WATERS TO THE SEA: DISCOVERING ALABAMA DEMO VERSION
TEACHER GUIDE

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Center for Global Environmental Education,

Hamline University School of Education

WATERS TO THE SEA: DISCOVERING ALABAMA – BETA VERSION TEACHER GUIDE

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About CGEE

The **Center for Global Environmental Education** (CGEE) is an integral program in the School of Education at Minnesota's oldest university—Hamline University, which celebrated its 150th anniversary in 2004. Since CGEE's inception in 1990, our mission of fostering environmental literacy and stewardship in citizens of all ages has led us far beyond the University's boundaries. While remaining true to the roots of our traditional academic mission, we have extended and amplified our reach and impact, primarily through leading and maintaining organizational partnerships.

The relationships we have developed include high-level representatives in agencies at all levels of government, prominent non-profit organizations, corporations and private enterprises that are American household names, numerous foundations, and prominent individuals.

For over a decade, teachers, students, community leaders, and concerned citizens have come to CGEE for inspired instruction and outstanding educational resources. The Center's pioneering work in environmental education is grounded in the tradition of progressive learning that has been a hallmark of Hamline's School of Education. CGEE's commitment to the strategic use of technology combined with hands-on learning creates and supports global communities of learners committed to the stewardship of local environments.

CGEE Mission

To foster environmental literacy and stewardship in citizens of all ages.

CGEE achieves its mission through complementary programs that impact four audiences:

- Distinctive professional development and graduate degree programs for educators
- Project-based, K-12 initiatives that have enriched learning for hundreds of thousands of students worldwide
- Multimedia programs that have impacted millions of citizens through multiple channels of dissemination
- Community outreach initiatives that engage citizens in local stewardship

Alabama's Environmental Documentary Series Supporting K-12 Science, Social Studies, and Other Subjects

Discovering Alabama is the Emmy-honored public television series that leads Alabamians on adventures across the diverse lands and waters of the state, exploring Alabama's forests, rivers, wildlands, and wildlife, from mountainous north Alabama to the central prairielands to the Alabama gulf coast. Host and series creator Dr. Doug Phillips tells the story of Alabama's geology, geography, flora, fauna, and important ecological relationships, together with related elements of the state's history and cultural heritage. In twenty-five years, *Discovering Alabama* has produced documentaries that are enjoyed by people of all ages and used in schools across Alabama.

Each *Discovering Alabama* program presents the wonders of Alabama in a manner that is comfortable for general audiences but also effective for K-12. Many of the *Discovering Alabama* documentaries and accompanying teacher guides are based on actual backcountry expeditions conducted during many years of providing outdoor education training for Alabama school teachers. *Discovering Alabama* is praised among educators for its unique value in helping to make learning locally relevant for students. The series is geared to serve as a springboard for schools seeking closer connections with local community resources, needs, and issues.

To further promote locally-relevant learning, *Discovering Alabama* offers a variety of additional resources designed for Alabama schools. These include D*iscovering Alabama*'s web-based Ask The Expert, an interactive natural diversity database expressly for Alabama students and teachers, and the K-12 yearly instructional programs Project Community and Discovering Our Heritage, developed in cooperation with the Alabama State Department of Education together with a collaborative of state organizations.

Discovering Alabama is based on an educational philosophy that emphasizes development of the whole student, academically, personally, and as a productive citizen. The series capitalizes on the interdisciplinary aspects of nature and natural history to enrich, vitalize, and complement required academic content. *Discovering Alabama* programs and instructional materials are correlated with the Alabama Courses of Study and with the State Graduation Exam.

For further information about the availability of *Discovering Alabama* DVDs/videos, Teacher Guides, and related materials and resources, visit www.discoveringalabama.org. Full feature viewing of each of the *Discovering Alabama* documentary programs is accessible via www.itunes.ua.edu.

Discovering Alabama is a production of the Alabama Museum of Natural History/The University of Alabama in cooperation with Alabama Public Television. *Discovering Alabama* programs have been supported over the years by a variety of sources. Current annual sponsors include the Solon and Martha Dixon Foundation, the Alabama Wildlife Federation, and the Alabama Department of Conservation and Natural Resources.

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Waters to the Sea: Discovering Alabama—Demo Version Teacher Guide

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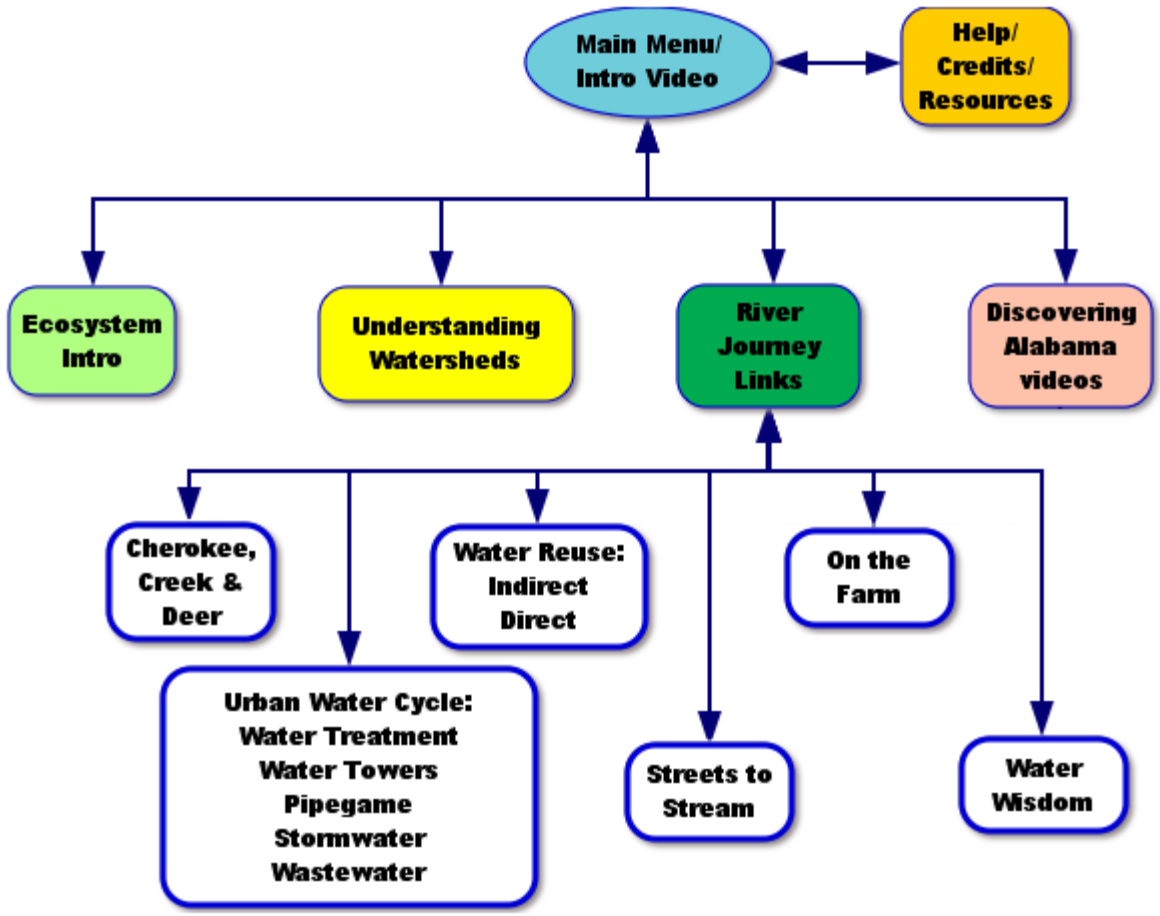
INTRODUCTION

Welcome to The *Waters to the Sea: Discovering Alabama—Demo Version* program! This program has been produced by Hamline University's Center for Global Environmental Education in collaboration with The University of Alabama's *Discovering Alabama* television program and the Alabama Clean Water Partnership. It is intended for use by students and teachers in grades 4-8 throughout the state of Alabama as a Web-based learning resource that uses a watershed perspective to explore the state's rich environmental history. This document is a complement to the online program and offers support for teachers in using *Waters to the Sea* in the classroom.

The *Waters to the Sea: Discovering Alabama—Demo Version* program is also intended to demonstrate the potential of a full-fledged *Waters to the Sea* program. The latter will include new modules that address additional concepts and themes as well as a number of features not included in the demo version (see below).

Waters to the Sea: Discovering Alabama—Demo Version Program Flowchart



The Demo version of the program does not include the following elements, which will be added in the final version:

- Water Quality Lab tutorial and integrated lab with links to relevant modules
- New historic guide videos introducing state regions and selected modules
- New map menu screens depicting regions within the state
- Alabama-specific content in the Watershed Introduction module
- Online Assessment function
- New modules on additional topics (subject to funding and partner approval)
- Additional *Discovering Alabama* videos

Suggestions for Using the Program

Waters to the Sea: Discovering Alabama—Demo Version is designed as a flexible curriculum resource that enriches learning in social studies and science for grades 4-8. It requires broadband internet access and a relatively new computer with the Flash plugin installed in the computer's web browser (more than 95-percent of computers are suitably configured). Though navigation of the program is non-linear and the program's modular elements can be explored in any order, we recommend that student begin with the introductory elements found on the "Explorers Wanted" screen before exploring the modules found on the "Alabama River Journey" screen and under the "Discovering Alabama" heading at the bottom (Doug Phillips icon).

All segments of the program have been correlated with Alabama education standards. You will find standards correlation information in the sections of this guide that address each program module.

Here are some ways teachers have used *Waters to the Sea* in the classroom:

- Use the program as a presentation tool, projecting the program's content to the class using a computer projector, screen, and audio speakers.
- Use the program with your students in a computer lab
- Use the program as a resources for individual students as part of class projects or when other classroom work is completed
- Have groups of students thoroughly explore different sections of the program and then present those sections to the rest of the class using *Waters to the Sea* as a presentation tool
- Have students use the program individually at home.

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Section 1: UNDERSTANDING WATERSHEDS

This interactive element includes:

- A video and interactive segment on the Water Cycle in nature
- A video introduction to the concept of a watershed
- An interactive exploration of major U.S. watershed regions.

Big Idea

Water is constantly changing forms (or phase) from liquid to gas to solid. Water also moves across the landscape and through soils in systems called watersheds.

Background

You cannot see it, but every day water all around us **evaporates** from rivers, lakes, and the ocean. Water held in plants is released as water vapor through **transpiration**. Water vapor rises in the atmosphere to form clouds in a process called **condensation**. Your students see water in liquid form and as snow when it falls to earth as **precipitation**. Precipitation that doesn't seep into the ground, to become **groundwater**, is called **surface water**, and feeds rivers, lakes, and the ocean where it evaporates once again. This never- ending basic process is called the **Water Cycle**—precipitation, evaporation and transpiration, and condensation. Water moves and changes from a solid (ice and snow) to a liquid (rain, surface water and groundwater) to a gas (water vapor) over and over again.

Your **regional watershed**—the area of surrounding land whose surface waters drain to a particular river, lake, or ocean outlet along the coast— links to the water cycle by catching precipitation in the forms of rain and snow. Where does a drop of water go when it falls in your yard? There are several possible answers, which your students might think of in a short discussion: 1) it evaporates back into the atmosphere; 2) it flows as surface water runoff along streets, sidewalks, fields and forests into creeks, rivers, lakes and the ocean; 3) it soaks into the soil and is sucked up by the roots of plants and trees for nourishment; and 4) it seeps, or percolates, through the soil where it pools in underground deposits called aquifers to become groundwater.

Essential Questions

Water Cycle:

- How does the water cycle impact you?
- Where does your drinking water come from?
- How do humans impact the water cycle?
- What would happen if the water cycle stopped?

Watershed:

- What watershed do you live in?
- What water resources (reservoirs, rivers, lakes) are in your watershed?
- What role does the watershed play in the local environment?
- What role does groundwater in our aquifers play in the local environment?
- How do human activities affect water quality in a watershed?

Learning Objectives:
After completing this section, students will:

- Appreciate the importance of the water cycle
- Identify the main parts of the water cycle
- Understand what a watershed is
- Be able to identify primary U.S. watershed regions in the lower 48 states

Alabama Course of Study Correlation for Understanding Watersheds

Grade 4 Science:

7) Describe geological features of Earth, including bodies of water, beaches, ocean ridges, continental shelves, plateaus, faults, canyons, sand dunes, and ice caps.

