multiply this area by the speed of the water.

area of cross section **X** speed of flowing water = flow rate

This is not perfect. A river's cross-section is not square, so the area calculation is only an estimate. That's not important. Students will be able to experience the work rivers do, even if the numbers are off by a bit.

Build a model to help your students visualize the measurement units. Tape 12 foot-long rulers, or 12 meter sticks, into a cube. Keep this where students can see it throughout this activity-maybe hanging from the

ceiling. For this activity, use cubic feet per sec (ft^3/sec), only because most readily available maps use feet as their unit of measure. Change your measurements to meters and the results will be in cubic meters per sec (m^3/sec).

REMEMBER: When finished the activity, have the students do something productive with the water from the jugs such as watering the flowerbed in front of school.

Activity

Step 1 -- Find the flow rate of a local river.
1. Provide students with an estimated width, depth, and speed.

Step 2 -- Convert the flow rate to gallons/minutes.
1. 1 cubic foot per minute = 7.481 gallons per minute
2. Guide student through the conversion.

Step 3 -- Fill 100 plastic 1-gallon milk jugs with water.
1. Yes, that really does say 100 jugs!
2. Seal the jugs tightly.
3. Collecting and storing a large number of milk jugs presents a challenge, but it is worth the effort.

Step 4 -- Find an appropriate location (school yard, non-carpeted classroom)

Step 5 -- Recreate the flow rate of the river
1. Place the jugs on the ground in an area free of any obstacles.
2. Draw a box around them with sidewalk chalk (or use a thin rope on the classroom floor).
3. Draw a similar size box 10 feet away.
4. Tell the students they have one minute to move as many gallon jugs as they can, one student at a time, to the second box.
5. If they move all the jugs and still have time left, have them move jugs in the other direction.
6. The total number of gallon jugs moved in a minute is their flow rate.
7. **THINK SAFETY**. Remind students to lift with their knees. Student unable to participate in physical activity can serve as timers and counters. Younger students can do the same activity with less water in each jug.

Step 6 -- Wrap up

1. Use the following formula for the calculations.
2. Have students predict what they think the flow rate is.

Work = Force x Distance.

In our example the force is the weight of the jug (1 gallon of water = 8.33 lbs.). The resulting unit is foot-pounds.

1 foot-pound = 1.356 joules.

Guide students through the work calculations.

Assessment

Check that the calculations are correct.

Ask the students the following questions:

- Were the predictions close or far from the final answer? Why?
- What impacts the flow rate of a river?
- What impact does the flow rate have on a river system?
- What impacts can humans have on the flow rate of a river system?

Extensions

- How many students would it take to match the flow of the Chattahoochee River?
- Try the same activity using ice cream pails to form a bucket brigade. Have students pour the water from student to student. This would best be done outside or in the previously mentions palatial office suite if the weather is not favorable.
- Let the river "flow" for a longer time-maybe 5 minutes. Will this change the flow rate?
- Let individual students be a "river" for a minute.
- Work with the PE department to build a River activity unit
- Have students decorate the jugs with the names and pictures of river plants and animals. This will remind students that rivers are more than just flowing water.
- Ask students to calculate the work done by the Chattahoochee River.
- Rivers meander. Have the students follow a meandering river, drawn with chalk, as they move the jugs of water.

	• Help your students explore plans to remove many of the small dams across the country. What impacts would this have on flow rate and the river system? • Find the flow rate of showers and faucets. Does this surprise you? Calculate your own water usage and that of your family.

Who Wants to be a Local Watershed Explorer?
(for grades 4 -5)

Grad Standard:
Science as Inquiry

Activity Type:
_X_ individual
_X_ small group
___ class

Discipline:
Water (Earth Science)
Technology

Introduction

Knowledge of the local environment is very important in the development of a 'sense of place' and knowing your role in the environment. This activity helps to develop this knowledge.

The student's task is to collect documentary evidence of the following phenomena in his/her local watershed. Depending on where and when you have the scavenger hunt, some of these phenomena may not be appropriate for your students. Students need to be able to defend their choices if the evidence is challenged.

Students can gather physical evidence or images of the phenomena. The students can do this activity in small groups or as individuals. In addition, students can be asked to gather evidence from around their homes or neighborhoods.

NOTE: If digital cameras are available, then they could be distributed to groups of students to take images which may be used with their collected evidence.

Materials

Worksheet; Pen/pencil; Bags for gathering evidence; Camera; Digital cameras, if available.

Preparation

Students need to be aware of their local watershed and the boundaries of it. You may need to create an awareness of certain concepts for the students or omit these phenomena from the list.

Activity

Students receive worksheets and a camera. (Use digital cameras, if available.)

Students gather evidence of the following possible phenomena from their

	local watershed **Scavenger Hunt** • Find a home • Identify a sound • Find something smelly • Find something that doesn't belong • Identify an animal track • Find a change • Find something fuzzy • Something good to eat **Find evidence of:** • A pattern • Parts of a system that influence each other • Predation • A boundary • Communication in the natural world • Communication in the human world • Waste Students complete the worksheet by checking off the evidence they have gathered. **Assessment** Here is a suggested scale for points: Correct answer- 1 point Correct answer that is especially creative- 1.5 points Questionable answer defended with a spectacular lie- 0.5 points Incorrect answer- 0 points **Extensions** Students' evidence can be incorporated into a PowerPoint presentation, and presented to the whole group. Photos can be scanned for use in the presentation. Students could be asked to do this activity exclusively in their local neighborhood. A poster presentation could also be created from the results.

Worksheet for
'Who Wants to be a Local Watershed Explorer?' activity

What did I find?	What does it look like?	Where did I find it?

River Words: Haunted by Waters
(for grades 4 - 5)

Grad Standard:
English: Applying Knowledge

Activity Type:
___ individual
___ small group
_X_ class

Discipline:
Communications

Introduction

The connection between human beings and rivers is widespread and deep.

Materials

Brief movie reviews from the newspaper.
Copies or transparencies of word lists and quotation.

Preparation

As a homework assignment, have students ask friends and family members to list books, films, songs, and poems that refer to rivers.

Activity 1

In small groups or a class unit, have students compile their lists and post in classroom space. Encourage students to add to the list throughout their study.

Activity 2

Brainstorm with students to list the words that could refer to rivers and river systems. Here are examples:

NOUNS

Stream, Bank, Flood, Eddy, Basin, Creek, Meander, Cascade, Ripple, Watershed, Rapids, Source, Fish, Canyon, Tributary, Trickle, Cataract, Backwater, Valley, Torrent, Waterfall, Channel, Brook, Mouth, Bend, Energy, Flowage

VERBS

Rush, Cascade, Erode, Tease, Waltz, Tug, Scour, Rolled, Cleanse, Carve, Slide, Flow, Tumble, Tear, Taunt, Yodel, Overpower, Silvered, Flow, Jog, Braid, Slip, Flood, Ripple, Sparkle, Invite, Lick, Command, Slivered, Dammed, Spill, Jog, Trickle, Tinkle, Heals, Reject, Lab, Control, Steamed,

	Rush, Spit, Laze, Glisten, Cut, Sing, Wander, Push, Plunge, Stroke, Shimmer, Split, Swept, Froth, Deposit, Whisper, Roam, Splinters, Frolic, Inundate, Brew, Rage, Crash ADJECTIVES Pristine, Savage, Hurried, Rapacious, Playful, Polluted, Demonic, Nourishing, Hidden, Brackish, Knowing, Laconic, Destructive, Silvery, Languid, Hungry, Immortal, Creative, Wise, Angry, Greedy, Private, Hungry, Patient, Mysterious, Talkative, Vengeful, Powerful, Innocent, Curious, Lazy Gentle Sweet Secret **Activity 3** Have students construct phrases or sentences utilizing as many of the above words to describe non-water related subject or events, such as • The captain's mood • The sound of a musical instrument in a canyon • A really bad and boring movie • A stifling hot day • An obnoxious peer Example: A dance – The students trickled in and formed levees of gender along the gym's banks. A few souls ventured into the middle, braving the current briefly, then fled back to the shore to reconstruct eroded confidence. **Activity 4** Have students share their examples and think of additional situations or topics that might lend themselves well to river metaphors. Students could write their favorites on large pieces of paper to be posted, or could use the computer to make each look more impressive, and then post them. **Activity 5** Focus again on the word lists. Construct poems with the following structures: Structure #1: Noun Two adjectives Three verbs – past particles

	Two adjectives Noun-similar in meaning but not the same noun as the first Example: cascade, kinetic crystalline, exploding-rolling-plunging, fluid-powerful, energy <u>Structure #2</u>: Write a poem to answer the basic questions of who? what? where? when? and why? Who/what is it? The heavy river What did/does it do? pushed its serious way Where? through green-brown plains and hazed murky cities When? Through light and dark and time and temperature How? Naturally - Knowingly Why? Gliding its way to rest. **Activity 6** Using the movie summaries brought in from the local paper, discuss what it is the reviewer's highlight and the kind of language used. Then ask students to create brief reviews for movies with the following titles (or some of their own). Be sure that the river plays a part in the story. Some examples:

Brown River, Smile
Requiem for a River Rat
The Good Child's River
I've Known Rivers
Blood River
River of Champions
The Glad River
The Deepest Current
If the River Was Root Beer
River of Sky
The Demon River
The River Why
At the Bottom of the River
Tomorrow is a River

Activity 7

"Of course, now I am too old to be much of a fisherman, and now of course I usually fish the big waters alone, although some friends think I shouldn't. Like many fly fishermen in western Montana where the summer days are almost Arctic in length, I often do not start fishing until the cool of the evening. Then, in the Arctic half-light of the canyon, all existence fades to a being with my soul and memories and the sounds of the Big Blackfoot River and a four-count rhythm and the hope that a fish will rise. Eventually, all things merge into one, and a river runs through it. The river was cut by the world's great fold and runs over rocks from the basement of time. On some of the rocks are timeless raindrops. Under the rocks are the words, and some of the words are theirs. I am haunted by waters." Norman Maclean, The River Runs Through It

- In what ways might someone be "haunted by waters"? What is the one into which "all things merge"? And what is the river that runs through it? What words might the rocks hold?
- It could be easily said from looking over the long lists of books, films, and songs with references to rivers (many more if you add lakes, the sea, the ocean, and rain and other forms of precipitation) that humans as a species are "haunted by waters". What are your thoughts on explanations for this fascination?

Assessments

	Activity 1. Points could be awarded for every title added to the original list. Other activities can be assessed using typical writing rubrics. **Extensions** • Students in small groups or individually could compare 2 or more films, recording, and/or books to discover similarities in the use of rivers. • Students in small groups or individually could compose a song about a river.

Life is Like A River: River as Metaphor
(for grades 4 - 5)

Grad Standard:
English: Applying Knowledge

Activity Type:
___ individual
___ small group
_X_ class

Discipline:
Communications

Introduction

Keith Harrison wrote in the Minneapolis Star Tribune in July, 1995 "Perhaps one of the reasons why people have been drawn to rivers since time immemorial and why they have regarded them as sacred is because they are the perfect metaphor for our lives." These activities provide students an opportunity to further understand and apply the use of metaphors.

Materials

Write the quotes on the board or use another visual presentation.

Preparation

It may be helpful to read several other writers use of the river as a metaphor to help guide student discussion. Internet search engines offer a variety of references by using the key phrase "river as a metaphor".

Activity 1

Discuss the meaning of metaphor and begin to explore the metaphor "life is like a river"

- In what ways is life like a river?

Always moving forward; has a source and an end; starts small and gains substance from its bed and its tributaries, has a history; does not maintain a constant speed; meanders; floods; rapids; change in depth and breadth of channel; reacts to forces around it, etc.

- In what ways is human existence (and the history of human existence) like a river?

Humans have a common source; groups of humans have cut new channels, migrated, meandered; humans are constantly evolving, carrying with them much for deposit elsewhere; humans cut larger

or smaller, more shallow or deeper, swaths than one another, etc.

