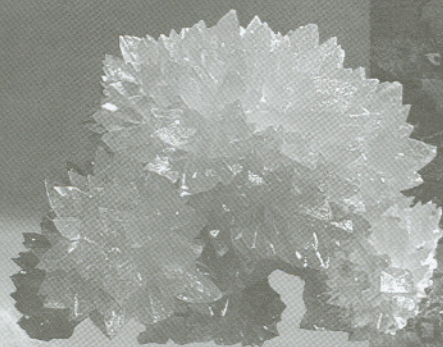


FLORIDA GEOLOGY EDUCATIONAL VIDEO PROJECT



I. FLORIDA'S GEOLOGY UNEARTHED

VHS cassette

II. EDUCATOR'S GUIDE

binder materials

III. SUPPLEMENTAL MATERIALS

inside back pocket



Project Manager: Jon Arthur, Ph.D., P.G.

This material was developed by the **Florida Geological Survey**, a bureau within the **Florida Department of Environmental Protection**. Financial assistance was provided through a grant from the **Florida Advisory Council on Environmental Education** with proceeds from the sale of manatee and panther license plates.

Numerous individual contributions to this project are gratefully acknowledged. For a detailed list, please refer to the Educator's Guide and the video's credits. This material is the sole property of the State of Florida. Information concerning this material may be obtained by contacting: Florida Geological Survey, Attention: Publications, 903 W. Tennessee St., Tallahassee, Florida 32304
Phone: 904/488-9380 • FAX: 904/488-8086 • e-mail:rnekeel_d@dep.state.fl.us

ON THE COVER

1. Photomicrograph of an igneous rock magnified roughly 30 times. These rocks make up parts of the Florida basement and are found thousands of feet beneath land surface. The rock is cut down to a thickness less than paper and is mounted on a glass slide for viewing through a microscope that uses crossed-polarized light. Photo taken by Jon Arthur, Florida Geological Survey.

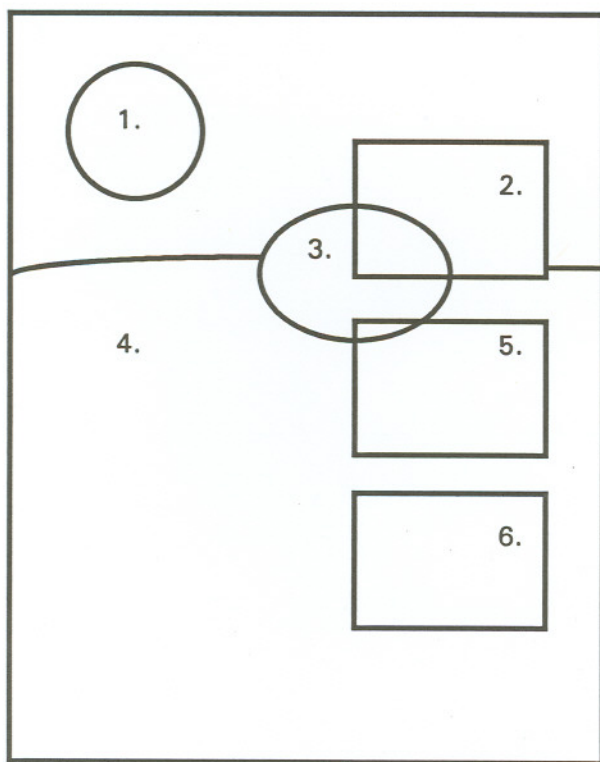
2. A clay mine in Gadsden County. Photo taken by Steve Spencer, Florida Geological Survey.

3. A calcite crystal found in a limestone quarry. The image is about one-half actual size. Photo taken by Tom Scott, Florida Geological Survey.

4. Image of the Florida peninsula taken from Space Shuttle flight STS052 (October, 1992) from an altitude of 158 nautical miles. Photo credit: NASA.

5. View of Suwannee Limestone exposed along the west bank of the Suwannee River in Hamilton County. Photo taken by Jon Arthur, Florida Geological Survey.

6. The Winter Park sinkhole, showing destruction of municipal swimming pool and other property. The sinkhole formed during May 8th and 9th, 1981. Photo credit: Florida Geological Survey files.



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voice: 904.488.9380 • fax: 904.488.8086 • e-mail: mekeel_d@dep.state.fl.us

EDUCATOR'S GUIDE

for

"FLORIDA'S GEOLOGY UNEARTHED"

by

Ed Lane
Frank Rupert

in conjunction with the

FLORIDA GEOLOGY EDUCATION VIDEO PROJECT

FLORIDA GEOLOGICAL SURVEY

Tallahassee, Florida

1996

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of

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INTRODUCTION

An understanding of Florida's geology is an essential part of an effective environmental and ecological education program. The upper few-hundred feet of the earth's crust have the most direct effect on life on the surface ... and they are the most affected by human activity. This segment of the earth's crust is a fundamental and critical component of Florida's environments and ecosystems. Characteristics and materials of the earth's upper crust, such as surface and ground water and economic resources, determine the location and nature of environments; and people, plants and animals are intimately connected with it. Dynamic geological processes constantly modify the environments, causing ecosystems to continually change in response.

The geology of the solid earth and the geological processes that act on it are the **reasons** why environments and ecosystems are **what** they are, as well as **where** they are.

Florida's Geology Unearthed is more than just an entertaining video. It is a program which tells how geology affects our lives here in Florida. It explores such topics as Florida's geological history, its rocks, minerals, and fossils, and its water resources. It gives students timely information regarding the topics of environmental degradation and waste disposal.

The Florida Geology Education Video, *"Florida's Geology Unearthed"* and the *Educator's Guide* are designed to help educators inform and stimulate students in a variety of topics related to earth sciences, natural resources, environments and ecosystems. These teaching resources are intended to provide a general understanding of those broad topics. Also, this creates a foundation for more specialized studies in such scientific fields as geology, biology, chemistry, and physics; other specialized fields could include geography, economics, resource management, urban planning, land-use planning, public health, and history. This material should stimulate a sense of stewardship in future decision-making citizens so they will appreciate, protect, conserve, and properly manage **their** natural resources.

The purpose of the materials provided in the kit with the video is to provide teachers of grades 8 and 9 with program information, suggested activities and other resource materials which will supplement the information in the video.

The suggested activities in the *Learning Activities* will help students to extend their knowledge and provide opportunities to develop skills which will enhance their experiences for functioning in "real life" situations, as well as preparing them for the future as citizens and consumers in society.

HOW TO USE THIS GUIDE

The Florida Geology Education Video, titled "FLORIDA'S GEOLOGY UNEARTHED," has four built-in "breaks." Based on these "breaks," the *Educator's Guide* is divided into five PARTS, thus allowing the educator to stop the video for discussion, or to assign activities. Part One of the *Educator's Guide* pertains to the PART ONE of the video, which ends with Video Break 1. PART TWO of the *Educator's Guide* follows Video Break 1, and so on until the end of the video. The video's "breaks" also can be coordinated with material in the *Learning Activities*, and *Special Publication 35*. Lists in the video, such as "How can we help win the battle against solid waste?," are included in PART FIVE of the *Educator's Guide* for use as handouts.

The text portions of PARTS ONE through FIVE of the *Educator's Guide* differ in length because the topics pertinent to each section are covered to differing extents in the video and *Special Publication 35*. For some PARTS, additional material is presented in the *Educator's Guide* to expand on the main topics. In other PARTS, *Special Publication 35* and the video provide sufficient information, thus the text portion in the *Educator's Guide* is brief.

Each PART has the following components:

SUNSHINE STANDARDS - These list Standards that are relevant to the topics discussed in each PART of the *Educator's Guide*. These standards provide educators an avenue for integrating these materials into other existing curricula.

The Florida Geology Education Video Project complements state-wide education curriculum standards as described in *Science For All Students* (1995, Florida Department of Education), and the **Sunshine State Standards** (adopted 1996, Florida Department of Education).

KEY QUESTIONS - These questions are provided as examples of some of the important topics covered in each PART. The educator is encouraged to add any other questions they feel are pertinent to the topics.

OBJECTIVES - These outline some of the main ideas intended to be communicated by the combined materials in the kit.

KIT RESOURCES - The two most important references for Florida geological material are the Florida Geological Survey publications: *Special Publication 35: Florida's Geological History and Geological Resources*, and *Map Series 125: A Guide Map to Geologic and Paleontologic Sites in Florida*. Both of these publications are provided in the original kit with the video and *Educator's Guide*. For those not having an original kit, these two publications can be ordered, see page v. These publications should be consulted for all of the activities in the *Educator's Guide* and *Learning Activities*, even if they are not specifically referenced.

DEPARTMENT of ENVIRONMENTAL PROTECTION RESOURCES - These materials are not provided in the original kit. They were chosen for their pertinence to the topics presented in the video or in the *Educator's Guide*. They should be readily available. Appendix 5 has information regarding resources from the Florida Department of Environmental Protection, Florida's water management districts, the U.S. Geological Survey, and other sources.

ORDERING FLORIDA GEOLOGICAL SURVEY PUBLICATIONS

NOTICE: Copies of this *Educator's Guide* can be obtained from the Florida Geological Survey, by requesting: *Special Publication 41*. This does NOT include the video or other materials supplied with the original kit.

Information Circular 87, "*List of Publications*," is available free, and can be ordered from the Florida Geological Survey Library. The Library is open to the public and on-premises research can be done by the public, educators, students, private consulting firms, and governmental agencies. The Florida Geological Survey is located in the Gunter Building, on the campus of Florida State University, at the corner of West Tennessee Street and Woodward Avenue, Tallahassee.

Florida Geological Survey
903 West Tennessee St.
Tallahassee, FL 32304-7708

Tel. 904.488.9380

The FGS World Wide Web (WWW) home page (<http://www.dep.state.fl.us/geo/index.html>) is currently under construction and is being added to the existing Florida Department of Environmental Protection WWW page (<http://www.dep.state.fl.us>). The purpose of the FGS page is to provide a cost-effective public service for the dissemination of geologic data and information for research and education.

Summaries of Florida's geological history, economic minerals industry, common rocks and minerals, fossils, and explanations of geological hazards (*e.g.*, sinkholes and radon) will be among the educational titles within the home page. "Downloadable" copies of recent issues of the FGS *Forum*, the Survey's biannual newsletter and the current list of FGS publications will also be accessible. The page will also include an overview of the FGS, including organizational history, current projects and an overview of each section within the Florida Geological Survey.

PART ONE -- Florida Geology, Ecosystems and You

SUNSHINE STANDARDS

SCIENCE: Processes that shape the earth

Standard 1. The student recognizes that the processes in the lithosphere, atmosphere, hydrosphere, and biosphere interact to shape the earth.

SOCIAL STUDIES: People, places and environments (geography)

Standard 1. The student understands the world in spatial terms.

Standard 2. The student understands the interaction of people and the physical environment.

LANGUAGE ARTS: Writing

Standard 2. The student writes to communicate ideas and information effectively.

KEY QUESTIONS

1. How does geology affect your life?
2. What is an ecosystem?
3. How did Florida get its shape?

OBJECTIVES - As part of this lesson the student will:

1. Develop an awareness of geology and geomorphology and how they affect our lives.
2. Expand their understanding of ecosystems to include geology and geological processes.
3. Demonstrate the relationship among geological processes, geomorphology, and ecosystems.
4. Become aware of the concept of how geological history and processes have controlled the shape of Florida's landscape.

KIT RESOURCES:

Part 1 Learning Activities .

Special Publication 35, pages 1-28, 47-50, 58-60.

DEPARTMENT of ENVIRONMENTAL PROTECTION RESOURCES (see Appendix 5 for other resources):

Florida's Hydrogeologic Environment, by Paulette Bond: Florida Geological Survey, color poster showing the hydrogeology of karst terrain.

Earth Systems: The Foundation of Florida's Ecosystems, by Ed Lane and Frank Rupert: Florida Geological Survey, full-color poster illustrating the relationships among Florida's ecosystems and geology (in preparation)

Italicized words in the text are defined in Appendix 1.

PART 1 GEO-FACT: No rocks ... No water ... NO ECOSYSTEM !

ECOLOGY is the study of the relationship between organisms and their *environment*, including the study of communities, patterns of life, natural cycles, relationships to each other, biogeography, and population changes.

An **ECOSYSTEM** is any area where the Earth's living and non-living systems interact; including the air that surrounds our planet, the water bodies above and below the Earth's surface, the soils and solid surfaces of the Earth's outer layer, and all the organisms that live on the Earth, including humans.

ECOSYSTEMS EXIST IN AN INFINITE VARIETY, and on many scales, from the microscopic to planet-wide. Therefore, an ecosystem's boundaries depend on the scope of your point of view. Most ecosystems have a diversity of animals and plants, each of which includes a range of environmental factors in its living requirements. Because of this, there is overlap among adjacent ecosystems. The Everglades is an example of a large-scale ecosystem; a smaller-scale ecosystem could be a local park, or the land and air encompassed by a school's property boundaries.

ECOSYSTEMS ARE NOT STATIC. They change in time and space, due to both natural and human influences. Shallow lakes, for example, tend to fill in over time with sediment and plant material; human activities around the lake can accelerate the process. Plant and animal communities also change as part of the life cycle of an ecosystem.

A knowledge of **EARTH SYSTEMS** is necessary to understand how biological and non-biological components interact to create and sustain ecosystems. The solid earth aspects of earth systems are included in the science of *geology*; the atmospheric components reside with meteorology; and hydrogeology and hydrology cover the aqueous parts of our physical earth system.

Stratigraphy refers to the composition, sequence, and correlation of the layered rock-sequences that make up the Earth's crust. The stratigraphic relationships of an area's rock *formations* are a major factor in determining the landforms, or *geomorphology*, of that area. An area's stratigraphy controls surface and ground-water conditions, such as flow, recharge and discharge areas, location and depth of aquifers, and water quality. Some geomorphic features can create very localized microclimates and restricted ecosystems; the Devil's Millhopper sinkhole, in Gainesville, is a good example of this phenomenon.

ROCKS ARE THE ULTIMATE SOURCE OF MOST NUTRIENTS IN FOOD CHAINS. The physical characteristics of rocks and geologic processes have direct relevance to ecosystems. Weathering processes break down rocks into their constituent minerals and chemical components, forming soils and nutrients. Erosion and sediment transport processes then make them available to the biosphere. Most nutrients are recycled many times through an ecosystem before losing their usefulness to the system.

- PART 1 LEARNING ACTIVITIES -

(VIDEO BREAK No. 1)

After watching Part 1 of the video:

ECOSYSTEMS

ACTIVITY 1. Write down the name of an ecosystem. List for this ecosystem all plants, animals, and geologic materials that you think are important to make it healthy and sustainable. Remember: No rocks ... No water ... NO ECOSYSTEMS !

ACTIVITY 2. Draw and label an ecosystem ... be sure to include the four major components.

ACTIVITY 3. Write a creative story about a water drop's journey through an ecosystem. In its travels, make sure the water drop encounters the atmosphere, the biosphere, the hydrosphere, and the lithosphere ... and stress the drop's interaction with each of the "spheres."

FLORIDA GEOLOGY

ACTIVITY 1. Think about one entire day in your life. Starting with the time you get up, make a list of the things, objects, or products you use that come from the Earth? How many of these probably needed the expertise of a geologist to find, remove, manufacture, or transport to you. Save this list; it will be used again in Part 4 Learning Activity.

