Prentice Hall

EARTH SCIENCE

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Chapter 1

Introduction to Earth Science

1.1 What Is Earth Science?

Overview of Earth Science

- Encompasses all sciences that seek to understand
  - Earth
  - Earth's neighbors in space

1.1 What Is Earth Science?

Overview of Earth Science

- **Earth science** includes
  1. **geology,** the study of Earth
  2. **oceanography,** the study of the ocean
  3. **meteorology,** the study of the atmosphere and the processes that produce weather
  4. **astronomy,** the study of the universe

1.1 What Is Earth Science?

Formation of Earth

- Most researchers conclude that Earth and the other planets formed at essentially the same time.
- Nebular Hypothesis
  - The solar system evolved from an enormous rotating cloud called the solar nebula.

1.1 What Is Earth Science?

Formation of Earth

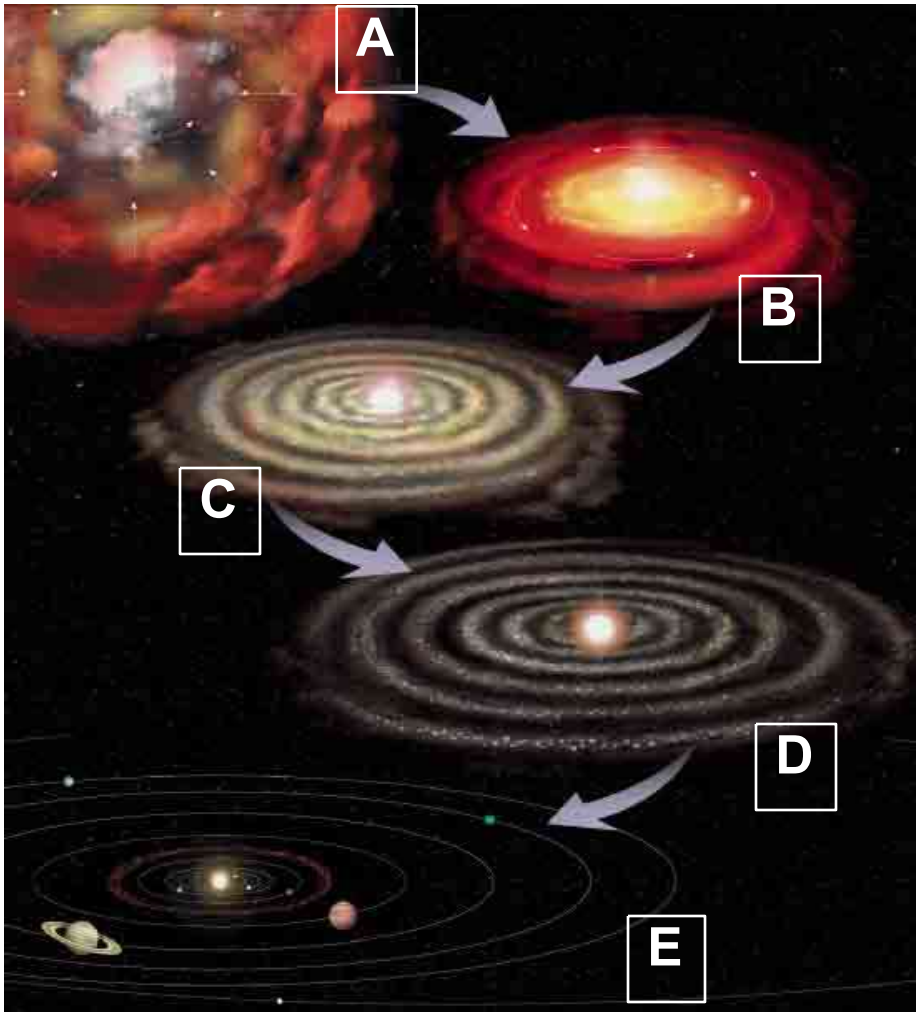
- Nebular Hypothesis
  - The nebula was composed mostly of hydrogen and helium.
  - About 5 billion years ago, the nebula began to contract.
  - It assumed a flat, disk shape with the protosun (pre-Sun) at the center.

