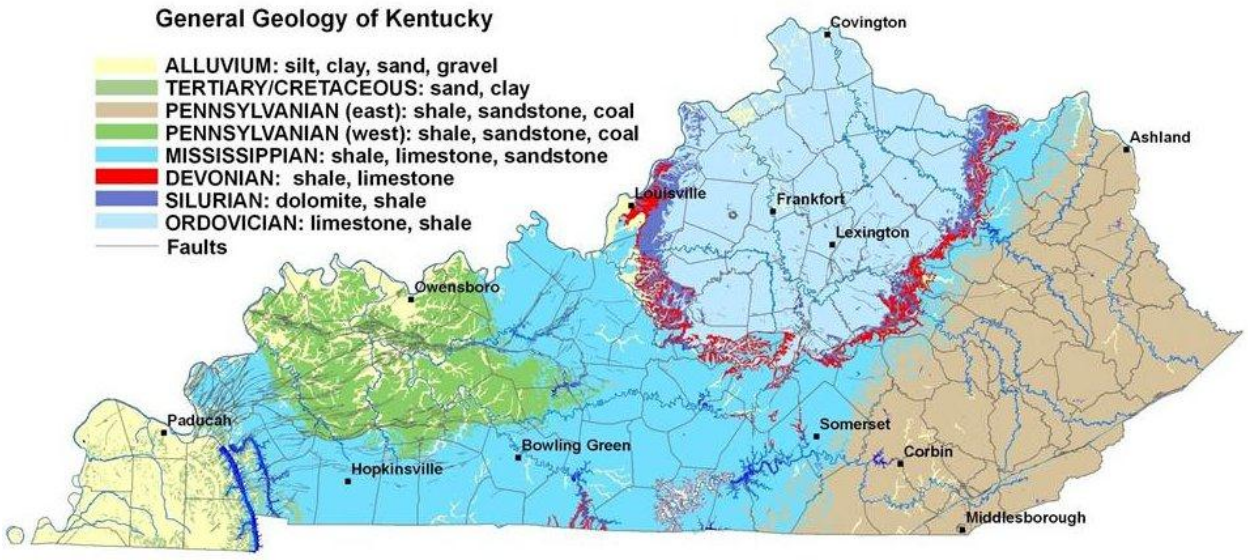
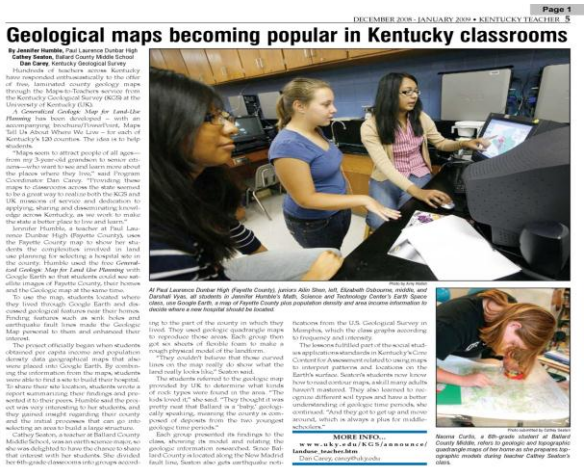
Earth Science Education
Learning about Kentucky's Land and Water
Resource Materials for Teachers



Overview

The Kentucky Geological Survey (KGS) at the University of Kentucky (UK) seeks to expand its efforts to bring Earth Science education home to K-12 students in Kentucky by providing maps and associated teaching materials for classrooms.

An earlier Maps-to-Teachers program at KGS was enthusiastically received by teachers and students, with maps being placed in more than 1,000 classrooms in over 400 schools. Teachers sent many pictures of students using the maps, and two classrooms were featured in the Kentucky Teacher newsletter.



Page 1

DECEMBER 2008 - JANUARY 2009 • KENTUCKY TEACHER 5

Geological maps becoming popular in Kentucky classrooms

By Jennifer Humble, Paul Laurence Dunbar High
Cathey Sexton, Ballard County Middle School
Dan Carey, Kentucky Geological Survey

Hundreds of teachers across Kentucky have responded enthusiastically to the offer of free, laminated county geology maps through the Maps-to-Teachers service from the Kentucky Geological Survey (KGS) at the University of Kentucky (UK).

Our particular *Geologic Map for Land-Use Planning* was developed – with an accompanying brochure/lesson/book, Maps Tell Us About Where We Live – for each of Kentucky's 120 counties. The idea is to help students.

"Maps seem to attract people of all ages—from my 3-year-old grandson to senior citizens—who want to see and learn more about the places where they live," said Program Coordinator Dan Carey. "Providing these maps to classrooms across the state seemed to be a great way to realize both the KGS and UK missions of service and dedication to applying, sharing and disseminating knowledge across Kentucky, as we work to make the state a better place to live and learn."

Jennifer Humble, a teacher at Paul Laurence Dunbar High (Fayette County), uses the Fayette County map to show her students the complexities involved in land use planning for selecting a hospital site in the county. Humble used the free *General-ized Geologic Map for Land Use Planning* with Google Earth so that students could see satellite images of Fayette County, their homes and the Geologic map at the same time.

To use the map, students located where they lived through Google Earth and discussed geological features near their homes. Finding features such as sink holes and earthquake fault lines made the Geologic Map personal to them and enhanced their interest.

The project officially began when students obtained per capita income and population density data (geographical maps that also were placed into Google Earth. By combining the information from the maps, students were able to find a site to build their hospital. To share their site location, students wrote a report summarizing their findings and presented it to their peers. Humble said the project was very interesting to her students, and they gained insight regarding their county and the initial processes that can go into selecting an area to build a large structure.

