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Simple English

Dinosaur

Dinosaurs are a group of Archosaur reptiles of the clade **Dinosauria**.[1] Dinosaurs eventually gave rise to birds.

Dinosaurs were the most powerful land animals of the Mesozoic era. Over 500 different genera of dinosaurs are known.[2] Fossils of dinosaurs have been found on every continent.

Dinosaurs began in the Upper Triassic, about 230 million years ago (mya).[3] The earliest date of a dinosaur fossil is that of *Eoraptor* and *Herrerasaurus* from Argentina, and *Saturnalia* from Brazil, 237 to 228 mya.[4]

By the early Jurassic they were the top land vertebrates, and dominated most environments on land. They continued until the K/T extinction event 66 million years ago.[5]

From the fossil record, it is known that birds are living feathered dinosaurs.[6] They evolved from earlier theropods during the later Jurassic.[7] They were the only line of dinosaurs to survive to the present day.[8]

Dinosaurs had adaptations that helped make them successful. The first known dinosaurs were small predators that walked on two legs.[9][10] All their descendants had an upright posture, with the legs underneath the body. This transformed their whole life-style. There were other features. Most of the smaller dinosaurs had feathers, and were probably warm-blooded. This would make them active, with a higher metabolism than modern reptiles. Social interaction, with living in herds and co-operation, seems certain for some types. The existence of communal egg-laying sites is best understood if the adults travelled in herds, as herbivores do today.

The first fossils were recognised as dinosaurs in the early 19th century. Some of their bones were found much earlier, but were not understood. William Buckland, Gideon Mantell and Richard Owen saw these bones were a special group of animals. Georges Cuvier was also important in explaining what dinosaurs were. Dinosaurs are now major attractions at

Dinosaur

Temporal range: (Possible Middle Triassic record)

A collection of fossil dinosaur skeletons. Clockwise from top left: *Microraptor gui* (a winged theropod), *Apatosaurus louisae* (a giant sauropod), *Edmontosaurus regalis* (a duck-billed ornithopod), *Triceratops horridus* (a horned ceratopsian), *Stegosaurus stenops* (a plated stegosaur), *Pinacosaurus grangeri* (an armored ankylosaur)

Scientific classification

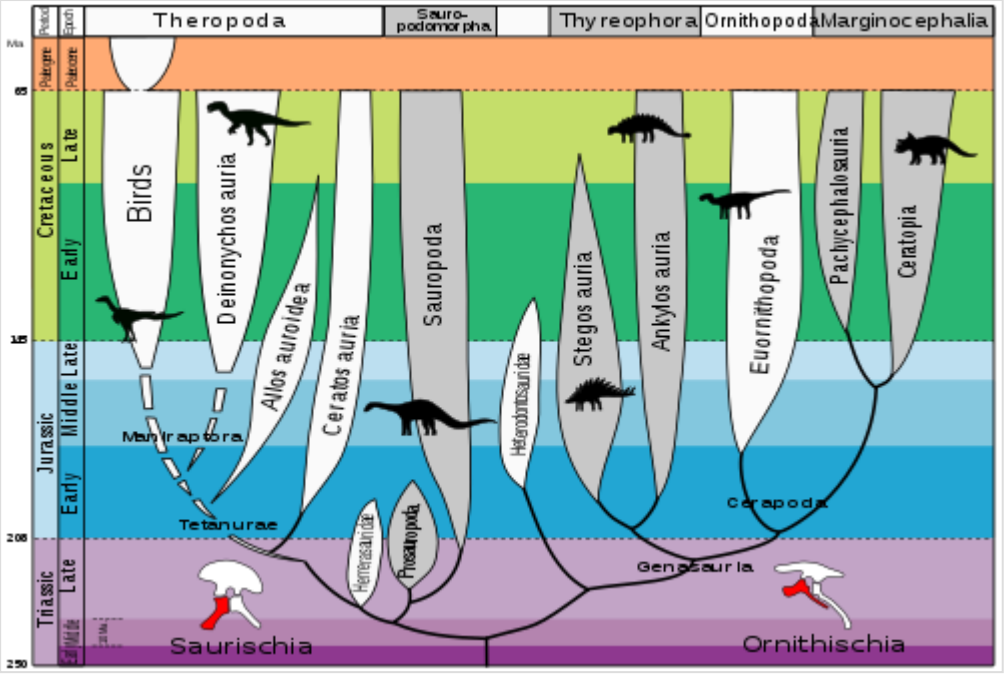
Domain:	Eukaryota
Kingdom:	Animalia
Phylum:	Chordata
Clade:	Dracohors
Clade:	Dinosauria Owen, 1842

Major groups

- †Sauropodomorpha
- Theropoda

museums around the world. They have become part of popular culture. There have been best-sellng books and movies. New discoveries are reported in the media.

