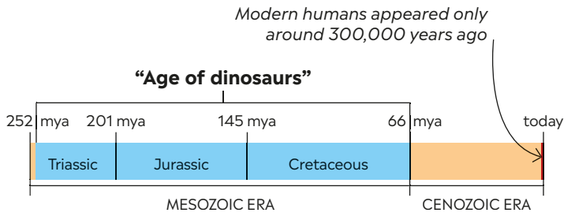
The age of **dinosaurs**

Dinosaurs began to evolve 240 million years ago (mya) and ranged in size from gigantic, now extinct, reptiles to tiny modern hummingbirds. Only one dinosaur group survived the mass extinction 66 million years ago to live in the modern world – birds.

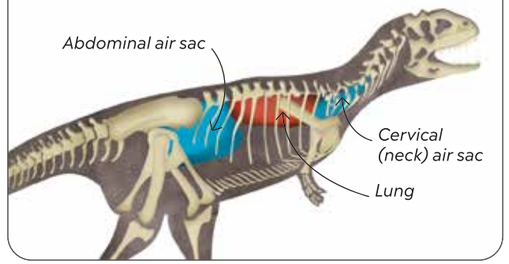
A TIME BEFORE HUMANS

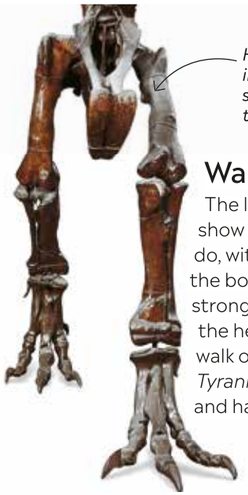
Non-bird dinosaurs lived in the Mesozoic Era, about 252–66 million years ago (mya). This era is further divided into the Triassic, Jurassic, and Cretaceous periods. Other than birds, all dinosaurs died out long before the first humans appeared.



A BREATH OF FRESH AIR

Unlike modern reptiles, some dinosaurs, such as *Majungasaurus*, had air sacs connected to their lungs, just as birds do. These sacs pushed a constant flow of fresh air through the lungs.



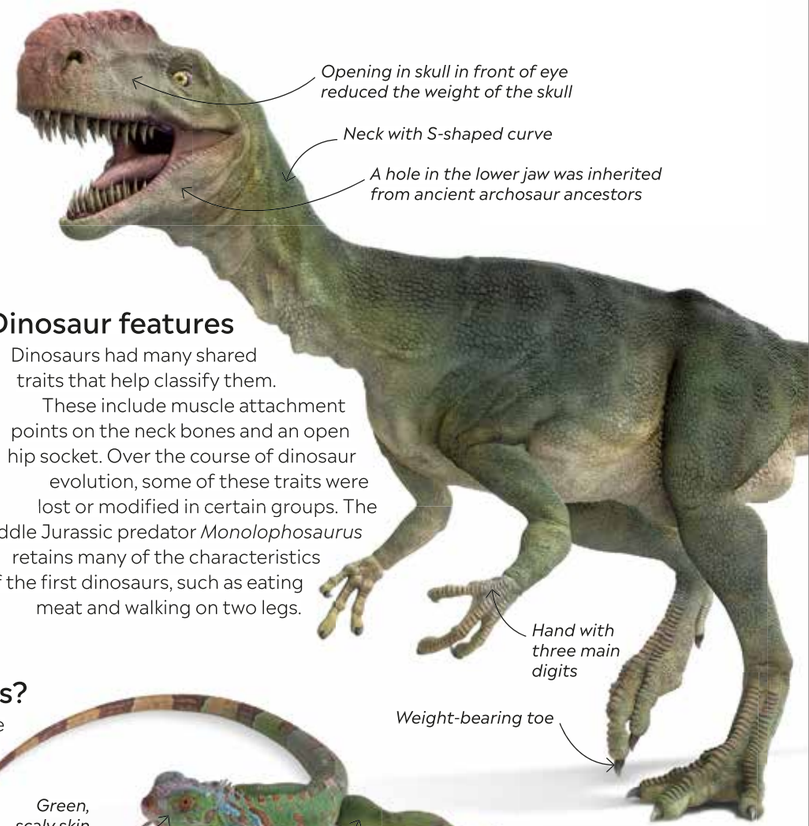


Walking tall

The limb bones of dinosaurs show that they walked as mammals do, with their legs underneath the body. The limbs had to be strong as some dinosaurs were the heaviest animals to ever walk on land. Like all dinosaurs, *Tyrannosaurus* walked on its toes, and had a hingelike ankle joint.

