

Kentucky-Based Natural Resources

Teacher's Packet

A KET professional development workshop for educators approved for Professional Development Training by the Kentucky Department of Education.

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This three-part series explores the natural resources found in Kentucky. Like previous KET earth science professional development seminars and electronic field trips, the series takes viewers on location to various points of geological interest around the state. Individual program topics are as follows:

Program 1: Minerals

Program 2: Rocks

Program 3: Hydrocarbons, Water, and Timber

Meet the Presenter

Dr. Frank Ettensohn is a professor in the geological sciences department at the University of Kentucky. Frank's background is in the fields of stratigraphy, sedimentology, and paleontology, but he commonly integrates these three fields of study with regional tectonics to better understand the geology of specific geographic regions. The results of his field research have been published in a number of geological journals. Frank earned his B.S. and M.S. from the University of Cincinnati and completed his Ph.D. at the University of Illinois at Champaign-Urbana.

About This Packet

Dr. Ettensohn developed the materials in this packet to supplement and support the content of the seminar. They include glossaries of terms used in the programs along with questions for study and reflection to help viewers internalize the information included in *Kentucky-Based Natural Resources*.

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Professional Development Credit

Stage of Participant Development: Practice/Application

The Kentucky Department of Education has approved all KET Star Channels Seminars for professional development credit if schools or districts choose to include them in their professional development plans. Districts or schools may choose to include preparation and/or follow-up time as part of professional development. For example, if a teacher participates in one 90-minute program and spends an additional 30 minutes in related activities, he or she could be awarded a total of two hours professional development credit.

Individual teachers who wish to use these videotapes for professional development credit should check with their school professional development chair or with their district professional development coordinator.

Professional development can also be used to satisfy requirements for the fifth year program. Contact your local university or the Division of Teacher Education and Certification at 502-564-4606 for more information.

Glossary and Questions for Study and Reflection

Kentucky-Based Natural Resources

Program 1: Minerals

Mineral: A naturally occurring, inorganic, crystalline substance with a definite composition and physical properties. Hot waters circulating along the Kentucky River Fault Zone in central Kentucky, the Rough Creek Fault Zone in western Kentucky, and other smaller fault zones in Kentucky precipitated several common minerals in voids along broken-up rock in the fault zone. The common minerals include calcite (CaCO_3), dolomite [$\text{CaMg}(\text{CO}_3)_2$], fluorite (CaF_2), barite (BaSO_4), pyrite (FeS_2), sphalerite (ZnS), and galena (PbS).

Note: The term “mineral” has also been used (perhaps incorrectly according to the above definitions) for any naturally formed, inorganic material as opposed to the “plant and animal kingdoms,” especially if it has economic or resource value. In this context, limestone, coal and sand have been referred to as minerals. Again, in this context, materials like coal, oil, and gas, which are used as fuels, have been called “fuel-related minerals,” whereas materials like calcite, fluorite, limestone, clay, sand, and gravel, have been called “non-fuel minerals.”

Rock: A natural aggregate composed of one or more minerals. Limestone, sandstone, dolostone, shale, and coal are common rocks in Kentucky.

Bedrock or Country Rock: The general term for rock or unconsolidated sediments that underlie the soil.

Fault: A surface or zone of rock fracture, along which blocks of the earth’s crust have moved.

Fault breccia: A coarse-grained rock composed of angular, broken fragments resulting from the crushing, shattering and shearing of rocks during movement on a fault. Minerals are commonly deposited in the voids between resulting fragments.

Fracture: A large break in a body of rock along which no movement or displacement occurs.

Kentucky River Fault Zone: A series of nearly east-west-oriented faults, that run from Lawrence County in the east to Jessamine and Fayette counties in the west. (See Kentucky Geological Map, available from the Kentucky Geologic Society. The KGS Web address is listed on page 12 of this packet.)

Lexington Fault Zone: A series of faults oriented nearly northeast-southwest that run from Bourbon County in the north to Casey County in the south. The zone extends through eastern Lexington. (See Kentucky Geological Map)

Rough Creek Fault Zone: A series of western Kentucky faults that run nearly east-west from Hart County in the east to Union County in the west. (See Kentucky Geological Map.)

Fluorspar District: Area in western Kentucky including parts of Livingston and Crittenden counties where fluorite was formerly mined until the 1970's.

Crystal: A largely homogeneous, solid form of an element or compound, whose orderly internal arrangement of atoms is expressed outwardly by a geometric form with plane faces. Many minerals exhibit crystals if sufficient room is available to grow.

Crystalline: Said of any substance, especially minerals, that have an orderly internal arrangement of atoms. By the commonly accepted definition, all minerals must be crystalline.

