

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

**Seminar 1
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 1

Targeted Audience: Science teachers, all levels

Geologist Dr. Frank Eddensohn and teacher Terri Koontz take a trip through the Bluegrass region of Kentucky to explore how its geological history affects the topography and how that impacts the ecology, culture, and economy of the region.

The trip begins in the inner Bluegrass on a Lexington horse farm. Then Frank and Terri travel down to the Clays Ferry fault, up into northern Kentucky, and then down the Ohio River to the Falls of the Ohio. During their journey, Frank explains the causes and effects of the variety of geologic ages and formations they encounter.

About This Teacher Packet

This packet includes a biography of the presenter, links to useful Web sites, and glossaries and discussion questions. You'll find more details in the table of contents on page 3.

Series Format

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

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Materials and Requirements Needed for Participation in the Seminar

- Pencil or pen
- Paper
- Teacher's packet

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.

About the Seminar 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.

Joining Frank is **Terri Koontz**, who teaches middle level science at Lexington Traditional Magnet School in Fayette County.

Glossary & Questions for Study and Reflection

Lay of the Land, Seminar 1

Introduction

Physiography: A branch of geology dealing with the description of and origin of surface landforms.

Topography: The “lay of the land” or the general configuration of the land surface including its variations in elevation (relief) and the positions of natural land features.

Geologic column: A columnar diagram that shows the subdivision of geologic time with the oldest on the bottom and the youngest at the top. Geologic time is typically divided into 14 arbitrary time intervals known as periods. The rocks in the Bluegrass region were largely deposited in the Ordovician Period (see page 6).

Geologic map: A map on which geologic information is recorded, especially the distribution of rocks relative to their time (geologic period) of distribution.

Physiographic map: A map which shows the distribution of similar landforms, commonly with the same underlying geology. Areas with similar landforms are commonly designated as physiographic provinces or regions.

Cincinnati Arch: A broad open anticlinal (upfold) fold of regional scale running from central Tennessee through central Kentucky, to northwestern Ohio. The Ordovician rocks of the Bluegrass region are exposed in central Kentucky in an updoming along that arch where erosion has penetrated through younger rocks.

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

Questions for Study and Reflection

Editor’s Note: The geologic and physiographic maps of Kentucky needed to answer the following questions could not be reproduced for the PDF format. They are posted at the following URL on the Kentucky Geological Survey Web site—www.uky.edu/KGS/education/education.html—or may be ordered from the KGS for a minimal cost.

- How are the geologic and physiographic maps of Kentucky related?
- What is the age of the oldest exposed rocks in Kentucky? Where are they located?
- How is the distribution of rocks by periods on the geologic map of Kentucky related to the Cincinnati Arch?
- Why do the rocks in Kentucky get progressively younger to the east and west of the Bluegrass?

Major Divisions of Geologic Time				
Millions of Years Ago	2	Quaternary	Ice Age, modern humans appear	Cenozoic
		Tertiary	Abundant mammals	
	66	Cretaceous	First flowering plants; extinctions of dinosaurs & others	Mesozoic
		Jurassic	First birds; abundant dinosaurs	
		Triassic	First dinosaurs & mammals; conifer forests	
	257	Permian	Extinction of trilobites & other marine animals	Palaeozoic
		Pennsylvanian	Fern forests; abundant insects; first reptiles	
		Mississippian	Large primitive trees	
		Devonian	First amphibians; fish diversity	
		Silurian	Early plants & animals on land	
		Ordovician	Jawless armored fish	
Cambrian		First abundant shelly invertebrates		
543	Proterozoic	One-celled organisms (bacteria, protists)	Precambrian	
	Archean	Oldest fossils: bacteria		
4600		Origin of earth		

Inner Bluegrass

Ordovician: A geologic time period encompassing geologic time between 490 and 438 million years ago. During this time period, most of the rocks in the Kentucky Bluegrass region were deposited in shallow seas that covered the area.

Middle Ordovician: The age of the oldest rocks exposed in Kentucky. They are approximately 450 million years old and are exposed in the Inner Bluegrass region. Most of these rocks are included in the Lexington Limestone Formation.

Bluegrass Region: A roughly circular area in north-central Kentucky comprising about one-fifth of the state and underlain by largely Ordovician limestones and shales. The region is named for an introduced grass, *Poa pratensis* or bluegrass, which has become common throughout the area. The area is the most urbanized and affluent in Kentucky and is known for its bourbon, horses, and tobacco. It is clearly both a physical and cultural area in Kentucky (see the Physiographic Diagram of Kentucky at www.uky.edu/KGS/education/education.html).