Cathey Sexton, a teacher at Ballard County Middle School, uses an earth science map, so she was delighted to have the chance to share that interest with her students. She divided her 6th-grade classrooms into groups according to the part of the county in which they lived. They used geologic quadrangle maps to reproduce those areas. Each group then got six sheets of flexible foam to make a rough physical model of the landform.

"They couldn't believe that those curved lines on the map really do show what the land really looks like," Sexton said.

The students referred to the geologic map provided by UK to determine what kinds of rock types were found in the area. "The kids loved it," she said. "They thought it was pretty neat that Ballard is a 'baby,' geologically speaking, meaning the county is composed of deposits from the two youngest geologic time periods."

Each group presented its findings to the class, showing its model and relating the geologic information researched. Since Ballard County is located along the New Madrid fault line, Sexton also gets earthquake notifications from the U.S. Geological Survey in Memphis, which the class graphs according to frequency and intensity.

The lessons fulfilled part of the social studies application standards in Kentucky's Core Content for Assessment related to using maps to interpret patterns and locations on the Earth's surface. Sexton's students now know how to read contour maps, a skill many adults haven't mastered. They also learned to recognize different soil types and have a better understanding of geologic time periods, she continued. "And they got to get up and move around, which is always a plus for middle schoolers."

MORE INFO...
www.uky.edu/KGS/announce/landuse_teacher.htm

Dan Carey, carey@uky.edu

At Paul Laurence Dunbar High (Fayette County), juniors Atiin Shon, left, Elizabeth Osbourne, middle, and Darshali Vyas, all students in Jennifer Humble's Math, Science and Technology Center's Earth Space class, use Google Earth, a map of Fayette County plus population density and area income information to decide where a new hospital should be located.

Photo by Amy Hilton

Photo submitted by Cathey Sexton

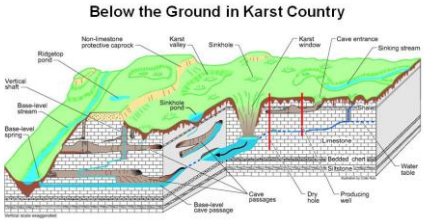
Neoma Curtis, a 6th-grade student at Ballard County Middle, refers to geologic and topographic quadrangle maps of her home as she prepares topographic models during teacher Cathey Sexton's class.

The success of the Maps-to-Teachers program was gratifying, but fewer than 25 percent of Kentucky schools were reached. Our goal is to reach out to classrooms in all the 1,600+ K-12 schools in Kentucky.

Available Materials

In recent years, the Kentucky Geological Survey has produced a variety of maps to help students learn about Kentucky's land and water and to better understand the place where they live, play, and may someday work and have a home. Even at an early age students like to explore maps to learn about the place where they live. We feel that this early exposure to earth science and issues of sustainability and the environment will lay the groundwork for a better-informed citizenry and, hopefully, future earth scientists.

The *Generalized Geologic County Maps for Land-Use Planning*, originally intended for homeowners, developers, and planners, have been particularly popular in the classrooms. These maps, developed for each of Kentucky's 120 counties, help the students better understand the physical environment of their neighborhood and their county. The maps illustrate the rock types that form the foundation of the county and how the rocks may affect home, road, and commercial development, the building of ponds, recreation, etc. Photos taken in the county, diagrams, and text illustrate local issues, such as sinkholes in karst regions, or landslides in Eastern Kentucky.

