

## Supplement to “Build Illinois”

### Objectives:

- To teach recognition of basic sedimentary geologic materials and the environments associated with them.
- To illustrate the variety of landscapes that, over the last 500 million years, formed Illinois.
- To relate landscapes to the geologic processes that created them and the mineral resources that formed.

Activity type: Demonstration

Grade level: 4–12

Illinois Learning Standards:

12.E.1; 2; 3; 4; 5

13.B.2e, f; 3a, c, d; 4c, d

Standards assignment:

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### Terms:

basin, bedrock, coal, delta, end moraine, glacier, ground moraine, limestone, outwash, sandstone, shale, till

### Background:

This demonstration is designed to accompany the ISGS GeoNote 4 “Build Illinois.”

The “Build Illinois” demonstration is a highly visual way of illustrating the vast changes to the landscape of Illinois over the last 500 million years. This quick “walk” through the geologic history of Illinois was first done as a 30-minute talk given on a sandbar in a creek. The core of this lesson is based on making a “map” out of sand or other suitable material (sand is cheap, but heavy) shaped into the outline of the state of Illinois.

The main landscapes that are illustrated as students “travel through time” are

- Ancient oceans of approximately 540 to 325 million years ago (early Paleozoic Era)
- Delta and swamp of approximately 325 to 290 million years ago (later Paleozoic Era)
- Dry landscape of most of the last 290 million years (latest Paleozoic, Mesozoic, and Cenozoic Eras)
- “Ice Ages” of the last 1.8 million years (late Cenozoic Era-Pleistocene Epoch)

### Materials:

**Damp sand:** Damp sand (about 50–75 lbs) should be shaped into the outline of Illinois on a board, table, sandbox, or other area. For the best effect, Illinois should be about 1 inch deep and 5 or 6 feet long, but a smaller scale will also work. Keep extra sand at the northern end of Illinois where it will be available to construct the delta and glaciers.

**Sediments:** One small bag of sand, one of dirt, and one of seashells.

**Rock samples:** Sandstone, limestone (with fossil shells), and shale (with fossil leaf).

**Fossils:** Additional fossil shells, leaves, etc.

**Props:** Toy boat, coal, dinosaurs, lichen (from a hobby shop), toy evergreen trees, toy mammoth, etc. Styrofoam, 1–2 inches thick, cut on two sides in the shape of the last glacial advance in northeastern Illinois (southwestern extent of the green area labeled “Wedron Formation” on the Quaternary Deposits of Illinois map).

**Maps:** Geologic Map of Illinois, Quaternary Deposits of Illinois, and Buried Bedrock Surface of Illinois (IMap 5). All maps are available from the ISGS.

**Model (optional):** 3-D Block Model of Illinois (see GeoActivity HIST-2).

## Procedures:

### Introduction

Build the Illinois damp-sand model, or ask students to do it. Ask students to identify the state’s boundaries (for example, Lake Michigan, Wabash River, Mississippi River, and Ohio River). Have students point out where they live on this map.

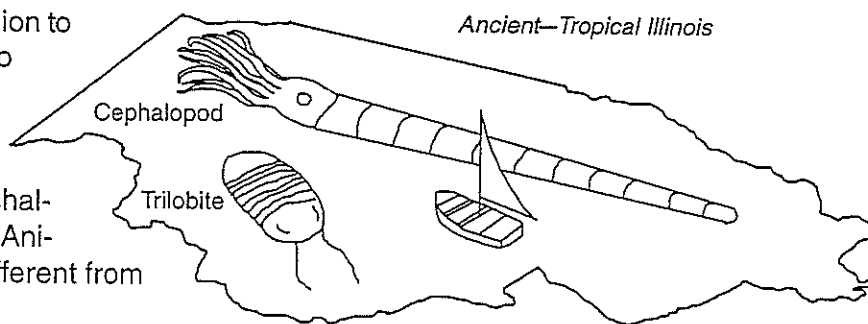
Mention that geologists are storytellers. They read the layers of rocks like pages in a book and put together the story of what happened long ago. The story of Illinois is a story of geologic processes and ancient landscapes and how they combined to “build Illinois.” The geologic story explains how Illinois slowly evolved into what it is today and how the changes that occurred control the water, coal, and other resources that are available to us today.

Our story starts 540 million years ago, but there is an older story that goes back more than a billion years ago, a story of continental collisions and mountain building. The older rocks that formed then provided the surface on which the ocean of 540 million years ago began to deposit sediments, which started this story.

### The ancient oceans

#### Main point

From about 540 million to 325 million years ago (Cambrian through Mississippian Periods), Illinois was covered by a shallow, tropical ocean. Animal life was very different from what we see now.