Inner Bluegrass: The central part of the Bluegrass developed around the Kentucky River. It is largely a gently rolling plain developed on phosphatic, Middle Ordovician limestones. The gently rolling nature of the area, combined with its very fertile soils due to high phosphate content, makes it one of the richest agricultural areas in the world. Farms are large, often in excess of 1000 acres.

Phosphate: An abbreviated chemical name for the calcium phosphate [$\text{Ca}_3(\text{PO}_4)_2$] which is present in the Lexington Limestone underlying the Inner Bluegrass.

Lexington Peneplain: A nearly flat-lying erosional plain developed at one time across the Bluegrass region, largely due to solutional processes. Although mostly destroyed now by subsequent stream erosion, concordant hilltops of the same elevation throughout the area are evidence of its former presence.

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

Kentucky River Fault Zone: A linear zone of faults stretching from eastern Kentucky to the Bluegrass region along which most blocks have downdropped to the south. Parts of the Kentucky River follow the fault zone.

Mineral: A naturally occurring, inorganic, crystalline substance with a definite composition and physical properties. Hot-waters circulating along the Kentucky River Fault Zone emplaced several common minerals in the fault zone, which include calcite (CaCO_3), dolomite [$\text{CaMg}(\text{CO}_3)_2$], fluorite (CaF_2), barite (BaSO_4), sphalerite (ZnS), and galena (PbS).

Rock: A natural aggregate composed of one or more minerals.

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

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

Acid test for calcite or limestone: Placing dilute (10%) hydrochloric acid or other acids on limestone will cause a fizzing or effervescent action on the rock due to escape of carbon dioxide.

“Taste” test for silt: Place a small piece of shale between front teeth and gently “grind” teeth together. A slimy feeling indicates the presence of clay only. A gritty feeling between the teeth indicates the presence of silt.

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

Cephalopod: A class of marine mollusks with a definite head and a mouth surrounded by tentacles as in squid or octopi. Those found in the fossil record have a long, partitioned, cone-like or coiled shell. The Ordovician Period is sometimes called the age of cephalopods, because of the abundance of cephalopod fossils.

Trilobite: An extinct class of marine arthropods related to horseshoe crabs, having a three-lobed, ovoid to subelliptical exoskeleton. They are common, fragmented fossils in Ordovician rocks.

Stromatoporoid: The massive, dome-shaped, calcitic skeletons of specialized marine sponges that commonly lived in high-energy environments. Because of their hard skeletons, they are sometimes called sclerosponges. They are common fossils in Ordovician rocks.

Questions for Study and Reflection

- How is the character of the Inner Bluegrass region related to the underlying rocks?
- What is the connection between horse farming and the rocks of the Inner Bluegrass region?
- Why would the Kentucky River follow the Kentucky River Fault Zone?
- What was the origin of the central Kentucky mineral industry in the late 1800’s and early 1900’s?
- Why is the Inner Bluegrass region one of the agriculturally richest areas in the world?

Outer Bluegrass

Outer Bluegrass: The outer portion of the Bluegrass region that completely encircles the Inner Bluegrass. It is largely developed on Upper Ordovician, interbedded limestones, and shales. Because the shales are not resistant to erosion and weathering, they give rise to an area of irregular rolling hills with narrow ridge tops. The shales also do not form very fertile soils. The combination of hilly terrain and soils of only medium fertility results in smaller farms where grazing of livestock predominates.

Eden shale belt: A part of the Outer Bluegrass region immediately surrounding the Inner Bluegrass. The rocks underlying the land are predominantly soft shales which erode easily and give rise to infertile, yellowish soils. The surface is deeply dissected by steep, v-shaped valleys and very narrow ridge-tops. Red cedars are especially common in the subregion because of their preference for acid, clayey soils.

Questions for Study and Reflection

- Compare and contrast the topography of the Inner and Outer Bluegrass subregions.
- How do the different types of bedrock in each area influence the topography of the Inner and Outer Bluegrass subregions?
- How does the topography and bedrock of the Inner and Outer Bluegrass influence the economy and culture of each subregion?

Glaciated Area

Glaciation: A term for the geologic processes involved in the formation and movement of glaciers or ice sheets, including erosion, deposition, and the resulting effects of these activities on the Earth's surface.

Glaciated area: A thin strip of northern Kentucky roughly parallel to the Ohio River and running from Kenton County to Oldham County, which was covered by ice sheets during parts of the Pleistocene Epoch.

Pleistocene Epoch: A subdivision of time during the Quaternary Period, from about 10,000 years ago to 1.8 million years ago, during which major glaciation covered parts of the northern hemisphere, including northernmost Kentucky. It is sometimes called the "ice age" or "great ice age."