1.1 What Is Earth Science?

Formation of Earth

- Nebular Hypothesis
  - Inner planets begin to form from metallic and rocky clumps.
  - Larger outer planets began forming from fragments with a high percentage of ices.

The Nebular Hypothesis



1.1 What Is Earth Science?

Formation of Earth

- Layers Form on Earth
  - As Earth formed, the decay of radioactive elements and heat from high-velocity impacts caused the temperature to increase.
  - Lighter rocky components floated outward, toward the surface.
  - Gaseous material escaped from Earth's interior to produce the primitive atmosphere.

1.2 A View of Earth

Earth's Major Spheres

1. **Hydrosphere**
   - Ocean is the most prominent feature of the hydrosphere.
     - Is nearly 71% of Earth's surface
     - Holds about 97% of Earth's water
   - Also includes fresh water found in streams, lakes, and glaciers, as well as that found underground

1.2 A View of Earth

Earth's Major Spheres

2. **Atmosphere**
   - Thin, tenuous blanket of air
   - One half lies below 5.6 kilometers (3.5 miles)
3. **Biosphere**
   - Includes all life
   - Concentrated near the surface in a zone that extends from the ocean floor upward for several kilometers into the atmosphere

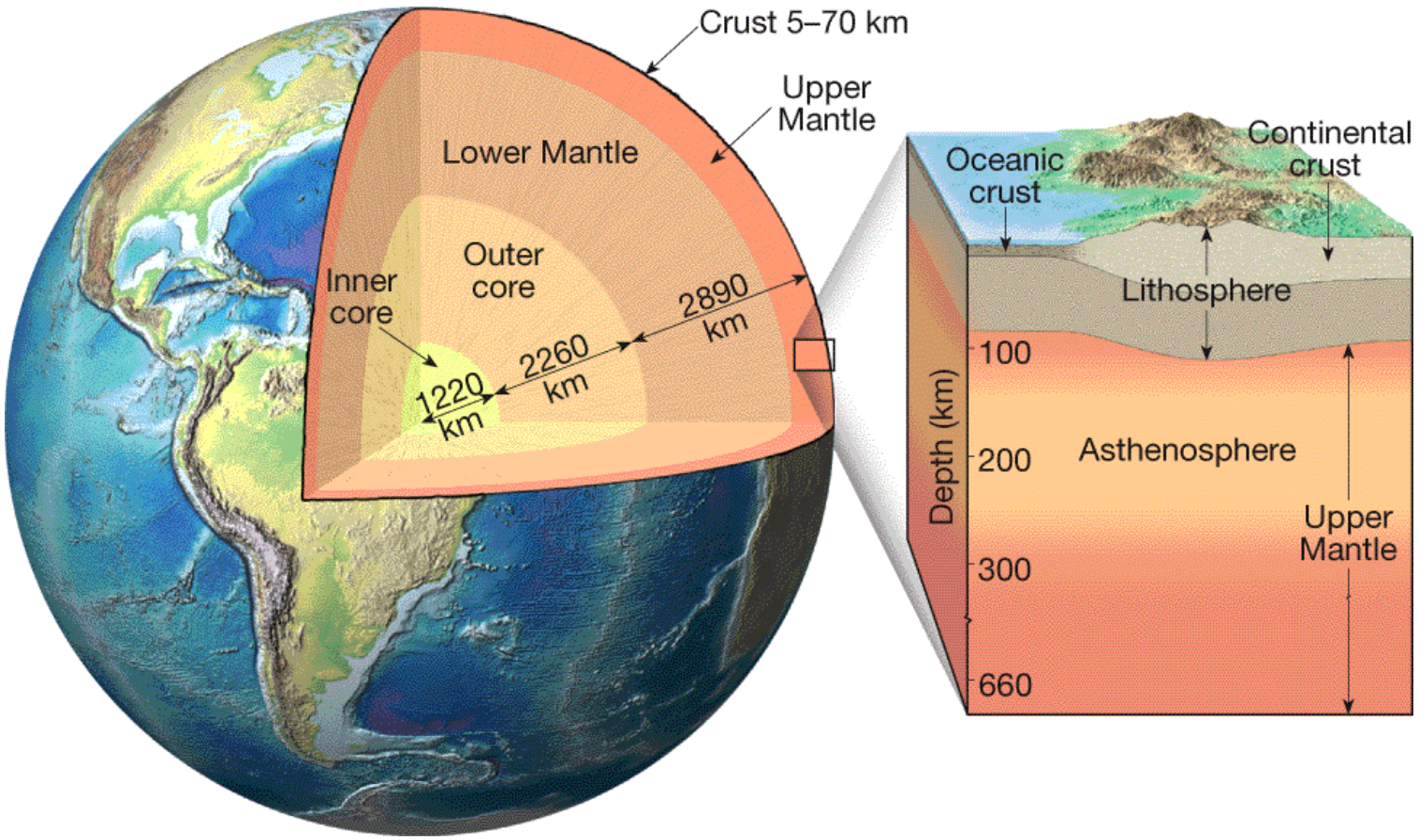
1.2 A View of Earth

Earth's Major Spheres

4. Geosphere

- Based on compositional differences, it consists of the crust, mantle, and core.
  - **Crust—**the thin, rocky outer layer of Earth.
  - **Mantle—**the 2890-kilometer-thick layer of Earth located below the crust.
  - **Core—**the innermost layer of Earth, located beneath the mantle.

Earth's Layered Structure



1.2 A View of Earth

Plate Tectonics

- Plate tectonics is the theory that proposes that Earth's outer shell consists of individual plates that interact in various ways and thereby produce earthquakes, volcanoes, mountains, and Earth's crust itself.

1.3 Representing Earth's Surface

Determining Location

- Latitude and longitude are lines on the globe that are used to determine location.
