

# Important Dates and Cool Creatures in Earth History



Numbers shown for eons, periods, and epochs in the following list are in millions of years before the present, and are based on the [International Stratigraphic Commission's 2003 time chart](#). Eons are the largest subdivisions of time, then periods, then epochs. Relative ages of important dates and creatures are also in millions of years before the present.

*List compiled by Stephen Greb, Kentucky Geological Survey*

## Hadean time

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### **(Beginning of Precambrian time)**

- 4,600 Beginning of the Earth based on data from meteorites.

## Archean Eon (From oldest rocks on earth to 2,500 million years ago)

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- 3,800 Oldest age-dated rocks on the present surface of the Earth.
- 3,500 Fossil evidence of cyanobacteria, also called blue-green algae. These cellular organisms lived in large mounds, called stromatolites. Stromatolites dominated the world for the next 2 and a half billion years.

## Proterozoic Eon (2,500 to 542 million years ago)

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### **(latter part of Precambrian time)**

- 1,750 Oldest fossil evidence of single-celled life with a nucleus (eukaryotes).
- 1,500 The oldest multi-celled (metazoan) organisms, based on fossils, were algae.
- 670 Ediacara fossil site. Famous locality in Australia, in which soft-body impressions of primitive marine invertebrate (lacking a backbone) life is preserved. Oldest fossil evidence of marine worms and jellyfish.

## Phanerozoic Eon (542 million years ago to the present)

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## Paleozoic Era (542 million to 245 million years ago)

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### **Cambrian Period (542 to 488 million years ago)**

- 542 Abundant fossil evidence of invertebrate life throughout the world, sometimes termed the “Cambrian Explosion” because of the sudden appearance of diverse fossils in rocks of this age. Brachiopods, corals, sea snails, and many types of arthropods, including trilobites were common.
- 530 Oldest fossil vertebrates, which are also the oldest fossil fish. The fossil *Myllokunmingia* was found in China. It was a small fish, about the size of a sardine, but had no jaws.
- 515 Burgess Shale organisms. Famous fossil locality in Canada in which soft parts of marine invertebrate organisms were preserved. Sponges and trilobites were common. The top predator in the world was a 2-foot long marine arthropod called *Anomalocaris* , from the Burgess Shale.

### Ordovician Period (488 to 443 million years ago)

- 488 Invertebrate (no backbone) fossils of sea life are common in Ordovician rocks because much of North America was covered with shallow seas. Trilobites and brachiopods were still common. Cephalopods, which were squids that lived in long shells, became common.
- 480 Taconic mountain-building event in eastern North America. Formed an early mountain chain in what is now the Appalachians, but prior to the Appalachian mountains we know today. This mountain-building event lasted for 40 million years.
- 470 Oldest fossil evidence of land plants. The first plants looked like lichen.
- 440 End-Ordovician mass extinction. Continental glaciation in the southern hemisphere triggered global climate changes and falling sea levels, which caused global extinctions. An estimated 60% of life went extinct.

### Silurian Period (443 to 416 million years ago)

- 438 Large coral reefs flourished and coral fossils are common.
- 428 Oldest fossil evidence of vascular land plants, *Cooksonia* . Vascular plants have internal tissues for exchanging liquids and gases. Vascular tissue also provides internal support so plants could begin to grow up off of the ground. These primitive plants had no leaves and were less than an inch (1-2 cm) tall.
- 428 Oldest fossil land animal, the millipede *Pneumodesmus* from Scotland. Scorpions also lived on land by the late Silurian.
- 419 Eurypterids (called “sea scorpions”) were common from the late Silurian into the Devonian. The largest was *Pterygotus* from New York, which grew to nearly 6 ft in length.

### Devonian Period (416 to 359 million years ago)

- 416 The Devonian is called “The Age of Fishes.” Many different types of strange-looking fish became widespread.
- 412 Oldest fossil insect, *Rhyniognatha*, from Scotland. The earliest insects were small springtails, also called bristletails. *Rhyniognatha* has what have been interpreted as support structures for wings, which means that it may have been able to fly, although no wings were found on the fossil.
- 412 Approximate age of oldest lungfish (dipnoans). The fossil *Powichthys* (a proto-lungfish) from North America, and *Youngolepis* and *Diabolepis* from South China are all from the Early Devonian.
- 410 Acadian mountain building on the eastern coast of North America, formed another mountain system in what is now the Appalachians. This mountain-building event lasted for 30 million years.
- 409 Oldest fossil shark, *Doliodus* from New Brunswick, Canada. These ancient sharks had spines that stuck out of their back in front of their pectoral fin.
- 400 Coral fossils are common, especially horn corals. Many animals lived among the corals including bony fish called arthrodiras.
- 395 Rhynie Chert fossil Beds. This famous fossil locality includes preservation of primitive land plants and small arthropods (crustaceans and spider-like trigonotarbid) that were living and dieing in a geyser basin.

