Discovering Alabama

Teacher's Guide

Tracks Across Time

Suggested Curriculum Areas
Science
History
Art

Suggested Grade Levels
4–12

Key Concepts
Geological Time
Scientific Inquiry
Prehistoric Life

Key Skills
Inquiry
Research
Creative Thinking

Synopsis

Alabama's surface coal mines, known as "strip mines," have often been the subject of environmental criticism. These sites are created when shallow seams of coal are excavated by first stripping away the earth's surface, thus removing forest cover, wildlife habitat, etc., and leaving nearby streams vulnerable to sediment loading. In the 1970s, environmental activists won passage of new laws providing strict guidelines for such mining activity and requiring that mining sites be "reclaimed," i.e., excavated surfaces be filled and restored, and then planted in new vegetative cover, so as to help rectify environmental impacts.

Federal authority for compliance with these laws is quite strict, mandating a series of formal procedures according to specific performance deadlines. Ironically, in 1995, these very environmental requirements became an impending threat to the unique natural values of an unrestored strip mine located near Jasper, Alabama. The site, now known as the Stephen C. Minkin Paleozoic Footprint Site, is considered by experts to contain the world's most significant record of fossilized Paleozoic-age animal tracks.

In this *Discovering Alabama* program, viewers examine fossil remains from the Minkin site and visit with scientists who tell the story of these remarkable tracks across time. Also, various officials, local leaders, and area residents explain how this unique mine site was saved from ruin to eventually gain permanent protection by the Alabama Department of Conservation, State Lands Division.

THE UNIVERSITY OF ALABAMA

ALABAMA MUSEUM of Natural History

Discovering Alabama is a production of the Alabama Museum of Natural History in cooperation with Alabama Public Television. For a complete list of titles in the *Discovering Alabama* series, as well as for information about ordering videos and accompanying Teacher's Guides, contact us at either: *Discovering Alabama*, Box 870340, Tuscaloosa, AL 35487–0340; (205) 348–2036; fax: (205) 348–4219; or email: orders@discoveringalabama.org. Also visit our website: *www.discoveringalabama.org*.

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The Solon and Martha Dixon Foundation

Alabama Wildlife Federation AWF

Alabama Department Of Conservation and Natural Resources State Lands Division

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Before Viewing

1. Provide students the opportunity to hold and examine a sampling of fossils from different geological eras. For example, you might include a trilobite from the Paleozoic, sharks' teeth from the Mesozoic, and a mammoth tooth or bone from the Cenozoic. (Since the Cenozoic is the latest era, even an Indian arrowhead, deer antler, or other handy artifact will serve to represent life forms that emerged in this era. Check with the Alabama Museum of Natural History for help in obtaining sample fossils.) Next, place students in small groups and have each group a) surmise the prehistoric age of each fossil or artifact, and b) try to describe what conditions might have prevailed across the Alabama landscape during the time when these creatures lived.
2. Have each group report their conclusions to the class. Discuss the thinking/reasoning used by the groups to derive their conclusions. If there are major differences between the groups, discuss how and why these differences occurred. (To provide useful context, you might wish to show the *Discovering Alabama* program, "Geological History of Alabama," together with conducting appropriate activities from the corresponding Teacher's Guide.)

While Viewing

1. Have students watch for information pertaining to the age and geological era of the fossils/artifacts they examined in #1 above.
2. Have the students note the names of the various organizations featured in the video, particularly those with a significant role related to the story being presented. **Video Mystery Question**: When we gaze at the stars at night, we are seeing them as they were when the earth was much younger. Why? (**Answer**: Most stars are at such great distance from the earth that the light from these stars must travel through space for millions of years before it reaches the earth. Thus the light from a particular star seen today is actually an image projected vastly long ago at a time when the earth itself was many millions of years younger and different geologically than it is today.)

After Viewing

1. Return students to their small groups and have them review and, where needed, make corrections in the assessments they developed in the previewing activities. Have each group present their revised assessments.
2. Discuss the geological age and era of the fossil tracks presented in the video. Discuss how conditions of the Alabama landscape were different during the Paleozoic compared with conditions today. Consider the forces of geological change that continue to shape our planet.

Extensions

1. Have students research the major eras of geological time to develop lists of corresponding geological periods and the kinds of creatures/fossils associated with the progression of geological time.
2. View other *Discovering Alabama* programs featuring significant aspects of Alabama's geological history and diversity. Among these programs are "Geological History of Alabama," "Alabama Black Belt, Part I," "Wetumpka Impact Crater," and "Alabama's Natural Diversity.

