

GEOLOGICAL ERAS: INTRODUCTION FOR THE TEACHER

Precambrian Era: 4.5 billion - 570 million years ago

Concepts

1. Geological evidence indicates the beginning of life on the earth about 3.7 billion years ago.
2. Fossil records show the first evidences of life were bacteria living in shallow waters.

Background Information

The geological history of life from the Precambrian Era is meager. There are indications that life was rather abundant; however, the fossil remains are limited. It is thought that the metamorphism of the rocks and the diastrophism of the earth's crust destroyed many of the simple fossils formed during the early years of the Precambrian Era. Some of the most ancient fossils found are those of simple, aquatic bacteria. The calcareous algae were microscopic fossils in chert. Rocks from the latter part of the Precambrian Era have fossils of sponge spicules, jellyfish, and worm burrows. Chemical geologists have also identified carbon deposits of organic origin.

For Further Study

1. Find out about the fossil bacteria recently found in Precambrian rocks.
2. Find out about the formation of ore deposits during the Precambrian Era.

Paleozoic Era: 570 million - 250 million years ago

Cambrian Period, Ordovician Period, Silurian Period, Devonian Period

Concepts

1. The early periods of the Paleozoic Era are noted for their diverse invertebrate fauna.
2. Aquatic forms evolved into terrestrial forms.

Background Information

The fossil remains of the Paleozoic are very abundant from the Cambrian Period on (570,000,000 - 510,000,000 years ago). Ancient life on earth was marine. The warm, shallow seas teemed with invertebrate fauna. Many of these early creatures had rigid body parts or shell structures. These hard portions preserved well as fossils. A study of these fossils has extended our knowledge of life in the distant past.

The ocean shores of the Cambrian Period would have revealed many shells of brachiopods. These animals have two shells (valves) unequal in size. The adult form is attached to submerged objects and feeds on organic matter strained from the water. Another abundant creature of the sea was the trilobite. These crustaceans had a three-segmented body. The many legs enabled the animal to crawl on the sea bottom and up onto wet, sandy beaches.

A very interesting echinoderm made its appearance in the Ordovician Period (510,000,000 - 440,000,000 years ago). The crinoids are animals that look like plants. Crinoid is a Greek word meaning 'sea lily'. The 'stem' is actually a supporting column. The 'flower-head' is the structure holding the creature's vital organs and the feathery arms that serve to gather food. The most common parts

of the crinoid to be found as fossils are the segments of the supporting column or 'stem'. Modern cephalopods include the squid, octopus, and cuttlefish. In the Ordovician Period, a shelled animal evolved that was the ancestor of the modern forms. It had a tapering shell with tentacles protruding from the opening. The cephalopod became very abundant with some species reaching a length of 15 feet, so that the cephalopods became the rulers of the sea. The first vertebrate, a primitive fish, also came into existence during this period. They were small in size and possessed heavy dermal armor of bony plates.

Solitary and colonial corals were found beginning in the Silurian Period (440,000,000 - 410,000,000 years ago). The corals secrete a rigid external skeleton usually of calcium carbonate. Crinoids became very abundant. The first land invertebrate, a scorpion-like creature, appeared, as did millipedes.

The Devonian Period is marked by a diversity of fauna and flora. The period is often referred to as the 'Age of Fishes' due to their extreme abundance in the seas. Sharks and lung fish developed and from the latter evolved the primitive amphibians. The early amphibians were long-bodied creatures with short, stubby legs, and long tails. These were the first vertebrates to leave the water and take up a more or less permanent residence on land. Invertebrate land life also rapidly developed - spiders and land snails. While animal life was becoming abundant and diverse, the plant life was also developing. Primitive land plants were widespread. Many of the plants first inhabited swamps and low, wet regions in river valleys.

For Further Study

1. Find out about the early amphibians.
2. Find out about early Paleozoic Era fossils in your area.

3. Find out about trilobites.
3. Find out about the various types of primitive fishes such as crossopterygians and the lung fish.
4. Find out how salt deposits were formed during the Silurian Period.

Paleozoic Era - Carboniferous (Mississippian, Pennsylvanian), Permian

Concepts

1. The Carboniferous and Permian Periods are the two latest periods of the Paleozoic Era.
2. Each period varied in duration and had distinct natural occurrences.
3. The Mississippian and Pennsylvanian Periods are often referred to as the Carboniferous Period.
4. Vast swamplands are characteristic of these periods.

