

## Internal Structure of the Earth and Pangean Geography

### Objectives

The learner will learn about plate tectonics and the roles of orogenic processes.

### Vocabulary

P-waves, S-waves, surface waves, Pangea, plates, glacial striations, plate tectonics, orogeny, paleontology, Alfred Wegner, continental drift, plate boundaries, divergent margin, convergent margin, transverse (strike-slip) margin, crust, mantle, outer core, inner core, surficial landscapes, density, earthquake, seismic waves, lithosphere, asthenosphere, elements, convection, theory, glacier, supercontinent, technology, shadow zone, long axis, scale, model, eruption, schematic diagram, hypothesis, scientific community.

### Background Information

Movements within the interior of the Earth affect the Earth's surficial landscapes. The Earth is composed of four basic layers of varying densities and materials, which have been determined by careful examination of earthquake-generated seismic waves through the Earth. Seismic waves are energy waves generated by earthquakes or human generation that travel through the layers of the Earth. There are three types of seismic waves, P-waves, S-waves, and surface waves, each of which travels through materials differently. The P-waves travel through all mediums but move more slowly through liquids, the S-waves do not travel through liquids (they change into other waves), and the surface waves only travel along the surface.

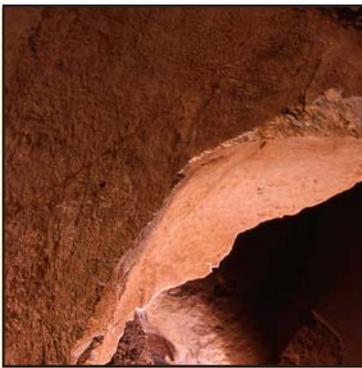
By examining the characteristics of these three seismic waves it was determined that there were four layers of the Earth. These are the inner core, which is solid and composed of heavy metals; the outer core, which consists of liquid, metallic elements; the mantle, the thickest layer with a dense plastic consistency; and finally the thin, brittle and broken crust on which we live. Convective motion in the hot upper mantle moves the pieces of broken crust (called *plates*). This motion causes various interactions between plates that are collectively called *plate tectonics*.

The theory of plate tectonics is a relatively recent theory (1970s); however Alfred Wegner suggested *continental drift*, a similar process, in the early 1900s. Wegner, a well traveled meteorologist, noticed that there were surprising similarities in fossils, geology, glacial striations on different continents, and several of the continents such as Africa and South America look like they fit well together. Using these various lines of evidence, Wegner proposed that a supercontinent called *Pangea* existed about 200 million years ago from which all the present continents broke away.

Today, we know that Pangea did exist by using many of the same lines of evidence as Wegner in conjunction with more evidence procured with modern technology. Pangea was together during the Permian Period, approximately 250 million years ago, when the sea was present in Delaware Basin.

### Pre-activity Thought Questions

Has the world always appeared as it does now? If not, how has it changed?



# CAVE OF THE WINDS

## Assessments

1. Notes in science notebooks
2. Scale diagram of the Earth's interior
3. World map with the plate boundaries and labeled plates

## Activity: Earth's Internal Structure

### Materials needed:

Science notebooks

Hard-boiled eggs (with shell on)

Slinkies

The seismic wave and eruption programs (free download from: <http://www.geol.binghamton.edu/faculty/jones/jones.html>)

Diagram of the Earth's interior: see Student Resource Sheet in this lesson.

Graph paper

### The teacher will:

1. Split students into groups and give each group a hard boiled egg with the shell on. Have them crack it lightly and then cut it in half along the long-axis.
2. Explain that the layers of the egg are similar to the internal structure of the Earth, where the shell represents the thin, cracked crust, the white of the egg is similar to the mantle, and the yolk represents the inner and outer core.
3. Define and diagram the crust, mantle, outer core, and inner core explaining composition and thickness.
4. Ask the students to brainstorm on how people might have determined the internal structure of the earth when we have only drilled several km into the crust.
5. Define the three types of seismic waves, P-waves (compression waves), S-waves (side-to-side waves), and surface waves (up and down waves).
6. Have students demonstrate the different motions of these waves with slinkies and record their observations in their science notebooks.
7. Explain that each wave moves differently through different materials (solid and liquids). The P-waves move through both materials and therefore are detected through the inner and outer core, the S-waves don't move through liquids and therefore the outer core so a *shadow-zone* is seen directly on the other side of the world from the epicenter of an earthquake, and surface waves only travel along the surface.
8. Have students draw a *scale* model of the Earth's cross-section on graph paper.

TAKE A  
GEO|VENTURE

## Diagram of the Earth's Core

