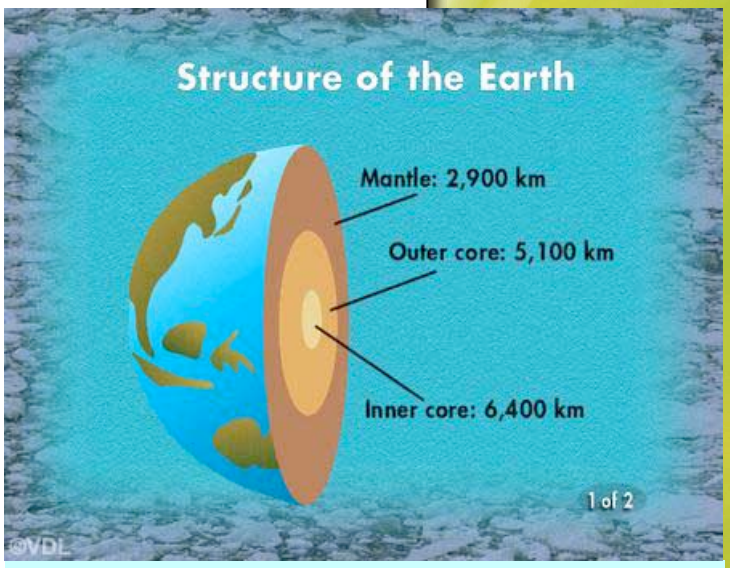
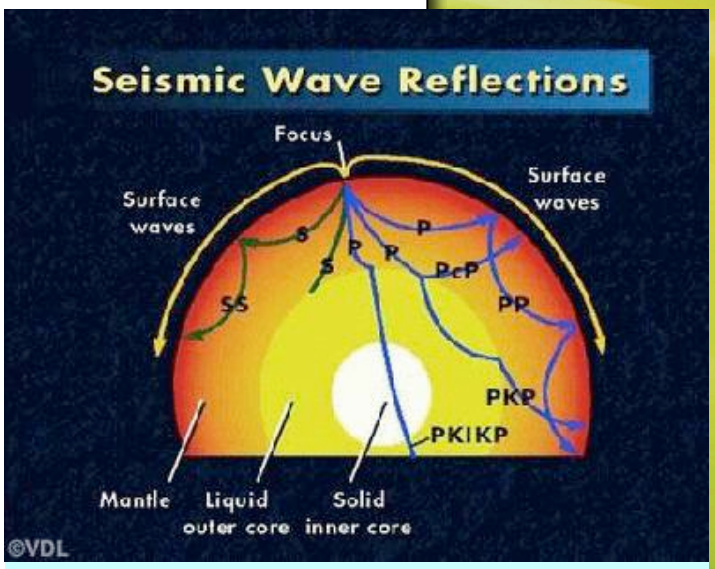
Understanding How the Earth Rotates

The Earth is composed of four main layers: the crust, mantle, outer core, and inner core. Each layer is made of different materials and has a different density. Density refers to the amount of matter per unit volume in something. If two objects are the same size, the denser object is typically heavier because it contains more matter in the same amount of space. For example, a rock has a higher density than a same size piece of crumpled-up paper.



The earth is made of four main layers: the crust, mantle, inner core, and outer core. This image shows the depths of each layer.

Scientists called geologists study the differences in Earth's layers. Geologists have found evidence to suggest that as the Earth formed, the heavier, denser material sank towards the center of the Earth, and the lighter material rose to the outside of the planet. This explains why the crust is made of the lightest, or least dense, materials, such as basalt and granite rocks, and the inner core is made of very dense metals, such as nickel and iron. The inner core is under a great deal of pressure from the weight of the layers on top of it. This pressure keeps the metals in the inner core very tightly packed, or dense.



Seismic waves travel through the layers of the Earth at different speeds. This data tells geologists what the different layers of the Earth are composed of.

Geologists use data from earthquakes to help them learn about the composition of the layers of the Earth. Earthquake vibrations, or seismic waves, travel through different materials at different speeds. Seismic waves travel slower through liquids and faster through solids. Some seismic waves do not travel through liquids at all. This knowledge has allowed geologists to

