

PAPER WORLD

# DINOSAURS

Take a  
closer look  
at Dinosaurs –  
with 40 flaps  
to lift!

*illustrated by*  
**GAIL ARMSTRONG**

# DINOSAURS

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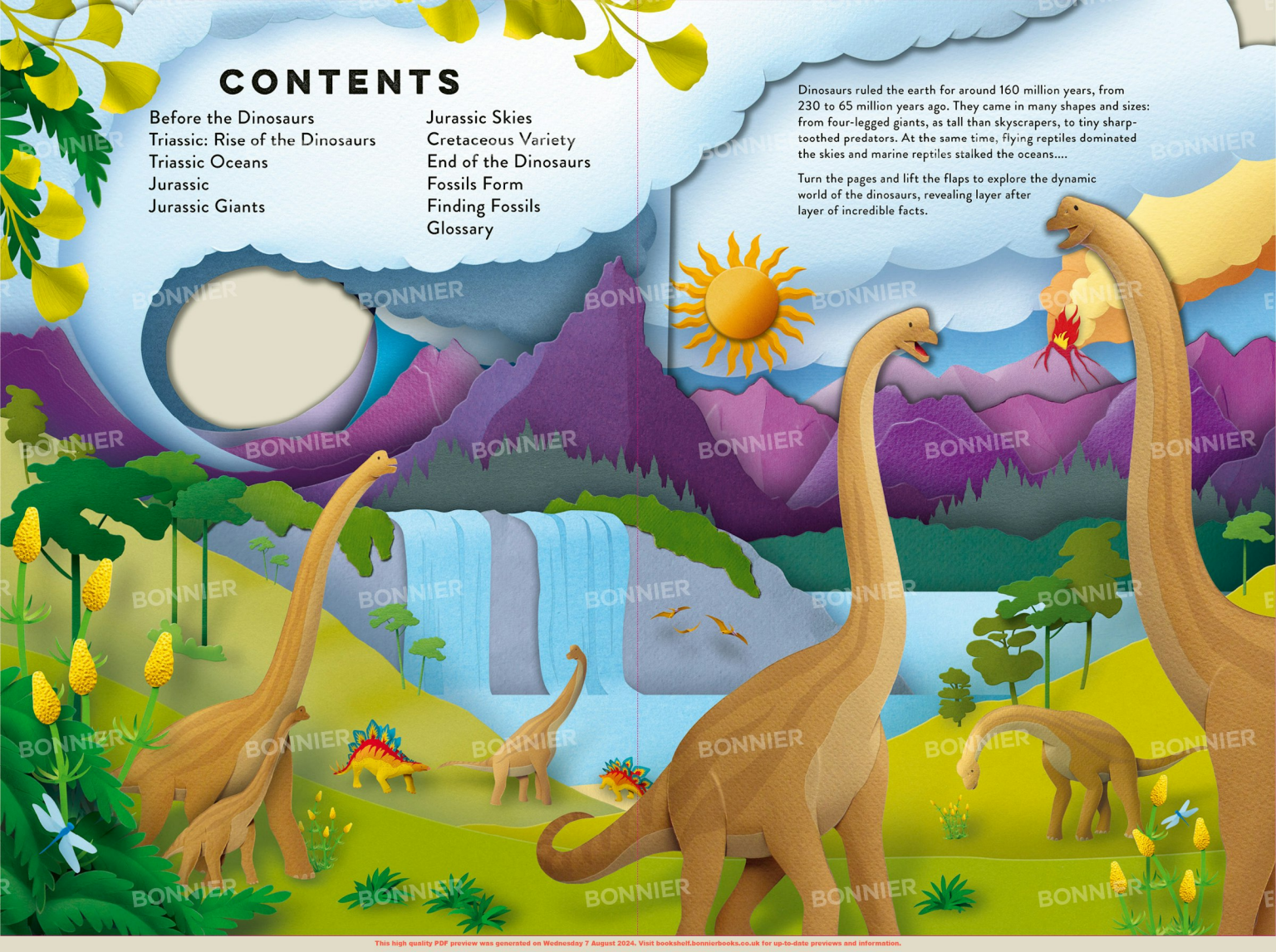
Fossils Form

Finding Fossils

Glossary

Dinosaurs ruled the earth for around 160 million years, from 230 to 65 million years ago. They came in many shapes and sizes: from four-legged giants, as tall than skyscrapers, to tiny sharp-toothed predators. At the same time, flying reptiles dominated the skies and marine reptiles stalked the oceans....