Fossil feathers

The brown fringes around the skeleton of this fossil *Microraptor* are traces of feathers. Some dinosaurs had downy feathers for warmth; others had showy feathers to attract a mate. *Microraptor's* long feathers helped it to glide between trees.

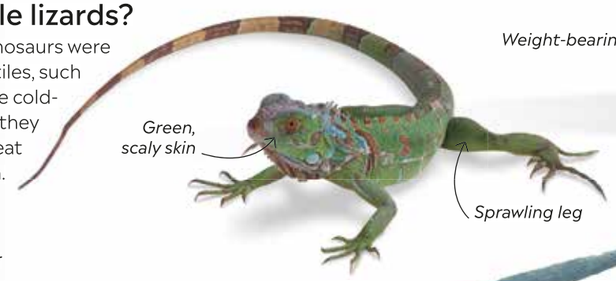


Dinosaur features

Dinosaurs had many shared traits that help classify them. These include muscle attachment points on the neck bones and an open hip socket. Over the course of dinosaur evolution, some of these traits were lost or modified in certain groups. The Middle Jurassic predator *Monolophosaurus* retains many of the characteristics of the first dinosaurs, such as eating meat and walking on two legs.

Terrible lizards?

Evidence suggests that dinosaurs were warm-blooded. Modern reptiles, such as this iguana lizard, are cold-blooded, which means they rely on the Sun's heat for body warmth.



The 72 vertebrae in *Elasmosaurus*'s neck made scientists initially mistake it for the reptile's tail.

Reptile relations

During the Mesozoic Era, the seas were ruled by large non-dinosaur reptiles, such as the plesiosaurs, mosasaurs, and ichthyosaurs. *Elasmosaurus* was the longest-known plesiosaur, growing to lengths of up to 10 m (33 ft).

Dinosaur **types**

Scientists usually divide dinosaurs into two groups according to how their hip bones are arranged. The saurischians included the plant-eating sauropods and the meat-eating theropods. The ornithischians were mainly plant-eaters and included the ornithopods, as well as the plated, armoured, and horned dinosaurs. The family tree on pages 64–65 shows how all these dinosaurs were related.

Heavy tail

Large snout may have been used in display

Ornithopods

Some of these herbivores had showy crests for display, and hundreds of plant-crushing teeth. Evidence suggests ornithopods were social and formed herds.

***Muttaburrasaurus*, an ornithopod**

Hip bones face in different directions

Hip bones lie next to each other

***Eoraptor*, a saurischian**

***Psittacosaurus*, an ornithischian**

A hip issue

Saurischians and ornithischians can be split based on the shape of their hip bones. In saurischians, one of the hip bones called the pubis points forwards. However, in some saurischians, such as several theropods and birds, the pubis evolved to point backwards. This orientation of the pubis also evolved in the ornithischians, in which all the hip bones pointed backwards.

Marginocephalians

Two major groups made up the marginocephalians: the horned and frilled ceratopsians, and the dome-head pachycephalosaurs. Ceratopsians were large herbivores, while pachycephalosaurs were smaller and may have been omnivores, eating both plants and meat.

Bony spike jutting from skull

Bony neck frill

Short, sharp horn on the snout

Cutting beak

***Pentaceratops*, a ceratopsian**

Immensely long neck

Air-filled spaces in the bones helped lighten the skeletons of giant sauropods

***Brachiosaurus*, a sauropod**

Sauropodomorphs

Although early species were bipedal – they walked on two legs – most members of this group walked on four legs and had a distinctive long neck. One sub-group, the sauropods, evolved into the largest animals to ever walk the planet.

Scientists have found fossils of more than 800 different species of dinosaur.

Theropods

The dinosaurs that would eventually give rise to birds were bipedal. Many theropods were predators and ate meat, but some evolved plant-based diets.

Bony plate

***Stegosaurus*, a stegosaur**

Thyreophorans

This group included the stegosaurs and ankylosaurs, as well as some close relatives. Armour in the form of osteoderms protruded from the skin in all thyreophorans.

Bulky neck muscles helped tear flesh and bone from carcasses

***Tyrannosaurus rex*, a theropod**

Triassic times

The Triassic Period lasted from around 252 to 201 million years ago (mya). Life was recovering from the world's most devastating mass extinction, and conditions were harsh. Great deserts covered much of Earth, and there was less oxygen in the air than today. Dinosaurs evolved early on in the Triassic, but the first ones were small and rare compared to other animals.

