

Chapter Outlines

NOTE: This is intended to help students ‘organize’ their understanding of each topic.
It is not a comprehensive study guide for quizzes or midterms, i.e. study your text!



Introduction to Earth Science

➤ What is Earth Science?

- Includes all sciences that seek to understand Earth and its neighbors in space. Including:
 - **Geology** – the study of physical Earth. It has two components:
 - Physical geology – the materials composing Earth
 - Historical geology – study of the origin and development of Earth
 - **Oceanography** – not a separate science. It integrates:
 - Chemistry
 - Physics
 - Geology
 - Biology
 - **Meteorology** – study of the atmosphere and weather
 - **Astronomy** – study of the universe

➤ Earth Science, People, Environment

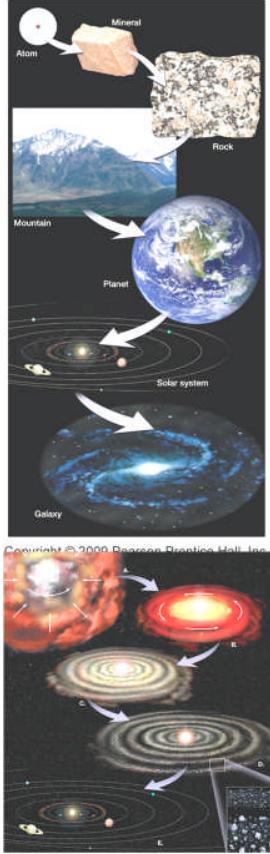
- Environment is that which surrounds and influences organisms. It encompasses:
 - Water
 - Air
 - Soil
 - Rock
- Resources – are an important focus of Earth science. You want to buy that new car?...you want that new phone?...heat your house?...use makeup?...etc. Someone must find and mine the natural resources to produce those items. Resources encompass:
 - Water
 - Soil
 - Minerals
 - Energy
- Resources have two broad categories
 - **Renewable** – items that can be replenished in less than your lifetime (\pm)
 - Plants
 - Water
 - Energy from flowing water, wind, hydrothermal, etc
 - **Nonrenewable** – items that require long period of time to renew (\pm millions of years...). (This does not necessarily mean we need to worry about running out.) This includes:
 - Metals
 - Fuels
 - Etc.

➤ Scientific Inquiry and the Scientific Method

- Science assumes the natural world is consistent and predictable
- The **Scientific Method** is the general procedure used by scientist to unravel the secrets of our natural world, and to help differentiate between the possible & impossible, science & superstition, and sense & non-sense. It consists of the generalized steps:
 1. Presentation of an idea or a problem
 2. Gathering of related data/information
 3. Formulation of a **hypothesis** (educated guess)
 4. Experiments to test the hypothesis
 5. Modify the hypothesis if needed
 6. Publish (make known) the results
- If a hypothesis remains true and accepted by most scientists over time, it becomes a **theory**

➤ Scales of Space and Time

- Understand that the size of the universe is enormous! A long trip for humans is traveling to the moon, a distance of 384,403 km. The distance to the nearest neighboring galaxy is $9,460,730,472,580 \times 10^6$ km. (the distance light travels in 2 million years)



- Earth Science requires the understanding of huge lengths of time. A long human lifespan is 100 years. Earth is only middle age, yet it was 'born' approximately 4,500,000,000 years ago!
- Earth's Early Evolution
 - The universe was formed from the 'big bang' approximately ±14 billion years ago
 - Earth was formed along with the rest of our solar system approximately ±4.5 billion years ago in our galaxy, the Milky Way
 - The current hypothesis for the formation of our solar system is the **Nebular Hypothesis**:
 - Previously there existed in our area of space a cloud of gas (*mostly hydrogen and helium*) and dust
 - This cloud began to contract and spin due to its own gravity
 - Bits of debris began to clump together forming the Sun and the individual planets
 - The inner planets (*including Earth*) are more metallic and rocky than the outer planets because the early sun 'blew' away their lighter gasses
 - Earth heated as a result of high-velocity impacts with early debris, causing it to heat, and heavier material therefore to sink to the center. This created Earth's layered structure with an iron core and a rocky crust
 - Gases escaped from Earth's early interior (commonly by volcanism) to create Earth's early atmosphere and early oceans. Water may have also arrived by comet impacts.

➤ Earth's Spheres – the study of Earth can be organized into 'spheres' to simplify understanding:

- **Hydrosphere** – all water, including oceans, rivers, groundwater, glaciers, and rain
- **Atmosphere** – The very thin blanket of air enveloping Earth
- **Biosphere** – includes all life
- **Solid Earth (geosphere)** – includes the core, mantle, crust
- Earth's outer portion is important:
 - The **lithosphere** is the 'brittle' skin which includes the crust and uppermost mantle
 - The lithosphere is made of many separate 'plates' that very slowly move around Earth's surface (*Plate Tectonics*)
 - Continents and ocean basins are made of very different materials



➤ The Face of Earth – major features of Earth's surface

- On continents, there are mountain belts and stable interiors
- On the ocean floor are abyssal plains, mid-ocean ridges, deep-ocean trenches, & seamounts
- The ocean water overlaps onto the edge of most continents on the area called the continental shelf

➤ Earth as a System – Earth system science studies Earth as a system composed of numerous parts, or subsystems

- Humans (*and other life*) are a part of the Earth system
- System properties may include:
 - **Closed system** – self-contained
 - **Open system** – both energy and matter flow into and out of the system
 - **Positive feedback** – promotes change once it has already begun
 - **Negative feedback** – tries to return to conditions before the start of change
 - Earth's systems are powered by two sources of energy:
 - Internal processes are powered by internal heat from Earth's core
 - Surface processes are largely powered by heat from the Sun

