Section Objectives

► Explain the development and purpose of the geologic column.

► List the major units of geologic time.

18.1 The Geologic Time Scale

►Evidence of changing conditions on Earth's surface is recorded in the rock layers of Earth's crust.

►The geologic time scale outlines the development of Earth and of life on Earth.

The Geologic Column

geologic column an ordered arrangement of rock layers that is based on the relative ages of the rocks and in which the oldest rocks are at the bottom.

►Rock layers in a geologic column are distinguished by the types of rock the layers are made of and by the kinds of fossils the layers contain.

►Fossils in the upper layers resemble modern plants and animals.

►Many of the fossils discovered in old layers are from species that have been extinct for millions of years.

►Allows us to determine the relative age of rock layers even if the rock contains no radioactive minerals.

Divisions of Geologic Time

►The geologic history of Earth is marked by major changes in Earth's surface, climate, and types of organisms.

►Geologists use these indicators to divide the geologic time scale into smaller units.

►Rocks grouped within each unit contain similar fossils and each unit is generally characterized by fossils of a dominant life-form.

Eons

►The largest unit of geologic unit of time is an **eon**. Geologic time is divided into four eons: the Hadean eon, the Archean eon, the Proterozoic eon, and the Phanerozoic eon.

►the Hadean eon, the Archean eon, the Proterozoic eon = Precambrian Time. This 4 billion year interval contains most of Earth's history.

Eras

era a unit of geologic time that includes two or more periods

►The Phanerozoic eon is divided into smaller units of geologic time called eras.

►Examples: Paleozoic, Mesozoic, and Cenozoic eras

Periods

period a unit of geologic time that divides eras into smaller units of time.

►Eras are divided into shorter time units called periods. Each period is characterized by specific fossils.

►Example periods: Devonian, Jurassic, Quaternary periods.

Epochs

epoch a subdivision of geologic time that divides periods into smaller units of time.

►Where the rock record is most complete, a detailed fossil record may allow scientists to divide period into shorter time units called epochs.

►Examples: Paleocene, Pleistocene, Holocene epochs.

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17.3 The Fossil Record

Interpreting the Fossil Record

fossils the trace or remains of an organism that lived long ago, most commonly preserved in sedimentary rock

paleontology the scientific study of fossils

- Fossils are an important source of information for finding the relative and absolute ages of rocks.
- Fossils also provide clues to past geologic events, climates, and the evolution of living things over time.

Fossilization

- Only dead organisms that are buried quickly or protected from decay can become fossils.
- Generally only the hard parts of organisms, such as wood, bones, shells, and teeth, become fossils.
- In rare cases, an entire organism may be preserved.

Mummification

- Mummified remains are often found in very dry places, because most bacteria which cause decay cannot survive in these places.
- Some ancient civilizations mummified their dead by carefully extracting the body's internal organs and then wrapping the body in carefully prepared strips of cloth.

Amber

- Hardened tree sap is called *amber*. Insects become trapped in the sticky sap and are preserved when the sap hardens.
- In many cases, delicate features such as legs and antennae have been preserved. In rare cases, DNA has been recovered from amber.

Tar Seeps

- When thick petroleum oozes to Earth's surface, the petroleum forms a tar seep.
- Tar seeps are commonly covered by water. Animals that come to drink the water can become trapped in the sticky tar.
- The remains of the trapped animals are covered by the tar and preserved.

Freezing

- The low temperatures of frozen soil and ice can protect and preserve organisms.
- Because most bacteria cannot survive freezing temperatures, organisms that are buried in frozen soil or ice do not decay.

Petrification

- Mineral solutions such as groundwater replace the original organic materials that were covered by layers of sediment with new materials.
- Some common petrifying minerals are silica, calcite, and pyrite.
- The substitution of minerals for organic material other results in the formation of a nearly perfect mineral replica of the original organism.

Trace Fossils	**trace fossil** a fossilized mark that formed in sedimentary rock by the movement of an animal on or within soft sediment ●In some cases, no part of the original organism survives in fossil form. But the fossilized evidence of past animal movement can still provide information about prehistoric life. ●A trace fossil is an important clue to the animal's appearance and activities.
Imprints	●Carbonized imprints of leaves, stems, flowers, and fish made in soft mud or clay have been found preserved in sedimentary rock. ●When original organic material partially decays, it leaves behind a carbon-rich film. An imprint displays the surface features of the organism.
Molds and Casts	●Shells often leave empty cavities called *molds* within hardened sediment. When a shell is buried, its remains eventually decay and leave an empty space. ●When sand or mud fills a mold and hardens, a natural cast forms. ●A cast is a replica of the original organism.
Coprolites	●Fossilized dung or waste materials from ancient animals are called *coprolites.* ●They can be cut into thin sections and observed through a microscope. The materials identified in these sections reveal the feeding habits of ancient animals, such as dinosaurs.
Gastroliths	●Some dinosaurs had stones in their digestive systems to help grind their food. In many cases, these stones, which are called *gastroliths,* survives as fossils. ●Gastroliths can often be recognized by their smooth, polished surfaces and by their close proximity to dinosaurs remains.
Index fossils	●**Index fossil** a fossil that is used to establish the age of rock layers because it is distinct, abundant, and widespread and existed for only a short span of geologic time. Paleontologists can use index fossils to determine the relative ages of the rock layers in which the fossils are located.