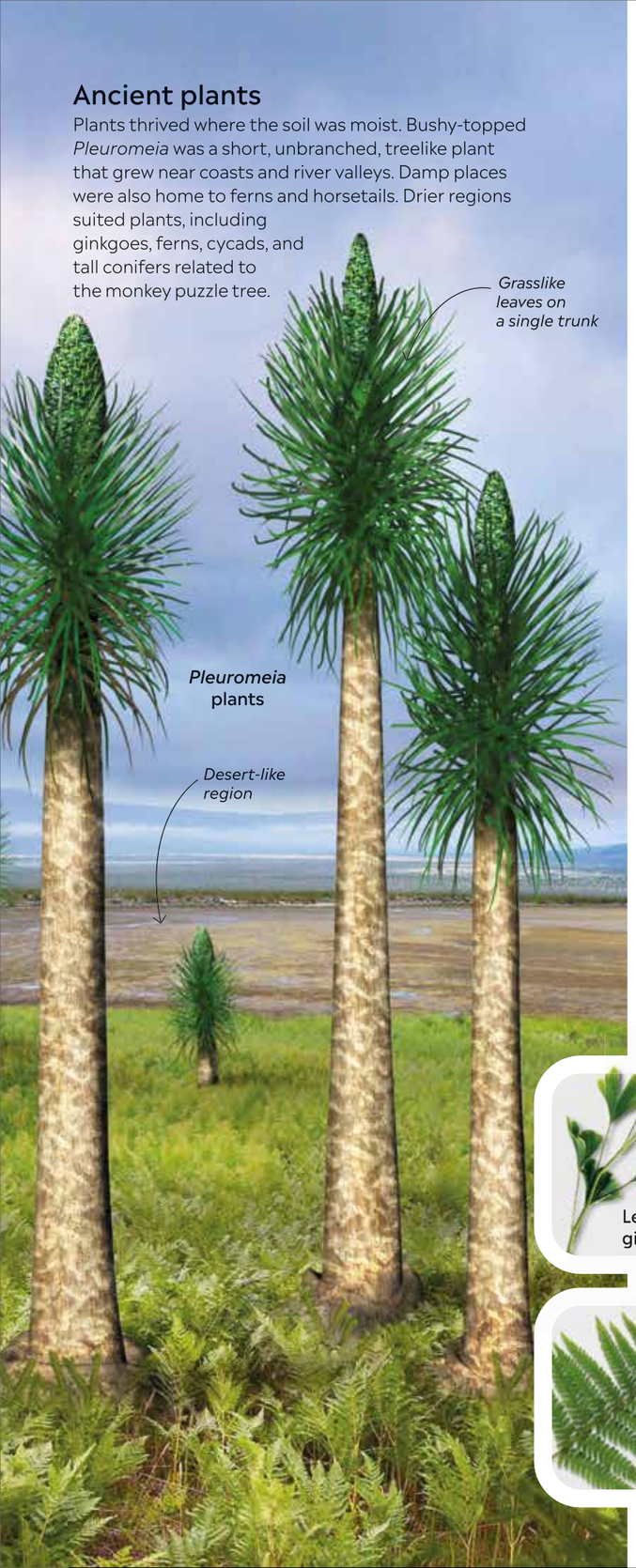
Ancient plants

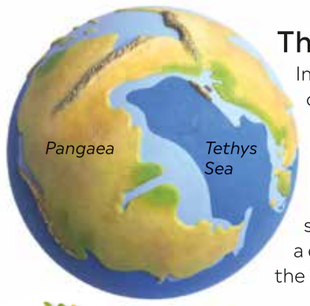
Plants thrived where the soil was moist. Bushy-topped *Pleuromeia* was a short, unbranched, treelike plant that grew near coasts and river valleys. Damp places were also home to ferns and horsetails. Drier regions suited plants, including ginkgoes, ferns, cycads, and tall conifers related to the monkey puzzle tree.

Grasslike leaves on a single trunk

Desert-like region

***Pleuromeia* plants**





The Triassic world

In this period, Earth's continents were joined together as a single landmass called Pangaea. Surrounding this landmass was a single ocean, with a great inlet called the Tethys Sea.

Leaves of a ginkgo tree

Fern frond

Fur probably covered body

Mammal-like teeth of different shapes and sizes

Mammals

During the Triassic Period, the closest relatives of mammals evolved. The small, shrewlike *Megazostrodon* lived in southern Africa and had almost all the features of a mammal. It would have snapped up insects and lizards, but kept well clear of hungry dinosaurs.

