Middle and Recent Earth History

The Mesozoic Era

Dinosaurs have captured people’s imaginations since their bones first were unearthed more than 150 years ago. Dinosaurs and other interesting animals lived during the Mesozoic Era, which was between 248 and 65 million years ago. The Mesozoic Era also was marked by rapid movement of Earth’s continents.

The Breakup of Pangaea

The Mesozoic (meh zuh ZOH ihk) Era, or era of middle life, was a time of many changes on Earth. At the beginning of the Mesozoic Era, all continents were joined as a single landmass called Pangaea, as shown in Figure 11.

Pangaea separated into two large landmasses during the Triassic Period, as shown in Figure 20. The northern mass was Laurasia (law RAY zhuh), and Gondwanaland (gahn DWAH nuh land) was the southern landmass. As the Mesozoic Era continued, Laurasia and Gondwanaland broke apart and eventually formed the present-day continents.

Species adapted to the new environments survived the mass extinction at the end of the Paleozoic Era. Recall that a reptile’s skin helps it retain bodily fluids. This characteristic, along with their shelled eggs, enabled reptiles to adapt readily to the drier climate of the Mesozoic Era. Reptiles became the most conspicuous animals on land by the Triassic Period.
**Dinosaurs** What were the dinosaurs like? Dinosaurs ranged in height from less than 1 m to enormous creatures like *Apatosaurus* and *Tyrannosaurus*. The first small dinosaurs appeared during the Triassic Period. Larger species appeared during the Jurassic and Cretaceous Periods. Throughout the Mesozoic Era, new species of dinosaurs evolved and other species became extinct.

**Dinosaurs Were Active** Studying fossil footprints sometimes allows paleontologists to calculate how fast animals walked or ran. Some dinosaur tracks that have been found indicate that these animals were much faster runners than you might think. *Gallimimus* was 4 m long and could reach speeds of 65 km/h—as fast as a modern race horse.

Some studies also indicate that dinosaurs might have been warm-blooded, not cold-blooded like present-day reptiles. The evidence that leads to this conclusion has to do with their bone structure. Slices through some cold-blooded animal bones show rings similar to growth rings in trees. The bones of some dinosaurs don’t show this ring structure. Instead, they are similar to bones found in modern mammals, as you can see in Figure 21.

These observations indicate that some dinosaurs might have been warm-blooded, fast-moving animals somewhat like present-day mammals and birds. They might have been quite different from present-day reptiles.

**Good Mother Dinosaurs** The fossil record also indicates that some dinosaurs nurtured their young and traveled in herds in which the adults surrounded their young.

One such dinosaur is *Maiasaura*. This dinosaur built nests in which it laid its eggs and raised its offspring. Nests have been found in relatively close clusters, indicating that more than one family of dinosaurs built in the same area. Some fossils of hatchlings have been found near adult animals, leading paleontologists to think that some dinosaurs nurtured their young. In fact, *Maiasaura* hatchlings might have stayed in the nest while they grew in length from about 35 cm to more than 1 m.
Birds appeared during the Jurassic Period. Some paleontologists think that birds evolved from small, meat-eating dinosaurs much like Bambiraptor feinberger, shown in Figure 22A. The earliest bird, Archaeopteryx, shown in Figure 22B, had wings and feathers. However, because Archaeopteryx had features not shared with modern birds, scientists know it was not a direct ancestor of today’s birds.

Mammals Mammals first appeared in the Triassic Period. The earliest mammals were small, mouselike creatures, as shown in Figure 23. Mammals are warm-blooded vertebrates that have hair or fur covering their bodies. The females produce milk to feed their young. These two characteristics have enabled mammals to survive in many changing environments.

Gymnosperms During most of the Mesozoic Era, gymnosperms (GYHM nuh spurmz), which first appeared in the Paleozoic Era, dominated the land. Gymnosperms are plants that produce seeds but not flowers. Many gymnosperms are still around today. These include pines and ginkgo trees.

Angiosperms Angiosperms (AN jee uh spurmz), or flowering plants, first evolved during the Cretaceous Period. Angiosperms produce seeds with hard outer coverings. Because their seeds are enclosed and protected, angiosperms can live in many environments. Angiosperms are the most diverse and abundant land plants today. Present-day angiosperms that evolved during the Mesozoic Era include magnolia and oak trees.
End of an Era  The Mesozoic Era ended about 65 million years ago with a major extinction of land and marine species. Many groups of animals, including the dinosaurs, disappeared suddenly at this time. Many paleontologists hypothesize that a comet or asteroid collided with Earth, causing a huge cloud of dust and smoke to rise into the atmosphere, blocking out the Sun. Without sunlight the plants died, and all the animals that depended on these plants also died. Not everything died, however. All the organisms that you see around you today are descendants of the survivors of the great extinction at the end of the Mesozoic Era.