ACTIVITY 2. Draw an example of how erosion helps shape the land. Remember that erosion can be either physical (as ocean waves cutting a beach face), or chemical (as rocks dissolving). Write a paragraph that describes the geological process that you have drawn. In the paragraph, mention how this process might become a geological hazard.

PART TWO -- Geological Time, Rocks and Minerals, and Fossils

SUNSHINE STANDARDS

SCIENCE: The nature of science

Standard 1. The student uses the scientific processes and habits of mind to solve problems.

Standard 2. The student understands that most natural events occur in comprehensible, consistent patterns.

Standard 3. The student understands that science, technology, and society are interwoven and interdependent.

SCIENCE: How living things interact with their environment

Standard 1. The student understands the competitive, interdependent, cyclic nature of living things in the environment.

MATHEMATICS: Measurement

STANDARD 1. The student measures quantities in the real world and uses the measure to solve problems.

STANDARD 2. The student compares, contrasts and converts within systems of measurement (both standard/non-standard and metric/customary).

STANDARD 3. The student estimates measurements in real-world problem situations.

MATHEMATICS: Number, sense, concepts, and operations

STANDARD 1. The student understands the different ways numbers are represented and used in the real world.

STANDARD 2. The student understands number systems.

SOCIAL STUDIES: Time, continuity, and change

Standard 1. The student understands historical chronology and the historical perspective.

Standard 2. The student understands the world from its beginning to the time of the Renaissance.

KEY QUESTIONS

1. How do geologists study the earth "beneath our feet?"
2. What is geological time?
3. What is important about *limestone*, *dolostone*, *fossils*, and *tectonics*?
4. Why are rocks and minerals important to ecosystems?
5. What is geological history?
6. Why are some geological hazards that occur in other parts of the country not of major concern to us in Florida?

OBJECTIVES - As part of this lesson the student will:

1. Develop an understanding of why geologists study the Earth.
2. Understand the concept of geological time.
3. Explain the relationships of limestone, dolostone, fossils, and tectonics to Florida's geological history.
4. Explain the importance of rocks and minerals in ecosystems.

5. Describe Florida's geological history up to the Ice Age.

6. Explain those factors in Florida's geological history which "protect" Florida from some geological hazards which exist elsewhere.

KIT RESOURCES:

Part 2 Learning Activities.

Special Publication 35, pages 1-25, 50-55.

Map Series 125

Appendix 3 - Creating sedimentary rock strata.

Appendix 4 - List of fossil clubs in Florida.

Appendix 4 - List of rock and mineral clubs in Florida.

DEPARTMENT of ENVIRONMENTAL PROTECTION RESOURCES (see Appendix 5 for additional resources):

Florida Rock Kit, available from Florida Geological Survey.

Florida Minerals: Florida Geological Survey, full-color poster showing common minerals.

OTHER RESOURCES:

Rocks and Minerals - A Guide to Field Identification, Golden Press; available in most local bookstores.

Students' personal rock, mineral, and fossil collections.

Italicized words in the text are defined in Appendix 1.

PART 2 GEO-FACT: Most of Florida's beach sands have come from the erosion of the Appalachian Mountains, over a period of millions of years.

ROCKS AND MINERALS

Most of the *sedimentary* rocks now exposed at the earth's surface, as well as those under the surface, were either laid down under water or were precipitated out of water. In Florida such rocks include the *clastics*, such as gravel, sand, and clay, and the *precipitates*, like *limestone* and *dolostone*. Florida's clastic rocks, the gravels, sands, and clays, are derived from the weathering and erosion of the Appalachian Mountains to the north. The Appalachians were once as tall and jagged as the Rocky Mountains are today. Over eons of geological time, these erosion products have been, and still are being, carried by streams and rivers to the Gulf of Mexico and Atlantic

Ocean. When this debris reaches the Gulf, or any quiet body of water, the particles settle out of the water and stack up on the bottom of the body of water or Gulf. In this way layers of sediments can build up. They can become *lithified* into sedimentary rocks through various processes. One such process is cementation, where individual particles are bound together by minerals, which precipitate out of ground water.

A mineral is a naturally occurring chemical element or compound formed as a product of inorganic processes. Minerals are crystalline solids; thus, all mechanical mixtures, no matter how homogeneous in texture, are excluded. Although certain things may be thought of logically as

being minerals, they are not; some common non-minerals are: coal, amber, oil, animal bones, sea shells, pearls, synthetic gems, cement, glass, and steel. Rocks and soils are aggregates of minerals. *Mineralogy* is the study of the chemical and physical properties of minerals, and their occurrence as economic mineral deposits.

A crystal is a mineral having a solid form, and possessing a three-dimensional internal order of its atoms and molecules. *Crystallography* is the scientific study of these solid bodies.

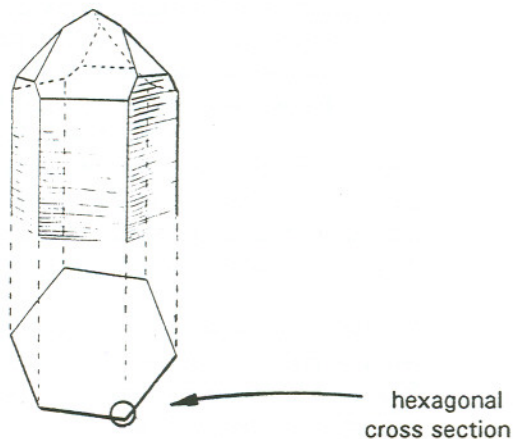
Under favorable conditions some minerals form solid bodies with regular geometric shapes, having smooth, planar surfaces, that is, crystals. For example, table salt forms crystals in the shape of cubes. This mineral, sodium chloride (NaCl), is called *halite*. An examination of table salt with a magnifying glass will reveal its cubic form.

Also, some plants and animals produce crystalline substances. By definition, though, they are not minerals. Sugar, produced by many plants, is probably the most commonplace such substance, and its crystalline shape can be seen by examining table sugar. Many organisms that live in the sea, both plants and animals, extract the mineral calcium carbonate (CaCO_3) from the water and then, as part of their life-processes, secrete hard, crystalline, calcite shells or plates. Similarly, some marine plants and

animals secrete the mineral quartz (SiO_2) to form protective shells or internal support structures.

In Florida, the two most common minerals are quartz and calcite. In Florida almost all quartz occurs as sand, though some good crystals are found in cavities in limestone in quarries. **Amorphous** forms of quartz occur frequently as chert nodules which are, again, usually found in limestone rocks. Prehistoric inhabitants of Florida worked the chert nodules to create their stone implements and weapons, such as arrow and spear heads, or knives. Some sites along streams, where the limestone outcrops contained abundant chert nodules, became favorite places for the primitive craftsmen to set up their "stone-age factories" to produce large quantities of implements.

A good example of a crystalline substance is quartz, one of the most common minerals on earth. Because it is so plentiful, good quality specimens of quartz crystals usually can be bought from rock and mineral merchants for reasonable cost. Glass, though mainly quartz, is an amorphous material having no regular internal crystalline structure. Colored glass is made by adding small amounts of other minerals to the quartz during manufacturing. Quartz is harder than steel, and can scratch a knife blade. Paradoxically, quartz crystals are very brittle, and can be easily shattered with a sharp blow, just like glass.



QUARTZ CRYSTAL

QUARTZ : silicon dioxide, SiO_2

FORM : Six-sided prismatic crystals, terminated by 6-sided triangular faces. Also, massive or amorphous, as chert.

OTHER PROPERTIES : Commonly colorless or white, but may be yellow, pink, smoky-gray, brown, or black; amethyst is a semi-precious, purple variety. Transparent to opaque.

FOSSILS AND FOSSILIZATION PROCESSES

A *fossil* is any trace of prehistoric life. The study of fossils is called *paleontology*. Fossils may consist of shells, bones, molds, casts, petrified wood, leaf impressions, and the tracks, trails or burrows left in the rock by organisms. The creation of fossils was dependent upon preservation of the organism's remains before wind, water, weather, bacteria, or predators could destroy them. Preservation was commonly accomplished by rapid burial of an animal's body, or an organism's remains, in the bottom sediments of an ancient sea, lake or stream; by entombment underground in a cave or sinkhole; or by entrapment in amber or tar. The most common fossilization process is permineralization (replacement of original materials by a new mineral, such as quartz, which precipitates out of ground water). Other fossilization processes include: freezing (in glaciers or permafrost), dessication or mummification (in deserts or saline environments), and carbonization (organic material is changed into a thin layer of carbon).

Florida's oldest fossil is a *trilobite*, a type of extinct marine arthropod related to the modern crab (see *Special Publication 35*, p. 1). This trilobite lived on an ancient

seafloor about 450-million years ago during the Ordovician Period. Its fossil remains were recovered from an oil well core sample taken at a depth of 4,628 feet below land surface in Madison County. Dinosaur fossils are not found in Florida. During the reign of the dinosaurs, the area of present-day Florida was submerged beneath the sea, precluding the presence of land-dwelling dinosaurs. Additionally, the rocks deposited during the age of dinosaurs are now buried thousands of feet deep under Florida.

The most common fossils found in Florida are the shells, bones, and teeth of sea animals. These creatures lived in the shallow seas which covered all or part of Florida during the *Cenozoic Era*. Much of the *limestone* bedrock underlying our state is comprised of fossil shells, ranging from the tiny *foraminifera* to the larger *mollusks*, *corals*, and *echinoids*. As these sea creatures died, their remains became buried in the sea bottom, which ultimately solidified into carbonate rock. Some dolostone in Florida also contains the delicate carbonized impressions of 50-million-year-old sea grasses, which flourished on the bottom of an ancient, shallow sea. Pleistocene mollusk shell beds in southwestern Florida, which contain beautifully preserved specimens, are mined for road base material. *Vertebrate* fossils are also found in

Florida's marine sedimentary rocks. Complete skeletons are rare because predators and scavenging organisms quickly tear apart and scatter the skeletal remains. Shark teeth, whale and fish vertebrae, and dugong ribs are common finds in many areas of Florida.

Florida also contains numerous land animal fossils. As sea level began a gradual fall about 30 million years ago, significant areas of dry land began to emerge. This land was inhabited by a variety of mammals, many of which are now extinct or no longer live in the state. The land animal populations changed through time, resulting in the rich and diverse vertebrate fossil remains found in Florida today. During the Pleistocene Epoch, Florida's land animal diversity and abundance probably resembled the modern plains of Africa. Mastodons, mammoths, horses, camels, giant sloths, dire wolves, bears, capybaras, glyptodonts, and saber-toothed cats, among others, roamed the woods and grasslands of Ice Age Florida. Today their remains are found as individual bones and rarely as complete skeletons in rivers, mines, and other excavations.

Fossil hunting in Florida - where to look: Florida offers the student collector a variety of opportunities to find fossils. The best locations are mines, quarries, and other excavations, which expose the buried fossiliferous rock units. Spoil piles in the phosphate mines of the famous Bone Valley district, in Polk and Hillsborough Counties, offer some of the best vertebrate fossil collecting in the state. In recent years most mining companies have stopped allowing collectors into their mines for liability and insurance reasons.

Rivers and streams, from the panhandle to southern Florida, offer good potential for finding fossils. Deeply incised streams

may have fossiliferous strata exposed in the stream banks. Fossils, particularly more durable bones and teeth, may be concentrated on bars or in depressions on the stream floor. The Peace River, near Arcadia in Polk County, is accessible by canoe or wading, and contains abundant fossils in the streambed. Other streams may require snorkeling for best results.

Canals and other man-made excavations will commonly expose fossiliferous strata. The spoil material removed from such excavations may contain abundant fossils, as well. This material may have been trucked some distance from its origin to serve as construction fill or road base; thus, fossils may sometimes be collected far from their original site and without the need to enter a quarry or other off-limits location.

Vertebrate fossils wash ashore on the beaches along Florida's west and northeast coasts. Walking the beaches at low tide is the best method for spotting the brown to dark gray to black fossils in the sand. Venice Beach, in southwest Florida, is famous for its abundant shark teeth. Beach renourishment projects occur statewide; these dredged spoils may also yield fossils that have been pumped from offshore fossil beds.

Practical uses of fossils: Some fossils have significant economic value; they are used to help locate oil and gas deposits, and other mineral deposits. Some fossils are good for correlating strata and in determining relative geologic age. Fossils record past forms of life, which indicate changing environments and geographic patterns during geological history.

Florida Fossil Clubs: There are several fossil clubs in Florida. They have a variety of activities, such as regular meetings, field trips, and specimen sales. A listing is given in Appendix 4.

- PART 2 LEARNING ACTIVITIES -

(VIDEO BREAK No. 2)

ACTIVITY 1. VISUALIZING GEOLOGICAL TIME

HELPFUL ITEMS: calculator
clock
geological time scale (see *Special Publication 35*, page 5).

1. Assemble class on 100-yard-long football or athletic field. The length of the field represents 5-billion-years, the approximate age of the Earth.
2. Divide class into 7 or 8 groups.
3. Each group is assigned a significant occurrence in Earth history, such as the appearance of the first photosynthetic, one-celled life. The last group should represent the appearance of humans. The groups then consult the geological time scale for that date and convert the time into yards distance on the playing field. Having designated one end zone to represent the beginning of Earth history, a member of each group moves the appropriate distance from that end zone to a position on the field.
4. When all students have assumed their proper positions, they shout out, in turn, the occurrence in Earth history that their position represents.
5. The spacing dramatically reveals the history of the Earth and the short period of time of humans' existence.
6. At the "recent" end of the field, a similar exercise could be performed by having students represent various events in Florida's geological history.
7. Sample conversions:

100 yards	=	5,000,000,000 years (approximately)
1 yard	=	50,000,000 years

ALTERNATE ACTIVITY 1. VISUALIZING GEOLOGICAL TIME

1. Draw a large, round clock face with hours labelled. Do not draw hands, they will be added as part of the demonstration.
- ALTERNATIVE:** Use an actual clock, the bigger the better, with a sweep-second hand.
2. Divide the class into 7 or 8 groups.
3. Assign each group a significant occurrence in Earth history. The last group should represent the appearance of humans. Each group consults the geological time scale for that date and converts the time into approximate hours, minutes, or seconds, as appropriate. All of the clock's hands are set at 12 o'clock midnight, to represent the beginning of Earth history. Starting with earliest geological event, a member of each team, in turn, sets the clock's hands to the approximate elapsed time for that event.
4. As the clock is set, each team announces the occurrence that this time represents.
5. This demonstrates the relatively brief period of time of humans' existence, about 15 to 20 seconds before 12 o'clock noon.
6. Sample conversions:

12 hours	=	5,000,000,000 years (approximately)
1 hour	=	400,000,000 years
1 minute	=	7,000,000 years
1 second	=	117,000 years

- PART 2 LEARNING ACTIVITIES -

(VIDEO BREAK No. 2)

ACTIVITY 2. ROCKS, MINERALS and CRYSTALS

Supplies needed:

- Rock and mineral specimens.
- Quartz sand and crystals, calcite crystals.
- Small quantity of table salt.
- Magnifying glasses or microscope.

1. Examine the specimens with the naked eye, then with the magnifying glass. Study the shapes of each variety of crystals. Draw a picture of each one.
2. Separately, put the quartz sand and calcite crystal in a glass of plain water. Separately, put some of the salt in a glass of water.

Discussion:

1. How are all of the specimens different? What similar characteristics do they have?
2. What happened to the specimens when put into water? Why? What physical or chemical properties could account for their behavior?

ALTERNATE ACTIVITY 2. Attend a meeting of your local rock, gem, and mineral club (see Appendix 4).