Background Information

The Mississippian and Pennsylvanian Periods are often called collectively the Carboniferous Period because of the predominance of coal forming swamps.

The Mississippian Period began about 355,000,000 years ago and lasted about 35,000,000 years. During this period, most of the Mississippi Valley was covered by water, causing warm swamplands that supported different forms of life: plants, insects, and amphibians that flourished. Typical invertebrates included crinoids, blastoids, spiny brachiopods, and ammonites. The 'corkscrew' and 'lacetype' byzoa were abundant. Sharks known as 'shell crushers' were a distinct form of vertebrates. A wide variety of land plants thrived in thick swamp-forests - scale trees, huge mosses and ferns, scouring rushes, and seed ferns. Species of these

plants are referred to as typical coal-producing plants of Carboniferous times.

The Pennsylvanian Period began about 320,000,000 years ago and lasted about 30,000,000 years. The Pennsylvanian Period was much like the Mississippian. However, it is marked by the greater development of land organisms. The Pennsylvanian Period is famous for its formation of vast coal deposits. Within the dense, dank swamp-forests of this period, a wide variety of animal life thrived. Centipedes, spiders, scorpions, snails, and primitive insects such as the dragonfly and cockroach flourished. Dragonflies with wingspreads of 29 inches and cockroaches 3 to 4 inches long were common. A noteworthy event of the Pennsylvanian Period was the appearance of the first reptiles. For the first time, there was evidence showing an abundance and variety of animals living on land. This land would undergo a drastic change in the Permian Period.

The Carboniferous Swamp

During the Mississippian Period the world climate was generally warm with heavy rainfall. There were large areas of lowlands covered with shallow water. These swamps supported luxuriant vegetation. The tree ferns were seed-bearing plants. Other trees were spore-bearing, such as spore trees, and scale trees.

The tree ferns resembled in form some of our modern forest-floor ferns. However, some species were quite large, being 30 feet tall. One of the most abundant species was the scale tree. These specimens were giant plants, often over a hundred feet tall having base diameters of nearly four feet. The scale-like leaves of the scale tree grew directly from the trunk and the branches. The leaves

were shed throughout the year leaving a distinct leaf scar.

The giant rushes would look somewhat familiar to us in present times. They were structurally identical to the horsetail rushes of today except for their very large size. The cordaites were ancestors of our modern gymnosperms, the conifers. They grew to a height of fifty feet.

The carboniferous swamps were the habitats of the primitive amphibians and insects. Geological evidence indicates that at their peak the carboniferous swamps extended into the Arctic and Antarctic regions. During both the Mississippian and Pennsylvanian Periods, the seas invaded the swamps periodically. The submerged vegetation formed massive layers of debris.

During the later portion of the Pennsylvanian Period, the climate became cooler and the vast swamps declined. The plant material became compressed as it was buried under layers and layers of sediment. Slowly, the organic material was converted to coal. It has been estimated that about twenty feet of uncompressed vegetative debris was required to form one foot of bituminous coal. In some of the coal fields there are beds more than sixty feet thick, giving evidence of the luxuriance of these ancient swamplands.

For Further Study

1. Find out about plant fossils in coal beds.
2. Find out where the coal fields are found in the United States.

3. Find out about the seed fern trees.

The Permian Period began about 290,000,000 years ago and lasted about 40,000,000 years. Geographic and climatic changes in this period had a marked effect on plant and animal life. There were alternating periods of heat and cold, humidity and aridity. Land upheavals, desert formation, mountain building, and glaciation all had an effect on life during the Permian Period. Many species of plant and animal life became extinct - carboniferous plants, trilobites, eurypterids, blastoids, and others. The greatest extinction in the history of the earth resulted in about 96% of all species disappearing.

During the Permian Period, geological changes caused the elimination of many swamps and of shallow marine waters. The reptiles diversified and became the main land vertebrates. Some modern forms of insects developed.

New plant species appeared (cone-bearers), marine animal species expanded (ammonoids, cephalopods, and gastropods), and amphibians and reptiles continued to flourish. Fin-backed reptiles were common, such as *Dimetrodon*. Early ancestors of mammals, Thecodonts, were present at this time. The close of the Permian Period brought an end to the Paleozoic Era.