Turn the pages and lift the flaps to explore the dynamic world of the dinosaurs, revealing layer after layer of incredible facts.



# BEFORE THE DINOSAURS:

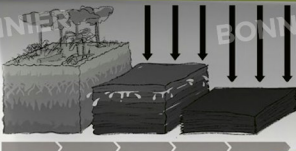
## THE CARBONIFEROUS FOREST

The very first life appeared in the oceans: simple life-forms which evolved over millions of years. Eventually some fish developed limb-like fins and made the move onto land – they were the first amphibians. Their homes were the Carboniferous Forests: hot, swampy regions that stretched across the continents, from 358 million years ago until the Permian Period, 298 million years ago.

Like frogs and toads today, the amphibians of the Carboniferous Period had to keep close to the water, and lay their eggs beneath its surface. But another kind of creature was evolving around this time: the first reptiles. Unlike amphibians, reptiles could venture further from the water as they could lay eggs that would become hotter.

### Formation of coal in the carboniferous forest

When plants in the carboniferous forest died, their remains sank, making a dense material called peat. As the peat got trampled and sank deeper and deeper, it heated up until it cooked, turning into hard coal.



...counterparts.

### Eryops

The first amphibians had short limbs, evolved from the fins of fish. Eryops had a long flat skull, and hunted like a crocodile today.

### Journey on to land

The first life appeared in the oceans about 358 million years ago. Initially, just single cells, with the evolution of increasingly animals with skeletons appeared during the Carboniferous period, and fish pulled themselves from the water, as they on insects. They were the first amphibians.

### Early reptiles

Hylonomus was one of the earliest reptiles. Around 20cm long, it spent most of its time in trees and probably ate insects.

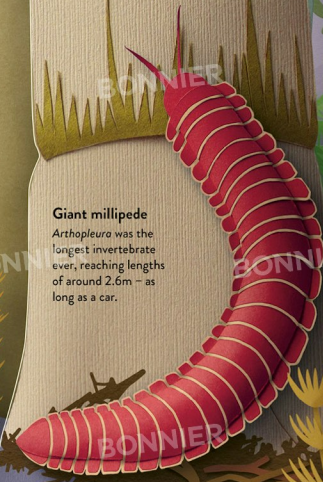


### Giant dragonflies

*Meganeuropsis* was the biggest insect ever, with a wingspan of up to 75cm, and a fierce predator. It is thought that insects grew so large at this time because of a surplus of oxygen in the air.

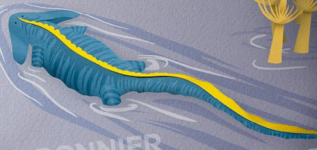
### Giant millipede

*Arthropleura* was the longest invertebrate ever, reaching lengths of around 2.6m – as long as a car.



### Diplocaulus

Diplocaulus had a boomerang-shaped head, which gave it a streamlined shape for swimming, and made it hard for predators to swallow.



### Tetrapods

Roughly 380 million years ago, a type of fish with leg-like fins crawled out of the water to find food. It became the first tetrapod – the ancestor of all land vertebrates (animals with backbones).



### Eggs

Like amphibians today, prehistoric amphibians had to go back to the water to lay eggs.



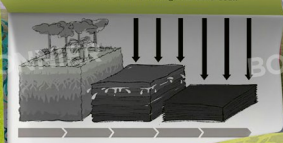
# BEFORE THE DINOSAURS: THE CARBONIFEROUS FOREST

The very first life appeared in the oceans: simple life-forms which evolved over millions of years. Eventually some fish developed limb-like fins and made the move onto land – they were the first amphibians. Their homes were the Carboniferous Forests: hot, swampy regions that stretched across the continents, from 358 million years ago until the Permian Period, 298 million years ago.

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**Formation of coal in the carboniferous forests**  
When plants in the carboniferous forest died, their remains sank, reaching a dense material called peat. As the peat got squashed and sunk deeper and deeper it turned up until it 'cooked' turning into hard coal.



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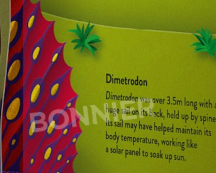
**Giant dragonflies**  
Meganeurus was the biggest insect ever, with a wingspan of up to 75cm, and a fierce predator. It is thought that insects grew so large at this time because of a surplus of oxygen in the air.