Philosophical Reflections

A recent television special featured a scientist expressing his conviction that "truth is relative," that "there are no absolute truths" because everything we know is always subject to new or changing evidence. When the TV host challenged him about this view, the scientist remained resolute and sternly asserted that his contention must be accepted because "it is true."

Needless to say, scientists, like the rest of us, are sometimes susceptible to contradictory thinking, personal biases, peer pressures, and even politically correct viewpoints. Nevertheless, in this scientist's case maybe some further sympathetic reflection is warranted. His seemingly contradictory position might prove to be less contradictory if allowed a bit of analysis.

By definition, science investigates our world and draws conclusions (truths) based upon observing physical evidence. The interpretation of such evidence is often prone to change as new or different evidence emerges, thus scientific conclusions must often change accordingly. So, the prudent scientist accepts this possibility, rather than becoming rigidly given to a particular "truth" of the moment. On the other hand, all of us, scientists and laymen alike, also make determinations about truth based on certain absolutes of logical necessity. Therefore, our TV scientist's observation that changing scientific evidence frequently results in changing scientific conclusions is a reality that fits easily a simple rule of logic: if A = B and if B = C, then A = C. Namely, if changing evidence (A) equals changing conclusions (B), and if changing conclusions (B) equals changing knowledge (C), then changing evidence (A) equals changing knowledge (C). In this respect, knowledge ("truth") is indeed relative, i.e., contingent upon evidence that is open to further investigation. Therefore, when the scientist asserts "it is true that truth is relative," he may be committing a linguistic contradiction in his choice of phrasing, but he is also alluding to a basic rule of logical necessity. (But, of course, this reasoning does not apply to those folks who don't accept the fundamental assumption that we and the world actually exist as physical reality.)

You might want to discuss the example above with your class and have students develop a list of "truths" that are relative to changing evidence and compare these with a few truths of logical necessity. In which category would we place scientific conclusions about fossil evidence?

Nature in Art

In Act IV of Julius Caesar, William Shakespeare makes the assertion that "nature must obey necessity." And indeed, as Shakespeare suggests, the design of every existing thing must, of necessity, conform to the dictates of mass, pressure, flow, and other structural constraints imposed by space. The immense variety of harmony and beauty we see in the world is largely the result of nature working and reworking only a few basic structural patterns. The branching of trees is essentially the same as the branching of human arteries and the branching of rivers. Patterns of equilateral triangles form the same structural basis for crystals as for tortoise shells. Likewise, the spiral fossils of the ancient sea nautilus are similar in pattern to the spiral arrangement of the largest galaxies. In fact, many functional forms are common to physics, mathematics, art, and music. Invite students to draw, paint, or photograph examples of different things in nature that have the same patterns of design or structure.

Community Connections

1. Gather specimens of local rocks and fossils, and create a classroom exhibit of local geology. Invite a geologist to visit the class and speak about local geological features.

2. Study the *Geological Map of Alabama* (see **Additional References and Resources**) to determine the age of prevailing rocks and related geology in your area. Locate a suitable subsurface exposure (roadway cut, rock outcropping, etc.) and arrange a class field trip to examine this site for evidence of characteristic rocks, fossils or other signs of associated geological age and events.

Complementary Aids and Activities

Project Learning Tree, Activity Guide 7–12, Activity 77, "You've Come a Long Way, Maybe." Available through Alabama Forestry Association, 555 Alabama St., Montgomery, AL 36104.

Project WILD K–12 Activity Guide, pp. 88–89, "Photos Keep It Happening." Available through Project WILD, 5430 Grosvenor Lane, Bethesda, MD 20814; (301) 493–5447.

Earth Science Information Center, U.S.G.S., 507 GH National Center, Reston, VA 22092; (800) USA–MAPS. Write on school letterhead and specify grade level to obtain geography and map-reading study guides.

Additional References and Resources

• *NatureSouth*: vol. 1, no. 3; vol. 2, no. 2; vol. 3, no. 4; vol. 5, no. 1. Contact: Alabama Museum of Natural History, Box 870340, Tuscaloosa, AL 35487–0340; (205) 348–7550.

• Geologic Inquiry Group, U.S. Geological Survey, 907 National Center, Reston, VA 22092; (703) 648–4383. They will answer your questions about geology.

