Pangea Revisited

Objectives:

- To recognize radical changes that have occurred to the Earth's surface over geologic time.
- To reconstruct Pangea based on several types of evidence.

Terms:

continental drift theory, Mesozoic Era, Paleozoic Era, Pangea, Panthalassa, plate tectonics theory

Activity type: Activity

Grade level: 4–12

Illinois Learning Standards:
11.A.1; 2; 3; 4
11.B.1; 2; 3;
12.E.1a; 2a, b; 3a, b; 4; 5
13.A.1b, c; 2b, c; 3b, c; 4b, c
13.B.1c

Standards assignment:
Joseph M. Schoen

Background:

More than 250 million years ago, a supercontinent—known as Pangea (or Pangæa)—existed on the earth. Pangea was formed as numerous smaller continents slowly converged throughout the Paleozoic Era. The formation of Pangea by the late Paleozoic created an enormous ocean, Panthalassa, that covered the rest of the earth. The supercontinent began to break apart approximately 250 million years ago, at the beginning of the Mesozoic Era, splitting into the numerous continents presently found around the globe. As Pangea rifted, or split apart, Panthalassa shrank to what today is called the Pacific Ocean. The Atlantic Ocean and other oceans also were formed.

Alfred Wegener was the first to consider the existence of a supercontinent, which he named Pangea. In the early 1900s, Wegener developed the continental drift hypothesis. This hypothesis stated that the less dense continents "floated" on a denser molten rock foundation. The present continents were formed as the pieces of Pangea rifted and drifted across the oceans to their current locations.

Wegener believed that, when Pangea broke apart, the continents plowed through the ocean floor on their journey to their present locations. Mountains formed as the leading edges of the continents buckled and as masses of ocean floor sediments were plowed in front of each continent. However, actual evidence of this type of continental movement was not found. In addition, Wegener could offer no hypothesis as to why the continents drifted. Thus, Wegener's hypothesis of continental drift was not accepted.

However, the existence of the supercontinent was believed by many scientists, and additional evidence now shows that the entire surface layer of the planet consists of pieces, called plates, that move, carrying the continents with them. The process is driven by the movement of hot rock rising and cool crustal material sinking. This evidence led to the development of the theory of plate tectonics.

How do we know of Pangea's existence? There are several compelling pieces of evidence:

- Puzzle-like fit of the continents. In several cases, modern shorelines of continents look as though they were once joined. The most obvious "fit" is between the east coast of South America and the west coast of Africa.
- Fossil evidence. Fossils of a fresh-water swimming reptile, Mesosaurus (Figure 1), have been found on the east coast of southern Brazil and the west coast of southern Africa. This reptile could not have swum the 3,000 miles currently between the two locations, across the present south Atlantic Ocean.
- Glacial deposits. Paleozoic (more than 250 million years old) glacial deposits have been found in the southernmost regions of South America, Africa, and Australia. Glacial striations, the parallel "scrape" marks from moving glaciers found on the rocks in these regions, are of similar orientation to corresponding striations found on Antarctica, indicating that glaciers moved across the regions when they were attached.
- Mountain belts. Some mountain belts, or mountain chains, have rocks and structures (folds and faults) that are very similar to those found in mountain belts on other continents. Some of these "paired" mountain belts are much older than 250 million years and were formed when Pangea assembled. When the continents collided in the late Paleozoic Era, enormous "wrinkles" of mountains were created. These mountain belts were originally elongate and parallel to the contact line of collision. Some of the mountain belts formed during the assembly of Pangea have been significantly eroded and are not as prominent today. The Himalayan Mountains are an example of a mountain belt being formed today from the collision of two continental land masses, India and Asia.

Materials:

copies of the worksheets to use as puzzle pieces
scissors
physical map of the continents
large sheet of background paper (blue may be desired)
optional: glue
optional: lightweight cardboard or heavy paper