**Coelurosaurus**  
This little reptile could glide between trees using wing-like sails supported by bony rods down its sides.



**Parasaurus**  
Parasaurus was an armoured reptile. Its skin covered in bony plates called osteoderms. It walked on thick legs, like an elephant, which played up to its sides, much like reptiles today.



**Dimetrodon**  
Dimetrodon was over 2.5m long with a flat, bony back, held up by spines. Its tail may have helped maintain its body temperature, working like a solar panel to soak up sun.



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## Eryops

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**Early Insects**  
Mylodon was one of the earliest reptiles. Around 20cm long, it spent most of its time in trees and probably ate insects.

# PERMIAN PERIOD

By the Permian Period, conditions had become hotter and drier, and reptiles fared better than amphibians. Then, around 251.9 million years ago, volcanic activity wiped out more than 90 percent of species in the oceans, and 70 percent of species on land. It was the most extreme extinction event ever in Earth's history and the end of the Permian.

## Gorgonops

Gorgonops was a sabre-toothed Permian reptile and one of the top predators of its day.

## Archosaurs

This animal family includes dinosaurs, marine reptiles, pterosaurs, birds and modern crocodiles.

## Archeria

Like a crocodile today, Archeria could walk on land or swim in the water.

## Coelurosaurus

This little reptile could glide between trees using wing-like sails supported by bony rods down its sides.

## Parasaurus

Parasaurus was an armoured reptile, its skin covered in bony plates called osteoderms. It walked on thick legs, like an elephant's, which jiggled out to its sides, much like reptiles today.

## Dimetrodon

Dimetrodon was over 2m long with a ridge of 25 to 30 spikes lined up by spines. These may have helped maintain its body temperature, working like a solar panel to soak up sun.

## Diadoctes

Most early animals couldn't breathe and eat at the same time. The first exception to this was Diadoctes! This ability enabled it to grow up to 3m long – making it the first large animal to live only on land.

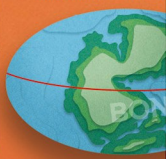
## Coelurosaurus

This little reptile could glide between trees using wing-like sails supported by bony rods down its sides.

### Mussaurus

This plant-eater was one of the ancestors of the huge sauropods that evolved in later years. It reached lengths of up to 8m – about as long as a bus!

By the end of the Triassic, had begun to drift apart in continents: Laurasia in the north and Gondwana in the south.



Permian  
225 million years ago

Pangea  
All the land of the world  
Earth and sea level were  
at a low point and the  
temperature was much  
warmer. The land was  
dry, and there had been  
no ice at the poles.

### Eudimorphodon

Pterosaurs were a family of winged reptiles – but not dinosaurs. Eudimorphodon was one of the first pterosaurs, perfect for grabbing fish from the water.



### Placerias

This hippopotamus-like plant-eater belonged to a family called 'dicynodonts', meaning 'two dog tooth' – thanks to their two tusks.



### Parasuchus

Crocodile-like Parasuchus ate fish and grew to around 2m long



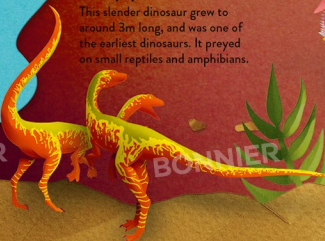
### Herrerasaurus

This fearsome predator reached lengths of 3m, with sharp claws for grabbing its prey.



### Coelophysis

This slender dinosaur grew to around 3m long, and was one of the earliest dinosaurs. It preyed on small reptiles and amphibians.



Triad-hipped (trichian), depending on the way their pubic bones pointed.



### Nyasaurus

Nyasaurus fossils have been discovered in rocks 243 million years old, making it the earliest known dinosaur.



### Crocodyl



# TRIASSIC

The Triassic Period (252–201 million years ago) began after the worst extinction event in Earth's history. Almost 20 per cent of species were wiped out, but as Earth slowly recovered, plant and animal life boomed. Reptiles became increasingly diverse. Then, around 240 million years ago, the first dinosaurs evolved. Quick, two-legged reptiles, these early dinosaurs were tiny compared to the giants that followed in their footsteps, and fed on a mixture of plants and meat.

Over the course of the Triassic, dinosaurs and their relatives grew in number and became more and more diverse – varying wildly in size, diet and lifestyle. By the end of the period, they and their relatives were increasingly dominant: dinosaurs roamed the land, pterosaurs soared the skies and huge marine reptiles swam in the oceans.