- †Ornithischia



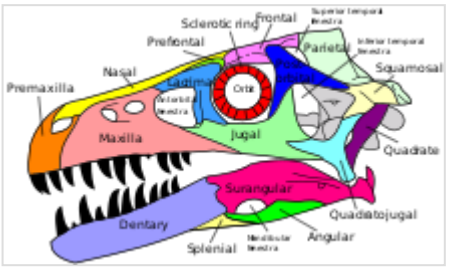
Evolution of dinosaurs

Dinosaur features

Dinosaurs are so varied that it is not easy to find what they all share. A reasonable list would include many features of the skeleton which are not familiar to the general reader.[11]

Dinosaurs were, at the start, small and bipedal: they walked on their hind legs. They laid eggs in nests, and included both carnivores and herbivores. We now know that birds are their living descendents, and more about that later.

Changes in the basic set-up of dinosaurs happened because of adaptations to different lifestyles. From the start of their fossil record, there were both herbivores and carnivores.

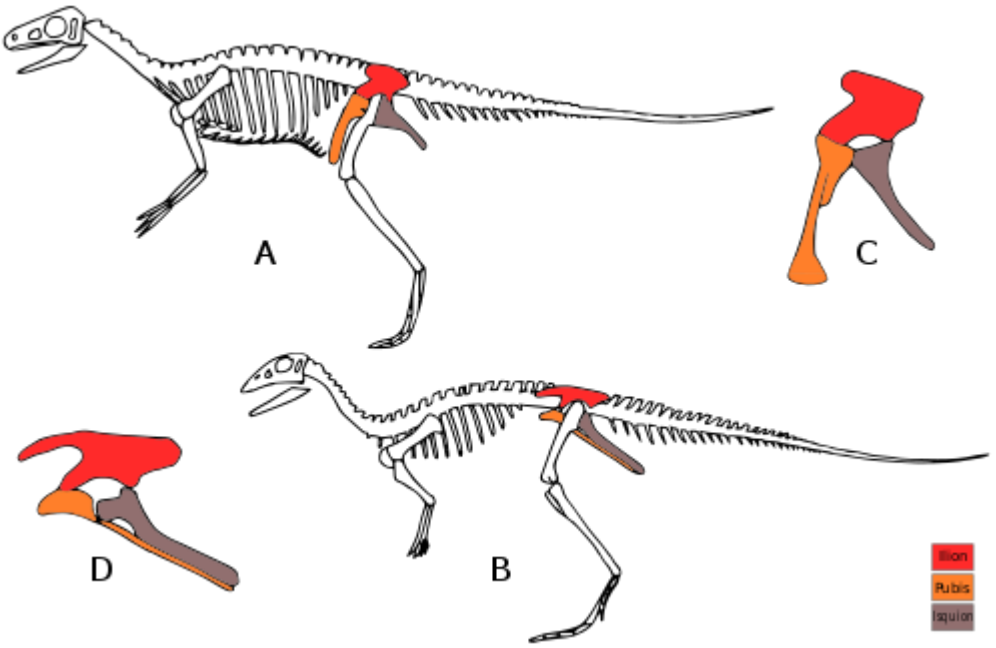


Labeled diagram of a typical archosaur skull, the skull of *Dromaeosaurus*

Types of dinosaurs

Dinosaurs are united by at least 21 traits in their skulls and skeletons.[12] These common characters (called 'synapomorphies') are the reason palaeontologists are sure dinosaurs had a common origin.