ALTERNATE ACTIVITY 2. Visit a museum with rock and mineral collections (see Appendix 4 and MS 125).

ALTERNATE ACTIVITY 2. Create a classroom rock and mineral exhibit. Ask a geologist to visit the class and help to identify the specimens. As a class, write the Florida Geological Survey and request a rock and mineral kit for your class.

- PART 2 LEARNING ACTIVITIES -

(VIDEO BREAK No. 2)

ACTIVITY 3. FOSSILS AND FOSSILIZATION PROCESSES

KIT RESOURCES:

Special Publication 35, pages 8 - 25.

Map Series 125, A Guide Map to Geologic and Paleontologic Sites in Florida, by Frank Rupert, Florida Geological Survey.

HELPFUL ITEMS:

student's personal fossil collections

museum visits

field trips

Florida's Fossil Mammals, FGS poster.

Common Cenozoic Echinoids From Florida, FGS poster.

A Guide to Identifying Florida Fossil Shells and Other Invertebrates, by Lelia and William Brayfield, Florida Paleontological Society, University of Florida, Gainesville, 113 p.

Florida's Fossils, Guide to Location, Identification and Enjoyment, by Robin Brown, Pineapple Press, Sarasota, 208 p.

Fossils - A Guide to Prehistoric Life, A Golden Nature Guide, Golden Press, available at most local book stores.

1. Arrange a field trip to a mine, beach, or other collecting site to look for Florida fossils. *Map Series 125* gives locations of many prospective sites. Permission must be obtained before entering any property, anywhere. Two phosphate companies in the Mulberry, Polk County, area which still permit group collecting at the time of this publication are: IMC Agrico (contact Larry Peace or Larry Issac, 813-428-2500), and Cargill Corporation (Joyce Bode, 813-285-8125).

TIP: Make a sieve for separating and washing fossils. It can be easily made by nailing together a square frame, about 12" x 12" x 2.5" high, then tacking onto one side some heavy wire (hardware cloth) with about 1/4" mesh.

2. Create a classroom fossil exhibit. With student finds, label each fossil by name, age, geological formation in which it was found, and the location. Consult the suggested reference materials and museum experts for help in identifying the fossils.

3. Visit a museum housing representative fossils and fossil displays; consult telephone directory. *Map Series 125* lists several Florida museums with fossil collections. Others are listed in Appendix 4.

4. Contact the Florida Geological Survey or the Geology departments at local universities to request speakers or guided tours.

5. Contact local fossil clubs for information on their activities. See Appendix 4 for listing of Florida fossil clubs.

PART THREE -- Geological Hazards

SUNSHINE STANDARDS

SCIENCE: The nature of science

Standard 2. The student understands that most natural events occur in comprehensible, consistent patterns.

Standard 3. The student understands that science, technology, and society are interwoven and interdependent.

SCIENCE: Processes that shape the Earth

Standard 1. The student recognizes that processes in the lithosphere, atmosphere, hydrosphere, and biosphere interact to shape the Earth.

SCIENCE: Force and motion

Standard 1. The student understands that types of motion may be described, measured, and predicted.

Standard 2. The student understands that the types of force that act on an object and the effect of that force can be described, measured, and predicted.

SOCIAL STUDIES: Economics

Standard 1. The student understands how scarcity requires individuals and institutions to make choices about how to use resources.

KEY QUESTIONS

1. What are glaciers?
 2. Why does the sea level rise and fall?
 3. What causes Florida's coastlines to be a battleground between geological forces?
 4. Why doesn't Florida have earthquakes?
 5. What is karst?
 6. What is radon?
-

OBJECTIVES - As part of this lesson the student will:

1. Understand how glaciers function.
2. Understand the role of climate in shaping Florida's landforms.
3. Understand how wind, waves, and plate movements can affect shorelines.

KIT RESOURCES:

Part 3 Learning Activities.

Special Publication 35, p.15-29; 47-57.

OTHER RESOURCES: (see Appendix 5).

Italicized words in text are defined in Appendix 1.

PART 3 GEO-FACT 1: Paleoindian people lived in areas of Florida that are now underwater.

PART 3 GEO-FACT 2: Eighty percent of Florida's 14 million residents live within 30 miles of the coast.

PART 3 GEO-FACT 3: We cannot stop geological processes, but understanding the processes helps us to live more safely with them.

FLOODPLAINS

Flooding of urban areas causes serious problems in Florida, such as destruction of property, loss of life, the threat of disease, and huge losses of money. Many times, the damage from flooding is magnified by society's actions. Conversely, by understanding how natural drainage systems work, people can plan their developments or construction to avoid flooding problems.

Under natural conditions it is normal for all streams or rivers, of any size, to occasionally overflow their channel embankments and flood the surrounding land. The land adjacent to a stream that is subject to flooding is called a *floodplain*. Such flooding usually is caused by larger than normal amounts of rainfall.

Historically, floodplains have always been prime real estate. Their soils usually are thick, rich in nutrients, and well watered; ideal for growing crops and animals. Consequently, people have always farmed them and built on them or near them. Communities grew up at important stream junctions or bridge crossings and, with continued growth, tended to encroach upon the floodplains. Each farming operation, bridge or other building within the limits of a stream's floodplain will incrementally obstruct the flow of water,

resulting in the lowering of the stream's ability to carry the runoff from rainfall. If there are enough obstructions, and higher than normal rainfall, the chances are good that there will be a flood, to some local degree. In Florida, not just "higher than normal rainfall," but torrential rainfall events are common, both from tropical storms, as well as from hurricanes. Another critical factor to be considered is the effect of urban growth, even that which is not directly on a floodplain. Florida's explosive population growth has resulted in ever-increasing demands for housing, roads, and other urban infrastructure to support it. Every square meter of new roof, new road, or new parking lot represents another square meter of impervious surface that will shed rainfall, creating and increasing runoff of rainwater. Some of this runoff will be absorbed by soil. However, once the capacity of the soil to absorb rain is surpassed, the excess water will add to local streamflow. At some point, the stream will fill, reach floodstage, then overflow its channel.

These facts, then, lead to an important conclusion: each new impervious surface on a floodplain or near a stream will increase both the frequency and magnitude of a flood; the stream will flood more often and the flood waters will rise higher.

- PART 3 LEARNING ACTIVITIES -

(VIDEO BREAK No. 3)

GEOLOGICAL HAZARDS

HELPFUL ITEMS: Magazines and newspapers in libraries or from newsstands: Reports of flooding, hurricanes, earthquakes, landslides, radon, or sinkhole formation.

ACTIVITY 1. Based on a newspaper article about a natural disaster anywhere in the world, write a brief explanation of why you think the publisher thought this would be of interest to readers.

ACTIVITY 2. Do you think the citizens of Florida should be concerned about this type of geological natural disaster happening to them? List the historical, climatological, and geological factors that you think support your answer.

ACTIVITY 3. Examine the land use in the area or region where the natural disaster occurred, paying particular attention to population and building density in urban areas, roads, water resources and uses, coastal zone or floodplain uses, and farming practices. Write a summary list of those activities of humans that you think may have contributed to increasing the damage or financial losses from the disaster. Alongside each contributing factor, briefly list the reason for its significance. Also, comment on policies or practices that society could have done differently to lessen the damages.

ACTIVITY 4. Plan a field trip to a sinkhole. Note the character of the surrounding landscape -- does it slope into the sinkhole; are there cracks in the soil; does it look very old or relatively younger? If it has water, does its level appear to go up and down with rain; does surface water appear to run directly into it? Critical observations of these characteristics of the sinkhole will give clues to its hydraulic connection to the underlying aquifer, and the potential for water-borne, surface contaminants to enter the aquifer directly through the sinkhole. After studying the sinkhole, discuss reasons why it is dangerous to swim and scuba dive in sinkholes.

PART FOUR -- Economic Minerals, Water Resources, and Waste Disposal

SUNSHINE STANDARDS

SCIENCE: The nature of matter

Standard 1. The student understands that all matter has observable, measurable properties.

SOCIAL STUDIES: Economics

Standard 1. The student understands how scarcity requires individuals and institutions to make choices about how to use resources.

MATHEMATICS: Measurement

Standard 1. The student measures quantities in the real world and uses the measures to solve problems.

Standard 2. The student compares, contrasts, and converts within systems of measurement (both standard/non-standard and metric/customary).

Standard 3. The student estimates measurements in real world problem situations.

Standard 4. The student selects and uses appropriate units and instruments for measurement to achieve the degree of precision and accuracy required in real world situations.

MATHEMATICS: Algebraic thinking

Standard 1. The student describes, analyzes and generalizes a wide variety of patterns, relations and functions

MATHEMATICS: Number sense, concepts, and operations.

Standard 1. The student understands the different ways numbers are represented and used in the real world.

Standard 2. The student understands number systems.

Standard 3. The student understands the effects of operations on numbers and the relationships among these operations, selects appropriate operations, and computes for problem solving.

KEY QUESTIONS

1. What resources do we get from the earth?

2. What is reclamation?

3. Why is the hydrologic cycle important to Florida?

4. What are, *permeability, transmissivity and porosity*?

5. How do our activities affect the quality of our drinking water?

6. How can we reduce the amount of solid waste which goes into our landfills?

OBJECTIVES - As part of this lesson the student will:

1. Explain the uses of materials we get from the Earth.
2. Show how mining disrupts ecosystems and explain how reclamation recycles land.
3. Illustrate hydrologic cycle and describe its functions.

4. Improve their awareness of how ground water flows through rocks.

5. Discover the relationships between human activity and the quality of our drinking water.

6. List 5 things that will help in reducing the amount of solid waste going into landfills.

KIT RESOURCES:

Part 4 Learning Activities.

Special Publication 35: pages 29 - 46, 58 - 60.

DEPARTMENT of ENVIRONMENTAL PROTECTION RESOURCES (see Appendix 5 for additional resources):

Florida Rock and Mineral Kit, available from Florida Geological Survey.

OTHER RESOURCES:

Students' personal rock and mineral collections.

Italicized words in text are defined in Appendix 1.

PART 4 GEO-FACT 1. 1.5 billion dollars worth of minerals are mined annually, ranking Florida 10th nationally in value of minerals produced.

PART 4 GEO-FACT 2. Florida generates over 19 million tons of solid waste each year. That's enough to fill a football stadium once a day.

PART 4 GEO-FACT 3. The amount of water used in Florida each year (approximately 1,500,000,000,000 gallons) is almost twice the amount of water found in Lake Okeechobee.

AQUIFERS Almost all of the fresh water used in Florida comes from ground-water *aquifer* systems. They are, therefore, natural resources of incalculable value. An understanding of the geological factors that control these aquifers' occurrences, and the flow of water through them, is crucial to protecting them from pollution.

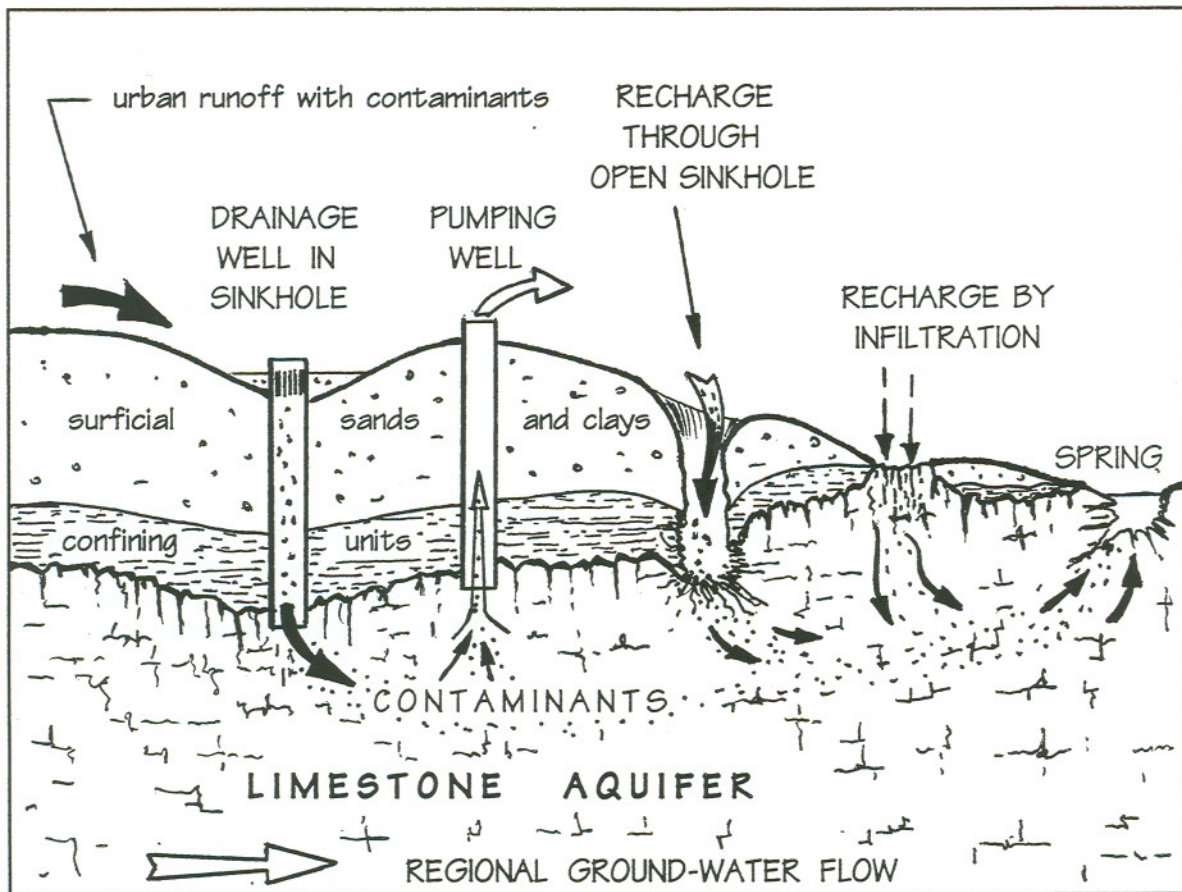
Porosity and *permeability* are physical attributes of some rocks that allow them to store and transmit water (SP-35, p. 43). All ground water occupies the open spaces, or pores, that occur in rocks. All

of Florida's aquifers are in sedimentary rocks, either sand, gravel, *limestone*, or *dolostone*, or some combination of these rocks. The pores in Florida's sedimentary rocks result from the stacking arrangement among the irregular grains. Florida's limestones or dolostones are thought of as being "solid" rocks, but they often have granular textures and considerable porosity. Quite often, the pores of these rocks are interconnected, making the rocks permeable, and capable of allowing water to flow through them.

The accompanying diagram illustrates the usual configuration of the sedimentary units that create the aquifers in Florida. Most of Florida is mantled with *clastic* sediments, of varying combinations of gravels, sands, silts, or clays. Underlying these clastics are carbonate rocks, such as limestones or dolostones. In some areas rocks having relatively low permeability, called confining beds, effectively seal-off and separate the clastics from the carbonates, making the deeper carbonate aquifer a *confined aquifer*. This situation commonly occurs in Florida, where two or more aquifer "systems" lie adjacent to one another, each having water with different characteristics, such as quality or temperature. If the integrity of a

confining bed is broken, ground water can flow from one aquifer to another. The usual breaches in confining beds are natural, caused by sinkholes, or man-made, by drilling wells through them. Any breach, however, can create an easy route for contaminants to enter the aquifers, polluting their water. This polluted water can be the source of contamination to private or public water supply systems, or to springs that discharge to surface streams.