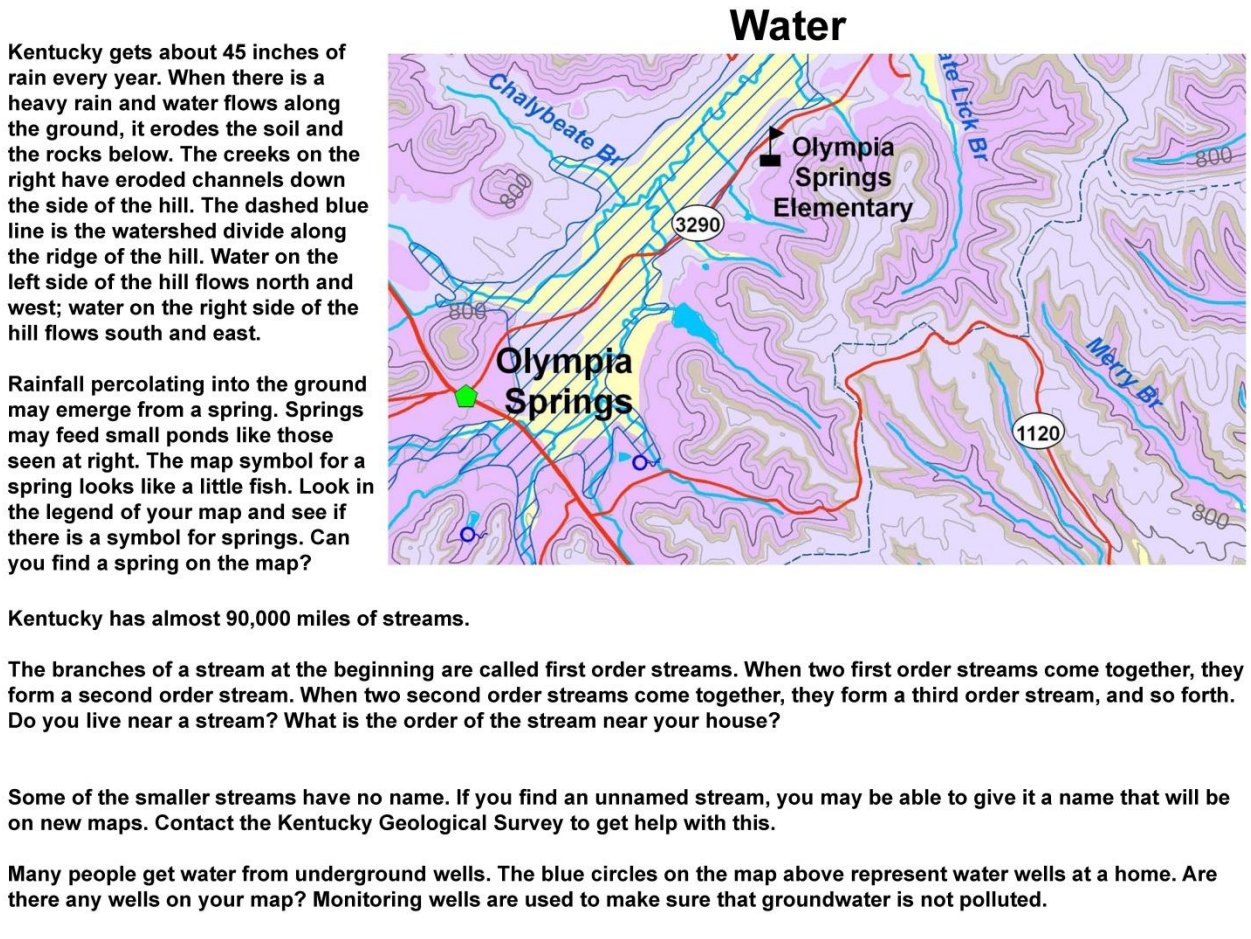


In karst areas, water flows through the limestone beneath the ground.

Karst Geology

Karst areas are indicated by sinkholes. The term "karst" refers to a landscape characterized by sinkholes, springs, sinking streams (streams that disappear underground), and underground drainage through solution-enlarged conduits or caves. Karst landscapes form when slightly acidic water from rain and snowmelt seeps through soil cover into fractured and soluble bedrock (usually limestone, dolomite, or gypsum). Sinkholes are depressions on the land surface into which water drains underground. Usually circular and often funnel-shaped, they range in size from a few feet to hundreds of feet in diameter. Springs occur when water emerges from underground to become surface water. Caves are solution-enlarged fractures or conduits large enough for a person to enter.

The maps help students learn about map reading, topography, geology, mineral resources, energy resources, geologic hazards, hydrology, watersheds, wetlands, ground water, water quality protection, and generally how geology can affect what we do with the land. All this in the context of the student's neighborhood: "Find your school on the map. What is the elevation? If you were a bird, how far would you have to fly to get to school from your house? At 20 miles per hour, how long would it take? What kind of rock lies beneath your house? What does the map table say about this rock? What is the nearest stream to your house? Do you live in an area of karst? Are there any sinkholes in your neighborhood? Are there wetlands in your county? Why are wetlands important? Etc. Other classroom resources will use the maps to present related concepts.



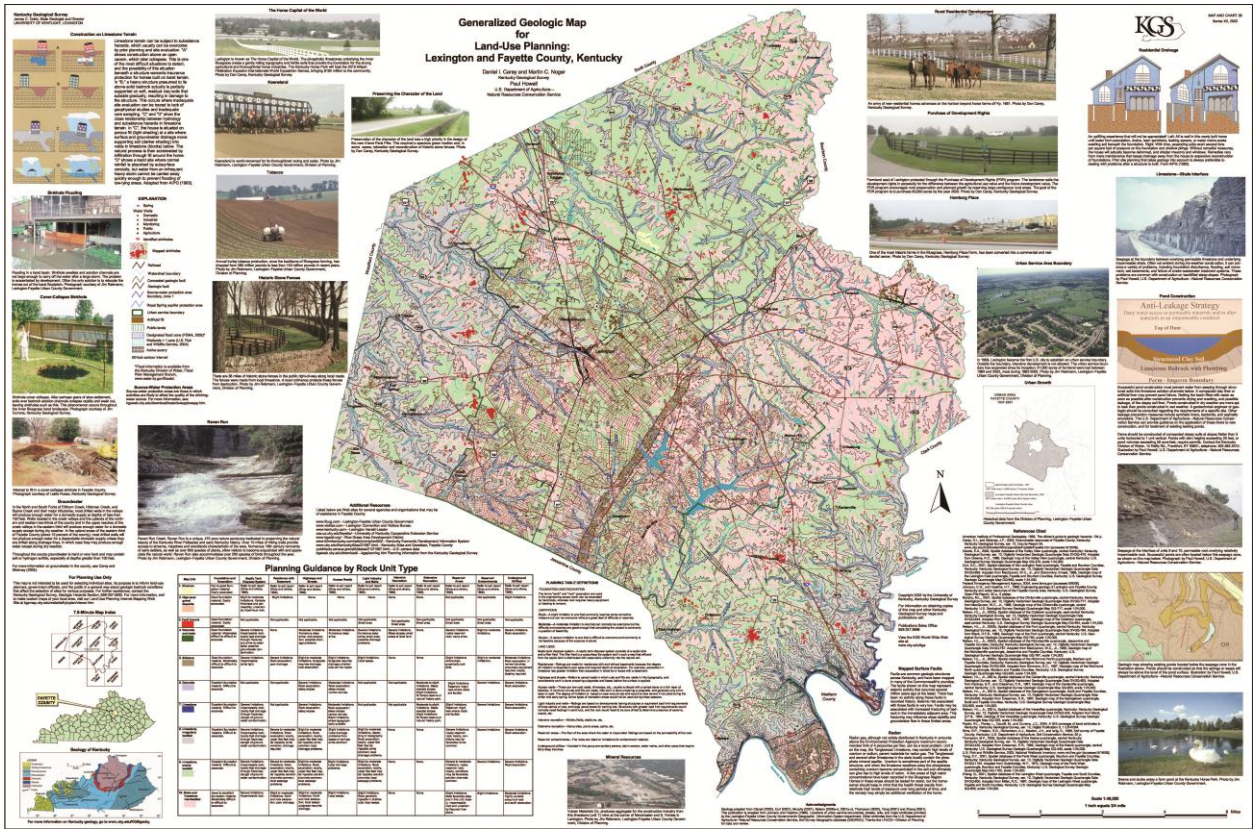
The county maps have been recognized by the Geologic Society of America and the American Association of State Geologists with the 2008 John C. Frye Memorial Award in Environmental Geology, and by the Lexington-Fayette Environmental Commission 2008 Environmental Award.