- What is a river's end?

A body of water such as a lake, sea, or ocean.

- What is at a river's end?

A delta, a deposition of its load/sediment.

- What are your thoughts on the parallels between a river's end and the end of human life?

Activity 2

"You can never step into the same river twice." - Plato

- Have students first write and then discuss their ideas as to what they think Plato meant by this quotation. With your interpretation in mind, do you agree or disagree with him? State your reasoning?
- Thinking about the metaphor of "life as a river", can the same be said about a person's life? You can never step into the same life twice? In which ways do you agree and in which ways do you disagree?

Activity 3

"Poetry is a section of river-fog and moving boat-lights, delivered between bridges and whistles, so one says, "Oh!" and another, 'How?'"

- Have students create a poem or poems prompted by something discussed in this activity. Create a river or water abstraction to serve as the background on which to write the poem/free writing/commentary.

<u>Some ideas</u>:

The River of Me	Losing My Source
Adolescence: The Rapids	Go with the Flow
Watching My River Flow	Stepping in the River
Come Join My River	Tribute to Tributaries

	Assessment Writing rubrics. **Extensions** • Students individually write how a river as a metaphor relates to their life. • In small groups, students could create a visual image of a river metaphor component (i.e., dams, bends, banks, flow) and relate it to an aspect of life.

Exploring Experts
(for grades 6-8)

Grad Standard:
Technology- Basic Operations and Concepts

Activity Type:
_X__ individual
_X__ small group
___ class

Discipline:
Technology
Water (Earth Science)

Introduction

In this activity, students will explore the main screen of the CD, the picture with the canoe, the bear and the lake. This is an orientation activity, to allow familiarization with the main menu.

Materials

- CD
- Computer with CD player
- Paper
- Pen/pencil

Preparation

Make sure that all the CDs are loaded and ready to be viewed.

Activity

While the students are looking at the main screen of the CD, the picture with the canoe, the bear and the lake, have them answer the following questions:

- Which picture do you click on to explore water testing on the computer?
- Which picture do you click on to learn about watersheds on the computer?
- Which picture do you click on to learn about ecosystems on the computer?
- Which picture do you click on to explore one of the regions on the computer?
- What are the three regions that this CD explores?

Once these questions are completed, ask the students to examine the watershed section of the CD in greater detail. Ask them to complete the following questions on the watershed section:

- Name three of the North American watersheds.

	• In which watershed would you find each of the following states? California. Minnesota. Texas. Georgia. • Into what two oceans do rivers from Georgia flow? **Assessment** Check the students' answers to see if they are correct. **Extensions** Ask the students to look for other large rivers in the US and to find the watersheds they are located in and the oceans the rivers flow into. Ask the students to examine where their own water comes from, what watershed they are located in and the history (geological, ecological and cultural) of their watershed.

River Work—River Play
(for grades 6 - 8)

Grad Standard:
Physical Science

Activity Type:
___ individual
_X_ small group
_X_ class

Discipline:
Water (Earth Science)

This is adapted from an activity of the same name by Joe Riederer, a science teacher in Wisconsin Rapids, WI.

Introduction

One way for students to appreciate the work of a river is to play with water. I know what you're thinking-the word "play" is not found in the State Academic Standards and will not look good in your lesson plans. Just substitute "kinesthetic inquiry" for the word "play" and you're home free. If you can find a way to use "metacognition" or "paradigm shift," it would make it sound even more impressive. The truth is that kids will be playing with water and learning about rivers.

Materials

- Twelve foot long rulers or 12 meter sticks
- Tape
- Rope (for hanging model from ceiling)
- 100 plastic 1 gallon milk jugs (Don't forget to recycle them at the end of the activity)
- Water
- Sidewalk chalk or rope
- Watches
- Maps

Preparation

Finding Flow Rate: The flow rate of a river is the amount of water that passes a given point in a given amount of time. Imagine looking at a cross section of a river. This slice has an area that can be measured in square feet (Depth x Width). Multiply this area by the speed of the water.

area of cross section **X** speed of flowing water = flow rate

This is not perfect. A river's cross-section is not square, so the area calculation is only an estimate. That's not important. Students will be able to experience the work rivers do, even if the numbers are off by a bit.

	Build a model to help your students visualize the measurement units. Tape 12 foot-long rulers, or 12 meter sticks, into a cube. Keep this where students can see it throughout this activity-maybe hanging from the ceiling. For this activity, use cubic feet per sec (ft3/sec), only because most readily available maps use feet as their unit of measure. Change your measurements to meters and the results will be in cubic meters per sec (m3/sec). REMEMBER: When finished the activity, have the students do something productive with the water from the jugs such as watering the flowerbed in front of school. **Activity** Step 1 -- Find the flow rate of a local river. • Ask students to devise a way to find flow rate. • Use maps to determine width, estimate depth from on-site observations, and time a floating stick to find the speed. This would be a great time to introduce students to spreadsheets. Step 2 -- Convert the flow rate to gallons/minutes. • 1 cubic foot per minute = 7.481 gallons per minute • Ask students to make the conversion. Step 3 -- Fill 100 plastic 1-gallon milk jugs with water. • Yes, that really does say 100 jugs! • Seal the jugs tightly. • Collecting and storing a large number of milk jugs presents a challenge, but it is worth the effort. Step 4 -- Find an appropriate location (school yard, non-carpeted classroom) Step 5 -- Recreate the flow rate of the river • Place the jugs on the ground in an area free of any obstacles. • Draw a box around them with sidewalk chalk (or use a thin rope on the classroom floor). • Draw a similar size box 10 feet away. • Tell the students they have one minute to move as many gallon jugs as they can, one student at a time, to the second box. • If they move all the jugs and still have time left, have them move jugs in the other direction.

- The total number of gallon jugs moved in a minute is their flow rate.
- **THINK SAFETY**. Remind students to lift with their knees. Student unable to participate in physical activity can serve as timers and counters.

Step 6 -- Wrap up

- Use the following formula for the calculations.
- Have students predict what they think the flow rate is.

Work = Force x Distance.

In our example the force is the weight of the jug (1 gallon of water = 8.33 lbs.). The resulting unit is foot-pounds.

1 foot-pound = 1.356 joules.

Ask students to calculate the amount of work they did.

Assessment

Check that the calculations are correct.

Ask the students the following questions:

- Were the predictions close or far from the final answer? Why?
- What impacts the flow rate of a river?
- What impact does the flow rate have on a river system?
- What impacts can humans have on the flow rate of a river system?

Extensions

- How many students would it take to match the flow of the Chattahoochee River?
- Try the same activity using ice cream pails to form a bucket brigade. Have students pour the water from student to student. This would best be done outside or in the previously mentions palatial office suite if the weather is not favorable.
- Let the river "flow" for a longer time-maybe 5 minutes. Will this change the flow rate?
- Let individual students be a "river" for a minute.
- Work with the PE department to build a River activity unit
- Have students decorate the jugs with the names and pictures of

	river plants and animals. This will remind students that rivers are more than just flowing water. • Ask students to calculate the work done by the Chattahoochee River. • Rivers meander. Have the students follow a meandering river, drawn with chalk, as they move the jugs of water. • Help your students explore plans to remove many of the small dams across the country. What impacts would this have on flow rate and the river system? • Find the flow rate of showers and faucets. Does this surprise you? Calculate your own water usage and that of your family.

Who Wants to be a Local Watershed Explorer?
(for grades 6 - 8)

Grad Standard:
Inquiry

Activity Type:
_X__ individual
_X __ small group
___ class

Discipline:
Water (Earth Science)
Technology

Introduction

Knowledge of the local environmental is very important in the development of a 'sense of place' and knowing your role in the environment. This activity helps to develop this knowledge.
The student's task is to collect documentary evidence of the following phenomena in his/her local watershed. Depending on where and when you have the scavenger hunt, some of these phenomena may not be appropriate for your students. Students need to be able to defend their choices if the evidence is challenged.

Students can gather physical evidence or images of the phenomena.
The students can do this activity in small groups or as individuals. In addition, students can be asked to gather evidence from around their homes or neighborhoods.

NOTE: If digital cameras are available, then they could be distributed to groups of students to take images which may be used with their collected evidence.

Materials

Worksheet; Pen/pencil; Bags for gathering evidence; Camera; Digital cameras, if available.

Preparation

Students need to be aware of their local watershed and the boundaries of it. You may need to create an awareness of certain concepts for the students or omit these phenomena from the list.

Activity

Students receive worksheets and a camera. (Use digital cameras, if available.)

Students gather evidence of the following possible phenomena from their local watershed

	• Geologic activity • Differentiation in cell development • Succession of ecosystems • Solid and non-solid di-hydrous oxide • An illustration of the principle of "lift • A non-native or invader species • An edible plant (Note: you don't have to photograph the edible part.) • A fractal • The presence of mammals (not humans!) • Parasite or decomposer • A mushroom • A fruit • A crystal • Combustion • Illustrate and identify one of Newton's Law • A delta or alluvial fan • A seed • The four elements • A human produced artifact • Changing a river, or lake system Students complete the worksheet by checking off the evidence they have gathered. **Assessment** Here is a suggested scale for points: Correct answer- 1 point Correct answer that is especially creative- 1.5 points Questionable answer defended with a spectacular lie- 0.5 points Incorrect answer- 0 points **Extensions** Students' evidence can be incorporated into a PowerPoint presentation, and presented to the whole group. Photos can be scanned for use in the presentation. Students could be asked to do this activity exclusively in their local neighborhood. A poster presentation could also be created from the results.

‘Who Wants to be a Local Watershed Explorer?’ Activity

Phenomena from local watershed	Gathered physical evidence or image	Location

River Words: Haunted by Waters
(for grades 6 - 8)

Grad Standard:
Language Arts-Communication Skills

Activity Type:
___ individual
___ small group
_X_ class

Discipline:
Communications

Introduction

The connection between human beings and rivers is widespread and deep.

Materials

Brief movie reviews from the newspaper.
Copies or transparencies of word lists and quotation.

Preparation

As a homework assignment, have students ask friends and family members to list books, films, songs, and poems that refer to rivers.

Activity 1

In small groups or a class unit, have students compile their lists and post in classroom space. Encourage students to add to the list throughout their study.

Activity 2

Brainstorm with students to list the words that could refer to rivers and river systems. Here are examples:

NOUNS

Stream, Bank, Flood, Eddy, Basin, Creek, Meander, Cascade, Ripple, Watershed, Rapids, Source, Fish, Canyon, Tributary, Trickle, Cataract, Backwater, Valley, Torrent, Waterfall, Channel, Brook, Mouth, Bend, Energy, Flowage

VERBS

Rush, Cascade, Erode, Tease, Waltz, Tug, Scour, Rolled, Cleanse, Carve, Slide, Flow, Tumble, Tear, Taunt, Yodel, Overpower, Silvered, Flow, Jog, Braid, Slip, Flood, Ripple, Sparkle, Invite, Lick, Command, Slivered, Dammed, Spill, Jog, Trickle, Tinkle, Heals, Reject, Lab, Control, Steamed,

Rush, Spit, Laze, Glisten, Cut, Sing, Wander, Push, Plunge, Stroke, Shimmer, Split, Swept, Froth, Deposit, Whisper, Roam, Splinters, Frolic, Inundate, Brew, Rage, Crash

ADJECTIVES

Pristine, Savage, Hurried, Rapacious, Playful, Polluted, Demonic, Nourishing, Hidden, Brackish, Knowing, Laconic, Destructive, Silvery, Languid, Hungry, Immortal, Creative, Wise, Angry, Greedy, Private, Hungry, Patient, Mysterious, Talkative, Vengeful, Powerful, Innocent, Curious, Lazy Gentle Sweet Secret

Activity 3

Have students construct phrases or sentences utilizing as many of the above words to describe non-water related subject or events, such as

- The captain's mood
- The sound of a musical instrument in a canyon
- A really bad and boring movie
- A stifling hot day
- An obnoxious peer

Example: A junior high dance – The students trickled in and formed levees of gender along the gym's banks. A few souls ventured into the middle, braving the current briefly, then fled back to the shore to reconstruct eroded confidence.

