

# Time Line: Rise of Life

◀ BACK TO INTRO

4,600 m.y.a.

3,950 m.y.a.

2,300 m.y.a.

570 m.y.a.

PRECAMBRIAN

CAMBRIAN



Earth Forms



Hard-Sh



Oxygen Levels Rise



World's Oldest Rock Forms



m.y.a. = million years ago



⊕ ENLARGE

## Earth Forms

Earth was created between 4.5 and 4.6 billion years ago, when our solar system took shape around the sun. Born from exploding stars called supernovae, the new star gathered a swirling disk of dust and gases around it. As the sun heated up, this orbiting matter accumulated, and successively larger bodies collided to eventually create protoplanets with their own gravitational pull. The emerging Earth survived a massive interplanetary collision that threw up the moon. Heat generated by such bombardments,



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## World's Oldest Rock Forms

The world's oldest known rock structure represents early chunks of the Earth's crust made when molten lava rose from cracks in the seafloor. Discovered in western Greenland, these formations have been dated to 3.8 billion years ago. Rocks in the same area are also thought to record the first fossil traces of bacterial life. Similarly ancient formations have been identified in Canada and Australia. The earliest recorded minerals, from Western Australia, are 4,400-million-year-old zircon crystals, making them



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← BACK TO INTRO

y.a.

3,950 m.y.a.

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PRECAMBRIAN

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Earth Forms



Hard-Shelled Mollusks Appear



Oxygen Levels Rise



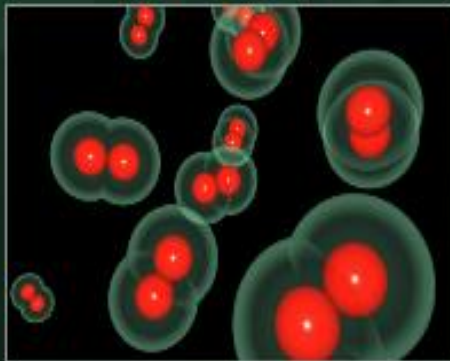
Earliest Vertebrates



World's Oldest Rock Forms



m.y.a. = million years ago



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## Oxygen Levels Rise

The Earth was a suffocating place until oxygen in the atmosphere slowly began to climb from almost nonexistent levels about 2.5 billion years ago. Breathable air is thought to have been created by cyanobacteria, single-celled microbes living in the sea. These bacteria harnessed the energy of the sun through photosynthesis—the biochemical process used by plants—producing oxygen as a by-product. The oxygen-rich ozone layer was also established, shielding the Earth's surface from harmful solar radiation.





# Time Line: Rise of Life

◀ BACK TO INTRO

2,300 m.y.a.

570 m.y.a.

500 m.y.a.

CAMBRIAN

ORDOVICIAN



Hard-Shelled Mollusks Appear



Earliest Fish Ev



Oxygen Levels Rise



Earliest Vertebrates Appear

ms

m.y.a. = million years ago



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## Hard-Shelled Mollusks Appear

Shelled mollusks show up in the fossil record 545 million years ago. The origins and earliest evolution of this diverse group, which includes clams, snails, squid, and octopuses, remain unclear. Among the first fossil specimens were the monoplacophorans—the ancestors of many shelled mollusks alive today. Thought to be descended from annelids, monoplacophorans lacked eyes and moved on a rounded foot under a simple, limpet-like shell. In Cambrian times, they inhabited warm, shallow

# Time Line: Rise of Life

◀ BACK TO INTRO

a.

570 m.y.a.

500 m.y.a.

435 m.y.a.

CAMBRIAN

ORDOVICIAN

SILURIAN



Hard-Shelled Mollusks Appear



Earliest Cartilaginous Fish Evolve

Oxygen Levels Rise



Earliest Vertebrates Appear



m.y.a. = million years ago



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## Earliest Vertebrates Appear

The earliest vertebrates (backboned animals that include mammals) were jawless fishes known as agnathans. The oldest vertebrate species were discovered in the 1990s in 530-million-year-old shale fossil beds in China, where scientists uncovered two types of tiny jawless fish they named *Haikouichthys* and *Mylokunmingia*. Previously, fish weren't thought to have arisen until some 50 million years later, well into the Ordovician period. Agnathan fishes were prominent in the seas until they gave rise to jawed fish,

# Time Line: Rise of Life

◀ BACK TO INTRO

500 m.y.a.