  - **Latitude** is distance north or south of the equator, measured in degrees.
  - **Longitude** is distance east or west of the prime meridian, measured in degrees.

1.3 Representing Earth's Surface

Maps and Mapping

- No matter what kind of map is made, some portion of the surface will always look either too small, too big, or out of place. Mapmakers have, however, found ways to limit the distortion of shape, size, distance and direction.

1.3 Representing Earth's Surface

Topographic Maps

- Topographic maps represent Earth's surface in three dimensions; they show elevation, distance directions, and slope angles.
  - **Contour lines** are lines on a topographic map that indicate an elevation.
  - **Contour interval** is the distance in elevation between adjacent contour lines.

1.4 Earth System Science

What Is a System?

- A **system** is any size group of interacting parts that form a complex whole.
- Closed systems are self contained (e.g., an automobile cooling system).
- Open systems allow both energy and matter to flow in and out of the system (e.g., a river system).

1.4 Earth System Science

Earth as a System

- Earth is a dynamic body with many separate but highly interacting parts or spheres.
- Earth system science studies Earth as a system that is composed of numerous parts, or subsystems.

1.4 Earth System Science

Earth as a System

- Sources of Energy
  - Sun—drives external processes such as weather, ocean circulation and erosional processes
  - Earth's interior—drives internal processes including volcanoes, earthquakes and mountain building

1.4 Earth System Science

Earth as a System

- Consists of a nearly endless array of subsystems (e.g., hydrologic cycle)
- Humans are part of the Earth system.

1.4 Earth System Science

People and the Environment

- Environment
  - Surrounds and influences organisms
  - Physical environment encompasses water, air, soil, and rock
  - The term *environmental* is usually reserved for those aspects that focus on the relationships between people and the natural environment.

