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opening extract from

Insiders Children's Encyclopedia of Dinosaurs

written by

Michael K. Brett-Surman

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Size and strength

There are certain things that happen to all animals as they get bigger. The heavier they get, the more energy they need to move. The larger the animal, the more they can hurt themselves if they fall down. It also gets harder for them to cool down when they move fast. Two-legged animals are always smaller than four-legged animals because two legs cannot bear as much weight as four legs can. There is a stage an animal reaches when it can walk fast, with one leg on the ground at all times, but it cannot run with all legs off the ground. An example of this in today's world is the difference between rhinoceroses and elephants—rhinoceroses can run but elephants cannot.

SPEED

There is a simple way to tell how fast a dinosaur could have run. If its thigh bone was as long as its shin bone, then it could move fast. If the thigh bone had bumps and knobs, for the insertion of muscles, then it had a powerful leg and could run fast. No dinosaur was as fast as the fastest living mammal but, in the Mesozoic world, dinosaurs were the fastest animals on Earth.

The legs of an ostrich are better designed for speed than *Struthiomimus* legs.

The legs of *Struthiomimus* were not up to modern standards but they could outpace a tyrannosaur.

HEAVIEST

Argentinosaurus and *Sauroposeidon* are both estimated to have weighed more than 50 tonnes.

Argentinosaurus weighed the same as 15 African elephants!

BIGGEST PREDATOR

If "big" means massive, then *Tyrannosaurus rex* wins. If "big" means longest, then *Giganotosaurus* or *Spinosaurus* wins. They are the "biggest of the big", so far.

LONGEST

Amphicoelias could have been the longest dinosaur at 50 metres (196 ft) long, but the bone that was found in the late 1800s is now missing. The next longest, but with a more complete skeleton, is *Argentinosaurus*.

DID YOU KNOW?

Mammals grow to a certain size and then stop. However, dinosaurs have "indeterminate growth"—they keep growing for as long as they are healthy. We may never find the "biggest" dinosaur to have ever lived.

SMALLEST

Newly hatched two-legged plant eaters would fit in the palm of a child's hand. *Micropachycephalosaurus* (below) was one of the smallest plant eaters—it was only 0.5 metres (1½ ft) long. *Compsognathus* (below right) was one of the smallest meat eaters. It was only 1 metre (3 ft) long and about the same height as a chicken.

Micropachycephalosaurus

Compsognathus

Becoming a Fossil

Fossils are essential for studying dinosaurs but only a small percentage of animals become fossilized. Animals begin to decay quickly after death and scavengers, predators, insects and the weather all help to increase the rate of decay. The best fossils come from animals that were buried quickly and surrounded by finely grained earth. If the rocks containing the fossil wear away or if the fossil is buried too deeply, it may never be found.

EASY MEAL

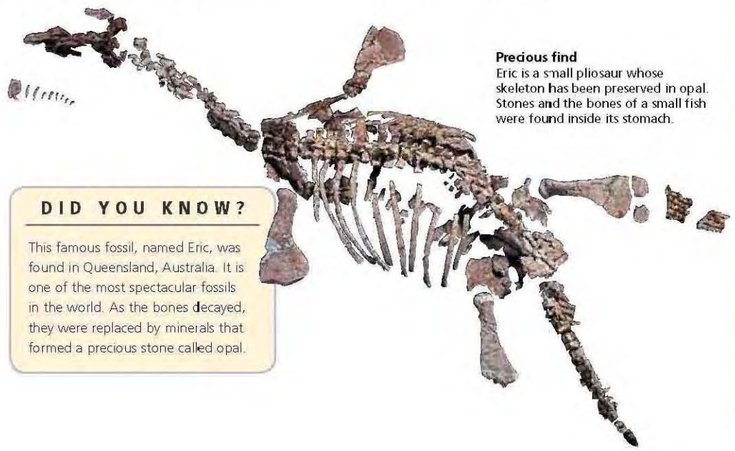
A dinosaur has just died. Two pterosaurs land on its foot and look for parasites, insects and pieces of meat. Meat-eating theropods have not yet discovered the carcass. If they do, not much will be left. This dinosaur has died on a flood plain, so a rainstorm might cover it with sand and silt and preserve it.

