Ch 17

17-1 **The fossil record provides evidence about the history of life on Earth. It also shows how different groups of organisms, including species, have changed over time. The fossil record provides incomplete information about the history of life. Over 99% of all species that have lived on Earth have become extinct, which means that the species has died out.**

Most fossils form in sedimentary rock. Sedimentary rock forms when exposure to the elements breaks down existing rock into small particles of sand, silt, and clay. Water carries small rock particles to lakes and seas. Dead organisms are buried by layers of sediment, which forms new rock. The preserved remains may be later discovered and studied.

**Interpreting Fossil Evidence**

Paleontologists determine the age of fossils using relative dating or radioactive dating. In **relative dating**, the age of a fossil is determined by comparing its placement with that of fossils in other layers of rock. Rock layers form in order by age—the oldest on the bottom, with more recent layers on top. Index fossils are used to compare the relative ages of fossils.

An **index fossil** is a species that is recognizable and that existed for a short period but had a wide geographic range. **Relative dating allows paleontologists to estimate a fossil's age compared with that of other fossils.**

**Radioactive Dating**

Scientists use radioactive decay to assign an absolute age to rocks.

Some elements are radioactive and steadily break down into nonradioactive elements. **Radioactive dating** is the use of half-lives to determine the age of a sample. A **half-life** is the length of time required for half of the radioactive atoms in a sample to decay.

**In radioactive dating, scientists calculate the age of a sample based on the amount of remaining radioactive isotopes it contains** **Carbon-14 begins to decay when an organism dies.**

**Carbon-12 is not radioactive and does not decay.**

**By comparing the amounts of carbon-14 and carbon-12 in a fossil, researchers can determine when the organism lived.**

**Geologic Time Scale**

**Scientists first developed the geologic time scale by studying rock layers and index fossils worldwide.**

**Formation of Earth**

Hypotheses about Earth’s early history are based on a relatively small amount of evidence. **Earth's early atmosphere probably contained hydrogen cyanide (HCN), carbon dioxide (CO2), carbon monoxide (CO), nitrogen (N2), hydrogen sulfide (H2S) and water (H2O).**

About 3.8 billion years ago, Earth’s surface cooled enough for water to remain a liquid, and oceans covered much of the surface.

**The First Organic Molecules**

Could organic molecules have evolved under conditions on early Earth? In the 1950s, Stanley Miller and Harold Urey tried to answer that question by simulating conditions on the early Earth in a laboratory setting.

**Miller and Urey's experiments suggested how mixtures of the organic compounds necessary for life could have arisen from simpler compounds present on a primitive Earth.**

Although their simulations of early Earth were not accurate, experiments with current knowledge yielded similar results. Evidence suggests that 200–300 million years after Earth had liquid water, cells similar to modern bacteria were common.

**Formation of Microspheres**

In certain conditions, large organic molecules form tiny bubbles called **proteinoid microspheres**.

Microspheres are not cells, but they have selectively permeable membranes and can store and release energy. Hypotheses suggest that structures similar to microspheres might have acquired more characteristics of living cells.

**Evolution of RNA and DNA**

How could DNA and RNA have evolved? Several hypotheses suggest:

Some RNA sequences can help DNA replicate under the right conditions.

Some RNA molecules can even grow and duplicate themselves suggesting RNA might have existed before DNA.

Phosphorus existed in the rocks, but not in the atmosphere.

**Free Oxygen**

Microscopic fossils, or **microfossils**, of unicellular prokaryotic organisms resembling modern bacteria have been found in rocks over 3.5 billion years old. These first life-forms evolved without oxygen.

About 2.2 billion years ago, photosynthetic bacteria began to pump oxygen into the oceans. Next, oxygen gas accumulated in the atmosphere.  **The rise of oxygen in the atmosphere drove some life forms to extinction, while other life forms evolved new, more efficient metabolic pathways that used oxygen for respiration.**

**Origin of Eukaryotic Cells**

**The Endosymbiotic Theory**

**The endosymbiotic theory proposes that eukaryotic cells arose from living communities formed by prokaryotic organisms.** About 2 billion years ago, prokaryotic cells began evolving internal cell membranes. The result was the ancestor of all eukaryotic cells. According to the endosymbiotic theory, eukaryotic cells formed from a symbiosis among several different prokaryotes.

**Sexual Reproduction and Multicellularity**

Most prokaryotes reproduce asexually. Asexual reproduction:

yields daughter cells that are exact copies of the parent cell.

restricts genetic variation to mutations in DNA.

Sexual reproduction shuffles genes in each generation. In sexual reproduction:

offspring never resemble parents exactly

there is an increased probability that favorable combinations will be produced

there is an increased chance of evolutionary change due to natural selection

**17-3. Do not memorize. Be able to use the Geologic Time Scale.**

17-4 SKIP FOR NOW

18-1

**To study the diversity of life, biologists use a classification system to name organisms and group them in a logical manner.**

In the discipline of **taxonomy**, scientists classify organisms and assign each organism a universally accepted name.

Carolus Linneaus developed a naming system called **binomial nomenclature**.

**In binomial nomenclature, each species is assigned a two-part scientific name.**

The scientific name is italicized. The first part of the name is the genus to which the organism belongs. A **genus** is a group of closely related species. The genus name is capitalized.

The second part of the name is unique to each species within the genus. This part of the name often describes an important trait or where the organism lives. The species name is lowercased.

**Linnaeus's seven levels of classification are—from smallest to largest—**

* + - * **species**
      * **genus**
      * **family**
      * **order**
      * **class**
      * **phylum**
      * **kingdom**
* Each level is called a **taxon**, or taxonomic category.
* Species and genus are the two smallest categories