Math Skills Activity

Calculating Extinction Using Percentages

Example Problem

At the end of the Cretaceous Period, large numbers of animals became extinct. Scientists still are trying to understand why some types of animals survived while others died. Looking at data about amphibians, reptiles, and mammals that lived during the Cretaceous Period, can you determine what percentage of amphibians survived the extinction?

Solution

1. This is what you know:

<table>
<thead>
<tr>
<th>Animal Type</th>
<th>Groups Living Before Extinction Event ((n))</th>
<th>Groups Left After Extinction Event ((t))</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amphibians</td>
<td>12</td>
<td>4</td>
</tr>
<tr>
<td>Reptiles</td>
<td>63</td>
<td>30</td>
</tr>
<tr>
<td>Mammals</td>
<td>24</td>
<td>8</td>
</tr>
</tbody>
</table>

2. This is what you need to find out:
   \[ p = \text{the percentage of amphibian groups that survived the Cretaceous extinction} \]

3. This is the equation you need to use:
   \[ p = \frac{t}{n} \times 100 \]
   Both \( t \) and \( n \) are shown on the above chart.

4. Substitute the known values:
   \[ p = \frac{4}{12} \times 100 = 33.3\% \]

Practice Problem

Using the same equation, calculate the percentage of reptiles and then the percentage of mammals that survived. Which type of animal was least affected by the extinction?

For more help, refer to the Math Skill Handbook.
The Cenozoic Era

The Cenozoic (sen uh ZOH ihk) Era, or era of recent life, began about 65 million years ago and continues today. Many mountain ranges in North and South America and Europe began to form in the Cenozoic Era. In the late Cenozoic, the climate became much cooler and ice ages occurred. The Cenozoic Era is subdivided into two periods. The first of these is the Tertiary Period. The present-day period is the Quaternary Period. It began about 1.8 million years ago.

Reading Check What happened to the climate during the late Cenozoic Era?

Times of Mountain Building Many mountain ranges formed during the Cenozoic Era. These include the Alps in Europe and the Andes in South America. The Himalaya, shown in Figure 24, formed as India moved northward and collided with Asia. The collision crumpled and thickened Earth’s crust, raising the highest mountains presently on Earth. Many people think the growth of these mountains has helped create cooler climates worldwide.

Figure 24
A The Himalaya extend along the India-Tibet border and contain some of the world’s tallest mountains. B India drifted north and finally collided with Asia, forming the Himalaya.
Further Evolution of Mammals

Throughout much of the Cenozoic Era, expanding grasslands favored grazing plant eaters like horses, camels, deer, and some elephants. Many kinds of mammals became larger. Horses evolved from small, multi-toed animals into the large, hoofed animals of today. However, not all mammals remained on land. Ancestors of the present-day whales and dolphins evolved to make their lives in the sea.

As Australia and South America separated from Antarctica during the continuing breakup of the continents, many species became isolated. They evolved separately from life-forms in other parts of the world. Evidence of this can be seen today in Australia’s marsupials. Marsupials are mammals such as kangaroos, koalas, and wombats (shown in Figure 25) that carry their young in a pouch.

Your species, Homo sapiens, probably appeared about 140,000 years ago. Some people suggest that the appearance of humans could have led to the extinction of many other mammals. As their numbers grew, humans competed for food that other animals relied upon. Also, fossil bones and other evidence indicate that early humans were hunters.

Figure 25
The wombat is one of many Australian marsupials. As a result of human activities, the number and range of wombats have diminished.

Section 3 Assessment

1. In which era, period, and epoch did Homo sapiens first appear?
2. Did mammals become more or less abundant after the extinction of the dinosaurs? Explain why.
3. How did the development of seeds with a hard outer covering enable angiosperms to survive in a wide variety of climates?
4. Give two reasons why some paleontologists hypothesize that dinosaurs were warm-blooded animals.
5. Think Critically How could two species that evolved on separate continents have many similarities?
6. Researching Information Arrange these organisms in sequence according to when they first appeared on Earth: mammals, reptiles, dinosaurs, fish, angiosperms, birds, insects, amphibians, land plants, and bacteria. For more help, refer to the Science Skill Handbook.
7. Converting Units A fossil mosasaur, a giant marine reptile, measured 9 m in length and had a skull that measured 45 cm in length. What fraction of the mosasaur’s total length did the skull account for? Compare your length with the mosasaur’s length. For more help, refer to the Math Skill Handbook.