### Saurosuchus

This 5-metre-long hunter was a non-dinosaur reptile that lived alongside dinosaurs. Tooth marks in fossils suggest it ate small dinosaurs.



### Eoraptor

This fox-sized dinosaur ran on two legs and only reached lengths of around 1m.



### Early mammals

Some of the earliest true mammals were found in the Triassic, such as the Eoacodon.



# TRIASSIC SEA

While dinosaurs roamed the earth, the oceans were teeming with life, too. Colourful corals stretched along the warm, shallow coastlines of Pangea. Like today's corals, they were the perfect home for thousands of species: from microscopic algae to enormous marine reptiles bigger than a blue whale.

Marine reptiles were only distantly related to dinosaurs. They could reach enormous sizes, because their body weight was supported by the water – just like whales today. The Triassic saw more diversity of marine reptiles than any other point in history. They came in many shapes and sizes, from dolphin-like ichthyosaurs to turtle-like *Hedonius*. They moved in different ways, too: plesiosaurs and sea turtles used their limbs like paddles; while other groups used their tail and long snake-like body to move. All were predators, feeding on fish, squid, shelled invertebrates and each other!

## Helicoprion

This shark-like fish had a spiral-shaped jaw, containing more than 100 teeth. It probably fed on squid and ammonites.

## Cyamodus

This small placodont had two separate shells and a long tail. It would have dived to the seafloor to feed then swum to the surface for air.

## Atopodentatus

This hammer-headed herbivore lived like marine iguanas today, scraping seaweed from the floor to eat.

## Temnodontosaurus

This ichthyosaur had a dolphin-like body and long, toothed beak. Reaching lengths of around 10m, it had huge eyes to help it find prey in dark water.

## Shonisaurus

This huge ichthyosaur may have been the largest animal ever alive. As long as a bowling lane, it grew up to 21m long.

## Hedonius

This metre-long reptile looked like a turtle with its wide, flat shell. It would have crushed shellfish with its beaklike mouth.

## Nothosaurus

This marine reptile had a long, flexible neck, webbed feet and sharp teeth. It may have spent some of its time on shore, like a seal today.

## First corals

During the mid-Triassic, corals became wide-spread. Like modern coral reefs, they were made colourful by the algae living within them.



# JURASSIC

The Jurassic Period (201–145 million years ago) was a time of huge change for the planet and its inhabitants. The super-continent Pangea continued to split apart, and new oceans rushed to fill the spaces in between, creating wide, shallow seas, dotted by tropical islands. On the continents, mountains burst up, separated by wide forests of conifers, ferns and cycads. The climate was hot and tropical. And in the oceans, new life forms emerged, and on the land, many new species evolved – filling the gaps left behind by a huge extinction event at the end of the Triassic.

On land, dinosaurs were dominant, and began to diversify in appearance and lifestyle. With so much plant-life to eat, herbivores reached enormous sizes: the first sauropods evolved, growing to mighty lengths. In response, predators grew larger, too. Alongside these fierce hunters, smaller feathered dinosaurs roamed the forests – these went on to become the ancestors of the birds.

## Anchiornis

This feathered theropod was one of the smallest dinosaurs. Its remains have been preserved in amazing detail, meaning scientists can tell what colour its feathers were. It's one of the first dinosaurs that may have been able to use its wings to fly.

It had a high neck like a giraffe, which enabled it to browse leaves from the highest tree tops. It was one of the largest dinosaurs ever.

## Coelurus

This smaller meat-eater grew to around 2m long and would have been about hip-height to an adult human.

## Mammals

The mouse-sized creature *Megazostrodon* was one of the first mammals. It had a small, shrew-like body. Mammals are warm-blooded animals with fur, whose young drink milk.

## Camptosaurus

This large herbivore grew up to 6m long. Its hand could have grabbed plants as it ate and it had a beak-like mouth for snipping leaves.