- 380 Oldest fossil large trees and therefore, forests. Fossil trunks of the tree *Eospermatopteris* are known from Gilboa, New York. Spider-like trigonotarbid, centipedes, spiders, mites, and wingless insects are also known from this site.
- 380 Oldest fossil spider, *Attercopus fimbriungus*, from the Devonian
- 375 Oldest fossil amphibian, *Acanthostega*, from Greenland. Also, the oldest evidence of land vertebrates.
- 375 Oldest fossil trees with bark (woody tissue) and leaves, *Archaeopteris*, eastern North America. The deep roots of forest trees changed the Devonian land landscape, by promoting soil formation, stabilizing the ground, and increasing photosynthesis, which changed the earth's carbon cycle, which may have led to another glaciation.
- 370 Armored fish called arthodires ruled the seas. The largest, *Dunkeosteus*, grew to lengths of 25 feet. Their heads were covered with bony armor and at their mouths the bony armor had large, hook-like protrusions that acted as teeth.
- 360 End-Devonian mass extinction. Another period of continental glaciation in the southern hemisphere triggered global climate changes and falling sea levels, which caused global extinctions. An estimated 70% of life went extinct.

## **Carboniferous Period (European term which equals the combined Mississippian and Pennsylvanian Periods in the United States)**

### **Mississippian Period (359 to 318 million years ago)**

- 359 Corals and crinoid fossils are common.
- 330 Oldest fossil evidence of conifers, seed-bearing plants with cones.
- 330 East Kirkton fossil site, England. This famous fossil site included the bones of many fish, lungfish, amphibians, and a reptile-like animal, once thought to be the oldest reptile.

### **Pennsylvanian Period (318 to 299 million years ago)**

- 318 Equatorial swamps were common in eastern North America and Europe, somewhat similar to the Everglades today. Common fossils include plant fossils like ferns, reeds like *Calamites*, and large swamp trees called *lycopods*. This is when most of eastern United States bituminous coal was formed.
- 315 Oldest fossil evidence of reptiles. *Hylonomus* was a small lizard-like reptile that was trapped in the trunk of a swamp tree in what is now Nova Scotia, Canada.
- 315 The largest land-arthropod of all time, *Arthropleura*, a 5 ft (3.8 m) long, millipede-like giant, which lived in the same swamps. Giant dragonfly-like insects were also common.
- 315 Oldest evidence of flying insects (unless Devonian *Rhyniognatha* had wings) Fossil wings on giant mayflies, dragonflies, and dragonfly-like arthropods make these the oldest definite evidence of flight in nature.
- 315 Alleghenian mountain building. This mountain-building event resulted from the collision of what is now Europe with eastern North America. The event lasted through the Permian, and formed the Appalachian mountains in eastern North America.

### **Permian Period (299 to 251 million years ago)**

- 299 During the Permian, many of the earth's continents began to collide. Global climates were dryer. Mammal-like reptiles, called synapsids, became the dominant large land animals. Sail-backed synapsid reptiles like *Dimetrodon* and *Edaphosaurus* are characteristic. They may have used their sails for display to attract a boyfriend or girlfriend, or for controlling their body temperature.
- 270 *Glossopteris* trees become the dominant vegetation on the southern continents, their fossils provide evidence that they were connected.

- 260 Karoo Basin fossils from South Africa include a wide array of large land reptiles, including the dicynodonts. The largest Permian animal was *Moschops* , a 16 ft-long mammal-like synapsid reptile from South Africa .
- 251 A long history of continental collision result in the formation of the supercontinent, Pangea, which stretches nearly from the North to South Pole.
- 251 The End-Permian, also called the End-Paleozoic Extinction. The greatest mass extinction of all time. More than 90% percent of all life went extinct. Giant lava flows pored out of what is now Siberia and continental collisions destroyed many shallow marine areas.

