Stories from Rocks (Every Rock Tells a Story)

Activity type: Activity
Grade level: 4–12
Illinois Learning Standards:
11.A.1; 2; 3; 4a–c; 5a–c
12.E.1a; 2a, b; 3a, b; 4; 5
13.A.1b, c; 2b, c
Standards assignment:
Joseph M. Schoen

Objectives:

- To interpret a story from rocks using direct observations.
- To learn to deduce the layout of an ancient landscape from present information.
- To learn how sedimentary rocks form and what kinds of environments they form in (their environments of deposition).
- To recreate an ancient Illinois landscape based on a suite of rocks.

Terms:

coquina, environment of deposition

Background:

This exercise provides an opportunity to apply geologic knowledge as a professional geologist does, using a greatly simplified situation.

Geologists do more than just identify rocks and minerals. Geologists are storytellers. They observe geologic materials and then interpret the story the rocks tell. This information allows geologists to recreate lost landscapes and to determine what happened where and when.

The story a geologist tells is more than just interesting. It may hold important information about the location of mineral resources (for example, where coal can be mined or oil produced). The story may also provide information about many other important issues, such as helping people decide where it is safe to build homes and where they can find clean water.

Students should leave this exercise with an understanding that geologists study rocks not just to learn their names, but to understand how they formed—what their story is! They should realize that it is not the rocks themselves, but what we learn from them that makes geology important and fun!

Introduction

Before your class begins the activity, discuss how and where sedimentary rocks form and what environmental clues can be derived from looking at rocks. Discuss with the class how to make deductions about environments of deposition based on rock type and grain size. The ISGS GeoNote 4, "Build Illinois," and GeoActivity HIST-1 describe the past landscapes and environments found throughout geologic time in Illinois and the

kinds of rock that typically form in various environments. The interpretations provided here are simplified. The main points that need to be understood by students before conducting the activity are listed in the next few sections.

Marine Versus Terrestrial Environments

Point out the differences between marine (ocean) environments and terrestrial (land) environments. Discuss the types of fossils that might be found in each setting (Table 1).

1. Rocks that formed from sediment deposited in a marine environment are typically characterized by fossils of marine organisms, mostly shells. These rocks are generally limestone or clean sandstone. Marine environments can be quiet and low energy (offshore) or very active and high energy (beaches).
2. Rocks that formed from sediment deposited in a terrestrial environment may contain terrestrial plant fossils. Sediments in terrestrial environments include sand, silt, and clay. In swamps, coal can form from plant material, and shales form from settling mud. Rivers can deposit sand and gravel that form sandstone and conglomerate. River sand may contain minerals other than quartz and so may not be as clean or pure as beach sand. Terrestrial environments can be quiet and low energy (slow-moving rivers, deltas, swamps, lakes) or very active and high energy (fast-moving rivers).

Table 1 Common marine rock types and their general environment of deposition.

rock type	environment of deposition
limestone	marine
coquina	marine beach
impure quartz sandstone	river
quartz sandstone	beach
shale with leaf fossil	delta, swamp, or lake
conglomerate	mountain stream
breccia	base of steep slope or cliff (fault)

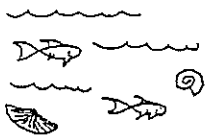
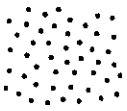
High-Energy Versus Low-Energy Environments

The energy level of an environment affects the rocks that form there. The faster water moves, the more energy it has and the heavier the material it can move. Water in a high-energy environment can break rocks and shells into smaller pieces, and it can transport larger grains than in a low-energy environment. For example, snow melt from the mountains can form a fast, raging river that can carry large boulders, as well as smaller grains such as gravel, sand, and clay. This same river at a different time of year, say summer, may be only a stream. It has less water, moves slower, and can carry only small grains such as fine sand and clay instead of boulders.

Stories from Rocks (Every Rock Tells a Story)

Congratulations! You have been hired by the prospecting firm of Who, Dunit, & Co. Your job is to write a report and make a drawing that shows the ancient landscape that was present in an area of Illinois about 300 million years ago. Throughout the room, there are outcrops (rocks exposed at the surface). You are going to travel to each outcrop that you can find and investigate the rocks there.