For Further Study

1. Find out about the formation of the Appalachian Mountains.
2. Find out about the life and work of William Smith (1679-1835), father of English geology.
3. Find out about the formation of the Ural Mountains.

4. Find out about Pangaea.

Mesozoic Era: 250 million - 65 million years ago

Concepts

1. The Mesozoic Era was a dramatic period in the history of life development.

Background Information

The Mesozoic Era is often referred to as the 'Age of Reptiles' or 'Age of Dinosaurs'. The reptiles were very abundant and became the dominant land vertebrates. They exhibited a great diversity of form from small chicken-sized creatures to huge beasts such as the *Brachiosaurus*. The dinosaurs inhabited both the land and seas and some forms developed into flying creatures. Among the various dinosaurs were carnivores and herbivores.

Early in the Mesozoic Era, the conifers had their origin. The petrified forests of Arizona give evidence of the large size of these early conifers. Plant life was abundant and widespread, possibly due to the warm climate. During the Cretaceous Period the hardwood trees developed as did the flowering plants. The mammals and birds made a modest beginning in the Jurassic. It was also during the Jurassic Period that almost all of the modern forms of insects appeared. At the end of the Mesozoic, the dinosaurs became extinct. Climatic changes were caused by a large asteroid striking the earth, and forming thick layers of dust that prevented sunlight from reaching the earth for many years. Many species of plants died and then animals died.

For Further Study

1. Find out about Mesozoic Era fossils found in your state.
2. Find out from where the periods of geological history derive their names.

3. Find out about the formation of the Rocky Mountains.

Mesozoic Era - Triassic Period

Concepts

1. The Triassic Period is the first of three periods of the Mesozoic Era.
2. Many new species of land and marine animals appeared in this period.

Background Information

Mesozoic or 'middle life' refers to the vast period of time between primitive life and times of the Paleozoic Era and the more modern life and times of the Cenozoic Era. The first period of the Mesozoic Era is the Triassic Period. It began about 250,000,000 years ago and lasted about 45,000,000 years.

Plant and animal life differed from the preceding Paleozoic Periods. Dominant examples of plant life in the Triassic Period were the conifers, broadleaf ferns, and cycads. Examples of common marine invertebrates were gastropods, pelecypods, crustaceans, and ammonites. Reef-building corals were starting to form present-day coral reefs throughout the world.

Vertebrates continued to make rapid gains in numbers and in the development of different species. Sharks and bony fishes were common in marine areas; reptiles were fast becoming the dominant form of life among the vertebrates. Phytosaurs, semi-aquatic animals resembling crocodiles, were very common. Early dinosaurs were small at this time compared to the 'giants' of later periods. Triassic dinosaurs were slender of build, and few species reached a length of more than 10 to 15 feet. Most were bipedal and shaped like a kangaroo with powerful hind legs and a thick powerful tail used for balancing. It is believed that these dinosaurs ran like an ostrich instead of leaping about. One of the largest

dinosaurs of this period, *Plateosaurus*, was about 20 feet long; one of the smallest dinosaurs, *Podokesaurus*, was about 3 feet long. An early mammal-like reptile of the Triassic Period was the *Cynognathus*. Fossil remains of this animal, chiefly teeth and jaw fragments, provide evidence of distinct mammalian characteristics.

For Further Study

1. Find out about other mammal-like reptiles-*Thrinacodon*, *Placerias*.
2. Find out about belemnoids.
3. Find out about 'lizard-hip' dinosaurs (Saurischians), and 'bird-hip' dinosaurs (Ornithischians).

Mesozoic Era - Jurassic Period

Concepts

1. Plant and animal life flourished during the Jurassic Period.
2. This period is famous for many its unusual reptiles, especially dinosaurs.

Background Information

The Jurassic Period began about 205,000,000 years ago and lasted about 70,000,000 years. The climate during this period appeared to be mild throughout the world, with only a few desert-like areas. Plant and animal life flourished everywhere, on the land, in the water, and in the air. The lush Jurassic forests consisted of pines, conifers, ferns, gingkos, scouring rushes, and cycads. In fact, cycads were so abundant that this period is often called the 'Age of Cycads'.