

Earth Science

Chapter 9 – A View of Earth’s Past

Section 1 – Geologic Time

E.Q.: *What is geologic time and the major divisions?*

STANDARDS:

SES4. Students will understand how rock relationships and fossils are used to reconstruct the Earth’s past.

e. Use geologic maps and stratigraphic relationships to interpret major events in Earth history (e.g., mass extinction, major climatic change, tectonic events).

SES5. Students will investigate the interaction of insolation and Earth systems to produce weather and climate.

f. Relate changes in global climate to variation in Earth/Sun relationships and to natural and anthropogenic modification of atmospheric composition.

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

d. Describe how fossils provide a record of shared ancestry, evolution, and extinction that is best explained by the mechanism of natural selection.

e. Identify the evolutionary innovations that most profoundly shaped Earth systems: photosynthetic prokaryotes and the atmosphere; multicellular animals and marine environments; land plants and terrestrial environments.

Objectives

- **Summarize how scientists worked together to develop the geologic column.**
- **List the major divisions of geologic time.**

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.

- **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.**
- **No single area on Earth contained a record of all geologic time, so scientists combined observations to create a standard geologic column.**
- **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.**

Reading Check

Where would you find fossils of extinct animals on a geologic column?

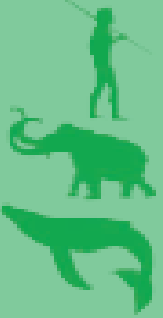

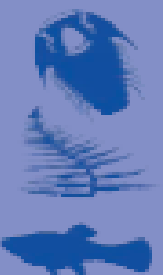
You would find fossils of extinct animals in older layers of a geologic column.

Using a Geologic Column

- **Scientists use geologic columns to estimate the age of rock layers that cannot be dated radiometrically.**
- **To determine the layer's age, scientists compare a given rock layer with a similar layer in a geologic column that contains the same fossils or that has the same relative position.**
- **If the two layers match, they likely formed at about the same time.**

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.

Geologic Time Scale				
Era	Period	Epoch	Beginning of Interval in Ma	Characteristics from geologic and fossil evidence
	Quaternary	Holocene	0.01	The last glacial period ends; complex human societies develop.
		Pleistocene	1.8	Woolly mammoths, rhinos, and humans appear.
	Tertiary	Pliocene	5.3	Large carnivores (bears, lions, wolves) appear.
		Miocene	23.0	Grazing herds are abundant; raccoons and wolves appear.
		Oligocene	33.9	Deer, pigs, horses, camels, cats, and dogs appear.
		Eocene	55.8	Horses, flying squirrels, bats, and whales appear.
		Paleocene	65.5	Age of mammals begins; first primates appear.
	Cretaceous		146	Flowering plants and modern birds appear; mass extinctions mark the end of the Mesozoic Era.
	Jurassic		200	Dinosaurs are the dominant life-form; primitive birds and flying reptiles appear.
	Triassic		251	Dinosaurs appear; ammonites are common; cycads and conifers are abundant; and mammals appear.
	Permian		299	Pangaea comes together; mass extinctions mark the end of the Paleozoic Era.
	Carboniferous	Pennsylvanian Period	318	Giant cockroaches and dragonflies are common; coal deposits form; and reptiles appear.
		Mississippian Period	359	Amphibians flourish; brachiopods are common in oceans; and forests and swamps cover most land.
	Devonian		416	Age of fishes begins; amphibians appear; and giant horsehairs, ferns, and cone-bearing plants develop.
	Silurian		444	Eurypterids, land plants and animals appear.
	Ordovician		488	Echinoderms appear; brachiopods increase; trilobites decline; graptolites flourish; atmosphere reaches modern O ₂ -rich state.
	Cambrian		542	Shelled marine invertebrates appear; trilobites and brachiopods are common. First vertebrates appear.
Precambrian time			4,600	The Earth forms; continental shields appear; fossils are rare; and stromatolites are the most common organisms.

Eons and Eras

- 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 first three eons are part of a time interval commonly known as Precambrian Time. This 4 billion year interval contains most of Earth's history.

Eons and Eras

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

- After Precambrian time the Phanerozoic eon began. This eon is divided into smaller units of geologic time called eras.
- The first era of the Phanerozoic eon was the Paleozoic Era, which lasted 292 million years.
- Paleozoic rocks contain fossils of a wide variety of marine and terrestrial life forms.
- After the Paleozoic Era the Mesozoic Era began and lasted about 183 million years.
- Mesozoic fossils include early forms of birds and reptiles.
- The present era is the Cenozoic Era, which began 65 million years ago. Fossils of mammals are common in Cenozoic rocks.

period - a unit of geologic time that is longer than an epoch but shorter than an era

epoch - a subdivision of geologic time that is longer than an age but shorter than a period.

- Eras are divided into shorter time units called periods. Each period is characterized by specific fossils and is usually named for the location in which the fossils were first discovered.

- **Where the rock record is most complete and least deformed, a detailed fossil record may allow scientists to divide period into shorter time units called epochs.**
- **Epochs may be divided into smaller units of time called ages.**
- **Ages are defined by the occurrence of distinct fossils in the fossil record.**