

***The Lay of the Land:
Effects of Kentucky Geology
on Culture***

**Seminar 3
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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The Lay of the Land: Effects of Kentucky Geology on Culture

Overview of Seminar 3

Targeted Audience: Science teachers, all levels

Seminar 3 explores the varied geology of Western Kentucky. Joined by Rico Tyler, a physics teacher from Franklin County High School, Dr. Frank Ettensohn, geology professor from the University of Kentucky, first takes viewers to the Pennyroyal region of Kentucky. From the Pennyroyal Plateau, it's on to the Western Kentucky Coalfield and finally to the Jackson Purchase, the westernmost region of the state and the site of the most violent earthquakes ever recorded in North America.

About This Teacher Packet

This packet includes glossaries, discussion questions, and links to useful Web sites. You'll find more details in the table of contents on page 4.

Series Format

This program was taped on location throughout Western Kentucky. Any information needed to participate in the seminar is included in the videotape or in this print packet.

Packet Contents

- Glossary and Questions for Study and Reflection 4
 - Pennyroyal Plateau 4
 - Western Kentucky Coalfield 7
 - Jackson Purchase 8
- Internet Resources 10

Materials Needed for Participation in the Seminar

- Pencil or pen
- Paper
- Teacher's packets for Seminars 1, 2, & 3

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 & Questions for Study and Reflection

Lay of the Land, Seminar 3

Pennyroyal (Mississippian) Plateau

Pennyroyal Plateau: The largest physiographic region of Kentucky, comprising about 30% of the state. It is an area of low hills and gently rolling plains largely developed on Mississippian rocks. The region extends in a great arc around the Western Kentucky Coal Field and extends from the Bluegrass and Cumberland Plateau regions in the east to the Jackson Purchase in the west.

Karst: A type of topography formed over soluble rocks like limestone due to rock dissolution, and characterized by closed depressions or sinkholes, caves and underground drainage. The name is derived from Karst, a limestone plateau in the Dinaric Alps of the former Yugoslavia.

Karst or Sinkhole plain: A planar region characterized by abundant sinkholes and a general absence of surface drainage or streams.

Resurgence: The point where an underground stream appears at the surface to become a stream.

Blue hole: A drowned sinkhole that forms a nonturbulent resurgence; the deepness of the hole may give upwelling waters a deep-blue color

Conduit: An underground passage that is completely filled with water under pressure.

Carbonic acid: A weak acid formed by the combination of carbon dioxide and water, which is thought to be responsible for much of the solution in limestone terrain.

Solution: A process of chemical weathering by which rock material passes into solution. In most karst areas, it involves the removal of calcium carbonate from limestone by carbonic acid.

Sink hole: A circular depression formed by the solution and collapse of limestones just below the surface.

Cave: A naturally formed, underground chamber or series of chambers large enough for a human to enter and generally formed through the solution of limestones.

Bedding plane: A planar or nearly planar surface that separates each successive layer of bedded rock. Water dissolving limestone along bedding planes may form broad, flat cave passages.

Crinoids: A common fossil organism in Kentucky rocks consisting of a calyx or “bud” with a series of arms sitting on top of a stem made up of small, tire-like, calcite discs. The organisms, also known as sea lilies, are formed from many small calcite plates or ossicles, that rapidly disaggregate upon death of the organism. The calyces are extremely rare, but stem segments and the individual tire-like discs are very common.

Brachiopod: Common solitary fossils in Kentucky that are composed of two calcareous shells with a plane of symmetry that cuts through both shells. Although looking like clams, brachiopods are unrelated to them.

Bryozoan: Common colonial fossils in Kentucky that often have a twig-like appearance. Each twig-like stem contains thousands of tiny pores which housed the almost microscopic animals that made up the colony. They are commonly mistaken for corals, except that the pores on corals are much larger and filled with vertical, plate-like septae.

Mineralization: The process of impregnating voids, especially fractures or joints, with minerals, usually from hot solutions.

Calcite: Calcium carbonate (CaCO_3), the principle constituent in limestone. In Kentucky, it commonly occurs in veins associated with faults and fractures. Although it occurs in many different colors, it is generally white or colorless and identified by its rhombohedral cleavage.