Ground water, with any entrained pollutants, that flows through caves or cavernous conduit systems can travel several miles in a few hours. In contrast, ground water flowing through less permeable rocks could take days, weeks, or even years to travel the same distance.



Simplified diagram showing features common to aquifers in Florida. The ultimate source of recharge to the aquifers is rain. This water can reach the underlying aquifers by several routes: (1) by infiltrating downward through the sandy soils or where limestone crops out at the surface; (2) through sinkholes that breach the confining beds; or (3) through wells or natural fractures that cut through the confining beds. Contaminants can enter the aquifers through these breaches and be carried long distances by the natural flow patterns of the ground water. Discharge from the aquifers is by pumpage from wells or at springs, such as Silver Springs or Wakulla Springs.

- PART 4 LEARNING ACTIVITIES -

(VIDEO BREAK No. 4)

SOLID EARTH MATERIALS AND MINING

After watching Part 4 of the video:

ACTIVITY 1. Think about one day in your life. Starting with the time you get up, make a list of how many things, objects or products you use that come from the Earth. How many of these probably needed the expertise of a geologist to find, mine, manufacture, or transport to you? Compare this list with the one you made at the beginning of the video, for PART ONE Learning Activity.

ACTIVITY 2. Indicate on your list those materials that are mined closest to your home.

KIT RESOURCES:

Special Publication 35, pages 43 - 50.

DEPARTMENT of ENVIRONMENTAL PROTECTION RESOURCES (see Appendix 5 for other resources):

Florida's Hydrogeologic Environment, by Paulette Bond: Florida Geological Survey, color poster showing the hydrogeology of karst terrain.

ACTIVITY 1. DEMONSTRATION of AQUIFER CHARACTERISTICS: porosity, permeability, recharge, and storage.

This simplified example shows how a hydrogeologist would approach an investigation or an analysis of the physical characteristics of an aquifer.

Supplies needed:

1. Transparent plastic container, such as a clear, two-liter, plastic soda bottle, with the top cut off neatly.
 2. A piece of transparent plastic tubing, about 2-feet long, 1/2" diameter.
 3. Food dye, Kool-Aid, or colored mouthwash.
 4. Clean sand or aquarium gravel, enough to fill the container in step 1, above. Beach sand can be used, but it should be washed thoroughly with tap water to remove the salt.
 5. Any other source of sand will probably contain significant amounts of silt, clay, or organic matter, which should be washed out. This can be done by putting the sand in a container, with a small amount of dish detergent, shaking or stirring to thoroughly mix the sand and soap, then pouring off the water. Repeat until the sand is relatively free of the clay and soap.
 6. Let the sand dry before beginning the demonstration, preferably air dry.
- CAUTION:** Do not microwave the sand to dry it.
7. A graduated container to hold enough water to fill the container in step 1, above. Any container will do, such as a clean, gallon milk-jug. A graduated scale can be made from a piece of paper marked off in centimeters, and taped to the side of the jug.

Demonstration:

1. Put the tubing in the container, but hold it a short way off the bottom.
2. Fill the container almost to the top with the sand. It does not need to be tamped down.
3. Fill the milk-jug with tap water, to the level of the top of the graduated scale; and add enough food dye, Kool-Aid, or mouthwash solution to color the water.
4. **RECORD** the reading of the level of the water in the milk-jug.
5. **SLOWLY** pour the water from the jug into the container of sand, trying not to disturb the surface very much, and allowing the water to *percolate* down through the sand. Continue pouring until the water just reaches the top of the sand. You have just filled a container with water that supposedly was already full of sand !
6. **RECORD** the reading of the level of the water in the milk-jug. Subtract the second reading from the first reading.
7. **SLOWLY** siphon some of the water up into the tubing; it can be held up by pinching the tube closed. Observe what happens to the water in the sand.

Discussion:

1. The sand-filled container represents an aquifer, a body of rock that holds water, and which can supply water to a well or spring.
2. The tubing represents a pumping water well drilled into the aquifer.
3. **POROSITY** is a measure of the amount of open spaces, or pores, in a material.
4. **PERMEABILITY** is the measure of how easily a fluid or gas can move through the pores of a material. Although this demonstration does not actually measure the sand aquifer's permeability, it does show that the water travels through the pores to supply the "pumping well."
5. **RECHARGE** is water that replenishes an aquifer, usually supplied by rain falling on the Earth's surface. In this demonstration, the aquifer was "recharged" by "rainwater" poured from the milk-jug, which then percolated downward through the aquifer's pores.
6. The "pumping well" withdrew water from the aquifer's pores. This water could have been used for drinking, irrigation, a manufacturing process, or any other use by society. As the well pulled in water from the surrounding sand, the water level in the aquifer fell. If the well was pumped for a long enough time, it could "de-water" the aquifer. Not all the water could be extracted, however, since some would remain stuck to the sand grains so tightly that it could not be pumped by the well.

Exercise: Calculate the porosity of this simulated aquifer. (The numbers used here are to show examples of calculations, only; every type of sand will produce different values. The letters used in the formulas are shown on the diagrams.)

1. The porosity of an aquifer is expressed as a *percentage* of voids relative to the total volume of rock being studied:

$$\text{Porosity (\%)} = \frac{\text{voids}}{\text{volume}} \times 100.$$

2. The amount of water poured into the sand-filled container is a good approximation of the volume of the voids of the sand aquifer, because the water just filled the voids. Calculate the volume of water poured into the aquifer from the milk-jug; this represents the volume of voids:

$$\text{voids (cubic centimeters)} = \text{side a} \times \text{side b} \times \text{height of water (x - y)}.$$

3. Calculate the volume of the sand "aquifer" in the container:

$$\text{volume (cubic centimeters)} = \pi r^2 h. \quad (\pi = 3.14)$$

4. Solve equation 1, for porosity:

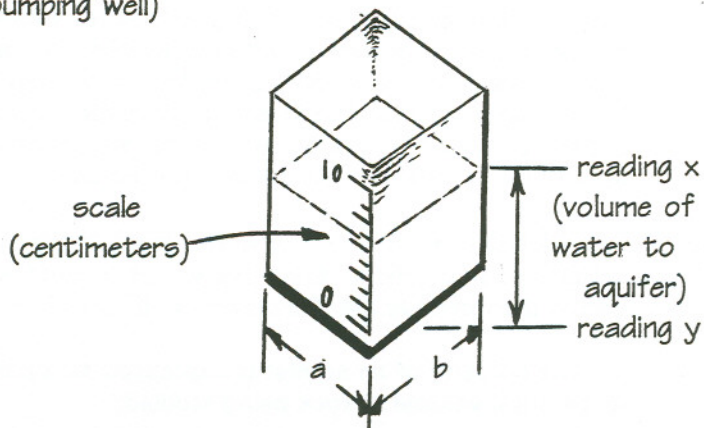
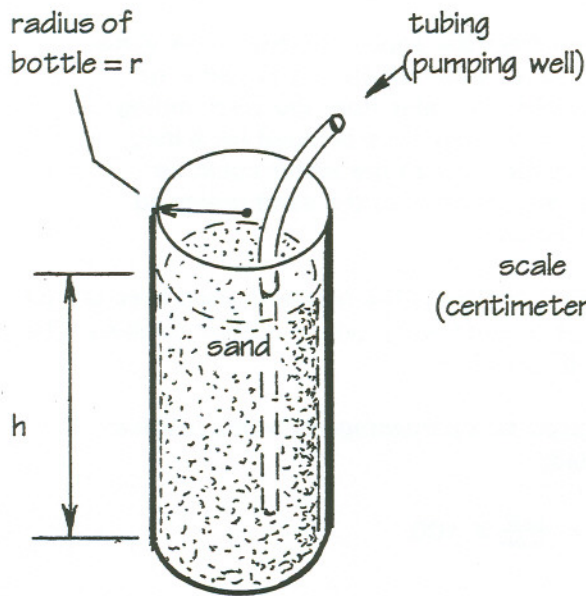
a. Calculate: $\text{voids} = \text{side a} \times \text{side b} \times \text{height of water (x - y)}$

$$\text{voids} = 14 \text{ cms} \times 14 \text{ cms} \times 1.25 \text{ cms} = 245 \text{ cubic centimeters.}$$

b. Calculate: $\text{volume} = \pi r^2 h = 3.14 \times (5 \text{ cms})^2 \times 10.5 \text{ cms} = 824.25 \text{ cubic centimeters.}$

c. Calculate: $\text{Porosity (\%)} = \frac{245}{824.25} \times 100 = 29.7 \text{ \%}.$

5. This percentage of porosity means that approximately one-third of the volume of the sand "aquifer" is open space, or voids. In this case, the porosity also approximates the amount of *storage* the aquifer has; in other words, it can "store" this quantity of water or gas. This is an important aquifer property, since it indicates to hydrogeologists the potential quantity of water that an aquifer could supply to a well.



"AQUIFER" CONTAINER

WATER SUPPLY

PART FIVE -- Environmental Concerns and Geological Careers

SUNSHINE STANDARDS

SCIENCE: Processes that shape the Earth

Standard 2. The student understands the need for protection of the natural systems on Earth.

SCIENCE: The nature of science

Standard 3. The student understands that science, technology, and society are interwoven and interdependent.

LANGUAGE ARTS: Listening, viewing and speaking

Standard 1. The student uses listening strategies effectively.

SOCIAL STUDIES: People, places, and environments (geography)

Standard 2. The student understands the interactions of people and the physical environment.

SOCIAL STUDIES: Economics

Standard 1. The student understands how scarcity requires individuals and institutions to make choices about how to use resources.

KEY QUESTIONS

1. What professional careers in the geological/sciences are available?
2. How do human activities impact the environment?
3. Why do we need to protect the environment and ecosystems?
4. How can waste be disposed of safely?
5. What is the role of government in protecting the environment?
6. What can individuals do to protect Florida's ground water?

OBJECTIVES - As part of this lesson the student will:

1. Explore different careers in geology.
2. List human activities which impact the environment.
3. Suggest ways that will contribute to the protection of the environment and ecosystems.
4. Suggest and analyze the safe disposal of wastes using geological knowledge.
5. Understand the different roles governmental agencies play in protecting the environment.
6. Discover how individuals can protect Florida's ground water.

KIT RESOURCES:

Part 5 Learning Activities.

Special Publication 35: pages 43 - 50, 58 - 60.

DEPARTMENT of ENVIRONMENTAL PROTECTION RESOURCES (see Appendix 5 for other resources):

EcoVentures™: Learning in Florida's Environment a multimedia environmental education program for middle school produced by Florida Department of Environmental Protection.

PART 5 GEO-FACT: Florida gains over 3,000 residents each week.

ENVIRONMENTAL CONCERNS

The video presents several ways that people can change their attitudes and

activities to help to protect environments and ecosystems. The educator can use these for hands-on activities or research projects.

List 1: How can we help conserve drinking water? (in Part 4 of video)

1. Use water-saving shower heads.
2. Do full loads of wash.
3. Fix leaks in plumbing.
4. Water lawn in early morning.
5. Use native plants that require little water.
6. Use shut-off nozzles on hoses.
7. Turn water off while brushing teeth.

List 2: How can we help win the battle against solid waste? (in Part 4 of video)

1. Don't litter.
2. Buy products with reduced packaging.
3. Use energy efficient light bulbs.
4. Use rechargeable batteries.
5. Buy recycled materials.

List 3: What can we do to protect ground water? (in Part 5 of video)

1. Follow directions when using fertilizers and pesticides.
2. Don't pour it down the drain.
3. Don't dump it on the ground.
4. Take household hazardous wastes to appropriate disposal facilities.
5. Keep septic systems maintained.
6. Buy biodegradable products.

- PART 5 LEARNING ACTIVITIES -

BREAK No. 5 - END OF VIDEO

ENVIRONMENTAL PROTECTION

ACTIVITY. What can I do to protect the environment?

"How can we help conserve drinking water?"

"How can we help win the battle against solid waste?"

"How can we protect our drinking water from pollution?"

Discuss with the students the different ways that they and their families can achieve these goals. Encourage them to start recycling programs in their homes, and generally come up with ideas regarding how each student's everyday behavior can be modified to help protect the environment. Discuss how the students or the entire class might start a new community program or participate in an existing community program to accomplish these goals. Now that they understand the importance of geology, have them "design" a new license plate or a poster that stresses geology's role in environmental conservation and protection.

GEOLOGY AS A CAREER

ACTIVITY 1. Resource People

Invite local geologists to visit the classroom and bring examples of work they do, hi-tech equipment they use, crystals, fossils, core samples, and the like. Check for geologists at local engineering consulting firms, universities, and community colleges.

ACTIVITY 2. Where are the geologists?

Discuss with the class the different agencies and places that a geologist might work. Let a team of students look in the phone book under: *geologist, environmental and ecological, sand and gravel, stone - crushed, erosion, and consultants*, to name a few. Also ask them to think of different governmental agencies, colleges, and universities that employ geologists. Local and regional agencies include city and county governments, water supply authorities, water management districts, planning councils, road departments, and environmental or planning offices. Examples of state and federal agencies include the Florida Geological Survey, Florida Department of Environmental Protection, the Florida Department of Health and Rehabilitative Services, Florida Department of Agriculture and Consumer Services, U.S. Geological Survey, U.S. Environmental Protection Agency, and the National Oceanographic and Atmospheric Administration.

ACTIVITY 3. What kind of geologist would I like to be?

Have the students make a list of "adventurous or 'cool' things that geologists do." The students should not limit their lists to things they observed in the video ... anything reasonable goes (for example: dinosaur fossil hunting, collecting rocks on the moon, studying volcanoes). The table below summarizes the most common geological professions, with references to associated "cool" things. Allow the students to discuss and become familiar with the different aspects of geology and the activities of geologists. Using the table as a guide, the instructor can select a few examples from the students' lists (or

classroom discussions) and mention or describe the related geological profession. For example, a student interested in beach erosion or the effects that Hurricane Andrew had on the coastline could be informed that this is primarily the job of a *coastal geologist*.

Instructors with more interested students could also discuss how the science of geology is unique because it integrates biology, chemistry, physics, and mathematics. For example, a geologist who studies ancient life needs to understand biological processes and anatomy; a geologist who studies earthquakes and how energy moves through the Earth's crust needs to understand principles of physics and know how to solve math problems. Nearly all of the geological professions make use of computers for creating models (such as the flow of ground water through limestone aquifers), storing and analyzing data, generating maps or cross sections, and for writing scientific reports.

Classroom discussion with interested students can be taken a step further. Some of the professions listed, such as *paleontologist* or *petrologist*, can be divided into more specialized areas of study. Recall the rock cycle and the different types of rocks ... there is a petrologist (who studies the origins of rocks) for every major type of rock: igneous petrology, metamorphic petrology, and sedimentary petrology. Sub-disciplines of paleontology include: paleobotany, paleoecology, invertebrate paleontology, and vertebrate paleontology. These examples may help the students understand the vast areas of specialization in the field of geology, as well as the composite nature of the science of geology.