1. Go to each outcrop and, using the data sheet, do the following:
   a. On the data sheet, describe the rock you find.
   b. Write any clues that help you describe where the rocks formed.
   c. Decide if the rock formed in a marine (ocean) or terrestrial (land) environment.
   d. Determine if the rock formed in a high-energy (fast-moving water) or low-energy (quiet water) environment.
2. When you are finished gathering data about the rocks get a blank map and do the following:
   a. Write the name of the rock you found at each outcrop on your map.
   b. Draw a line separating the areas where the different rock types occur. This will give you an outline of the ancient environments because each rock type represents a different environment.
   c. Add a symbol and a color to each environment, using the following key:

Environment	Color and Symbol	
ocean	blue seashells, fish	
delta & swamp	brown swamp plants	
river	gray dot pattern	

Stories from Rocks—Data Sheet

Outcrop	Description	Rock	Environment
1			
2			
3			
4			
5			
6			
7			
8			

High-Energy Environments

1. High-energy environments are places where water moves rapidly, for example, beaches and fast-moving rivers.

2. Rocks that formed from sediment deposited in high-energy environments are characterized by relatively large grains. Fast-moving water can carry large grains (pebbles and larger) as well as small grains. When water slows, it no longer has the capacity to carry the larger grains and drops them to the bottom; only the finer grains are carried along in suspension. Sandstone, conglomerate, and coquina (limestone made of coarse broken shell fragments) reflect formation in high-energy environments.

Low-Energy Environments

1. Low-energy environments are characterized by slow-moving or still waters, for example, slow-moving rivers, deltas, swamps, lakes, and offshore ocean water.

2. Rocks, such as shale, formed from sediment deposited in low-energy environments. These rocks are characterized by small grains, such as clay and silt, that settle out of quiet waters. Other features, such as mud cracks, ripple marks, and load casts, may be present in rocks that formed in low-energy environments. The presence of whole, unbroken, shell fossils in a shale or limestone indicates that the rock formed in a low-energy environment.

Procedure:

1. Rocks should be placed around the room in a layout similar to that shown in the Teacher's Guide to Rock Sample Layout. Placards can be placed at each site naming or numbering the outcrop.

2. Tell the class that they are geologists who have been hired to report on an uncharted ancient landscape of Illinois. Explain to the students that every rock tells a story, and observation of rock characteristics provides clues about which environment a rock formed in. For example, if a rock has seashells in it, then you know it was formed in a marine environment.

3. Give each student a data sheet.

4. Have the students describe the rocks they find at each outcrop and record their description on the data sheet. Direct the students to note relative grain size (big or small), shells or plant fossils, and any other characteristics they observe.

5. Ask the students to use the data from their observations to determine what kind of environment (marine or terrestrial and high energy or low energy) the rocks formed in. For example, a rock containing seashells is from a marine environment; if the seashells are broken, it was probably a high-energy environment.

