INTRODUCTION TO NATURAL RESOURCES

What Are Natural Resources?
A good working definition of Natural Resources requires defining the two words, natural and resources, separately and combining those definitions. “Natural” can be defined as something present or produced, in nature. “Resource” can be defined as that which is useful and for which there is an available supply. By combining these two definitions, “natural resources” can be defined as something present in, or produced by, nature with an available supply that can be drawn upon when needed. Natural resources also can be categorized as earth materials and as all life forms. Those natural resources include air, water, soils, natural vegetation, and all rocks and minerals.

Who Uses Natural Resources?
People use natural resources. Every aspect of life requires that we use natural resources. When one gets up in the morning and eats breakfast, one is using natural resources. The electricity that turned on the lights, the water in the shower, and the food that is on the table came from natural resources. All day long we use natural resources. Sometimes they are used in other ways, such as enjoying one’s surroundings by visiting a state or national park or forest.

Alabama’s Natural Resources
Alabama is fortunate in that it has an abundance of many natural resources. Farmers use the soil to produce many products, such as cotton, potatoes, tomatoes, and peanuts. On some areas of land, trees are grown to produce wood to build houses and to make paper for many purposes. In recent years, oil (a product that we use every day) has been found, and drilled, for in Mobile Bay. Across the state, people use water to produce electricity (hydroelectric dams) and to fish for food and sport. As one can see, Alabama has an abundance of natural resources, BUT we must manage them correctly so that they will last for generations to come.

Conserving Our Natural Resources for Future Generations
It is important for Alabamians to pay close attention to the ways they manage natural resources. There are many public and private organizations that work to assure that our natural resources are adequately maintained, but, in the end, it is up to the individual citizen to do his or her part. Whether it is by picking up trash, recycling, planting trees, or volunteering with an environmental organization, everyone makes a difference, and everyone must help to insure that generations to come have the necessary natural resources.

S*PARK*S

OBJECTIVES:

Students will be able to:

1. Describe the purposes for establishing national, state, county, and city parks.
2. List and locate on a map national parks of the U.S.
3. List and locate on a map parks in their state, county, and community.
4. Prepare a pictorial report.

Grades:
9-12

Subjects:
Biology, Ecology, Geography, Alabama History

Time Needed:
One class period

Materials:
copies of US national park map
404-562-3180
Alabama highway maps
cameras
poster board

BACKGROUND:

In 1872 Yellowstone In Wyoming was designated the world's first national park. By 1916 when the National Park System was established, there were an additional fourteen parks. Now the System manages about 83.6 million acres of land including 51 national parks, 102 national monuments and memorials, and 108 national historic sites and historical parks. Additionally, the U.S. Forestry Service manages many national recreation areas, states have established state parks on historic and recreational sites, and counties and cities have set aside land for their own parks.
The National Park Service mandate is to "conserve the scenery and natural and historic objects and the wildlife therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations."

Our parks have been visited, appreciated, used, and abused by so many visitors that many of them are now in danger of being "loved to death." Action is being taken to limit access to sensitive areas. In addition, many parks are underfunded, are not self-supporting, and are in dire need of repair work and refurbishing; there is a current push to sell some of these lands or to lease their management to for-profit organizations.

City parks are generally of the urban forest or playground variety. County parks tend to be recreational areas (boat launches, beaches, piers) or historic sites. Problems range from funding to vandalism.

Alabama has no national parks at present, but Little River Canyon near Fort Payne is slated to become Alabama's first. Currently, Little River Canyon is listed as a National Preserve. Twenty-four national forest recreation areas are managed for multiple use. Alabama has 24 state parks, plus abundant county and city parks. Alabama also has some national historic sites such as Sloss Furnaces in Birmingham.

VOCABULARY:

conservation, multiple use, preservation, stewardship, wilderness areas

ADVANCE PREPARATION

1. Make copies of the national park map and list for each student. Obtain an Alabama highway map for each student (free on request). The maps need to indicate the state parks and national forestry recreation areas. Obtain a list of county parks and maps, if available, from the county commission office.

PROCEDURE

Setting the Stage

1. Determine the extent of students' knowledge about public lands and their management.
2. Poll students to see who has visited a national or state park. Ask them to name the park and its location and to describe their experiences.
3. List on the board area county parks, first by students' suggestions and then by completing the list from your information. Again, see who has visited the parks and for what reasons.

Activity

1. After giving the students background on national parks and the National Park Service, pass out the maps and park lists. Ask them to list the national parks by region and discuss why some regions have more than others. List the first 10 parks to be established. Is there a connecting link between them? Which state has the most land set aside? What percentage of the total area is in the public trust? (Hint: 1 sq. mi.= 640 acres. Alaska's area is 591,004 sq. mi.)
2. Pass out the Alabama highway maps. The state parks and national forestry recreation areas are listed. Have them locate each on the map.
3. Assign each student or group of students a particular county or community park. Let them research the location, acreage, reason for being set aside, date of designation, and current usage. Create a large county map with each park location marked. Allow each group to present its findings.
4. Take the class on a field trip to a nearby park. Create a pictorial essay of that park. Assign different students to draw maps, measure, photograph, sketch, collect leaves (if permitted), and write descriptions of locations or activities.
5. If at all possible, let each group create a pictorial essay of "its" park. Include a map of the surrounding area; a map of the park area with usage marked; and a picture of the park sign, park scenery, roads, buildings, and activities.

Follow-Up

1. Play one of the land-use simulation games in which public land is in dispute.
2. Write newspaper articles, complete with pictures, detailing student findings and experiences with the city or county park system.

EXTENSIONS:

1. Choose an area that should be set aside and protected, and try to make it happen! Get the city or county to buy, develop, or clean up an area of beauty or interest. Write letters and visit the city council or county commission.
2. Invite a park ranger to visit the class as a resource speaker. Ask about the park service, the parks, describe a park ranger's job, explain training, and qualifications.
3. Assign research papers on each of the national parks. Write for information, do library and computer research, write a report, and make a poster or collage.
4. Show one or more of the national park videos produced by *National Geographic* and *Reader's Digest.* These may be available at a public library.

ORIGINAL DEVELOPMENT RESOURCES:

Arms, K. (1996). *Environmental science*. Austin, TX: Holt, Rinehart, and Winston.

Mitchell, J. (1994, October). *National geographic.* Our national parks: Legacy at risk. Plus Geoguide from the same issue.

Loving it too much. (1994). *Project learning tree.* (PreK-8).

The National Park Service. www.nps.gov

U.S. Major Public Lands

Major U.S. Public Lands	Approximate Size	Administered By	How the Land is Used
National Parks and Monuments	33.8 million hectacres (83.6 million acres)	National Parks Service (Department of Interior)	Hiking, camping , boating, fishing and other recreation; commemoration of historical sites. In some areas, hunting and mineral extraction are permitted.
National Wildlife Refuges	34 million hectacres (84 million acres)	U.S. Fish and Wildlife Service (Department of Interior)	Wildlife conservation, recreational activities, breeding areas for commercial fish, educationa dn scientific research. On some refuges, hunting, fishing mining for oil and gas, livestock grazing, and farming are permitted.
National Resources Lands	130 million hectacres (321 million acres)	Bureau of Land Management (Department of Interior)	Recreation, wildlife conservation, and industry such as livestock grazing or mining.
National Forests	76 million hectacres (188 million acres)	U.S. Forest Service (Department of Agriculture)	Recreational and commercial uses such as logging, grazing, and mining. Sometimes the land is leased for use as ski resorts or similar ventures.
Indian Reservations, Military Installations, etc.	29 million hectacres (72 million acres)	Bureau of Indian Affairs, Department of Defense, and others	Indian reservations: recreational and commerical uses such as farming, logging, grazing, and mining. Military installations: firing ranges, troop maneuvers, dumping ground from old military vehicles.

Notes

The Water Facts Of The Matter

Grades:
9-12

Subject:
Physical Science, Geography

Time Needed:
50 minute class period

Materials:
Wonder Water Fact Sheet to accompany Alabama Water Facts Activity Sheet

OBJECTIVES:

Students will be able to:
1. Read printed material from charts.
2. Demonstrate effective use of reference material and research skills.
3. Demonstrate an understanding of water facts for Alabama.

BACKGROUND:

Alabama is one of the leading states in water resources, which are used for work (navigation, power production), play (swimming, skiing, fishing, boating), drinking, food production (irrigation), tourism, and real estate development. Many Alabamians do not know a lot about, or value, their water resources. This activity presents water facts and improves understanding and appreciation of Alabama's bountiful water resources. The climate in Alabama is humid and subtropical with mild winters and hot summers. Average annual temperatures range from 58° in northwestern Alabama to about 68° in southwestern Alabama. Rainfall in Alabama usually is abundant and is distributed throughout all months of the year. Very little snow falls in Alabama in normal years.

VOCABULARY:

perennial, reservoir, wetlands, streamflow, navigable, barge, wastewater, intermittent streams, watercraft, runoff, groundwater, pumpout systems

PROCEDURE:

1. Have students complete the worksheet and then engage in a discussion of the facts. (See Alabama Water Facts.)

EVALUATION:

1. Research the impact of lack of rainfall in Alabama, particularly during the growing season.

EXTENSION:

1. Research how many marinas have pumpout stations for the boats in Alabama and determine what type of pumpout systems they are using. Have the students determine the amount of boating traffic at the marinas that require pumpout service.