COOL THINGS	PROFESSION	COOL THINGS	PROFESSION
volcanoes	volcanologist	crystals and minerals	mineralogist
explore caves, springs	karst geologist	explore the ocean floor	marine geologist
protect the environment	environmental geologist	mining for gold	economic geologist
protect the environment	geologist with degree in environmental law	dinosaurs, fossils, ancient life	paleontologist
earthquakes	seismologist	rocks and how they form	petrologist
high-tech laboratories	geochemist	water resources	hydrogeologist
huge sheets of ice, glaciers	glaciologist	hidden stories in ancient rocks	stratigrapher
sunny beaches	coastal geologist	the Moon, life on Mars	planetary geologist
oldest rocks on Earth	geochronologist	tectonic plates, faults	structural geologist
deep realms of Earth	geophysicist	make computer maps	geologist, cartographer
explore historic sites, study artifacts	geoarcheologist		

APPENDIX ONE

DEFINITIONS OF SELECTED GEOLOGICAL TERMS

amorphous - having no definite shape or boundaries; a term applied to rocks and minerals that have no definite crystalline structure.

Archaic Period - 8,000 BC - 500 BC, the period after which paleoindian people settled into permanent residence in Florida.

aquifer - a water-saturated zone of rock below the Earth's surface capable of producing water in useful quantities, as from a well.

artifacts - objects made by humans, such as stone tools; studied by geoarcheologists.

basalt - a dark-colored, fine-grained, igneous rock formed from molten rock that flowed onto the Earth's surface.

basement rocks or **basement** - refers to very deep, ancient rocks that underlie the continents and oceans.

basin - a large area of lower elevation than surrounding areas.

brachiopods - marine invertebrate animals in which the soft parts are enclosed by two shells, called valves.

bryozoa - tiny marine animals that build colonies with their shells.

calcareous - containing or primarily made of the mineral calcite (calcium carbonate, CaCO_3).

Cenozoic Era - the latest of the four eras into which geologic time, as recorded by the stratified rocks of the Earth's crust, is divided; it extends from the end of the Mesozoic Era to and including the present, or Recent.

clastics - consisting of fragments of rocks or organic structures: gravels, sands, silts, and clays.

confined aquifer - a zone of subsurface water-bearing rocks that contain water under pressure due to zones above and below it having low permeability, which restrict the flow of water into and out of it. An *artesian* aquifer is a type of confined aquifer.

coquina - soft, porous limestone composed of broken shells, corals, and other organic debris.

coral - small, colonial, bottom-dwelling, marine animals that secrete external skeletons of calcium carbonate (calcite). The colonies they create with their skeletons can make enormous reef-complexes, such as the Florida Keys, the Australian Great Barrier Reef, and many coral islands in the Pacific Ocean, and other oceans.

crinoid - a marine animal consisting of a cup or "head" containing the vital organs, numerous radiating arms, an elongate, jointed stem, and a root-like attachment to the sea bottom while the body, stem and arms float.

desalinization - the process of removing salt and other impurities from sea water in order to produce drinking water.

dolomite - $\text{CaMg}(\text{CO}_3)_2$, a rock-forming, carbonate mineral, very common in Florida.

dolostone - a term for a sedimentary rock composed of fragmental, concretionary, or precipitated dolomite of organic or inorganic origin.

echinoid - one of a group of invertebrate marine animals, many of which have spines; popularly called "sand dollars, sea biscuits, or sea urchins."

ecosystem - a community of organisms, including humans, interacting with one another and the environment in which they live.

environment - all of the external factors that may act on an organism, either plant or animal, or on a natural community. For example: gravity, air, wind, sunlight, moisture, temperature, soil, and other organisms are some of the environmental factors that may affect the life processes of an organism.

era - a large division of geological time consisting of two or more geological periods.

erosion - the natural processes of weathering, disintegration, dissolving, and removal and transportation of rock and earth material, mainly by water and wind, as well as by ice.

exotic terrain - a terrain that has undergone significant motion or travel with respect to the stable continent to which it is accreted. Florida could be considered an exotic terrain with respect to the North American continent, because it is thought to have once been part of northwestern Africa.

fault - a break in the Earth's rocks along which there has been displacement of the rocks. Displacement may vary from inches to miles.

floodplain - land next to a stream or river that is flooded during high-water flow.

foraminifera - small, one-celled, mostly marine animals which secrete shells of calcium carbonate or build them of cemented sand grains. They range in size from microscopic to a few centimeters across. They occur in such quantities that their fossil shells make up almost all of certain limestone rocks in Florida and other places in the world.

formation - a rock unit possessing distinctive characteristics, such as mineral content, fossils, or color, that allows it to be distinguished from adjacent rock units.

fossil - remains or traces of prehistoric animals or plants. The most common types consist of bones, carbon films, shells, molds, casts, and petrified wood.

fuller's earth - a type of clay that is commercially valuable and widely used as cat litter and as a dispersant in insecticides.

geology - the study of the planet Earth, the materials of which it is made, processes that affect these materials, the changes that the Earth has undergone in the past and the changes it is currently undergoing.

geomorphology - the branch of geology which deals with the form of the Earth, the configuration of its surface, and the changes that take place in land forms over time.

glacier - a large body of ice with definite lateral limits, which moves in a downslope direction due to its great mass, as in Alaska.

granite - a light-colored, coarse-grained, igneous rock formed from magma that cooled below Earth's surface.

groin - a shore-protection structure that projects away from shore, usually made of rocks, wood pilings, or sheet metal.

heavy minerals - a suite of accessory minerals of a sedimentary rock or sediments having specific gravities greater than 2.9. The most common heavy minerals found in Florida are: rutile, ilmenite, leucoxene, staurolite, zircon, kyanite, sillimanite, tourmaline, spinel, topaz, corundum, and monazite.

karst - a type of terrain characterized by sinkholes, caves, disappearing streams, springs, rolling topography, and underground drainage systems. Such terrain is created by ground-water dissolving limestone.

kaolin - a rock composed essentially of clay minerals of the kaolinite group, most commonly kaolinite. High purity deposits of this mineral are valuable for making quality ceramic products.

landfill - a method of waste disposal wherein materials are buried. Present environmental protection laws require the burial sites to be constructed with impermeable barriers, such as clay or plastic liners, to prevent hazardous wastes or pollutants from escaping to the surrounding soils or air.

lava - molten rock that flows onto the surface from a volcano or fissure.

limestone - a bedded sedimentary deposit consisting chiefly of calcium carbonate. Limestone is an important and widely distributed carbonate rock; it is the consolidated equivalent of limy mud, calcareous sand, or shell fragments.

lithify - to turn to rock. Several geological processes can operate to consolidate loose sediments into hard rocks. Pressure from thick sequences of overlying sediments can cause lithification; for example, loose sand turned into sandstone. Chemical changes caused by ground water can cement loose sediments into hard rocks; for example, loose sea shells and sand cemented into coquina limestone.

magma - molten rock generated within the Earth,

magnesium - a metal (Mg), which, when chemically combined with calcium carbonate, $\text{Ca}(\text{CO}_3)$, forms the mineral dolomite, $\text{CaMg}(\text{CO}_3)_2$.

marine - refers to sea water, to sediments deposited in sea water, or to animals that live in the sea, as opposed to fresh water.

mercury - a heavy, silver-white, metallic element, the only metal that is liquid at room temperature; also called quicksilver. A virulent poison, dangerous to handle and work with.

mollusks - invertebrate animals, including a variety of marine, fresh water and terrestrial snails; clams, oysters, mussels, scallops; squids, octopus, pearly nautilus, as well as the many extinct varieties.

paleoindians - archeological term referring to native American cultures prior to 8,000 BC; prehistoric inhabitants of Florida.

paleontology - the science that deals with the life of past geological ages, based on the study of fossils.

peat - a dark brown or black, organic residuum produced by the partial decomposition and disintegration of mosses, trees, and other plants that grow in marshes or other wet places. Peat deposits form when the rate of accumulation of plant matter exceeds the rate of destruction by weathering or organisms. One of the largest peat deposits in the world is in the Everglades.

percolation - movement of water through the pores or voids in rock or soil.

period - one unit of geological time into which Earth history is divided. A period is a subdivision of an era.

permeability - a measure of a porous material's ability to allow fluids or gases to flow through its pores. An important property of rocks that determines how much and how rapidly fluids or gases can move through them; for example, how much water can be pumped from an aquifer (see: *porosity*).

phosphate rock - a sedimentary rock containing calcium phosphate. Florida has some of the most extensive deposits of phosphate rocks in the world. Very important in the manufacturing of fertilizer.

plate tectonics - a theory that large "plates" of the Earth's colder, upper crustal rocks are capable of moving slowly (like rafts) on top of deeper, hotter, and more fluid rocks in the mantle. Geologists have identified seven large plates and 11 or more smaller ones on the Earth's surface.

Pleistocene Epoch - the earlier of the two epochs comprising the Quaternary period.

porosity - a measure of the amount of voids (pores) in a material. An important property of rocks that determines the quantities of fluids or gases they can store; for example, the amount of water an aquifer can store (see: *permeability*).

potable water - water that can be consumed by humans without ill effects. Government agencies have adopted standards of quality that specify limits of chemical constituents in water sources.

potentiometric surface - an imaginary surface defined by the level to which water in an aquifer would rise in a well due to the natural pressure in the rocks.

precipitate(s) - 1. the process whereby solids are left behind when liquids evaporate; for example, vast deposits of salt were created when ancient seas evaporated. 2. *precipitates*: the solid materials, themselves. (see: *precipitation*)

precipitation - 1. *hydrology*: water discharged from the atmosphere in the form of fog, rain, snow, sleet, or hail. 2. *chemistry*: the process of separating different minerals from a solution by evaporation; for example, salt from sea water.

radon - an invisible, odorless, tasteless, radioactive gas that is formed when uranium-238 decays. It can accumulate in buildings, causing potential health hazards.

reclamation - the act or process of restoring mined-out lands to a useful state. Also, the industry devoted to the recovery or re-use of waste materials.

rift or rifting - refers to the breaking apart of continental plates.

saline - salty; sea water or water nearly as salty as sea water.

salt-water intrusion - the phenomenon occurring when a body of salt water, because of its greater density, invades a body of fresh water. It can occur in bodies of either surface or ground-water. It is a common problem in coastal areas, caused when water supply wells over-pump the fresh water aquifers, pulling sea water into the aquifers.

sandstone - a type of sedimentary rock made of sand grains cemented together.

scarp - an escarpment, cliff, or steep slope along the margin of a plateau, mesa, or terrace.

seismic - pertaining to vibrations in the Earth, such as earthquakes; or to equipment or methods used to create Earth vibrations, such as exploding dynamite used in oil exploration.

shale - a type of sedimentary rock made of clay particles cemented together and which usually can be made to split into thin slabs (see: slate).

shoal - an underwater area covered by shallow water which may endanger boats.

siliciclastic - pertaining to clastic, non-carbonate rocks that are almost exclusively silicon-bearing, either as forms of quartz or as clays. Examples of Florida siliciclastics are loose quartz sands, silts, or clays.

siltstone - a sedimentary rock made of silt-size particles cemented together.

sinkhole - a depression in the land surface, usually round or funnel-shaped, that connects with a subterranean passage created by solution of limestone rocks by circulating ground water. Sinkholes may also form by collapse of a cavern roof.

slate - a type of metamorphic rock created from shale, and is usually harder than shale.

solution feature - a topographic or geomorphic feature of a landscape that was formed as a result of water dissolving rocks, usually limestone or dolostone, such as: sinkholes, caves, disappearing streams, springs, and sinkhole lakes.

spreading center - a fissure separating continental plates, created when the plates move apart.

stratigraphy - the branch of geology that studies the formation, composition, sequence, and correlation of the layered rock-sequences that make up the Earth's crust.

subduction - the geologic process whereby one continental plate slides under another and is gradually consumed in the Earth's interior.

suture - a line or mark of splitting open or of joining together, such as where parts of two continental masses collide and merge.

swale - a shallow depression in the land's surface which may be filled with water. In karst terrain it may indicate an incipient sinkhole forming.

tectonic - pertaining to the rock structures and external forms resulting from the deformation of the Earth's crust.

test - a hard covering or supporting structure of some invertebrate animals; a shell.

transmissivity - a property of an aquifer which defines the rate at which water moves through it.

transpiration - part of the life process of plants by which water vapor escapes from leaves and enters the atmosphere.

trilobites - ancient arthropods having a hard outer skeleton, and which became extinct over 200 million years ago.

unconfined - in reference to aquifers, it describes a condition whereby water-bearing rocks are at atmospheric pressure, *i.e.*, water table conditions.

unconformity - a surface of erosion or non-deposition that separates younger strata from older rocks. It represents a missing span of time from the rock record.

vertebrate - refers to animals that have a backbone.

water table - in an aquifer, it is the upper surface of the zone of saturation under unconfined conditions; water in the rocks is at atmospheric pressure.

APPENDIX TWO

QUIZZES: PRE- and POST-VIDEO VIEWING, WITH ANSWERS

See following two pages for the PRE- and POST-VIEWING "GEO-QUIZZES," which can be copied for hand-outs.

A PRE-VIEWING GEO-QUIZ
for the video
"Florida's Geology Unearthed"

Geology is all around us. Whether we know it or not, we see examples of its processes in action every day. The purpose of this video is to make viewers more aware of geology, how we are affected by geology, and how we affect environments and ecosystems. Before viewing the video, take this GEO-QUIZ. Don't be afraid if you don't know all the answers. There's lots to learn about geology !

Circle True or False.

- | | | | | | |
|--|---|---|---|---|---|
| 1. Geology is the study of the planet Earth, the materials of which it is made, and the processes that affect these materials. | T | F | 11. The peninsula of Florida formed as sediments from the Rocky Mountains eroded. | T | F |
| 2. Within the Earth's shallow layers are rocks, minerals, and water. | T | F | 12. Fossils can date back to a time before humans existed. | T | F |
| 3. An ecosystem is any area where only living systems are found. | T | F | 13. Ocean levels have basically remained the same for millions of years. | T | F |
| 4. The shape of the Earth's surface is determined by geologic processes. | T | F | 14. Coal and gold are mined in Florida. | T | F |
| 5. Sinkholes and coastal erosion are geological processes that affect Florida. | T | F | 15. Winds, waves, and plate movement can affect coastlines. | T | F |
| 6. Early humans appeared on Earth about two million years ago. | T | F | 16. Most of Florida's residents live near the coasts. | T | F |
| 7. The Earth's surface is divided into approximately 21 plates. | T | F | 17. Sinkholes form when sand and clay dissolve. | T | F |
| 8. The Atlantic Ocean is not widening. | T | F | 18. Floodplains are low-lying areas around rivers and streams. | T | F |
| 9. Pangea was an ancient continent. | T | F | 19. Florida does not produce oil or natural gas. | T | F |
| 10. The Florida Platform is wide and relatively flat. | T | F | 20. Less than 1 % of the Earth's water is drinkable. | T | F |

Now that you've completed the GEO-QUIZ, sit back and enjoy the video! Listen for the answers to the questions you just completed. You might know more about geology than you realized !

A POST-VIEWING GEO-QUIZ

for the video

"Florida's Geology Unearthed"

Circle True or False.