FOSSIL CLUES

If the bones of a dinosaur are found in the same position they were in life, they are said to be "in articulation", and scientists can study how the animal was designed and how it moved. We can also study any injuries or diseases the animal may have had: this is called "palaeopathology", the science of ancient diseases and injuries. This duckbill dinosaur skeleton is in articulation.

All that is left of this fish is a thin layer of carbon, which is a charcoal-like substance. All the body parts have decayed, leaving just this layer.

This insect fossil is an impression. The stain on the rock has the shape of the fossil but the body parts have decayed.



Precious find
Eric is a small pliosaur whose skeleton has been preserved in opal. Stones and the bones of a small fish were found inside its stomach.

DID YOU KNOW?

This famous fossil, named Eric, was found in Queensland, Australia. It is one of the most spectacular fossils in the world. As the bones decayed, they were replaced by minerals that formed a precious stone called opal.

HOW A DINOSAUR FOSSIL IS FORMED

Fossils do not form easily or quickly. Many things have to happen in a particular order for an animal to become fossilized. There are different kinds of fossils, such as bone, footprints, impressions, mineral remains, natural casts and, rarely, "mummies", in which organs are preserved. Less than one per cent of all fossils are complete animal skeletons.

DEATH
A dinosaur dies and the body is buried or washed into a river before it is completely destroyed. Usually the flesh rots away or is eaten; only the skeleton remains.

BURIAL
Layers of finely grained sand and mud cover the carcass. New layers added on top help stabilize the fossil and protect it from more decay and being washed away.

FOSSILIZATION
The sand and mud that surround the animal harden and its bones are replaced by minerals to form rock-hard fossils. This process takes thousands of years.

REDISCOVERY
Movements in Earth lift up the fossil and bring it close to the surface. The surface wears away and the fossil is exposed. If it is not found it may disappear in just one year.

Fossil Sites

There are thousands of sites around the world containing all kinds of fossils. Since the 1870s, specimens have been found in Africa, America, Australia, Canada, China and Mongolia. Everything scientists know about dinosaurs has come from fossils and there are many dinosaur bones that are yet to be discovered. Today people collect fossils as a hobby—they collect bones, teeth, plants and shells. However, they are not just pretty rocks—they need care and preservation and they are never collected without permission. Some sites offer classes and instructions on how to dig up and care for fossils.

DINOSAURS AROUND THE WORLD
This map shows the eight major sites pictured but there are thousands of dinosaur sites around the world. At some places bones are not being excavated because of political unrest, lack of money, or lack of easy access—one site is only 170 kilometres (100 m) from the South Pole, which makes it very hard to get to.

1 DINOSAUR NATIONAL MONUMENT, UTAH, USA
This Late Jurassic site was discovered in 1909 when palaeontologist Earl Douglass, from the Carnegie Museum of Natural History, in Pennsylvania, noticed the skeleton of a sauropod sticking out of an exposed sandstone ledge. Important fossils found here include the most complete skeleton of *Apatosaurus* ever to be discovered, as well as nearly complete skeletons of *Allosaurus*, *Dryosaurus* and *Stegosaurus*.

2 HELL CREEK, MONTANA, USA
In 1902, palaeontologist Barnum Brown, from the American Museum of Natural History, in New York, began searching the Hell Creek area for dinosaur fossils. At this Late Cretaceous site Brown discovered the first, incomplete, *Tyrannosaurus* skeleton. Dinosaur fossils found at Hell Creek include *Albertosaurus*, *Ankylosaurus*, *Ornithomimus*, *Pachycephalosaurus*, *Stegoceras*, *Torosaurus* and *Troodon*.

3 DINOSAUR PROVINCIAL PARK, ALBERTA, CANADA
The history of this Late Cretaceous park dates back to 1909, when a rancher, John Wagner, discovered dinosaur bones on his property. Early finds included complete skeletons of *Centrosaurus*, *Corythosaurus*, *Prosaurolophus* and *Struthiomimus*. Scientists have found about 250 dinosaur skeletons from 36 different species, including *Edmontonia*, *Euoplocephalus*, *Lambeosaurus*, *Struthiomimus* and *Troodon*.

4 SOLNHOFEN, GERMANY
One of the exciting discoveries from this Late Jurassic site was a partial skeleton of *Archeopteryx*, a rare feathered dinosaur. In 1860, a feather was found and, in 1861, a complete skeleton with feathers was uncovered. Many well-preserved fossils have come from Solnhofen, including 54 species of fishes and 28 kinds of reptiles. A complete dinosaur skeleton of *Compsognathus* has also been found.