435 m.y.a.

410 m.y.a.

361

PALEOZOIC ERA

ORDOVICIAN

SILURIAN

DEVONIAN

Land Mollusks Appear



Earliest Cartilaginous Fish Evolve



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Earliest Vertebrates Appear



Spiders and Scorpions Head for Shore



Plants Take Root on Land



m.y.a. = million years ago



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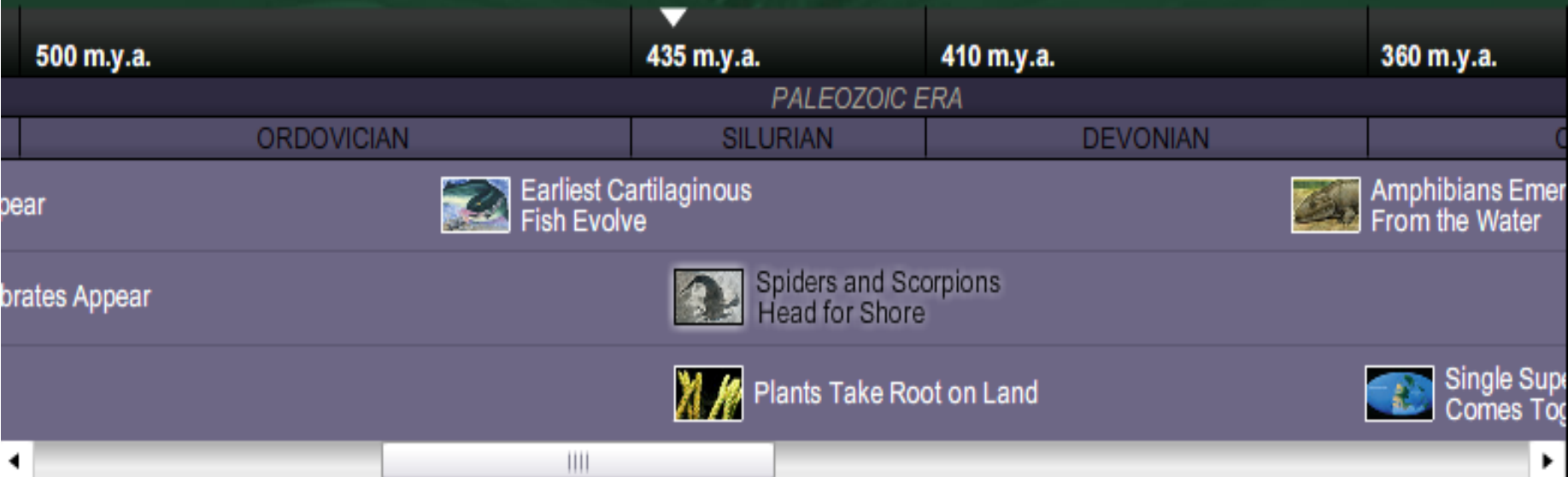
## Earliest Cartilaginous Fish Evolve

The ancestors of sharks first swam about 450 million years ago. Known as cartilaginous fish because their skeletons were made of cartilage, not bone, sharks and rays left very few early fossils. The oldest well-preserved specimen dates to 409 million years ago. Discovered in New Brunswick, Canada, *Doliodus* had spines on its pectoral fins and may have resembled a modern angel shark. *Cladoselache*, the first widespread fossil shark, grew up to six feet (two meters) long and hunted in waters off North America.