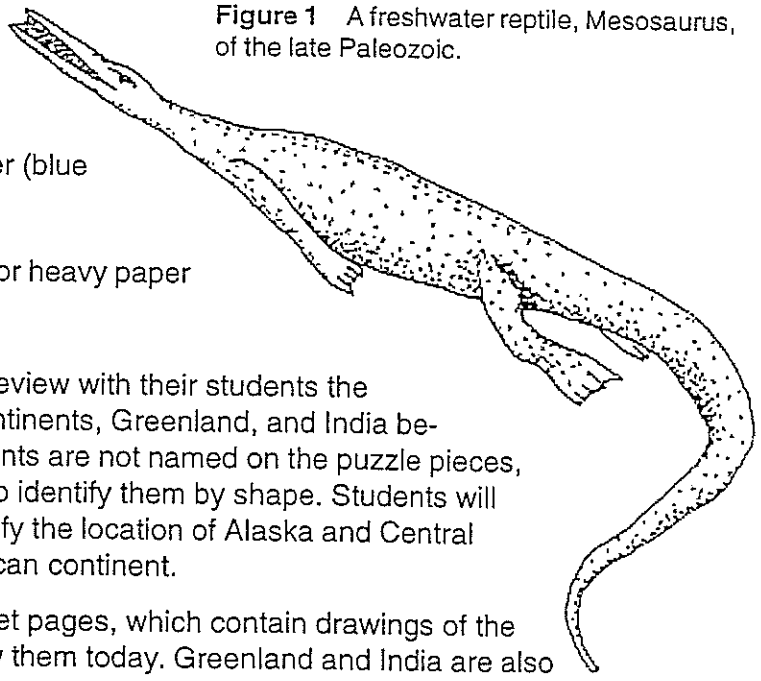


Figure 1 A freshwater reptile, Mesosaurus, of the late Paleozoic.

Procedure:

1. If needed, teachers should review with their students the geography of the various continents, Greenland, and India before proceeding. The continents are not named on the puzzle pieces, so students should be able to identify them by shape. Students will also need to be able to identify the location of Alaska and Central America on the North American continent.
2. Distribute the three worksheet pages, which contain drawings of the major continents as we know them today. Greenland and India are also included as separate pieces.

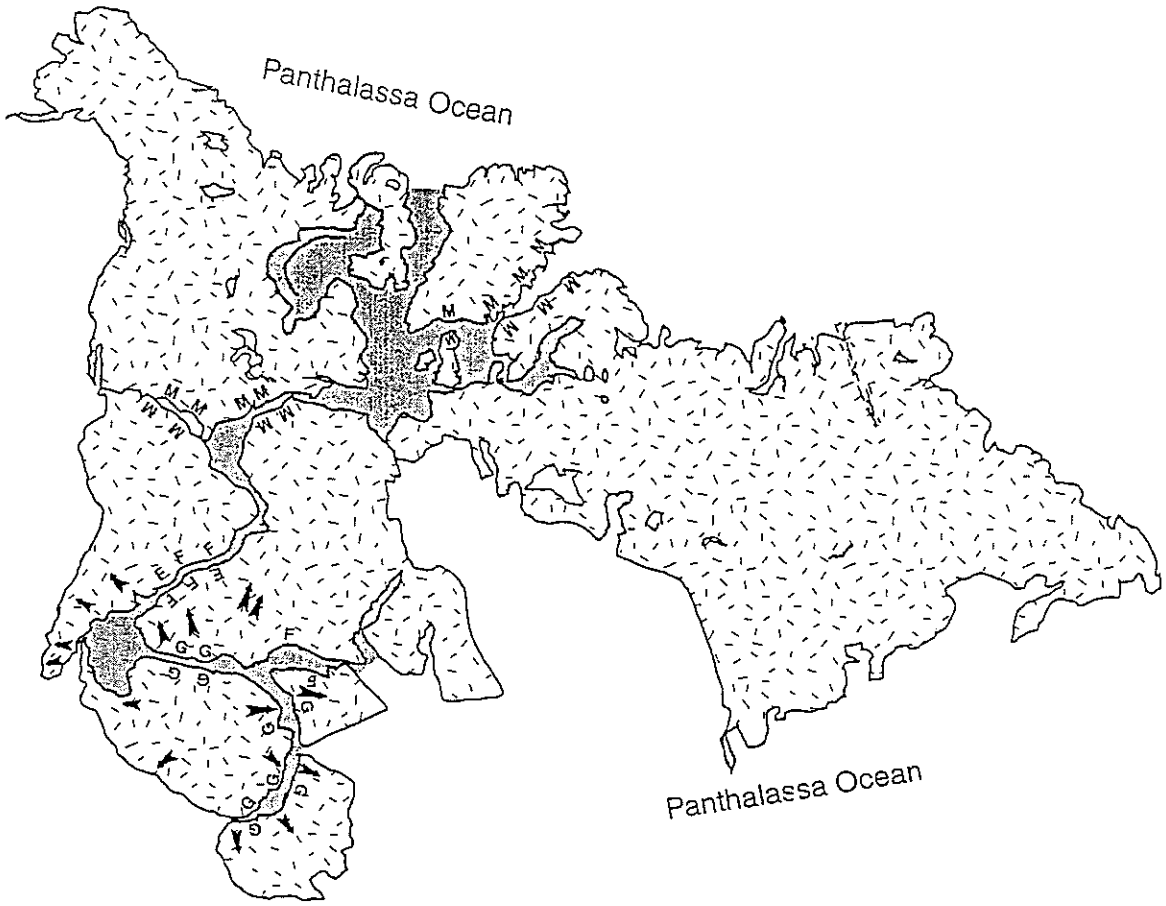


Figure 2 Reconstruction of Pangea using shorelines of today's continents. The Panthalassa Ocean is shown. Hatched areas were also continental when Pangea existed.