However, when definite dinosaur fossils appear (early in the Upper Triassic), the group had already split into two great orders, the Saurischia, and the Ornithischia. The Saurischia keep the ancestral hip arrangement inherited from their Archosaur ancestors, and the Ornithischia have a modified hip structure.



A. *Eoraptor*, an early saurischian, **B** *Lesothosaurus*, a primitive ornithischian, **C** A saurischian pelvis (*Staurikosaurus*) **D** *Lesothosaurus* pelvis

Dinosaur classification

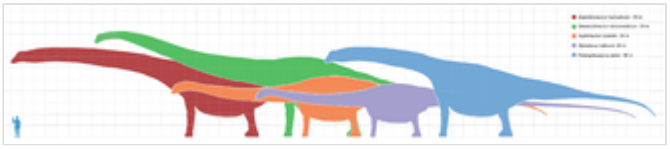
The following is a simplified list of dinosaur groups based on their evolution.[8] Groups with a dagger (†) next to them don't have any living members.

- **Dinosauria**
  - **Saurischia** ("lizard-hipped"; includes Theropoda and Sauropodomorpha)
    - **Theropoda** (all bipedal; most were carnivorous)
      - †Herrerasauria (early bipedal carnivores)
      - †Coelophysoidea (small, early theropods; includes *Coelophysis* and its close relatives)
      - †Dilophosauridae (early crested and carnivorous theropods)
      - †Ceratosauria (generally elaborately horned, the dominant southern carnivores of the Cretaceous)
      - Tetanurae (meaning "stiff tails"; includes most theropods)
        - †Megalosauroidea (early group of large carnivores including the semiaquatic spinosaurids)
        - †Carnosauria (*Allosaurus* and close relatives, like *Carcharodontosaurus*)
        - Coelurosauria (feathered theropods, with a range of body sizes and niches)[6]

The house sparrow is one of the most common living theropods

- †Compsognathidae (common early coelurosaurs)
- †Tyrannosauridae (*Tyrannosaurus* and its close relatives)
- †Ornithomimosauria (meaning "ostrich-mimics"; mostly toothless; carnivores to possible herbivores)
- †Alvarezsauroidea (small insectivores with short arms that each had one large claw)
- Maniraptora (meaning "hand snatchers"; had long, slender arms and fingers)
    - †Therizinosauria (bipedal herbivores with large hand claws and small heads)
    - †Oviraptorosauria (mostly toothless; their diet and lifestyle are uncertain)
    - †Archaeopterygidae (small, winged theropods or primitive birds)
    - †Deinonychosauria (small to medium-sized, bird-like, with a distinctive toe claw.)
    - Avialae (modern birds and their extinct relatives)
        - †Scansoriopterygidae (small primitive avialans with long third fingers)
        - †Omnivoropterygidae (large, early short-tailed avialans)
        - †Confuciusornithidae (small toothless avialans)
        - †Enantiornithes (primitive flying avialans that lived in trees)
        - Euornithes (advanced flying birds)
            - †Yanornithiformes (toothed Cretaceous Chinese birds)
            - †Hesperornithes (specialized aquatic diving birds)
            - **Aves** (modern, beaked birds and their extinct relatives)

- †**Sauropodomorpha** (herbivores with small heads, long necks, long tails)



Size differences of the largest sauropods compared to a human

    - †Guaibasauridae (small, primitive, omnivorous sauropodomorphs)
    - †Plateosauridae (primitive, bipedal "prosauropods")
    - †Riojasauridae (small, primitive sauropodomorphs)
    - †Massospondylidae (small, primitive sauropodomorphs)
    - †Sauropoda (very large and heavy, usually over 15 m (49 ft) long; quadrupedal)
        - †Vulcanodontidae (primitive sauropods with pillar-like arms and legs)

- †Eusauropoda ("true sauropods")
    - †Cetiosauridae ("whale reptiles")
    - †Turiasauria (European group of Jurassic and Cretaceous sauropods)
    - †Neosauropoda ("new sauropods")
        - †Diplodocoidea (skulls and tails elongated; teeth typically narrow and pencil-like)
        - †Macronaria (boxy skulls; spoon- or pencil-shaped teeth)
            - †Brachiosauridae (long-necked, long-armed macronarians)
            - †Titanosauria (diverse; stocky, with wide hips; most common in the late Cretaceous of southern continents)