# Time Line: Rise of Life

◀ BACK TO INTRO



m.y.a. = million years ago



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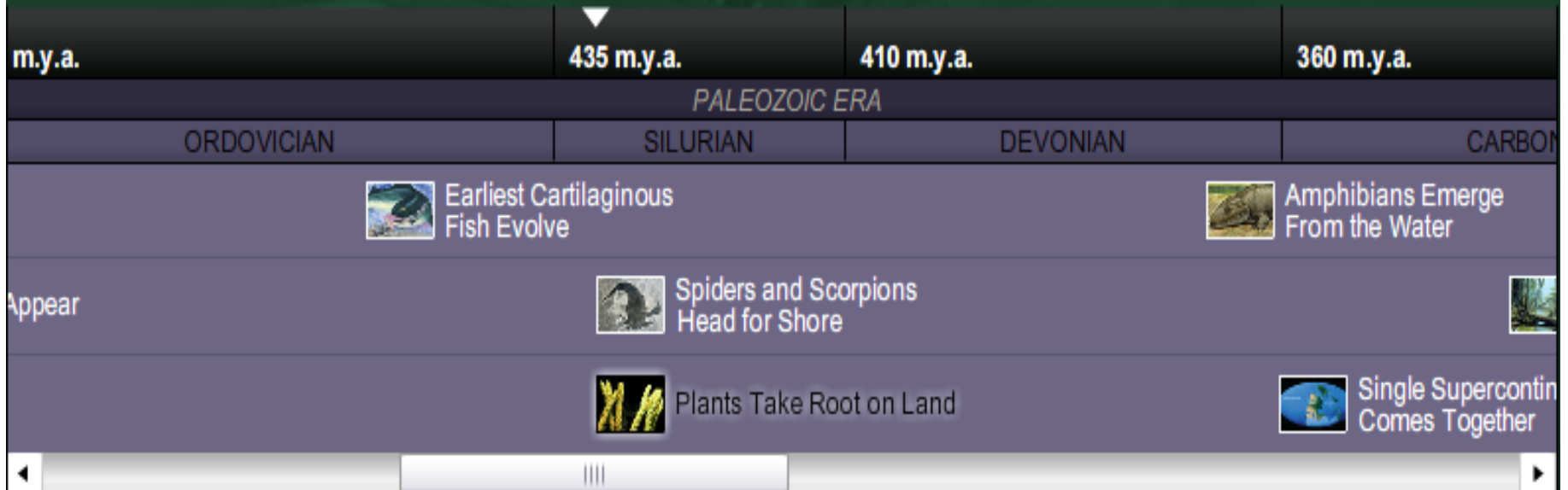
## Spiders and Scorpions Head for Shore

We know them on land today, but arachnids, a group that includes spiders, scorpions, and mites, started out in the sea. Scorpions are thought to be the oldest arachnids, appearing around 430 million years ago. Some marine species were huge, with one recently discovered fossil specimen estimated to be some 8.2 feet (2.5 meters) long. Scientists think this species, *Jaekelopterus rhenaniae*, was likely too large to have emerged from the water. But its smaller cousin, *Brontoscorpio*, which measured about



# Time Line: Rise of Life

← BACK TO INTRO



m.y.a. = million years ago



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## Plants Take Root on Land

Plants began to take root on land about 430 million years ago. The transition from water presented plants with a difficult evolutionary challenge. Their solution was a vascular system of tubelike tissues for transporting water and nutrients on dry land. Vascular plants also developed rigid stems for standing upright. The earliest species were confined to marshy ground, growing only to ankle height. One of the first known fossil examples was *Cooksonia*, which had leafless, branching stems with rounded spore



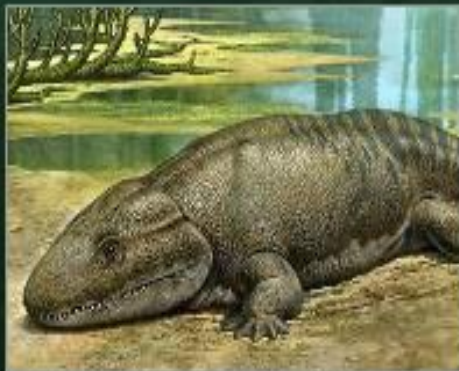


# Time Line: Rise of Life

◀ BACK TO INTRO



m.y.a. = million years ago



⊕ ENLARGE

## Amphibians Emerge From the Water

Amphibians started hauling themselves out of the water about 370 million years ago. The first vertebrates to walk on land, they evolved from air-breathing fish that waddled in the shallows on strong, limblike fins. So far, the closest fish candidate for the crossover animal identified is *Tiktaalik*. It had a crocodile-like head, as well as some features of land animals, such as ribs, a neck, and nostrils for taking in air. Proto-amphibians, such as *Elginerpeton*, probably had finned tails and breathed through simple lungs and their



# Time Line: Rise of Life

◀ BACK TO INTRO

410 m.y.a.

360 m.y.a.

290 m.y.a.