Other maps and resources for educators include *River Basins of Kentucky*—a state map showing river basins, and individual maps for 7 major basins, *Kentucky Terrain*—which

illustrates the landscape of Kentucky, *Geologic Hazards in Kentucky*— showing where hazards such as earthquakes, floods, landslides, radon, unstable and expansive shales, sinkholes, and mined areas occur, *Kentucky Landscapes Through Geologic Time*—shows how the sedimentary rocks that are the foundation of Kentucky were formed when Kentucky lay beneath equatorial seas hundreds of millions of years ago, and *GIS in Kentucky*—explaining what GIS is and how it can be used. Associated reference materials are also available to teachers.

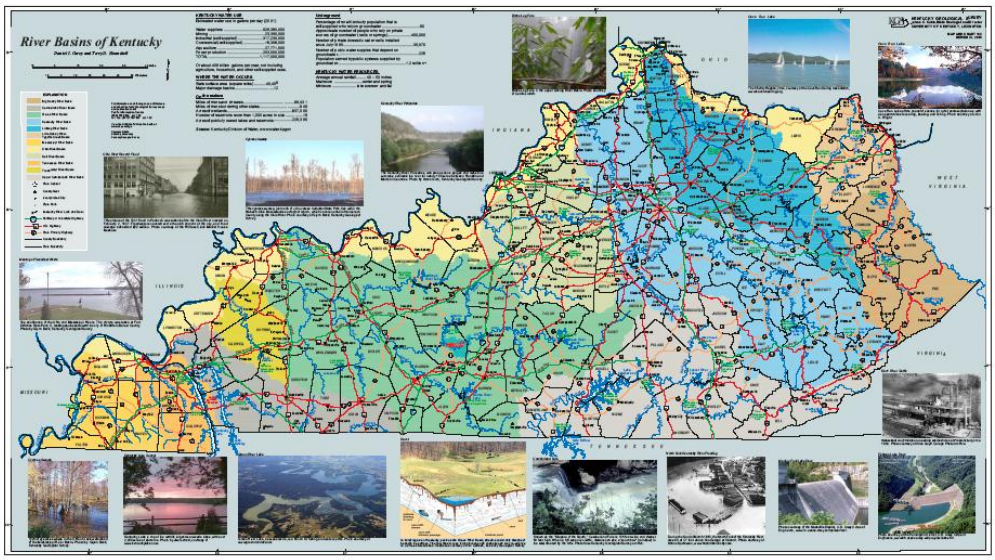
See more at www.uky.edu/KGS/announce/landuse_teacher.htm

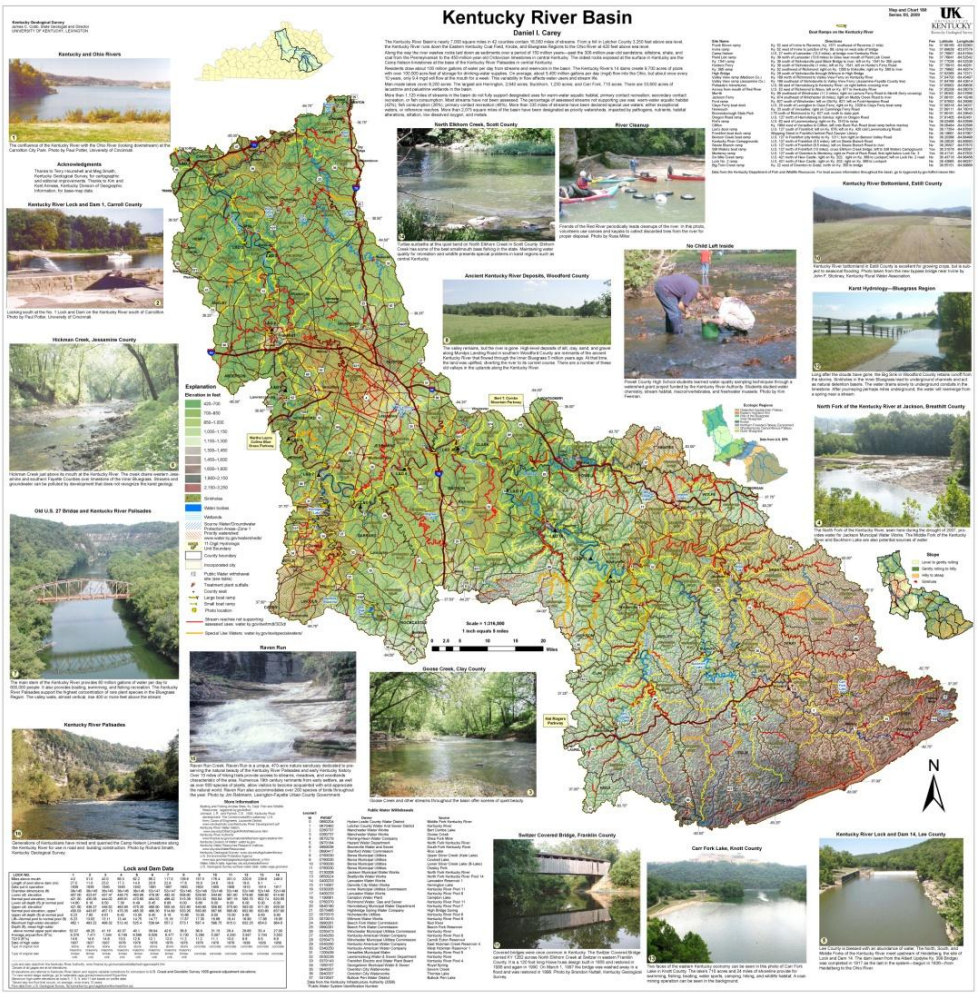
For more information, please contact Kentucky Geological Survey, University of Kentucky, at KGS-PUB@lsv.uky.edu.