Grade 4 Social Studies:

1) Identify historical and current economic, political, and geographic information about Alabama on thematic maps.
   - Discussing patterns and types of migrations as they affect the environment, agriculture, economic development, and population changes in Alabama.
4) Describe the relationship of the five geographic regions of Alabama to the movement of Alabama settlers during the early nineteenth century.
   - Describing natural resources of Alabama
   - Describing the natural environment of Alabama
   - Describing human environments created by settlement

Grade 5 Social Studies:

1) Locate physical features that impacted the explorations and settlement of the Americas.

Grade 6 Science:

2) Describe factors that cause changes to Earth's surface over time.
   - Comparing constructive and destructive natural processes and their effects on land formations.
3) Describe water and carbon biogeochemical cycles and their effects on Earth.

Grade 7 Science:

7) Describe biotic and abiotic factors in the environment.

Grade 7 Social Studies (Geography):

2) Analyze regional characteristics for factors that contribute to change and for their relative importance.
3) Describe processes that shape the physical environment, including long range

effects of extreme weather phenomena and human activity.
- Comparing how ecosystems vary from place to place and over time.

8) Describe positive and negative environmental effects of human actions on the four basic components of Earth's physical systems: atmosphere, biosphere, lithosphere, and hydrosphere.
9) Analyze environmental consequences of major technological changes in human history for both intended and unintended outcomes.
- Identifying the impact of urban growth on the environment.

11) Compare the distribution of natural resources in various parts of the world by mapping locations of major deposits.
- Discussing the relationship between a country's standard of living and its accessibility to natural resources.

12) Describe the problems involved in balancing the impact of human habitation on the environment and the need for natural resources essential for sustaining human life.
- Assessing differing attitudes of people regarding the use and misuse of resources.
- Predicting the future spatial organization of Earth if present conditions and patterns of consumption, problem-solving innovations, production, and rates of population growth and decline continue.
- Applying a problem-solving model to a geographic issue, including the development of sound arguments for specific actions on the issue.

Biology:

14) Trace biogeochemical cycles through the environment, including water, carbon, oxygen, and nitrogen.
- Relating natural disasters, climate changes, nonnative species, and human activity to the dynamic equilibrium of ecosystems.

Environmental Science:

6) Identify sources of local drinking water.
- Determining the quality of fresh water using chemical testing and bioassessment
- Describing the use of chemicals and microorganisms in water treatment
- Describing water conservation methods
- Describing the process of underground water accumulation, including the formation of aquifers

Vocabulary

- **aqueduct**—Man-made open canal built to carry a large quantity of flowing water
- **aquifer**—A water source under the ground
- **condensation**—Water vapor becoming a liquid or a solid
- **evaporation**—Liquid water becoming a gas

- **fresh water**—Comes from treated water sources or groundwater for drinking, washing, cooking, heating, cooling and industrial purposes.
- **groundwater**—Water under the ground that supplies springs and wells
- **hydrologic**—Relating to water
- **percolation**—Water moving downward through openings
- **precipitation**—Rain, snow, sleet or hail
- **regional watershed**—The area of surrounding land whose surface waters drain to a particular river, lake, or ocean outlet along the coast
- **surface runoff**—Water that runs along the soil and goes into rivers and lakes
- **surface water**—Water that collects and stands or is stored in lakes, ponds, rivers, bayous, streams, canals and reservoirs, either natural or man-made
- **transpiration**—The passage of watery vapor from a tree or plant through its leaves
- **water cycle**—The ongoing movement of water from land to the atmosphere to the land again
- **water evaporation**—Water as a gas in the air membranes
- **watershed**—A land region that drains all the precipitation, from the upper portion, such as a mountain, to the lower portion of the region, such as a lake, river or the ocean.

Discussion Questions

- Water Cycle: What is the driving natural force behind the water cycle? *The sun is the driving natural force which causes evaporation and transpiration. The cyclical process continues from there.*
- Watershed: How is a watershed different than a basin? *Watershed is a more general term, whereas basins are usually used to describe large watersheds, for example, the Mississippi River basin, which drains water from thirty-three states.*
- Why is percolation important to the urban water cycle? *Percolation maintains usable levels of groundwater in the local aquifers.*

Extension Activities

1. Hometown Rainfall: Research how many inches of rain fall each year in your hometown.

2. Connect the discussion of the water cycle to a watershed. What watershed is your school in? *Online mapping services, such as the EPA's Surf Your Watershed website (http://cfpub.epa.gov/surf/locate/index.cfm) can help you figure out the answer.*

3. Write a description of the role your home's roof, driveway and lawn play in the water cycle. *The roof and driveway typically push water to the street where the system of undergound stormwater pipes carries it to the ocean. The roof may push water to the front or backyard where the water will percolate to the underlying aquifer as groundwater.*

4. Investigate and document how human-made conditions—e.g., pollution, development, deforestation—affect water quality in a watershed. *Some industrial pollutants may leave groundwater sources unusable; commercial and residential development pushes more water to the sea rather than to groundwater aquifers; deforestation also pushes more water to the sea rather than to groundwater aquifers.*

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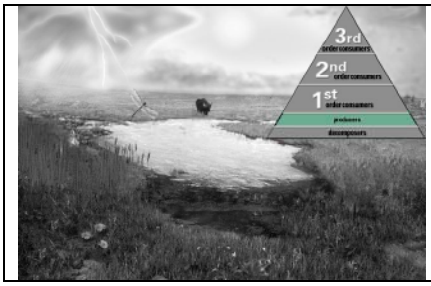
Section 2: Ecosystem Introduction



This interactive element includes:

- An introduction to the Energy Pyramid
- An introduction to Food Chains
- An introduction to Food Webs

Big Idea

An ecosystem is a system of interdependent organisms that share the same habitat and interact with non-living physical features of their environment.

Background information

Ecosystems are complex webs of interacting elements. According to Project 2061, (AAAS, 2009, http://www.project2061.org/publications/bsl/online/index.php) all systems, including ecosystems, share certain characteristics:

- Systems are made of parts.
- Systems may not continue to function if some of their parts are missing.
- When the parts of systems are put together, they can do things they couldn't do by themselves.
- Parts of a system usually influence one another.
- Systems may not function as well if parts are missing, damaged, mismatched or misconnected.
- Systems can include processes as well as things.
- The output from a system can become the input to other parts of systems.
- Systems are connected to each other and to other larger or smaller systems.
- Systems are defined by placing boundaries around collections of interrelated things to make them easier to study. A system interacts with its surrounding environment.
- When studying a system, it is important to keep track of what enters or leaves the system.

Some of the elements in an ecosystem, such as plants and animals, are **biotic**, or living elements. Other elements, such as rocks, the soil, water, and sunlight, are **abiotic**, or non-living elements. Every piece of an ecosystem has an important role in the healthy functioning of the whole system.

Sunlight is the ultimate source of all energy that flows through ecosystems. Scientists study the flow of energy in two primary ways. First, we can look at how energy is concentrated up an "**energy pyramid**," as organisms use other organisms as food sources. Animals that eat plants (**primary consumers**) are called **herbivores**. Animals that eat other animals are called **carnivores**. Carnivores that eat herbivores are **secondary consumers**. Animals such as wolves

(which eat herbivores like deer) are **second order consumers**. Carnivores that eat other carnivores are **third order, or tertiary, consumers**. Animals such as herons (which eat frogs, which eat insects) are third order consumers. Animals that eat both plants and animals, such as humans and bears, are called **omnivores**. Organisms that feed on decaying matter, speeding the process that returns nutrients to the soil, are called **decomposers**.

The higher we look up an energy pyramid, the less energy is available to nourish an organism. Because it takes many plants to feed a deer, there are fewer deer than plants in an ecosystem. It takes many deer to feed a wolf, thus there are fewer wolves in an ecosystem than deer.

A second way to study the flow of energy through an ecosystem is to investigate **food chains** and **food webs** that exist among organisms in an ecosystem. A food chain follows a series of relationships between organisms in an ecosystem in which one is food for another. Food webs are like maps that track the relationships between all or many species in an ecosystem based on the kinds of foods organisms eat to meet their food and energy needs. Food webs allow us to see how many sources it takes to supply the food and energy needs of each organism in the web.

Essential Questions

- How does energy flow through an ecosystem?
- What services do organisms need from habitats?
- How do the biotic and abiotic elements of ecosystems interact?

Learning Objectives

After completing this section, students will understand:

- Common elements of prairie and hardwood forest ecosystems.
- What a food chain is and what an energy pyramid is and how they function (with examples in both ecosystems)
- What a food web is and how it functions (with examples in both ecosystems)
- That interactions between ecosystem elements can be viewed as a transfer of energy between elements.

Alabama Course of Study Correlation for Ecosystem Introduction

Grade 4 Science:

5) Describe the interdependence of plants and animals.
   - Tracing the flow of energy through a food chain
   - Identifying characteristics of organisms, including growth and development, reproduction, acquisition and use of energy, and response to the environment.

6) Classifying animals as vertebrates or invertebrates and as endotherms or ectotherms.
   - Describing the groupings of organisms into populations, communities, and ecosystems

Grade 4 Social Studies:

4) Describe the relationship of the five geographic regions of Alabama to the

movement of Alabama settlers during the early nineteenth century.
- Describing natural resources of Alabama
- Describing the natural environment of Alabama

Grade 5 Science:

9) Describe the relationship of populations within a habitat to various communities and ecosystems.
   - Describing the relationship between food chains and food webs
   - Describing symbiotic relationships

Grade 6 Science:

7) Describe Earth's biomes.
   - Identifying geographic factors that cause diversity in flora and fauna, including elevation, location, and climate

Grade 7 Science:

7) Describe biotic and abiotic factors in the environment.
   - Arranging the sequence of energy flow in an ecosystem through food webs, food chains, and energy pyramids

Grade 7 Social Studies (Geography):

3) Describe processes that shape the physical environment, including long-range effects of extreme weather phenomena and human activity.
   - Comparing how ecosystems vary from place to place and over time

8) Describe positive and negative environmental effects of human actions on the basic components of Earth's physical systems: atmosphere, biosphere, lithosphere, and hydrosphere.

Biology:

15) Identify biomes based on environmental factors and native organisms.
16) Identify density-dependent and density-independent limiting factors that affect populations in an ecosystem.

Environmental Science:

1) Identify the influence of human population, technology, and cultural and industrial changes on the environment.

Vocabulary

- **abiotic**—Non-living elements of an ecosystem, including wind, rocks, weather
- **biotic**—Living parts of an ecosystem
- **carnivore**—Any animal that feeds chiefly on other animals
- **consumer**—Any organism that eats producers, or other consumers, as food
- **decomposer**—An organism that consumes dead or decaying organisms
- **ecology**—The branch of biology concerned with the interactions between organisms and their environment
- **Ecosystem**—A system formed by the interaction of a community of organisms with their physical environment
- **energy pyramid**—A representation of the loss of useful energy at each step in a food chain
- **environment**—The area or setting in which something exists or lives
- **food chain**—A community of organisms representative of the eating relationships between species where each member is eaten in turn by another member

- **food web**—A network of food chains in an ecosystem
- **forest**—The trees and other plants in a large densely wooded area
- **habitat**—An ecological or environmental area that is inhabited by a particular animal or plant species, providing that organism food, shelter, water, and space
- **herbivore**—Any animal that feeds chiefly on grass and other plants
- **interact**—A kind of action that occurs as two or more elements of a system have an effect upon one another
- **landscape**—The visible features of an area of land, including physical elements such as landforms, and living elements of plants and animals
- **omnivore**—Any species that eats both plants and animals as their primary food source
- **prairie**—An extensive area of relatively flat grassland with few, if any, trees, especially in North America
- **primary consumer**—An organism which is found near the very bottom of the food chain which consumes plant material
- **producers**—An organism that produces food from by using energy from light (by photosynthesis) or inorganic chemical reactions
- **secondary consumer**—An organism that feeds on primary consumers; a carnivore that eats plant eaters+
- **tertiary consumer**—a carnivore that feeds on other carnivores, usually the top predator in an ecosystem
- **trophic level**—The position that an organism occupies in a food chain -- what an organism eats, and what eats the organism.

Discussion Questions

- What is an ecosystem?
- In your own words, can you explain how sunlight provides energy in an ecosystem?
- If the population of producers in an ecosystem were removed, what other changes might happen?
- Are nutrients the same as food? Why or why not?
- Predict how an ecosystem would change if first order consumers suddenly died off.
- Which is more important in an ecosystem, producers or decomposers? Why?

Extension Activities

1. Food Web in a Terrarium: Using a small aquarium, construct a terrarium that includes a complete food web. Fill the terrarium with soil from a garden. Add fallen leaves, green branches, native flowers and grasses, and an asortment of insects, including ladybugs, snails, a spider, pillbug, mealworms, grub, centipedes, or worms.