Fluorite: A transparent to translucent mineral formed of CaF_2 , which is very common in parts of Kentucky. It occurs in many different colors, but blue and purple are most common. In Kentucky, it commonly occurs in veins associated with faults or fractures. It is usually identified by its cubic crystals and octahedral cleavage.

Cleavage: The ability of a mineral crystal to break along smooth planes that are everywhere parallel to each other throughout the crystal. Cleavage reflects the internal arrangement of atoms in a mineral, but not all minerals have good cleavage.

Vein: A tabular or sheet-like mineral filling of a fracture in a host rock.

Friable: A rock or mineral that crumbles easily or is easily broken, pulverized or reduced to a powder. The term is often used for poorly cemented sandstones.

Fluorspart District: An area in the extreme northwestern part of the Pennyroyal Plateau, largely in Livingston and Crittenden counties, where fluorite, emplaced in veins associated with the Pennyryle and Rough Creek fault systems, was formerly mined.

Pennyryle and Rough Creek Fault Systems: Large, east-west-trending fault systems that extend nearly 120 miles in length through parts of the Pennyroyal Plateau and Western Kentucky Coal Field. These faults have acted as conduits for mineral-bearing hot waters and as voids where these minerals could be emplaced.

Dripping Springs Escarpment: A belt of steep cliffs or slopes that forms the northern margin of the Pennyroyal Plateau. The belt rises 150 to 300 feet above the central limestone karst plain that comprises most of the Pennyroyal Plateau and is developed on the more resistant Big Clifty Sandstone, which intervenes in the Upper Mississippian limestone sequence.

Land Between the Lakes: A rough, hilly area located between Kentucky Lake and Lake Barkley that defines the western margin of the Pennyroyal Plateau. The area is developed on cherty Lower and Middle Mississippian limestones, deeply buried in places by unconsolidated

Upper Cretaceous gravels. The area lacks the karst features found to the east of Lake Barkley and is almost wholly part of a national recreation area.

Cretaceous Period: The period of geologic time from 145 to 65 million years ago. Rocks of this age in Kentucky are only found at the Land Between the Lakes and in eastern parts of the Jackson Purchase.

Muldraugh's Hill: An escarpment nearly 500 feet high that defines the eastern boundary of the Pennyroyal Plateau with the Bluegrass region. It is developed on resistant Lower Mississippian siltstones and roughly parallels the Rolling Fork River.

Siltstone: A rock whose grain-size composition is intermediate between sandstone and shale. Although clay may be present, at least two-thirds of the grains must be silt size (1/16 – 1/256 mm in diameter). The grains are so fine that they can not be felt, and so we use the “taste” test for silt described in an earlier program.

Questions for Study and Reflection:

- How are the Pennyroyal Plateau and Inner Bluegrass regions similar?
- Why are karst features absent from the Land Between the Lakes?
- Why is the Pennyroyal Plateau sometimes called a region “between places?”
- Explain the origin of the mineralization that occurs throughout the region.
- Explain the origin of karst features and why so many are present in the area.
- What is it about the underlying rocks that gives rise to escarpments?

Western Kentucky Coal Field (Shawnee Hills Area)

Western Kentucky Coalfield: A gently rolling to hilly upland completely encircled by the Pennyroyal Plateau to the south. The area is developed on Pennsylvanian sandstones and shales and is a major source of coal. Although the area is higher and has greater relief than surrounding parts of the Pennyroyal Plateau, the area is not as high and the relief is not as great as the geologically equivalent Cumberland Plateau in the east.

Loess: A widespread, homogeneous, unlayered, unconsolidated, but coherent, blanket-like deposit of wind-blown silt and clay. Loess commonly forms steep cliffs when weathered, and the blanket-like nature of the deposits commonly has a leveling effect on topography.

Bituminous coal: A very abundant type of coal that burns with a smoky flame and contains 15-20% volatile matter. Nearly all Kentucky coal is of this type.

Underclay: A layer of clay immediately underlying a coal bed. It represents the old soil in which the plants that formed the coal were rooted.

Acid mine drainage: Ground water that has drained from coal mines and spoil piles, which is commonly acid-rich and contains much dissolved iron. The acid character is in part derived from the weathering of pyrite (FeS_2) which produces sulfuric acid and releases iron into the water.

