

Assignment Discovery Online Curriculum

Lesson title:

Continental Drift

Grade level:

6-8, with an adaptation for older students

Subject area:

Earth Science

Duration:

Two to three class periods

Objectives:

Students will

1. understand how Earth changed over a long period of time; and
2. understand how scientists developed a theory using fossil evidence.

Materials:

- Computers with Internet access (optional but very helpful)
- Reference materials, including an atlas
- Large sheets of paper
- Colored pencils
- Pencils or pens
- Scissors
- Clear adhesive tape
- Copies of Classroom Activity Sheet: Prehistoric Landmasses
- Copies of Take-Home Activity Sheet: What Gondwanaland May Have Looked Like

Procedures:

1. Begin the lesson by showing the class a standard physical map of the world. Tell students to look closely at the continents. Ask if they think the continents always looked as they do on the map, or if they have changed shape or location throughout Earth's history. Write their ideas on a large sheet of paper or on the board.
2. Tell students that in early 1915, the German scientist Alfred Wegener developed a theory that the continents once formed a giant supercontinent that he called Pangaea. He speculated that Earth took this form about 245 million years ago, during the Triassic period of the Mesozoic era. (The Mesozoic is the era in which dinosaurs lived.) A few years after Wegener proposed his theory, South African geologist Alexander Du Toit further theorized that Pangaea divided into two supercontinents 205 million years ago. Du Toit called the northern supercontinent Laurasia and the southern one Gondwanaland.

3. The scientists used many kinds of evidence to advance their theories. They found similar fossil remains of plants and animals on different present-day continents. The scientists hypothesized that the continents were once connected.
4. Tell students that they'll follow steps similar to those of Wegener and Du Toit to see if fossil evidence supports the theory that one supercontinent divided into two. Hand out copies of the Classroom Activity Sheet: Prehistoric Landmasses. Tell students they will focus on Gondwanaland, the supercontinent that includes what is now South America, Antarctica, Australia, Africa, Madagascar, and India..
5. Explain that students will map the locations of four different fossils:
 - *Glossopteris*: a fern found on the southern continents
 - *Cynognathus*: a land reptile found in South America and Africa
 - *Lystrosaurus*: a land reptile found in Africa, Antarctica, and India
 - *Mesosaurus*: a freshwater swimming reptile found in Africa and South AmericaStudents should mark these locations on the sheet, using the map key code.
6. Next have students cut out the continent shapes and try to piece them together as Gondwanaland. Ask them to think about how the different shapes fit together. For homework, have students paste their finished version of Gondwanaland on the Take-Home Activity Sheet: What Gondwanaland May Have Looked Like.
7. During the next class period, have students share their versions of Gondwanaland. Are most constructions similar? Show students a picture of what scientists believe Gondwanaland looked like. For a picture, visit the Web site at <http://www.hartrao.ac.za/goedesy/tectonics.html>.
8. Discuss where the fossil remains have been found. Does this evidence support Wegener and Du Toit's theory? Do students think it is sufficient evidence? What other information would be helpful? Conclude by telling students that over the past century, scientists have continued to find evidence supporting this theory.

Adaptation for older students:

Have students create Gondwanaland from the southern continents and discover that the same fossil remains were found on many of these continents by following the steps in this lesson. Have them read the following passage and write a paragraph about whether this information further supports Wegener and Du Toit's theory:

Glaciers are huge masses of ice that move over the land. They leave behind information about the direction of their movement in the rocks they once covered. Rocks found in South America, Africa, India, and Australia all show evidence of glaciers at the beginning of the Mesozoic era (about 248 million years ago). These places must have been closer to the South Pole at one time.

Tell students that they must compare their map of Gondwanaland with a modern-day map in order to make an informed opinion.

Discussion Questions:

1. What characteristics do you think enable a plant or animal to survive the breakup of a continent? Try to think of at least two characteristics.
2. Scientists have found *Mesosaurus* fossils on the east coast of the southern tip of South America and the west coast of South Africa. Even though we know this animal could swim, does the presence of *Mesosaurus* fossil remains in two places support Wegener and Du Toit's theory? Give evidence to support your ideas.
3. Do you think that the breakup of Pangaea into Gondwanaland and Laurasia affected organisms originally living on Pangaea? Do you think that the breakup of Gondwanaland into the southern continents affected the organisms living in Gondwanaland? Give evidence to support your ideas.
4. Do you think the breakup of Pangaea during the Jurassic period led to the extinction of some dinosaurs and the evolution of other dinosaurs?
5. Scientists have evidence that *Glossopteris* was found in what is now India, Antarctica, Australia, and Madagascar. What does this tell you about *Glossopteris*? What does it tell you about the climate and environment of Gondwanaland?
6. Based on the geologic past, we can assume that Earth is always changing. What modern-day evidence supports this idea? Hint: Think about natural disasters. Where do they often occur?

Evaluation:

Use the following three-point rubric to evaluate students' work during this lesson.

Three points: demonstrated exemplary performance and effort in marking the landmasses, completing the chart, and constructing Gondwanaland; participated actively in the final class discussion.

Two points: demonstrated average performance and effort in marking the landmasses, completing the chart, and constructing Gondwanaland; participated somewhat actively in the final class discussion.