3. Students should glue the pages with continents onto cardboard or heavy paper (optional). Each continent should then be cut out, making eight puzzle pieces. Cutting the general shape of the continent, without all the fine details, is adequate. Remember that the modern shape of the continents is probably not the shape they had 250 million years ago, so the puzzle-like fit is far from perfect!

4. Once the puzzle pieces are ready, discuss the types of evidence pointing to the existence of Pangea. Note the letters written on the edges of some of the pieces. The key to these letters is as follows:

   F = fossils
   G = glacial deposits (arrows show the orientation of glacial striations)
   M = mountain belts

5. Tell students that the fit of continents will not be perfect, but there is only one correct arrangement of the continents. India was attached to Africa and Antarctica. It is much easier to place India into the puzzle last. You may want to assist the students for this part of the puzzle. Central America did not exist 250 million years ago and so it "gets in the way" of South America. See whether the students can figure this out themselves before you tell them that the lack of fit is an indication of Central America's younger age.

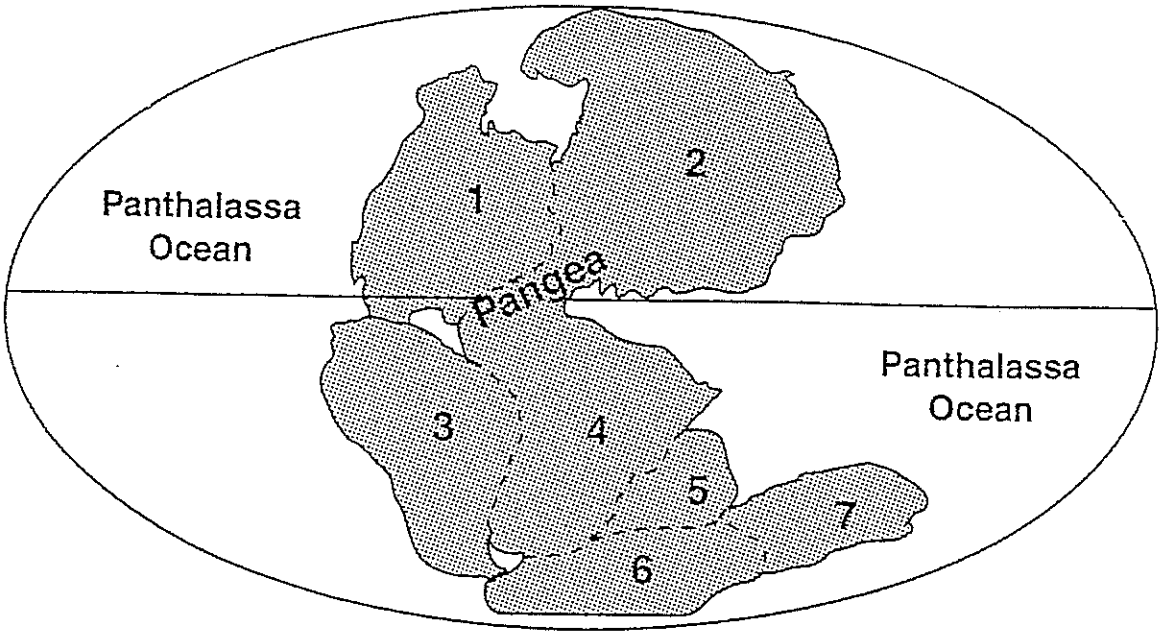


Figure 3 Reconstruction of the supercontinent Pangea as it may have appeared approximately 240 million years ago. Modern continents are numbered: (1) North America, (2) Eurasia, (3) South America, (4) Africa, (5) India, (6) Antarctica, and (7) Australia.