2. Food Web Photos on a Bulletin Board: Ask students to bring in newspaper articles about, or pictures of, local plants and wildlife. On a bulletin board, construct a food web based on your local habitats. Label each element of the food web, and categorize it by trophic level.

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Section 3: CHEROKEE, CREEK & DEER MODULE

	This module explores the many ways that native Cherokee and Creek Indians used the deer as a sustainable source of food, clothing, and various tools.

Big Idea
Natural resources have been used by indigenous people for millennia to meet their needs for food, clothing and shelter, often in ways that were sustainable; that is, that didn't deplete the resources on which they depend.

Background information
Whitetail deer have roamed the ecosystems of the Southeast for thousands of years. Well adapted to their habitat, they were an abundant and dependable year-round food source. The Cherokee and Creek people used a variety of methods to hunt the animals. Large groups would light forest fires, driving the deer toward waiting hunters. Single hunters stalked the deer through the forests.

Cherokee and Creek tribal members used many different methods to tan the deer hides. One traditional method involved soaking the hide for several days in a lye solution made from the ashes of a hickory fire. After two or three days, the hair could be removed by scraping the hide with the back of a knife or a scraper blade. Once the hair was removed, the hide was stretched tightly in a wooden frame, and left until it was nearly dry. The hide was rubbed with raw animal brains pounded into a paste with water, stretched even tighter, and the brain paste rubbed thoroughly into the hide with a buffing stick. According to the lore of many tribes, each animal has enough brains to tan its own hide. The final step in brain tanning was to smoke the hide, to cure it and seal in the brining process. The final result was a soft and durable material for clothing and other products.

Clothing was generally sewed with thread made of deer sinew, cut from the back or the legs of the animal, and split into thin lengths. Needles used to sew clothing and shoes were made from the bones of the deer. The antlers of the deer were used for a variety of tools, including rakes used to cultivate corn, and pressure tools to flintknap stone knives and arrow points.

Making a living off the land required indigenous people to use resources wisely, and waste nothing. Every part of the animal was useful in some way. Native people learned to make efficient use of every available resource as food, to make clothing, tools, and shelter.

Learning Objectives

After completing this section, students will:

- Understand that deer were hunted in a sustainable manner by native hunters.
- Investigate the many ways that the deer were used for food, clothing, and tools.

Essential Questions

- How do different cultures make use of natural resources?
- What effect does it have on animal populations when humans use animals for food, clothing, tools and other purposes?

Alabama Course of Study Correlations for
Cherokee, Creek & Deer

Grade 4 Social Studies:

4) Describe the relationship of the five geographic regions of Alabama to the movement of Alabama settlers during the early nineteenth century.
   - Describing natural resources of Alabama
   - Describing the natural environment of Alabama
   - Describing human environments created by settlement

Grade 5 Science:

9) Describe the relationship of populations within a habitat to various communities and ecosystems.

Grade 7 Science:

7) Describe biotic and abiotic factors in the environment.

Grade 7 Social Studies (Geography):

2) Analyze regional characteristics for factors that contribute to change and for their relative importance.
3) Describe processes that shape the physical environment, including long-range effects of extreme weather phenomena and human activity.
12) Describe problems involved in balancing the impact of human habitation on the environment and the need for natural resources essential for sustaining human life.

Biology:

16) Identify density-dependent and density-independent limiting factors that affect populations in an ecosystem.

Environmental Science:

12) Identify positive and negative effects of human activities on biodiversity.

Vocabulary

- **antlers**—A branching and bony structure on the head of deer, moose and elk
- **awl**—A bone or stone tool tapered to a point and used to pierce holes
- **hide**—The dressed skin of an animal
- **prehistoric**—Belonging to or existing in times before recorded history
- **sinew**—A tough band of fibrous connective tissue that usually connects muscle to bone
- **traditional**—An inherited pattern of thought or action, a specific practice of long standing
- **watershed**—The area of land drained by a river and its tributaries

Discussion Questions

- Can you list several parts of the deer that Native Americans used for different purposes?
- Can you explain what is meant by hunting that is done in a sustainable manner?
- What would result if the Native Americans had hunted more deer than was sustainable?
- Why do you think the Cherokee and the Creek used deer for so many different purposes?
- Predict how the lives of the Cherokee and Creek would have changed if there were no deer to hunt?
- Which is more important to the Cherokee and the Creek- the deer, or the forests in which the deer lived?
- Can you think of different examples of ways that we currently use resources that are either sustainable or unsustainable?

Extension Activities

1. Sewing by Hand: Using canvas or some other heavy cloth, have students design, cut and sew a piece of clothing by hand.

2. Make a Tool From Forest Materials: Challenge your students to make a rake or some other simple tool out of materials you find in a local forest.

3. Deer Observation: Visit a local forest or park preserve and observe deer in their habitat. Make detailed observations of their shape, size, what they eat, how they communicate, and how they behave once they see or hear you.

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URBAN WATER CYCLE MODULE

This interactive element includes sections on:

- World Without Water video
- Drinking Water Cycle
- Storm Water Cycle
- Waste Water Cycle

Big Idea
In urban environments, water is managed through three separate sub-systems: the Drinking Water system, the Storm Water system, and the Waste Water system.

Intro video: Dreaming of a World Without Water

Background Information
What would the world be like without water?

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

Essential Questions

- What are ways that water is essential to your daily life?
- What would the world be like without water?
- What does water mean to you?

Have students view the intro video.

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

- Were there any surprises?
- Name one thing for which water is not essential. For example what does an iPod have to do with water? Manufacturing of all products requires water. Food growing and processing requires water (think of beans).
- Do you recall your first memory of water?

- Where does the water we use every day come from? Where does it go? Have students brainstorm their thoughts.
- Follow a drop of water from the faucet back to its source. How does it get back to the faucet? Where does drinking water come from?
- Where does stormwater go?
- Where does wastewater go?
- What is the difference between wastewater and stormwater?

Alabama Course of Study Correlations for
Urban Water Cycle

Grade 4 Science:

7) Describe geological features of Earth, including bodies of water, beaches, ocean ridges, continental shelves, plateaus, faults, canyons, sand dunes, and ice caps.

Grade 5 Science:

9) Describe the relationship of populations within a habitat to various communities and ecosystems.

Grade 6 Science:

3) Describe water and carbon biogeochemical cycles and their effects on Earth.

Grade 7 Science:

7) Describe biotic and abiotic factors in the environment.

Grade 7 Social Studies (Geography):

2) Analyze regional characteristics for factors that contribute to change and for their relative importance.

8) Describe positive and negative environmental effects of human actions on the four basic components of Earth's physical systems: atmosphere, biosphere, lithosphere, and hydrosphere.

9) Analyze environmental consequences of major technological changes in human history for both intended and unintended outcomes.

12) Describe problems involved in balancing the impact of human habitation on the environment and the need for natural resources essential for sustaining human life.

- Applying a problem-solving model to a geographic issue, including the development of sound arguments for specific actions on the issue.

Environmental Science:

6) Identify sources of local drinking water.

- Determining the quality of fresh water using chemical testing and bioassessment
- Describing the use of chemicals and microorganisms in water treatment
- Describing water conservation methods
- Describing the process of underground water accumulation, including the formation of aquifers

- Identifying major residential, industrial, and agricultural water consumers
- Identifying principal uses of water.

8) Identify major contaminants in water resulting from natural phenomena, homes, industry, and agriculture.

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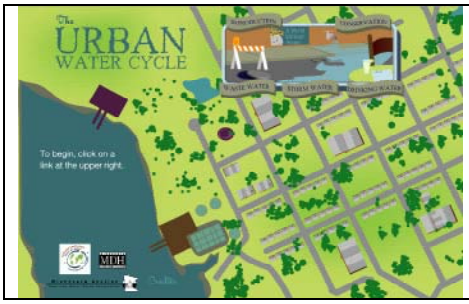
Section 4: URBAN WATER CYCLE (continued)
Menu Overview



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

The interactive series of menu screens, that appear after the introductory video is viewed visually, introduces the idea that there are **systems** within the urban water cycle that students have never thought about or, if at all, very little. Drinking water goes through a process involving transport, treatment, storage, and delivery. Our drinking water is a product often taken for granted. However it has a huge cost and requires a large **infrastructure** to create. Similar treatment processes make wastewater that goes down our drains and toilets suitable for being returned to the environment and/or the infrastructure for some types of reuse.

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

Drinking water obtained from surface water requires more treatment than water from wells. Processes for treating water may differ in different communities.

The world's limited supply of water perpetually moves through 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**, by way of its **aquifers**—underground deposits of water—replenishes surface waters through springs/pumps. Small surface waterways join larger ones to become rivers that further grow as they are carried downhill by gravity through the watershed toward the sea.

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

Though the world's waters are cleansed by the water cycle, human water use has increased as the human population and our evolving **technologies** demand more and more fresh water. The expanding impact of **climate change** is also contributing to a more limited supply. As a result, available clean, fresh water is increasingly scarce, and has become one of the critical issues in the 21st century. Over 1 ½ billion people in the world have limited or no access to fresh drinking water!

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Section 4: URBAN WATER CYCLE (continued)
Drinking Water: Water Treatment

(To get to this section in the program, click on the "Drinking Water" link once you are in the Urban Water Cycle module, then click on the "Treatment Plant" label on the city map.)

This interactive element includes a virtual exploration of a water treatment plant:

- Water Withdrawal
- Flocculation
- Sedimentation
- Filtration
- Disinfection
- Storage

Chemical Disinfection

Did you know that for more than 100 years, since the early 1900s, public water supply agencies have constructed treatment plants and have used chlorine or other chemicals (including ozone, more recently) to kill any germs in the drinking water supply? What you and your students need to become familiar with are the basics of this multi-step process:

a) *Screen* out fish and other organic materials, such as leaves, sticks and dirt.
b) Raw (untreated) water is transported to the treatment plant, a **disinfecting** chemical like chlorine or ozone [0_3] is added to the water.
c) Then, a chemical called **alum** (aluminum sulfate) is added to the water to begin the process of **coagulation** and **flocculation** where large particles clump together. These enlarged particles are called floc.
d) Next, comes **sedimentation** when floc settles to the bottom of the tanks and is removed. Using filters made of layers of sand, coal and gravel, **filtration** removes any remaining particles left in the water.
e) The final step, **disinfection**, again uses small amounts of chlorine or the ozone process to kill any remaining germs.

The finished water, now ready for distribution, is then sent directly to consumers or to another water agency in the region to distribute to local homes, businesses and industries, and community parks.

Essential Questions

- How have humans modified the natural water cycle for their use?
- How can we be sure clear water means it is clean water?
- How is the water in lakes and rivers different from our drinking water?
- How can sand, coal and gravel assist in making water clean?

- Life as we know it would be impossible without clean water. What does it mean to have clean water?

Learning Objectives
After completing this section, students will:

- Appreciate the importance of clean, safe drinking water
- Identify the main steps of the treatment process
- Understand how the treatment process mimics nature's filtration cycle
- Understand the benefits and challenges of drinking water processes and infrastructures, as well as solutions to today's issues
- Identify key water treatment concepts

Vocabulary

- **alum**—The common name for aluminum sulfate, a chemical used in the coagulation process to attract and then remove particles from water
- **chlorination**— The treatment of a substance, such as drinking water, with chlorine in order to kill disease-causing organisms
- **coagulation**—The process, such as in treatment of drinking water, by which dirt and other suspended particles become chemically "stuck together" so they can be removed from water
- **disinfectant**—An agent that destroys or inactivates harmful microorganisms
- **filtration**—passing water through coal, sand and gravel to remove particles
- **groundwater**—Water that has percolated into natural, underground aquifers; water in the ground, not water puddled on the ground
- **ozone**—A gas (O3) derived from oxygen that is bubbled through water during the treatment processes to kill microorganisms.

Alabama Education Standards Correlation for
Drinking Water: Water Treatment

Grade 5 Science:

1) Identify evidence of chemical changes through color, gas formation, solid formation, and temperature change.

Grade 6 Science:

2) Describe water and carbon biogeochemical cycles and their effects on Earth.

Grade 7 Science:

7) Describe biotic and abiotic factors in the environment.

Grade 7 Social Studies (Geography):

8) Describe positive and negative environmental effects of human actions on the four basic components of Earth's physical systems: atmosphere, biosphere, lithosphere, and hydrosphere.
9) Analyze environmental consequences of major technological changes in human history for both intended and unintended outcomes.
   - Identifying the impact of urban growth on the environment.
12) Describe problems involved in balancing the impact of human habitation on

the environment and the need for natural resources essential for sustaining human life.