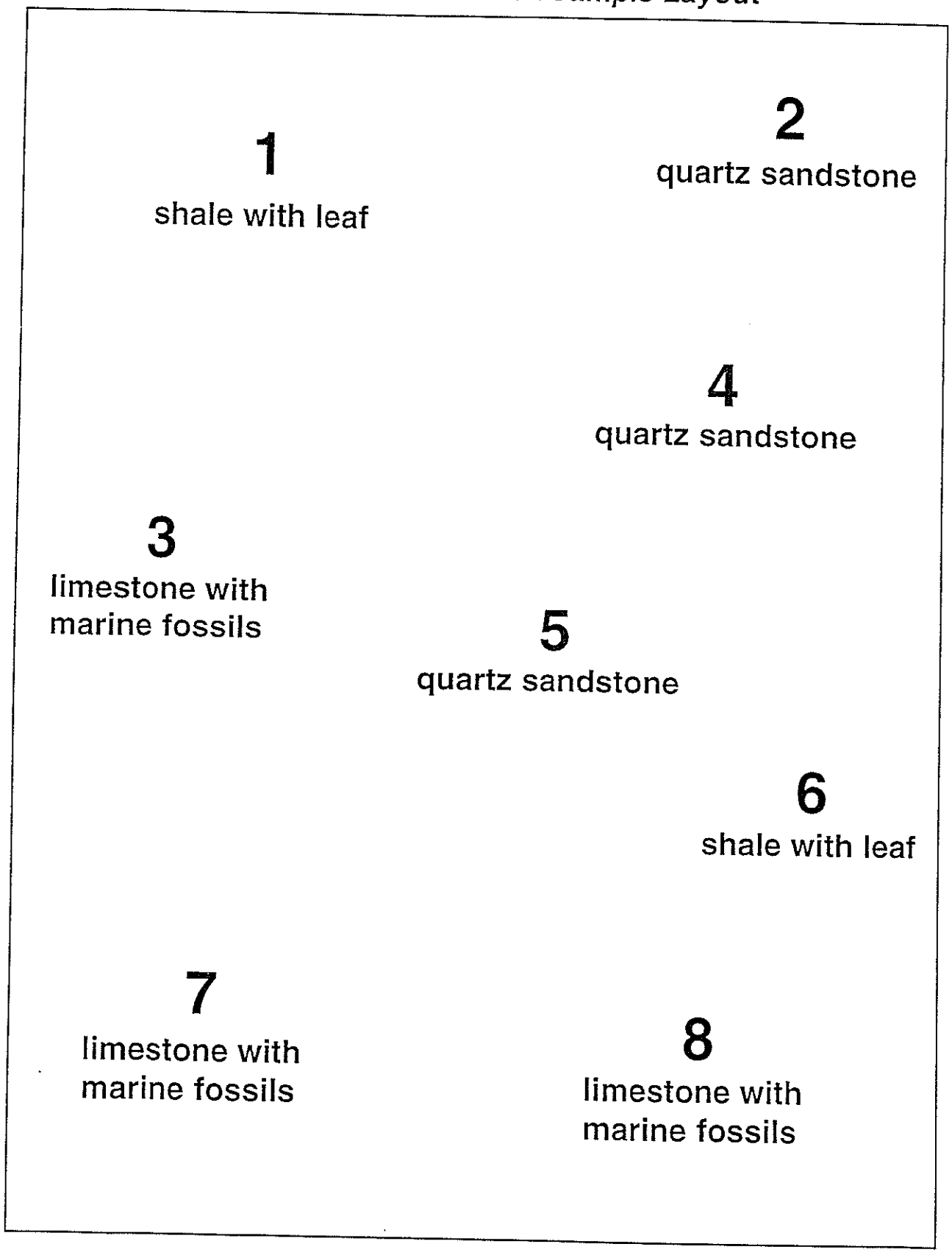
6. When the students have completed their data sheets, give them the blank map showing the outcrop locations. Instruct the students to make a drawing of the landscape based on their interpretation of the clues they read in the rocks. For example, if they found a rock with a plant fossil at Outcrop 1, indicate that that area is likely to be a swamp. Have them draw boundaries between different environments.