PALEOZOIC ERA

TRIASSIC

DEVONIAN

CARBONIFEROUS

PERMIAN



Amphibians Emerge From the Water

Insects and Scorpions lead for Shore



Coal-Forming Swamp Forests Flourish



Reptiles

Plants Take Root on Land



Single Supercontinent Comes Together



Earliest Reptiles Appear



m.y.a. = million years ago



⊕ ENLARGE

## Single Supercontinent Comes Together

During the Carboniferous, the Earth's major landmasses started coming together to create a single, vast supercontinent known as Pangaea. At the beginning of the period, most of the continents were already lumped

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# Time Line: Rise of Life

◀ BACK TO INTRO



and

m.y.a. = million years ago



⊕ ENLARGE

## Coal-Forming Swamp Forests Flourish

The Carboniferous period is named after its carbon-rich coal deposits formed from the remains of lush swamp forests that covered low-lying coastal regions. These forests had plenty of room to grow because sea levels

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# Time Line: Rise of Life

◀ BACK TO INTRO



*m.y.a. = million years ago*



⊕ ENLARGE

## Earliest Reptiles Appear

The earliest reptiles had evolved from amphibians by 300 million years ago. Known as anapsids, they outwardly resembled modern-day lizards, though there were key internal differences, including an amphibian-like skull that lacked holes except for the

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# Time Line: Rise of Life

◀ BACK TO INTRO



## Reptiles Take Over

The emerging supercontinent of Pangaea presented a hostile living environment, its vast, arid interior suffering huge daily temperature extremes. These conditions favored reptiles that could adapt to the dry conditions. Growing to large sizes, some



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m.y.a. = million years ago

# Time Line: Rise of Life

◀ BACK TO INTRO



m.y.a. = million years ago



ENLARGE

## Planet Suffers Largest Extinction Ever

The Permian period climaxed in the largest mass extinction in the Earth's history. About 95 percent of marine species and 70 percent of land animals were wiped out. Climate change is the main suspect. There's evidence of periods of rapid global warming

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◀ BACK TO INTRO



m.y.a. = million years ago



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## Dinosaurs Take First Steps

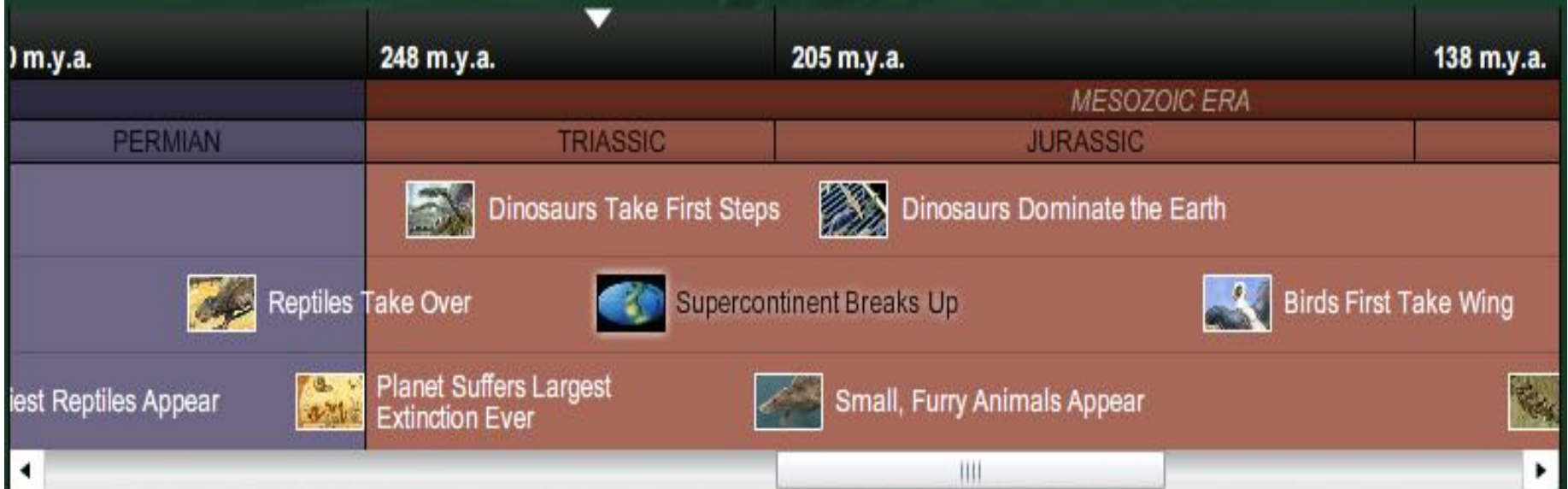
The age of the dinosaurs dawned some 240 million years ago—the time to which the oldest known dinosaur dates. Identified from fossil fragments in Madagascar, the kangaroo-size animal belonged to a group of primitive plant-eaters known as