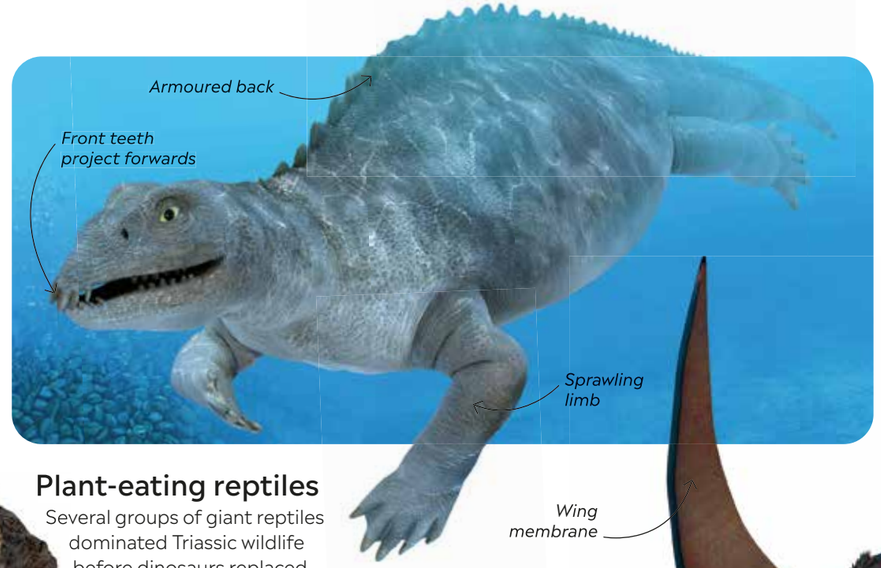
Sea reptiles

Placodus ("flat tooth") was as long as a man and belonged to a group of sea reptiles called placodonts. About 240 million years ago, this bulky, short-necked creature plucked shellfish from rocks with its jutting front teeth, then crushed them using flat teeth in the roof of its mouth.

Armoured back

Front teeth project forwards

Sprawling limb



Beaklike snout cropped plants

Fossil skull

Plant-eating reptiles

Several groups of giant reptiles dominated Triassic wildlife before dinosaurs replaced them. This beaked skull comes from *Hyperodapedon*, a piglike reptile that belonged to a group of plant-eating reptiles called rhynchosaurs.

Wing membrane

Clawed finger

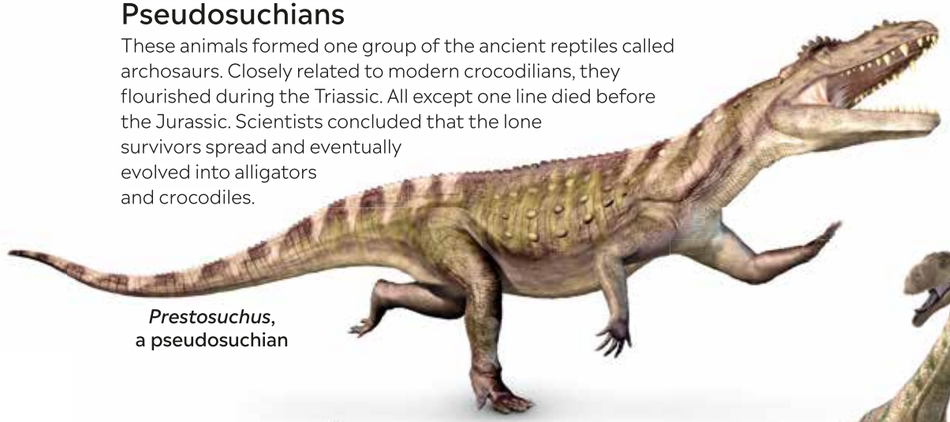
Flexible neck

Reptiles take flight

Eudimorphodon was a flying reptile about 70 cm (28 in) long. It was one of the earliest-known pterosaurs, which were flying relatives of dinosaurs. It had wings made of skin, a long, bony tail, and toothy jaws that could seize small fish.

Pseudosuchians

These animals formed one group of the ancient reptiles called archosaurs. Closely related to modern crocodilians, they flourished during the Triassic. All except one line died before the Jurassic. Scientists concluded that the lone survivors spread and eventually evolved into alligators and crocodiles.



***Prestosuchus*, a pseudosuchian**

Dawn of the dinosaurs

The first dinosaurs were probably small meat-eaters that were bipedal (walking on two legs). Plant-eaters, both bipedal and quadrupedal (walking on all fours), appeared at the end of the Triassic Period.

***Herrerasaurus* (231 mya)**
This bipedal hunter from Argentina is one of the earliest-known dinosaurs. It used its long tail for balance when running.

***Plateosaurus* (210 mya)**
This European "prosauropod" grew to 8 m (26 ft) long, but the bulky plant-eater supported itself on its hind limbs only.

***Coelophysis* (212 mya)**
This theropod had slim, pointed jaws and swallowed smaller creatures. It is known from hundreds of individual skeletons.