1. Geology is the study of the planet Earth, the materials of which it is made, and the processes that affect these materials.	T	F	11. The peninsula of Florida formed as sediments from the Rocky Mountains eroded.	T	F
2. Within the Earth's shallow layers are rocks, minerals, and water.	T	F	12. Fossils can date back to a time before humans existed.	T	F
3. An ecosystem is any area where only living systems are found.	T	F	13. Ocean levels have basically remained the same for millions of years.	T	F
4. The shape of the Earth's surface is determined by geologic processes.	T	F	14. Coal and gold are mined in Florida.	T	F
5. Sinkholes and coastal erosion are geological processes that affect Florida.	T	F	15. Winds, waves, and plate movement can affect coastlines.	T	F
6. Early humans appeared on Earth about two million years ago.	T	F	16. Most of Florida's residents live near the coasts.	T	F
7. The Earth's surface is divided into approximately 21 plates.	T	F	17. Sinkholes form when sand and clay dissolve.	T	F
8. The Atlantic Ocean is not widening.	T	F	18. Floodplains are low-lying areas around rivers and streams.	T	F
9. Pangea was an ancient continent.	T	F	19. Florida does not produce oil or natural gas.	T	F
10. The Florida Platform is wide and relatively flat.	T	F	20. Less than 1 % of the Earth's water is drinkable.	T	F

ANSWER SHEET

to the

pre- and post-viewing GEO-QUIZZES

1. True. Geology incorporates the sciences of biology, physics, and chemistry, as well as geology.
2. True. Underneath the Earth's crust are layers of solid and semi-molten rocks.
3. False. An ecosystem is any area where living *and* non-living systems are found.
4. True. Tectonic plate movement and volcanic activity are two processes that shape our Earth.
5. True. These are only two examples of geologic processes that affect Florida. Others include radon gas, unstable soils and clays, and river flooding.
6. True. Humans appeared on Earth long after fishes, reptiles, and birds.
7. True. The Earth's plates move in different directions, causing earthquakes at their borders.
8. False. The Atlantic Ocean is widening at a rate of less than five centimeters a year !
9. True. This ancient continent was composed of what is now North and South America, Africa, Europe, Asia, Australia, and most other land masses.
10. True. The Florida Platform lies between the Atlantic Ocean and the Gulf of Mexico.
11. False. Florida's peninsula formed as the Appalachian Mountains eroded.
12. True. Remember, humans appeared just two million years ago !
13. False. Ocean levels rose and fell as much as 300 feet during the Ice Age.
14. False. Neither gold nor coal are mined in Florida.
15. True. The storm surge associated with Hurricane Andrew drastically affected the coastline of southeast Florida.
16. True. 80 % of Florida's residents live within 30 miles of the coast !
17. False. Sinkholes can form when limestone dissolves, not clay and sand.
18. True. Homes and businesses built on floodplains are subject to flooding during periods of heavy rain.
19. False. Florida has produced oil and natural gas for more than 50 years.
20. True. Most of the water covering the Earth is salt water.

APPENDIX THREE

OPTIONAL ACTIVITIES

OPTIONAL ACTIVITY 1: MAPS, MAP READING, AERIAL PHOTOGRAPHS, and SATELLITE IMAGES.

- HELPFUL ITEMS:**
- Open-File Report 67:* Topographic Maps, by Frank Rupert, Florida Geological Survey.
 - County soil survey maps, U.S. Natural Resource Conservation Service, available at county district offices and some local and university libraries.
 - Topographic maps, aerial photographs, and satellite images: available from U.S. Geological Survey, some university libraries, and some local stores that sell maps.

A *map* is a representation of the geographical environment. Maps come in many different forms. Perhaps the most common type of map is printed or drawn on a flat surface, such as a sheet of paper. However, globes, physical models, line drawings, and both photographs taken from aircraft and electronic satellite images are also types of maps. Map makers are called *cartographers*.

Maps are vital tools in studying geology. Different types of maps are prepared and used by geologists to depict a variety of things about our physical environment, including the shape of the earth's surface, the types of soil and sediments which occur at the surface, the distribution of mineral resources, as well as the types of rocks found beneath the surface of the earth. The entire list of maps used by earth scientists is extensive, and beyond the scope of this introduction. Some of the most common types are described below.

Soil maps: A soil map shows the distribution of different soil types within a certain geographic region. The common types in use today show the standard soils types defined by the United States Department of Agriculture's Natural Resource Conservation Service. They are constructed to show the soil distribution within individual counties. The area of occurrence of various soil types are represented on the soil map by irregular polygons. Soils can be important indicators of the local geology. Many soils form from the erosion and chemical breakdown of the underlying bedrock. Others are carried in from distant areas and deposited by rivers, streams, or the wind. In this respect, soils are intimately related to the geology of the region. Soil maps are also useful to farmers, as certain soils are better for crops, and to construction engineers, who must consider the physical characteristics of soils when designing building foundations.

Topographic maps: A topographic map is a map illustrating the topography or shape of the land surface. Topographic maps show the locations and form of hills, valleys, streams, and other features as well as many man-made landmarks. They illustrate the shape and elevation of surface features by the use of *contour lines*. Contour lines are imaginary lines (they exist on paper only) which connect points of equal elevation on the earth's surface. They provide a means of displaying three-dimensional information on a two-dimensional sheet of paper. The vertical difference in elevation between adjacent contour lines is called the *contour interval*.

Consider the illustration in Figure 1. As shown in the upper portion, this figure illustrates a section of hilly coastline bisected by a flat stream valley, and featuring a flat, sandy spit enclosing a small bay. If we were to go to this site and actually paint horizontal lines of equal elevation on the hills and valley floor at each 20 feet interval above sea level in elevation, then look down on the scene from above, we would see a view similar to the map in the lower part of the figure. The lower portion of Figure 1 is a topographic map of this section of coast. Notice several things about the map in this figure which hold true of all topographic maps:

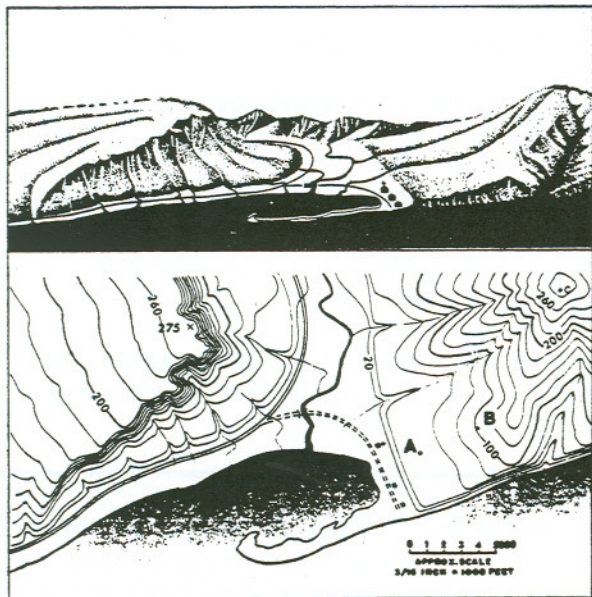


Figure 1. Perspective view and topographic map of a section of hilly coastline.

looking straight down at a yardstick lying flat on the ground, the inch marks appear spaced uniformly at 1 inch apart. Now slowly lift one end of the yardstick to form an imaginary slope face while still looking down at it and watch the inch marks appear to move closer together as you increase the slope of the stick.

2) The land slope, or the ratio of vertical to horizontal distance, may be determined from topographic maps. Slope is usually expressed as a ratio (*i.e.*, 1:100) or as a percent (1 percent). The slope between points A and B on Figure 1, for example may be calculated by dividing the elevation increase (vertical distance) from A to B by the horizontal distance between the points. In this case the vertical distance is the elevation at B (100 feet) minus the elevation at A (about 50 feet, as it is halfway between the 40 and 60 feet contour lines), which equals 50 feet. The horizontal distance between A and B is measured from the map bar scale at the bottom of the map, and is approximately 3500 feet. Therefore, the slope is 50/3500 or 1:70, or 0.014 (1.4 percent).

3) Contour lines do not intersect, cross, or branch. They may touch or coincide only on very steep slopes (and this is commonly due to the thickness of the printed contour lines - only on vertical slopes would the lines truly coincide).

4) Contour lines form a "V" pointing upstream (or up-gradient) in stream valleys or drainage rivulets. In closely spaced stream valleys, such as those shown on the hill on the right in Figure 1, a series of "W" shapes may result; the stream valley "V's" point towards the top of the hill, the down slope-pointed "V's" are the intervening noses of higher ground between streams.

1) Contour lines appear closely packed together on the steep bluff face on the left. In the flat valley and on the gently-sloping hill top above the bluff, they are widely-spaced. This is because on steep slopes elevation increases occur with greater frequency per unit of horizontal map distance and thus appear closer together. To visualize this, imagine a yardstick with the inch markings representing short, parallel contour lines;

5) The contour interval is constant on any map. Every fourth or fifth contour line is labeled with their elevation for reference; on actual topographic maps, the contour lines representing every 50 feet of elevation are commonly labeled, while those in between are not. Spot elevations are sometimes shown for specific points on the map. All elevations are relative to mean sea level, which is taken to be "0" foot elevation.

6) Wide rivers and streams are defined by parallel lines approximating their mean width; narrow streams and creeks are shown with single blue lines; coastlines and lake shores are shown with a single unlabeled line.

7) Local man-made structures, including buildings, roads, and bridges are commonly shown.

On actual topographic maps, many of the different features are delineated in color; contours lines are brown, water is blue, roads are printed in red or black, and structures are printed in black. Cities and other large areas of manmade disturbance are usually printed in either purple or gray shading. Areas of vegetation are shaded green.

Topographic maps are prepared today largely from composite aerial photographs, with field checking where needed, and provide some of the most accurate local detail available. Therefore they are a useful tool for locating possible new sites, planning fossil-hunting expeditions, and as references in accurately documenting the location of known fossil sites. Topographic maps can be especially useful in locating areas where fossiliferous strata may be exposed, either naturally by stream erosion and karst activity, or by man's excavations.

Topographic maps in Florida: The entire state of Florida has been mapped by the U.S. Geological Survey in 7.5 minute topographic quadrangles. These maps are termed *seven-and-a-half minute quadrangles* because each map covers a rectangular area of land surface equal to 7.5 minutes of longitude in width (about 7.5 miles) and 7.5 minutes of latitude in height (8.5 miles). Latitude and longitude tick marks are provided along the margins of topographic maps. One thousand and thirty-seven 7.5 minute quadrangles are required to cover the entire state. The actual paper quadrangle maps are about 23-inches wide by 27-inches high. This size allows a standard scale for the map of 1:24,000 (one unit of map distance, in inches, feet, or millimeters, etc., equals 24,000 of the same units on the surface of the earth). The fractional scale and a bar scale of distance is part of the information printed at the bottom of the map. The direction of true north is always towards the top of the map. Magnetic north, which may be a few degrees east or west of true north, is also indicated on the map.

Earlier topographic maps, generally dating from prior to 1940, were based on 15 minute quadrangles. These covered an area equivalent to four of the 7.5 minute maps, and had a scale of 1:62,500. The larger, modern 7.5 minute maps generally provide better detail, although the older maps can often be used to document historical changes in land features or urban sprawl.

Today, each topographic quadrangle map is given a specific name, usually based on some local geographic feature (*i.e.*, Tallahassee Quadrangle, Okeechobee NW Quadrangle, etc.). Certain of the maps, especially those in highly-populated areas, are updated every several years to show the expansion of civilization. Others in more remote locations may not have been updated since the original mapping in the 1940s. A handy index showing the locations and names of all 1,037 quadrangle maps covering the state is printed by the United States Geological Survey.

Geologic Maps: A geologic map illustrates the rock formations that occur at or near the earth's surface in a specific geographic area. Geologic maps may also show fault lines and other geologic features in an area. The various rock units occurring in an area are generally shown on the map with different colors or patterns. In an area of completely horizontal rock strata, only the uppermost rock unit would be shown covering the entire map. Rocks are rarely flat, and in many cases natural forces have tilted, folded, or domed up the local rock strata so that, once planed flat by erosional forces, two or more different rock units are exposed at the surface.

Geologic maps are useful in illustrating the occurrence of different rocks at the earth's surface. Geologic maps are typically used in searching for economic mineral deposits, fresh water-bearing rocks, or for locating fossiliferous strata, to name a few. They may be used by the construction industry to find suitable materials for building foundations. Such maps may also be used to locate areas of low-permeability strata for siting potentially dangerous waste dumps, land fills, or other environmentally-hazardous operations.

Aerial Photographs and Satellite Images: An *image map* is any photographic or electronic scanner image of the earth's surface. Image maps commonly include aerial photographs, taken by high-flying aircraft, and satellite images, taken from earth-orbiting satellites. Adjacent individual aerial photographs may be spliced together to show a broader area than the one single photo could show. Such a collage of photos is called a *mosaic*.

Image maps show the true configuration of features on the earth's surface, including rivers, lakes, coastlines, and mountains. Certain types of aerial photographs, called *stereo pairs*, taken simultaneously by twin cameras angled at slightly different angles to the surface, can even show the earth's surface in three-dimensions when viewed through a stereoscope. Image maps are very useful in constructing other types of maps. They are, for example, used extensively in the construction of the topographic quadrangle maps described above. Image maps are also viewed directly in studying natural features on the surface. False-color image maps are produced using special color-filters which alter the true colors of surface vegetation, wet areas, areas disturbed by man, and soils, commonly revealing features not readily observable in natural-color images. Geologists use image maps to trace rock formations, faults, study the configuration of rivers and coasts, and even prospect for mineral deposits from space.

The United States Geological Survey has produced several versions of a false color satellite image map of Florida. Many interesting geomorphic features are readily visible on this map. The varying vegetation types of crops, marshes, swamps, and scrub areas are easily discernible. Also apparent are the ancient coast-parallel beach ridges spanning the center of the peninsula. Florida's numerous lakes and larger sinkholes may also be observed, as well as cultural urban sprawl, particularly in metropolitan areas such as Jacksonville and Miami.

APPENDIX THREE

OPTIONAL ACTIVITIES

OPTIONAL ACTIVITY 2: CREATING SEDIMENTARY ROCK STRATA.

A. Supplies needed:

1. a transparent plastic container, about 6-inches square by 9-inches high;
2. a small amount of clean, light-colored sand ... enough to fill the container about two-inches deep;
3. a small amount of darker-colored sand ... enough to fill the plastic pan about one-inch deep.

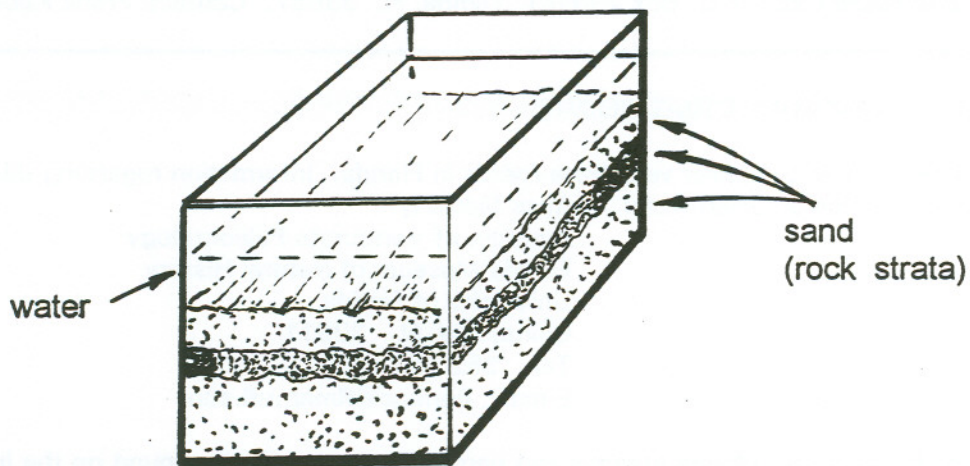
NOTE: the quantities of sand, water, and size of the container can be changed to enhance the final outcome of the experiment.