One point: demonstrated unsatisfactory performance and effort in marking the landmasses, completing the chart, and constructing Gondwanaland; did not participate in the final class discussion.

Extensions:

Geologic Time Line

Have students develop a time line showing when scientists think that Pangaea broke up, when Gondwanaland and Laurasia formed, and when Gondwanaland separated into the continents as we know them today. The Web sites in the lesson plan will provide information.

Theory of Plate Tectonics

The work of Wegener and Du Toit provided the foundation for the theory of plate tectonics, which was developed in the 1960s. What other information came to light that helped scientists develop this theory? Make a poster showing the progression of discoveries and scientists who were involved. The Web sites in the lesson plan, as well as earth science textbooks, have this information.

Suggested Reading:

Digging for Bird-Dinosaurs: An Expedition to Madagascar

Nic Bishop. Houghton Mifflin, 2000.

Follow paleontologist Cathy Forster on a expedition to Madagascar, an island off the coast of Africa, where she is looking for more fossils that will link dinosaurs and birds. She has previously discovered a new fossil, Rahonavis, that shows both characteristics of dinosaurs and birds. Using lots of color photographs, this book offers a detailed look at the intricate work involved in exploring the past.

Dance of the Continents

Roy A. Gallant. Benchmark Books, 2000.

Our earth has been in constant motion since it began. The continents have formed and reformed as evidenced by the geologic and fossil record. Mr. Gallant explains in clear and simple language how the continents have changed through what was first called

continental drift and now is known as plate tectonics. Maps, diagrams, and illustrations round out this presentation.

Quest for African Dinosaurs: Ancient Roots of the Modern World

Louis Jacobs. Villard Books, 1993.

The author has done extensive excavating in Africa and writes of his work with detail and lots of personal anecdotes. Occasional drawings punctuate the chapters, which range from a description of the African terrain where dinosaurs flourished, to specific African dinosaurs, to the search for early mammals. An extensive bibliography and index follow the text.

Vocabulary

fossil

Definition: The remains of an animal or plant preserved from an earlier era inside a rock or geological deposit, often as an impression or in a petrified state.

Context: Soft pieces of coal often contain plant **fossils**.

Mesozoic era

Definition: The era of geologic time that includes the Triassic, Jurassic, and Cretaceous periods.

Context: The **Mesozoic era** is known as the Age of Dinosaurs because these animals roamed the Earth during this span of time.

Pangaea

Definition: A supercontinent that existed during the Mesozoic era that included most of Earth's present-day continents.

Context: **Pangaea**, meaning “all land,” was a term first used by the German scientist Alfred Wegener.

plate tectonics

Definition: A theory that explains movements of continents and changes in Earth's crust caused by internal forces within the planet.

Context: The process of **plate tectonics** is responsible for building mountains and causing earthquakes.

Academic standards

Grade level:

6-8

Subject area:

Geography

Benchmark:

Knows the processes that shape patterns in the physical environment (e.g., the erosion agents, such as water and ice; earthquake zones; and volcanic activity).

Standard:

Knows the physical processes that shape patterns on Earth's surface.

Credit:

Robert Michael de Groot, science education consultant and curriculum designer.

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Prehistoric Landmasses

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Gondwanaland was a prehistoric supercontinent comprised of the modern-day landmasses of South America, Antarctica, Australia, Africa, Madagascar, and India. Use the landmass illustrations on page 2, the chart and map key code below to mark the locations where four types of fossils have been found.

| Fossil Name | Description | Present-Day Locations |
|---------------------|----------------------|---|
| <i>Glossopteris</i> | A fern | <ul style="list-style-type: none">- Southern tip of India near Madurai- Prince Harald Coast, Antarctica- Southern tip of Madagascar- Oates Coast, Antarctica- Southeastern Australia (near Melbourne) |
| <i>Cynognathus</i> | A land reptile | <ul style="list-style-type: none">- Southeastern Argentina (near Bahia Blanca)- Southwestern South Africa (near Cape Town) |
| <i>Lystrosaurus</i> | A land reptile | <ul style="list-style-type: none">- Wilhelm II Coast, Antarctica- Madagascar, north of Antananarivo- Central India (between Bangalore and Hyderabad)- Eastern Tanzania (near Dar es Salaam) |
| <i>Mesosaurus</i> | A freshwater reptile | <ul style="list-style-type: none">- Eastern Brazil (near Salvador)- Cameroon, West Africa |

Map Key Code

Glossopteris = Green "G"

Cynognathus = Orange "C"

Lystrosaurus = Red "L"

Mesosaurus = Blue "M"

Prehistoric Landmasses

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What Gondwanaland May Have Looked Like

1. Cut out the shapes of the following continents and countries from the Classroom Activity Sheet: South America, Antarctica, Australia, Africa, Madagascar, and India.
2. In the space below, arrange the continents into what you think Gondwanaland looked like. Look at the shapes of the continents. Then take a closer look at the fossil locations marked on your map. Assuming that Wegener and Du Toit's theory was correct, how can you use it as a guide? (Hint: Make the Gs on the shapes touch each other. Do you think different continents with the same initials should also be touching?)