• Geological Survey of Alabama, *Geological Map of Alabama* (1989); U.S. Geological Survey, *State of Alabama*, 1:500,000 topographic map (1966). Contact: Box 869999, The University of Alabama, Tuscaloosa, AL 35486–9999; (205) 349–2852.

• *Eyewitness Book* series, Alfred A. Knopf Publishers. Useful titles include *Crystal and Gem, Rock and Mineral, Dinosaur,* and *Fossil.*

• *The Weekend Fossil Hunter*, Jerry C. LaPlante, Drake Publishers, Inc., 801 Second Avenue, New York, NY 10017. Includes Do's and Don't's to ensure safe, ethical, and legal fossil hunting.

• *Lost Worlds in Alabama's Rocks: A Guide to the State's Ancient Life and Landscapes*, Jim Lacefield, The Alabama Geological Society. Contact: P.O. Box 866184, Tuscaloosa, AL 35486–0055.

Parting Thoughts

*The section "*Philosophical Reflections*" begins with a brief account of an actual television special and continues with a bit of analytical discussion about the views expressed in that TV special. More than mere word-play, this discussion offers a hint at a troublesome phenomenon. Many controversial issues of our day are exacerbated by the use of imprecise language, circuitous thinking, and rigid mind-sets, not to mention deeply-held emotions and beliefs that are wholly relative to the social, cultural, and religious experiences of different peoples.*

A prime example of this phenomenon is seen in the perpetual conflict pitting various defenders of evolution theory against various advocates of "creationism." The arguments of these individuals are usually tinged with unfortunate constraints to open, intellectually honest discourse. It is disappointing, for instance, to encounter strict proponents of creationism who deny scientifically verifiable evidence for the ancient age of the earth and the long progression of life forms on earth. Likewise, it is equally disappointing to witness strict advocates of evolution who protest the legitimacy of such basic questions of human existence as whether there is grand meaning in creation and ultimate purpose for life.

Of course, today we find the embattled factions embracing new tactics. Thus "Intelligent Design" now provides popular cover for those seeking to refute scientific evidence for evolution theory. And now, sophisticated new interpretations of the terms "science" and "theory" provide disguise for those seeking to discount the question of whether there is purposeful design in the cosmos. But despite such adaptiveness, opposing sides still exhibit the same kinds of human tendencies that interfere with intellectually honest debate.

It concerns me that such skewed debate frequently occurs in public forums and televised discussions, often reaching large audiences, without the benefit of helpful analysis that might better inform public understanding on these matters. Meanwhile, it seems to me, science and religion are both in the business of promoting fact versus fiction, truth versus falsehood. However, this shared pursuit is poorly served when debate is burdened by less than sensible and considerate discussion from either side.

Oh yeah, I almost forgot. Science has its origins in philosophy, where fundamental questions of meaning and purpose are standard fare. A few scientists I know would do well to remember this.

Happy outings,

Dr. Doug

GEOLOGIC TIMELINE
Tracing Development of Plants and Other Life Forms

Precambrian Time

From Earth's formation until about 600 million years ago; earliest life (non-nucleated, bacteria-like); first algal forms of plant life; first multicelled animals followed by development of early communities of complex animals

Era	Period	Epoch	Years Ago	Record of Plants and Animals
Paleozoic	Cambrian		570 million	first appearance of major groups of animals
	Ordovician			first fish; proliferation of invertebrates
	Silurian			first land plants and animals
	Devonian			first land vertebrates; proliferation of fishes
	Mississippian			proliferation of amphibians; proto-forests of carboniferous age
	Pennsylvanian			development of reptiles; extension of proto-forests of carboniferous age
	Permian		245 million	abrupt changes to plant & animal forms and extinction of much of Paleozoic life
Mesozoic	Triassic			rapid development of reptiles & mammals; first dinosaurs; development of coniferous plants
	Jurassic			proliferation of dinosaurs; first birds
	Cretaceous			development of flowering plants; abrupt changes to Mesozoic life, including extinction of dinosaurs
Cenozoic	Tertiary	Paleocene	65 million	rapid development of birds and mammals
		Eocene	55 million	appearance of grazing mammals, spread of open grasslands
		Oligocene	34 million	development of primates
		Miocene	24 million	development of many modern families of mammals and trees
		Pliocene	5 million	development of first hominids in Africa
	Quaternary	Pleistocene (ice age)	1.8 million	fluctuation and continued development of modern animals and plants; Man spreads out of Africa
		Holocene (recent)	10 thousand	Man inhabits North America, including southeast; present-day biota is established