## Mesozoic Era "Age of Reptiles" (251 to 65.5 million years ago)

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### Triassic Period (251 to 199 million years ago)

- 251 Life hangs on after the mass extinction. One hold-over, the synapsid dicynodont *Lystrosaurus* , is found on many continents and provides evidence that the continents were connected.
- 245 Reptiles diversify. Archosaurs (“ruling reptiles”) take to the air, sea, and land. One type of archosaur that was especially widespread in the Triassic were the thecodonts, a group of reptiles that were the ancestors of dinosaurs.
- 228 Oldest dinosaur fossil. *Eoraptor* was found in South America. This little dinosaur was a cat-sized meat eater.
- 225 Dinosaurs diversify. *Fabrosaurus* , *Lesothosaurus* , and *Saltoposuchus* are examples of early dinosaurs.
- 225 In the seas, dolphin-like marine reptiles called ichthyosaurs were common. *Shonisaurus* , from Nevada , was the largest, measuring 55 ft in length.
- 221 Oldest mammal fossils (they looked like shrews). Mammals remained small throughout the Mesozoic.
- 220 Petrified Forest National Park fossils contain a wide array of Triassic plant and animal life including the largest predatory animal of the day, the archosaur *Postosuchus*.
- 216 Dinosaurs continue to diversify. *Coelophysis* is an example from the American southwest. The oldest, large dinosaur fossil is *Plateosaurus* . Plateosaurs were the ancestors of the long-necked (sauropod) dinosaurs. They were called prosauropods.
- 210 Oldest turtle fossil, *Proganochelys*.
- 199 End-Triassic mass extinction. There appears to have been dramatic climate changes, which may have caused the extinctions. Large outpourings of lava from the break-up of Pangea, may have been a cause for the climate change. More than 50% of life, including all thecodonts and synapsids, went extinct.

### Jurassic Period (199 to 145.5 million years ago)

- 200 After the extinction, dinosaurs become the dominant large land animals.
- 195 *Dilophosaurus* is a good example of an early Jurassic dinosaur. It had twin bony crests on the top of its head, and was 20 ft long. This is much larger than it was shown to be in the Jurassic Park movies. Also, there is no evidence that it spit poison, as shown in the movies.
- 155 The oldest bird, *Archeopteryx* from the Solenhofen Limestone of Germany. This bird had many dinosaur characteristics, including a long tail, and reptile-like jaws with teeth. The same limestone contains fossils of dinosaurs and marine reptiles, including ichthyosaurs preserved with their babies.
- 150 Large, long-necked (sauropod) dinosaurs dominate the landscape. *Apatosaurus*, *Brachiosaurus*, and *Diplodocus* are good examples of late Jurassic long-necked dinosaurs. All are found in the western United States.

- 150 *Seismosaurus* was one of the longest long-necked (sauropod) dinosaurs, and possibly the largest land animal of all time, with an estimated length of 125 feet.
- 150 *Allosaurus* and *Centrosaurus* are good examples of late Jurassic meat-eating (theropod) dinosaurs from the western United States. At 25 feet in length, *Allosaurus* was the largest meat eater of the Jurassic, which has led to it being called the “lion of the Jurassic.”
- 150 *Stegosaurus* was an armored, plant-eating dinosaur that shared the floodplains of the Western United States with *Allosaurus* and *Diplodocus*. *Stegosaurus* had sharp spikes on its tail and large bony plates on its back. The plates may have been used for display or for controlling its body temperature.
- 149 *Liopleurodon* was a giant marine reptile called a pliosaur, which lived in the Jurassic seas of Europe. *Liopleurodon* was the largest carnivorous (meat-eating) animal of all time.