Name: _____

Alabama Water Facts

1. _____number of boats in use in Alabama
2. _____total number of miles of rivers or streams
3. _____miles of ditches and canals
4. _____amount of drainage water flowing into Mobile Bay
5. _____approximate number of people in Alabama
6. _____miles of Gulf Coast shoreline and beaches
7. _____acres of wetlands
8. _____percentage of Alabama streams meeting requirements
9. _____number of state parks
10. _____minimum water depth for use by barges
11. _____number of hydroelectric power production plants
12. _____number of lakes, reservoirs, and ponds
13. _____amount of water used each time a lock is operated
14. _____square miles of estuaries
15. _____number of times a drop of water entering Alabama can be reused
16. _____range of average rainfall in Alabama
17. _____number of navigable river miles in Alabama

Alabama Water Facts (Answers)

Alabama has:

14 river basins
77,242 total miles of rivers and streams
47,072 miles of perennial rivers and streams (7th nationally)
30,170 miles of intermittent streams
32 miles of ditches and canals
43 lakes, reservoirs, and ponds (excluding farm ponds)
563,000 acres of ponds, lakes, and reservoirs (14th nationally)
3,627,600 acres of freshwater wetlands (24th nationally)
27,600 acres of coastal wetlands
610 square miles of estuaries
50 miles of Gulf Coast shoreline and beaches

1. The average annual rainfall in Alabama ranges from 48 to 68 inches with only approximately 22 inches draining from the land to form the state's rivers and streams.
2. The average streamflow of all streams entering this state is 60,341 cubic feet per second (38,980 million gallons per day) while the average streamflow of streams leaving the state is 134,793 cubic feet per second (87,076 million gallons per day).
3. Sixty-three percent of all streamflow (drainage) in Alabama flows into Mobile Bay.
4. Fifty-six percent of Alabama's 4.0 million people drink water obtained from lakes and streams. Forty-four percent drink water from wells.
5. Alabama has 21 hydroelectric power production dams.
6. Alabama has 17 state parks that provide recreational use of Alabama's waters.
7. A drop of water entering Alabama from other states can be reused up to 25 times before leaving the state.
8. Alabama has more miles of navigable streams (1,438 miles) than any other state. Seven of the 14 river basins have navigable rivers.
9. Alabama's navigable rivers must be nine feet deep and 100 to 300 feet wide before use by barges is possible.
10. Locks are structures at dams that allow raising or lowering of barges and other watercraft from one level to another. Each time a lock is operated, 15 to 45 million gallons are needed.
11. More than 250,000 boats use Alabama's water.
12. Fishing is important in Alabama and popular in the state's 38 major lakes and 23 fishing lakes.
13. There are 275 towns and cities that discharge 435 million gallons per day of treated wastewater to Alabama's rivers and streams.
14. There are 548 industries that discharge 8,168 million gallons per day of treated wastewater to the state's rivers and streams.
15. President George Bush established the Clean Vessel Act of 1992 to improve water quality.
16. The Clean Vessel Act provides funds for the construction, renovation, operation, and maintenance of pumpout stations and waste reception facilities, as well as education programs, to improve water quality. "Pumpout stations" are facilities at some marinas by which boaters can pump on-bouard sewage into proper receprtacles for disposal instead of emptying the sewage into a lake or river.

Notes

Alabama's Public Lands

Grades:
9-12

Subjects:
Social Studies, Environmental Science, Math

Time Needed:
45-60 minutes

Materials:
One Alabama road map per student
Alabama State Park booklets

OBJECTIVES:

Students will be able to:
1. Name five state parks.
2. Name one federal land.
3. Distinguish between public and private lands.
4. Locate places on a road map.
5. List examples of responsible citizenship.

BACKGROUND:

The purpose of this activity is to teach the differences between public and private lands and to familiarize students with the public lands in Alabama.

The main difference between private and public lands is ownership. Private lands, of course, are owned by private individuals, businesses, corporations. Public lands, on the other hand, are owned by the people through the government. It may surprise some students that they are owners of the property. These lands are paid for by taxes based on the level of government (local, state, federal) that is in charge of the property.

As property owners, it is important for citizens to take responsibility for their land. Thus "ownership" requires responsibility, and students should think about this responsibility.

VOCABULARY:

public land, private land, estuarine

PROCEDURE:

Setting the Stage
1. Write the words "public lands" and "private lands" side by side on the board. Define and write the definition under each.
2. Ask the students for examples of each and add them to the list on the board. Add additional examples if needed.
3. Ask the students to compare and contrast the two lists.

Activity
1. Give each student a road map of Alabama and allow time to look over the map. Use this time to assess their degree of map skills, and supplement those skills if needed.
2. Discuss the legend and key, and locate examples of each.
3. Point out the major roadways, cities, and rivers.
4. When all students have completed the exercise (provided), go over the answers, and have the students locate each place mentioned.
5. Locate as many examples of different types of public lands as possible. See if one example for each of those listed under "public lands" can be found.

Follow-Up

1. Lead the class in a discussion of responsibility of public property. Who makes the decisions? How are priorities determined? Does everything that should be done get done? Why or why not? What should and should not be included in a park? What laws govern public lands? Who works at public places?
2. Continue with discussion of the responsibilities of individual citizens. Make a list of these.
3. Let the students share experiences from having visited public lands.

EVALUATION:

1. Students will take a written test on the material covered.
2. They also will design a "perfect" public land. (This can be any type of public land—parks, forests, monuments.) To design the public land, they must submit the following:
   - A mission statement (What is the purpose? Why is it here?).
   - A list of goals.
   - A set of rules and regulations.
   - A map of the entire area.

EXTENSIONS:

1. Assign one or several students one of Alabama's public lands, and have them investigate and report to the class.
2. If possible, take the students on a field trip to a public land, and them complete a service project while there.
3. Let students interview employees of a public land, such as forest or park rangers, and report to the class on their job responsibilities, the problems they see facing public lands, what they wish the public knew about lands. (Or bring the official into class as a guest speaker.)
4. Let the students figure mileage and cost of gasoline to get from place to place.
5. Let the students plan a vacation to the public land of their choice. Include expenses and activities.
6. Have students research Forever Wild and other programs that allow the State of Alabama to buy land for the natural preservation of wetlands, bottom land hardwood forests, and other valued resources.

ORIGINAL DEVELOPMENT RESOURCES:

Alabama State Parks (1-800-ALA-PARK): www.dcnr.state.al.us.

U.S. Department of Interior: www.doi.gov

U.S. Department of Agriculture: www.usda.gov

Alabama's Public Lands
Crossword Puzzle

Word Bank:

Talladega	Golf	Russell	Estuarine
Bon Secour	Mound	Rickwood	Chattahoochee
Pier	Birmingham	Tennessee	Capitol
Sixty-five	Bankhead	Lakepoint	Wetlands
Florala	Guntersville	NASA	Chickasaw
Clio	Lurleen	Opp	Gulf
Wheeler	Desoto	Canyon	Cheaha
Martin	Chewacla	Pets	Farm

Alabama's Public Lands
Crossword Puzzle

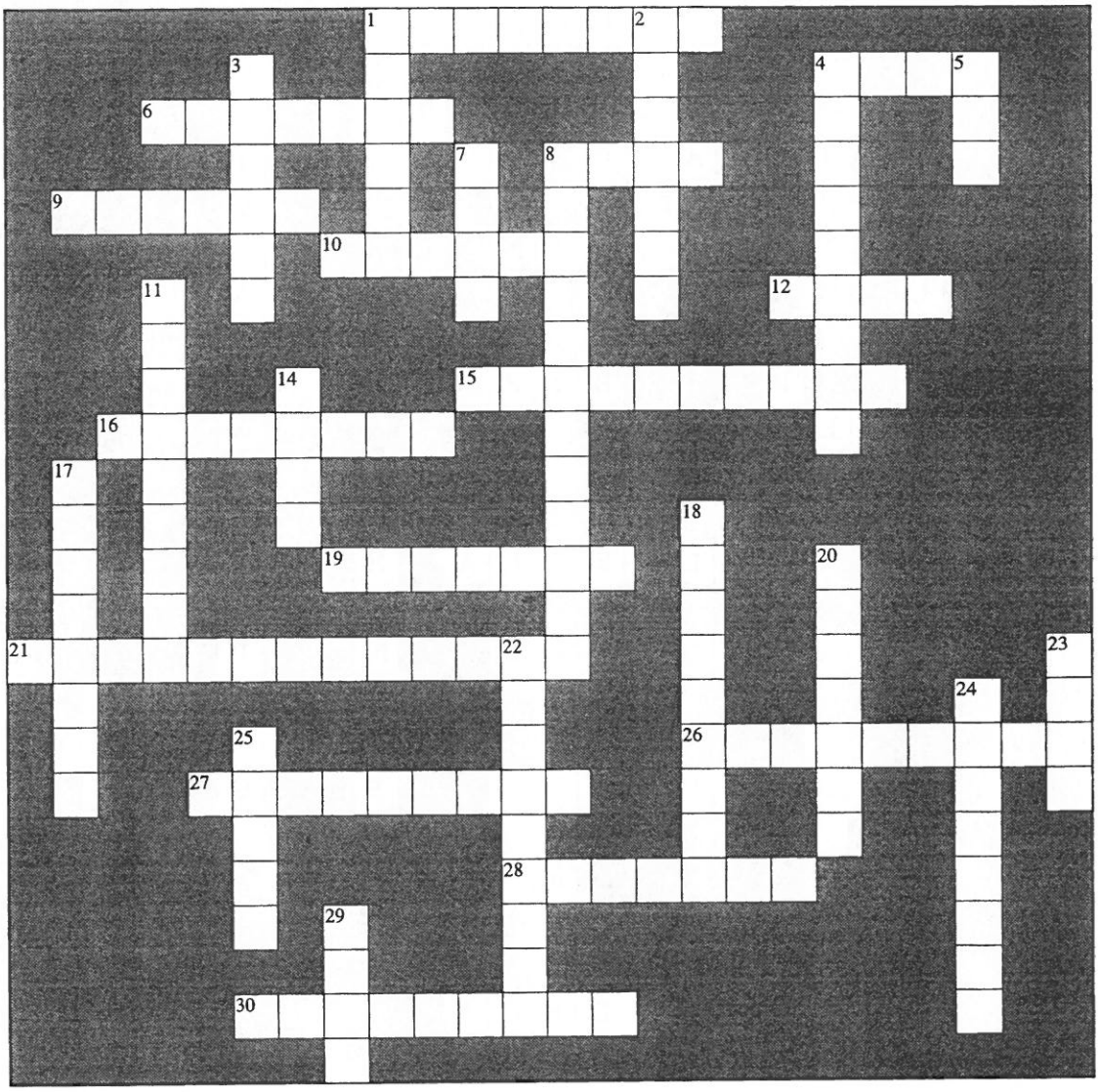
ACROSS

1. You might stay at this state park when you go to an Auburn football game.
4. Blue Springs State Park is located near the city of _____.
6. "Fighting Joe _____," a Confederate general, is for whom a large state park is named.
8. If you want to walk along a sandy beach, _____ State Park is the place.
9. The deepest _____ east of the Mississippi River can be seen when visiting DeSoto State Park.
10. Wind Creek State Park is located along the shores of Lake _____.
12. While staying at Monte Sano State Park, you also could visit this important space agency.
15. Oak Mountain State Park is located near Alabama's largest city, which is _____.
16. Meaher State Park is a good place to study the _____.
19. Which state park combines the names of two states?
21. This park is named for an important river, which is located nearby.
26. To get to Rickwood Caverns State Park, you would drive on Interstate _____.
27. _____ is a national wildlife refuge located in south Alabama.
30. Mt. Cheaha State Park is located in this national forest.