- Applying a problem-solving model to geographic issue, including the development of sound arguments for specific actions on the issue.

Biology:

14) Trace biogeochemical cycles through the environment, including water, carbon, oxygen, and nitrogen.

16) Identify density-dependent and density-independent limiting factors that affect populations in an ecosystem.

Environmental Science:

1) Identify the influence of human population, technology, and cultural and industrial changes in the environment.

6) Identify sources of local drinking water.

- Describing the use of chemical and microorganisms in water treatment.

8) Identify major contaminants in water resulting from natural phenomena, homes, industry, and agriculture.

Discussion Questions

- What does this part of the program show about drinking water?
- What patterns does this show?
- Describe the treatment path to clean water.
- Where in the world are there drinking water issues?
- Where in the world can a person safely drink surface water without treatment?

Extension Activities

1. Design a Treatment Plant: Challenge students to design and construct a model drinking water treatment plant. Ask them to draw their design, create a list of materials, and estimate how much water they could treat in a 24-hour period. The plan must be practical, it must be possible to build it with common materials, and meet an agreed upon budget. As a class, vote on the best plan.

2. Treatment Plant Field Trip: Take a field trip to your local water treatment plant. Ask students to create a set of questions for the plant engineers. After the field trip, students can write up a report on the trip, a personal narrative of their experience, or a letter thanking the engineers.

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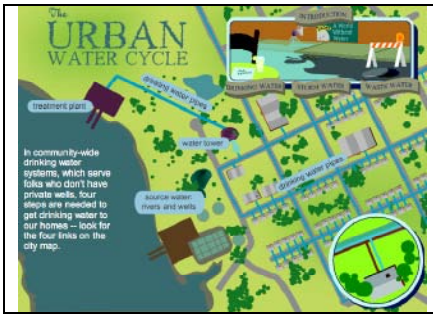
Section 4: URBAN WATER CYCLE (continued)
Drinking Water: Water Tower

(To get to this section in the program, click on the "Drinking Water" link once you are in the Urban Water Cycle module, then click on the "Water Tower" label on the city map.)



This interactive element within the Urban Water Cycle module includes segments on:

- A series of visualizations explaining **how water towers work** and providing **water tower facts**
- An interactive element showing **water-saving strategies**

Big Idea

Water towers serve communities by providing an elevated water reservoir filled by a pump and distributed to homes, businesses and other places through pipes using gravity. These reservoirs can handle varying demands on water resources.

Background Information

Many towns provide water to residents using a combination of pumps and water towers. Pumps can usually provide enough water during times of average water use. When demand for water increases dramatically, like in the morning when a large number of residents take showers, brush their teeth, flush toilets and make meals before work or school, water from water towers can supplement what the pumps deliver.

For instance, your town might have a pumping station that delivers 500 gallons per minute. Most of the time, that pump provides enough water for everyone who needs it. But in times of peak water use, demand might rise to 1000, even 2000, gallons per minute. At those times, water from the water tower can deliver the additional water that residents demand.

Fighting fires is another example of peak demand. Fighting a fire can consume hundreds of gallons per minute. If residents in other parts of town are taking showers, cooking dinner, or watering lawns, water towers can help make sure there is enough water for fire fighters to use. Water towers help city planners deliver adequate water supplies for average, peak and emergency needs. Water towers are very reliable because gravity draws the water out of water towers, meaning water towers are able to supply water even during power outages when pumps would stop working. If power outages continue for long periods of time, however, water towers might run out of water, because a pump is required to refill the tower.

Water towers typically store a one-day supply of water for the areas they serve. Pumps are used to refill water towers to maintain an adequate supply of fresh water. Water towers are designed

to satisfy two major design criteria: They must be able to deliver a sufficient *quantity* of water to meet demand, with enough *pressure* to get water to every home in a community.

The flow rate of water out of a water tower is a measure of the volume of water that moves out of the tower in a fixed period of time. Examples of units for flow rates include cubic feet per second, and milliliters per second. Water towers are also measured by the force of water flowing from tower to consumer. Water pressure is affected by the difference in elevation between the water tower and the point of use. The pressure of water flowing from a tower increases 1 pound per square inch (psi) for every 2.31 feet of elevation. Or, each foot of height provides 0.43 psi of pressure.

Learning Objectives

After completing this section, students will understand that:

- The design and placement of water towers allows water to flow to homes and businesses using only the force of gravity.
- Flow rate is the measure of the volume of water that moves out of the tower in a fixed period of time.
- Water pressure is the force at which water moves out of a water tower to the consumer. Water pressure is affected by the difference in elevation between the tower and the point of delivery.
- Adequate flow rate and pressure for fire fighting is a consideration in water tower design.

Alabama Course of Study Correlations for
Drinking Water: Water Tower

Grade 7 Social Studies (Geography):

3) Describe processes that shape the physical environment, including long range effects of extreme weather phenomena and human activity.

8) Describe positive and negative environmental effects of human actions on the four basic components of Earth's physical systems: atmosphere, biosphere, lithosphere, and hydrosphere.

9) Analyze environmental consequences of major technological changes in human history for both intended and unintended outcomes.

12) Describe problems involved in balancing the impact of human habitation on the environment and the need for natural resources essential for sustaining human life.

Biology:

16) Identify density-dependent and density-independent limiting factors that affect populations in an ecosystem.

Environmental Science:

6) Identify sources of local drinking water.

Geology:

9) Describe the movement and storage of water in terms of watersheds, rainfall, surface runoff, aquifers, and surface water reservoirs.

Essential Questions:

- How does the nature and practice of engineering help humans transport and store water for daily use?
- How does the landscape of a town affect the design and placement of water towers?

Vocabulary

- **Flow** —A measure of the volume of water that moves past a point in a fixed period of time
- **Pressure**—Force (measured in pounds) per unit area (square inch) exerted by the weight of water
- **Elevation**—The distance of something above a reference point (such as sea level)

Discussion Questions

- What is a water tower?
- In your own words, can you explain how a water tower works?
- What variables would you change to increase the water pressure of a water tower?
- Why do you think a water tower is important to a town?
- How would you test the relationship between water pressure and elevation?
- Which is more cost effective – building a tall water tower on a small hill, or building a short water tower on a high hill? Remember to use evidence to support your thinking.

Extension Activities

1. Science Investigation – Elevation, Flow and Pressure: Have students design a science investigation to see how elevation affects the flow and pressure of water. Provide student with a variety of simple construction materials and measurement tools. Materials might include buckets, cups, flexible hoses, scissors, plumber's putty or other sealants. Measuring tools might include rulers, tape measures, stop watches, graduated cylinders and beakers. Ask students to gather and analyze data, communicate their findings and defend their conclusions using evidence.

2. Science Investigation – Pipe Size, Flow and Pressure: Have students design a second science investigation to measure how the size of the pipe that delivers water affects the pressure of the water flow. Use the same kinds of materials as listed above.

3. Water Towers & Culture Research: Research different types and styles of water towers. What does the shape and style of a local water tower communicate about the culture of the town?

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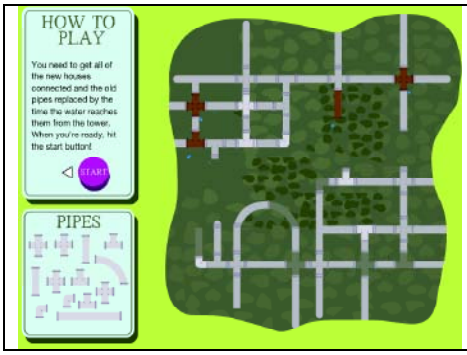
Section 4: URBAN WATER CYCLE (Continued)
Drinking Water: Water Pipes – "The Pipe Game"

(To get to this section in the program, click on the "Drinking Water" link once you are in the Urban Water Cycle module, then click on the "Drinking Water Pipes" label on the city map.)



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

Big Idea
The network of pipes delivering water to homes and business must be maintained.

Background
How does that drinking water get to each of your student's homes and countless other places? Simply put, drinking water leaves the treatment facility and water towers through large pipes in your city's streets that in turn are connected to smaller pipes that bring water to homes, businesses, and countless other indoor and outdoor locations. That series of larger and smaller pipes is part of a community's infrastructure.

Infrastructure can be defined as the basic physical systems of a country's, state's, city's, or community's population. By physical systems, we are referring to those systems that have been built by human beings such as: roads, railroad tracks, dams, reservoirs, flood control channels, storm drains, power plants, and utility pipelines for gas, electricity, telecommunications, and water.

Ancient examples of infrastructure can be found within the history of civilizations that were built along the world's great rivers, such as: Mesopotamia along the Tigris-Euphrates, Egypt along the Nile, Kush along the Nile, China along the Yangtze, and countless others.

Essential Questions
- What is infrastructure?
- What would your life be like without infrastructure?

Learning Objective
After completing this section, students will understand:
- The importance and function of infrastructure, especially the drinking water system.

- The importance of repairing and creating infrastructure to meet a growing community's needs.

Alabama Course of Study Correlations for
Drinking Water: The Pipe Game

Grade 4 Social Studies:

1) Identify historical and current economic, political, and geographic information about Alabama on thematic maps.
   - Discussing patterns and types of migrations as they affect the environment, agriculture, economic development, and population changes in Alabama
4) Describe the relationship of the five geographic regions of Alabama to the movement of Alabama settlers during the early nineteenth century.
   - Describing human environments created by settlement

Grade 7 Social Studies (Geography):

2) Analyze regional characteristics for factors that contribute to change and for their relative importance.
3) Describe processes that shape the physical environment, including long-range effects of extreme weather phenomena and human activity.
8) Describe positive and negative environmental effects of human actions on the four basic components of Earth's physical systems: atmosphere, biosphere, lithosphere, and hydrosphere.
9) Analyze environmental consequences of major technological changes in human history for both intended and unintended outcomes.
12) Describe problems involved in balancing the impact of human habitation on the environment and the need for natural resources essential for sustaining human life.

Environmental Science:

1) Identify the influence of human population, technology, and cultural and industrial changes on the environment.
6) Identify sources of local drinking water.

Vocabulary

- **aqueduct**—man-made open canal built to carry a large quantity of flowing water
- **infrastructure**—the system of public works of a country, state or region; also, the resources, such as personnel, buildings or equipment, required for an activity
- **historical river valleys**—Mesopotamia – Tigris-Euphrates; Egypt – Nile, Kush; and China – Yangtze

Discussion Questions

- Why is there a need for infrastructure?
- Is infrastructure necessary for civilization? Why?
- Without civilization what sort of societies would human-kind have?

Extension Activities

- Government Planner Visit: Invite representatives from state, county, and city planning departments to speak about the challenges they face in regard to maintaining existing and planning for future infrastructure needs at their respective levels of government.

- Design a Future City: Have groups of students design futuristic cities and various infrastructure components that would support those cities.

- Who Are Your Utility Providers?: Have students research who their utility providers are and where each of their utilities comes from.

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Section 4: URBAN WATER CYCLE (continued)
Storm Water: The Journey of a Raindrop

(To get to this section in the program, click on the "Storm Water" link once you are in the Urban Water Cycle module, then click anywhere on the city map.)

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

• Pet waste • Oil and gas • Fertilizer & pesticides	• Litter • Leaves & grass clippings

Big Idea

The storm water system, which drains water from urban yards and streets, can carry pollution to nearby waterways.

Background

When it rains, the **stormwater** flows down streets into nearby **storm drains**, which lead to nearby rivers and the ocean. As stormwater travels down the streets, it picks up litter, pet waste, oil, and other non-point source pollution (NPS) with it. The NPS pollution causes problems for aquatic life in the rivers and ocean and increases bacteria levels in these bodies of water, causing beach closures.

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

The primary cause of NPS pollution is runoff from rainfall or snowmelt that picks up natural and human-made pollutants from land surfaces and carries them into groundwater, streams, rivers, lakes, wetlands and the oceans. Impervious surfaces and construction sites in urban areas also contribute to NPS pollution.

The four major types of NPS pollution are:

- Sediments—Soil particles washed off the land
- Nutrients—Fertilizers and animal waste
- Toxic Substances—Pesticides, motor oil, etc.
- Pathogens—Such as bacteria from pet waste.

In general, NPS pollution comes from:

- Roads and streets (stormwater runoff)
- Agriculture
- Logging
- Mining
- Construction and land development sites
- Lawns, parks and golf courses
- Boating and marine activities.