Area stripping: In more level areas where coals are extensive and flat-lying with minimal overburden, entire areas are leveled, the overburden removed, and the coals taken. The aerial extent of this process contrasts sharply with contour stripping in hilly areas where vertical cuts are made in the side of a hill and the coal seam is followed around the mountain.

Questions for Study and Reflection:

- How does Kentucky's western coalfield differ from the eastern coalfield?
- Both the eastern and western coalfields are formed on the same types of Pennsylvanian rocks. Why is the relief so much less in the western coalfield?
- Explain why the Pennsylvanian rocks of the western coalfield are isolated in a basin surrounded by the Mississippian Pennyroyal Plateau.

Jackson Purchase

Tertiary: The period of geologic time from 65 to 1.8 million years ago. The deposits in Kentucky from this period are mostly unconsolidated clays, silts, sands, and gravels and are largely restricted to the Jackson Purchase.

Quaternary: The period of geologic time from 1.8 million years ago to the present, which includes the Pleistocene and Holocene epochs. This is the period of northern hemisphere glaciation, although only northernmost parts of the state were glaciated. Most of Kentucky's other Quaternary deposits are alluvial deposits along its rivers and streams.

Holocene: The latest epoch of the Quaternary Period, which includes the last 10,000 years of geologic time. Much of the alluvium and loess in the Jackson Purchase is probably Holocene in age.

Alluvium: The general term for clay, silt, sand, and gravel deposited during relatively recent geologic time by streams or other bodies of running water.

Desiccation: The drying out or loss of water from sediments, generally due to exposure and evaporation at the surface.

Ball clay: A highly plastic clay, commonly containing organic matter, with unfired colors ranging from dark gray to white or pink, that is used in making glazes and certain ceramic wares. The name is derived from the early, English practice of rolling the clays into balls weighing 30-50 pounds and having diameters of about 10 inches.

New Madrid Earthquakes of 1811-12: The series of earthquakes that began on December 16, 1811, and lasted for at least a year thereafter in northeastern Arkansas, southeastern Missouri, northwestern Tennessee, and western Kentucky. The four major earthquakes, and at least six smaller ones, were the greatest recorded sequence of earthquakes in the history of North America.

Fault scarp: A steep slope formed by movement along one side of a fault and representing the exposed surface of the fault before modification by erosion.

Earthquake lake: A lake formed through the accumulation of water in an area that subsided as a result of surface displacement during an earthquake. Reelfoot Lake in Fulton County, Kentucky, and Lake County, Tennessee, is such a lake and formed in response to the New Madrid earthquakes of 1811-1812.

Oxbow lake: A short-lived, crescent-shaped lake formed in an abandoned, cut-off meander bend on a river flood plain.

Mississippi Embayment: A low, north-south-trending plain along the Mississippi River, which extends from southern Illinois to the Mississippi delta in Louisiana. The embayment has been a persistently subsiding trough apparently bound at depth by faults on both sides. Subsidence is probably still occurring today as evidenced by the New Madrid earthquake. Because of its depressed nature, it has been the site of Cretaceous and Tertiary marine incursions from the Gulf

of Mexico, as well as a sink for alluvial sediments. Today, the area contains Cretaceous and Tertiary marine, marginal-marine, and alluvial sediments, as well as Quaternary alluvial sediments. The area includes the Jackson Purchase of Kentucky.

Gulf Coastal Plain: An intensive, very gently dipping, lowland that forms the southern margin of the United States. The plain protrudes inland along the Mississippi Embayment and includes the Jackson Purchase of Kentucky.

Questions for Study and Reflection:

- How do the rocks underlying the Jackson Purchase differ from those underlying the rest of the state?
- The Ohio, Mississippi, and Tennessee rivers have played major roles in the development of the Purchase. Explain some of the benefits and drawbacks related to these rivers.
- Why is land in the Purchase more subject to earthquake damage than other parts of Kentucky?
- Why is the Purchase more like parts of the “Deep South” than other parts of Kentucky?

Internet Resources

Kentucky Geologic Society

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

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

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

www.ket.org/trips/geotime/

This field trip, led by Dr. Frank Eddensohn 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.