1.4 Earth System Science

People and the Environment

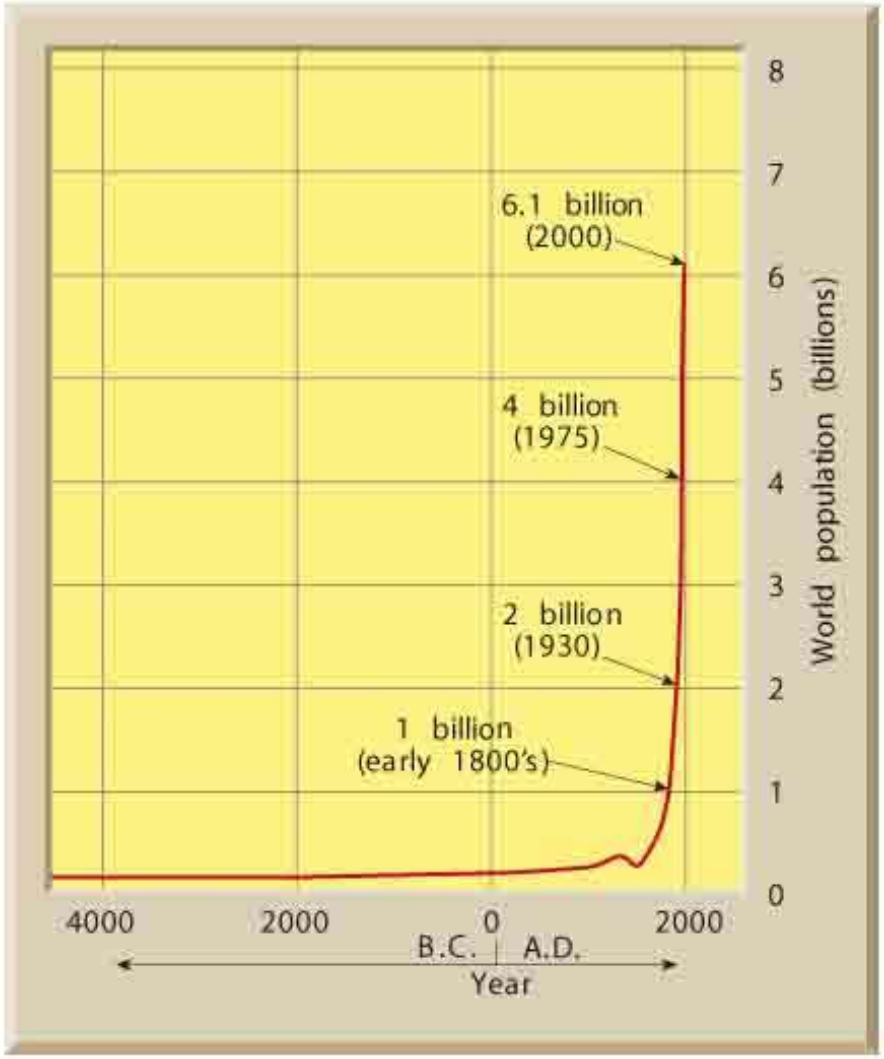
- Resources
  - Include water, soil, minerals, and energy
  - Two broad categories
    1. Renewable—can be replenished (e.g., plants, energy from water and wind)
    2. Nonrenewable—cannot be replenished in the near future (e.g., metals, fuels)

1.4 Earth System Science

People and the Environment

- Population
  - Population of the planet is growing rapidly
  - Use of minerals/energy has climbed more rapidly than the overall growth of population

Growth of World Population



1.4 Earth System Science

Environmental Problems

- Local, regional, and global
- Caused by people and societies
  - Urban air pollution
  - Acid rain
  - Ozone depletion
  - Global warming
- Caused by natural hazards
  - Earthquakes
  - Landslides

1.5 What Is Scientific Inquiry?

Science

- Science assumes the natural world is
  - consistent
  - predictable
- Goals of science are
  - to discover patterns in nature
  - to use the knowledge to predict

1.5 What Is Scientific Inquiry?

Hypothesis and Theory

- An idea can become a
  - **hypothesis—**tentative or untested explanation
  - **theory—**tested, confirmed, supported hypothesis
- Scientific Method
  - Gather facts through observation
  - Formulate hypotheses
  - Test hypotheses to formulate theories

1.5 What Is Scientific Inquiry?

Science Methods

- Scientific knowledge is gained through
  - following systematic steps
    1. Collecting facts
    2. Developing a hypothesis
    3. Conducting experiments
    4. Reexamining the hypothesis and accepting, modifying, or rejecting it
  - theories that withstand examination
  - totally unexpected occurrences