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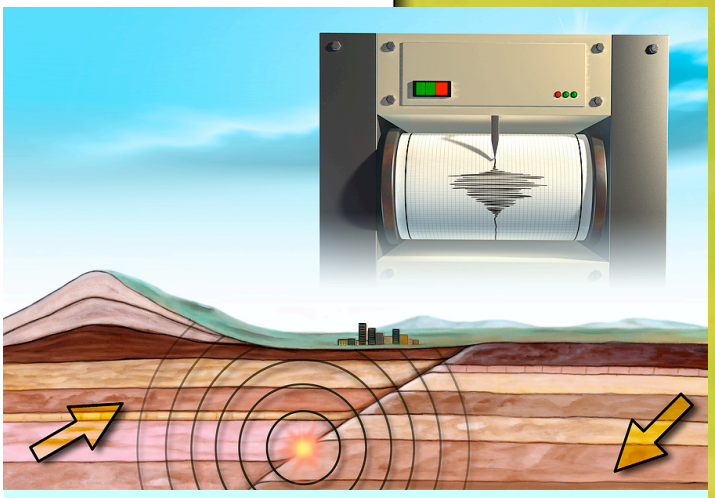
discover that the mantle and outer core consist of different states of matter than the crust and inner core.

Seismic waves travel faster through the crust than through the mantle because the crust is more rigid. They also travel faster through the inner core than through the outer core, knowledge that has enabled geologists to discover that the inner core is solid and the outer core is liquid. Although the upper mantle is rigid like the crust, the mantle becomes increasingly soft the closer it is to the extremely hot core. The lower mantle consists mostly of molten, or melted, rock. The outer core is also molten, though it consists mostly of metals: nickel and iron. In contrast, the inner core is a solid ball of metals.

Geologists use machines called seismographs to measure seismic waves. There are many of these machines throughout the world that record how strong seismic waves are and how fast the waves reach different parts of the Earth. Geologists can collect data from seismographs all over the world after an earthquake and compare the data. These data show them how the waves traveled through the Earth and give them clues as to what the inner layers are composed of.



Seismographs are machines that record the strength of an earthquake's seismic waves.

Different Layers Rotate at Different Speeds

By studying how seismic waves pass through the inner core, geologists have discovered that the inner core is rotating faster than the rest of the Earth. They have used the data to determine that it is completing its daily rotation two-thirds of a second faster than the rest of the Earth. This may not seem like much of a difference, but over time it adds up. Over the course of one hundred years, this difference in rotation speeds will cause the inner core to become one quarter of a rotation ahead of the rest of the Earth. When thinking in terms of geologic time, which is usually measured in millions of years, this is a very fast change in movement. For example, the change of the inner core's

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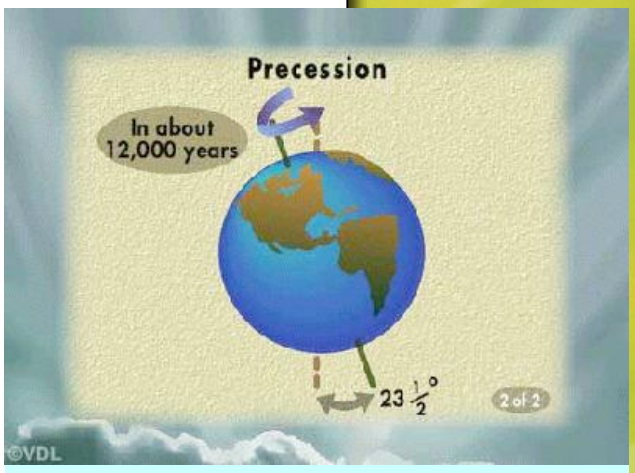
rotation is 100,000 times faster than the rate of continental drift.

This discovery has aided geologists in understanding how the poles of the Earth have changed positions over the course of the planet's history. The Earth's poles are like the ends of an imaginary line that runs through the Earth. Earth rotates on this imaginary line as a wheel does on its axle. (In fact, this imaginary line is called Earth's axis.) As the inner core rotates at a faster speed, it causes the whole planet to rotate on a slightly different imaginary axis. This makes the position of the poles on the Earth move. The position of the poles indicates how much the Earth is tilted on its axis. Earth's axial tilt is the primary cause of the seasons. At any time during its orbit, the half of Earth tilted toward the Sun is experiencing summer, and the half of Earth tilted away from the Sun is experiencing winter.



The Earth is currently tilted 23.5 degrees on its axis. This tilt causes different parts of the planet to receive different amounts of sunlight throughout the year, causing the seasons.

The current tilt of the Earth is 23.5°. Throughout its history, the Earth has been tilted at several different angles. Its tilt continues to change at a very slow pace. As the position of the poles change, so will the tilt of the Earth. This causes changes in seasonal patterns on the planet.

Studying the factors that cause the Earth to rotate on its axis has allowed geologists to discover important information about the Earth's history.

The tilt of the Earth is slowly changing due to different rotation speeds of the inner core and the rest of the planet. The change in the tilt of the earth will cause different seasonal patterns.

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