5 GOBI DESERT, MONGOLIA
This Late Cretaceous site in remote Mongolia was discovered by Dr Roy Chapman Andrews, of the American Museum of Natural History, in 1922. His expedition found the first dinosaur nest. The most famous find, however, was in 1971. This was the complete skeletons of two fighting dinosaurs—*Velociraptor* gripping the skull of *Protoceratops*. Other fossils from here include theropods, sauropods and hadrosaurs.

6 LIAONING, CHINA
In 1996, a local farmer discovered a *Sinosauropteryx* fossil at this Early Cretaceous site. It was the first dinosaur specimen with primitive feathers. Two small dinosaurs with typical bird feathers, *Caudipteryx* and *Protoarcheopteryx*, were also found at this site, as were ancient bird skeletons. The fossils discovered at Liaoning show the many stages of evolution from small agile, running dinosaurs to flying birds.

7 DINOSAUR COVE, VICTORIA, AUSTRALIA
In the 1980s, teams led by Tom Rich, of the Museum of Victoria, explored this site. Excavations involved using mining equipment to tunnel directly into sea cliffs. This was the first time that a dinosaur mine was created. Dinosaurs discovered here include *Atlascopcosaurus*, *Leaellynasaura* and *Qantassaurus*—there are many other fossils waiting to be described. These dinosaurs lived in a polar forest.

8 VALLEY OF THE MOON, ARGENTINA
The Valley of the Moon and surrounding areas are famous for their Late Triassic dinosaur fossils. The first fossils were found between 1959 and 1961. These include the oldest well-preserved dinosaur fossils in the world as well as more primitive reptiles that show evolutionary links to the first dinosaurs. The skeleton of the most primitive dinosaur, the tiny *Eoraptor*, was discovered here in 1988.

Allosaurus

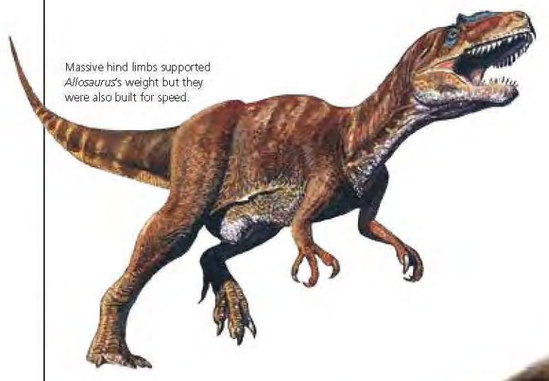
PRONUNCIATION: AL-oh-SAW-rus

This is one of the most well-known dinosaurs. It has become the defining Jurassic meat eater and the model of a carnosaur—a large, heavily built theropod. *Allosaurus* was terrifying at any stage of its life. As a baby it ate lizards, mammals and insects. As a child it ate other baby dinosaurs. As a teenager it ate anything smaller than itself. As an adult it ate everything—what it could not hunt it scavenged. Its arms were muscular and its serrated teeth ripped flesh faster than a chainsaw.

THE FACTS

MEANING: Other lizard
DATE: Late Jurassic
GROUP: Theropoda
DIET: Meat
SIZE: 12 metres (39 ft) long
FOSSIL LOCATIONS: USA 1877

Allosaurus



Massive hind limbs supported *Allosaurus's* weight but they were also built for speed.

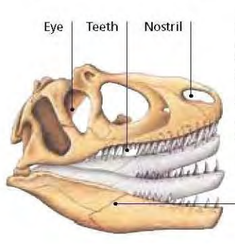
FEEDING THE FAMILY

Allosaurus roamed the forests of North America 150 million years ago. It hunted mostly small plant eaters, such as *Camptosaurus,* and sometimes, giant sauropods, such as *Diplodocus*. These dinosaurs often hunted in pairs or packs but they also hunted on their own.

ALLOSAURUS ANATOMY

Allosaurus was well equipped for hunting. Strong, grasping claws on its front legs, razor-sharp teeth and a flexible jaw made this dinosaur a formidable predator.

Sharp daws
Three-fingered hands ended in hooked claws. It may have used them like grappling hooks.



Flexible jaws
A flexible joint in its lower jaw allowed its jaw to bend outwards and enlarge its mouth for a deadlier bite.