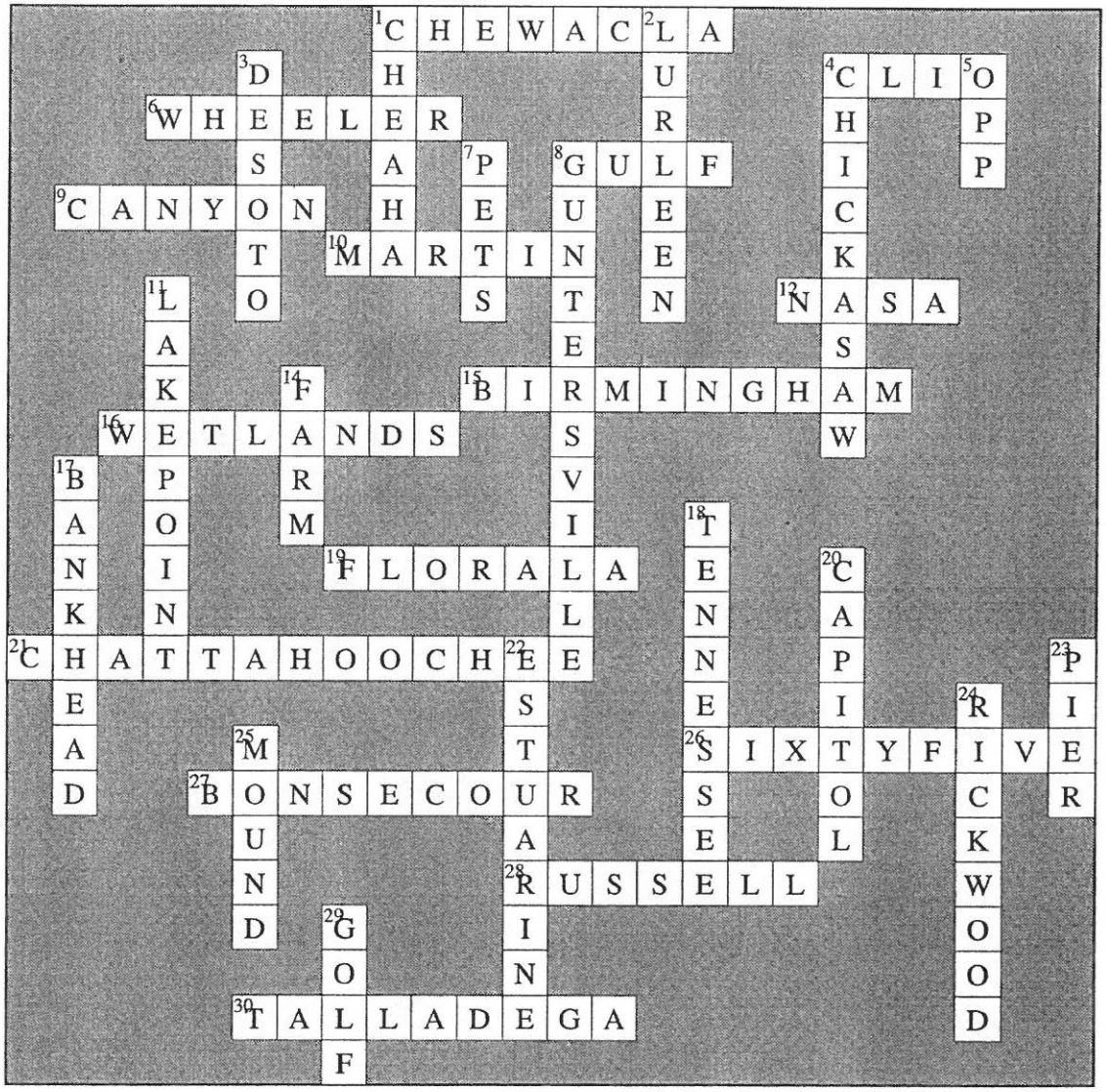
DOWN

1. This state park is located atop the state's highest mountain.
2. Lake _____ State Park was named for Alabama's only woman governor.
3. One state park is named for a famous Spanish explorer. Which one?
4. Which state park is named for one of the major Native American tribes in Alabama?
5. Frank Jackson State Park is located near the town of _____.
7. You should not see these in Alabama state parks.
8. This state park is one of the winter homes of our national symbol.
11. This state park is located on the "bass capital of the world."
14. You could enjoy this _____ at Oak Mountian State Park.
17. The Sipsey Wilderness is located in this national forest.
18. Lake Guntersville is located on this river.
20. The _____ of Alabama is Montgomery and the location of many important state buildings.
22. Weeks Bay is the state's only National _____ Reserve.
23. Gulf State Park has something that is 825 feet long. What is it?
24. Blind fish inhabit this state park.
25. _____ State Monument was set aside to protect important Native American relics.
28. This is one of the many recreational activities at Alabama state parks.

Alabama's Public Lands
Crossword Puzzle



Alabama's Public Lands
Crossword Puzzle (Answers)



Chain Gang

Grades:
9-12

Subjects:
Biology, Environmental Science

Time Needed:
One class period

Materials:
calculators
life science and biology texts and other reference materials

OBJECTIVES:

Students will be able to:
1. Construct a salt marsh food chain using organisms indigenous to Alabama.
2. Compute the amount of energy available to each order of consumers.

BACKGROUND:

When an organism eats, sleeps, walks, or performs any other daily activity, it is using energy. This energy must be replaced if the organism is to survive. In almost all ecosystems, the initial source of energy is supplied by the sun to the plants in the ecosystem. Light energy from the sun is transformed into usable energy (food) by the photosynthetic activity of autotrophs. As energy flows through the ecosystem, it can be separated into two channels: production and respiration. Through production, the energy is used in growth to create new tissues; while during respiration, the energy is lost permanently to the ecosystem. Since all living organisms respire, the loss of energy through respiration is very high.

The energy that is not lost through respiration is passed through the ecosystem. One can separate the organisms into different trophic levels: producers, herbivores, and carnivores. Herbivores feed almost exclusively on plants, while carnivores feed on other animals. With energy loss in every step between the trophic levels, many producers are needed to support fewer herbivores, which support even fewer carnivores.

The loss of energy from one level in a food chain to the next can be shown in a pyramid of energy (See included diagram.) The base of the pyramid consists of producers. Consumers make up each of the other levels. The size of each level represents the amount of energy available at each level.

VOCABULARY:

ecosystem, respire, herbivores, carnivores, trophic levels

PROCEDURE:

1. Using life science books, biology books, and/or encyclopedias, construct a salt marsh food chain indicating organisms that are producers, first-order consumers, second-order consumers, and third-order consumers.
2. Complete the food chain pyramid by labeling each level with appropriate organisms from your food chain.
3. As energy moves upward in the pyramid, only 9% of the energy is available to the next level in the pyramid. Assume that your chain has 10,000 kilocalories of energy available to plants (producers)..
4. Determine the amount of energy available to each order of consumers.

EVALUATION:

1. Diagrams and pyramids may be graded for content and creativity. Arithmetic calculations can be checked for accuracy.

EXTENSIONS:

1. How to feed the world's human population is becoming a major concern. Consider two types of human diets: one that consists almost completely of plants and one that consists mainly of meat. Which type of diet would better meet the food/energy needs of the world's population? Explain your answer.

ORIGINAL DEVELOPMENT RESOURCES:

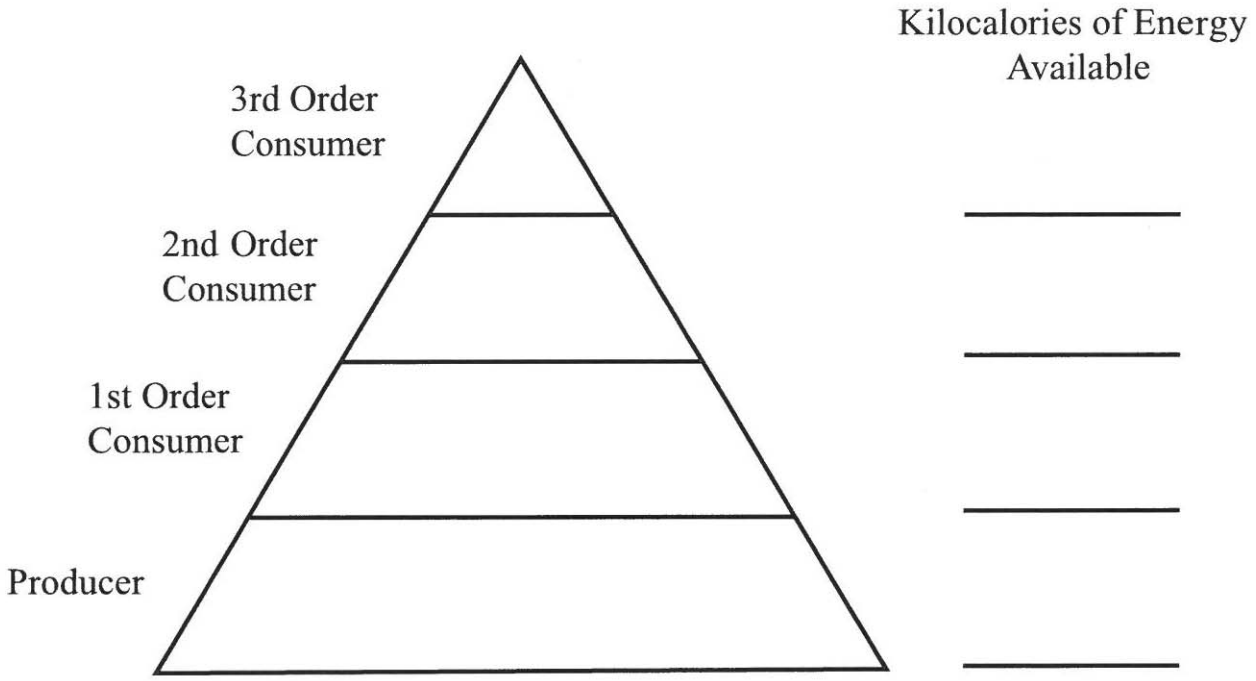
Discovering Alabama - Wildlife History. Videotape. www.discoveringalabama.com. May be obtained by writing Discovering Alabama, Box 870340, Tuscaloosa, AL 35487.

www.planetpals.com/foodchain

Animals for Food Chain Diagram

Alligator
Atlantic stingray
Bald eagle
Black skimmer
Blue crab
Brown pelican
Common egret
Cormorant
Cottonmouth moccasin
Diamondback terrapin
Fiddler crab
Field cricket
Flounder
Ghost crab
Great blue heron
Great horned owl
Green anole
Hermit crab
Horseshoe crab
Jellyfish
Kingfisher
Laughing gull
Marsh hawk
Marsh periwinkle
Mosquito
Osprey
Oyster
Possum
Raccoon
Red drum
Sandpiper
Shark
Sheepshead minnow
Shrimp
Snapping turtle
Snowy egret
Spotted sea trout
Striped mullet
Swamp rabbit
Toadfish
Wharf crab
Whelk

Food Chain Diagram
(Draw And Label Organisms)



Check It Out

OBJECTIVES:

Students will be able to:

1. Describe the groundwater contamination problem.
2. Research local underground storage tank facilities and discuss the differences in their operations.
3. Simulate, in class, an inspection of an underground storage tank facility.