There are many things we can do to prevent nonpoint source pollution. We can clean up after ourselves, picking up litter, pet waste, and using only the fertilizer we need. We also can prevent as much water as possible from traveling down the storm drain, by among other ways, sweeping our driveways instead of hosing them down and redirecting the gutters on our homes to pervious surfaces (where water can soak in).

Essential Questions

- Where does your stormwater go?
- Do you know where the storm drains are near your school?
- Do you know where the storm drains are near your home?
- Where does the water that runs off the roads, buildings, lawns, and parking lots go?
- What pollutants could be in the water and end up in a storm drain?

Learning Objectives

After completing this section, students will learn the following:

- Stormwater flows through storm drains out into the rivers and ocean
- Stormwater carries pollutants from our neighborhoods to the ocean, where it impacts the aquatic life
- Ways they can prevent nonpoint source pollution by picking up pet waste, litter, and more.

Alabama Course of Study Correlations for Stormwater

Grade 4 Social Studies:

1) Identify historical and current economic, political, and geographic information about Alabama on thematic maps.

Grade 5 Science:

9) Describe the relationship of populations within a habitat to various communities and ecosystems.

Grade 6 Science:

2) Describe factors that cause changes to Earth's surface over time.

- Comparing constructive and destructive natural processes and their effects on land formations

3) Describe water and carbon biogeochemical cycles and their effects on Earth.
7) Describe Earth's biomes.
   - Identifying geographic factors that cause diversity in flora and fauna, including elevation, location, and climate

Grade 7 Social Studies (Geography):

3) Describe processes that shape the physical environment, including long-range effects of extreme weather phenomena and human activity.
   - Comparing how ecosystems vary from place to place and over time
8) Describe positive and negative environmental effects of human actions on the four basic components of Earth's physical systems: atmosphere, biosphere, lithosphere, and hydrosphere.
9) Analyze environmental consequences of major technological changes in human history for both intended and unintended outcomes.
12) Describe problems involved in balancing the impact of human habitation on the environment and the need for natural resources essential for sustaining human life.

Biology:

14) Trace biogeochemical cycles through the environment, including water, carbon, oxygen, and nitrogen.

Environmental Science:

1) Identify the influence of human population, technology, and cultural and industrial changes on the environment.
6) Identify sources of local drinking water.
8) Identify major contaminants in water resulting from natural phenomena, homes, industry, and agriculture.

Vocabulary

- **fertilizer—**substance, such as manure or a chemical mixture, used to make soil more fertile
- **herbicide—**an agent used to destroy or inhibit plant growth
- **pesticide—**an agent used to destroy bugs, insects, pests
- **storm drain—**catchment system along the street to capture excess stormwater
- **stormwater—**commonly refers to the excess water that runs off roofs, driveway, sidewalks and streets; may or may not be treated before dumping into a local or regional waterway, lake or the ocean

Discussion Questions

- What happens to rainwater at our school and in our neighborhoods?
  Water drains from the street, into the gutter, and enters the system through an opening in the curb called a catch basin. The catch basin leads to storm drains, large underground tunnels carrying stormwater.

- Where do these storm drains go? *Storm drains empty into our local channels and rivers, and eventually flow into the ocean. Most of the time, there is no treatment process before water reaches the ocean.*

- What is the problem with having these drains go straight to the ocean?
  The rainwater picks up the litter, dog droppings, oil, and other pollutants in our streets before it goes into the storm drains. These pollutants flow into the ocean, causing harm to aquatic life and making the water unsafe for human contact.

- What can we do to reduce the amount of pollutants we send with our rainwater down our storm drains to the ocean? *Pick up after our pets, put trash where it belongs, fix oil leaks in our cars, don't over fertilizer our lawns, and more. Also, if rain water is collected or allowed to soak into the ground, then it does not go to the storm drain and carry pollutants with it.*

Extension Activities

1. Observations: Ask students to work in pairs for this activity. Outside on the school grounds, have students make observations of pollutants they see that will end up in the waterways during a rain. Challenge them to make far more observations than they think possible- no fewer than 20! Not only should students note the kind of pollutant, but the source of that pollutant, if they can. Once you return to the classroom, discuss their observations. Identify the single most prevalent form of pollution present on school grounds, or in the surrounding neighborhood. Create a series of pamphlets to educate neighbors on how to reduce urban run-off.

2. Poster Creation: Create a series of posters to hang around the school, teaching other students how to reduce run-off into the waterways.

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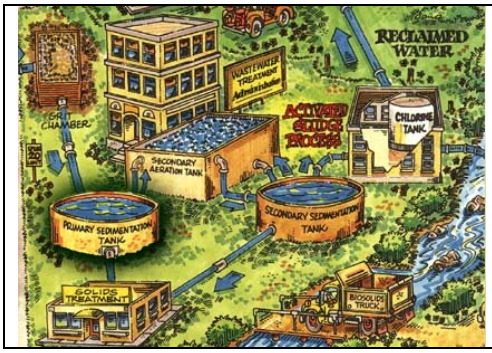
Section 4: URBAN WATER CYCLE (continued)
Wastewater Treatment

(To get to this section in the program, click on the "Waste Water" link once you are in the Urban Water Cycle module, then click anywhere on the city map.)



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

- Grit Chamber
- Disinfection
- Primary sedimentation
- Secondary sedimentation
- Solids treatment

Big Idea

Water that has been used in homes and businesses must be treated before it can be released into the environment or used again.

Background

In the United States, the Clean Water Act of 1972 requires that your local community build and upgrade wastewater treatment plants. What does that mean? These plants treat the wastewater; that is the bath, sink, laundry and sewage water from your homes and businesses. They must meet very strict standards before the treated water can be discharged into our rivers and ocean. Wastewater treatment is essential to the health of humans and our environment. It keeps polluted water out of our water supply, reducing the spread of illnesses and disease.

Wastewater is first collected from your homes and businesses through a series of pipes, or sewers. The sewers mostly run downhill, and gravity makes the water flow towards the treatment plants. Pumping stations pump the water up at the treatment plant. When wastewater arrives at the treatment plant it first undergoes preliminary treatment where large objects are removed from the water. The wastewater then goes through roughly three steps: primary treatment, secondary treatment and tertiary treatment.

Primary treatment involves settling tanks. The flow of the water is slowed to allow particles to settle out of the water, while grease and oil float to the surface. The solids, which settle, and the grease, which floats, are removed by skimming. These solids are further processed, turned into biosolids, and recycled as a soil amendment.

Secondary treatment is the biological treatment of wastewater. It involves the addition of microorganisms and oxygen to the wastewater. The organisms use the oxygen to decompose the remaining dissolved pollutants. The microorganisms are then removed in secondary clarifiers, or large settling tanks.

Tertiary and advanced treatment involves filtering the water and then disinfecting it with either chlorine or ultraviolet light.

Wastewater treatment takes about 10-14 hours. Once the water is clean, it may be released into a river or ocean, or can be reused for irrigation, industrial uses, groundwater recharge, and more. Reusing the water is especially important in the dry, arid climates.

Essential Questions

- What goes down the drain at your house?
- Is there anything that goes down the drain that shouldn't?
- Why treat wastewater?
- How does the wastewater treatment system compare to the drinking water treatment system?
- How does treating wastewater benefit the environment?

Learning Objectives

After completing each section, students will understand:

- What wastewater is
- The steps in the wastewater treatment process
- The importance of wastewater treatment

Alabama Course of Study Correlations for Wastewater Treatment

Grade 4 Science:

5) Describe the interdependence of plants and animals.
   - Identifying characteristics of organisms, including growth and development, reproduction, acquisition and use of energy, and response to the environment.

Grade 5 Science:

9) Describe the relationship of populations within a habitat to various communities and ecosystems.
   - Describing the relationship between food chains and food webs
   - Describing symbiotic relationships

Grade 7 Science:

7) Describe biotic and abiotic factors in the environment.
   - Arranging the sequence of energy flow in an ecosystem through food webs, food chains, and energy pyramids

Biology:

14) Trace biogeochemical cycles through the environment, including water, carbon, oxygen, and nitrogen.
16) Identify density-dependent and density-independent limiting factors that affect populations in an ecosystem.

Environmental Science:

1) Identify the influence of human populations, technology, and cultural and industrial changes on the environment.
8) Identify major contaminants in water resulting from natural phenomena, homes, industry, and agriculture.

Vocabulary

- **microorganisms**—an organism of microscopic size, such as bacterium
- **primary treatment**—the first state of the wastewater treatment process where mechanical methods, such as filters and scrapers, are used to remove pollutants. Solid materials in sewage also settle out in this process
- **secondary treatment**—involves the biological process of reducing suspended and dissolved organic matter from the primary treatment system. Treatment may be accomplished by biological or chemical methods. Disinfection is the final stage of secondary treatment.
- **settling tanks**—that part of the filtration process where sedimentation occurs; here floc particles settle to the bottom and the water moves to the filtration phase
- **wastewater**—water that has waste material in it

Discussion Questions

- How are businesses and homes connected to a treatment plant?
  Each home or business has a pipe that is connected to a larger network of pipes (sewers) and pump stations, which carries the wastewater to a treatment facility.

- How do settling tanks work? *Settling tanks are used to remove heavy solid particles as well as light matter, such as oils and greases, floating at the top. Wastewater flows in settling tanks very slowly, giving time for the materials to fall or float. Skimmers then collect the solids at the bottom and top of the tank, and these solids are further processed.*

- What are the two processes involved in the secondary treatment of wastewater?
  Secondary treatment includes aeration tanks and final clarifiers.

- What do microorganisms do in secondary treatment of wastewater?
  In aeration tanks, microorganisms use the remaining organic material and nutrients in the wastewater as their food supply, thus removing those materials from the water. They then travel to the secondary clarifiers where they sink to the bottom. Most of these microorganisms are recycled back into the aeration tanks. Some are removed and undergo solids processing. These microorganisms are beneficial to us.

- What is the final treatment process in most wastewater treatment plants?
  The final treatment process in most plants is disinfection.

- What extra step is required when the clean water is used for the irrigation of golf courses and parks? *The water is filtered through sand and crushed coal to removed small solid particles.*

- Where does the treated water end up? *Clean wastewater is returned to the ocean, lake, river, or stream. Treated wastewater can also be reused for industrial purposes and landscape irrigation, such as golf courses.*

- Why do you think wastewater treatment is important? *It helps keep our environment, especially oceans and rivers, clean. It also stops people and animals form getting sick from water.*

Tell students that today they will learn about the wastewater treatment process. Have them click on the wastewater tab on the menu page. The wastewater pipes will be highlighted. Then click anywhere on the map to be connected a diagram of the wastewater treatment process.

Extension Activities

1. Using common "pollutants" like sand, leaves, small pieces of paper, or food scraps, "pollute" a sample of water. Have your students design a model wastewater treatment plant. Using a variety of easy, inexpensive monitoring strategies, like turbidity, or color, ask students to measure the quality of the water coming out of their treatment models.

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Section 5: WATER REUSE MODULE

This module includes an exploration of ways that water can be reused by communities to help ensure future water supplies through:

- Direct Use: Purple Pipe Game
- Indirect Use: Wetland Game

Big Idea
Water is always reused in nature and in society.

Background information
In nature, as in human communities, all water is always reused. In the water cycle it is constantly being transformed from liquid (whether it's within a living organism or in an aquifer, river, or ocean) to gas (water vapor) to solid (ice and snow), and back to liquid again. Earth's water resources are fixed and finite—in other words, the water we have today is the same water that has always existed, and all there ever will be. So, the water we drink is the same water that quenched the thirst of dinosaurs millions of years ago.

Wetlands are one of nature's most versatile, hardest working ecosystems and they play an important role in the water cycle. Wetlands are transitional areas between water and land. They provide habitat for fish and other wildlife, protect shorelines, slow erosion, reduce flooding, and improve water quality. Wetlands filter pollutants, nutrients, and sediments from surface water and groundwater. When rivers are at routine water levels, they store water and release it slowly, maintaining flow in streams. When rivers **flood**, wetlands act as sponges, temporarily storing floodwater and releasing it slowly, reducing the severity of floods and protecting areas downstream from damage. The root systems of wetland plants hold and stabilize the soil at the shoreline, helping to control erosion. As supplies of clean water diminish, and demand for clean water increases, people are learning to mimic wetland processes to clean water for reuse by communities situated along rivers.