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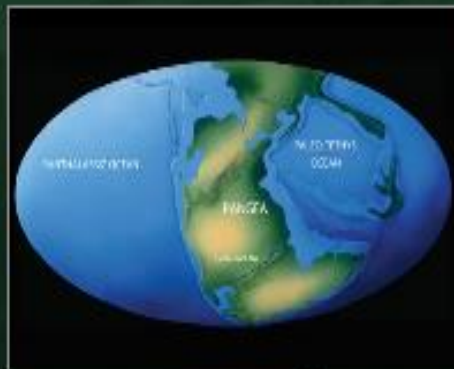
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# Time Line: Rise of Life

◀ BACK TO INTRO



m.y.a. = million years ago



⊕ ENLARGE

## Supercontinent Breaks Up

The giant supercontinent of Pangaea began breaking up toward the end of the Triassic. The process started with Europe's separation from Africa, leaving a widening breach filled by the so-called Tethys Ocean. This seaway gradually extended right through

## Related Content

- Photos: Triassic Period

# Time Line: Rise of Life

◀ BACK TO INTRO

248 m.y.a.

205 m.y.a.

138 m.y.a.

MESOZOIC ERA

PERMIAN

TRIASSIC

JURASSIC

CRETACEOUS



Dinosaurs Take First Steps



Dinosaurs Dominate the Earth



Reptiles Take Over



Supercontinent Breaks Up



Birds First Take Wing

appear



Planet Suffers Largest Extinction Ever



Small, Furry Animals Appear



Flowering Plants Begin to Bloom

m.y.a. = million years ago



⊕ ENLARGE

## Small, Furry Animals Appear

Mammals emerged from the terminal decline of their immediate ancestors, the therapsid mammal-like reptiles. The few therapsids that managed to survive the Permian mass extinction included mini, burrowing species that scientists think may have been warm-

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# Time Line: Rise of Life

◀ BACK TO INTRO

248 m.y.a.

205 m.y.a.

138 m.y.a.

MESOZOIC ERA

TRIASSIC

JURASSIC

CRETACEOUS



Dinosaurs Take First Steps



Dinosaurs Dominate the Earth



Reptiles Take Over



Supercontinent Breaks Up



Birds First Take Wing



Planet Suffers Largest Extinction Ever



Small, Furry Animals Appear



Flowering Plants Begin to Bloom

m.y.a. = million years ago



⊕ ENLARGE

## Dinosaurs Dominate the Earth

The main blueprints for the animals that would reign supreme for almost 150 million years were drawn up in the early Jurassic. *Vulcanodon*, for instance, helped lay the massive foundations for plodding, plant-eating sauropod dinosaurs. Equipped with a

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# Time Line: Rise of Life

◀ BACK TO INTRO

205 m.y.a.

138 m.y.a.

63

## MESOZOIC ERA

TRIASSIC

JURASSIC

CRETACEOUS

Dinosaurs Take First Steps



Dinosaurs Dominate the Earth



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Supercontinent Breaks Up



Birds First Take Wing

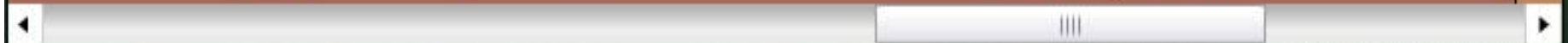
As Largest  
er



Small, Furry Animals Appear



Flowering Plants  
Begin to Bloom



m.y.a. = million years ago



⊕ ENLARGE

## Birds First Take Wing

Birds became airborne some 150 million years ago, the earliest record coming from a well-preserved fossil discovered in Germany in 1861. The fossil showed a creature with unmistakable wing feathers but also reptilian features, such as a bony tail, arm claws, and

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# Time Line: Rise of Life

◀ BACK TO INTRO

138 m.y.a.

63 m.y.a.