BONNIER

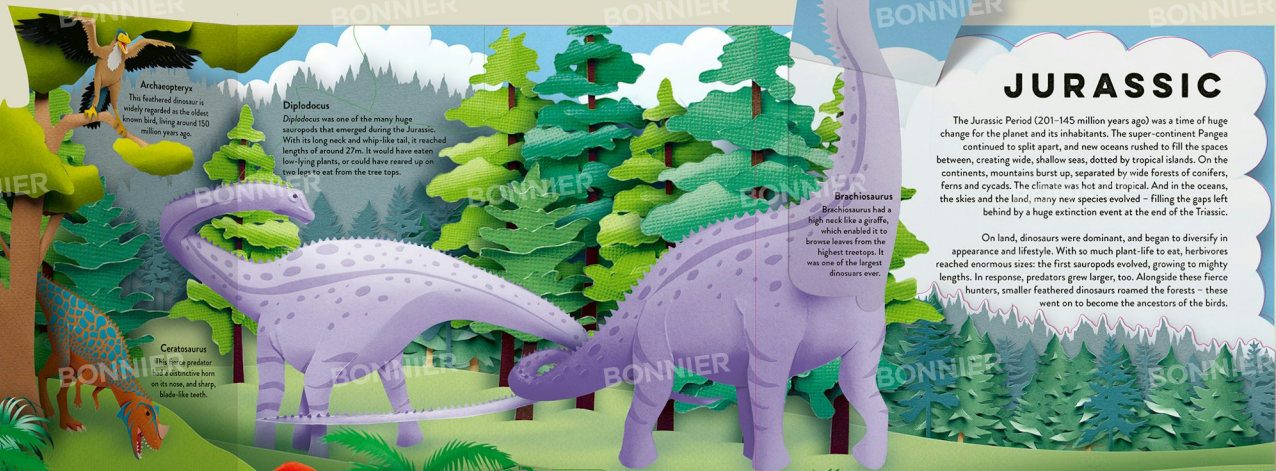
BONNIER

BONNIER

BONNIER

BONNIER

BONNIER



**Archaeopteryx**  
This feathered dinosaur is widely regarded as the oldest known bird, living around 150 million years ago.

**Diplodocus**  
Diplodocus was one of the many huge sauropods that emerged during the Jurassic. With its long neck and whip-like tail, it reached lengths of around 27m. It would have eaten low-lying plants, or could have reared up on two legs to eat from the tree tops.

**Brachiosaurus**  
Brachiosaurus had a high neck like a giraffe, which enabled it to browse leaves from the highest treetops. It was one of the largest dinosaurs ever.

**Ceratosaurus**  
This fierce predator used a bony horn on its nose, and sharp, blade-like teeth.

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**Tyrannosaurus**  
This was the most common hunter in the Jurassic. Allosaurus was a quick and fearsome predator, preying on plant-eaters such as Stegosaurus.



This dinosaur was about the same size as a horse. It had fierce tail spikes for fighting and two rows of bony plates down its back. These may have changed colour to signal to other members of the herd, or to help it regulate its temperature.



**Camptosaurus**  
This large herbivore grew up to 6m long. Its hand could have grabbed plants as it ate and it had a beak-like mouth for ripping leaves.

BONNIER

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BONNIER

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# JURASSIC SKIES

The skies of the Jurassic Period were not populated by birds, but by huge flying reptiles with tooth-lined beaks! They were the pterosaurs. These reptiles were not dinosaurs, but were part of the same wider family known as the archosaurs, to which all dinosaurs, pterosaurs and crocodiles belong. They first appeared in the Late Triassic, and ruled the skies for more than 160 million years until the end of the Cretaceous.

Pterosaurs had wings made of skin and muscle, stretched from their long fourth finger to their body. Hollow bones reduced their weight, so they were light enough to fly, despite their huge size. And many had tails, which would have been used like a rudder on an aeroplane to help them steer in mid-air. On land, pterosaurs could have folded their wings and walked on their forelimbs like legs. Like many birds today, they probably roosted on cliff edges or trees, and could have used the height to help them take off.

**Roost**  
Like modern birds today, pterosaurs have roosted on cliff edges. This close to the food helped them find it.

## Pterodactylus

This pterosaur is thought to have fed on smaller land animals, crushing them with its powerful beak.

## Dimorphodon

This small-sized pterosaur may have been an insect-eater. Its relatively short wings mean it probably only flew short distances.

## Flying insects

Dragonflies and other insects also buzzed in the Jurassic skies.

## Rhamphorhynchus

This pterosaur used its needle-like teeth to catch fish as it flew over rivers and lakes.

## Anurognathus

This tiny pterosaur had a wingspan of just 35cm – and weighed just 40g. That's about the same weight as a chocolate bar!

## Eggs

Like dinosaurs, pterosaurs' young hatched from eggs.