Grades:
9-12

Subjects:
Biology, Physical Science, Environmental Science, Social Studies

Time Needed:
30 to 90 minute class period

Materials:
pen
paper

BACKGROUND:

Inspection of underground storage tanks (USTs) is one way of protecting our nation's groundwater. Groundwater is the most common source of clean drinking water known to humans. Groundwater contamination, in most cases, is very expensive to correct and, in many cases, is impossible to correct. Therefore, prevention is critical.

Federal, state, and local governements are able to oversee the operation of these facilities through regulatory inspections. Regulatory inspections cover a variety of operation procedures that owners and operators must follow: registering all active underground storage tank systems with the proper agency; recording and maintaining inventory records for petroleum input and output for each day of system operation; and meeting leak detection requirements for both tanks and piping by choosing an appropriate method, depending on the size and type of tank systems (See diagram). The last two requirements, which are corrosion protection and spill/overfill equipment, apply to underground storage tank systems that have been installed since December 1988 as well as any new or proposed installation to be installed in the future.

Most inspections indicate that owners and operators are aware of the rules, but the finer details of compliance are simply overlooked. That is where the inspector's job comes in. Advising, reviewing site-specific characteristics, and clarifying any rules and regulations are key roles in monitoring USTs. Being familiar with their local facilities might encourage people to have an active concern about their health and the protection of the environment for years to come.

VOCABULARY:

corrosion, groundwater, inspection, inventory, pressurized, record, suction, underground storage tank

PROCEDURE:

Setting the Stage

1. Read the background information aloud to the class.
2. Provide the students with access to a drawing or diagram showing pathways to groundwater pollution. (One such drawing is the Pathways to Groundwater Pollution Figure on Legacy's "Alabama's Water Resources Poster.")
3. Provide students with a copy of the background information and have them divide into groups of four for discussion.
4. Have the students participate in a question-and-answer session.
5. Have the students discuss the prevention of groundwater contamination versus cleanup. Which is more difficult? Which costs more? Is cleanup always possible?

Activity

1. Have the students create a checklist and include the following:
   - Number of tanks.
   - Inventory records (Y/N).
   - Method of leak detection (tank or piping).
   - Type of piping (pressurized or suction).
   - Corrosion protection (if applicable).
   - Spill/Overfill equipment (if applicable).
2. Determine if the checklist indicates compliance based on background information. (Compliance can be distinguished by whether or not each of the answers on the checklist is marked if applicable.)

EVALUATION:

1. Have the students research their neighborhood gas stations and ask some of the same questions from their checklist.
2. Once students have completed their neighborhood inspections, have them compare the differences between the types of gas stations in that area.

EXTENSION:

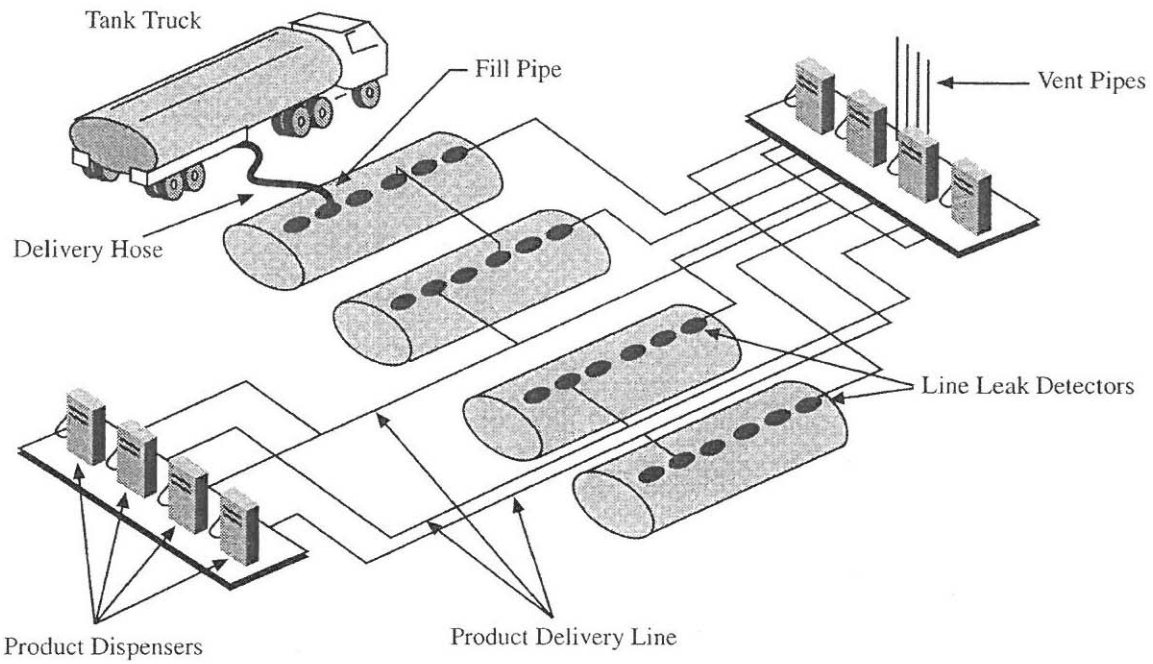
1. Additional research can be done to determine if old tanks have been removed from former service station sites.

ORIGINAL DEVELOPMENT RESOURCES:

Operating and maintaining underground storage tank systems, help and checklists. (2002) The Alabama Department of Environmental Management. 1400 Coliseum Blvd. Montgomery, AL 36110. www.adem.state.al.us.

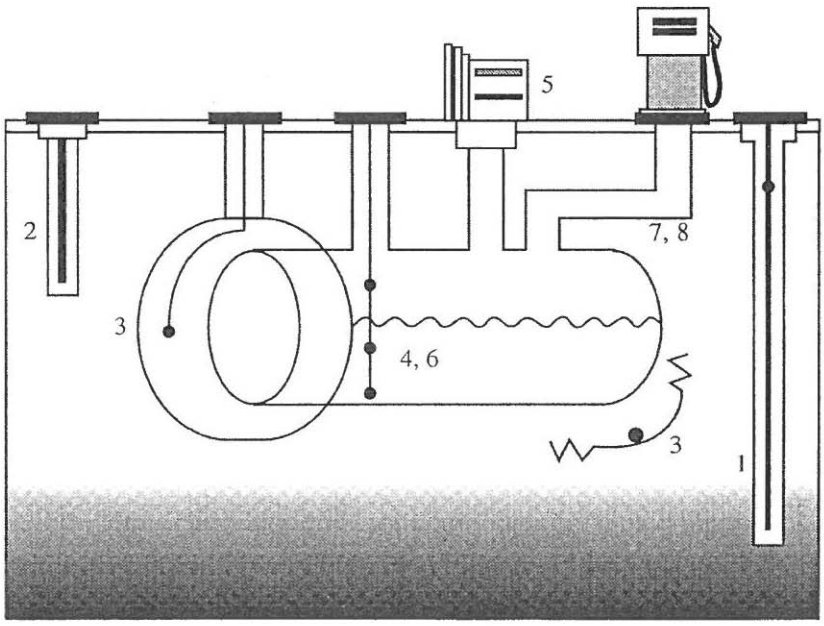
"Alabama Water Resources" poster, Legacy, Inc. P.O. Box 3813, Montgomery, AL 36109, www.legacyenved.org, 1-800-240-5115.

A Typical Tank Facility



Leak Detection Methods for Tanks and Piping

1 Ground-Water Monitoring
2 Vapor Monitoring
3 Secondary Containment with Interstitial Monitoring
4 Automatic Tank Gauging Systems
5 Tank Tightness Testing and Inventory Control
6 Manual Tank Gauging
7 Leak Detection for Underground Suction Piping
8 Leak Detection for Pressurized Underground Piping



Notes

Designer Streams

Grades:
9-12

Subjects:
Chemistry, Physics, Environmental Science, Biology, Art, Geography

Time Needed:
One 50-minute period

Materials:
pencils
colored pencils

OBJECTIVE:

Students will be able to:

1. Describe the importance of stream water quality and beautification in their area.

BACKGROUND:

Often, improvements can be made to streams to offset human impacts and to improve water quality.

Many towns and cities have made scenic improvements to high-exposure, urbanized streams; and streams often have been improved through various volunteer and cost-share programs. Techniques that have been used to improve streams include (1) adding rock weirs or lowhead dams for aeration, (2) constructing erosion barriers to stop siltation, (3) installing stream-side management zones by planting appropriate vegetation, and (4) planting trees for shading. Many other techniques, such as targeted upgradient improvements and stormwater controls, also are used.

All of the above actions have positive cost-benefits. Nonetheless, they are typically done only after stream assessment studies that include analyses of the cost-benefit ratios of various actions. Government funding for improvements generally is dependent on a favorable cost-benefit ratio. Many of the benefits are aesthetic and thus are very difficult to assign an economic value to. Benefits often extend beyond aesthetic and water quality into economic benefits, since businesses will go where people go; and people will move to clean, environmentally appealing areas.

VOCABULARY:

substrate, embeddedness, water quality, weir, debris

PROCEDURE:

1. Students should visit a stream in the area. Using the Student Information Sheet as a guide, students will complete the lab sheet and drawings. One drawing will consist of a present-day stream in the area. The second drawing will consist of improvements that would enhance its beauty and would improve water quality.

EVALUATION:

1. Have students complete the Student Lab Sheet.

EXTENSIONS:

1. Have a “Designer Stream” contest that allows students to construct models of their improved streams.
2. City officials could act as judges with the winning model then submitted to local government as a guide toward enhancing the stream.
3. Have the class join the Adopt-A-Stream Program sponsored by ADEM.

ORIGINAL DEVELOPMENT RESOURCES:

Information on water quality. The Alabama Department of Environmental Management (ADEM) 1400 Coliseum Blvd., Montgomery, AL 36110: www.adem.state.al.us.

Alabama Water Watch, 203 Swingle Hall, Department of Fisheries, Auburn Univeristy, Auburn, AL 36849, 1-800-844-4785.

Alabama Rivers Alliance: www.alabamarivers.org.

Arello, G. (ed.) *Alabama the river state*. (1998) Birmingham, AL: Natura Press.(available through the Office of Water Resources, Alabama Department of Economic and Community Affairs.

Student Information Sheet

Read the following stream characteristics. They will provide helpful information for completing the lab sheet.

HOW TO CHARACTERIZE THE SETTING: The setting is the land area immediately adjacent to or visible from the stream bank. Think in terms of perhaps 1/4 mile on either side of the stream channel. In other words, what kind of land does the stream flow through? If one (or more) of the land uses is dominant, place a "D" in the appropriate box(es). If a land use is present in small areas, place an "X." Use the blank spaces to fill in other land uses.

STREAMBANK CHARACTERISTICS
Left Bank (facing upstream) or Right Bank (facing upstream)

Sketch a segment of the river stream bank and corridor; indicate the location of the sample site. (NOTE: any unusual observations.) Sketch a bird's eye view of the stream segment containing your sample site. Circle the arrow that indicates the direction in which the current is flowing. Sketch as much of the segment as you can see from the bank, upstream and downstream of the site. Note any observations you think are important.