At this point, make some “waves” in the sand, toss out a toy boat, and scatter seashells across the sand map.

#### Evidence

How do we know that Illinois was covered by an ocean?

1. The ocean left vast thicknesses of sand that formed sandstone (beaches and off-shore). Ask the students what oceans leave behind. Take sand from a bag or the sand map and then bring out sandstone samples.
2. The ocean also left great thicknesses of limestone formed from shells, ground-up shells, and calcium carbonate mud. The types of sea animals that had these shells lived in water that was no more than a few hundred feet deep and could survive only in tropical and subtropical areas. Bring out seashells and then show the students limestone with fossils. Even the youngest student will quickly see that the rock was made in an ocean! Seashells mean oceans, not deserts or mountains.

In the early Paleozoic Era, life was concentrated in the oceans. The common fossils of the ancient oceans were

brachiopods (ancient seashells)  
 crinoids ("sea lilies," cousins of starfish)  
 cephalopods ("octopus in an ice cream cone shell")  
 trilobites (ancient "crablike" arthropods)

Show fossils and pictures of them. Draw them in the sand or on a board. This beach and offshore sand is compelling evidence of the ancient ocean in Illinois. The sand became sandstone, and the billions of shells formed limestone, rocks that are more than three miles thick in some parts of Illinois!

### *The delta*

From about 325 to 290 million years ago (Pennsylvanian Period), Illinois was a landscape in transition. The oceans were retreating from Illinois as great river systems buried the shallow ocean bed under a series of deltas.

#### *Main points*

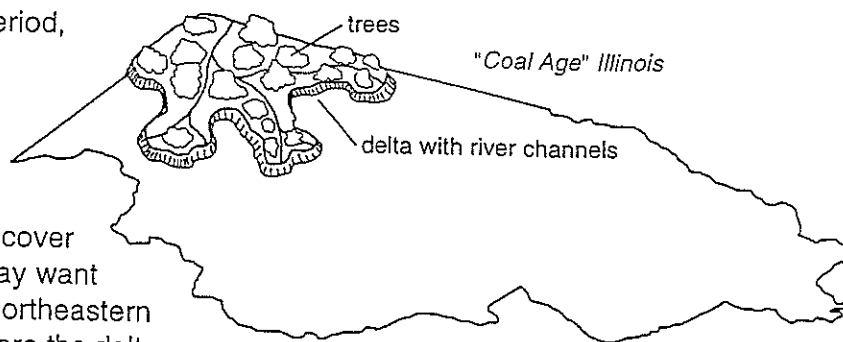
- A new landscape formed—a river delta dominated Illinois during this time.
- Great forests grew on the ancient delta. These trees were buried and eventually compressed to form coal. *All coal in Illinois comes from this time period.*
- Strange new animals and land plants were part of this new landscape.

#### *Evidence*

How do we know Illinois was a vast river delta covered with forests?

1. Rivers entering a body of water deposit broad floodplains of mud with narrow ribbons of sand in the channels. The mud becomes the rock we call shale. Take the dirt out of its bag and show the students a sample of shale, preferably a piece with a leaf fossil. This new landscape left a thick layer of mud, like chocolate frosting on a cake, over the accumulated sandstone and limestone left by the ancient oceans of the earlier Paleozoic Era.
2. Great numbers of plant fossils—leaves, stems, even tree trunks—have been found in the delta shale. Coal is formed from compressed plant material. Coal miners often find mineralized tree trunks and branches in the coal. Thick deposits of coal up to 10 feet thick within the shale provide a major energy resource for Illinois.

To illustrate this time period, create a delta-shaped wedge (roughly triangular) on the sand map (check a map of the Mississippi Delta for ideas). Rather than cover the whole state, you may want to concentrate on the northeastern portion of the state, where the delta



first entered Illinois. Carve a few quick river channels through it and scatter lichen to represent the forest covering the delta. Make it clear that the delta later covered the whole state. It built up great thicknesses of sediment as the land underneath gradually subsided over millions of years. The sediments compacted to rock that is over 2,000 feet thick in southern Illinois. Hand out samples of coal to students to pass around or, if you have enough, to keep.

Amphibians became well established during this time. Reptiles had just appeared, and many types of insects, some giant size, wandered the landscape. Use posters or fossils or draw pictures in the sand or on a chalk board to illustrate the animal and plant life. Life-size drawings or models of dragonflies with three-foot wingspans go over well!

