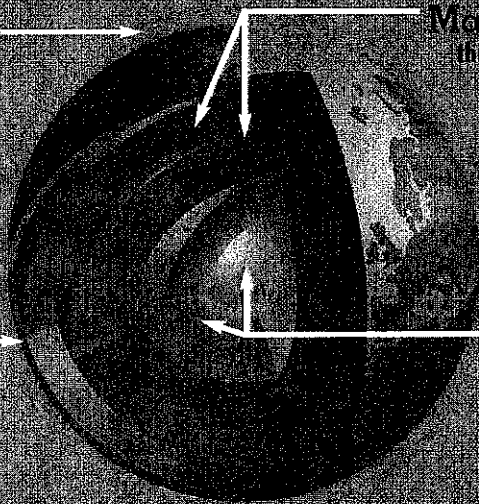


# Earth: Inside and Out

## The Core of the Matter Earth is bubbling with activity. Let's take a look.

**Atmosphere:** Collection of gases that extends about 1,000 miles (1,609 km) into space. Close to the surface, nitrogen makes up 78 percent of the atmosphere; most of the rest is oxygen.

**Crust:** Earth's solid surface. Under the oceans, the crust is mostly basalt, about three to seven miles (4-7 km) thick. Under the continents it's thicker—up to 40 miles (64 km).



**Mantle:** At about 1,800 miles (2,897 km) thick, this makes up 85 percent of Earth's volume. Top part is sometimes called "plastic" because although it's solid, it moves. The outer part of the mantle and the crust together are called the *lithosphere*. The *lithosphere* consists of huge plates that move continually.

**Core:** Earth's center. The *outer core*, about 1,400 miles (2,253 km) thick, is mostly liquid iron, along with of nickel and other elements. The *inner core*, about 800 miles (1,287 km) thick, is solid and 9,000°F (4,982°C).

**Super Sleuthing** Years and years of observing rock samples, fossils, and other evidence combined with a lot of deep and creative thought have helped scientists uncover some secrets of Earth's structure and history. And one key discovery often led to another down the line. Here are some highlights of their work.

**Rocks Evidence:** In the 1780s, James Hutton develops idea that current rocks hold clues to Earth's past by observing rocks in his native Scotland. Hutton also suggests Earth is much older than previously thought.

**Earth's Age**

**Radiometric Dating:** In 1907, Bertram Boltwood provides method for dating rocks using radioactivity. Boltwood puts Earth's age at 2.2 billion years.

**Earth's Age**

**Meteorite Analysis:** In 1953, Clair Patterson puts Earth's age at 4.6 billion years after studying lead in meteorites and rock samples.

**Clues from Space**

**Iridium Found in Ancient Rocks:** In 1980, Luis and Walter Alvarez discover samples of iridium, which is rare on Earth and may have been carried here on meteorites that collided with Earth about 65 million years ago; leads to theory that meteorite collision may have wiped out dinosaurs.

**Earth's Crust**

**Theory of Continental Drift:** In 1912, Alfred Wegener proposes idea of supercontinent Pangaea that broke apart; says continents are still drifting.

**Ocean Floor**

**Mid-Ocean Ridge:** In 1958, Bruce Heezen and Marie Tharp discover vast mountain range at the ocean floor, extending around the globe for 47,000 miles.

**Ocean Floor**

**Sea-Floor Spreading:** In 1960, Harry Hess develops the notion that sea floor spreads from giant rifts at bottom of the oceans; proof of this leads to idea of plate tectonics and confirms Wegener's theory of continental drift.

**Below the Surface**

**Origin of Earthquakes:** In 1927, Kiyoo Wadati shows that some earthquakes begin deep in Earth's crust, although they are felt on the surface.

**Below the Surface**

**Earth's Inner and Outer Core:** In 1936, after studying seismic waves caused by earthquakes, Inge Lehmann proposes that Earth's center is solid rather than molten liquid, and that it is composed of an outer and an inner core.

## Get Your Spheres Here

Scientists classify everything in, on, and above Earth into four main categories, or spheres. You've already read about the atmosphere. Here are the others.

**Atmosphere**

The collection of gases that surround Earth

**Biosphere**

All living things on the planet

**Lithosphere**

Earth's crust and mantle

**Hydrosphere**

Water in all its forms: solid, liquid, and gaseous

## Plates with a Past

Think today's continents always sat where they do now? No way—these landmasses are long-time movers and shakers.

800–700 Million Years Ago  
All continents came together to form Rodinia

600 Million Years Ago  
Continent of Gondwana begins to form. Includes: Australia, Antarctica, South America, Africa, and India

450 Millions Years Ago  
Lapetus Ocean separates the continents of Laurentia and Baltica, which form part of Europe and North America

250 Million Years Ago  
"Supercontinent" Pangaea, surrounded by one "superocean" called Panthalassa

200–130 Million Years Ago  
Gondwana splits off from Pangaea; formation of oceans as continents drift apart. Atlantic, Indian, and Pacific oceans

**Clues from Space**

**Meteorite Crater Found off Mexico:** In 1987, Charles Duller finds first surface evidence of a meteorite impact possibly related to extinction of the dinosaurs.

**Clues from Space**

**Discovery of Meteorite Fragment:** In 1995, while examining samples from the Pacific Ocean floor, Frank Kyte finds what may be evidence of the meteorite that may have wiped out dinosaurs.

**Ocean Floor**

**Ocean Vents Exploration:** In 1977, Robert Ballard and others unexpectedly find sea creatures near vents deep at ocean floor; may have been source of all life on Earth.

**Ocean Floor**

## Activity

**How MUCH IS A MILLION?** Earth's history is measured in millions of years. To understand "million," get a group of your friends and discuss collecting a million toothpicks, pennies, bottle caps, or small rocks. Since we use a base 10 number system, organize your collection as follows: 10 groups of 10 into sandwich baggies; 10 groups of 100 into larger-sized freezer baggies; 10 groups of 1000 into a grocery bag. How many of each bag will you need for the entire collection?