7. After the students have completed their landscapes, discuss their drawings. Discussion questions might include these:

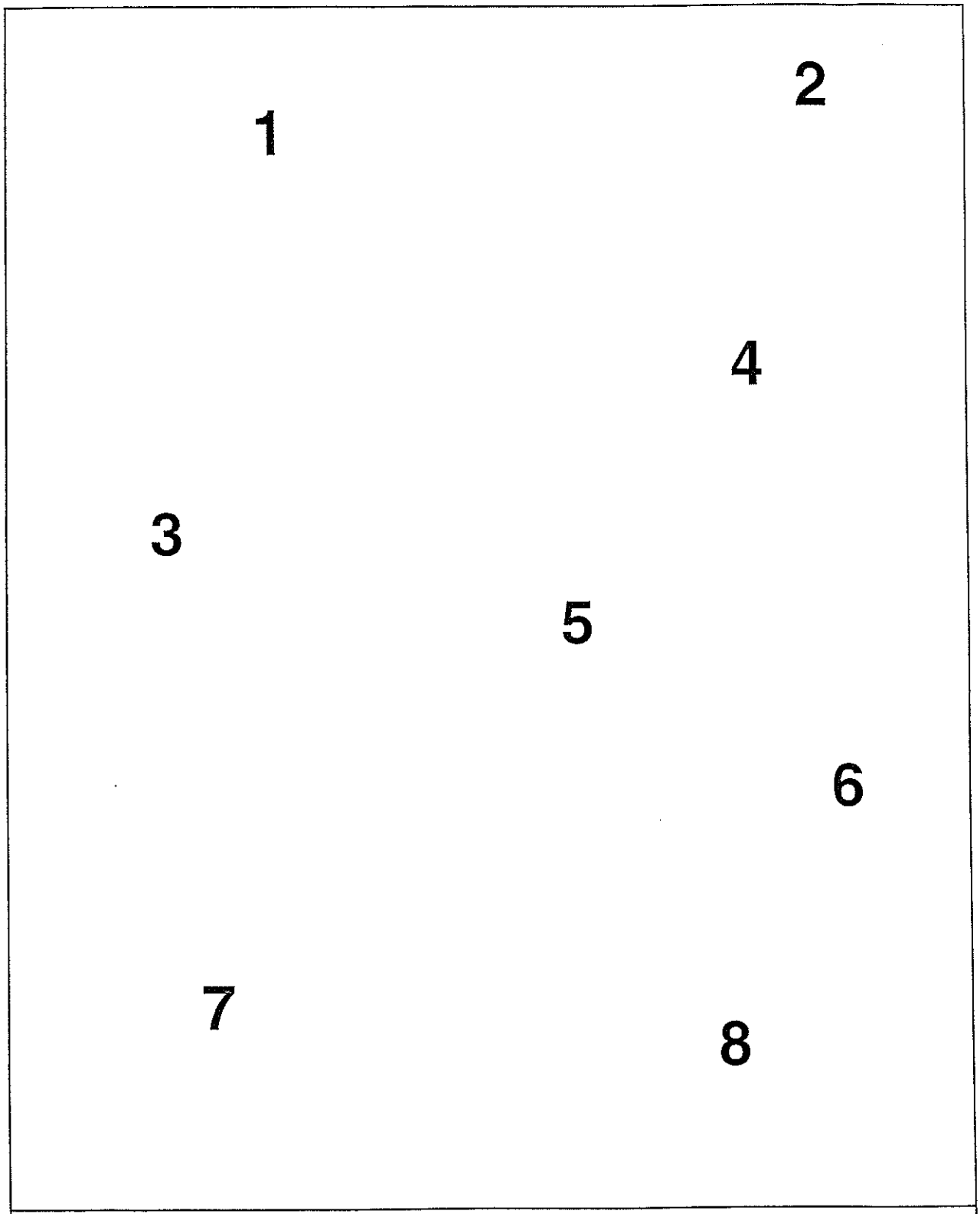
   - Where on the drawing did you find a river?
   - Since we know that coal is formed from ancient trees that were buried, where on the drawing might you find coal?
   - Where on the map could you find fossils of trees?
   - Where on the map could you find fossils of fish or seashells?