During all of this time of ancient oceans and delta, tectonic forces gradually folded the bedrock of Illinois. The bedrock slowly sank to form a "bowl" or basin that centered in the southeastern part of the state. Great thicknesses of sediment were deposited there by the oceans and the delta. For this reason, the rocks of the Paleozoic Era are much thicker in southern Illinois than in northern Illinois. Use the cross section of Illinois (on the right of the Geologic Map of Illinois or on the 3-D Block Model of Illinois) to show the great thickness of sandstone and limestone and, later, the shale that formed in that area as the bedrock sank.

On the Geologic Map of Illinois, the coal-bearing shale rocks are represented by the green colors. These have been removed in the northern part of the state where the ancient ocean rocks (pink, purple, and orange) are at the bedrock surface.

### ***The Mesozoic and Cenozoic Eras***

During the last period of the Paleozoic Era (Permian Period 290 to 250 years ago) and throughout the Mesozoic Era (250 to 65 million years ago) and most of the Cenozoic Era (65 to 1.8 million years ago), Illinois was "dry" uplands, not mountains, but rolling countryside. Water carved valleys into the exposed ancient ocean and delta rocks, called bedrock, and great rivers passed through Illinois.

#### ***Main points***

- Illinois was mostly dry land and possibly hilly during this time.
- Dinosaurs were probably here, but no dinosaur fossils have ever been found (most of our rocks are too old!).
- A new landscape of river valleys was carved into the bedrock formed by the ancient oceans and delta:

The ancient Mississippi River cut through western Illinois.

The ancient Mahomet-Teays River cut through eastern Illinois and joined the Mississippi River in western Illinois.

### *Evidence*

How do we know Illinois was mostly dry land during much of this time?

1. The bedrock in most of the state is more than 290 million years old. Younger rock is missing; it was either never deposited, or it was deposited and later eroded away. An ocean or delta would have left younger age rock.
2. Illinois was “carved” by erosion, creating great river valleys later buried by glaciers. These valleys would not have been carved if Illinois had been an ocean or a delta during this time.

Represent this time period by simply carving river valleys in the sand, illustrating a time of water erosion predominating in Illinois. The exact location on the sand map is not critical. The ancient Mississippi River flowed through northwestern Illinois and roughly followed the modern Illinois River Valley south past Peoria. The ancient Mahomet-Teays River cut through the central part of the state from the Indiana border through Vermilion and Champaign Counties and on to the ancient Mississippi River Valley southwest of Peoria (just connect it somewhere down there!). The Ohio River did not exist then. After the Mahomet River Valley was buried, water found a new path to the south that we call the Ohio River. Toss out a few plastic dinosaurs when you are talking about them, or make a large dinosaur footprint in the sand.

Use the Buried Bedrock Surface of Illinois map if you want to show precisely where the old rivers flowed. The map is complex. One way to simplify it is to color in areas below 500 feet elevation in central Illinois. This will show the ancient channels of the Mississippi and Mahomet-Teays Rivers quite well. The Mississippi River went through Rock, Henry, Whiteside, Lee, Bureau, Putnam, Marshall, LaSalle, Peoria, Woodford, and Tazewell Counties before following the path of today’s Illinois River. Note that the Mississippi channel splits in Tazewell County. The Mahomet-Teays entered Illinois at the boundary between Vermilion and Iroquois Counties and joined the Mississippi River in Mason County. If you color the northern part of the map, you will notice that the Rock River Valley had a twin river system, the Troy River, just a few miles east. That valley is totally buried today.

### ***The “Ice Ages”***

Then the world cooled down, and the glaciers formed. From about 1.8 million years to the present, variations in the world climate produced the “Ice Ages.”

#### *Main points*

- Glaciers are moving ice sheets, formed when thick snow turns to ice. They act like “machines” that (1) grind up, carry, and bulldoze material and (2) melt, releasing great amounts of water and ground-up rock debris.
- Illinois was repeatedly covered by ice sheets that completely rearranged the landscape.

- Vast herds of exotic animals—mammoths, mastodons, ground sloths, and others—wandered across Illinois during this time.

### Evidence

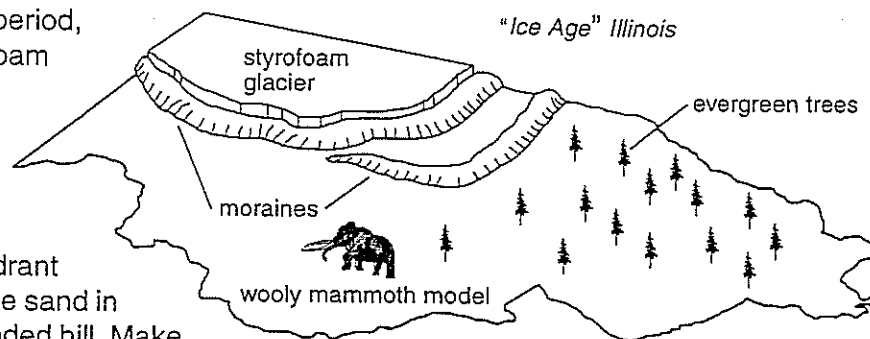
How do we know that Illinois was covered by several ice sheets (continental glaciers)?