Activity 4

Have students share their examples and think of additional situations or topics that might lend themselves well to river metaphors. Students could write their favorites on large pieces of paper to be posted, or could use the computer to make each look more impressive, and then post them.

Activity 5

Focus again on the word lists. Construct poems with the following structures:

Structure #1:

	Noun Two adjectives Three verbs – past particles Two adjectives Noun-similar in meaning but not the same noun as the first Example: cascade, kinetic crystalline, exploding-rolling-plunging, fluid-powerful, energy <u>Structure #2</u>: Write a poem to answer the basic questions of who? what? where? when? and why? Who/what is it? The heavy river What did/does it do? pushed its serious way Where? through green-brown plains and hazed murky cities When? Through light and dark and time and temperature How? Naturally - Knowingly Why? Gliding its way to rest. **Activity 6** Using the movie summaries brought in from the local paper, discuss what it is the reviewer's highlight and the kind of language used. Then ask students to create brief reviews for movies with the following titles (or some of their own). Be sure that the river plays a part in the story.

Some examples:

Brown River, Smile
Requiem for a River Rat
The Good Child's River
I've Known Rivers
Blood River
River of Champions
The Glad River
The Deepest Current
If the River Was Root Beer
River of Sky
The Demon River
The River Why
At the Bottom of the River
Tomorrow is a River

Activity 7

"Of course, now I am too old to be much of a fisherman, and now of course I usually fish the big waters alone, although some friends think I shouldn't. Like many fly fishermen in western Montana where the summer days are almost Arctic in length, I often do not start fishing until the cool of the evening. Then, in the Arctic half-light of the canyon, all existence fades to a being with my soul and memories and the sounds of the Big Blackfoot River and a four-count rhythm and the hope that a fish will rise. Eventually, all things merge into one, and a river runs through it. The river was cut by the world's great fold and runs over rocks from the basement of time. On some of the rocks are timeless raindrops. Under the rocks are the words, and some of the words are theirs. I am haunted by waters." Norman Maclean, The River Runs Through It

- In what ways might someone be "haunted by waters"? What is the one into which "all things merge"? And what is the river that runs through it? What words might the rocks hold?
- It could be easily said from looking over the long lists of books, films, and songs with references to rivers (many more if you add lakes, the sea, the ocean, and rain and other forms of precipitation) that humans as a species are "haunted by waters". What are your thoughts on explanations for this fascination?

Assessments

	Activity 1. Points could be awarded for every title added to the original list. Other activities can be assessed using typical writing rubrics. **Extensions** • Students in small groups or individually could compare 2 or more films, recording, and/or books to discover similarities in the use of rivers. • Students in small groups or individually could compose a song about a river.

Life is Like A River: River as Metaphor
(for grades 6 - 8)

Grad Standard:
Language Arts-Communication Skills

Activity Type:
___ individual
___ small group
_X_ class

Discipline:
Communications

Introduction

Keith Harrison wrote in the Minneapolis Star Tribune in July 1995 "Perhaps one of the reasons why people have been drawn to rivers since time immemorial and why they have regarded them as sacred is because they are the perfect metaphor for our lives." These activities provide students an opportunity to further understand and apply the use of metaphors.

Materials

Write the quotes on the board or use another visual presentation.

Preparation

It may be helpful to read several other writers use of the river as a metaphor to help guide student discussion. Internet search engines offer a variety of references by using the key phrase "river as a metaphor".

Activity 1

Discuss the meaning of metaphor and begin to explore the metaphor "life is like a river"

- In what ways is life like a river?

Always moving forward; has a source and an end; starts small and gains substance from its bed and its tributaries, has a history; does not maintain a constant speed; meanders; floods; rapids; change in depth and breadth of channel; reacts to forces around it, etc.

- In what ways is human existence (and the history of human existence) like a river?

Humans have a common source; groups of humans have cut new channels, migrated, meandered; humans are constantly evolving, carrying with them much for deposit elsewhere; humans cut larger

	or smaller, more shallow or deeper, swaths than one another, etc. • What is a river's end? A body of water such as a lake, sea, or ocean. • What is at a river's end? A delta, a deposition of its load/sediment. • What are your thoughts on the parallels between a river's end and the end of human life? **Activity 2** "You can never step into the same river twice." - Plato • Have students first write and then discuss their ideas as to what they think Plato meant by this quotation. With your interpretation in mind, do you agree or disagree with him? State your reasoning? • Thinking about the metaphor of "life as a river", can the same be said about a person's life? You can never step into the same life twice? In which ways do you agree and in which ways do you disagree? **Activity 3** "Poetry is a section of river-fog and moving boat-lights, delivered between bridges and whistles, so one says, "Oh!" and another, 'How?'" • Have students create a poem or poems prompted by something discussed in this activity. Create a river or water abstraction to serve as the background on which to write the poem/free writing/commentary. <u>Some ideas</u>: The River of Me — Losing My Source Adolescence: The Rapids — Go with the Flow Watching My River Flow — Stepping in the River Come Join My River — Tribute to Tributaries

	Assessment Writing rubrics. **Extensions** • Students individually write how a river as a metaphor relates to their life. • In small groups, students could create a visual image of a river metaphor component (i.e., dams, bends, banks, flow) and relate it to an aspect of life.

Chattahoochee Watershed Timeline

By Tracy Fredin

The following timeline chronicles major, and some minor, geological, and environmental events in the Chattahoochee's past. In the dates, the following abbreviations are used BYBP (billion years before present) , MYBP (million years before present), etc.

Date	Event	Reference
2 BY BP	Earth's atmosphere becomes aerobic, causes massive iron deposits world wide	
500 MY BP 350MY BP*	Appalachian Mountains formation begins approximately 500 MY's Ago (Taconian Orogeny*). During this time Europe and N. American Plate collide, forming a mountain system on the interior the super continent Pangaea. This forms a connection between the Appalachian system and the Paleozoic mountains in Europe. Climax of Appalachian Mountain building occurs 250 MY ago.	(Skinner, 93 , 454)
410 MY BP	Unusual Silurian iron-rich sedimentary deposits in S. Appalachian Mts. provide ore for the Birmingham steel industry. Apparently iron was introduced by rivers in unusual concentrations to a somewhat restricted, marginal marine environment. Sediments forming there, including marine shells, became replace and cemented with red hematite.	(Dott and Batten, 250)
225-200 MYBP	Pangaea begins to split apart and form the Atlantic Ocean. Appalachian Mountains separate from Europe.	(Skinner, 454)
175 MY BP-present	Piedmont Plateau. Folded crystalline rocks (Precambrian metamorphics and Paleozoic volcanics) are eroded to an open plain with hills,	(Butzer, 439)
65-36 MYBP	Stone Mountain. Morphologically, Piedmont development is being replicated in parts of Africa. Stone Mountain is a prototype of a "Domed Inselberg or Monodack" formation and the contemporary red soil mantle in Georgia (reddish brown lateritic soils" has an affiliation to the tropical soils currently developing in tropic Africa. This indicates a possible legacy of tropical climate that has left a deep weathering on Stone Mt. with ribbing relief of 20 inches.	(Butzer, 373, 416)
60 MY	Ocean shore along the Fall line. Fall line runs through Montgomery, Columbus, Macon, Augusta Raleigh, Richmond, and Baltimore	(Brown & Smith,162-168)

Date	Event	Reference
35,000 B.P.	Sangamon interglacial (warm temperate), pines alternating with oak-hickory-sweet gum forest with sugar maple, beech, and basswood in north central Florida. Mid-Wisconsin interstadial place at 50,000 B.P. Broecker (1970) Watts (1969)	(Wharton, 12)
25,000 B.P.	Oak-hickory forest predominates. Broecker (1970) Watts (1973)	(Wharton, 12)
23,000 B.P.	More diverse forest with pines and some spruce. Cypress locally abundant, as well as shrubs of Coastal Plain swamps. Near temperate flora ends. Watts (1973)	(Wharton, 12)
20,000 B.P.	Main (full) Wisconsin Glacial Stage northern jack pine and spruce, oaks, fornbeam (latter three in small amounts). All of the aquatics resemble modern New England species Watts (1973)	(Wharton, 12)
19,500 B.P.	Full Glacial Forest Pine ranges from 25% to 45%; oak ranges from 30% to 40%. Hickory and chestnut present. Spruce 1-2%. Top of Pigeon mountain is presumed bare, with pollen transport from valley coniferous and deciduous forests.	(Wharton, 12)
14,000 B.P.	Abrupt decimation of boreal forest between 14,000 and 11,000. Sea level begins rapid rise. Watts (1971) Wright (1971)	(Wharton, 12)
11,000 B.P.	Acceleration of warming process; megafauna intact in Southeast Guilday (1971)	(Wharton, 12)
10,500 B.P.	Mesic forest: Beech 10-20%; Hornbeam type 6%;butternut 1%; spruce 2-3%; Pinus 20%; oak and hickory next most important deciduous trees. No modern analogues for this forest. Watts (1975)	(Wharton, 12)
10,000 B.P.	(First evidence of humans in Florida). Driest time begins and lasts until 6,000 B.P. Wright (1971)	(Wharton, 12)
9,000 B.P.	Hypsithermal of Deevey and Flint begins 9000; lasts until 2,500 B.P. spalling ends, silt deposition begins in Russel Cave, Alabama, Hack (1969)	(Wharton, 12)
8,500 B.P.	Clovis points of Paleo-indians present in Suwannee and Santa Fe Valley (S.O. us Clovis points date 12,000-11,000 B.P.	(Wharton, 12)
7,000 B.P.	Sea level stops rapid rise, begins steady but slower rise. No critical evidence of time of megafauna extinction, sites in Florida give improbably young date of 2040 B.P. Watts (1971)	(Wharton, 12)

Date	Event	Reference
6,500 - 5,500 B.P	Maize Domestication. Earliest cultivation of maize occurred in Mexico between 6,500 and 5,500 B.P. The domestic plant was derived from teosinte, a native wild grass. Wide spread archaeological finds indicate that several varieties were experimented with and improved upon. Corn is not introduce to Georgia until much later	(Scarre, 88)
6,300 B.P.	Cotton. Two species of domesticated cotton in the early America's One, Ghuacan Valleyossypium hirsutum, was domesticated in the Tehhkucan Valley, Mexico by 6,300 B.P., and the other G. barbadense, was domesticated in Peru and Ecuador, 5,300-5,100 B.P.	(Scarre, 90)
5,000 B.P.	Potatoes are domesticated in Andes	(Scarre, 100)
4,500 B.P.	Pottery develops independently in at least three different areas in the Americas. At Stallings Island in Georgia sherds tempered with plant fiber are dated to 4,500 B.P. Evidence is also found in Mexico and Ecuador.	(Scarre, 96)
4,000 B.P.	Sea level at minus 2 meters. Longleaf forest predominant on upland sites (presumably with wild fire). Rising water tables result in cypress swamps and bayheads. Beech also becomes abundant for first time. Essentially modern environments continue until present day Watts (1971). Sclerophyllous oak forest, scrub or savanna with patches of bluestem prairie. Some sage present. Water table estimated 12m below present,	(Wharton, 12)
3,800 B.P.	Chenopds and sunflowers are domesticated in eastern N. America. This results in making this region an independent center of plant cultivation. These seeds can be stored over winter.	(Scarre, 112)
3,000 B.P.	Sea level at minus 1.5 m	(Wharton, 12)
2,700 B.P.	Growth of permanent villages in S.E. linked to cultivation of several native plants, including squash, knotweed, Lamb's quarter, marsh elder, and sunflower.	(Scarre, 136)
2,500 B.P.	Colder in n. latitudes until 6000 BC	(Wharton, 12)
3,000 B.P. to 800	Woodland Period. Sedentary villages based on horticulture allow pottery to flourish	(Scarre, 225)
1000 to 1500	Mississippian period	

