

Earth Science

Chapter 2 – Earth as a System

Section 1 – Earth: A Unique Planet

E.Q.: *What are the compositional and structural layers of the Earth and the possible source of the Earth's magnetic field?*

SES1. Students will investigate the composition and formation of Earth systems, including the Earth's relationship to the solar system.

- e. Identify the transformations and major reservoirs that make up the rock cycle, hydrologic cycle, carbon cycle, and other important geochemical cycles.**

SES6. Students will explain how life on Earth responds to and shapes Earth systems.

- c. Explain how geological and ecological processes interact through time to cycle matter and energy, and how human activity alters the rates of these processes (e.g., fossil fuel formation and combustion).**

Objectives

- Describe the size and shape of Earth.
- Describe the compositional and structural layers of Earth's interior.
- Identify the possible source of Earth's magnetic field.
- Summarize Newton's law of gravitation.

Earth Basics

- Earth is the third planet from the sun in our solar system.
- Earth formed about 4.6 billion years ago and is made mostly of rock.
- Approximately 70% of Earth's surface is covered by a thin layer of water known as the *global ocean*.
- Earth is an oblate sphere, or a slightly flattened sphere. Earth's pole-to-pole circumference is 40,007 km. Its equatorial circumference is 40,074 km.

Earth's Interior

- Scientists have made important discoveries about Earth's interior through studies of seismic waves.
- Seismic waves are vibrations that travel through Earth and that are caused by earthquakes and by explosions near Earth's surface.
- By studying seismic waves as they travel through Earth, scientists have determined that Earth is made up of three major compositional zones and five major structural zones.

Compositional Zones of Earth's Interior

- **crust the thin and solid outermost layer of Earth that lies above the mantle**
- **Oceanic crust, which lies under the oceans, is only 5 to 10 km thick. The continental crust varies in thickness from 15 km to 80 km.**
- **mantle in Earth science, the layer of rock that lies between Earth's crust and core**
- **The mantle is nearly 2,900 km thick and makes up almost two-thirds.**
- **core the central part of Earth that lies below the mantle**
- **The center of Earth is a sphere composed mainly of nickel and iron whose radius is about 3,500 km.**

READING CHECK

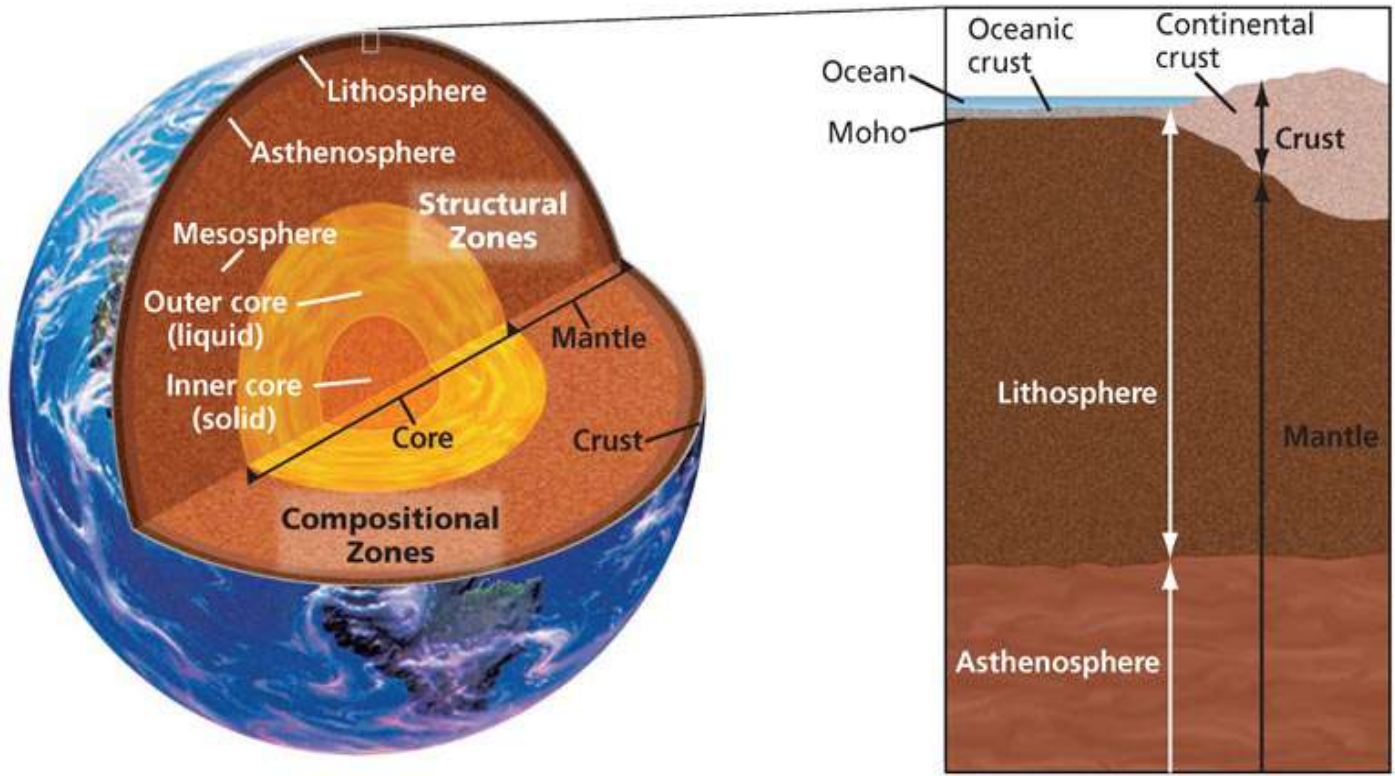
Explain why scientists have to rely on indirect observations to study Earth's interior.

- **Indirect observations are the only means available for exploring Earth's interior at depths too great to be reached by drilling.**

Structural Zones of Earth's Interior

- **The three compositional zones of Earth's interior are divided into five structural zones.**
- **lithosphere the solid, outer layer of Earth that consists of the crust and the rigid upper part of the mantle**
- **The rigid lithosphere is between 15km and 300 km thick.**
- **asthenosphere the solid, plastic layer of the mantle beneath the lithosphere; made of mantle rock that flows very slowly, which allows tectonic plates to move on top of it**
- **The plastic asthenosphere is about 200 km thick.**
- **mesosphere literally, the "middle sphere"; the strong, lower part of the mantle between the asthenosphere and the outer core**
- **The mesosphere reaches from the bottom of the asthenosphere to a depth of about 2,900 km.**
- **Below the mesosphere is the liquid outer core.**
- **The outer core surrounds the solid inner core, which begins at a depth of 5,150 km.**

The diagram below shows the layers of Earth's interior.



Earth as a Magnet

- Earth's magnetic field extends beyond the atmosphere and affects a region of space called the *magnetosphere*.
- Scientists think that motions within the liquid iron of Earth's outer core produce electric currents that in turn create Earth's magnetic field.

Earth's Gravity

- Gravity is the force of attraction that exists between all matter in the universe.
- According to Newton's law of gravitation, the force of attraction between any two objects depends on the masses of the objects and the distance between the objects.
- The larger the masses of two objects are and the closer together the objects are, the greater the force of gravity between the objects will be.

Weight and Mass

- Weight is a measure of the strength of the pull of gravity on an object.
- An object's weight depends on its mass and its distance from Earth's center.

Weight and Location

- Because the distance between Earth's surface and its center is greater at the equator than at the poles, the weight of an object at the equator is about 0.3% less than its weight at the North Pole.