Constructed wetlands are ponds that are constructed at strategically located sites along a waterway. When flows of wastewater are directed into an artificial wetland, vegetation, **berms**, gates, and deep water pools slow the flow of water, allowing the **sediment** to settle to the bottom. Biofilm on native **vegetation** absorbs excess nutrients and other pollutants, trapping them and further purifying the water. Constructed wetlands can remove suspended solids, nitrogen, phosphorus, hydrocarbons, and even metals from industrial and commercial wastewater, agricultural runoff, and stormwater runoff. In addition to cleaning the water flowing

through them, constructed wetlands also provide critical habitat for native birds and other wildlife.

Just as natural systems continually cycle water through different states in the water cycle, societies also reuse water in many ways. Within a river system, communities use water from surface water or groundwater reserves, treat it, and release it back into **reservoirs** or rivers where it might be used by communities downstream. Other reuse strategies extend this idea by making repeated use of an amount of water before it is released into the environment. These strategies include *direct* and *indirect* water uses. Industrial processes, agricultural irrigation, and watering parks, golf courses, cemeteries, and lawns are all great *direct* uses of reused water. In each of these cases, water is partially treated, and then *directly* put to use again in some way.

Treated water may also be filtered through a wetland then sent through another treatment process before being tapped as a source for drinking water. This is an example of *indirect* reuse. Recycling and reusing water has become part of the solution to the challenge of supplying potable water to communities around the world.

Because reused water is only partially treated, it is not appropriate for every use. Water usage that involves drinking or other hygienic uses of water must use drinking quality water. Swimming pools and other municipal uses also require treated water.

Essential Questions

- What conditions would need to be put in place to ensure there is enough water to meet human needs?
- How do we get the water we use every day?
- Why are wetlands mportant?
- Why reuse water?

Learning Objectives

<u>After completing each section, students will understand</u>:

- That all water is constantly being reused—in nature and in civilization.
- Indirect and direct water reuse strategies
- Different applications for direct and indirect water reuse
- That reusing water is a safe, responsible community planning strategy

Alabama Course of Study Correlations for Water Reuse

Grade 4 Science:

5) Describe the interdependence of plants and animals.
   - Identifying characteristics of organisms, including growth and development, reproduction, acquisition and use of energy, and response to the environment.

7) Describe geological features of Earth, including bodies of water, beaches, ocean ridges, continental shelves, plateaus, faults, canyons, sand dunes, and ice caps.

Grade 4 Social Studies:

1) Identify historical and current economic, political, and geographic information about Alabama on thematic maps.
    - Discussing patterns and types of migrations as they affect the environment, agriculture, economic development, and population changes in Alabama.

Grade 5 Science:

9) Describe the relationship of populations within a habitat to various communities and ecosystems.

Grade 6 Science:

2) Describe factors that cause changes to Earth's surface over time.
    - Comparing constructive and destructive natural processes and their effects on land formations.
3) Describe water and carbon biogeochemical cycles and their effects on Earth.
7) Describe Earth's biomes.
    - Identifying geographic factors that cause diversity in flora and fauna, including elevation, location, and climate

Grade 7 Science:

7) Describe biotic and abiotic factors in the environment.

Grade 7 Social Studies (Geography):

2) Analyze regional characteristics for factors that contribute to change and for their relative importance.
3) Describe processes that shape the physical environment, including long-range effects of extreme weather phenomena and human activity.
    - Comparing how ecosystems vary from place to place and over time.
8) Describe the positive and negative environmental effects of human actions on the four basic components of Earth's physical systems: atmosphere, biosphere, lithosphere, and hydrosphere.
9) Analyze environmental consequences of major technological change in human history for both intended and unintended outcomes.
    - Identifying the impact of urban growth on the environment
11) Compare the distribution of natural resources in various parts of the world by mapping locations of major deposits.
12) Describe problems involved in balancing the impact of human habitation on the environment and the need for natural resources essential for sustaining human life.
    - Applying a problem-solving model to a geographic issue, including the development of sound arguments for specific actions on the issue

Biology:

16) Identify density-dependent and density-independent limiting factors that affect populations in an ecosystem.

Environmental Science:

1) Identify the influence of human population, technology, and cultural and industrial changes on the environment.
8) Identify major contaminants in water resulting from natural phenomena, homes, industry, and agriculture.
9) Describe land-use practices that promote sustainability and economic growth.
12) Identify positive and negative effects of human activities on biodiversity.

Vocabulary

- **absorbent**—The ability of a material to take up moisture
- **berm**—A level space, shelf, or raised barrier separating two areas
- **flood**—The rising of a body of water and its overflowing onto normally dry land
- **nutrients**—A chemical that an organism needs to live and grow
- **pollutants**—The introduction of contaminants into an environment that causes instability, disorder, harm or malfunctioning to the ecosystem
- **purify**—Remove impurities from a substance
- **reservoir**—Lake used to store water for community use
- **retention**—The ability to hold on to moisture
- **saturated**—Soaking thoroughly with a liquid, to the point where no further absorption is possible
- **sediment**—Any particulate matter that can be transported by fluid flow, and which eventually is deposited
- **vegetation**—The flora system of a specific region or ecosystem
- **wastewater**—Any water that has been used for some human domestic or industrial activity and, because of that, now contains waste products
- **wetland**—An area of land whose soil is saturated with moisture either permanently or seasonally

Discussion Questions

- What is wastewater?
- How would you describe how water is purified as it moves through a wetland?
- If you decreased the amount of wetlands around a community, what other changes might happen?
- How are water reuse strategies similar to processes in the natural water cycle?
- How are water reuse strategies different from processes in the water cycle?
- Design an artifical wetland that would fit into our community: Where would you put it? What features would it need?
- Which is more important in an artificial wetland, vegetation or structures that change the depth and flow rates of water? Why?

Extension Activities:

1. Build a Water Treatment Plant Model: Removing pollutants from water is a complex process and ultimately, it is better and less expensive to keep them out of water by preventing pollution rather than to try and remove them once they get in. Challenge

students to create a water treatment plant model that will remove a pre-determined set of pollutants from the water. Pollutants might include vinegar, corn oil, red food coloring, sticks, twigs, leaves, grass, pinecones, paper torn into small pieces, baking soda, and/or soil. Filtering materials might include sand, gravel, activated charcoal, coffee filters, sponges, pantyhose, cotton balls and other common household materials. There are many online activities available that detail how to create water treatment plant models.

2. Wetland Field Trip – Natural Filtration: Take a field trip to a local wetland, and observe the features that filter water. What kinds of vegetation do you see? What kinds of macroinvertebrates live in the water and the soils? What kinds of wildlife do you observe around the wetland? Ask students to create a variety of writing projects to report on their field trip, including poetry, non-fiction reports, narratives, essays or friendly letters to local landowners whose property is adjacent to the wetland.

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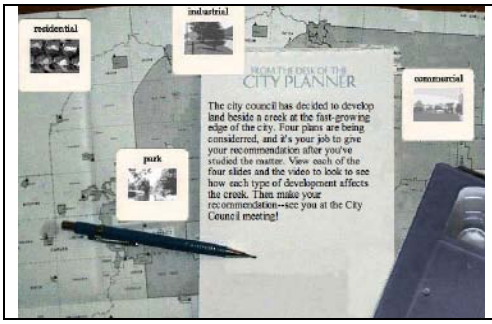
Section 6: STREETS TO STREAMS MODULE



This module investigates what happens in urban environments when extensive areas get covered with impervious surfaces (those that prevent water from seeping into the ground) through:

- A **city planner activity**

Big Idea
Pervious surfaces allow surface waters to be cleansed by natural filtration processes and to recharge ground water supplies. In urban areas, increased impervious surfaces change how surface waters flow, reduce groundwater supplies, and negatively impact water quality in streams.

Background information
Natural environments usually are covered with surfaces that absorb most of the rainwater that falls on them. These are called **permeable** surfaces. In a forest, for example, very little of the rain that falls will run off directly into streams and rivers. Most of it soaks into the ground, recharging **groundwater**, slowly making its way to local streams and rivers through seeps and springs. **Flow rates** in local waterways go up and down slowly, even after heavy rains, as permeable surfaces help regulate the flow of water.

As cities grow, more and more surfaces are covered with hard surfaces—asphalt-covered streets, concrete parking lots, and buildings. These **impervious** surfaces, or surfaces that do not allow water to pass through, prevent water from soaking into the ground. Rain that falls on impervious surfaces flows into **storm drains**, and directly into local waterways, bringing with it all the pollutants that are deposited on the ground, including gasoline, oil, litter, leaves, grass, and other **non-point source pollutants**.

The increased speed and volume of surface run-off due to impervious surfaces can have many serious impacts on a watershed's streams and rivers. Rain falling on impervious surfaces causes water in streams to rise quickly and flow faster, increasing the **erosion** of stream banks and widening stream channels. As streams carry a heavier load of eroded soils, the water scours the streambed, deepening the stream channel. In times of low water flow, rates in streams can decrease as water runs off instead of **recharging** groundwater. Water temperatures rise as waters flow across hot asphalt and other impervious surfaces. Dirt and pollutants picked up from impervious surfaces increase **turbidity** and pollution in streams.

To combat the negative impacts of impervious surfaces, cities have begun using a design approach called, "**Smart Growth**." Smart Growth design is compact. Developments cluster homes and businesses around shared **green spaces**, increasing the amount of **contiguous**

pervious surfaces and minimizing the amount of impervious surfaces in a development. Smart Growth principles are inclusive of all kinds of development - commercial, industrial and residential - resulting in a greater mix of residential, commercial and retail uses, while maintaining healthy, functioning open space and other **ecological** features and services.

Essential Questions

- What are the effects of community development on watersheds?
- How can smart-growth design principles reduce the impact of human activity on watersheds?

Learning Objectives

After completing this section, students will:

- Distinguish between pervious and impervious surfaces.
- Understand how different kinds of urban development bring different levels of impervious surface.
- Understand primary impacts of extensive impervious surfaces on water quality

Alabama Course of Study Correlations for Streets to Streams

Grade 4 Science:

7) Describe geological features of Earth, including bodies of water, beaches, ocean ridges, continental shelves, plateaus, faults, canyons, sand dunes, and ice caps.

Grade 4 Social Studies:

4) Describe the relationship of the five geographic regions of Alabama to the movement of Alabama settlers during the early nineteenth century.

Grade 5 Science:

9) Describe the relationship of populations within a habitat to various communities and ecosystems.

Grade 7 Social Studies (Geography):

2) Analyze regional characteristics for factors that contribute to change and for their relative importance.
   - Using field observations, maps, and other tools to identify and compare physical characteristics of places
3) Describe processes that shape the physical environment, including long-range effects of extreme weather phenomena and human activity.
   - Comparing how ecosystems vary from place to place and over time
8) Describe positive and negative environmental effects of human actions on the four basic components of Earth's physical systems: atmosphere, biosphere, lithosphere, and hydrosphere.
9) Analyze environmental consequences of major technological changes in human history for both intended and unintended outcomes.

12) Describe problems involved in balancing the impact of human habitation on the environment and the need for natural resources essential for sustaining human life.

Biology:

14) Trace biogeochemical cycles through the environment, including water, carbon, oxygen, and nitrogen.

Environmental Science:

1) Identify the influence of human population, technology, and cultural and industrial changes on the environment.
8) Identify major contaminants in water resulting from natural phenomena, homes, industry, and agriculture.
12) Identify positive and negative effects of human activities on biodiversity.

Vocabulary

- **aquatic**—Relating to water; living in or near water, taking place in water
- **channel**—A passage for water to flow through
- **contiguous**—Touching along a boundary or at a point
- **erosion**—Condition in which the earth's surface is worn away by the action of water and/or wind
- **flow rates**—The amount of water (gallons or liters) per unit of time (per minute, per hour) flowing past a fixed point in a stream
- **green space**—Any vegetated land or water within or adjoining an urban area
- **groundwater**—Water located beneath the ground in soil pore spaces and in the spaces between rock formations.
- **impervious**—Material that does not allow water to infiltrate or pass through
- **permeable**—Having pores or openings that permit liquids or gases to pass through
- **pervious**—Material that allows water to infiltrate or pass through
- **pollution**—Contamination of air, soil, or water with harmful substances
- **smart growth**—Environmentally-sensitive land development that protects open space and attempts to achieve more compact, efficient, mixed-use communities
- **springs**—An uprising and out flowing of ground water
- **storm drain**—A drain through which excess water passes from paved streets, parking lots, sidewalks and roofs into a storm sewer.
- **streambed**—The channel bottom of a stream, river or creek; the physical confine of the normal water flow in a waterway
- **temperature**—The measure of the internal energy that a substance contains
- **turbidity**—The muddiness or opacity of water caused by the suspension of matter such as silt, sediment, organic matter or algae

Discussion Questions

- Can you list examples of pervious and impervious surfaces?
- Can you summarize how rain falling on pervious surfaces helps to protect areas from flooding?