Date	Event	Reference
1200	Kolomoki Mounds, standing 56 feet above the plain and covering 1.5 acres, are created with two million baskets of earth. 3,000 Indians may have lived in this area.	(Brown & Smith, 211)
1525	Little ice age–post 16th century glacial advance	(Wharton, 12)
700-1600	Rood Indian Mounds (Lake Eufaula) Chattahoochee River is home to largest native population in the east US other than Cohokia (1,000 to 1,3000) on the Mississippi	(Cook, 193)
1639	Spanish saw falls at Columbus as early as 1639	(Brown & Smith, 164)
Early 1670's	Spanish soldiers and Catholic priest go upstream searching for gold on the Rio de la Apalachicolas	(Cook,.192)
1685	Englishman Henry Woodward arrives overland from coast to Coweta (Columbus) to establish trade.	(Cook, 192)
1689	Spanish build a fort at Apalachicola, to keep an eye on English traders. Two years later Spanish troops abandoned and destroyed their northernmost outpost in the New World, 17 miles south of present-day Phenix City, they go back to Florida because of a threatened French attack.	(Brown & Smith, 164)
1733	James Oglethorpe sails up the Savannah river to found the thirteenth colony of the US	
1763	Spanish leave North Florida	(Cook, 192)
1773	Bartram reports that the new settler found in the eastern piedmont region , numerous fields, second-growth forest, and occasional stands of pine attributable to Indian agriculture and to Indian use of fire	(Wharton, 144)
1775	Bartram crosses the Chat near modern-day Columbus. "We arrived at the banks of the Chata Uche river opposite the Uche town….The river here is about 300 or 400 yard wide, caries 15 or 20 feet of water and flows down with an active current; the water is clear, cool and salubrious."	(Brown & Smith, 172)
1781	Spanish and English establish boarder between Georgia and Florida. The river changes name from Chat to Apalachicola because of this.	(Brown & Smith, 251)
1793	Development of cotton gin drives the first peak of the cotton mono-culture in the south. The second peak is driven is driven by the attainment of Chilean nitrate.	(Wharton, 144)
1785	Cherokee sign treaty to secure their land. Two later treaties are signed in the 1790's	(English, Jones 1998, 74)

Date	Event	Reference
1799	Indian Agent Benjamin Hawkins records for the first time the meaning of Chattahoochee Chato—stone Hoche Flowered or marked. Now referred to River of the flowered or painted rock.	(Cook, 192)
1800's	Frank Schnell, historian at the Columbus Museum indicates that the land below the fall line was the richest agricultural area on the river. The change in topography allows the river to drop its nutrient rich sediments in the bottomlands of this area. This area has the highest concentration of early Native settlements. At the mouth of almost every stream in the coastal area there is a pocket of fertile land and the correlating mound indicating native settlement. The English traders provide major disrupter of agriculture, want to trade for pelts. This drives Indians to abandon their farming in order to trade pelts for European goods. Ultimately they are driven from their lands too.	(Brown & Smith,162-163)
1800's	Frank Schnell, historian at the Columbus Museum feels that the Chattahoochee was one of the most important trade routes from Florida into the central core of the Mississippian and Woodland centers of the U.S. Schnell estimates that around 1800 Cusseta Town are was the largest center of Native American population in the SE, probably rivaling Charleston in population.	(Brown & Smith, 162-163)
1802	Georgia cedes all territory west of the Chattahoochee to the Union but set the boundary as "running thence up the said River Chattahoochee and along the western bank thereof." 1819 Alabama becomes a state.	(Cook, 71, 288)
1812	Fort Peach Tree was built at the village of Standing Peach Tree (one of the most important native villages that served as a trading center with the white traders. This fort was built to protect settlers in the area from the Creek who were allies with the British in the war. In 1814, a road connecting Ft. Peach Tree to Fort Daniel at Hog Mt. 30 miles distant became the original Peachtree Drive	(Brown & Smith, 107)
1812-65	Fort Gadsden is built on an overlook on the east bank of the Apalachicola. The fort, 18 miles inland, has been held by four different countries. An interesting fact is that, for a short period of time, the fort was called the Negro fort as it was controlled by a group of runaway slaves.	(Brown & Smith, 262)
1814	Andrew Jackson defeats Creek at Horseshoe Bend Alabama,	(English, Jones 1998, 74)

	Creek forced to turn over 23 million acres	
Date	**Event**	**Reference**
1819	Alabama becomes a state.	
1821	U.S. gains control of Florida	(Brown & Smith, 265)
1824	First dam on the Chat is put in below Helen for grist and lumber mill. Dam still running at site is the northernmost dam on the Chat.	(Brown & Smith,.26)
1825	Lafayette visits Ft. Mitchell a few miles below Columbia as he travels on the Old federal Road from New Orleans to Washington.	(Brown & Smith,.193)
1827	Georgia legislature establishes Columbus in 1827 with a reservation of 1,200 acres allotted for the town and commons, By the end of 1829, the city had 1,000 inhabitants	(Brown & Smith, 165, 175)
1828	First dam on the Chat is put in at Columbus for grist and lumber mill.	(Cook,.129)
1828	Sternwheeler Fanny arrives in Columbus, becoming the first steamboat to travel the 262 miles from the gulf to the fall line. Last river boat arrives in 1939 111 years of commercial transportation to Columbus. There were 240 stops from the gulf to Columbus	(Cook,129) (Brown & Smith, 164)
1829-1940	Dahlonega gold rush occurs is Upper Chat. Major environmental impact. Also an impact on Native population as settlers disregard the rights of the natives and the US government turns a blind eye.	(Brown & Smith, 29)
1830	President Jackson proposes and congress passes the Indian Removal Act. Displacing thousands of the Chickasaws, Choctaws and Creeks	(English, Jones, 1998, 74)
1832	Cherokee's claim of their land is upheld by the US Supreme Court	(English, Jones 1998, 74)
1832	Horace King builds first bridge across the Chat at Giraurd. Wins his freedom from slavery.	(Brown & Smith, 182)
1834	Holcomb Bridge built to cross Chat. One of the first bridges over the river. Burned in 1864 by union troops and rebuild 1906.	(Cook, River Song, 78)
1837	Chattahoochee River is called the Chota River by the Cherokee in their territory. In 1837 the last reference to the Chota River is made in the Georgia Gazetteer. After this the entire river is referred to as the Chattahoochee.	(Brown & Smith, 137)
1838	President Martin Van Buren orders removal of Cherokee from their lands. 17,000 are rounded up into concentration camps and relocated to Indian Territory as they struggled on the "Trail of Tears."	(English, Jones 1998, 74)

Date	Event	Reference
1850's	Railroads begin to take over steamboats as primary means of commercial transportation.	(Brown & Smith, 165)
1850's	Power generated from the mills at the fall line makes Columbus the second largest industrial center in the south after Richmond.	(Brown & Smith, 165)
1860	Especially bad flood on the Apalachicola pushed a sandbar across the mouth of the Chiploa River. This backed up the water and cause five lakes to be flooded. The Corps of Engineers then dug a shortcut across the SE portion of the lake, inadvertently making the change permanent. This caused permanent flooding and killed 12,000 acres of Cypress trees that needed periodic flooding to survive	(Brown & Smith, 252)
1864	Johnson's River Line. Gen. Joe Johnson defies military convention and builds a massive defense works on the north side of the Chattahoochee, leaving the river at his back. He does have a wagon and railroad bridge and three pontoon bridges. The impressive line was constructed by slaves and the Georgia Militia and is five miles long and one mile deep. Sherman chooses not to do a frontal attack but orders a flanking maneuver. On July 8, Union troops cross the river on a fish dam six miles above Pace's Ferry and also use pontoon boats and cross at the mouth of Sope's Creek. The next day cavalry troops cross the Chat at Shallow Ford and Cochran's Ford. The Corcoran troops dismounting and wading across with nothing but their hats on their heads and their guns in the air. Outflanked, Gen. Johnson orders retreat from the impenetrable line, and after his troops retreat across the railroad bridge, burns it	(Brown & Smith, 105-6)
1865	Confederate navy gunboat still in port awaiting armament captured in Columbus. The Chattahoochee Rivers proves more treacherous than the Union army.	(Cook, 241)
1865	April 16, seven days after the war is over, 13,000 Federal troops invade Columbus from across the Chat from Alabama in one of the last major land battles of the Civil War. Columbus was a major provider of materials for the war including: cotton products, swords and cannon. All war related mills, warehouses and foundries are burned. Area quickly rebounds and the Eagle Mill is renamed the Eagle and Phenix mill to signify rebirth as it becomes the largest textile mill in the south.	(Brown & Smith, 179)

Date	Event	Reference
1868	Hydraulic mining is begun on the weathered bedrock from the hills and is washed into sluices and then into streams and rivers. Mercury is then used to separate gold from other materials. Mercury contamination of 10 to 100 times greater than natural background levels.	(Brown & Smith, 29)
1875	Atlanta builds 52 acre reservoir on South River. Could provide 3 million gallons per day	(Cook, 57)
1877	Sidney Lanier, a Macon, Georgia native wrote the poem "the Song of the Chattahoochee," a poem about the call of duty over the pleasures of life	(Brown & Smith, 46)
1880's	City leaders drill an ill-fated 2,044 foot hole that proves there is little water in the bedrock	(Cook, 57)
1880	Atlanta is a privy town with fourteen miles of sewer line. First sewer ditch was created when spring that flowed into the south river was rock-lined and covered. Unfortunately this spring also flowed to the reservoir which was the city's primary water source	(Cook, 90)
1884	First Atlanta sewer committee meets. Reports that Atlanta has woefully neglected her sewage.	(Cook, 90)
1889	2,829 flush toilets and 9,000 privies create waste management dilemma. Twelve two-horse "night soil" wagons transport 7,112 loads of sewage outside city limits.	(Cook, 90)
1890	Atlanta builds first sewer system. 35 miles of line that emptied into the cities five creeks. Center city smells better but poor black neighborhoods where the creeks flow through smell bad	(Cook,.90)
1890	City health board declares artesian well unfit to drink	(Cook, 57)
1893	Mayor W.A. Hemphill states, "I believe that it is conceded that our greatest need is water–water that is pure and in full supply. Our supply must come from flowing streams and not from ponds. He puts pumps into the Chattahoochee	(Cook, 57)
1900	20 million gallons pumped from Chat.	(Cook,.57)
1900	Bibb Manufacturing is built uses hydropower instead of mechanical turbines. Becomes largest textile mill in the country. Redefines manufacturing's relationship with river as it allows the mills to be moved away from the riverbank to avoid flooding.	(Brown and Smith, 179)

Date	Event	Reference
1902-04	The Morgan Falls dam is built, providing Atlanta its first hydro electric and fueling Atlanta's early industrial growth. This large concrete dam is among the first hydro-electric plants built in Georgia. Much of the 10,500-kilowatt output initially ran Atlanta's streetcar system. The Westinghouse generators are still in use. Drought in 1925 shows weakness in being dependent on water quantity Atlanta Constitution headline March 6, 1904 states: "Bull Sluice Dam has Bridled Chattahoochee-Has Cost the company one million and a half dollars to turn the power of the river into channels of commerce".	(Brown and Smith, 87)
1905	Atlanta sewer system not functioning well. Typhoid is rampant, especially among blacks. 1905 Census shows that typhoid rate is double national average	(Cook, 90)
1908	Atlanta Chamber of Commerce study "Urgent Needs of Atlanta" reported 16,295 water closets in use and 50,000 residents still relying on privies. "Night soil" carts still in use. During dry spell of 1908 30% of Proctor Creek was waste.	(Cook, 90)
1908	Chattahoochee is damned at Gainesville, Provides electricity	(Cook, 55)
1913	Gainesville and Northwestern Railroad constructed to transport timber from the Chat's riverbank. Logged out by 1931. Log rafts not floated on river????	(Cook, 18)
1914	R.M. Clayton, Atlanta's city engineer installs state of the art Imhoff tanks at the end of the sewer lines on Entrenchment, Proctor and Peachtree Creeks. This is a first in the US and Atlanta gains international attention for its progressive measures	(Cook, 91)
1916	Federal congress passes Federal Aid Road Act which made funds available to states. This new act encouraged more cooperation between local state authorities when it came to choosing routes and building roads. In 1920 the U.S. had 3 million miles of roads with only 36,000 miles of them having all weather surface suitable for autos. In 1921 the federal Highway act was amended to call for the construction of a system of interconnected interstate highways. States had to designate up to 7 percent of their roads as national highways if they wanted to receive federal dollars. In 1926 the first interstate routes were approved.	(Wallis, 5 (2001)