SUBSTRATE COMPOSITION: What is the stream bottom made of? Look at a 3-4 ft. band of streambed across the stream (transect). Check the percentage of the bottom that is composed of different materials.

EMBEDDEDNESS: Embeddedness is the percent surface area of larger particles (boulder, rubble, or gravel) surrounded or covered by fine sediment (sand or silt). This fine sediment can clog up spaces where aquatic organisms would otherwise live.

OVERHEAD CANOPY: What percentage of the stream width is covered or shaded by overhanging grasses, shrubs, and trees? This shading plays an important role in keeping the water cool in the heat of the summer.

NOTES: In your suggestions for changing the stream to enhance its natural beauty and improve water quality, include the stream location.

Name: _____

Student Lab Sheet

Creek or Stream: _____ Segment Studied: _____

1. How would you characterize the setting? Place a "D" for Dominate and "X: if Present (otherwise leave blank).

Roadless Wooded Area		Cropland		Dairy Farm		Scattered Residential	
Wooded Area with Roads		Grazing Pasture		Park Area		Village or Urban	
Woodlot Logging Area		Ungrazed Meadow		Golf Course		Commercial/ Insustrial	
Other (Specify)							

STREM BANK CHARACTERISTICS

2. What are the characteristics of the left bank (facing upstream)?
   a. Shrubs ___% Grass ___% Trees ___% Unvegetated ___%
   b. Is the left bank unstable or eroding into the stream?

3. What are the characteristics of the right bank (facing upstream)?
   a. Shrubs ___% Grass ___% Trees ___% Unvegetated ___%
   b. Is the right bank unstable or eroding into the stream?

4. Sketch a segment of the river stream bank before your improvements are made and after your stream improvements are implemented.

Before	After

SUBSTRATE COMPOSITION

5. What is the composition of the streambed in the are of your sample?
   Bedrock ___% Boulder ___% Rubble ___% Gravel ___% Sand ___% Silt ___%
   Organic Debris: >10" ___ 2-10" ___ .01-2" ___ <.01" ___

EMBEDDEDNESS

6. What is the percentage of surface area of larger particles (boulder, rubble, or gravel)?
   >5% ___ 5-25% ___ 25-50% ___ 50-75% ___ <75% ___

OVERHEAD CANOPY

7. What is the percenteage of stream width covered by overhanging grasses, shurbs, and trees?
   >5% ___ 5-25% ___ 25-50% ___ 50-75% ___ <75% ___

Journey To The Center Of A Tree

OBJECTIVES:

Students will be able to:

1. Measure the diameter and circumference of the cross section of a tree.
2. Identify and explain similarities and differences in tree rings.
3. Create a time-line on a tree cross section.

BACKGROUND:

People record events through oral stories, physical monuments, and written accounts. History helps us learn about the present—where we are today—by looking at what happened in the past. (Teachers should give an example of relevant historic/current perspectives relative to the age, location, and issues of students.)

In order to interpret the history of a particular tree, one must first look at the method a tree uses to record its history. A tree records "memories" within the structure of its trunks. Everything that impacts upon the tree throughout its life — from insects, cars, or disease to heat, nutrients, or flooding— will leave a mark. Trees can be used as bio-indicators. Environmental factors, such as drought, pollution, and fire, usually can be detected through analysis of sap, wood, and leaves. Impact may be positive, resulting in rapid growth or negative, resulting in slower growth.

A tree records its growth in its rings. Rings are a function of temperate zone seasonal changes—trees growing in the tropics do not have annual growth rings because their growth is fairly constant. A growth ring usually appears each year in dry weather with the outer growth rings being the most recent. When growth rings are very close together, the tree grows very slowly. When rings are widely spaced, the tree grows very quickly. This comparison should be used only when comparing the same species of trees.

Grades:

9-12

Subjects:

Botany, Biology, Environmental Science, Geometry, Social History, Natural History

Time Needed:

Two 40-minute class periods (minimum)

Materials:

A cross section of a tree or a core sample of a tree. A tree (or limb) cross-section usually can be obtained from a local tree-trimming service, forest industry, or utility company that is clearing or trimming trees from power or telephone lines. Other resources include your state or county Department of Natural Resources, Forestry, or Extension Service. Tree "cookies" can be obtained from a local paper company or forestry department. Sample pictures of tree cores can be included.

The trunk is the arterial system—like our arteries and veins—that transports material to the leaves in the outer layers of the tree trunk and inner layers of the bark. Just beneath the bark is the cambium, the "cell factory" of the tree. Cells that form outward from the cambium layer develop into the phloem (the layer of tissue that transports food up and down the trunk) and the bark. Cells that form inward from the cambium become xylem, or sapwood, which conducts water up and down the trunk.

As the tree grows outward, older xylem stops its transport function and becomes heartwood. In some cases, this heartwood actually may rot away completely, leaving a perfectly hollow tree with only the living outer rings performing all the necessary vital functions of the trunk. It is here in the outer layer of wood that, in a large tree, hundreds of gallons of water and nutrients are sucked up from the roots, and a great amount of sugar-laden sap is pushed down from the leaves in a pump-like action. This massive flow of fluids makes the tree the largest vascular creation on the planet.

A tree grows upward much like adding an ice cream cone to an extending stack of other cones. A branch that grows out of the trunk at a height of four feet from the ground certainly will grow in diameter, as will the trunk itself; but the branch will remain the same distance from the ground for the duration of the tree's life. The same goes for injuries, whether they are initials carved on a tree trunk or slashes from a mower. Trees overcome injuries and fight infections by sealing off the affected part. Whether wounded by a badly pruned branch or the attack of a bark beetle, a tree will carry its scars for the rest of its life.

VOCABULARY:

phloem, xylem, cambium, sapwood, board foot

PROCEDURE:

1. Obtain a cross section or core sample of a tree.
2. Measure the diameter and circumference of the cross section. Discuss how the circumference of the tree relates to its age and growing conditions. Calculate the surface area of the cross-section ($A=Cr^2$).
3. Identify similarities and differences in sizes of, and spaces between, tree rings. Discuss possibilities for these differences.
   - What do you think widely spaced growth rings mean for the tree?
   - What natural factors might have affected the tree's growth?
   - What man-made factors might have affected the tree's growth?
4. Have students create a time-line for the life of the tree. Start with an estimate of when the tree germinated (when it began to grow from a seed) and continue to the current date. Charting the time lines in five-year increments may be sufficient if the tree is relatively old.
5. Include memorable points along the time-line, relative to the student's point of view: birth dates, year began school, year the town or community was settled, year the state entered the union, year of the first presidential election they remember.

EVALUATION:

1. Present findings to the class. Have students quiz their classmates on the information presented.

EXTENSIONS:

1. Display the findings in a central location of the school.
2. Invite a person from a paper company or the logging industry to speak to the class.
3. Find out what wood or paper products are made at the paper plant in the area.
4. Make a list of the paper products you use each day.
5. Estimate what percentage of your home is made from wood.
6. List all the wooded furniture in your house/classroom.
7. Call a lumberyard or home improvement store. Find out the cost of different types of lumber per board foot.
8. Find the largest tree on the school campus and in the neighborhood. Measure its circumference.
9. Call the Alabama Forestry Commission and ask for a champion tree list for the state and counties.

ORIGINAL DEVELOPMENT RESOURCES:

Adapted from the *Growing Greener Cities* Education Guide, used with permission.

Alabama Forestry Commission, 513 Madison Avenue, P.O. Box 302550, Montgomery. AL 36130-2550. www.forestry.state.al.us.

Alabama Forestry Association, 555 Alabama Street, Montgomery, AL 36104, (334) 265-8733.

Alabama Trees. Discovering Alabama videotape. www.discoveringalabama.com

Lakes And Dams of Alabama

OBJECTIVES:

Students will be able to:

1. Demonstrate an understanding of the major and diverse efforts of people to control and use natural resources to their advantage.
2. Appreciate the system of man-made lakes in Alabama.

Grades:
9-12

Subject:
Biology, Environmental Science, History, Math

Time Needed:
One class period

Materials:
Alabama highway map (published and distributed by the Alabama Bureau of Tourism and Travel, 401 Adams Street, Montgomery, AL 36104-

BACKGROUND:

Although Alabama has no large natural lakes, the state is fortunate to have vast constructed lakes that provide recreational navigation and hydroelectric power. The three major builders of Alabama's lakes are the Alabama Power Company, a subsidiary of the Southern Company; the U.S. Army Corps of Engineers; and the Tennessee Valley Authority, the last two of which are under the jurisdiction of the federal government. The facilities of TVA are located on the Tennessee River and the Bear Creek rivers. Alabama Power Company has constructed dams on the Tallapoosa River, Coosa River, and the Black Warrior River. The Army Corps of Engineers has constructed dams on the Black Warrior, Tombigbee, Alabama, and Chattahoochee Rivers. Smaller electricity generating companies have built lakes on other rivers around the state. Many Alabamians enjoy the recreational opportunities offered by these lakes.

VOCABULARY:

reservoir, hydropower, navigation, locks, lakes

ADVANCE PREPARATION:

1. Make a transparency of "Alabama Rivers" map and copy the "Alabama's River-based Lakes" and "Alabama Rivers" for each group.
2. Obtain enough Alabama highway maps for groups of students.

PROCEDURE:

1. Show the transparency of "Alabama Rivers". Discuss the number of rivers and streams in the state. Relate how lakes are formed from rivers and stream. Locate the ones nearest the community.
2. Discuss how energy is obtained from rivers for electrical power and how locks and lakes are used for navigation in Alabama.
3. Give a highway map to each group of students. Ask them to locate the major rivers.
4. Using the highway map, ask students to label and highlight the major rivers on their copy.
5. Now ask students to locate the major lakes in Alabama on the highway map.
6. Using "Alabama's River-based Lakes," have students locate each lake and its associated river on the highway map. Calculate the length of each river using the scale of miles. Research who the developer of the lake was.
7, Discuss interstate water concerns between Alabama, Georgia and Florida. Contact the Alabma Rivers Alliance (www.alabamarivers.org) for current status and information.

EVALUATION:

1. Locate the lakes listed on “Alabama’s River-based Lakes” and their associated dams on the map.

EXTENSIONS:

1. Have a speaker from the Alabama Power Company, TVA, or Army Corps of Engineers speak to the class.
2. Find out the approximate amount of water in each lake.
3. Write and request brochures about lakes that are designated as recreational.
4. Find out the purpose(s) of the dams (irrigation, hydroelectric power, recreation).