Fayette County Land-Use Planning Map (54”x36”)

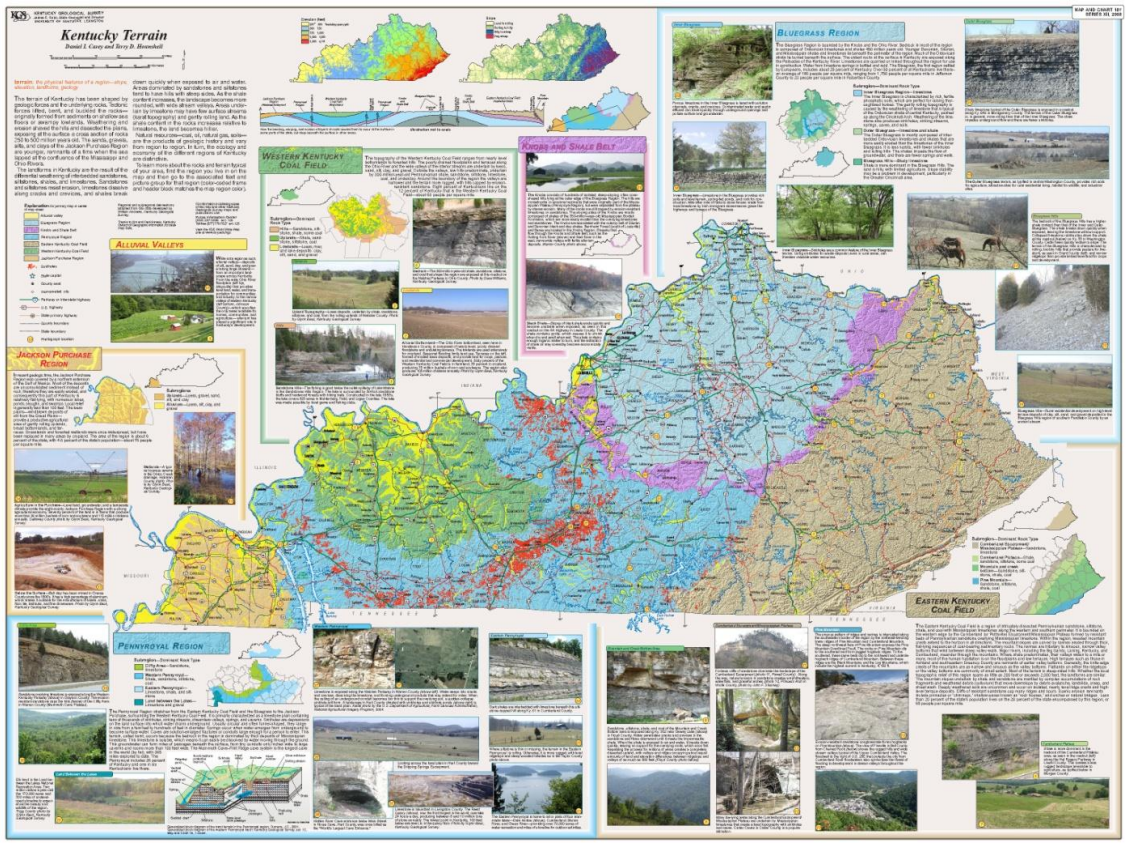
River Basins of Kentucky (38”x22”)