- †**Ornithischia** ("bird-hipped"; diverse bipedal and quadrupedal herbivores)
    - †Heterodontosauridae (small basal ornithopod herbivores/omnivores with prominent canine-like teeth)
    - †Thyreophora (armored dinosaurs; mostly quadrupeds)
        - †**Ankylosauria** (scutes as primary armor; some had club-like tails)
        - †**Stegosauria** (spikes and plates as primary armor)
    - †Neornithischia ("new ornithischians")
        - †**Ornithopoda** (various sizes; bipeds and quadrupeds; evolved a method of chewing using flexible skulls and many teeth)
        - †Marginocephalia (Had dome-like growths on their skulls made of bone)
            - †Pachycephalosauria (bipedal with domed or knobby growth on skulls)
            - †**Ceratopsia** (quadrupeds with frills; many also had horns)

1.

Dinosaur origins and evolution

Archosaurs

The Archosaurs evolved into two main clades: those related to crocodiles, and those related to dinosaurs.

- **Archosauria**
    - Pseudosuchia: clade of the crocodiles and their relatives.
    - Avemetatarsalia: clade of the dinosaurs, pterosaurs, birds and relatives.
        - Aphanosauria (small group in middle Triassic)
        - Ornithodira: clade of the pterosaurs and dinosaurs.

- Pterosaurs
- Dinosaurs

Earliest dinosaurs

The first known dinosaurs were bipedal predators that were one to two metres long.[9][13]

The early forms *Herrerasaurus* (large), *Eoraptor* (small) and a *Plateosaurus* skull

The earliest confirmed dinosaur fossils include the saurischian ('lizard-hipped') dinosaurs *Herrerasaurus* 230–220 mya, *Staurikosaurus* possibly 230–225 mya, *Eoraptor* 231.4 mya,[14] and *Alwalkeria* 230–220 mya. *Saturnalia*, 232–225 mya, may be a basal saurischian or a prosauropod. The others are basal saurischians.

Among the earliest ornithischian ('bird-hipped') dinosaurs is *Pisanosaurus* 230–220 mya. Although *Lesothosaurus* comes from 199 to 189 mya, skeletal features suggest that it branched from the main Ornithischia line at least as early as *Pisanosaurus*.

Early saurischians were similar to early ornithischians, but different from modern crocodiles. Saurischians differ from ornithischians by keeping the ancestral configuration of bones in the pelvis (shown in a diagram above). Another difference is in the skull: the upper skull of the Ornithischia is more solid, and the joint connecting the lower jaw is more flexible. These features are adaptations to herbivory; in other words, it helped them grind vegetable food.

Adaptive radiation

Dinosaurs were a varied group of animals. Adaptive radiation happened. This let them live in many ecological niches. Paleontologists have identified over 500 different genera and 1,000 species of non-avian dinosaurs.[15] Their descendants, the birds, number 9,000 living species, and are the most diverse group of land vertebrates.

The largest dinosaurs were herbivores (plant-eaters), such as *Apatosaurus* and *Brachiosaurus*. They were the largest animals to ever walk on dry land. Other plant-eaters, such as Iguanodon, had special weapons to help them fight off the meat-eaters. For example, *Triceratops* had three horns on its head shield, *Ankylosaurus* was covered in boney plates, and *Stegosaurus* had spikes on its tail.

The carnivores were bipedal (walked on their back legs), though not as we do. Their body was more towards the horizontal, balanced at the back by their tail. Some were very large, like *Tyrannosaurus*, *Allosaurus* and *Spinosaurus*, but some were small, like *Compsognathus*. It was the smaller sized meat-eaters that may have evolved into birds. The first fossil bird, *Archaeopteryx*, had a skeleton which looked much like that of the dinosaur *Compsognathus*, as T.H. Huxley commented.