B. Demonstration:

1. Fill the container about half-full of water.
2. Gently dump into the water about half of the light-colored sand and let it settle.
3. Gently dump the darker sand into the water and let it settle ... this should have created two separate strata of sediments, roughly parallel to the bottom of the container.
4. Gently dump the rest of the light-colored sand into the water ... this should create a third strata, roughly parallel to the other two.

C. Discussion:

1. Which size particles settle out first?
2. If you saw this type of "layer cake geology" in a quarry, dirt pit or road-cut, what would you think was the mechanism that created the sedimentary rock strata?



ANSWERS: The instructor may wish to delete these before copying for students' use.

C - 1. The larger, heavier particles settle out of the water first.

C - 2. The sediments were probably deposited by the action of water, either by streams or by waves along a shoreline.

APPENDIX FOUR

FOSSIL COLLECTIONS and FOSSIL CLUBS in FLORIDA

Florida Museum of Natural History, University of Florida, Gainesville.
Jacksonville Museum of Science and History, Jacksonville.
Museum of Arts and Sciences, Daytona Beach.
Museum of Florida History, Tallahassee.
Museum of Science and Industry, Tampa.
South Florida Museum and Bishop Planetarium, Bradenton.
The Conservancy Nature Center, Naples.
Silver River Museum, Ocala.

FLORIDA FOSSIL CLUBS: There are several fossil clubs throughout Florida. They have a variety of activities, such as regular meetings, newsletters, field trips, and specimen sales.

Bone Valley Fossil Society: 2704 Dixie Road, Lakeland, FL 32746. Contact: Ed Holman.
Florida Fossil Hunters: P.O. Box 533736, Orlando, FL 32853. Contact: Dean Sligh.
Florida Paleontological Society: Florida Museum of Natural History, Museum Road, University of Florida, Gainesville, FL 32611. Contact: Eric Taylor.
Fossil Club of Miami: 12540 SW 37th St., Miami, FL 33175. Contact: Dr. Gordon Hubbell.
Paleontological Society of Lee County: P.O. Box 151651, Cape Coral, FL 33915. Contact: David Cale 941.656.6111.
Southwest Florida Fossil Club: 2265 Gulf Drive, 240E, Sanibel, FL 33957. Contact: Al Bridell.
Space Coast Fossil Club: 6252 Weston Lane, Orlando, FL 32810. Contact: Dean Sligh.
Suncoast Archeological and Paleontological Society: 1529 30th Avenue N, St. Petersburg, FL 33704. Contact: Ray Robinson 813.821.0805.
Tampa Bay Fossil Club: P.O. Box 290561, Tampa, FL 33687. Contact: Frank Kocsis, Jr.

FLORIDA FOSSIL COLLECTING PERMIT

A permit is required to collect *vertebrate* fossils in Florida. Information regarding this requirement can be obtained from:

Russ McCarty
Program of Vertebrate Paleontology
Florida Museum of Natural History
University of Florida
Gainesville, FL 32611
Tel: 352.392.1721
E-mail: cormac@flmnh.ufl.edu

Copies of the pertinent Florida statutes and permit application can be found on the Internet:

<http://www.flmnh.ufl.edu/vertpaleo/vppermit.htm>

Exclusions: Fossil shark teeth are specifically excluded from these regulations, as are fossil plants and invertebrates, including shells, so no permit is required to collect these specimens.

APPENDIX FOUR

ROCK and MINERAL CLUBS in FLORIDA

Anclote Earth Science Club
P.O. Box 36
Port Richey, FL 34673

Central Brevard Rock & Gem Club
3985 Seville Ave.
Cocoa, FL 32926

Gem & Mineral Club of DeLand
P.O. Box 265
DeLand, FL 32721

Gulf Coast Gem & Mineral Society
P.O. Box 1885
Panama City, FL 32409

Imperial Polk County Gem & Mineral Society
P.O. Box 2054
Auburndale, FL 33823

Lake City Gem & Mineral Society
Route 2, Box 479-L
Lake Butler, FL 32054

Miami Mineral & Gem Society
P.O. Box 558172
Miami, FL 33135

Orlando Gem & Mineral Club
1604 Tanager Drive
Orlando, FL 32803

St. Lucie County Rock & Gem Club
P.O. Box 354
Ft. Pierce, FL 334954

Treasure Coast Rock & Gem Society
P.O. Box 531
Vero Beach, FL 32961

Tomoka Gem & Mineral Society
140 Warwick Avenue
Ormond Beach, FL 33174

Canaveral Mineral & Gem Society
2526 Watkins Drive
Melbourne, FL 32901

Florida Gold Coast Gem & Mineral Society
13511 S.W. 16th Court
Davie, FL 33325

Gem & Mineral Society of the Palm Beaches
P.O. Box 3041
West Palm Beach, FL 33402

Highlands Gem & Mineral Club
2115 Van Pelt Road
Sebring, FL 33870

Jacksonville Gem & Mineral Society
P.O. Box 7084
Jacksonville, FL 32073

Manasota Rock & Gem Club
P.O. Box 5872
Sarasota, FL 34277-5872

Mid-Florida Gem & Mineral Society
14958 S.W. 35 Circle
Ocala, FL 34473

Pinellas Geological Society
P.O. Box 6263
Clearwater, FL 34618-6263

Suncoast Gem & Mineral Society
P.O. Box 13254
St. Petersburg, FL 33733

Tropical Mineral & Gem Society
P.O. Box 560893
Miami, FL 33256-0893

Withlacoochee Rockhounds
4215 Orchard Drive
Hernando Beach, FL 34607

APPENDIX FIVE

ADDITIONAL SOURCES FOR LITERATURE AND MATERIALS

FLORIDA DEPARTMENT of ENVIRONMENTAL PROTECTION:

EcoVentures™ : The Florida Department of Environmental Protection also has produced a multimedia environmental education program for middle schools. **EcoVentures™** helps middle school students learn about Florida's aquatic environment and its relationship to other Florida ecosystems and ecosystems management problems that affect us. Information about this program is available from:

Department of Environmental Protection
Division of Marine Resources
Office of Marine Fisheries Management and Assistance Services
MS 240
3900 Commonwealth Blvd.
Tallahassee, FL 32399-3000 Tel. 904.922.4340

Various divisions of DEP have produced hundreds of publications, brochures, pamphlets, and handouts that are environmentally and ecologically oriented. A complete list of these materials, *Environmental Education Publications of the Florida Department of Environmental Protection*, can be obtained from:

Department of Environmental Protection
Office of Environmental Education
3900 Commonwealth Blvd.
Tallahassee, FL 32399-3000 Tel. 904.488.7326

The following list is of *selected* publications from: *Environmental Education Publications of the Florida Department of Environmental Protection*.

TITLE

DESCRIPTION

Division of Air Resource Management 904.488.0114

Questions and Answers
About Ozone

Explains difference between Stratospheric & Tropospheric ozone. Also the ground level ozone problems in Florida.

Protecting the Ozone Layer-EPA

A checklist for citizen action.

Clearing the Air About Ozone

Pamphlet on ground-level ozone problems in the southern United States.

Help Prevent Further Destruction of our Ozone Layer

Pamphlet on recycling your vehicle air conditioning refrigerant.

TITLE

DESCRIPTION

**The Acid Rain Program
It's Working-EPA**

Pamphlet explains a new approach to environmental management. How we can reduce and what will control Acid Rain.

**Environmental Benefits of
Acid Rain-EPA**

Pamphlet answers the most commonly asked questions about Reducing Acid Rain.

**Emergency Planning and
Community
Right-to-Know**

Booklet on hazardous materials, answers Who & What on Response.

Division of Environmental Resource Permitting 904.488.0130

Bureau of Aquatic Plant Management 904.487.2600

**How to Create A Lake
Management Plan**

Booklet outlines a successful method used to develop lake management plans.

**Non-native Plants: Unwanted
Biological Invaders of Florida's
Ecosystem**

Booklet outlines activities for students (grade 4 and up) to learn how to conduct an aquatic plant survey and compare plant species diversity.

**"Florida's Native Underwater
Forests"**

Poster with underwater photography of submersed aquatic plants of Florida.

**Aquatic Plants: Underwater
Forests of Lakes and Rivers**

Student activity book, describes the importance of native aquatic plant species and the problems caused by invasive non-native plants in freshwater ecosystems.

**"Florida's Spring-fed River
Ecosystems"**

Pamphlet describes unique ecology of spring-fed rivers and gives tips on how to preserve the plant communities found in them.

**"Rules of Green-Thumb at the
Coast"**

Pamphlet describes three basic rules for yard care in sensitive habitats of coastal areas.

Bureau of Mine Reclamation 904.488.8217

**Ongoing Projects & Programs
Which are Interrelated With the
Implementation of the Integrated
Habitat Network Coordinated
Development Area**

Information for participants in the State Phosphate Mine Reclamation Program. The title says it all.

**A Regional Conceptual
Reclamation Plan for the
So. Phosphate District of
Florida**

An analysis of environmental, economic & political factors within a 9-county region of central Florida. Includes maps.

TITLE**DESCRIPTION**

Bureau of Submerged Lands & Environmental Resources 904.488.0130

Florida State of the Environment: Wetlands Resource Permitting	Describes wetlands types and why we should protect our wetlands, and the rules and regulations for permitting.
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Division of Law Enforcement 904.488.5757 ext 74

Bureau of Emergency Response	Pamphlet describes the Bureau of Emergency Response programs and contacts.
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Division of Marine Resources 904.488.6058

Office of Fisheries Management 904.922.4340

Reef Report	Quarterly Newsletter- Provides artificial reef information to the recreational fisherman.
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Florida Marine Research Institute (FMRI) 813.896.8626

Estuaries: The Cradle of the Ocean	Pamphlet describing estuaries and their importance to marine and fisheries resources.
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Florida's Mangroves: Walking Trees	Pamphlet describing the species of mangroves that live in Florida, their importance and where they are found.
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Florida Salt Marshes	Pamphlet describes plants that make up salt marshes, roles they play in the coastal environment and various threats to the marshes.
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The Underwater World Florida's Seagrasses	Pamphlet describing types and kinds of seagrasses in Florida, their roles as marine nurseries, threat to seagrass beds throughout Florida.
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Bureau of Coastal & Aquatic Managed Areas (CAMA) 904.488.3456

Aquatic Preserves	General fold-out describing Florida's aquatic preserve system and the habitats that are protected in the system.
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Coastal & Aquatic Managed Areas	Brochure describing programs of the bureau including map sites.
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Specific Aquatic Preserves	Brochures describing the following preserves: Apalachicola Aquatic Preserve (AP), St. Martins Marsh, Tampa Bay, Southwest Florida, Pine Island Sound, Banana River, North Fork of the St. Lucie, Indian River Lagoon, and the Aquatic Preserves of the Florida Keys.
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TITLE**DESCRIPTION****Apalachicola National Estuarine Research Reserve (ANERR) 904.653.8063**

Apalachicola National Estuarine Research Reserve (ANERR)	Leaflet describing the resources and purpose of the Reserve.
Shells of the ANERR	Field checklist and visitors guide.
Project Estuary	Middle/High school curriculum, available for checkout from ANERR library.
Estuarine Pathways	Elementary curriculum available for checkout from the ANERR library.
Aquatic Preserves of Apalachicola Bay Region	Information on Apalachicola Bay Aquatic Preserves.
Coastal Connections	Educational field trip opportunities from ANERR.

Florida Keys National Marine Sanctuary (FKNMS) 305.743.2437

Florida Keys National Marine Sanctuary (NMS)	Pamphlet describing sanctuary and its habitats, geological history and Past-Present-Future hydrology..
Looe Key NMS Mooring Buoy System	Mooring buoy locations and descriptions of coral found at each buoy.
Looe Key NMS	Brochure describing the Keys common marine life/aerial photos of interesting spots.
Key Largo NMS	Brochure with map describing the Keys marine life and interesting sites.
Inside the Florida Keys National Marine Sanctuary (FKNMS)	Brochure/map describing threats to coral reef ecosystems, summary objectives of management plan and overview of FKNMS Plan.
Inside The New Florida Keys	Quarterly newsletter about the NMS, describes current events & issues.
Florida's Coral Reef Ecosystem	Brochure (in several languages) describing the Florida Coral Reefs.
Nat'l Marine Sanctuary Program	Fact sheet on the NMS program.
Marine Sanctuary Magazine	Quarterly magazine on all National Marine Sanctuaries in U.S.

TITLE**DESCRIPTION**

Rookery Bay National Estuarine Research Reserve (RBNERR) 941.775.8845

Rookery Bay National Estuarine Research Reserve RBNERR) Pamphlet describing the purpose and activities of Rookery Bay National Estuarine Research Reserve.

Rookery Bay Reserve: An Opportunity for Estuarine Research & Education Leaflet describing educational opportunity at the Reserve.

The "Big Picture" Poster Depicts nine habitats of RBNERR watershed and describes functions of each.

Marine Science Curriculum Manual includes field, lab and classroom activities for high school students.

KEEP IT CLEAN - A Citizen's Guide to Protecting Our Estuary Describes actions citizens can do to avoid contributing to non-point pollution.

Division of Recreation and Parks 904.488.9872

Florida State Parks Guide Booklet describing each park and facilities offered.

Know the Facts Pamphlet on Florida Boating Improvement Program, Florida Recreation Development Assistance Program, Land and Water Conservation Fund Program.

Help Our State Parks Gift Catalog with listing ways business, industry or the public can help support the Park System.

Become a Volunteer Pamphlet showing how volunteers can help at State Parks.

Florida Leisure Resource Directory Directory of leisure services provided and support groups in Florida.

Individual Park Brochures Describing individual State Parks.

Open Lands Florida Brochure listing Parks not listed in Park Guide that allow public access.

Management of Florida's State Park Lands Brochure describing the land management of the State Park Service.

Division of Technical Services 904.488.2790

Bureau of Geology - Florida Geological Survey 904.488.4191

Map series 125 A Guide Map to Geologic & Paleontologic sites in Florida.

<u>TITLE</u>	<u>DESCRIPTION</u>
Open File Report 34	The Geology and Geomorphology of Florida's Coastal Marshes.
Open File Report 50	A Geological Overview of Florida.
Open File Report 63	A Fossil Hunter's Guide to the Florida Panhandle.
Open File Report 65	A Fossil Hunter's Guide to The Northern Florida Peninsula.
Open File Report 66	A Fossil Hunter's Guide to Southern Florida.
Open File Report 67	Topographic Maps: Useful tools for the Florida Fossil Hunter.
Leaflets (various)	Geologic guides to various Florida State Parks.
Biennial Reports	Activities and research at the Florida Geological Survey.
Special Publication 35	Florida's Geological History and Geological Resources.
Special Publication 41	Educator's Guide for the video "Florida's Geology Unearthed"
Information Circular 87	List of Publications.
Open File Maps Series	Geologic maps of the State, by county.
Map Series 112	Geology and Waste Disposal in Florida.
Florida Geology Forum	Newsletter of the Florida Geological Survey.
Geology Posters :	
Florida's Hydrogeology	Illustrates the Hydrogeology of karst terrain with text.
Common Cenozoic Echinoids	Illustrates 22 fossil echinoid species.
Florida's Fossil Mammals	Illustrates reconstructed skeletons of large Miocene-Pleistocene mammals.
Earth Systems: The Foundation of Florida's Ecosystems	Illustrates the role of geology toward the understanding of Florida's various ecosystems.

TITLE**DESCRIPTION**

Division of Water Facilities 904.487.1855

Bureau of Drinking Water and Ground Water Resources 904.488.3601

Florida Ground Water Quality Monitoring Network Newsletter Newsletter designed to improve communication between those who maintain the state Ground Water Quality Monitoring Network.