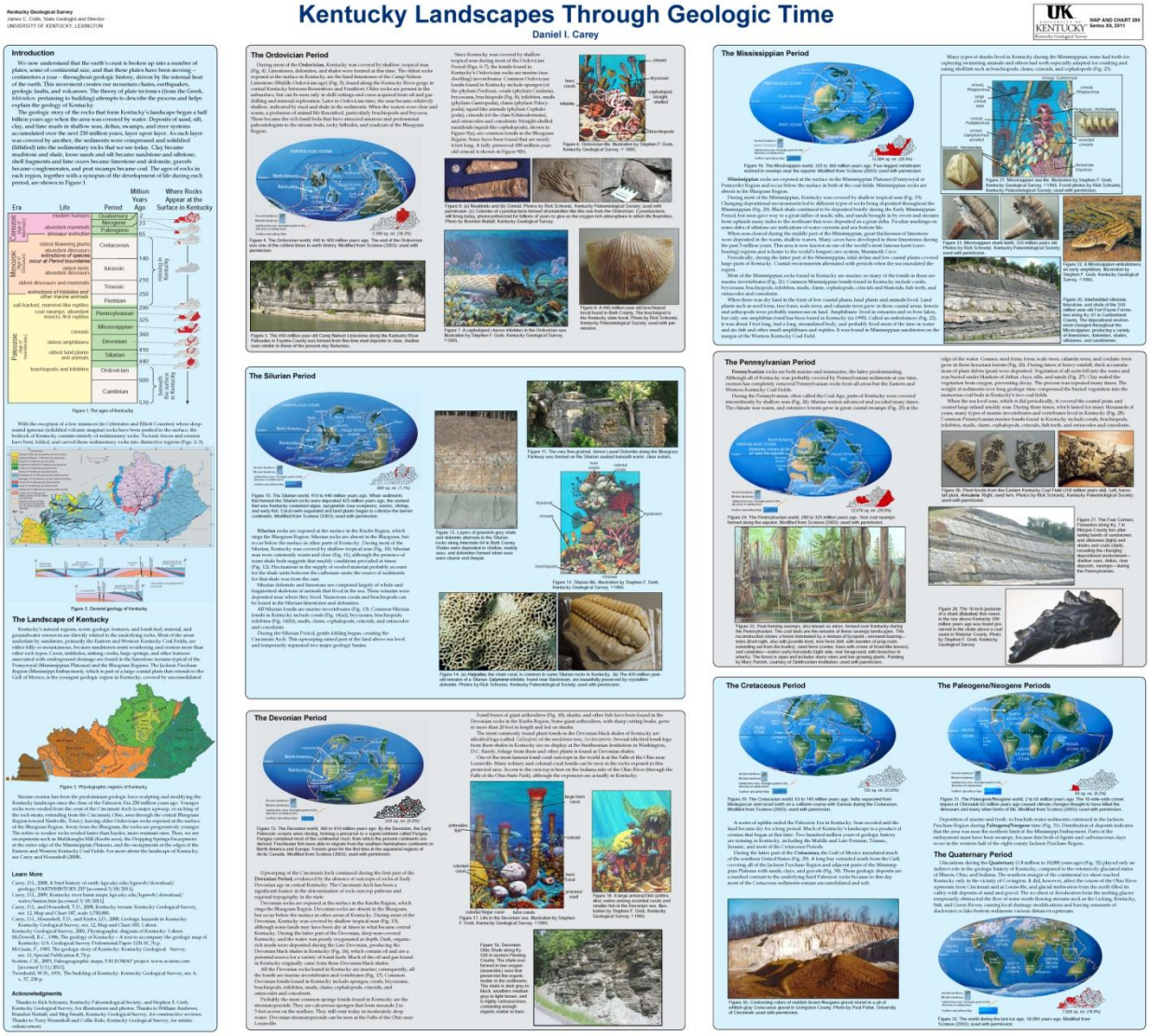
Kentucky River Basin (36”x36”) (One of seven individual basin maps)

Geologic Hazards in Kentucky (45”x28”)

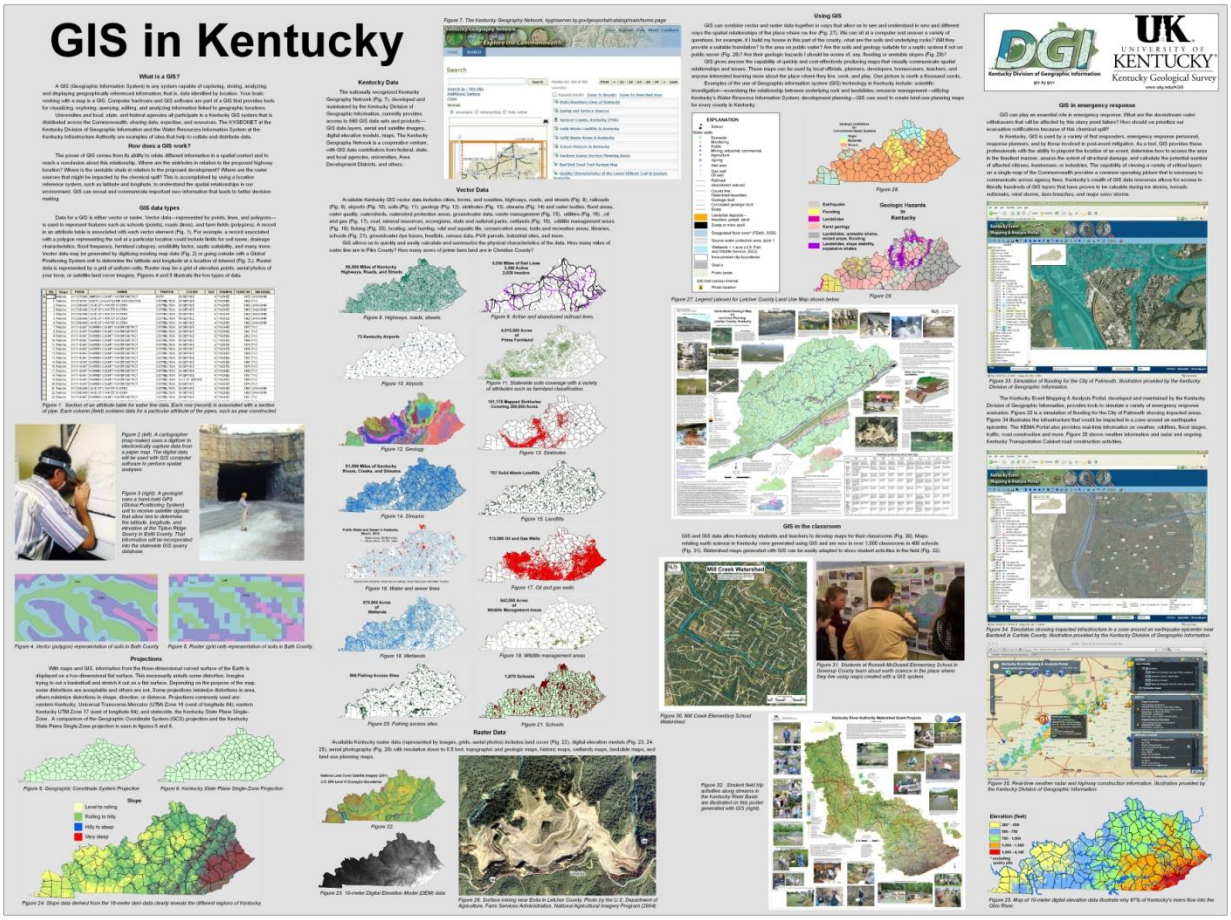


Kentucky Terrain: How geology shapes the landscape (44”x33”)