"Glacial": A term used informally to describe a period of regional glaciation. In North America, four such glacial periods are recognized, including the Nebraskan, Kansan, Illinoian, and Wisconsinan. Each "glacial" is separated from the next by an "interglacial."

"Interglacial": A term used informally to describe a period of warmth and milder climate separating two glacials, during which ice sheets melted and retreated.

Nebraskan glacial: North American period of glaciation from 920,000 to 580,000 years ago, which possibly reached northern Kentucky.

Kansan glacial: North American period of glaciation from 480,000 to 240,000 years ago which accounts for most of the glaciation to reach northern Kentucky.

Illinoian glacial: North American period of glaciation from 120,000 to 170,000 years ago, which also reached northern Kentucky.

Wisconsinan glacial: North American period of glaciation from 70,000 to 10,000 years ago, which did not reach northern Kentucky. This glacial front stalled out north of Cincinnati.

Till: An unconsolidated mixture of clay, sand, gravel, and boulders deposited directly by a glacier with no reworking by water. Such deposits lack any layering or stratification.

Granite: An intrusive igneous rock composed of quartz, feldspar, mica, and a dark mineral like amphibole or pyroxene. Such rocks do not occur naturally at the surface in Kentucky. They may be transported into the state as pebbles, cobbles, or boulders by water or ice. Granite pebbles from Canada are common in Kentucky tills.

Chert: A very hard, compact, microcrystalline form of quartz (SiO₂) commonly found in sedimentary rocks. It is synonymous with flint. Chert is very common in Kentucky rocks, but that which is present in northern Kentucky tills was derived from southern Canada or Ohio.

Salt Lick: A place where salty, often sulfurous, water emanates like a spring from the ground. As the water evaporates, the salt impregnates the soil surrounding the spring, and wild game very eagerly come to these areas to lick salt from the ground. Fifteen to twenty thousand years ago

during the Wisconsin glacial period, animals moved along the front of the ice sheet looking for places like Big Bone Lick to get needed salt. They often became trapped or mired in the surrounding bogs where their bones were buried and preserved.

Cutbank: The outside bend of a meander where most erosion on a meander occurs.

Questions for Reflection and Study

- How is the topography of the glaciated area in northern Kentucky different from other parts of the Outer Bluegrass subregion?
- How did granite pebbles get into Kentucky?
- What is the source of the salt at Big Bone Lick?
- Compare the age of the glacial till in northern Kentucky with that of the underlying bedrock.

Falls of the Ohio

Falls: A series of rapids on a stream where the stream passes over a resistant ledge of rock and hence descends rapidly across a short distance.

Falls of the Ohio: A series of rapids in the Ohio River at Louisville where the river crosses a resistant ledge of Jeffersonville Limestone. The river falls about 26 feet in three miles forming a break in navigation for most river travel.

Jeffersonville-Limestone: A Middle Devonian (357 million years old) limestone formation about 33 feet thick in west-central Kentucky and adjacent parts of Indiana, which represents a biostrome or “reef-like” accumulation of corals and other fossils.

Devonian Period: The period of geologic time from 415 to 360 million years ago. Rocks deposited during the Devonian Period define the outer margin of the Bluegrass Region.

Reef: A ridge or mound-like sedimentary structure built by sessile organisms and characterized by resistance to waves and topographic relief above its surroundings. The Falls of the Ohio was not a reef.

Biostrome: An extensive, bedded, blanket-like body of sedimentary rock formed from the remains of sessile organisms; it had no relief above its surroundings. The Falls of the Ohio was an ancient biostrome.

Fossil hash or Coquina: A rock made from cemented shells or shell fragments; a type of fossil-fragment limestone.

Coral: A general name for a large group of bottom-dwelling, sessile, marine invertebrates belonging to the class Anthozoa in the phylum Cnidaria. In life they are effectively a cylindrical tube with a crown of tentacles on the upper surface. They commonly secrete skeletons of calcite and may be single individuals (solitary) or colonial.

Corallite: The tube- or cone-like skeleton of an individual coral animal.

Solution flute: Shallow, oval-shaped depressions formed by the dissolution of limestone in turbulent water over long periods of time.

Northward-flowing drainage: Prior to glaciation, the Ohio River was not present and the major drainage, the Salt, Kentucky, and Licking Rivers, flowed northward toward central Ohio. During glaciation, these rivers were dammed by ice, until they overflowed and cut through the divides to drain westward near the present course of the Ohio River.

Questions for Study and Reflection

- How are the rocks at the Falls of the Ohio responsible for the city of Louisville?

- Explain why the rocks at the Falls of the Ohio are younger (Devonian) than the Ordovician rocks that characterize most of the Bluegrass Region.
- What kinds of animals lived in the Middle Devonian seas that deposited rocks around Louisville?

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 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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