### **Cretaceous Period (145.5 to 65.5 million years ago)**

- 142 Oldest flowering plants (angiosperms). Angiosperms are seed plants that dominate the world today (deciduous trees, grasses, etc.). The oldest, *Archaeofructus* was a submerged wetland plant, found in China. By the mid-Cretaceous (120 to 130 million years) lily pads, *Nypa* palms, and magnolias had developed.
- 110 *Sauroposiedon* , a long-neck (sauropod) brachiosaur from Oklahoma , possibly the tallest animal of all time, at an estimated height of 60 feet.
- 105 *Argentinosaurus* , a long-neck (sauropod) titanosaur from South America, possibly the longest animal of all time, at an estimated 130 to 140 feet length.
- 100 *Carnotaurus* , a horned, meat-eating (theropod) dinosaur from South America , shown in Disney's Dinosaur movie. The fossil includes skin impressions of its face.
- 95 *Spinosaurus* was perhaps the largest meat-eating dinosaur, estimated to have been 45 to 50 feet long. It lived in Africa and may have used the 6-foot sail on its back for display (to attract a boyfriend or girlfriend) or to help this giant animal control its temperature. The only skeleton ever found was destroyed during World War 2.
- 84 Beginning of Laramide mountain-building in the western United States, which led to the formation of the Rocky Mountains. This mountain-building continued for more than 30 million years.
- 82 Duck-billed dinosaurs (hadrosaurs) were common like *Corythyosaurus* , *Edmontosaurus* , *Lambeosaurus* , *Maiasaurus* , and *Parasaurolophus* . Maiasaurs are examples of dinosaurs from which fossil nests, eggs, and baby dinosaurs have been found.
- 80 *Protoceratops* was an early shield-headed (ceratopsian) dinosaur. It was the first dinosaur discovered with fossil eggs. These eggs and nests were found in Mongolia in the 1920's.
- 80 Raptors (dromaeosaurs) are famous Cretaceous dinosaurs, which had large, hook claws on their feet. *Velociraptor* is the most famous because of the Jurassic Park movies, although the actual dinosaurs were much smaller than shown in the movies; about 3 feet high at the hip and 5 to 6 feet in length. The most famous *Velociraptor* is a skeleton preserved in combat with a *Protoceratops* from Mongolia, China.
- 75 Ceratopsian (shield-headed) dinosaurs were common in the late Cretaceous. Examples are *Monoclonius* , and *Styrakosaurus* . *Triceratops*, which lived at the end of Cretaceous, was the largest of its kind, reaching 30 feet in length. .
- 70 Two of the largest (longest, tallest, and heaviest) meat-eating dinosaurs of all time (which also makes them the largest land-dwelling carnivores of all time) lived at the end of the Cretaceous. In North America, *Tyrannosaurus rex* was king, in South America *Giganotosaurus* ruled. Both were 45-50 feet long.
- 70 The armored ankylosaurs (shield back and/or club tails) become the most heavily armored land-animals of all time. These plant-eating tanks were as much as 25 feet in length, but built low to the ground for optimal protection. Many had spikes that stuck out from their bone-covered back. *Ankylosaurus* even had bony plates on its eyelids!
- 70 Giant marine reptiles ruled the inland seas throughout the Mesozoic but toward the end of the Cretaceous they were home to the largest turtle of all time, *Archelon*, which was 12 ft long. Mososaurs, a type of sea serpent, hunted the turtles and grew to 75 ft in length!

- 65 Pterosaurs, the flying reptiles of the Mesozoic reached their largest size with *Quetzalcoatlus*, which had a wing span of 40 ft. This was the largest flying animal of all time.
- 65.5 End-Cretaceous mass extinction. This extinction is also called the K-T extinction for the Cretaceous-Tertiary extinction (Cretaceous is spelled Kretaceous, hence “K” in German and Latin). Huge amounts of lava erupted from India, and a comet or meteor collided with the Earth in what is now the Yucatan Peninsula of Mexico. No large animals survived on land, in the air, or in the sea.

## Cenozoic Era "Age of Mammals" (65.5 million years ago to the present)

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**Tertiary Period (65.5 to 1.81 million years ago).** *In Europe the beginning of the Cenozoic Era is called the Paleogene Period (65.5 to 23.03 million years ago)*

### Paleocene Epoch (65.5 to 55.8 million years ago)

- 65 Rapid increase in new species of fossil mammals after the extinction of the dinosaurs. Most early Cenozoic mammal fossils are small.
- 60 In South America, the Andes mountain chain began to form.
- 60 Oldest fossil rodents.
- 60 The creodonts, cat-like predators, including *Oxyaena*, from North America, were common.
- 57 Oldest hooved mammals, the condylarths, from North America. These were the ancestors of all hooved animals including pigs, deer, and cattle.
- 57 *Coryphodon*, a pantodont, was the largest Paleocene mammal.