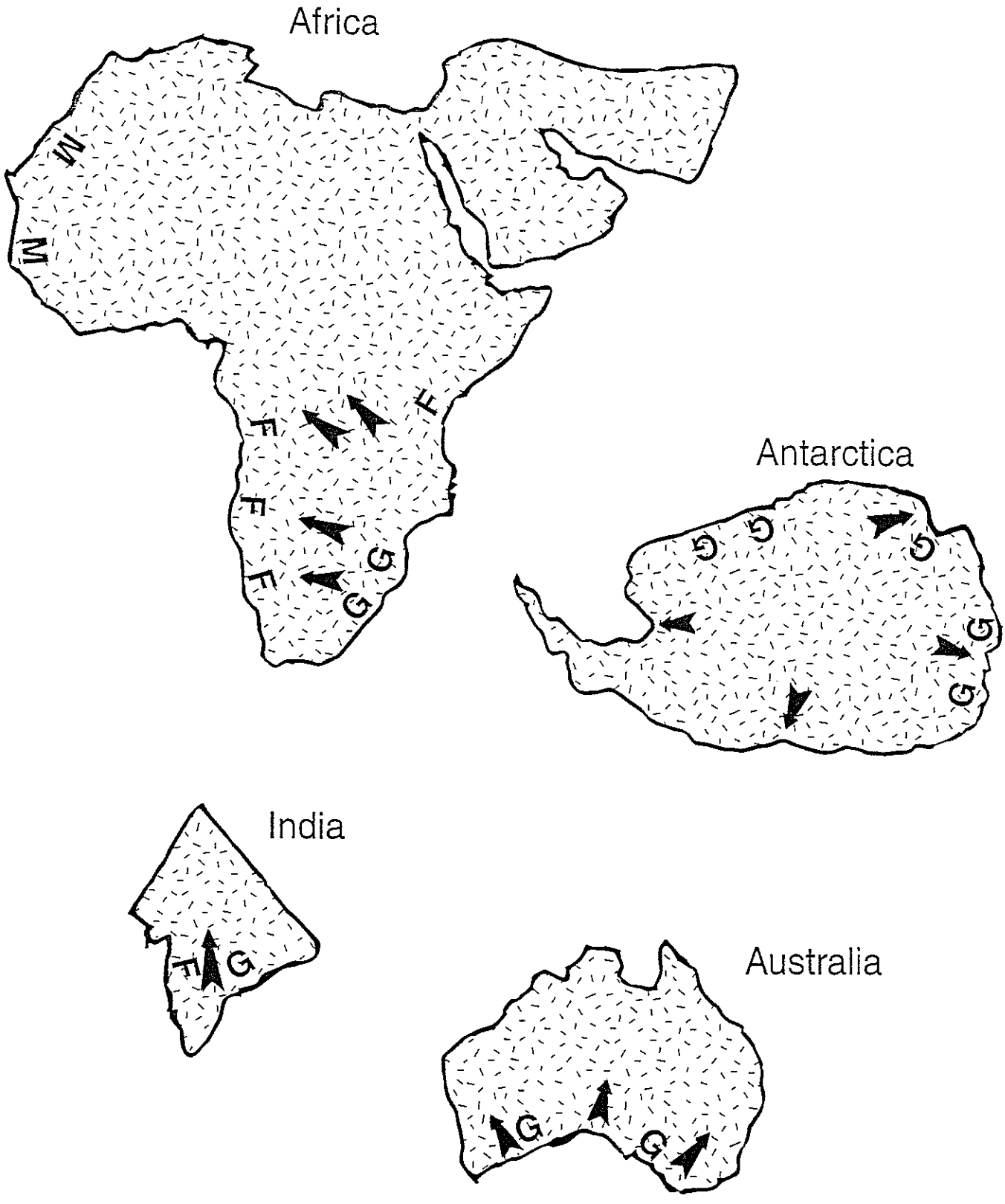
6. Begin the reconstruction with the North American continent. Have students locate Alaska and Central America (they may need to look at a map of North America). Alaska and Central American should be oriented so that they are on a north-south line with Alaska directly above Central America. Tape this piece onto the background paper to ensure that the orientation of Pangea is correct after assembly.
7. Ask students to use the "evidence" shown by the letters, as well as the puzzle-like fit of the continents, to reconstruct or reassemble Pangea. For each letter, there is only one corresponding continent with those same letters. For example, a continent with three G's should fit another continent with three G's.
8. Compare the completed puzzles with Figure 2. Once all of the students' puzzles have been arranged correctly, compare them with Figure 3, which illustrates what the ancient shorelines probably looked like. Have students discuss differences between the ancient shoreline shapes and today's shoreline shapes. Point out that the Mesosaurus and other animals, as well as plants, could easily have traveled between the now-distant continents. The movement of the continents has had a profound effect on the lives of plants and animals, allowing them at one time to wander freely and then splitting them into isolated groups.

Source:

Project Coast, 1998; modified 1999.

Contributed by Dr. Leslie Sautter, Department of Geology, University of Charleston, South Carolina

WORKSHEET 1



WORKSHEET 2

WORKSHEET 3

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