24 m

MESOZOIC ERA

JURASSIC

CRETACEOUS

PALEOGENE

Dinosaurs Dominate the Earth



Dinosaurs Go Extinct

Up



Birds First Take Wing



Mammals Fill Dinosaurs' Shoes

Curry Animals Appear



Flowering Plants Begin to Bloom



Primates Appear

m.y.a. = million years ago



⊕ ENLARGE

## Flowering Plants Begin to Bloom

Flowering plants bloom in the fossil record about 125 million years ago, the oldest known examples coming from China. The plants probably first took root in the Jurassic, but it wasn't until the Cretaceous that they flourished, encouraged by a predominately

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# Time Line: Rise of Life

◀ BACK TO INTRO



m.y.a. = million years ago



⊕ ENLARGE

## Dinosaurs Go Extinct

The end of the Cretaceous, 65 million years ago, was signaled by a massive extinction event that wiped out the non-avian dinosaurs. Up to 50 percent of the planet's animal and plant species disappeared. Other notable victims included giant marine reptiles,

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# Time Line: Rise of Life

◀ BACK TO INTRO



m.y.a. = million years ago



⊕ ENLARGE

## Mammals Fill Dinosaurs' Shoes

With the dinosaurs suddenly gone, tiny mammals stepped into their big shoes, rapidly diversifying and growing in size as the animals filled newly vacant ecological niches. Before long—about 60 million years ago—there was a dramatic explosion in

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# Time Line: Rise of Life

◀ BACK TO INTRO



m.y.a. = million years ago



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## Primates Appear in the Trees

Exactly when the first primates appeared isn't clear. While teeth remains suggest their emergence could date as far back as the late Cretaceous, the earliest certain primate fossils are about 55 million years old. These belonged to tarsier-like mammals such as those in the genus *Teilhardina*, remains of which have been identified in North America, Asia, and Europe. They were small, furry, agile tree-dwellers with relatively large brains for their body size; well developed, grasping hands; and big, saucer-like eyes that





# Time Line: Rise of Life

◀ BACK TO INTRO

63 m.y.a.

24 m.y.a.

2 m.y.a.

CENOZOIC ERA

PALEOGENE

NEOGENE

QUATERNARY



Dinosaurs Go Extinct



Hominins Descend From the Trees



Mammals Fill Dinosaurs' Shoes



Ice Ages Begin to Grip World



Primates Appear in the Trees



Modern Humans Are Born

m.y.a. = million years ago



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## Hominins Descend From the Trees

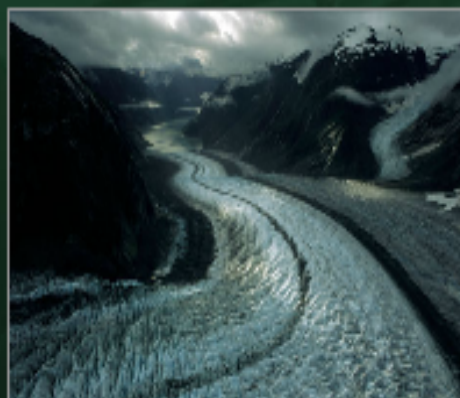
Hominins—humans and their immediate ancestors—are thought to have split from the lineage that also gave rise to modern chimpanzees between six million and eight million years ago. The oldest discovered hominin remains (*Ardipithecus*) date to about 5.8 million years ago, with the australopithecines appearing about a million years later. Various australopithecine species have been described, most of them from fossils from the Great Rift Valley region of Africa. These hominins had brains similar in size to those

# Time Line: Rise of Life

◀ BACK TO INTRO



m.y.a. = million years ago



## Ice Ages Begin to Grip World

The last 1.8 million years of the Earth's history have been dominated by a series of ice ages of varying intensity, the most recent ending some 10,000 years ago. The coldest of these glacial episodes lasted tens of thousands of years, when massive ice sheets spread as far south as New York and London. Linked to factors including variations in the planet's orbit around the sun, these ice ages saw the rise of a range of distinctive animals such as mastodons, woolly mammoths, and woolly rhinos, all now extinct.

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# Time Line: Rise of Life

◀ BACK TO INTRO



m.y.a. = million years ago



⊕ ENLARGE

## Modern Humans Are Born

Fossils indicate our own species, *Homo sapiens*, arose in eastern Africa some 190,000 years ago. First venturing beyond Africa about 70,000 years ago, early modern humans eventually penetrated as far as Australia and South America. Hunter-gatherer groups in Europe and western Asia came into contact with closely related Neandertals, who subsequently died out—possibly because the newcomers outthought and outcompeted them. Some experts, however, suggest that the Neandertals and other non-African

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