Date	Event	Reference
1921	River of Eufaula catches fire at Neil's landing marks beginning of the end of the river's steamboat era	(Cook, 236)
1930's	Chestnut blight (a fungus from Asia) decimates major species throughout SE	(Wharton, 133)
1934	Georgia Appalachian Trail Club become first "riverkeeper" by halting construction of road through the Chattahoochee Gap	(Cook, 16)
1935	Most or all of the topsoil in the piedmont region has been eroded. Piedmont agriculture lands abandoned in three stages. 1. Civil War 10% 2. Depression of 1880 30% 3. Boll weevil in 1920's	(Wharton, 144)
1938	Outgrown sewer system is given a boost when federal WPA dollars funds Atlanta's first true sewer system. It consists oftener treatment plants including the R.M. Clayton Plant that can treat 42 million gallons daily.	(Cook, 91)
1939	Last commercial boat, George W. Miller, docks in Columbus	
1940's	Turpentine productions production ends. Pines were tapped for their sap which was converted into turpentine. Many poor people tried to make a living with this tough way of life. Spanish moss was also harvested a great deal until the 1940's	(Brown & Smith, 264)
1940's	Push is made to make Atlanta a port city, efforts given up by early 70's. A series of locks and dams put in from the 50's makes Columbus an ocean port. In the early 1990's the Apalachicola-Chattahoochee-Flint (ACF) sys is the 26th out of 27th of the country's inland waterways to operate on a ton-per-mile basis.	(Cook, 238)
1946	Hartsfield's lobbying begins to bring in federal dollars for beginning of Lake Lanier for water source.	(Cook, 58)
1950's-78	Three coal-fired power plants are built on the Chat. Plant Yates in the 50's and 70's; McDonough Plant in 1960's located five miles north west of Atlanta; and Plant Wansley in 1976	(Brown & Smith, 170)
1950-75	Fifty-two reservoirs with over 1 million acre-feet were constructed in U.S.	(Cook, 169)
1956	Feb. 1 Flood gates close at Buford Dam, Lake Lanier, a 38,000 acre impoundment take two years to fill. Creates two billion dollar a year tourist industry. 13,000 homes on lake. 7 million visitors annually.	(Cook, 52)

Date	Event	Reference
1956	At Eisenhower's vision, Congress enacts the Federal Aid Highway Act of 1956, spelling out guidelines for a 42,500 – mile national interstate highway system.	(Wallis, 25)
1962	Sewage treatment bad in Georgia. 52 cities have no treatment plants. Atlanta's Clayton plant receiving twice its treatment capacity daily and each day up to 50 million gallons of untreated sewage diverted into the river.	(Cook, 91)
1962	West Point Dam construction is authorized by congress for flood control, navigation, hydroelectric power, fish and wildlife and recreation. It is the first time in the SE that the Corp uses recreation as prime objective.	(Brown & Smith, 149)
1967	Alligators granted federal protection	(Cook, 151)
1968	Clayton plant expansion that would triple capacity was begun at a cost of 33 million. Completed in 1978. Even then plant is labeled the state's "largest water pollution problem."	(Cook, 91)
1967	Ray Scott has mystic vision and forms BASS: Bass Angler Sportsman's Society	(Cook, 169)
1969	Original "perimeter" Highway completed around Atlanta	(Cook, 72)
1970	Friends of the Chattahoochee River formed to fight sewage treatment pipe placement. Beginning of modern Atlanta's reconnection to the river.	(Cook, 76)
1972	Passage of Clean Water Act	
1973	Chattahoochee River Recreation Area created. 3 million visitors a year now enjoy	(Cook, 76)
1980	Flood gates closed on West Point Lake	(Cook, 17)1
1982-92	2% (740,000 acres) of Georgia farm and forest land lost to development	(Cook, 74)
1989	Corp devises plan for Atlanta to withdraw more water to meet demand	(Cook, 257)
1990	Apalachicola Bay provides 90% of the oysters eaten in Florida and 10% in consumed in the U.S.	(Cook, 259)
1990	Florida and Georgia file suit against Georgia. Seven year water study results at a cost of 15 million	
1990's	Pressure builds in Atlanta to clean up waste-water. 1995 city pay's fines of 4 million. In 1998 it pays $20 million.	(Cook, 93)
1992	Alan Jackson's song, "Chattahoochee" hits # 1	(Jessup, Pam)

Date	Event	Reference
1994	"Tunnel Project" Fiasco. $ 20 million spent on tunnel project that would once again put Atlanta at the forefront of wastewater treatment. Black residents unite with charge of environmental racism and stop project from dumping waste water into their community.	(Cook, 93)
1996	Chattahoochee makes list of American Rivers ten most endangered waterways	(Cook, 12)
1998	Mussels on the lower Chattahoochee are listed as endangered species after bitter four year battle	(Cook, 243)

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Key Concepts

This chart lists in alphabetical order key concepts addressed in *Waters to the Sea* and indicates which segments of the program relate to each concept.

Concept	Location in CD ROM
Atlanta, city of 1. water consumption 2. Terminus, former name of	1. Mountain region, Dams and Reservoirs, multimedia program 2. Piedmont Region, intro video
Bartram, William: biographical information	Introduction to Mountain Region
Best Management Practices [see Water Quality]	
Competing interests, conflicts over resources	1. Mountain region, Dams and Reservoirs module 2. Coastal region, An Oyster's Tale
Dams and Reservoirs: number and location in the basin, impacts and services of	Mountain region, Dams and Reservoirs [video]
Energy Pyramid	What is an Ecosystem
Estuary [Apalachicola Bay]: General characteristics to, threats, potential solutions	Coastal Region, An Oyster's Tale
Fire: 1. Role in prairie ecosystem 2. Use by Native Americans 3. Role in longleaf pine-wiregrass ecosystem	1. What is an ecosystem 2. Mountain Region, Deer video 3. Coastal Region, modern logging movie
Flooding: 1. undesirable, urban settings 2. beneficial to natural system function [estuary ecosystem]	1. Piedmont Region, Streets to Streams, Impervious Surfaces 2. Coastal region, An Oyster's Tale, "heron" video
Food Web	What is an Ecosystem, Forest Food Web
Forest, native [longleaf pine-wiregrass]	Coastal Plain Region, Modern Logging [video]
Geologic Features • Brevard Fault	1. Piedmont Region, Intro video
Gold mining, European settlers	Mountain region, Intro video
Impervious surfaces: impacts, solutions	Piedmont Region, Streets to Streams, Impervious surfaces

King, Horace	Piedmont region [intro video] and Horace King's Life and Times
Logging [see Timber Harvest, Water Quality]	
Maps: 1. Chattahoochee-Apalachicola basin, physiographic Regions] 2. topographic	1. Understanding Watersheds 2. Coastal region, On the Farm, Water Wise Farmer game
Musgrove, Mary	Coastal region [intro video] and Mary Musgrove's Life and Times
Native Americans [Creek and Cherokee] 4. Burial mounds 5. Fishing weirs 6. Travel [dugout canoe] 7. River cane [uses of] 8. Deer [uses of]	4. Mountain region, intro video 5. Mountain region, Dams and Reservoirs [video] 6. Piedmont region, Intro [video] 7. Coastal region, Raising Cane the Creek Way 8. Mountain region, Cherokee, Creek and Deer
Non-point pollution	Piedmont Region, Journey of a Raindrop video and interactive, and Streets to Streams, Impervious surfaces; Coastal Region, An Oyster's Tale, Stormwater Runoff
[Physiographic] regions of the Chattahoochee and Apalachicola Watersheds	Understanding Watersheds [4]
Point source pollution	Piedmont region, Typhoid Trouble, Point Source Pollution
River features: defined [delta/mouth, tributary, height of land, floodplain, headwaters, main channel]	Understanding Watersheds [3]
Timber harvesting: historical and present-day, problems associated w/sedimentation, best management practices, longleaf-wiregrass ecosystem	1. Mountain region, intro video 2. Coastal region, modern logging movie and interactive
Water Cycle	Understanding Watersheds, Water Cycle Video
Water Quality 1. Threats and protective measures (best management practices) as related to: farming, logging, construction, ranching, urban planning, and wastewater management 2. Measuring/Testing for : [dissolved oxygen, indicator species, pH, temperature, turbidity]	1. Mountain Region, Dams and Reservoirs, "We can't all live upstream;" Coastal Region, On the Farm video and Water Wise Farmer game; Mountain Region, the Buffer Zone; Coastal Region, Modern Logging movie and Interactive; Piedmont region, Streets to Streams, Impervious surfaces; Piedmont region, Typhoid Trouble, Point Source Pollution, Open Sewers, Go with the Flow. 2. Testing for Water Quality: Water Lab Tutorial; and at conclusion of each module

Watersheds, major U.S.	Understanding Watersheds

Glossary

A	
abundant	many, amply supplied
acidic	high in acid content, below 7 on pH scale
adaptable/adaptation	the ability of an organism to tolerate differing environmental conditions; an organism's physical or behavioral adjustments to its environment (usually helps to increase chances of survival)
aerator	a device that adds oxygen to water
aerial	occurring in the air
algae	a diverse group of aquatic, plant-like organisms (many of which belong to the Kingdom Protista), which lack true roots, stems and leaves, but have chlorophyll and other pigments for carrying out oxygen-producing photosynthesis (up to 90% of the photosynthesis occurring on earth)
aquatic	occurring in or relating to water
aquatic habitat	an environment for plants and animals where water is a major and essential feature
asphalt	a dark-colored material found naturally in underground beds (and resulting from refining of petroleum), composed mostly of hydrocarbons. Used for making pavement
assessment	an evaluation; to take a measure of; the act of determining importance, value, or size
atmosphere (earth)	a 500 kilometer-thick layer of gases (known collectively as air) that surrounds the earth and is held in place by gravitational forces
B	
bacteria	a group of single-celled microorganisms that can live in the air, in soil, water, organic matter, or in other organisms. Some forms are necessary for human life; others pose a serious threat
basic	low in acid content, above 7 on the pH scale
bedrock	the solid rock underlying the surface soil
biome	a major ecological community (such as tundra, grassland, tropical rainforest) that is usually defined by its dominant vegetation
C	

Carbon dioxide (CO^2)	a heavy, colorless gas that dissolves in water to form carbonic acid and accumulates in the atmosphere as a "greenhouse gas." Sources include animal respiration (breathing out) and combustion of animal and vegetable matter (such as the burning of fossil fuels in auto engines). Plants absorb CO^2 from the air during photosynthesis.
Celsius	a scale used to measure temperature, where 0 degrees is the freezing point of water and 100 degrees is its boiling point
channel	the bed where a natural stream of water runs
channelize	to straighten a stream by directing it to run through an artificially created channel
chlorophyll	the green pigment found chiefly in plants that is used in photosynthesis. Plants use chlorophyll to convert energy from sunlight into chemical energy that can be stored and used to fuel growth
clarity	the state of being clear
combustion	the act of burning, commonly a chemical process that produces heat and usually light. Engines convert energy from combustion of fossil fuels into mechanical force and motion
commercial	occupied or engaged in commerce or business. For example, a store is a commercial operation
condensation	the conversion of a substance (such as water) from the vapor state to a denser liquid
confluence	the point where two or more streams meet and flow together
conifers	an order of mostly evergreen trees and shrubs, belonging to the division Gymnospermae, in which the seed is borne in a cone. For timber harvest purposes, conifers are considered "softwoods" (as opposed to hardwoods such as oaks)
conservation	a careful preservation and protection of something to allow for its continued health and function; especially: planned management of a natural resource to prevent exploitation, destruction, or neglect
consumer	an organism that obtains its food by eating other organisms or particles of organic matter
continental divide	a divide separating streams that flow to opposite sides of a continent
contour line	a contour line on a map connects points of land with the same elevation above sea level. If placed close together, contour lines indicate steep terrain; far apart indicates more level topography

