12.4 The Geologic Time Scale

**Key Concepts**
- What is the geologic time scale?
- How is the geologic time scale constructed?

**Reading Focus**

**Reading Strategy**

**Build Vocabulary**

**Paraphrase** Tell students to list the vocabulary terms on a sheet of paper, leaving enough space for definitions. As they read, students should write the definitions in their own words.

**Reading Strategy** Sample answers include:

The Geologic Time Scale

<table>
<thead>
<tr>
<th>Structure of the Time Scale</th>
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<tbody>
<tr>
<td>A.</td>
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<tr>
<td>B.</td>
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**Facts and Figures**

Changes to the Geologic Time Scale If you look at different reference books, you might notice that the time boundaries between different eras and periods are slightly different. This is part of the scientific process, and happens for two reasons. The rate of radioactive decay is extremely slow for isotopes that are useful for dating, which makes determining the exact rates of decay a difficult task. As physics experiments get more advanced and accurate, the exact numbers are refined, sometimes causing a reassessment of geologic ages. In addition, new fossils are continuously being discovered. Since time divisions are often based on extinction events, new fossils can sometimes shift the locations of the time-division boundaries.

**Figure 20** These cliffs on the coast of England are made of rock that formed about 200 million years ago. Over geologic time, forces in the crust slowly bent the rock’s flat-lying layers into folds.
Eons  Geologists divide Earth's history into four long units called eons. About 88 percent of
goetic time is made up of the first three of these
eons—the Hadean, Archaean, and Proterozoic.
During these eons, Earth formed, the atmosphere
and oceans developed, and early life evolved.

Another term for this long time span is
Precambrian time. Precambrian fossils are
scarce. One reason for this is that there is very little
Precambrian rock left at the surface. Over billions
of years, most Precambrian rocks have been
eroded or metamorphosed, destroying or altering
fossils. In addition, for most of Earth's history life
existed only as single-celled organisms, and these
do not leave easily identifiable fossils. Only very
late in the Precambrian did multi-celled organ-
isms evolve in the oceans.

About 540 million years ago, the Phanerozoic
eon began. The term Phanerozoic comes from the
Greek words meaning “visible life.” The term is
appropriate because the rocks of this eon contain
abundant fossils. These fossils document the evo-
lution of more complex life forms.

Eras  There are three eras within the Phan-
eroic eon: the Paleozoic, Mesozoic, and
Cenozoic eras. The term Paleozoic comes from the
Greek words for “ancient life.” During the
Paleozoic era, most of the major groups of organ-
isms that live on Earth today evolved. For
example, vertebrates (animals with backbones)
and plants appeared.

The term Mesozoic means “middle life.”
During the Mesozoic era, forests developed on
land and many types of reptiles, including
dinosaurs, became abundant. Later in the
Mesozoic, the first mammals evolved.

Customize for Inclusion Students

Learning Disabled  For students who have
difficulty absorbing large blocks of text, use
Figure 21 as a visual aid as you discuss the
goetic time divisions. Consider adding
benchmarks to the time scale to help students
recall the various geologic divisions. For
example, you could point out that mass
extinctions mark the end of both the Paleozoic
and Mesozoic eras. The first fish appear in the
fossil record in the Ordovician Period; the first
land plants appear in the Silurian Period.
The term *Cenozoic* means “recent life.” During the Cenozoic era, many different types of mammals and birds evolved, and flowering plants became abundant.

The fossil record shows that the Paleozoic and Mesozoic eras both ended with dramatic, worldwide changes in life forms. Many types of organisms became extinct, although others survived. The Cenozoic era continues today.

**Periods and Epochs** Each era is subdivided into periods. Different geologic events, environmental conditions, and life forms characterize each period. For example, the Carboniferous period is named for the large coal deposits that formed during that period. *Carboniferous* means “carbon bearing.” Other geologic periods are named for the region where geologists first described the period’s rocks and fossils. For example, Jurassic refers to the Jura Mountains of France and Switzerland.

Traditionally, geologists divided the Cenozoic era into two periods: the Tertiary and Quaternary. Today, most geologists divide the Cenozoic into the Paleogene and Neogene, as shown in Figure 21. The periods of the Cenozoic are divided into still smaller units called epochs. For example, we live in the Holocene epoch of the Quaternary (or Neogene) period. The epochs of other periods, however, are not usually referred to by specific names. Instead, the terms early, middle, and late are generally applied to the epochs of these earlier periods.

### Section 12.4 Assessment

#### Reviewing Concepts

1. The geologic time scale divides Earth’s history into units that each represent specific amounts of time.
2. Eons, eras, periods, and epochs
3. During the 1800s, the geologic time scale was based on relative ages of the rock record. During the 1900s, absolute ages based on radiometric dating were added to the time scale.

#### Thinking Critically

5. Interpreting Diagrams To which era does each of the following periods belong: Ordovician, Tertiary, Permian, Triassic?
6. Calculating What percentage of geologic time is made up of the Cenozoic era?

#### Writing a Definition

- **For:** Researchers one of the periods of the geologic time scale. Write a definition of the period that includes the name of the era to which the period belongs, when the period began and ended, one major event from the period, and an explanation of the period’s name.

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**Figure 22** An imprint fossil preserves fine details of this prawn, a freshwater crustacean of the Jurassic period.