- What would result if we replaced our school parking lots with pervious surfaces?
- What is the relationship between the amount of impervious surface in an area and the water quality in local waterways?
- Create a plan for a new housing development including important businesses like grocery stores, gas stations and other services that would have a minimal impact on water quality.
- What recommendations would you make to our city council to help them make city planning decisions that improve water quality as our community grows?

Extension Activities

1. Property Development Perspectives: Divide students into small groups. Assign each group a role in a community debate about how to develop a nearby piece of property. Groups will argue that the property, just like in the *Waters To The Sea* interactive module, should be developed as a park, residential, commercial, or industrial site. Ask each group to research their position on the issue, and defend their position using evidence from their research.

2. Community Planning Commission Visit: Invite a member of your local commuunity planning commission to talk with students about plans to develop a local parcel of undeveloped land. Investigate what kinds of questions community planners must ask, and what kinds of issues they must take into consideration before making decisions on land zoning.

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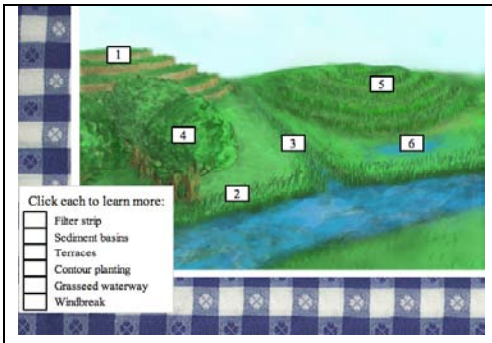
Section 7: ON THE FARM MODULE



This module explores ways of reducing erosion of topsoil on farms by following "best practices." The module includes:

- "Who Gets the Largest Slice of Pie?" **graph**
- Water Wise Farmer **game**: (1) matching and (2) multiple choice
- Modern Farming **video** (1 min)

Big Idea
Best practices in farming can reduce negative impacts on water quality by preventing top soil from being carried into streams by surface runoff.

Background information
Farming can have a significant impact on natural systems. Each time a plow cuts through the soil, it releases **carbon dioxide** into the atmosphere. When rain falls on the exposed soils in a farm field, it carries soil particles and agricultural chemicals into waterways, eroding topsoil and depositing **sediments** into rivers and streams. The sediments increase **turbidity**, and eventually are deposited in streams and rivers. Excess **siltation** and **deposition** can **degrade** river **habitats**, making them unsuitable for **aquatic** organisms. Excess fertilizers can run off fields into rivers and streams, causing algae to grow at unhealthy rates. When the algae die, they fall to the bottom of the water body. The microorganisms that flourish by feeding on the decaying algae absorb much of the oxygen in the water, making it uninhabitable for fish and other wildlife.

In order to reduce the negative impacts of farming on the land, farmers can employ a variety of **conservation** practices. Each of these practices works in combination with others to reduce erosion in order to maintain the ecosystem's health and productivity.

In **contour planting**, tilling and planting follows the contours of the land, rather than plowing up and down hillsides in straight rows. This practice creates small ridges of soil that slows water runoff, allowing more water to absorb into the ground, and reducing erosion. Contour planting is typically used on hillsides with a moderate slope.

Terracing changes the steep slope of a hill into a staircase of flat strips of land where crops are planted. Terraces hold water on the field, allowing rainwater and melting snow to soak into the ground and, reduce soil erosion. Since terraces prevent water from rushing downhill, they keep topsoil in place and waterways clean.

Sediment basins are ponds at the base of hillsides where surface **runoff** is collected. The ponds slow the flow of runoff before the sediments enter a waterway and allow sediments to settle to

the bottom of the pond. They also help restore groundwater. As a result, sediment basins trap fine particles in cropland **runoff** and help keep waterways clean.

A **filter strip** is a buffer area between farm fields and waterways that uses undisturbed natural vegetation or selected permanent plantings instead of crops. When rains or melting snows flow across farm fields, the filter strip forms a barrier that traps or filters out sediments and keeps eroded materials out of waterways.

Many farm fields are situated on rolling hills with steeper gullies. Planting grass in places where gullies would naturally form in a field prevents erosion of soil from rain and melting snows. **Grassed waterways** also slow the flow rate of the runoff, which helps sediment stay on the field where it belongs, and prevents surface **runoff** from scouring a deeper waterway as water flows across plowed soil.

A **windbreak** is a row of trees planted between farm fields. The trees, which are usually planted to stop the force of the prevailing winds and snow, lessen or break the force of the wind that can blow through a field and carry off topsoil. Trees and shrubs in a windbreak slow wind on the downwind side of the windbreak for a distance of up to10 times the height of the trees, reducing wind erosion, providing a sound barrier, and offering habitat for wildlife.

Essential Questions

- How do farming practices affect the health of watersheds?
- What kinds of farming practices can reduce the impacts of farming on waterways?

Learning Objectives

After completing this section, students will:

- Understand that sediment carried from farm fields causes pollution in streams.
- Be introduced to impacts of sediment in streams on aquatic plants and animals.
- Be able to identify key ways that sedimentation can be reduced through best practices

Alabama Course of Study Correlations for
On the Farm

Grade 4 Science:

5) Describe the interdependence of plants and animals.

Grade 4 Social Studies:

1) Identify historical and current economic, political, and geographic information about Alabama on thematic maps.
   - Discussing patterns and types of migrations as they affect the environment, agriculture, economic development, and population changes in Alabama.

Grade 5 Science:

9) Describe the relationship of populations within a habitat to various communities and ecosystems.

Grade 6 Science:

2) Describe factors that cause changes to Earth's surface over time.
   - Comparing constructive and destructive natural processes and their effects on land formations.

Grade 7 Social Studies (Geography):

2) Analyze regional characteristics for factors that contribute to change and for their relative importance.
3) Describe processes that shape the physical environment, including long-range effects of extreme weather phenomena and human activity.
8) Describe positive and negative environmental effects of human actions on the four basic components of Earth's physical systems: atmosphere, biosphere, lithosphere, and hydrosphere.
9) Analyze environmental consequences of major technological changes in human history for both intended and unintended outcomes.
12) Describe problems involved in balancing the impact of human habitation on the environment and the need for natural resources essential for sustaining human life.

Biology:

16) Identify density-dependent and density-independent limiting factors that affect populations in an ecosystem.

Environmental Science:

1) Identify the influence of human population, technology, and cultural and industrial changes on the environment.
9) Describe land-use practices that promote sustainability and economic growth.
   - Defining various types and sources of waste and their impact on the soil.
11) Describe agents of erosion, including moving water, gravity, glaciers, and wind.
   - Describing methods for preventing soil erosion.

Vocabulary

- **aquatic plants**—Plants which grow in, live in, or live on the water
- **carbon dioxide**—a heavy odorless colorless gas that is the waste product of cell respiration and the combustion of fossil fuels
- **conservation**—An ethic of resource use, allocation, and protection focused on maintaining the health of the natural world
- **contour planting**—A planting strategy in which tilling and planting follows the contours of the land, rather than plowing straight up and down rows
- **cover crop**—Crops planted between others in order to prevent erosion and to improve soil quality

- **cultivation**—Digging up or cutting the soil to prepare land for the production of food, control weeds, aerate the soil; or work organic matter, crop residues, or fertilizers into the soil
- **filter strip**—A buffer area between farm fields and waterways that forms a barrier that traps or filters out sediments and keeps eroded materials out of waterways
- **grassed waterways**—Grass strips planted in places where gullies would naturally form in a field that prevent erosion of soil from rain and melting snows
- **global warming and climate change** —Changes in climate due to human activities that includes an overall increase in world temperatures caused by additional heat being trapped by greenhouse gases
- **habitat**—An ecological or environmental area that is inhabited by a particular animal or plant species, providing that organism food, shelter, water, and space
- **harvest**—The process of gathering mature crops from the fields
- **no-till farming**—Planting crops without cultivating the land, into an existing crop residue
- **pollution**—Contamination of air, soil, or water with harmful substances
- **productive**—The quality of being productive or having the power to produce
- **runoff**—Water flow which occurs when soil is infiltrated to full capacity and excess water, from rain, snowmelt, or other sources flows over the land
- **sediment**—Any particulate matter that can be transported by fluid flow, and which eventually is deposited
- **sediment basins**—Ponds at the base of hillsides where surface runoff is collected
- **strip-till farming**—A low-impact cultivation technique system that uses a minimum tillage
- **terracing**—A planting strategy that changes the steep slope of a hill into a staircase of flat strips of land where crops are planted, holding water on the field, allowing rainwater and melting snow to soak into the ground and eroded soil to be redeposited on the field
- **toxic**—Having a chemical nature that is harmful to health
- **windbreak**—A row of trees planted between farm fields to stop the force of the prevailing winds and snow and lessen or break the force of the wind that can blow through a field

Discussion Questions

- Can you list several conservation farming practices?
- Can you explain how contour planting (or any other conservation farming practice) helps keep sediments out of waterways?
- If every farmer used as many conservation practices as was practical, what other changes might happen?
- Why do you think farmers should, or should not, adopt conservation farming practices?
- How would you test whether conservation farming practices actually make any difference in the amount of sediment going into waterways?
- What would you recommend a farmer do to improve his conservation practices without costing him or her any money?

Extension Activities

1. Build a Model Farm Field: Build a small model of a farm field using a shallow pan, set on a table top at a tilt. Poke a hole in the bottom of the pan at the low end, and fit a piece of plastic or rubber tubing in it. Place a bucket or basin under the tubing to catch the runoff. Add soil to a depth of several inches. Make a hillside and test several of the conservation farming practices in your model, using a watering can to add "rain." Use inexpensive coffee filters to filter out the sediments that are eroded so they can be weighed after each "rain" event.

2. Meet a Local Farmer: Invite a local farmer to come to class to talk about the kinds of conservation farming practices he or she uses. Arrange a field trip to a local farm to see how these methods look when applied to a real setting. Design a field investigation to measure the amount of sediments coming off one of the fields.

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Section 8: WATER WISDOM (Water Conservation)

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

Big Idea
Water conservation is critically important to ensuring enough water for future human needs.

Background
You may know that about 75% of the Earth is covered by water. But just 3% of that water is fresh water with about 2.5% locked in glaciers and icebergs. That leaves roughly one-half percent of the Earth's available water to use as drinking water.

That one-half percent of available fresh water has to be shared by a global population of nearly 7 billion people. That global population grows by thousands of people every day, and they all need fresh water.

Since "creating" new water through water recycling and **desalination** each has its own set of challenges, one of the best ways to stretch our existing water supplies is through **conservation**. Indoors, water can be conserved by using low-flow showerheads, ultra-low-flush toilets, and front loading (high efficiency) washing machines. Making behavioral changes such as not leaving the water running while brushing your teeth and not using the toilet as a wastebasket also help to conserve water. Outdoors, where up to 70% of daily water usage occurs, water can be conserved by installing more efficient irrigation systems and planting native or drought-tolerant plants that are visually appealing and require very little water.

If we all begin to conserve water both indoors and outdoors, not only will we become better **stewards** of our environment, we will begin to move toward a more **sustainable** future.

Essential Questions
- How do you use water throughout your day?
- In what ways is water commonly wasted at home?
- What ways can water waste be reduced?
- What changes could you make to conserve more water indoors and outdoors?

Learning Objectives:
After completing this section, students will:

- Understand the need for water conservation.
- Understand ways in which water can be conserved indoors and outdoors.

Alabama Course of Study Correlations for
Water Wisdom (Water Conservation)

Grade 4 Science:

5) Describe the interdependence of plants and animals.
   - Identifying characteristics of organisms, including growth and development, reproduction, acquisition and use of energy, and response to the environment

Grade 5 Science:

9) Describe the relationship of populations within a habitat to various communities and ecosystems.

Grade 6 Science:

3) Describe water and carbon biogeochemical cycles and their effects on Earth.

Grade 7 Science:

7) Describe biotic and abiotic factors in the environment:

Grade 7 Social Studies (Geography):

3) Describe processes that shape the physical environment, including long-range effects of extreme weather phenomena and human activity.

Biology:

14) Trace biogeochemical cycles through the environment, including water, carbon, oxygen, and nitrogen.