D	
deciduous	a plant or tree that loses its leaves seasonally. Most are broad-leaved, but some (for example, tamarack trees) have needles
decomposer	any of various organisms (including many bacteria and fungi) that return organic substances to the soil by feeding on and breaking down dead matter
delta	a feature that may be found at a river's mouth. It is formed by the accumulation of sediments that have dropped out of the water column and settled onto the bed of the lake or sea
deposits	something laid down; especially: matter deposited by a natural process
detritus	loose material (such as rock fragments or organic particles) that results directly from disintegration; commonly refers to the accumulation of organic material on the ground (from plants as well as remains of small animals)
diameter	a measurement of the distance "across" an object (for example, a tree trunk or pipe) determined by the length of a straight line through the object's center
dissolved oxygen	the amount of oxygen that has been absorbed into a liquid, usually water. The capability of water to hold oxygen is affected by temperature, pressure, and salinity (saltiness)
diverse	differing from one another or composed of distinct or unlike elements or qualities
domestic	living near or about human habitations; tame
downspout	a vertical pipe used to drain rainwater from a roof
downstream	in the direction of or nearer to the mouth of a stream
E	
ecological	concerned with the interrelationship of organisms and their environments
ecosystem	the complex system of a community of organisms and its environment and how they function together
era	a period of time identified by some prominent figure or characteristic feature
erosion	the process of wearing away; commonly refers to the loss of soil due to the action of wind, water, or glacial ice
estuary	an area where freshwater from a river or stream meets and mixes with saltwater in a semi-enclosed or protected area, creating an aquatic environment that is affected by tides but has a lower average salinity (saltiness) than seawater

European	a native or inhabitant of Europe, a continent of > 40 countries bounded on the west by the Atlantic ocean, the north by the Arctic Ocean, the east by the Ural Mountains and Ural River, the SE by the Caspian Sea, Caucasus Mountains and Black Sea, and the south by the Mediterranean Sea.
evaporation	the process of converting from a liquid to a vapor
expedition	a journey or excursion undertaken for a specific purpose
extinct	no longer existing
species extinction	the complete and final loss of all individuals and populations of a given species: may be natural or caused by humans through activities such as over-hunting and land-use changes that destroy habitat
F	
fecal coliform	general name for a group of bacteria associated with the fecal material (sewage, animal waste) of warm blooded animals. Escherichia coli, (E. coli) is among the bacteria in this group that pose a serious threat to human health
fertilizer	a substance (such as manure or a chemical mixture) used to make soil more fertile in order to increase quality or quantity of harvest
filter	a natural or man-made material that functions as a screen or strainer, serving to limit what passes through it
filter strip	a strip of plants or material that prevents the passage of unwanted particles: e.g. prevents topsoil from eroding off farm fields into a river
fire resistant	able to withstand fire
floodplain	low-lying land near a lake or river that may be submerged by floodwaters
fungi	plant-like organisms that belong to the Fungi Kingdom (which includes molds, rusts, mildews, smuts and mushrooms); are parasitic and lack chlorophyll
G	
geology	a science that deals with the history of the earth and its life, especially as recorded in rocks
grassed waterway	a strip of plants or material planted where water flows to filter out unwanted particles
gravel	loose, rounded fragments of rock
grit chambers	tanks where grit and sand are removed during the wastewater treatment process
gullies	trenches which were originally worn in the earth by running water, and through which water often runs after rains

H	
habitat	the environment where a plant or animal naturally lives, where it is provided with appropriate food, shelter, and conditions necessary for successful reproduction
hardwood	trees that belong to the group of plants known as "Angiosperms," which have true flowers and bear their seeds in a protective coat. These trees(such as oak, hickory, and sugar maple) are typically deciduous and are known for their strong wood
headwaters	a stream or river's point of origin, often at the site of a spring
height of land	a ridge-line that serves as the boundary between two watersheds, from which water flows in different directions
herbicides	an agent used to destroy or inhibit plant growth
herbivore	a plant-eating animal
hydrogen	a nonmetallic element that is the simplest and lightest of the elements, and is normally a colorless, odorless, highly flammable gas
I	
impervious	not allowing entrance or passage; a surface (such as cement) through which water cannot pass
incineration	to cause to burn to ashes
industrial	commonly used to refer to businesses that are involved in the manufacture of a product (e.g. chemicals, cars)
inefficient	wasteful of time or energy
inland	land that is not located on the shoreline or coastline of a body of water; of or relating to the interior of a country
inorganic	being or composed of matter that is not and has never been alive; a material (such as a mineral) that is not plant or animal in origin
intolerant	not able to thrive (or not able to survive) in certain conditions
invertebrate	lacking a spinal column
J,K,L	
larval/larva	generally applied to insects, refers to an early stage in the life cycle of an animal when it is able to move and feed itself, but has no wings and usually cannot reproduce. This stage is commonly followed by a inactive period in a cocoon or chrysalis, from which the insect emerges in its adult form
lichen	belonging to a group of pollution-intolerant organisms in the division Lichenes, which are composed of an alga and a fungi living together;

	typically found growing on rocks or tree trunks
M	
marsh	a plant community of shallow wetland basins, dominated by non-woody aquatic plants such as cattails and bulrushes. Marshes usually have standing water during all seasons
meander	a naturally-occurring curve or bend in a stream or river. Over time, the erosive action of the river's currents can change the shape and size of a meander, changing the course of the river channel
Mercury (Hg)	originating from sources such as combustion of coal, industrial waste, batteries, and paint, this toxic metal can accumulate in river and lake sediments. It is then taken up by small aquatic organisms that are in turn eaten by fish. Humans and other animals eating these fish may be exposed to mercury-related health risks
metal refining	an industrial process where metals are freed from impurities or unwanted material through the use of extreme heat
metamorphosis	a dramatic change in the form or structure of an animal that occurs as a normal part of its life cycle (e.g. tadpole to frog; caterpillar to winged butterfly)
metropolitan	of, relating to, or characteristic of a large city, sometimes refers to an extensive region that includes the suburbs surrounding a major city
microbes	tiny life forms; a term especially applied to disease-causing bacteria
microorganisms	tiny life forms; organisms generally viewed with the help of a microscope
molecule *(molecule, cont.)*	the smallest possible unit of a substance (e.g., a chemical compound) that has all of the defining qualities of that substance; a group of atoms held together by a chemical bond
mouth (river)	the point where a stream or river enters into a larger body of water (a larger river, a lake, or sea)
murky	in reference to water, indicates a cloudy quality that may result from suspended sediment or pollution; not clear
N	
native species	species that are naturally occurring in a region, that have not been introduced as a result of human activity
negotiate	in the context of decision-making, refers to the process of arriving at a decision by participating in discussions in which opposing views are given respectful consideration and in which a degree of compromise is expected from all parties involved
non-point source pollution	a pollution source that cannot be identified as originating from discrete points such as pipe discharge or industrial emissions stacks (examples include runoff from fertilizer and pesticide applications, deposition of

	toxins from the atmosphere, runoff into streams and rivers from impervious surfaces in urban areas)
nutrients (nutrients, cont.)	element or compound that is essential for animal and plant growth. Common nutrients in fertilizer include nitrogen, phosphorus, and potassium. In excessive amounts, nutrients in a waterway can be considered as pollutants
O	
observation	the act of recognizing and noting a fact or event, often involving measurement with an instrument and the keeping of a record
organic	of, relating to, or derived from living organisms
oxygen	a colorless, tasteless, odorless gaseous element that makes up 21 percent of the atmosphere and is found in water, in most rocks and minerals, and in numerous organic compounds
P	
pulp	the soft fibrous mass used in production of paper and formed by the mechanical and chemical processing of rags, straw and especially wood (in particular, coniferous softwoods)
peak flow rates	*flow rates* are a measure of the volume of water moving past a given point over a specified period of time; *peak* flow rate indicates the period of highest or greatest measured flow during the specified period
pesticides	a chemical applied to crops, roadside ditches, lawns, or elsewhere in order to control weeds, insects, fungi, rodents, or other organisms considered undesirable. If improperly used, can also pose a threat to non-target species, including humans
pH	a measure of the acidity (pH less than 7) or alkalinity (pH greater than 7) of a solution. Neutral pH is 7.
photosynthesis	a process that occurs in the chlorophyll molecules of green plants, that uses radiant energy from the sun, carbon dioxide (from the atmosphere), basic salts (from the soil) and water to result in the production of simple sugars (such as glucose)
pine	belonging to the family Pinaceae, a group dominated by coniferous evergreen trees with slender, elongated needles
plantation	an area of trees (commonly same-aged, single species) planted as a crop, for purposes of timber production
point-source pollution	a distinct, discrete location from which pollution is emitted, such as a discharge pipe, concentrated livestock operation, or emission stack
pollen	the male reproductive cells of a flowering plant, formed in the anthers and usually appearing as a fine dust

pollution	contamination with poisonous or harmful substances, which causes undesirable changes in the physical, chemical, and biological processes that support life
prairie	a fire-dependant plant community dominated by grasses and broad-leaved, non-woody plants
precipitation	the deposition of atmospheric moisture in the form of rain, hail, sleet, snow
predator	typically, an animal that catches, kills, and eats other animals, which are known collectively as "prey"
prediction	an estimation of a future outcome, usually on the basis of experience, observation, or scientific reason
prehistoric	of, relating to, or existing in times before written history
producer	term generally applied to green plants, making reference to their ability to produce their own food (create organic compounds) using the sun's energy. This ability distinguishes producers from life forms (known as consumers) that must consume other organisms for food.
Q, R	
Ravine	steep-sided valley that is usually worn by running water
raw sewage	fecal matter (animal waste) that has not been processed through a wastewater treatment system
recommendation	Suggestion
redeposited	returned to; put back in a place or position occupied at an earlier time
regulation	a rule or order issued by a government agency, having the force of law
remnant	a small part remaining from a once-larger piece (e.g. prairie or forest remnant)
Renew	to restore to a previous state or condition
residential	an area of mostly homes rather than businesses
residents	the people who live in a community or place
resistant	having the ability to ward off or to avoid the negative impacts of a condition (e.g. a drought-resistant plant can survive extended periods of drought; a disease-resistant variety of apple tree is less likely to be harmed by disease)
Ridge	a raised strip
riparian	relating to, living, or located on the bank of a natural watercourse
Rivulet	very small streams of water
Runoff	rainwater or snowmelt that is transported to streams by overland flow rather than absorbed into the ground
S	