ORIGINAL DEVELOPMENT RESOURCES:

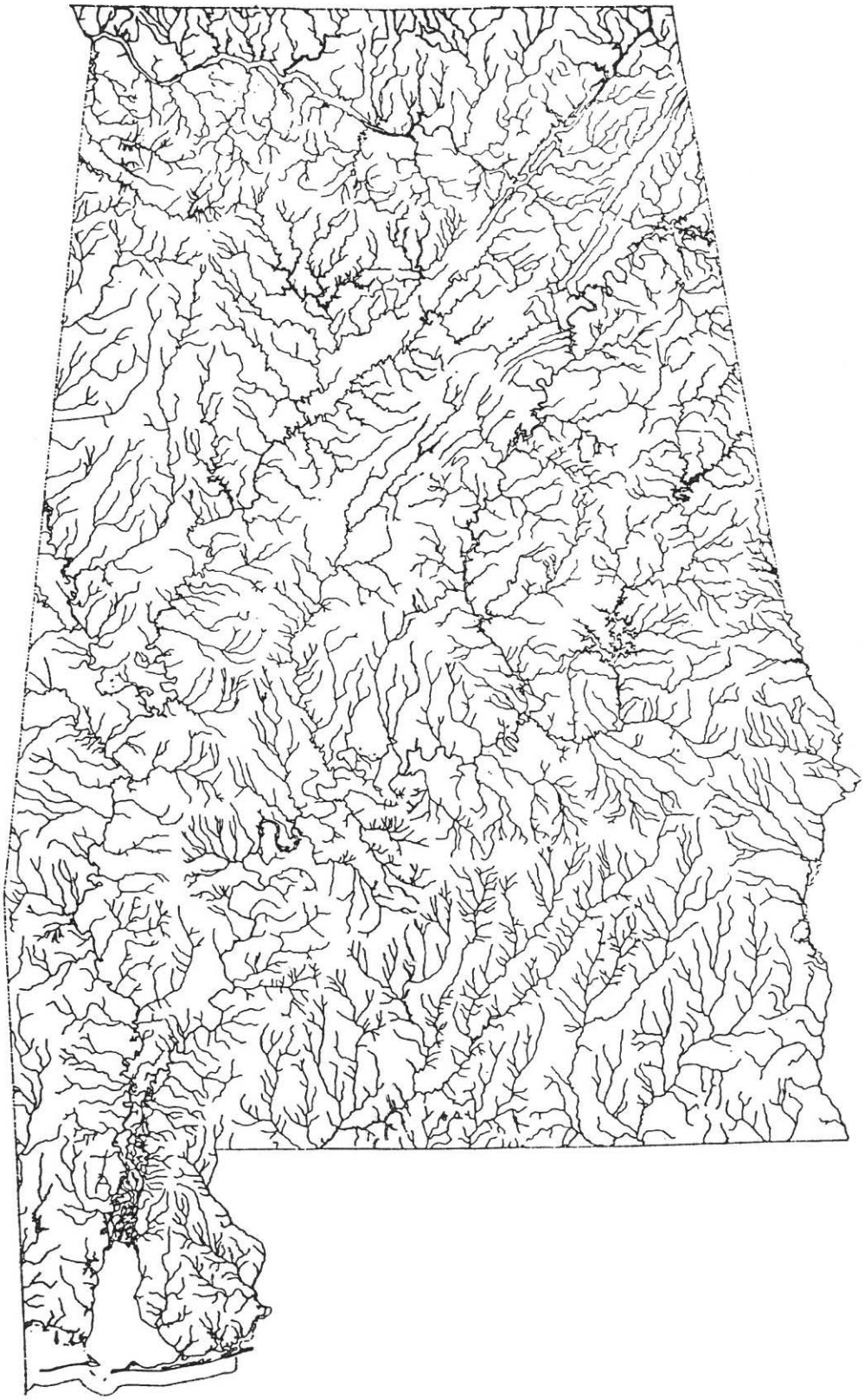
“Alabama Water Resources” poster, Legacy, Inc. P.O. Box 3813, Montgomery, AL 36109, www.legacyenved.org, 1-800-240-5115.

Alabama's River-based Lakes

Lake	River	Length	Developer
Wilson	_____	_____	_____
Smith	_____	_____	_____
Pickwick	_____	_____	_____
Wheeler	_____	_____	_____
Eufaula	_____	_____	_____
Weiss	_____	_____	_____
Martin	_____	_____	_____
Tuscaloosa	_____	_____	_____
Harris	_____	_____	_____
Jordan	_____	_____	_____
Bouldin	_____	_____	_____
Logan Martin	_____	_____	_____
Guntersville	_____	_____	_____
Lay	_____	_____	_____
Aliceville	_____	_____	_____
Demopolis	_____	_____	_____
Holt	_____	_____	_____
Mitchell	_____	_____	_____
Dannelly	_____	_____	_____
Robert Henry	_____	_____	_____
Bear Creek Reservoirs	_____	_____	_____
Bankhead	_____	_____	_____
Henry Neely	_____	_____	_____

Alabama's Rivers

Figure 1: Alabama Rivers



Name That Mineral

OBJECTIVES:

Students will be able to:
1. Examine techniques to identify minerals.
2. Differentiate basic minerals based on the techniques learned.

BACKGROUND:

Many things in our world involve minerals. A mineral is a naturally formed inorganic solid with a definite range of chemical compositions and usually a characteristic crystal form. In the United States, 35,000 to 40,000 tons of minerals are mined per year. Alabama contains many important economic minerals. For example, 350 million tons of the mineral hematite (iron ore) have been mined from the Red Ore District near Birmingham. Gold was also mined in Alabama between 1830 and 1946, producing 49,495 troy oz. (0.02 percent of the United States' production). Quartz, one of the most common minerals, is used for jewelry, glass, and common sand (play sand or construction sand). Mica and talc are mined in east central Alabama. There are several varieties of mica, which vary in metal-ion composition and color from white to black to green or purple. All varieties have the characteristic thin sheet structures.

Mica is used in oven windows in place of glass. Ancient Indian cultures in Alabama used it in pottery. Talc is used in the production of talcum powder. Large deposits of halite are found along the Gulf Coast. Halite is the mineral name for table salt. Pyrite is found in coal and marble deposits, although it is often considered an undesirable impurity in these deposits, its shiny cubic crystals are popular with rock collectors. Calcite is the mineral that makes up marble, chalk, and limestone, both of which are extremely common in Alabama.

Grades:
9-12

Subjects:
Physical Science, Geology, Chemistry

Time Needed:
Five class periods

Materials:
- pennies
- nails
- glass jar or microscope slide that can be scratched
- streak plate (small piece of unglazed porcelain)
- balance
- cups of water
- string
- pyrite
- hematite
- quartz
- mica
- calcite
- halite
- talc

In this activity, students will learn a good method for identifying unknown minerals using examples of minerals found in Alabama.

VOCABULARY:

pyrite, hematite, quartz, talc, streak, hardness, luster, mica, calcite, halite, mineral, specific gravity, fracture, cleavage

PROCEDURE:

1. Discuss with students the concept of hardness.
2. Have students rank fingernail, penny, nail, glass as to relative hardness.
3. Give hardness numbers from the attached list.
4. Students should determine hardness of samples of quartz, talc, and calcite.
5. Have students identify hardness using Moh's scale.
6. Discuss with students the concept of luster.
7. Have students look at quartz, calcite, talc, pyrite, and hematite; then describe luster.

8. Describe standard luster terms used and give examples.
9. Have students imagine that the samples of quartz, calcite, talc, pyrite, hematite are all the same size. Then they should rank them in order of increasing "heaviness."
10. Have students define specific gravity.
11. Weigh each mineral. (It may be useful to assign different minerals to different groups since this step will take a while.)
12. Weigh a plastic or paper cup containing enough water to cover the mineral easily. (Halite will dissolve in water, so you might want to skip it for this.)
13. Tie a string around the mineral and hang it from the balance into the water. It should be completely submersed but not touch the bottom. Reweigh water with mineral.
    Calculate: a) weight of cup of water with mineral minus weight of cup of water = weight of mineral in water
    b) $\frac{\text{weight of mineral in air}}{\text{weight of mineralin air minus weight of mineral in water}}$ = specific gravity
14. Identify minerals by comparing measured specific gravity to actual values.
15. Define fracture and cleavage and show examples.
16. Look at broken edges of quartz, calcite, talc, mica, and halite.
17. Have students identify the minerals based on fracture and hardness.
18. Have students define streak.
19. Have students test each mineral by scratching it on the streak plate. (They may notice that some may leave no streak.)
20. For each mineral sample, have students list its characteristics in each of the categories (hardness, luster, specific gravity, fracture or cleavage, streak) and try to identify it.

EVALUATION:

1. Give students unknown samples of the same minerals. Have them give the results of the test for each sample. Then have them identify it using the characteristics lists they developed during the activity.

EXTENSIONS:

1. Have students research the impact of mining on the land. Have them investigate land reclamation efforts currently taking place in Alabama. Refer to the Alabama Surface Mining Commisstion.
2. Find minerals and use these characteristics to identify them using a mineral guide such as the *Golden Guide to Rocks and Minerals*.
3. Visit a museum to observe a wider range of samples. The Alabama Museum of Natural History has many smaples.

ORIGINAL DEVELOPMENT RESOURCES:

Chesterman, C.W. *The Audubon Society Field Guide to North American Rocks and Minerals*. (1978). New York, NY: Alfred A. Knopf.

Dictionary of Geological Terms. American Geological Institute.

Klein, C. (1993). *Manual of Mineralogy*. New York, NY: Wiley & Sons.

Alabama Surface Mining Commission. www.surface-mining.state.al.us

Zim, H.S. & Schaffer, P. R. (1957). *Golden guide to rocks and minerals*. Western Publishing Co. ISBN: 0307244997.

Alabama Geological Survey www.gsa.state.al.us (contact to obtain rock and mineral samples)

Name that Mineral - Appendices

A. Definitions

Cleavage: the splitting or tendency to split along planes determined by crystal structure (example: cubic, planar, fibrous)

Fracture: manner of breaking and appearance when broken (example:conchoidal—curved, uneven)

Hardness: resistance to scratching or abrasion, measured relative to Moh's scale

Luster: the character of the light reflected by minerals (example: metallic, glassy, pearly)

Specific gravity: ratio of the mass of an object to the mass of the volume of water displaced by the object.