Drinking Water News Newsletter generated from Drinking Water Section.

Division of Waste Management 904.487.3299

Bureau of Solid Waste 904.488.0300

Directory of Solid Waste Facilities List all of the solid waste management facilities--landfills, incinerators, etc., in the state, 153 pages.

Solid Waste Management in Florida Legislative report on status of solid waste management and recycling in Florida, 310 pages.

Used Oil: various posters, etc. Order form for posters, displays, PSAs decals, handouts, rubber coin mats, etc., available upon request.

Pollution Prevention Program Fact sheets to assist businesses in: cutting cost, reducing waste, protecting the environment.

Florida State of the Environment: Solid Waste Management, Hazardous Waste Site Cleanup Two brochures describing Florida's programs for solid waste management and hazardous waste site cleanup.

Ecosystem Management - Office of Water Policy/SWIM Program 904.488.0784

SWIM: Environmental Progress Through Partnership Booklet provides information on the progress and success of the SWIM program.

The Florida Coastal Sediment Contamination Atlas Document contains maps illustrating the spatial extent of chemical contamination in Florida's Coastal waterbodies.

A Guide to the Interpretation of Metals Concentrations in Estuarine Sediments Document explains variable metal backgrounds, and how to quantitatively measure levels of metal contamination in estuarine sediments.

Development of an Approach to Assessment of Sediment Quality of Florida Coastal Waters Document provides numerical guideline for over 30 common contaminants found in sediments. Four volumes.

TITLE**DESCRIPTION**

Magnitude and Extent of Sediment Toxicity in Tampa Bay

Report on the sediment toxicity in Tampa Bay area.

Office of Greenways and Trails 904.487.4784

Greenways and Trails

Describing the Office of Greenway and Trails.

FL Recreational Trails System

Brochure describes 36 canoe trails with order form for maps of each.

HIKE-The Florida Trail

Pamphlet describes the Florida Trail.

FL State Parks Bicycle Tours

Pamphlet has three tours charted, maps, tips for touring.

Information Guide For Bicycle Tourist

Packet lists information on bicycling in Florida, the laws, best trails, on/off road and mountain biking, climate, tours, restriction and maps.

Fact Sheets: Hiking and Backpacking, Horseback riding, and Bicycling Opportunities in Florida

Fact sheets listing these opportunities in Florida State Parks.

Directory-Canoe Liveries & Outfitters

Directory of organizations with canoe-livery and rental service.

Canoe Information Resource Guide

Guide to organizations with canoe activities.

Office of Environmental Education 904.488.9334

Guide to the Florida Department of Environmental Protection

Brief descriptions of the programs of the Department divisions and offices, including phone numbers.

Publications List

Environmental education publications distributed by DEP.

Florida--State of the Environment Series

8 booklet series describing the regulatory programs: Solid Waste Management, Wastewater Management, Hazardous Waste Site Cleanup, Ground Water, Reuse of Reclaimed Water, Air Quality, Stormwater Management, and Wetlands.

Asbestos Removal--What You Should Know

Fold-out pamphlet describing the danger of asbestos, how to handle it, and where to get more information.

Classroom and Field Experiments for Florida's Environmental Resources

Booklet describing 14 laboratory and field experiments for middle and high school environmental and science classes.

TITLE

DESCRIPTION

Your Environment	Booklet aimed at upper elementary/middle school children with information and activities describing Florida's environment and how you can help to protect it.
Environmental Education	Two-page environmental education series of materials punched for 3-hole binders, describing in some detail various environmental problems and issues in Florida and the nation.
#1 Wetlands in Florida	
#2 Ground Water in Florida	
#3 The Auto and the Environment	
#4 Solid Waste and Recycling	
#5 The Water You Drink	
#6 Mercury in Florida's Environment	
#7 Invading Exotic Species in Florida	
Estuarine Habitats- Elementary Teaching Activities Series	A set of seven Supplemental Teaching Activities for estuarine habitats.
EPA-Earth Trek...Explore your Environment	Activities booklet for 6-12 grade students and teachers.
EPA-Science Demonstration Drinking Water (K-12)	Pamphlet has brief selections of science demonstrations relating to projects in Drinking Water.
Minerals Activity Booklet	For teachers and elementary students exploring the role of minerals in our society.
Living In Florida's Environment	Tabloid-size publication with basic information one needs to know to appreciate Florida and its environmental assets. Covers from pre-history through modern times.
EPA "Wetlands--Reading List" Pre-K to 12th	Reading list for pre-kindergarten through grades K-12 on Wetlands.
Educational Resources	Additional listing of educational resources.
Career Profiles	Special publication from the Association for Women Geoscientists.
Implementing Ecosystem Ecosystem Management	Booklet is a summary of how the department is implementing Ecosystem Management.
Career Fact Sheets:	Brief overview of Environmental careers, what they do, where they work, education requirements, employment and salaries.
Geology, Toxicology, Engineering, Botany, Ecology, Biological Science, Park Ranger, Forestry, and Chemistry	

<u>TITLE</u>	<u>DESCRIPTION</u>
Towards Environmental Citizenship	A preliminary guide to what it takes to be an environmental citizen in Florida.
Ecosystem Management News	Quarterly newsletter describing current Ecosystem Management in Florida.
Ground Water-How You Can Help	Brochure describing ways you can help protect your ground water.
Bookmark	Ecosystem Management and Environmental Citizenship.
Storage Tank Systems... Responsibilities for Owners and Operators in Florida.	Brochure on Keeping our groundwater safe.
An Environmental State of the State of Florida	Pamphlet developed for Earth Day '95 describing the state of Florida's environment.
From Earth Day 1 to 25	Pamphlet discussing 25 Years of Environmental Lawmaking in Florida.
Florida Environmental Regulation Commission (ERC)	Pamphlet describes duties of Environmental Regulation Commission.
End of Department of Environmental Protection publications	
Florida Limerock and Aggregate Institute: 1007 DeSoto Drive Tallahassee, FL 32301	Provides technical and promotional material relative to the mining industry in Florida. (904) 942-0781
Florida Phosphate Council: P.O. Box 367 Lakeland, FL 33802-0367	Provides technical and promotional material relative to the phosphate mining industry in Florida. Tel. 904.224.8238
Florida Petroleum Council: Suite 800, First Florida Tower 215 South Monroe St. Tallahassee, FL 32301	Provides technical and promotional material relative to the oil and gas industry in Florida. Tel. 904.561.6300

Careers in the Geosciences, brochures from:

America Geological Institute
4220 King St.
Alexandria, VA 22302-1507

Geological Society of America
3300 Penrose Place
P.O. Box 9140
Boulder, CO 80301

American Association of Petroleum Geologists
P.O. Box 979
Tulsa, Oklahoma 74101

U.S. GEOLOGICAL SURVEY:

A series of general-interest publications is available to inform the public about the activities of the U.S. Geological Survey. The following offices can provide information about the USGS, its publications, maps, and its programs and activities:

Public Inquiries Office
U.S. Geological Survey
503 National Center
Reston, VA 22092
703.648.6892

Geologic Inquiries Group
U.S. Geological Survey
907 National Center
Reston, VA 22092
703.648.4383

Public Affairs Office
U.S. Geological Survey
119 National Center
Reston, VA 22092
703.648.4460

Hydrologic Information Office
U.S. Geological Survey
419 National Center
Reston, VA 22092
703.648.6817

National Cartographic Information Center
U.S. Geological Survey
507 National Center
Reston, VA 22092
703.860.6045

Earth Science in the Public Service (30-page booklet from):

Book and Open-File Reports Section
U.S. Geological Survey
Federal Center, Box 25425
Denver, CO 80225

Tel. 303.236.7476

FLORIDA WATER MANAGEMENT DISTRICTS:

The five water management districts that encompass all of Florida publish educational and technical materials that are pertinent to ecosystems and environmental issues. For your area of the state, inquire at that water management district's information office.

NORTHWEST FLORIDA

Water Management District
81 Water Management Drive
Havana, FL 32333
850-539-5999

SUWANNEE RIVER

Water Management District
9225 County Road 49
Live Oak, FL 32060
(904) 362-1001 or 1-800-226-1066 (FL only)

ST. JOHNS RIVER

Water Management District
P.O. Box 1429
Palatka, FL 32178-1429
(904) 329-4103 or 1-800-226-4181 (FL only)

SOUTHWEST FLORIDA

Water Management District
2379 Broad St. .
Brooksville, FL 34609
(352) 796-7211 or 1-800-423-1476 (FL only)

SOUTH FLORIDA

Water Management District
P.O. Box 24680
West Palm Beach, FL 33416-4680
(561) 686-8800 or 1-800-432-2045 (FL only)

FLORIDA'S GEOLOGY UNEARTHED

VIDEO CREDITS

Producer:	Jon Arthur	
Associate Producers:	Diane Wilkins, Nathan Hipps	
Director:	Diane Wilkins	
Director (South Florida):	Nathan Hipps	
Screenwriter:	Nathan Hipps	
Videographers:	Diane Wilkins and Robert Seidler	
Editor:	Diane Wilkins	
Production Assistants:	Beatrice Queral, Amy Seidler	
Animation:	Scott Reese	
Computer graphics and Art:	Diane Wilkins Scott Reese Michael Hulver	Rick Green Ed Lane Charles Knight
Additional animation:	U.S. Geological Survey, NASA, Run Time Software, Southwest Florida Water Management District, TASA Graphic Arts, Inc.	
Photos:	Jon Arthur, Russell Dorsey, Tom Scott, Brian Moore, NASA	

Cast

Starring:	Bill Kimble	Will Stith	Kristen Wilson
Featuring:	Heather Brown	Carmen Cummings/Tamara Gant	
Interviews:	Jon Arthur, Ph.D., P.G. Don Hargrove Jim Ladner, P.G. Donnie McClaugherty, P.G. Bill Parker, Ph.D. Roger Portell Judy Richtar, P.G. Tom Scott, Ph.D., P.G. Walter Schmidt, Ph.D., P.G. Gene Shinn Sam Upchurch, Ph.D., P.G. Bill Wilson, P.G.	Florida Geological Survey Florida Geological Survey Florida Geological Survey Florida Department of Environmental Protection Department of Geology, Florida State University Fl. Museum of Natural History, Univ. of Florida Florida Department of Environmental Protection Florida Geological Survey Florida Geological Survey U.S. Geological Survey ERM-South, Inc. Subsurface Evaluations, Inc.	
Special Appearances:	Billy L. Cypress, Executive Director, Ah Tha Thi Tiki Museum Dave DeWitt, Southwest Florida Water Management District Andrea Kerlinger, Yesterday ~ Today		
Also Appearing:	Haile Quarry: FGS Drill Rig: Laboratory: Geo-questions: Geo-lists: Southwest Florida WMD Rig:	Stephanie Nagy, Justin Pooser, April Hayes Jim Trindell, Alex Howell Frank Rupert Katie Kimble, Kellan Lawing, Salleeta Lloyd and Crystal Franklin Mary Aaron, Allison Carver, Asha Dhanarajan, Ivey Johnson Dave DeWitt, ROMP Geophysical Logging Unit	
Narrators:	John Schultz, Ann Daugherty, Diane Wilkins		

Additional footage:

Florida Public Television, *Florida Crossroads*
Ron Compton
Tom Scott
Russell Dorsey
Florida Keys National Marine Sanctuary
Ann Tihansky and Dan Duer
Gene Shinn
U.S. Geological Survey
In Motion Productions, Mark Barrett
Karst Productions, Inc., Wesley Skiles

Northwest Florida Water Management District
"WaterWays" Program
Richard Harder
Jim Leonard
WESH -TV, Channel 2
Steve Wessells
Richard Horodner - The Hurricane Photographer
Jim Cassel
Cathy Veatch

Acknowledgments:

Locations:

Anastasia State Recreation Area
Black Diamond Ranch
Bok Tower Gardens
Brooks Sink - Container Corporation
C & C Peat Co., Inc.
Calumet Florida, Inc.
Castillo de San Marcos National Monument
Cherry Lake Farms
Devil's Millhopper State Park
Fakahatchee Strand State Preserve
Falling Waters State Recreation Area
Florida Caverns State Park
Florida Museum of Natural History
Floridin Company
Haile Quarry

IMC/Agrico
Independent Aggregates
Leon Sinks Special Interest Area ,
Apalachicola National Forest
Museum of Arts and Sciences, Daytona Beach
Museum of Florida History
National High Magnetic Field Laboratory
Quality Aggregates, Inc.
RGC Minerals, Inc.
Sarasota County Utilities
St. Joseph State Park
Suwannee River State Park
Suwannee River Water Management District
The Nature Conservancy
Vulcan/ICA Distribution Company

Other:

American Geological Institute, Portrait_USA_CD-ROM
American Museum of Natural History
Christopher M. Keane and Robert W. Ridkey - Joint Education Initiative, University of Maryland
City of Tallahassee
Denver Museum of Natural History
Department of Geology, Florida State University
Department of Geophysical Sciences, University of Chicago
Faculty and students from Leon High School, Leon County
National Geographic Society
South Florida Water Management District
Suwannee River Water Management District

A Production of the FLORIDA GEOLOGICAL SURVEY and DIANE WILKINS Productions

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The Florida Geology Education Video Project (FGEV) includes:

"Florida's Geology Unearthed"
Educator's Guide
Supplemental written materials

Project Manager: Jon Arthur, Ph.D., P.G.

Educator's Guide Authors: Ed Lane and Frank Rupert

FGEV Project Distribution: Deborah Mekeel

FGEV Communications: Cindy Collier and La Marr Mitchell

FGEV Package Design: Chameleon Graphics and Design, Tallahassee, FL

FGEV Environmental Education Advisory Committee:

Dr. Jon Arthur	Florida Geological Survey
Ms Cindy Cosper	Florida Department of Environmental Protection
Ms Joan Crow	Academic Resource Center, Leon County
Dr. Robin Denson	Gulf Archeology Research Institute
Ms Penny Kisiah	Fairview Middle School, Leon County
Mr. Ed Lane	Florida Geological Survey
Mr. Jim Lewis	Florida Department of Environmental Protection
Dr. Larry Olsen	Panhandle Regional Environmental Education Center
Ms Janice Ouimet	Leon High School, Leon County
Ms Georgann Penson	Northwest Florida Water Management District
Mr. Frank Rupert	Florida Geological Survey
Mr. Richard Stevens	Lincoln High School, Leon County
Ms Koren Taylor	Florida Department of Environmental Protection
Ms Diane Wilkins	Diane Wilkins Productions
Ms Dodie Zeiler	Florida Department of Environmental Protection

FGEV Geology Technical Advisory Committee (GTAC):

Dr. Jim Cowart	Department of Geology, Florida State University
Mr. Dave DeWitt	Southwest Florida Water Management District
Mr. Russell Dorsey	Gulf Archeology Research Institute
Mr. Jim Frazee	St. Johns River Water Management District
Mr. Joe May	Florida Department of Environmental Protection
Ms Katherine Milla	Northwest Florida Water Management District
Dr. Paul Ragland	Department of Geology, Florida State University
Ms Ann Tihansky	U.S. Geological Survey

Florida Geological Survey GTAC members:

Dr. Jon Arthur
Mr. Jim Balsillie
Mr. Ken Campbell

Mr. Rick Green
Mr. Jim Ladner
Ms Jackie Lloyd

Dr. Walt Schmidt
Dr. Tom Scott
Mr. Steve Spence