Seasonally	of, relating to, or varying in occurrence according to the season
secondary treatment	part of a wastewater treatment process, in which oxygen is added to the water and it is cleaned by tiny bacteria
Sediment	particles of rock, sand, soil and bits of organic material. May be suspended in water or carried downstream and deposited; excessive amounts may harm aquatic systems
sediment basin	a manmade pond that collects runoff (especially from farm fields) in order to keep excessive sediment from entering nearby streams or rivers
sedimentation process	part of a wastewater treatment process, in which larger pieces of matter settle to the bottom of a tank and are removed
septic system	a tank stored under the ground in which bacteria works to break down the solid matter in sewage
Settlers	term commonly used to describe people who move into an area to make it their home, especially as regards a "new region." In America, the term commonly refers to people who moved to America from Europe in the 1800s, although the land had already been occupied for thousands of years by Native Americans as well as early (prehistoric) peoples
Sewage	fecal material; animal waste
sewer	an underground pipe that carries sewage and sometimes stormwater; generally directs its contents to wastewater treatment plants, but overflows may result in unintended contamination of waterways
silt	loose sedimentary material with particles usually 1/20 millimeter or less in diameter
skidder	a tractor or other heavy equipment used to haul cut logs
source	the point of origin of a stream or river
subwatersheds	the smaller units that make up a major watershed, based on divisions resulting from the direction and flow of water
T	
terraces	a series of horizontal ridges made in a hillside to increase the area of farmable land, conserve water, and/or minimize erosion
tolerant	the ability of a plant or animal to survive under changing environmental conditions (e.g. certain species of aquatic insects are more pollution tolerant than others)
topography	an aspect of landscape, in which the surface contours, relative elevations, orientation, and scale of natural landforms and man-made features are considered; commonly depicted on maps with finely detailed graphics
topsoil	surface soil, usually including the organic layer in which plants are rooted
toxic	Poisonous

transpiration	the loss of water vapor from the internal spaces of a plant through pores, located mainly on the undersurfaces of leaves (On warm, windy days a single oak tree can transpire more than 118 gallons of water)
tributaries	a stream feeding a larger stream or lake
turbidity	thick or opaque with sediment; exhibiting a lack of clarity
U	
upstream	in the direction of a river's source; in the direction opposite to the flow of a stream
V	
vapor	a substance in a gaseous state (e.g. water vapor), as distinguished from the liquid or solid state
vegetation	plant life or total plant cover
vial	a small closable container, especially for liquids
voracious	having a huge appetite
W	
waterfowl	term applied generally to wild ducks, geese and swans; the broader term "water bird" typically extends to those birds that live in or around water and which rely upon aquatic habitats
watershed	a region or area that drains ultimately to a particular watercourse or body of water, and which is commonly separated from other watersheds by divides (heights of land from which water is directed by landform and gravity to flow in opposite directions)
wetland	habitat where soil is saturated or covered with water for part of the year
windbreak	a growth of trees or shrubs serving to break the force of the wind (usually planted rather than naturally occurring)
woodlot	an area of usually privately-owned woodland, managed and maintained for the purpose of providing a continued source of fuel, posts, and lumber
X, Y, Z	
Zone/zoning	to arrange in or mark off into zones; specifically, to partition land by ordinance into sections reserved for different purposes (such as residential or business)

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National Education Standards Correlations

Study Guide Activity	*Standard Area (From Education World)*	*Standard Criterion*	*Underlying Concepts (Quoted and/or paraphrased from various sources)*
Classroom Activities 4 - 5		**As a result of their activities, all students should develop an understanding:**	
Exploring Experts	Technology: basic operations and concepts	Students demonstrate a sound understanding of the nature and operation of technology systems. Students are proficient in the use of technology.	Students investigate a range of devices that handle information. Information is stored in and retrieved from a variety of media, including CD-ROMS. (AAAS Project 2061)
River Work--River Play	Science: Physical Science	Motions and forces Transfer of energy	Energy helps make sense of many things in the natural world. Heat is one kind of energy; movement is another. Energy is associated with work, or getting things done. (AAAS Project 2061)
	Mathematics: Understand meanings of operations and how they relate to one another	Understand various meanings of multiplication and division; Understand the effects of multiplying and dividing whole numbers	Analogy is an important principle in mathematical reasoning. One way to make sense of something is to think how it is like something more familiar. (AAAS Project 2061)
Who wants to be a local watershed explorer?	Science as Inquiry	Abilities necessary to do scientific inquiry Understanding about scientific inquiry	Students should have the opportunity to learn about an increasing variety of living organisms, both the familiar and the exotic, and should become more precise in identifying similarities and differences among them. Interactions among organisms within an

			environment should start with relationships they can directly observe. (AAAS Project 2061)
River Words: Haunted by Waters	English: Applying Knowledge	Students apply knowledge of language structure, language conventions (e.g., spelling and punctuation), media techniques, figurative language, and genre to create, critique, and discuss print and non-print texts.	This activity emphasizes "the connections between reading and writing and the importance of gaining a working knowledge of language structure and conventions." (National Council of Teachers of English)
Life is Like A River: River as Metaphor	English: Applying Knowledge	Students apply knowledge of language structure, language conventions (e.g., spelling and punctuation), media techniques, figurative language, and genre to create, critique, and discuss print and non-print texts.	This activity emphasizes "the connections between reading and writing and the importance of gaining a working knowledge of language structure and conventions." (National Council of Teachers of English)
Classroom Activities 6 - 8			
Exploring Experts	Technology-Basic Operations and Concepts	Students demonstrate a sound understanding of the nature and operation of technology systems. Students are proficient in the use of technology.	This activity reinforces the concept that "today, the knowledge base for technology can be found as well in libraries of print and electronic resources and is often taught in the classroom." (AAAS Project 2061)
River Work--River Play	Physical Science	Motions and forces Transfer of energy	"At this level, students should be introduced to energy primarily through energy transformations… Students should trace where energy comes from (and goes next) in examples that

			involve several different forms of energy" including motion of objects…Energy appears in different forms" including the energy of motion. (AAAS Project 2061)
Who wants to be a local watershed explorer?	Inquiry	Abilities necessary to do scientific inquiry Understandings about scientific inquiry	Inquiry project offer an opportunity to foster students' curiosity. This activity reinforces the idea that "there are often several different ways of making sense out of a body of existing information." (AAAS Project 2061)
River Words: Haunted by Waters	Language Arts-Communication Skills Applying Knowledge	Students employ a wide range of strategies as they write and use different writing process elements appropriately to communicate with different audiences for a variety of purposes. Students apply knowledge of language structure, language conventions (e.g., spelling and punctuation), media techniques, figurative language, and genre to create, critique, and discuss print and nonprint texts.	This activity offers an opportunity to "tap into the diverse and rich experiences these language users have been building over their 10-14 years of life…Writing is a social activity; writing instruction should be embedded in social contexts." (National Council of Teachers of English, What We Know About Writing, Grades 6-8 http://www.ncte.org/researchissues/113177.htm)
Life is Like A River: River as Metaphor	Language Arts-Communication Skills Applying Knowledge	Students employ a wide range of strategies as they write and use different writing process elements appropriately to communicate with different audiences for a variety of purposes. Students apply knowledge of	This activity offers an opportunity to "tap into the diverse and rich experiences these language users have been building over their 10-14 years of life…Writing is a social activity; writing instruction should be embedded in social contexts." (National Council

		language structure, language conventions (e.g., spelling and punctuation), media techniques, figurative language, and genre to create, critique, and discuss print and nonprint texts.	of Teachers of English, What We Know About Writing, Grades 6-8 http://www.ncte.org/researchissues/113177.htm)

Watershed Links

Discover For Yourself

Surf Your Watershed. This interactive site allows you to look at a variety of information on watersheds throughout the United States. This site also allows you to search for watersheds by zip code, city, county or river!
http://www.epa.gov/surf/

Know Your Watershed. This site provides information on all the tools needed to start a watershed group and put together a watershed management plan to successfully implement a local, voluntary plan. This site also allows you to search for watersheds by zip code, city, county or river!
http://ctic.purdue.edu/kyw/kyw.html

Watershed Initiatives. This group provides: mediation, facilitation, education forums, and management of watershed and natural resource protection and restoration projects.
http://www.watersheds.com

The Water FAQ. This list of Frequently Asked Questions explains common water problems and possible solutions to them through different treatment methods. This site also provides information on testing water for pesticides.
http://www.softwater.com/faq.html

Water Environment Federation is both a technical and educational organization. This site provides a wide variety of valuable information and resources about water quality, more specifically, preservation and enhancement of the global water environment. If you are seeking water quality education resources for all ages, programs/workshops, products, or are curious to know what water quality issues are being discussed in legislation, this is the is the site for you.
http://www.wef.org/

The Green Map System (GMS) brings a locally adaptable framework into the hands of many. It invites design teams of all ages and backgrounds to create a Green Map by charting urban areas in a manner that illuminates the interconnections between the natural and designed environments.
http://www.greenmap.org/home/home.html

Government Information

Office of Water. An office of the Environmental Protection Agency.
http://www.epa.gov/OW/

Office of Wastewater Management. An office of the Environmental Protection Agency
http://www.epa.gov/OWM/

Office of Wetlands, Oceans and Watersheds. An office of the Environmental Protection Agency.
http://www.epa.gov/OWOW/

Watershed Science Institute (WSI). Part of the Natural Resources Conservation Service of the US Department of Agriculture. WSI works to "incorporate ecological principles into natural resource conservation and accelerate the development and transfer of appropriate technology in response to comprehensive watershed needs and environmental sustainability at the watershed and landscape scales."
http://www.wsi.nrcs.usda.gov/about/

Educational Programs

Yahara Watershed Education Network. The Yahara Watershed Education Network is an informal umbrella for K-16 educational activities that focus on local issues using "watershed" and "ecosystem health" as integrating concepts. It is a collaborative effort of Edgewood College, the University of Wisconsin-Madison, the Wisconsin Department of Natural Resources, local teachers and school districts, their students, and other interested educators.
http://danenet.wicip.org/ywen/index.html

Watershed Initiatives. Watershed Initiatives develops public education workshops, facilitates public meetings and mediates among stakeholder interest groups struggling with difficult natural resource issues. Project management for watershed restoration projects are also provided..
http://www.watersheds.com/index.htm

Watershed Education Committee. The Watershed Education Committee (WEC) provides a diverse forum for teachers, scientist and educators interested in watershed issues, to exchange educational and scientific information. The group works with groups such as boater's, farmers and business's, to address a wide range of issues including; agricultural runoff, oil spills, urban runoff and wetland deterioration and restoration.
http://www.mbnms.nos.noaa.gov/educate/teachprg.html

Internet Watershed Educational Tool (InterWET). The Internet Watershed Educational Tool was developed to help educate local officials and other concerned citizens about water resources. InterWET gives a technical and multi-perspective response to local watershed issues, using as a case study the Spring Creek Watershed in central Pennsylvania.

InterWET can be used as a stand-alone educational resource and as part of larger watershed educational efforts for a variety of people in many different watersheds.
http://www.interwet.psu.edu/

US EPA Watershed Academy. This program is an academy for watershed managers, focusing and based on local, states, tribal and federal experiences.
http://www.epa.gov/owow/watershed/wacademy/

Adopt-A-Watershed. This site is home to the K-12 adopt-a-watershed science curriculum. Its focus is the watershed as a basis for hands-on, in the field learning, for students and the community, developing partnerships, and reinforcing learning through community service.
http://www.adopt-a-watershed.org

Global Water Sampling Project. A collaborative online project, allowing students from all around the globe to compare the quality of their local water.
http://k12science.stevens-tech.edu/curriculum/waterproj

Water Science for Schools. Information on many aspects of water, along with pictures, data, and maps, from the US Geological Survey.
http://wwwga.usgs.gov/edu

Watershed-The System. This is a Geographic Information Systems (GIS) based watershed management information system designed for community based organizations dealing with soil, water, and habitat conservation.
http://www.watershedthesystem.com

Organizations and Resources

The WaterShed Partners. The WaterShed Partners is an informal association of organizations in the Twin Cities metropolitan area (Minneapolis/St. Paul, Minnesota) committed to addressing shared goals pertaining to watershed education.
http://cgee.hamline.edu/watershed/index.htm

The Allegheny Watershed Network. The goals of the Allegheny Watershed Network are to increase communication among the many groups and individuals living and working in the Allegheny River watershed and to bring attention to the resources of the region.
http://www.pecwest.org/

National Watershed Coalition (NWC). The NWC is a nonprofit 501(c)(3) Coalition *(F.E.I.N. no. 84-1142882) (Dun & Bradstreet Number, DUNS, 09-053-1299)* made up of national, regional, state, and local organizations, associations, and individuals, that advocate dealing with natural resource problems and issues using watersheds as the planning and implementation unit. NWC advocates using total resource management principles in planning,

and believes the USDA assisted small watershed programs are among the best planning and implementation vehicles available for wise water and land management.
http://www.watershedcoalition.org/