Hardness: The resistance of a mineral to scratching relative to a standard scale of 10 minerals known as Mohs' hardness scale. Hardness may be a reflection of the bonding strength between atoms in the crystal lattice of minerals.

Streak: The color of a mineral in its powdered form, usually obtained by rubbing the mineral on a porcelain streak plate and noting the mark that it leaves. The color of the streak may be different than the color of the material.

Cleavage: The ability of a mineral to break along smooth planes at distinct angles to each other. Cleavage reflects the internal crystal structure of the mineral. Not all minerals have a good cleavage; instead some break on irregular or uneven surfaces called fractures.

Vein: A tabular or sheetlike mineral infilling of a fracture in the country rock, often associated with or related to faults in the area.

Table of Common Kentucky Minerals

Mineral	Composition	Hardness	Diagnostic Characters	Color
Calcite	CaCO ₃	3	Rhombohedral, cleavage; easily attacked by acid	Varies greatly
Dolomite	CaMg(CO ₃) ₂	3.5-4	Saddle-shaped or rhombohedral crystals; slightly attacked by acid	Flesh-pink color
Quartz	SiO ₂	7	Crystals commonly hexagonal prisms; no cleavage	Varies greatly
Fluorite	CaF ₂	3-3.5	Cubic crystals; octahedral cleavage	Varies greatly
Barite	BaSO ₄	3-3.5	Very heavy; prismatic or tabular crystals	White
Galena	PbS	2.5	Cubic crystals and cleavage	Silver metallic
Sphalerite	ZnS	3.5-4	Resinous to submetallic	Yellow-brown to black
Pyrite	FeS ₂	6-6.5	Metallic with cubic crystals	Brassy yellow

Questions for Study and Reflection

1. What is the relationship between some mineral deposits and faults in Kentucky?

2. How can some minerals be crystalline but yet lack crystals?

3. What is the difference between a mineral and a rock?

4. Name some common non-fuel “minerals” from Kentucky and describe their uses.

5. Why is Kentucky no longer a major mineral producer?

6. How would you distinguish between the two common Kentucky minerals, calcite and quartz, both of which may be clear and colorless?

Program 2: Rocks

Limestone: A sedimentary rock composed largely of calcite. In the Lexington Limestone, most of the calcite comes from fossil fragments.

Dolostone: A sedimentary rock composed largely of dolomite. Unlike limestones, which fizz violently in dilute acid, dolostones will fizz only slightly or not at all in dilute acid. Most dolostones in Kentucky are tan, light-brown, or orange-brown in color.

Shale: A very fine-grained, mud-rich, sedimentary rock composed largely of clay deposited in very thin laminae. Because of their fine-grained, clay composition, shales are generally not very resistant to weathering or erosion.

Bentonite: A soft, plastic, clay-rich sedimentary rock formed from altered volcanic ash that settled out of the air during volcanic eruptions, and usually accumulated in shallow seas or lakes. Alteration of the ash by water generally produces plastic clays that swell when wet. The deposits look like shales and are common in the lower Lexington Limestone and upper High Bridge Group in central Kentucky.

Sandstone: A sedimentary rock composed of sand-size grains (often quartzose in composition) that have been cemented together.

Lexington Limestone: Middle and Upper Ordovician, blue-gray limestones common in the central Kentucky Bluegrass region.

Highbridge Group: White to tan, massive, dense limestones and dolostones, which are late Middle Ordovician in age, that occur below the Lexington Limestone, usually in the gorge of the Kentucky River. These are the oldest exposed rocks in the state, and some of them have a peculiar tan, gray and white color mottling that is described as “Kentucky River Marble” when used as building stone.

Fireclay: A rock composed of silica-rich clay, which when fired as a clay, can withstand high temperatures without deforming. Hence, they are commonly used in the manufacture of refractory bricks for kilns, furnaces, and fireplaces. Many fireclays are found below coals and at one time formed the underclay or soil on which coal swamps developed. Fireclays are commonly mined in the Kentucky coal fields.

Ball Clay: Plastic clays, commonly containing organic matter, that are used to make ceramics and glazes. All of Kentucky’s ball clays are quarried from very young, Tertiary rocks in western Kentucky.

Meander: A sinuous curve, bend, or loop in the course of a stream.

Point Bar: Arcuate ridges of sand and gravel that accrete on the inside of a meander bend.

Coal: An organic-rich rock, containing more than 50% organic matter, formed from the compaction and alteration of plant materials originally deposited in ancient swamps. Kentucky’s

major coals formed as extensive swamps during the Pennsylvanian Period, 300-325 million years ago.

Soil: A series of layers of loose, unconsolidated rock debris and organic matter that forms on the surface of the earth in many places due to weathering of the underlying bedrock.