### Eocene Epoch (55.8 to 33.9 million years ago)

- 55 Oldest (definite) fossil primates, *Teilhardina*, from Europe, North America, and Asia.
- 55 The unitatheres, like *Unitatherium*, became the largest land animals.
- 55 Oldest fossil horse, *Hyracotherium*, the oldest horse was tiny, about the size of a dog).
- 50 Oldest fossil elephants, an unnamed fossil from Algeria.
- 50 Green River Formation fossils from the western United States. This is where many of the fossil fish sold in stores come from.
- 50 India collided with Eurasia, resulting in the formation of the Himalayan mountains. This mountain-building event continued for millions of years.
- 49 Messel Quarry fossils from Germany. This famous fossil site was a lake in which many early Tertiary mammals died, including primitive horses and the oldest fossil bats. Many reptiles, amphibians, and fish also perished in the lake. A large otter-like animal from the Messel shales, called *Ambulocetus*, may be the ancestor of whales.
- 49 The largest meat-eating land animals of the Paleocene and Eocene epochs were flightless birds, like *Diatryma* from America, and *Gastornis* from Europe.
- 40 In Europe, the Alpine mountain chain began to form. This mountain-building episode lasted for millions of years.
- 40 Mid-Eocene weasel-like fossils of *Miacis*, the ancestor of dogs and bears.
- 37 Oldest fossil dog, the weasel-like *Hesperocyon*.

### Oligocene Epoch (33.9 to 23.03 million years ago)

- 30 *Indricotherium* was the largest land mammal of all time. It stood 18 feet high at the shoulder and lived in India.
- 30 Oligocene and Miocene mammal fossils are abundant from the Badlands of South Dakota. Some of the Oligocene mammals included brontotheres, rhinos, horses, creodonts, and camels.

- 25 Oldest fossil cat, *Proailurus*.

***In Europe, the latter part of the Cenozoic is called the Neogene Period (23.03 to the present)***

### **Miocene Epoch (23.03 to 5.33 million years ago)**

- 20 Grasslands become widespread in the warmer, dry climates of the Miocene. It is hard for most people to imagine, but prior to the Miocene, ground cover was dominated by small ferns and other plants, rather than grasses.
- 15 The largest shark of all time, *Carcharodon megalodon* lived during the Miocene and Pliocene. It may have been 40 feet in length.

### **Pliocene Epoch (5.33 to 1.81 million years ago)**

- 5 The Pliocene was a time of global cooling, which led to ice build ups at the poles and culminated in the Ice Ages.
- 4 *Australopithecus*, the oldest hominid (human-like ancestors) fossils from Africa. Many different species from 4 million to 1.1 million years ago.
- 3 Closing of the isthmus of Panama and connection of North and South America through central America.
- 2.5 to 1.5 *Homo habilis*, a hominid from Africa that made crude spear points.
- 2.4 Arctic glaciation begins. For the next 2 million years ice sheets would advance and retreat across the northern continents.
- 2.4 Marks the beginning of what archeologists call the Paleolithic Age

### **Quaternary Period (1.81 million years ago to the present)**

#### **Pleistocene Epoch (1.81 to 0.015 million years ago)**

- 1.2 *Homo erectus*, the oldest evidence of hominids outside of Africa.
- 1.0 First of many ice ages in North America. Thick, glacial ice sheets covered the northern parts of North America. These are the great Ice Ages. Woolly mammoths, woolly rhinos, mastodons, ground sloths, and ice age buffalo roamed the plains in front of the advancing ice.
- 0.50 Neandertal man, *Homo sapiens neandertalis*. This Ice Age human lived in Europe during the Ice Age and went extinct approximately 35,000 years ago when the last continental glaciers retreated.
- 0.09 Cro-Magnon (modern) man, *Homo sapiens sapiens*, coexisted with neanderthals, but survives to the present day.
- 0.06 The last of the great North American Ice Ages (Wisconsinan) begins
- 0.05 Age uncertain, but close to the age of Ice Age mammoth, mastodon, ground sloth, and bison bones fossils at Big Bone Lick, Kentucky. Baron Georges Cuvier, a French scientist, used bones from Big Bone Lick as evidence for the theory of extinction. Benjamin Franklin and Thomas Jefferson also studied fossils from Big Bone Lick, Kentucky.
- 0.04 Sabre-tooth cats, mammoths, american lions, and dire wolves were trapped in the La Brea tar pits from 40,000 to 10,000 years ago, in what is now downtown Los Angeles, California.

#### **Holocene Epoch (0.015 million or 15,000 years ago to the present)**

- 0.01 Beginning of what archeologists term the Mesolithic Age
- 0.006 Beginning of what archeologists term the Neolithic Age