1. Lying on top of the bedrock in most of the state are multiple layers of rock debris—clay mixed with sand, silt, and gravel. Each layer of this type of material (till) was produced by a glacier advancing over the landscape.
2. The present land surface of Illinois is a gently rolling landscape of long, low, curved hills (moraines), great sand and gravel outwash plains, extremely flat dried lake beds, and even sand dunes. These features, associated with the glacial processes, were left by the last glaciers.

To illustrate this time period, use a sheet of Styrofoam cut roughly in the shape of the last glacial ice sheet.

Put the Styrofoam on the map, covering the northeastern quadrant of the state. Mound the sand in front of it in a low rounded hill. Make

a similar hill in front of that one to simulate remaining moraines as the glacier melted back. Add some toy evergreen trees south of there. Illinois was cold at that time. There were no oaks or elms, but Black Spruce grew here, as it does in Canada today. Toss in a toy mammoth or two, and there is Illinois of 20,000 years ago!



While creating the landscape, bury the bedrock valleys—the glaciers did! The ancient rivers were buried or rerouted: the Mississippi River moved to where it is today, and the Mahomet-Teays Bedrock Valley was completely buried.

The Quaternary Deposits of Illinois map can be used to show the deposits left by the glaciers. The map is complex (and colorful!), but some basic features can be seen:

1. Pink represents the deposits left by the glaciers of the Illinois Episode that covered most of the state.
2. The blues and greens represent the deposits left by the most recent glaciers of the Wisconsin Episode. These glaciers covered only the northeastern quarter of the state.
3. The tan-orange areas (labeled “hm,” “hb,” and “hw”) represent areas of sand and gravel outwash left by water from melting glaciers. Most of this material is from the most recent Wisconsin glacier.
4. The scattered dark reddish-brown areas (labeled “pl”) near the outwash are areas of sand dunes, created by winds blowing the outwash sand.

For more details, see *Illinois' Ice Age Legacy* (ISGS GeoScience Education Series 14, 1998).

## **Today**

Explain that the glaciers melted away about 13,000 years ago. The big herds of mammoths and other animals mostly died off, perhaps from the climate change, perhaps from human hunting. A few thousand more years of wind and water have made minor changes in the landscape since the end of the Ice Ages. Now large numbers of people live in this area. We now build houses and shopping centers on the hills the glaciers left. We farm crops in the soil that developed on glacial till and windblown silt. Remove the ice, evergreens, and mammoths. Put a few toy houses on the sand map.

### **Main points**

- We live on a landscape built by different geological processes.
- We use the resources produced by those processes.

### **Evidence**

How does this story of Illinois affect us today?

1. Where the delta shale is near the surface, we can mine coal.
2. Where the ancient ocean rock is near the surface, we can drill wells and obtain water from sandstone or limestone. We also obtain water from sand and gravel left by the glaciers. All of these materials act like “sponges” and hold water.
3. We also mine the same materials—sand, gravel, and limestone—for building. Folding of the bedrock brought the ancient ocean sandstone to the surface at Ottawa. It is mined there to make glass for many uses—including the outer protective tiles for the space shuttle!
4. Oil is recovered from limited zones within the “ancient ocean” rocks in certain areas.
5. Clay from the delta shale and from glacial deposits have been used to make bricks and drainage tiles. A very absorbent clay, left behind by the Gulf of Mexico in extreme southern Illinois, is mined for kitty litter.

Virtually everything we use in our society—our buildings, our transportation, and most of the things we work and play with—are mined from the earth. Much of what we use in Illinois is mined right here in Illinois. To understand what resources we have, where they are and why, we must understand the geology—the story of how these processes combined to “build Illinois.”

### **Related activities:**

GeoActivity HIST-2: Illinois in Three Dimensions—A Block Model

GeoActivity MINR-1: Mineral Resources of Illinois

### **Related readings:**

Killey, Myrna M., 1998, *Illinois' Ice Age Legacy*, GeoScience Education Series 14, ISGS.

Vaiden, Robert C., 2000, “Build Illinois,” GeoNote 4, ISGS.

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