Contributed by Sallie E. Greenberg, Janis D. Treworgy, and Robert C. Vaiden

Map of An Ancient Illinois Landscape
Teacher's Guide to Rock Sample Layout



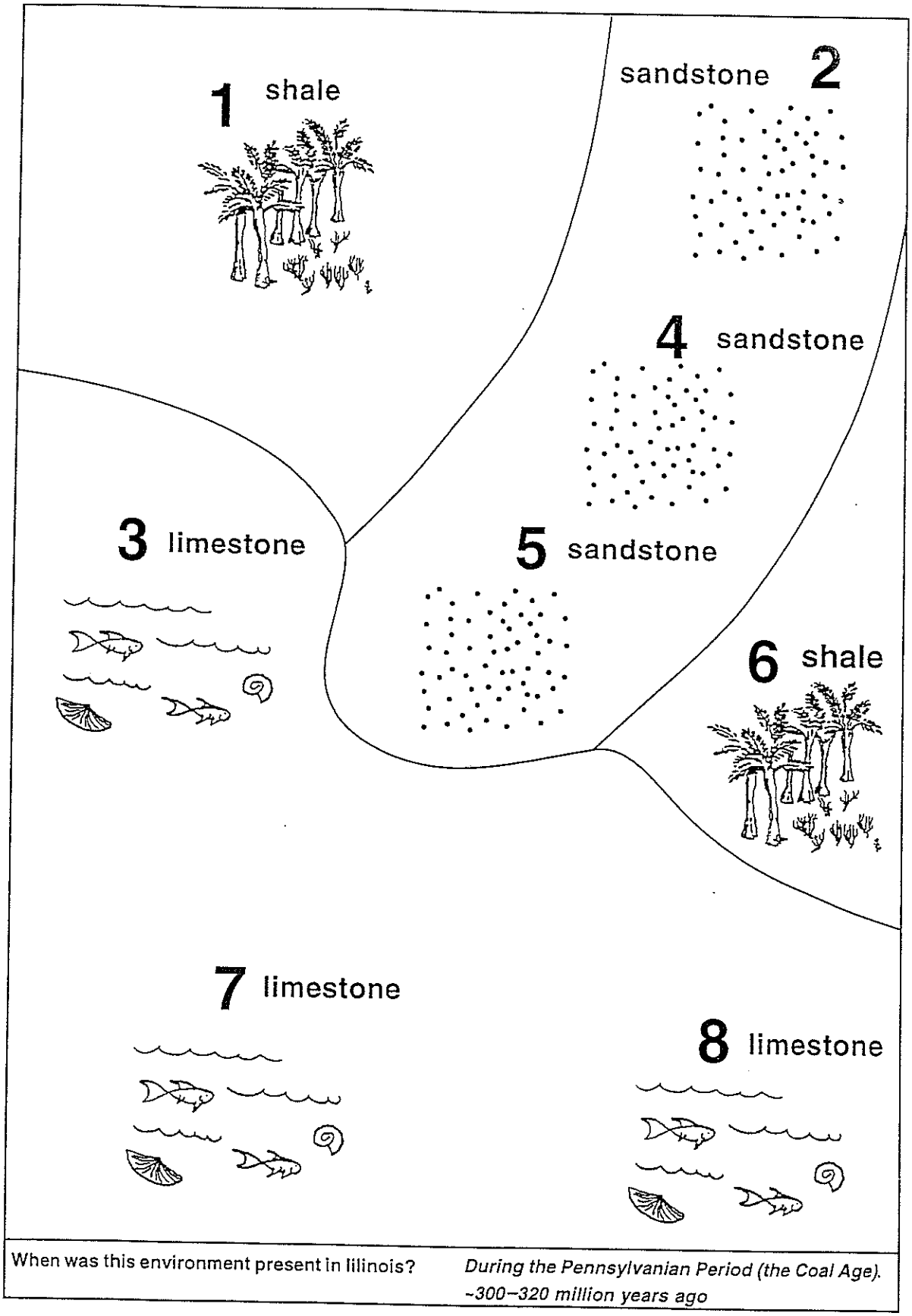
Map of An Ancient Illinois Landscape



When was this environment present in Illinois?

Map of An Ancient Illinois Landscape

Answer Key



When was this environment present in Illinois?	*During the Pennsylvanian Period (the Coal Age). ~300–320 million years ago*

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Stories from Rocks—Data Sheet

Outcrop	Description	Rock	Environment
1	*fine-grained rock, rock color, fossil leaves*	*shale*	*swamp, delta*
2	*coarse-grained rock, rock color, primarily quartz plus other minerals*	*sandstone*	*river*
3	*fine-grained carbonate rock, rock color, broken/intact fossils of seashells*	*limestone*	*ocean (warm, shallow)*
4	*coarse-grained rock, rock color, primarily quartz plus other minerals*	*sandstone*	*river*
5	*coarse-grained rock, rock color, primarily quartz plus other minerals*	*sandstone*	*river*
6	*fine-grained rock, rock color, fossil leaves*	*shale*	*swamp, delta*
7	*fine-grained carbonate rock, rock color, broken/intact fossils of seashells*	*limestone*	*ocean (warm, shallow)*
8	*fine-grained carbonate rock, rock color, broken/intact fossils of seashells*	*limestone*	*ocean (warm, shallow)*