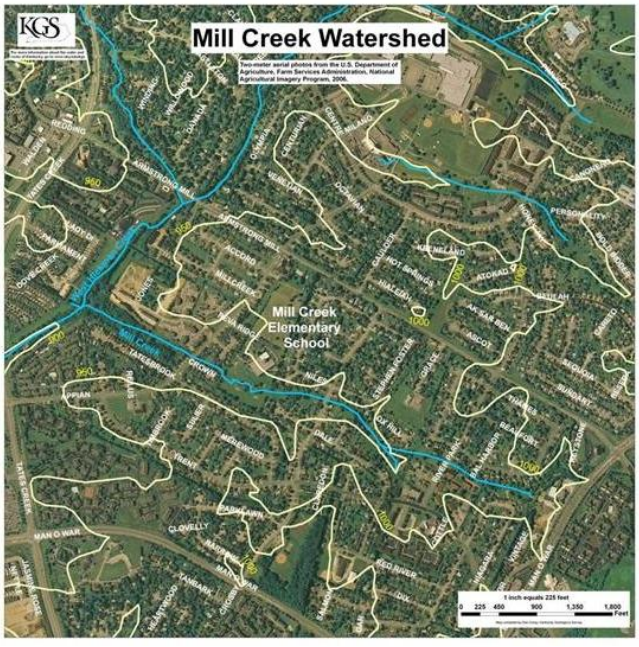
Where Kentucky was when the rocks were formed?



(40”x36”)



Kentucky has one of the finest GIS systems in the U.S. The poster, GIS in Kentucky (48”x36”) explains what GIS (geographic information systems) is, the GIS infrastructure that has been developed in Kentucky, where you can get GIS resources, and what you can do with them.



Map of the Mill Creek Watershed at Mill Creek Elementary School created with GIS tools and resources.

KGS Maps in Kentucky Classrooms

Teachers across the Commonwealth are using Kentucky Geological Survey maps in their classrooms to help students of all ages to learn more about the geology and landscape of their own and surrounding counties.

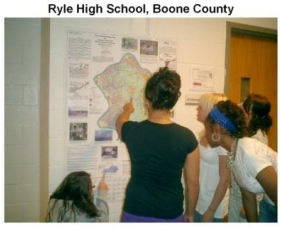
Southern Oaks Elementary, Daviess County

Lee County Middle School

Western Elementary, Ohio County

North Middle School, Henderson County

Ryle High School, Boone County

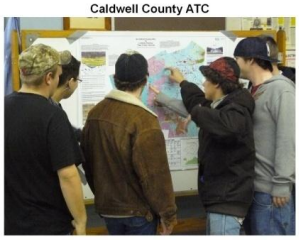


Russell-McDowell Elementary, Greenup County

Marion County Conservation District

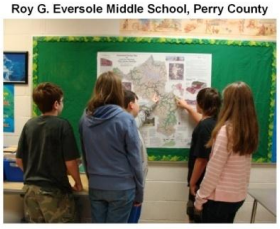
Ballard County Middle School

Caldwell County ATC



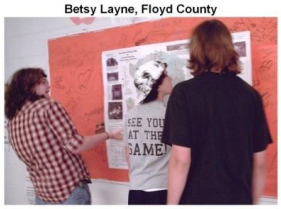
Conway Middle School, Jefferson County

Roy G. Eversole Middle School, Perry County



Taylor Mill Elementary, Kenton County

Betsy Layne, Floyd County



Beaver Dam Elementary, Ohio County

Henderson County High School

Scott High School, Kenton County

Representative teacher responses to the KGS Maps-to-Teachers program:

"On behalf of our entire Science Department, I want to thank you for the beautiful map of Mason County. It is full of terrific learning opportunities for our kids."

"Thank you so much for sending my class the geology map for Fayette County. I have it prominently displayed in the classroom and my students started using it as soon as I hung it up to find sinkholes near their homes. The resource that you have provided will greatly enhance my instruction by clearly illustrating to my students the importance of earth science in their daily lives."

“Our map looks great and was an instant hit! The kids were so excited while they were locating their homes and identifying the types of rocks in the area. Thank you for providing this wonderful learning tool!”

"I recently received the Floyd county map and it is wonderful. In fact it is so nice that the social studies teachers in my building and the rest of the science department asked if they could each get one. That is a total of 7 teachers. Just checking if it would be possible to get some more of those? Have a great day and great job on the map."

"Thank you so much for sending the maps of Allen County. They are very neat. I shared one of mine with the social studies teacher. However, when one of the other S.S. teachers saw them she really wanted one. If you are capable of sending another set that would be great! Once again thank you for sending such a wonderful resource!"

Russell-McDowell Elementary School, Greenup County

Ask and try to answer every question you can think of about everything below, above, and on the ground where you live. There’s no better textbook, no better laboratory, no better place for teaching and learning earth science than right here.