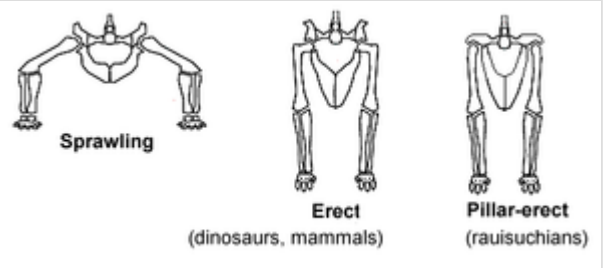
Life style

Locomotion

Dinosaurs were primitively *bipedal*: their probable ancestors were small bipedal Archosaurs. The date of the early dinosaur genus *Eoraptor* at 231.4 million years ago is important. *Eoraptor* probably resembles the common ancestor of all dinosaurs;[16] its traits suggest that the first dinosaurs were small, bipedal predators.[17] The discovery of primitive, pre-dinosaur,[18] types in Middle Triassic strata supports this view. Analysis of their fossils suggests that the animals were indeed small, bipedal predators.

Those dinosaurs which returned to four-legged stance kept all four legs under their body. This is much more efficient than the sprawling legs of a lizard.

The big sauropods could never have reached so large a size without their pillar-like legs. A review surveys what we know about the mechanics of dinosaur movement.[19]



Hip joints and hindlimb postures

Warm blooded

A major change in outlook came in the 1960s, when it was realised that small theropods were probably warm-blooded.[20] The question of whether all theropods or even all dinosaurs were warm blooded is still undecided.

It is now certain (from fossils discovered in China: see Jehol biota) that small theropods had feathers. This fits well with the idea that they were warm-blooded, and that the origin of birds can be traced to a line of small theropods.

Activity

Warm blooded animals have a high metabolic rate (use up food faster). They can be more active, and for longer, than animals who depend on the environment for heating. Therefore, the idea of warm-blooded dinosaurs insulated by feathers led to the idea that they were more active, intelligent and faster runners than previously thought.[20]

Main-stream palaeontologists have followed this view for small theropods, but not for larger herbivores.[21] Since we know that the size of a *Stegosaur*'s brain was about the size of a walnut, there is good reason to think its intelligence was limited.

Limitations

Despite their great success over a long period, there were life-styles which the dinosaurs never evolved. None ever evolved to live entirely in water, as many mammals do, though *Spinosaurus* was semi-aquatic. They never entirely dominated the small terrestrial niche. All through the Mesozoic most small vertebrates were mammals and lizards.[22] We have much to learn still about the smaller fauna of the Mesozoic.

Extinction

The extinctions at the end of the Cretaceous were caused by a catastrophic event: a massive meteorite hit the Earth (the Chicxulub impact). We now know where it hit: in the Yucantan peninsula in what is now Mexico.

Badlands near Drumheller, Alberta. Erosion has exposed the claystone K/T boundary

Several other impact craters, and massive volcanic activity in the Deccan Traps in India, have been dated to about the time of the extinction event. These geological events may have reduced sunlight and hindered photosynthesis, leading to a massive disruption in Earth's ecology.[23]

Did any terrestrial dinosaurs survive the great extinction event? Yes they did, because we now know that birds are descended from dinosaurs. But dinosaurs as generally understood were eliminated. Several fossils have been found in the Hell Creek Formation about 40,000 years later than the K/T extinction event. Many scientists dismiss the "Paleocene dinosaurs" as re-worked, that is, washed out of their original places and then re-buried in much later sediments.[24] An associated skeleton (e.g. more than one bone from the same individual) found above the K/T boundary would be convincing, but no such finds have been reported.

Dinosaurs in fiction

> "...Dragons of the prime,
> that tare each other in their slime". Tennyson, *In Memoriam*,1849.

Books about dinosaurs have been popular, especially with children, but adults have also enjoyed these kinds of books. In Edwardian times, Arthur Conan Doyle wrote a novel about a plateau filled with dinosaurs which he called *The Lost World*.

Jurassic Park in 1990 started a new phase in dinosaur popular culture.

Novel and film adaptations

- *Jurassic Park* (novel), a 1990 novel by Michael Crichton
  - *Jurassic Park* (film), the 1993 film adaptation directed by Steven Spielberg, based on the

novel

- *The Lost World: Jurassic Park* (1997), the second film in the series
- *Jurassic Park III* (2001), the third film in the series

Related pages

- List of dinosaurs
- Dinosaur brains and intelligence
- For "**dinobirds**", see Origin of birds
- K/T extinction event

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