Environmental Science:

1) Identify the influence of human populations, technology, and cultural and industrial changes on the environment.
6) Identify sources of local drinking water.
9) Describe land-use practices that promote sustainability and economic growth.
   - Defining various types and sources of waste and their impact on the soil
   - Identifying ways to manage waste, including composting, recycling, reusing, and reclaiming
12) Identify positive and negative effects of human activities on biodiversity.

Vocabulary

- **aqueduct**—a channel designed to transport water from a remote source, usually by gravity
- **desalination**—the removal of salts from saline water to provide freshwater
- drought-tolerant
- **precipitation**—rain, snow, hail, sleet, dew and frost
- **population**—the whole number of people or inhabitants in a region
- **stewardship**—the careful and responsible management of a natural resource
- **sustainability**—a method of using or harvesting a natural resource so that the resource is not permanently depleted or damage
- **water conservation**—planned management of water resources to prevent exploitation, destruction or neglect
- **water recycling**—wastewater cleaned for re-use, usually for nonpotable purposes such as irrigating landscape and refilling aquifers

Discussion Questions

- What would your day be like without water or a very limited amount of available water? *Student answers will vary.*
- Should each household be allocated a certain amount of water a month? *Answers will vary.*
- What should happen when a household uses more water than allocated? *Answers will vary.*

Extension Activities

1. Home & Energy Family Survey: Conduct a home water and energy audit and make a personal/family conservation plan

2. Home & Energy School Survey: Conduct a school water and energy survey and make a school conservation plan

3. Water Conservation Products Research: Research new water conservation products at your local home improvement store.

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Sections 9-13: *DISCOVERING ALABAMA* "GO-DEEPER" VIDEOS

	This section includes 5 videos from the *Discovering Alabama* video series. These videos include: *Section 9: Alabama River* *Section 10: Bear Creek* *Section 11: Black Warrior River* *Section 12: Cahaba River Watershed* *Section 13: Delta Revisit*

About *Discovering Alabama*

Discovering Alabama is the Emmy-honored documentary television series that leads viewers on adventures across the diverse lands and waters of the state, exploring Alabama's forests, rivers, wildlands, and wildlife, from mountainous north Alabama to the central prairielands to the Alabama gulf coast. The series supports K-12 science, social studies and other subjects. Host and series creator Dr. Doug Phillips tells the story of Alabama's geology, geography, flora, fauna, and important ecological relationships, together with related aspects of the state's history and cultural heritage.

More than 80 *Discovering Alabama* programs are available in DVD/video format for instructional use in Alabama classrooms, where the series provides unique value in making learning locally relevant for students. To further promote locally-relevant learning, *Discovering Alabama* offers the web-based "Ask The Expert," an interactive natural diversity database designed especially for Alabama schools, and additional Virtual Field Trips exploring such topics as Alabama Forests, Geology, and Wildlife. Also, full feature viewing of each *Discovering Alabama* documentary is available via www.itunes.ua.edu.

Discovering Alabama programs and instructional materials are correlated with the Alabama Courses of Study and with the State Graduation Exam. For further information about the availability of *Discovering Alabama* DVDs/videos, Teacher Guides, and related materials and resources, visit **www.discoveringalabama.org**.

Discovering Alabama is a production of the Alabama Museum of Natural History/The University of Alabama in cooperation with Alabama Public Television. Major annual sponsors include the Solon and Martha Dixon Foundation, the Alabama Wildlife Federation, and the Alabama Department of Conservation and Natural Resources.

Teacher Tips For Using *Discovering Alabama*

While attracting a diverse TV audience of outdoor enthusiasts, *Discovering Alabama* is much more than an "outdoor show". Many teachers use *Discovering Alabama* as a versatile resource supporting the whole development of students – academically, personally, and as responsible citizens. Beyond showcasing Alabama's outdoors, *Discovering Alabama* integrates content

across the curriculum, connects learning to real world topics, and promotes environmental stewardship. Some teachers even consider *Discovering Alabama* to be an effective antidote to the hectic pace and short attention spans prevalent in society today. The series' comfortable style provides students a rare window for tranquil pause and thoughtful reflection, and even a moment of reverent embrace for the marvels of nature.

Discovering Alabama began as an extension of actual field expeditions offering outdoor and natural science training for Alabama teachers. Today *Discovering Alabama* DVDs/videos are a favorite resource for teachers throughout the state. Many of these teachers share observations and suggestions for instructional use of *Discovering Alabama,* as listed below.

1. **Optimal Conditions for Viewing *Discovering Alabama***: A foremost value of *Discovering Alabama* is in simply providing quiet, inspirational enjoyment of Alabama's natural wonders. In this respect the programs could be considered "movies" rather than DVDs/videos. Therefore, it is important to ensure that students have sufficient opportunities conducive to "movie viewing". Some schools accomplish this by arranging a special viewing area equipped with a large screen, a quality projector, and ample speakers so that students can better experience the natural scenes and sounds presented in the *Discovering Alabama* programs. If such special arrangements are not possible in your situation, try at least to provide a quiet room and a big screen/TV.

> *I just want to tell you how impressed I am with the usability of your videos in the classroom. I am a new, first year teacher of Environmental Science… I have used your video about Village Creek to supplement my lessons concerning non-point source pollution. The students enjoy the video and it correlates with the causes of NPS Pollution very well . . . [Y]our personality and manner of speaking is very appealing to my students*
>
> —high school environmental science teacher, Jefferson County

2. **Bites vs. Full Programs:** Schools today are starting to meet new educational demands by adding new technologies. (This, in fact, is part of the rationale for computer-based virtual field trips.) And teachers often feel pressured to select strategies that appeal to techno-conditioned short attention spans while also delivering bites of information that quickly target specific requirements. Therefore, *Discovering Alabama* accommodates this reality by providing quick access to selected program bites via virtual field trips and other special formats.

   However, many teachers emphasize that students should also have ample opportunity to view *Discovering Alabama* programs in full feature because "each program is a complete story with a beginning, a middle, and an ending; useful in teaching conceptual thinking, critical thinking, content comprehension, and writing composition, and often useful in drawing meaningful connections to literature and the arts."

3. **Using As Virtual Field Trips:** In this age of increasing technology in the classroom, Alabama teachers have observed that *Discovering Alabama* represents a combination of

technology – videography, audiography, computerized production methods, etc., not to mention the technologies involved both for statewide TV broadcasts and for classroom viewing. Moreover, many Alabama teachers point out that each *Discovering Alabama* program is itself a virtual field trip, taking viewers on location for a virtual visit and exploration of actual natural areas in Alabama while also representing a combination of technology, adventure, interdisciplinary content, and inspirational message – a combination of unique educational value for Alabama schools.

> *I am writing to say how much I enjoy your series on Public Television about* Discovering Alabama*. I, like many others, am very proud of our state and your walks around the state are not only interesting, but enlightening.*
>
> —high school principal, Jefferson County

4. ***Discovering Alabama* Teacher Guides** (available for most DVD/video programs) are teacher friendly, contain helpful activities and information for augmenting student learning, and can stimulate additional teaching ideas.

5. **For Parent Involvement and Seeking Assistance:** Due to *Discovering Alabama*'s wide public popularity, teachers often find it advantageous to mention their use of *Discovering Alabama* when encouraging parent involvement and when seeking assistance from other community or state sources.

6. **Using the Full Set:** Many teachers find it helpful to have the entire set of *Discovering Alabama* DVDs/videos as a reference source in developing activities and lesson plans. Often the school librarian obtains a complete set for such reference purposes. Sometimes, a parent or community member is pleased to provide the school with *Discovering Alabama* DVDs/videos.

> *I just wanted to share with you how much my fourth graders enjoy watching your videos. I ordered the entire collection several years ago. Keep up the good work!*
>
> —fourth grade teacher, Talladega

7. **Connection to Other Organizations and Agencies:** *Discovering Alabama* DVDs/videos and Teacher Guides always highlight the positive works and educational materials of other organizations and agencies, and thus are a good means of finding out about such resources.

8. **Use As a Reference Resource on Environmental Issues:** *Discovering Alabama* has been a leader in many efforts for environmental progress and protection in Alabama. Teachers can be sure that *Discovering Alabama* program content is grounded in substantial knowledge and experience with environmental issues. And this can be a good reference source for teachers who want to further explore important environmental issues.

> *I just wanted to tell you how much I appreciate all that you do for Alabama, for environmental awareness, and for environmental education. You have reached more people in the general adult population with your programs and your very balanced message than anyone else in Alabama. That is a segment of the population that many of us struggle with how to reach with environmental education, and I think we often lose sight of how much you have contributed to that effort. Thank you for all that you do.*
>
> —university professor, Birmingham

9. **Use As a Reference Resource for Expanding School Environmental Programs:** *Discovering Alabama* has been a leader in many advances for environmental education. Teachers can be sure that *Discovering Alabama* is based on substantial knowledge and experience in the effective design and delivery of environmental education. And this can be a good reference source for teachers who want to expand school environmental programs.

10. **Year-long Frameworks that Connect with Academic Requirements:** *Discovering Alabama* has been a pioneer in developing innovative K-12 programs incorporating natural history and environmental studies to support the attainment of academic requirements in science, social studies, mathematics, language arts, and other subjects.

    Notable examples of such programs include *Discovering Alabama*'s acclaimed instructional models Discovering Our Heritage – A Community Collaborative Approach, and "Project Community – Enhancing Alabama's Human Communities Through The Stewardship of Alabama's Natural Communities". These provide teachers with year-long frameworks to ensure easily adaptable nature study in ways that support the local school curriculum, are endorsed by the Alabama State Department of Education, and correlate with state standards.

11. **Helping Get Viewers Outdoors and Experiencing Local Settings First Hand:** Another important value of *Discovering Alabama* is in enabling locally relevant learning. And while *Discovering Alabama* is broadcast on television, a major aim of the series is to inspire viewers to get outdoors and experience local natural settings first hand. *Discovering Alabama* Teacher Guides typically provide valuable ideas and suggestions in this regard.

12. **Teacher Workshops and In-Service Trainings:** A great way to learn more about the many values, resources, and instructional uses of *Discovering Alabama* is through *Discovering Alabama* teacher workshops and in-service training. Such assistance can be arranged by contacting *Discovering Alabama* at (205) 348-2039 or info@discoveringalabama.org.

> *Discovering Alabama reaches students in a way that few educational programs do . . . Each program captivates, teaches, and provides a springboard for further study in a variety of areas. Our teachers feel that students really do "discover Alabama."*
>
> —elementary teacher, Homewood School System

Appendix A:

Alabama Course of Study Correlations

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Alabama Course of Study Correlations to Waterways to the Sea: Discovering Alabama

S = Science SS = Social Studies	**Understanding Watersheds**	**Ecosystem Introduction**	**Cherokee, Creek & Deer**	**Urban Water Cycle**	Urban Water Cycle – Drinking Water: **Water Treatment**	Urban Water Cycle – Drinking Water: **Water Tower**	Urban Water Cycle- Drinking Water: **The Pipe Game**
Grade 4	S 7 SS 1, 4	S 5, 6 SS 4	S 4	S 7			SS 1, 4
Grade 5	S 1	S 9	S 9	S 9	S 1		
Grade 6	S 2, 3	S 7		S 3	S 2		
Grade 7	S 7 SS 2, 3, 8, 9, 11, 12	S 7 SS 3, 8	S 7 SS 2, 3, 12	S 7 SS 2, 8, 9, 12	S 7 SS 8, 9, 12	SS 3, 8, 9, 12	SS 2, 3, 8, 9, 12
Grade 8							
Biology	14	15, 16	16		14, 16	16	
Environmental Science	6	1	12	6, 8	1, 6, 8	6	1, 6

Alabama Course of Study Correlations to Waterways to the Sea: Discovering Alabama

S = Science SS = Social Studies	Urban Water Cycle- **Storm Water: The Journey of Raindrop**	Urban Water Cycle: **Wastewater Treatment**	**Water Reuse**	**Streets to Streams**	**On the Farm**	**Water Wisdom: Water Conservation**
Grade 4	SS 1, 4	S 5	S 5, 7 SS 1	S 7 SS 4	S 5 SS 1	S 5
Grade 5	S 9	S 9	S 9	S 9	S 9	S 9
Grade 6	S 2, 3, 7		S 2, 3, 7		S 2	S 3
Grade 7	SS 3, 8, 9, 12	S 7	S 7 SS 2, 3, 8, 9, 11, 12	SS 2, 3, 8, 9, 12	SS 2, 3, 8, 9, 12	S 7 SS 3
Grade 8						
Biology	14	14, 16	16	14	16	14
Environmental Science	1, 6	1, 8	1, 8, 9, 12	1, 8, 12	1, 9, 11	1, 6, 9, 12