Streak: the color of the powder of a mineral as obtained by scratching the surface of the mineral

B. Moh's Hardness Scale (1 is the softest, 10 is the hardest)

1. Talc
2. Gypsum

<———— fingernail 2-2.5, penny 2.5-3

3. Calcite
4. Feldspar
5. Apatite

<————- nail 5-5.5, glass 5.5-6.5

6. Fluorite
7. Quartz
8. Topaz
9. Corundum
10. Diamond

C. Mineral Characteristics

	Calcite	Halite	Hematite	Mica	Pyrite	Quartz	Talc
Hardness	2.5-3.0	2.5	5.5-6.5	2.0-3.0	6.0-6.5	7.0	1.0
Luster	Grassy to Earthy	Transparent to Transluscent	Metallic or Dull, Earthy	Glassy to Pearly	Metallic	Glassy	Pearly to Glassy
Specific Gravity	2.7	2.16	5.26	2.75-3.20	5.02	2.65	2.70-2.80
Fracture/ Cleavage	Rhombo-hedral Cleavage	Cubic Cleavage	Fracture	Planar Cleavage	Fracture	Conchoidal Cleavage	Nonright Regtangular Prism Cleavage
Streak	White	White	Reddish Brown	Variable	Greenish Black	Too Hard To Scratch Plate	White

Notes

Threatened And Endangered Species of Alabama

OBJECTIVE:

Students will be able to:

1. Use materials and activities to understand the methodology of federal listing designations, descriptions of listed species, and means of preserving vanishing species.

BACKGROUND:

In comparison to other states, Alabama has a large number of threatened and endangered plants and animals. According to a 2002 report called States of the Union: Ranking America's Biodiversity, Alabama is fourth in the nation in the total number of species facing extinction. Alabama ranks second in the number of extinct species (first in the continental United States) and ranks fifth overall in biodiversity. The low rankings is due in part to the phenomenal number of different physiographic regions in the state, which contributes to the high level of biodiversity found here. Most species in trouble are being threatened by habitat conversion.

Endangered species are like fire alarms. They tell us about problems in our home we call Earth. If we listen to their alarm calls, they could help us improve our lives and the health of our planet. Threatened means the species is likely to become endangered if it is not protected. Endangered refers to being in danger of extinction throughout all or most of the species' range. Extinct means it is no longer in existence.

Grades:

9-12

Subjects:

Environmental Science, Biology, Art, Computer Science, History

Time Needed:

Approximately two weeks from assignment to completion; students can accomplish parts of the project as an outside assignment.

Materials:

drawing chalk
tempera paints
posterboard
surface for combined mural (classroom wall, school hallway)
lists of Alabama's threatened and endangered species
access to research materials (could be set up in a classroom learning area)

VOCABULARY:

Environmental Protection Agency, Fish and Wildlife Service, extirpated, endemic, endangered, extinct, threatened, genus, species

ADVANCE PREPARATION:

1. Obtain the *Discovering Alabama: Red-Cockaded Woodpecker* video and the Teacher's Guide from Discovering Alabama (see Resources).
2. Make copies of the attached list of Alabama Endangered Species for each group. of students.

PROCEDURE:

Setting the Stage

1. Have the class view the video. Introduce the issues of controversy and use the "Description of the Red-Cockaded Woodpecker" as a research assignment model.
2. Set up a learning center about threatened and endangerous species with resources available from the many agencies listed in the Resources section of this guide.
3. Discuss the difference between a threatened and an endangered species.
4. Discuss the following factors and the way they can threaten a species' survival:
   - The present or threatened destruction, modification, or curtailment of the species' habitat or range.
   - Over-utilization for commercial, recreational, scientific, or educational purposes.
   - Disease or predation.

- The inadequacy of existing regulatory mechanisms.
- Other natural or man-made factors affecting the species' continued existence.

5. Explain how a species is formally and legally listed by the U.S. Fish and Wildlife Service.
6. Compare the amount of listed species for each state on a map of the United States.

Activity

1. Assign threatened and endangered species to cooperative learning groups (composed of 3-4 students). Extensive information is available about some species, and very little is available about others. Groups should begin research on assigned species for presentations, an original art poster of the species, and a research paper with bibliography. Information gathered should include species' common and scientific names, limited classification information (kingdom, phylum/division, class, order if applicable, genus, and species), general characteristics, habitat, range, current and historical population, life habits (reproduction, feeding, and life spans), anatomy and physiology, student-determined "most interesting facts," folklore and mythology, reasons for listing (why a species is threatened or endangered), ways the species could be preserved (both technical and students' suggestions). Students should use professionally approved research paper formats.
2. Students should accomplish the necessary research with both class time and out-of-class time. The teacher should set definite deadlines for notecards, outlines, and first draft. Students should give 10-15 minute presentations on their group's assignments, using their original drawings of the species as a visual aid. The poster drawings should depict animals and plants in their natural habitats and should identify each species by common and Latin names. Teacher should emphasize participation, enjoyment, and learning experiences versus exact artistic rendition as students are completing their posters.
3. After the project is completed, the posters may be mounted for longer display on a classroom or hallway wall. Each member of the group should be required to complete part of the presentation. The presentation should be an abbreviated version of the research paper but should include taxonomic information, general description, range, population trends, most interesting facts, why listed, and ways to preserve the species. Students should submit the first draft of the research paper within two days after presentation, using experiences from the presentation to supplement/improve the research paper. Teachers should review drafts and should return the drafts to students in a timely manner for their revision.

Follow-Up

1. At project completion, students could compile the research paper final drafts into a student publication.
2. Students also may research the purpose and objectives of the National Endangered Species Act and write a paper on the conflicts, obstacles, and facilitating practices that relate to management in this area.

EVALUATION:

1. Evaluation will be based on completed research paper, presentation, and participation.

EXTENSIONS:

1. Use the project to present findings to parents, environmental groups, and/or elected officials.
2. Have the students research threatened species in their area and find ways they can help protect them.
3. Write the state fish and game/natural resources department to find out which species are rare in the area and what is being done to conserve them.
4. Visit a wildlife refuge in the area.

ORIGINAL DEVELOPMENT RESOURCES:

Alvin Diamond's Alabama slide show—especially slides of *Amphianthus pusillus, Sarracenia oreophila, Apios pricena,* and *Trillium relinquum.* Professor, Troy State University. Contact at adiamon@trojan.troyst.edu.

Discovering Alabama: Red-Cockaded Woodpecker Video and Teacher's Guide, Alabama Museum of Natural History. www.discoveringalabama.com

Endangered Species Issue Pacs, available from the U.S. Fish and Wildlife Service, P.O. Box 25485, Denver Federal Center, Denver CO 80225; or the National Institute for Urban Wildlife, 10921 Trotting Ridge Way, Columbia, MD 21044.

Endangered and Threatened Plants and Animals Under U.S. Fish and Wildlife Service Jurisdiction, U.S. Fish and Wildlife Service, Division of Endangered Species, February, 2000.

Additional information available from:

Alabama Environmental Council
EPIC, Jacksonville State University
Center for Environmental Research and Service, Troy State University
Alabama Department of Conservation and Natural Resources
Auburn School of Forestry and Wildlife Sciences
U. S. Forest Service/National Forests in Alabama
The Nature Conservancy www.nature.org

Alabama Threatened and Endangered Species List:
http://ecos.fws.gov/tess_public/pub/stateListingAndOccurrenceIndividual.jsp?state=AL

Notes

Treeless City

OBJECTIVES:

Students will be able to:
1. Describe and identify locations of treeless areas.
2. Compare contrasting habitats.

BACKGROUND:

It's easy to take trees for granted—they've always been there quietly providing many valuable services: slowing water, preventing flooding and soil erosion; stabilizing and adding nutrients to the soil; providing habitat, food, shade, shelter, recreation, and beauty. But what if there were no trees? What would our world be like? What would Alabama be like? Are there treeless cities in Alabama?

VOCABULARY:

habitats, erosion, degraded habitat, ecosystem

Grades:
9-12

Subjects:
Ecology, Social Studies, Geography, Biology, Environmental Science

Time Needed:
Two to three 40-minute class periods

Materials:
quiet area

PROCEDURE:

Setting the Stage

1. The teacher should lead the class through this journey.

   Sit back, close your eyes, and come with me on a journey to a strange and different world. Imagine taking a walk down a street on a warm summer day. Everything looks pretty and fresh. Overhead, leafy trees are giving you plenty of nice, cool shade. You hear birds chirping high in the branches. The air smells fresh and clean. Off in the distance, you see gently rolling green hills. A sparkling stream runs near you. You think you will go fishing later. People are setting up tables in a nearby park to enjoy a picnic.

   The neighborhood is quiet and peaceful today.

   But wait! Something strange is happening. You turn a corner, and a whole different scene appears. The air is hot, and you cannot find a spot of shade anywhere. Chirping birds and scurrying squirrels are fleeing because they have no place to live.

   The ground looks sun-baked and fried. The neighborhood doesn't look very pretty because everything is bare. Dust and soil fly through the air and make it hard to breathe. The wind blows all the time.

   You look at the hillsides in the distance. They are brown and bare and covered with gullies. When it rains, water rushes down those hillsides carrying lots of soil with it. The soil ends up everywhere, much of it collecting in streams and lakes. You wonder if the soil buildup is what has been killing fish and making the little stream in your neighborhood flood its banks.

   People in the parks are putting umbrellas over their tables to shade their picnics. You hear humming noises everywhere. Air conditioners are working overtime as people try to keep cool.

   What has made such a difference in your world? You have the feeling something important is issing—something that used to prevent and correct some of these problems. What is it?

   What is a world without trees?

   A world without trees would be a barren world. Giant dust storms would roll across the countryside blowing away precious topsoil and choking people, plants, and animals. Sunbaked fields could no longer grow enough food to feed the world's population. Hillsides would wash away, clogging rivers and streams with soil and silt.

   Without trees we would have little protection from summer heat and cold winter air. Air conditioners would burn precious energy 24 hours a day in the summer, and furnaces would work overtime in the winter. People would live most of their lives indoors because life outdoors would be too uncomfortable.

Activity

1. Have the students describe and identify locations for each of the following situations in the United States and throughout the world–past, present, and future. Look at urban, suburban, and rural settings for each scenario. Discuss why the area is treeless. Has it always been treeless, or was it caused by people or climatic factors?
   • **Blowing Soil**—Without trees or other vegetative cover, the wind easily picks up exposed topsoil. Dust clouds fill the air. What negative effects occur?
   • **Unprotected Farmland**—Without trees to serve as shade and windbreaks, crops, livestock, barns, farm homes, and other buildings catch the full strength of the wind and the full heat of the sun. What results?
   • **Dirty, Flood-Prone Rivers**—Without trees to stabilize the soil, erosion from hillsides can choke streams, killing fish and destroying wildlife habitats. The eroded soil raises the river beds. How would this make the river more likely to flood? What happens to surrounding lands?
   • **Overheated Cities**—Without trees our streets, buildings, and parking lots soak up the sun's heat and raise the overall temperature. No trees means nothing absorbs carbon dioxide, methane, or carbon monoxide. What does this do to air quality?
   • **Rapid Runoff**—Without trees and other vegetative cover, the soil on the hillsides is easily washed away. Rain flowing on the surface picks up speed and gathers more soil with each inch of slope, carrying topsoil, nutrients, pesticides, and herbicides. How does this affect the soil quality and water quality of the ecosystem? What does this mean in economic terms for the community relying on the ecosystem?
   • **Gullied Land**—Without tree roots to hold the soil in place, gullies eat their way into pastures and crop fields. In a suburban setting, gullies creep under fences, foundations of buildings, and roads. How does this affect land usage?
   • **Degraded Habitat**—Without trees, tree dwellers, such as birds, squirrels, and insects, would have nowhere to live, could not escape from enemies, and might have difficulty obtaining food. Without trees, especially in the tropics, other plants, fungi, and bacteria would not have nutrients, protection, or a place to grow. How does this impact upon the entire ecosystem?
2. Have students imagine a degraded habitat and a healthy or ideal habitat. Discuss these questions:
   • Do all healthy ecosystems look the same?
   • Is a desert a healthy ecosystem?
   • Could an area have many trees and still be a damaged ecosystem?
3. The students can illustrate two contrasting habitats in several ways. Have the students write paragraphs describing two habitats. They may write about areas they know, places they have read or heard about in the media, or fictional places.