The National River Conservation Organization. As the nation's leader in supporting grassroots river and watershed conservation groups, this website has been designed to link activists with river information, resources and services.
http://www.rivernetwork.org

Watershed Science Centre. WSC is an inter-disciplinary and inter-institutional alliance focusing on watershed ecosystem management, health, protection and rehabilitation.
http://www.trentu.ca/wsc/

The Watershed Company specializes in the evaluation and rehabilitation of rivers, streams, wetlands, and other wildlife habitat.
http://www.watershedco.com

Conservation Technology Information Center. Home to information about environmentally beneficial and economically viable management practices for agriculture, urban and other watershed stakeholders.
http://ctic.purdue.edu

Water Environment Research Foundation. WERF works on water quality issues, focusing on four major points: Collection and Treatment Systems, Human Health and Environmental Effects, Watershed Management, and Residuals Management.
http://www.werf.org

AmeriCorps Watershed Stewards Project. WSP is committed to conserving, restoring, and sustaining natural habitats for future generations by linking education with high quality scientific practices.
http://northcoast.com/~fishhelp/

Waterkeeper Alliance is a grassroots organization with over 100 local programs and growing. Waterkeeper Alliance is dedicated to preserving and protecting YOUR water from polluters! The Waterkeeper Alliance also connects and supports local Waterkeeper programs to provide a voice for waterways and their communities worldwide.
http://waterkeeper.org

Chattahoochee River & Georgia Water Resources Information

Upper Chattahoochee Riverkeeper. UCR advocates and secures the protection and stewardship of the Chattahoochee River, its tributaries and watershed, in order to restore and

conserve their ecological health for the people and fish and wildlife that depend on the river system. This site contains Chattahoochee facts, maps, laws, and activities for children of all ages and resources for educators. There is also a comprehensive list of local /regional environmental groups.
http://www.chattahoochee.org/

Clean Water Campaign. This website is your source for information on how you can be part of the "solution to stormwater pollution." Based in Atlanta this website examines stormwater pollution in Georgia listing community programs, events, and resources. Don't miss the fun, interactive stormwater facts and activities for kids!!!
http://www.cleanwatercampaign.com

UGA River Basin Science and Policy Center. The River Basin Science and Policy Center conducts scientific and policy research projects on water-related problems and issues. Educational programs and materials for K-12 students, teachers, and the general adult public are available to better understand water resources and the challenges we face in effectively managing these issues. Additional information about Georgia's water includes: water issues, facts and maps, what's in the news, and water conservation.
http://rivercenter.uga.edu/

Chattahoochee Nature Center. Are you looking for environmental educational classes taught by a naturalist or an environmental curriculum comprehensible for all ages? Go a on a virtual tour through: the Georgia Wetlands (Mountain Bog, the Piedmont Flood Plain, the Okefenokee Swamp, the Pitcher Plant Bog, and a Longleaf Pine and Wiregrass Community), raptor aviaries, the beaver exhibit, and down the Chattahoochee exploring issues unique the river and it's ecosystem. This site explores Georgia as an environmental treasure full of variety and beauty.
http://www.chattnaturecenter.com/

Environmental Education in Georgia. EEinGEORGIA.org is the online clearinghouse for environmental education (EE) in Georgia. This site provides EE lesson plans based on Georgia's Quality Core Curriculum standards, a searchable directory of Georgia's EE providers and the resources they offer, a statewide calendar of EE events, EE news, and easy-to-access facts about Georgia's environment.
http://eeingeorgia.org

Georgia Adopt-A-Stream

The goals of this organization are: to increase public awareness of the state's nonpoint source pollution and water quality issues, provide citizens with the tools and training to evaluate and protect their local waterways, encourage partnerships between citizens and their local government, and collect quality baseline water quality data.
http://www.riversalive.org/aas.htm

Georgia Project WET (Water Education for Teachers) is an international, interdisciplinary, water education program for formal and nonformal educators of students 5 to 18. Each year, Project WET holds an international environmental art and poetry contest (**River of Words Activity**) for grades K-12. By encouraging children to explore their own watershed, discover its importance in their lives, and express what they learn, nurtures respect and understanding of the natural world. Children are encouraged to learn their "ecological address" by honing their observation skills, (the basis of both art and science), then describing through poetry and art their own "place in space."
http://www.projectwet.org

Elachee Nature Center Elachee invites you to visit and participate in educational programs for schools and groups designed to be engaging, educational, and memorable. Elachee's sprawling campus consists of a woodland refuge and an interactive museum that will excite and educate visitors of all ages. Visit our animal exhibits or set sail on the Chota Princess—a floating classroom on Lake Lanier—to learn about lake ecology and the Chattahoochee River watershed. Surrounding the Center is the 1,300 acre Chicopee Woods Nature Preserve laced with over 12 miles of nature trails.
http://www.elachee.org

River Connections in Children's Literature

Ecology

The Colorado: A River At Risk. Jim Carter. (photographs)
Come Back, Salmon. Molly Cone. (photographs)
Earth Keepers. Joan Anderson & George Ancona (photographs) [Hudson River]
Our Endangered Planet: Rivers and Lakes. Mary Hoff & Mary M. Rogers. (photographs)
Pollution. Janine Amos
Protecting Rivers and Seas. Kamini Khanuri.
Riverkeeper. George Ancona. (photographs) [Hudson River]
Waste and Recycling. Janine Amos.
Water Pollution. Darlene R. Stille.

Fiction Stories With River, Stream, Brook, or Creek Settings

Crocodile Creek - The Cry in the Night. Colin and Jacqui Hawkins.
Hot Hippo. Mwenye Hadithi and Adrienne Kennaway.
Letting Swift River Go. **Jane Yolen and Barbara Cooney.**
Make Way for Ducklings. Robert McCloskey.
Minn of Mississippi. Holling Clancy Holling.
Mr. Gumpy's Outing. John Buringham.
My River. Shari Halpern.
One Less Fish. **Kim Michelle Toft.**
Over The Steamy Swamp. Paul Geraghty.
The Pattaconk Brook. James Stevenson.
Riddle By The River. Marcia Vaughan.
River Parade. Alexandra Day.
The River. **David Bellamy.**
The River Ran Wild. **Lynn Cherry.**
The Story About Ping. Marjorie Flack.
Think Hippo. Wendy Smith.
Trouble River. **Betsy Byars.**
Zeke Pippin. William Steig.

Folktales, Myths, and Legends

How Iwariwa The Cayman Learned to Share. George Crespo. [South American - Yanomani]
Legend of the Li River. Jeanne M. Lee [Chinese]
The Loon's Necklace. Pictures by Elizabeth Cleaver. [Tsimshian]
Magic Spring. Nami Rhee. [Korean]

Man From Snowy River. A. Paterson.
Mother Crocodile. Birago Diop. [Sengalese]
River Dragon. D. Pattison.
The River That Gave Gifts. Margo Humphrey. [Afro American]
Talk Talk. Deborah M. Newton Chocolate. [Ashanti]
Toad Is The Uncle of Heaven. Jeanne M. Lee. [Vietnamese]
Tsubu the Little Snail. Carol Ann Williams. [Chinese]
The Waiting Day. Harriet Diller. [Chinese]
Wesakesack and the Bears. Bill Ballantyne. [Cree]
When Jaguars Ate the Moon. Maria Christina Brusca & Tona Williams [Americas]
Why Snails Have Shells. Carolyn Han.
The Willow Pattern Story. Allan Drummond. [Chinese]

Geography

Our Great Rivers and Waterways. Eleanor Ayer. [U.S. rivers]
River. Brian Knapp. [world rivers]
Rivers and Oceans. Barbara Taylor.

Rivers And People Around The World - Fiction

Amazon Boy. Ted Lewin.
Anna's Athabaskan Summer. Arnold Griese.
The Banshee Train. Odds Bodkin.
Deep River. Elaine Moore.
The Great Fishing Race. David Kherdian.
Letting Swift River Go. Jane Yolen.
Lights On The River. Jane Resh Thomas.
Moonlight on the River. Deborah Kovacs.
Paddle-To-The-Sea. Holling Clancy Holling.
River Day. Jane B. Mason.
A River Dream. Allen Say.
Three Days On A River In A Red Canoe. Vera B. Williams.
To Climb A Waterfall. Jean Craighead George.
Where The River Begins. Thomas Locker.

River And People Around The World - Nonfiction

Amazon Basin: Vanishing Cultures. Jan Reynolds. (Mavaca River)
The Children of Mauritania: Day in the Desert and by the River Shore. Lauren Goldsmith (photographs) [Africa]
Children of the Yukon. Ted Harrison.

Homes on Water. Alan James.
On The Go. Ann Morris.
This Place Is Wet. Vicki Cobb. [Brazilian Rainforest]
Tintin's Travel Diaries: The Amazon And The Americas. Martine Noblet & Chantel Deltenre.
Warriors. Wigmen, And The Crocodile People: Journeys to Papua New Guinea. Barbara A. Margolies. (photographs)
Yukon River: An Adventure to the Gold Fields of the Klondike. Peter Lourie. [photographs]

Poetry

Turtle in July. Marilyn Singer.

Rivers In History - Historical Fiction

The Boats on the River. Marjorie Flack. [Hudson River]
The Drinking Gourd: A Story of the Underground Railroad. F.N. Monjo.
The Floating House. Scott Russell Sanders. [Ohio River]
Follow The Drinking Gourd. Jeanette Winter

River In History - Nonfiction

The Amazing Impossible Erie Canal. Cheryl Harness.
A River Ran Wild. Lynne Cherry. [Nashua River]
The Story of Rosy Dock. Jeannie Baker. [Finke River - Australia]

River Life - Animals and Atmosphere

Box Turtle At Long Pond. William T. George.
Let's Explore a River. Jane McCauley. (photographs) [National Geographic Society]
Manatees. Christine Causse. (photographs) [The Cousteau Society]
Nature Hide & Seek: Rivers & Lakes. John Norris Wood and Kevin Dean.
On The River ABC. Caroline Stutson.
Otter Swims. Derek Hall
Otters Under Water. Jim Arnosky.
Pond Lake River Sea. Mary Jo Koch.
Pond & River. Steven Parker (Eyewitness Book) (photographs) [Explores/contrasts four season]
Ponds and Streams. John Stidworthy.
Playful Slider: The North American River Otter. Barbara Juster Esbensen.
River. Judith Heide Gilliland. [Amazon]
The Riverbank. Gallimand Jeunesse and Laura Bour. [First Discovery]
River Life. Barbara Taylor. (photographs)
Sea Otters River Otters. S. Robinson.

Secrets of Rivers and Streams. Peter J. Swenson.
Think of an Eel. Karen Wallace.

Water and the Water Cycle

Experiments With Water. Ray Broekel.
The Magic Schoolbus At The Waterworks. Joanna Cole.
Rain Drop Splash. Alvin Tresselt.
Rain Rain Rivers. Uri Shulevitz.
Water. Frank Asch.
Water. Brian Enting. (photographs)
Water. Carme Sole Vendrell and J.M. Parramon. (The four elements series)
Water. Ken Robbins. (The Elements)
Waters. Edith Newlin Chase and Ron Broda.
The Water's Journey. Eleanore Schmid.
Wonderful Water. Bobbie Kalman & Janine Schaub.

Chapter Books

Across The Great River. Irene Beltran Henandez. [Rio Grande]
The Crossing. Gary Paulsen.
The Dead Man in Indian Creek. Mary Downing Hahn.
Devil's Bridge. Cynthia DeFelice.
Face To Face. Marion Dane Bauer.
The House of Sixty Fathers. Meindert De Jong.
On My Honor. Marion Dane Bauer.
The River. Gary Paulsen.
The Roaring River Mystery. Franklin W. Dixon. [The Hardy Boys]
Streams to the River, River to the Sea. Scott O'Dell.
Toughboy & Sister. Kirkpatrick Hill.