Learning about Kentucky's Land and Water:
Resource Materials for Teachers
Questions for the Classroom

Maps and Map Reading

- Geographic Information Systems
  - Global Positioning Systems, GPS
- Data layers and sources
- Scale and Legend
- Topographic Maps
- Questions for the Classroom
  - *What is GIS?*
  - *What is the scale of your map?*
  - *One inch on the map equals how many inches on the ground?*
  - *One inch on the map equals how many feet on the ground?*
  - *One inch on the map equals how many miles on the ground?*
  - *If the map scale is 1:63,360, then one inch on the map equals 63,360 inches on the ground or, 63360/12=5,280 feet=1 mile.*
  - *Can you find your neighborhood and school on the map?*
  - *How far is your neighborhood from your school?*
  - *If you were a bird, how far would you fly from your house to your school?*
  - *If you flew 20 miles per hour, how long would the flight take?*
  - *What is the elevation of your school?*
  - *What is a contour line?*
  - *What is the contour interval of your map?*
  - *What does it mean if contour lines are close together? Far apart?*
  - *Is the land steep or level near your neighborhood?*
  - *How far is the nearest stream, wetlands, sinkhole, spring, or well from your school?*
  - *Are there sinkholes in your county? Are there wetlands? Are there mined areas? Are there oil and gas wells? Are there water wells? Are there springs?*
  - *What are some things you might want to put on a map?*
- What Students Should Know
  - How to read a topographic map
  - Understand contour lines
  - Understand the map scale concept and apply it to the map.
  - Understand the Map Legend.
  - Understand the importance of where things are in relation to each other and why GIS is useful
  - What GPS is and how it can be used.

Geology and Landforms

- Sedimentary Rocks
- Geologic History: The Building of Kentucky
  - Fossils
- Stream Deposits
- Geologic Faults
- Physiographic Regions
  - How the Land has been Shaped
  - Karst
- Questions for the Classroom
  - *What are sedimentary rocks?*
  - *What are the different rock types in your county?*
  - *When and where were the sedimentary rocks in Kentucky formed?*
  - *Why are the rocks older in central Kentucky than in eastern and western Kentucky?*
  - *What is a geologic fault?*
  - *What is alluvium?*
  - *What is karst?*
- What Students Should Know
  - Younger rocks lay atop older rocks.
  - How the rocks in their county were formed.
  - Approximate ages of the rocks in their county.
  - Kentucky once lay beneath the sea.
  - The topography of Kentucky
  - The relationship between geology and the shape of the land.
  - The geology of karst.
  - The Physiographic Regions: Eastern Coal Field, Knobs, Bluegrass, Mississippian Plateau, Western Coal Field, Purchase
  - The region or subregion they live in.

Water

- The Hydrologic Cycle
- Kentucky Water Facts
  - Rainfall
  - Streams
  - Droughts
  - Floods
- Water and Early Development
  - Springs, Wells, and Streams

Water for Communities, Industry, Agriculture, and Wildlife
Water Usage
Water Sources
River Basins and Watersheds
River basin facts
Ground Water
Water in Karst Areas
Questions for the Classroom

How much water falls on Kentucky in an average year?
How many miles of streams in Kentucky?
What is a perennial stream? Intermittent stream? Ephemeral channel?
Where does the water in your house come from?
How much water does the average Kentuckian use each day?
What is ground water?

What Students Should Know
What is the hydrologic cycle?
What a watershed is.
The major river basins of Kentucky
Which river basin they live in and where.
Where their water comes from.
About how much water they use in a year.
Why early settlers established towns where they did.
What an aquifer is.
Water wells and their uses.
Underground flow in karst areas.

<u>Resources and Environment</u>
Minerals
Energy Resources
Oil and Gas
How it was formed
How much we have
Coal
How it was formed
How much we have
Electric Power
Coal-fired power plants
Usage of electricity by Kentuckians
Dealing with CO2

- Hydroelectricity
- Agriculture
  - Importance to Kentucky economy
  - Prime Farm Lands and Pasture Lands
- Recreation
  - Public Lands
    - Wildlife Management Areas
    - State and National Parks
  - Lakes and Waterways
    - Large lakes
    - Ponds
    - Wetlands
    - Aquatic life
    - Fishing
    - Boat Ramps
    - Locks and Dams
- Questions for the Classroom
  - *Is there a farmer's market in your county?*
  - *Energy resources in the county?*
  - *Minerals used in the community?*
  - *What are the recreational areas in your county?*
- What Students Should Know
  - How electricity is generated and where their electricity comes from.
  - Where their food comes from.
  - The resources within their county.

<u>Living with the Land</u>

- Understanding the Land We Live On
- Protecting the Air, Land, and Water
  - Water quality
    - Wastewater Treatment
      - Public
      - Domestic
      - Straight Pipes
  - Wetlands
  - Storm Water Management
  - Source and Ground Water Protection Areas
  - Air quality
- Geologic Hazards
  - Flooding

- Landslides
- Earthquakes
- Unstable Shales
- Radon
- Mined Areas
- Shrinking and Swelling Shales
- Sinkholes

Questions for the Classroom

- *How does water get polluted?*
- *What are some of the pollutants and what are the problems that they cause?*
- *What are the nonpoint sources of pollution in your county?*
- *Where are the areas in your county that might get flooded?*
- *Are there shales in your county?*
- *Should you build a house on or near a sinkhole?*
- *Why should you not throw trash in a sinkhole?*
- *What is the risk of an earthquake where you live?*
- *Are there mined areas in your county?*
- *Why do we need to know about radon? Is it in your county?*
- *How is the wastewater from your house treated?*
- *What percent of your county is on public sewer?*
- *If you could live anywhere in your county, where would it be and why?*
- *If you could live anywhere in Kentucky, where would it be and why?*

What Students Should Know

- Understand water quality
- Why wastewater treatment is important.
- Where geologic hazards may occur and what to do about them.
- Best uses for floodplains.
- What wetlands are and why they are important.
- Why it is important to understand the geology of where they live.