EVALUATION:

1. Have the students create collages of unhealthy and healthy ecosystems. They may cut scenes from magazines or newspapers and add their own artwork.

EXTENSION:

1. Have the students draw or paint their interpretations of unhealthy, bad, and healthy ecosystems. Again, these pictures can be based on real or fantasized places.

ORIGINAL DEVELOPMENT RESOURCES:

Moll, G., et al. (1992). *Growing greener cities: environmental education guide*. American Forests, Washington. D. C. (activity adapted from guide - used with permission).

Alabama Urban Forestry Association. www.aufa.com

Develop A Stream Of Consciousness

OBJECTIVES:

Students will be able to:

1. Locate a stream or creek in the community
2. Adopt the stream or creek and monitor factors.
3. Create a plan to keep the stream clean.

BACKGROUND:

This year-long (or as long as it can be) project will serve as a focal point for water activities during the year. Students will be able to set up a plan, monitor factors, and make decisions about various environmental components of the environment as those components affect the stream or creek chosen. Many other activities in this guide can be used as part of this project. By using this project over the course of a year to integrate other activities, the teacher will be able to help students uderstand the relationship of a variety of interactions through seasonal changes in an area.

VOCABULARY:

erosion, habitat, pollution, watershed, weathering

Grades:

9-12

Subjects:

Physical Science, Environmental Science, Social Studies, Language Arts, Art, Geography

Time Needed:

Year-long project

Materials:

map of Alabama showing streams
vary depending upon group choice of activity

PROCEDURE:

1. Explain what a watershed is, and have students determine the boundaries of their watershed.
2. Have the class locate streams and creeks associated with the watershed in the community. Choose one as the study area.
3. Visit the site once as a group to brainstorm and to decide what to accomplish for the year.
4. In the classroom, divide into groups and have each group write one major goal and several objectives of how to accomplish the goal. Have each group share its goals and objectives then combine to make a final set everyone agrees upon. (Examples could include tree planting, habitat improvement, seasonal changes, fisheries rehabilitation, interpretive trails, water pollution sampling, litter patrol, funds collection to donate picnic tables, and so forth.)
5. Each group is to select a task and is responsible for creating a plan and timeline to accomplish the objective. Students should create a form with the following headings:

Task	Steps to Accomplish	Evidence of Accomplishment
1.	1.	1.
2.	2.	2.
3.	3.	3.

Entries under Evidence of Accomplishment will serve as a checklist for final evaluation to determine if the task was accomplished satisfactorily.

6. Set up a visiting schedule with activities to be completed within the time period.
7. Each group will develop a plan to keep the area clean. Consider the Adopt-a-Stream porgram for the segment or location being studied.

EVALUATION:

1. Groups will keep a journal of what they have done and the procedures they have followed.
2. Timelines will be checked for adherence to the proposed schedule.
3. Each task will be evaluated with a checklist created from the entries under Evidence of Accomplishment.

EXTENSIONS:

1. Build a model of the watershed which includes their stream.
2. Create a habitat diorama of the stream.
3. Collect rocks or soil from the area and display them.
4. Create a fish life cycle display.
5. List the trees along the stream, start a leaf collection.
6. Set up a weather station to record rainfall in relation to stream water depth changes.
7. Track the water level and rates of erosion throughout the year.

RESOURCE:

Adapted with permission from The Children's Groundwater Festival Outreach Packet, The Groundwater Foundation, Lincoln, NE.

Adopt-a-Stream program in Alabama. Contact Alabama Water Watch. www.alabamawaterwatch.org. or write to Alabama Water Watch Program, 203 Swingle Hall, Department of Fisheries, Auburn University 36849.

Water Woebegone

OBJECTIVE:

Students will be able to:

1. Discuss the impact of various water uses in a watershed on stream flow.

Grades:

9-12

Subjects:

Environmental Science, Earth Science, Mathematics, Economics

Time Needed:

One class period

Materials:

(per 2-3 students)
one 1-liter clear plastic beverage container
mL measuring cylinder
masking tape
marker
graduated cylinder or pre-calculated measuring cup

BACKGROUND:

A watershed is the geographical region composed of a drainage system. The water in this drainage system is allocated to many different users. If the total amount of water available in the watershed becomes allocated, then a drought situation occurs with conflict over who will get the resulting water. These conflicts may be settled by cooperation among water users; through emergency water allocation by state governments; or, in some cases, by the courts according to "water rights." Water rights are vastly different in different parts of the United States. In the western United States, water rights are based upon prior use. New water users must pay or otherwise compensate prior or existing users if they reduce the amount of water available. They must purchase water rights. In the eastern United States, water rights are less well defined and are based on what is known as riparian water rights. Landowners or others with access to streams can withdraw water without purchasing water rights. The only recourse when a water user harms another party (for instance, by excessive water withdrawal) is to seek legal relief. In such cases, the injured party must prove that the water user's activities were unusual or were not a normal practice. In any case, resource managers must be careful to maintain minimum stream flow so that populations of organisms in the watershed can be healthy.

VOCABULARY:

watershed, drought, water rights, resource manager, minimum stream flow, carrying capacity

PROCEDURE:

1. Mark a clear plastic 1-liter beverage container with forty 25 mL graduations by placing a strip of masking tape along its length and marking the units: pour in 25 mL of water, mark the waterline on the tape, and so on until the bottle is full. (Or use graduated cylinders).
2. Tell the students that the water in the bottle represents the amount of water available in their watershed.
3. They are responsible for allocating this water for their town, which has grown to 1000 households.
4. Give them the following chart and values to aid them in their task of water distribution:

minimum stream flow	322 mL
household use	42 mL/1000 households
industry use	42 mL/500 households
irrigation use	42 mL/500 households
hydroelectric use	42 mL/500 households

5. Calculate how much water would be used to support this town of 1000 by adding the amounts in mL needed per 1000 households for each of the uses from the list in procedure (4) above.. (294 mL)
6. Remove that amount of water from the bottle and record how much is left. Repeat these steps with a town of 2000 households, then 3000 and 4000.

TOWN SIZE	TOTAL WATER USED
1000	42+84+84+84 = 294 mL
2000	84+168+168+168 = 588mL
3000	126+252+252+252 = 882 mL
4000	168+336+336+336 = 1176 mL

7. Have the students note when there is no longer at least 322 mL of water left in the bottle such that the minimum stream flow is affected.

EVALUATION:

1. How large a town population can be sustained before the stream goes dry? Graph the town size (number of households) versus water use. Have the students use the graph to determine the population at which the entire stream flow would be used up.
2. Have the students discuss the compounding problem of low or no stream flow if the town's sewage discharge pipe is downstream of the town.
3. What have you learned about the carrying capacity of a habitat such as a watershed? (limited to how many people that it can support, not counting all of the other organisms present)

EXTENSIONS:

1. Research which watersheds in the world have problems with water overuse and why. Suggest ways to prevent the overuse of a water supply.
2. Invite a local water official to brief the class about the water user rate in your town.
3. Research the "Water Wars" between Alabama, Georgia, and Flordia. Contact the Alabama Office of Water Resouces for information and current status. 334-242-5499.

ORIGINAL DEVELOPMENT RESOURCES:

"Watershed Woes." (1992-1993). *National Science and Technology Week.*

Alabama Department of Economic and Community Affairs - Office of Water Resources, 401 Adams Avenue, Montgomery, AL 36104. www.adeca.state.al.us.

What A Watershed

OBJECTIVES:

Students will be able to:
1. Create a watershed diagram or model.
2. Illustrate the importance of the watershed in planning and locating a city or community.

BACKGROUND:

A watershed is a region or an area bounded peripherally by water parting and draining ultimately to a particular watercourse or body of water. Watershed, river basin, and drainage basin all refer to the same type of area. Watersheds are created by natural, rising elevations that act to divide the flow of water. The dividing line between two adjacent watersheds generally is along the highest points between the waterways in each watershed. The most well-known watershed separater is the Continental Divide in the western United States.

VOCABULARY:

watershed, agriculture, debris, erosion, terrestrial, topography, Continental Divide

Grades:
9-12

Subject:
History, Earth Science, Environmental Science, Biology

Time Needed:
Two 55-minute class periods

Materials:
regular-size poster board
markers
crayons
pencils

PROCEDURE:

1. Have students draw or create a model of a watershed that includes the following elements in the specific geographical location of a town:
   - Four mountains located northwest of the town
   - Rolling hills located to the southeast of the town
   - A major river flowing southeast from the mountains
   - Six tributaries entering the major river from the mountains and hills
   - A town that includes the following:
     a. School
     b. Post office
     c. Reservoir
     d. Shopping center
     e. Four churches
     f. Court house
     g. Water supply intake
     h. Municipal swimming pool
     i. Interstate highway going east and west
     j. A state highway that runs parallel to the river
     k. Two bridges over the river
     l. A recreational area west of town
     m. Neighborhood of at least 20 homes
     n. Municipal wastewater discharge
     o. Industrial wastewater discharge
     p. Municipal landfill site
     q. Recreational lake
   - An agricultural area south of the town with at least one barn

EVALUATION:

1. Complete the poster or model.
2. Explain poster or model and the implications of things located in the watershed.

EXTENSIONS:

1. Have a city planner speak to the class about how knowledge of watersheds affects planning.
2. Obtain a map of Alabama, or use the "Alabama Rivers" map in the Lakes and Dams of Alabama activity, and roughly outline each of them state's watershed areas.
3. Trace the drainage pattern in each watershed area to the Gulf of Mexico.

ORIGINAL DEVELOPMENT RESOURCES:

U.S. Environmental Protection Agency: watershed information network. www.epa.gov/win

Dobson, C. & Beck, G.G. (1999) *Watersheds: a practical handbook for healthy water.* Firefly Books. ISBN: 1-55209-330

"Alabama Water Resources" poster, Legacy, Inc. P.O. Box 3813, Montgomery, AL 36109, www.legacyenved.org, 1-800-240-5115.