Soil Profile: A series of layers or horizons forming in typical soils; each with different properties such as structure, color, texture, or composition, and relating to a different degree of weathering or accumulation of weathering products.

Weathering: The change in physical character (color, texture, firmness) or chemical composition of rocks exposed at the surface due to interaction with atmospheric (water, O₂, CO₂, freeze and thaw) or organic (plants) agents.

Erosion: The movement and transportation of weathered, broken-up rock debris by natural processes.

Phosphorite: A mineral substance [Ca₃(PO₄)₂] that occurs naturally in the Middle Ordovician rocks of the Lexington Limestone. It is an important nutritional “mineral” for all organisms and very important for metabolism and strong bones in all vertebrates.

Loess: Fine, wind-blown silt deposits that commonly form thick, unconsolidated, blanket-like deposits. They can form moderately rich soils and even topography. They are common in western Kentucky and are related to winds blowing off the fronts of former ancient glaciers to the north.

Glaciation in Kentucky: During the Quaternary time period from about 10,000 to 1.8 million years ago, parts of North America, largely north of the Ohio and Missouri rivers, were covered by extensive ice sheets. Only a thin strip of northern Kentucky running from Kenton to Oldham counties was so glaciated, but the effects of glaciation were felt throughout the state.

Questions for Study and Reflection

1. What are the uses for limestones, bentonites, and fire clays?
2. How are the sands and gravels of the Ohio River related to glaciers in the last ice age?
3. What is the source of the sands and gravels in the Kentucky River?

4. What are the major types of coal mining in eastern and western Kentucky, and why are the forms of mining different in each region?

5. What is the relationship between phosphorite-rich limestones and the horse industry in central Kentucky?

6. How are rocks turned into soil?

7. Why do different parts of Kentucky have different soils with different levels of fertility?

Program 3: Water, Hydrocarbons and Timber

Surface Water: The part of the precipitation that travels over the soil surface to the nearest surface stream or body of water.

Ground Water: That part of the precipitation that infiltrates into subsurface soils and rock.

Karst: A type of topography formed over limestone areas due to solution of the limestone. Such areas are characterized by sinkholes, caves, and underground drainage. Kentucky's major cave areas are karst regions.

Carbonic Acid: A weak acid (H_2CO_3) formed by the interaction of water and carbon dioxide. This acid is thought to be responsible for the dissolution of limestone in karst regions.

Hydrocarbon: Any organic compound, gaseous, liquid or solid, formed largely of hydrogen and carbon. Crude oil and natural gas are both complex mixtures of hydrocarbons.

Black shales: Thinly laminated (fissile) shales which are rich in organic matter (4-20%). In Kentucky, these shales are Devonian in age (365-400 million years old), and they are the source for most of Kentucky's oil and gas deposits.

Knobs: A physiographic region in central Kentucky composed of large, conical to flat-topped knobs that rim the Bluegrass Region. Basal parts of the Knobs are formed of easily eroded black shales with protective caps of Mississippian (325-365 million years old) siltstone or limestone.

Questions for Study and Reflection

1. What is the ultimate source for all of Kentucky's surface and ground waters?
2. What is the origin of Kentucky's oil and gas deposits? Where do most of these occur in the state?
3. Why are Kentucky's forests so diverse relative to types of trees?
4. How do black shales form?
5. Where are Kentucky's major karst areas?
6. Why are karst areas especially prone to pollution?

Internet Resources

Kentucky Geologic Society

<http://www.uky.edu/KGS/>

This site includes information about the geology of Kentucky; fossils and prehistoric life; K-12 education and earth science links; rocks and minerals; mapping; and KGS publications. The KGS publishes beautiful full-color geologic maps of Kentucky; teachers can visit this site to see what's available and how they can obtain these maps as well as other KGS materials.

Kentucky Paleontological Society

<http://www.uky.edu/OtherOrgs/KPS/>

This site provides information about fossils and fossil hunting, as well as photographs of fossils.

Electronic Field Trip to the Falls of the Ohio

<http://www.ket.org/trips/falls/index.htm>

In fall 1999, KET aired "Electronic Field Trip to the Falls of the Ohio." This important Kentucky geological site is explored in depth during the program. The Web site developed to accompany the field trip includes links to other resources, a teacher's guide for the program, information about the Falls' history and wildlife, and more.

Electronic Field Trip Through Geologic Time

<http://www.ket.org/trips/geotime/>

This field trip, led by Dr. Frank Ettensohn of the University of Kentucky, takes students to the Jenkins Pound Gap in Letcher County, the first site in Kentucky designated as geologically significant. The Web site includes links to other geology-related Web sites, a glossary, educational resources, and a geologic timeline.

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