## Feathers

Many dinosaurs had basic proto-feathers on their bodies – not like the acaly reptiles we know today!

## Pteractyl



## Bat



● Humerus  
● Radial/Ulna  
● Metacarpals  
● Fingers

● Bat

# CRETACEOUS PERIOD

The Cretaceous Period lasted from 145–66 million years ago. These were the final years of the dinosaurs, before a huge extinction event wiped them out and drew a close to the Age of the Dinosaur. By the Cretaceous, dinosaurs were bigger, faster and fiercer than ever before. They were also more diverse in appearance and lifestyle. Alongside ferocious meat-eaters such as Tyrannosaurus rex, lived enormous sauropods, and huge ranging herds of plant-eaters, which had amazing appearances and defensive features. These included armoured dinosaurs such as the ankylosaurs; horned ceratopsians such as Triceratops and duck-billed dinosaurs such as Parasaurolophus.

Not only were dinosaurs more diverse, but the creatures around them were, too. These included the ancestors of modern mammals, as well as many varieties of reptiles, insects, trees and even the first flowers. Constant volcanic eruptions made the environment much warmer than it is today. Even the north and south poles were free from ice and covered in forests! Because of this, ocean levels were about 200 metres higher than they are now.

## Ornithomimus

This ostrich-like meat-eater had a long, slender neck and ran quickly on two long legs.

## Duck-billed dinosaurs

Hadrosaurs, or duck-billed dinosaurs, were known as the cows of the Cretaceous. This is because they grazed in huge herds across the Cretaceous plains. They are also known as duck-billed dinosaurs because of their beak-like mouth shape.

## Pachycephalosaur

This 4-metre-long dinosaur may have used its thick-domed skull to fight other males – like deer do today. The top of its skull was up to 25cm thick!

## Tyrannosaurus rex

One of the largest land predators ever, T.rex grew over 12 metres long and had huge sharp teeth the size of bananas. Its name means 'king of the lizards'.

## Ankylosaurus

This eight-metre-long dinosaur had a broad, tank-like body armoured with bony plates. Even its eyelids were armoured! Its tail acted like a club, which it could swing from side to side at attackers.

## Triceratops

This huge ceratopsian (horned dinosaur) was the size of an African elephant, with three horns on its face, the longest nearly one metre long. It had a large frill at the back of its skull to defend its vulnerable neck from attack, and a beak-like mouth for eating plants.

## Nests

Maiaura lived in herds to rear their young, like many animals today. The nests were scooped out of the ground and held as many as 40 eggs.

## Deinonychus

This smaller predator grew up to 3.5 metres long. Its name means 'terrible claw' referring to the sickle-shaped claw on each rear foot which it held up as it ran to keep it sharp

1978  
evidence that  
their young

# CRETACEOUS GIANTS

Sauropods were large, long-necked plant-eaters that first emerged in the Jurassic. They walked on four pillar-like legs to support their enormous weight, and spent all day grazing on leaves, ferns and horsetails, in order to take in enough nutrients. However, their long necks enabled them to reach even the highest trees, like giraffes today, so they could reach shoots and leaves inaccessible to smaller animals.

By the Cretaceous, some well-known species, such as Diplodocus had died out. But in their wake came the largest sauropods ever: the titanosaurs. Named after the mythological Titans of Ancient Greece, they grew to lengths of up to 30 metres: longer than three buses. They were the last great group of sauropods before the dinosaurs all went extinct.

## Saltasaurus

This huge dinosaur was covered in bony osteoderms to defend it from predators.

## Amargasaurus

This was a comparatively small sauropod, reaching lengths of just 13m. It had two rows of spines down its neck and back, which could have been used for display or defence

**Sauropod teeth**  
Most sauropods had pencil-shaped teeth, which scraped leaves or pine needles of trees but were little use for chewing.

## Dreadnoughtus

This 26m long giant was only discovered in 2005, from fossil remains in Patagonia, Argentina. It stood about as tall as a two-storey building.

## Abelisaurus

Few predators could have taken on the sheer size of a sauropod as prey, but one of those that could was Abelisaurus, a 7.5-metre-long hunter from what is now South America.

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### What's in a name?

The huge Dreadnoughtus was named after the mighty Dreadnought battleships of the earliest 20th century. The name means 'fears nothing' in Latin.

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### Patagotitan

Possibly the largest land animal ever, scientists estimate Patagotitan may have reached lengths of over 30m.