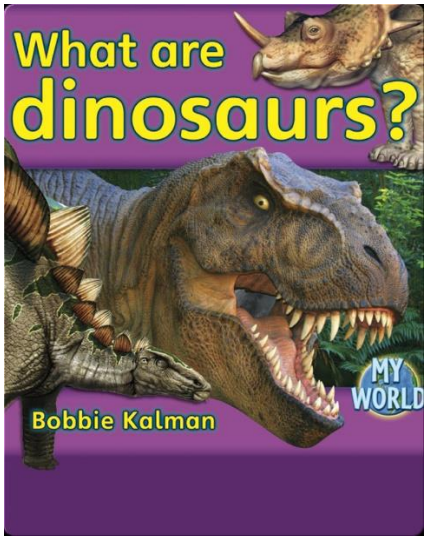


Dinosaur or Not!? Are All Prehistoric Reptiles “Dinosaurs”?

There is no doubt that for many reptile keepers, breeders, and enthusiasts, an early childhood interest and fascination with dinosaurs was the precursor to developing an interest in reptiles and amphibians of today’s world. Owing perhaps to their similarities in evolutionary and ancestral history to modern day birds and reptiles, dinosaurs were an extremely diverse group of reptiles most likely first appearing during the early Triassic period, some 243 to 233 million years ago (or MYA), although their exact origins and timing of their evolution remains subject to further research and debate to this day. Dinosaurs, furthermore, then went on to become the dominant terrestrial (or land-dwelling) vertebrate animals throughout the Jurassic and Cretaceous periods, approximately 201 to 65 million years ago.

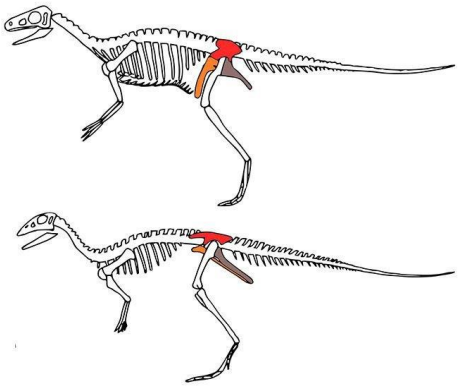
Early History of Dinosaurs

Evidence of dinosaurs, in the form of their fossils and tracks have previously existed throughout the world long before modern scientists referred to themselves as such today. For instance, Native Americans of Flag Point in southern Utah chiseled photographs of distinctly three toed tracks likely inspired by fossilized dinosaur tracks seen in the Jurassic rocks. In 1677, Robert Plot was credited with having been the first to discover a dinosaur bone, which at the time, was simply believed to have been a giant humanoid bone. However, it was not until at some time later on that these bones were correctly identified as dinosaur bones by William Buckland, the first professor of geology at Oxford University. Furthermore, although these dinosaur fossils were being discovered in Britain, and throughout the world, it was not until 1842 that these

groups of reptiles began to be called “dinosaurs” by Sir Richard Owen.

At the time, Buckland had developed the name “Megalosaurus”, the first dinosaur species to be officially named, in 1824, even though most early geologists and other scientists were still largely in the dark as to what these animals actually were. These early findings, such as “Megalosaurus”, as well as other early described species such as “Iguanodon”, were essentially envisioned as large, prehistoric iguanas or crocodiles longer than a city bus.

Owen, however, then came to realize some relationships and consistencies between all of these findings, by concluding that “Megalosaurus”, “Iguanodon”, and a third species, “Hylaeosaurus”, all were united by similar skeletal structures in their hip bones to the exclusion of other saurian reptiles of the same time. It was then that Owen noted that these hip bones were “peculiar among reptiles”, and then proclaimed and argued that “this was sufficient ground for establishing a distinct tribe, or sub-order of saurian reptiles, for which I propose the name of Dinosauria-the terrible lizards.”



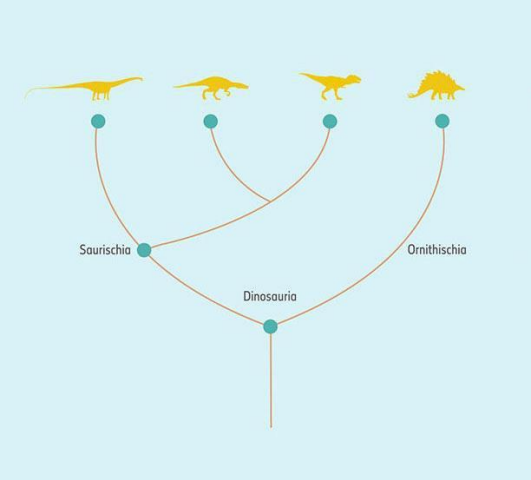
*How Hip Bones, today, Separate the Clade Dinosauria into two groups; Saurischia (lizard-hipped), above, and Ornithischia, below, or the “bird-hipped” dinosaurs. © Natural History Museum.

Ever since then, discoveries of fossilized dinosaur bones, tracks, and other forms of evidence have filled museums and science centers throughout the world as more and more species continued to become recognized and described by paleontologists and other scientists. Even though dinosaurs, and other prehistoric reptiles may be long extinct, they, furthermore, continue to this day to play very large roles in today’s popular culture in all forms of media, from books and stories, to films and movies (perhaps most notably Jurassic Park of 1993, Disney’s “Dinosaur”, “The Land Before Time”, “Walking With Dinosaurs”, and many other titles). The more we learn and discover, as time goes on, the more we continue to learn what actually are, and are not “dinosaurs”.

So What Actually Are Dinosaurs!?

To begin to answer this question, dinosaurs were an extremely diverse group of animals, with there now being well over 1,000 distinctly described “non-avian” species. Some were tiny, or miniscule in size, feeding mostly on insects and other invertebrates, to perhaps small vertebrates, such as the Procomsognathus, while many others were herbivorous, feeding mostly on plants and other vegetative matter, and which had horns, plates, dome shaped skulls, thickened or hardened scutes and armor, or other distinct features used for defense and/or perhaps mating and territorial displays. Well known examples of these herbivorous dinosaurs included species such as Pachycephalosaurus, Anklylosaurus, Stegosaurus, and Triceratops. Some groups of herbivorous dinosaurus, such as the “sauropods”, had long necks for grazing in treetops or other places where most other dinosaurs could not access, and included such species as Diplodocus, Brachiosaurus, and Apatosaurus.

Many other dinosaurs, yet, were carnivorous, using their sharp claws and teeth, and probably good vision, to hunt and feed primarily on other dinosaurs, or other animals, and often includes many species of upright, or two-legged “therapod” dinosaurs such as Allosaurus, Carnotaurus, Giganotosaurus, and perhaps the most famous and well known dinosaur of all, the Tyrannosaurus rex (or “T-Rex”).

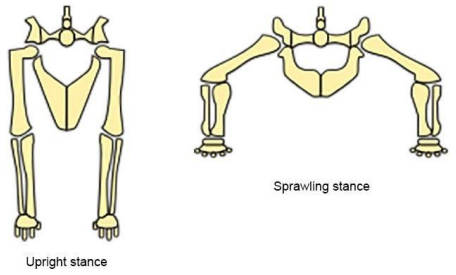


*Simplified Version of the Dinosaur Family Tree, Prior to Any Shakeups. © Natural History Museum.

When it comes to the common use of the word “dinosaurs”, and what we may consider as such in popular culture usage, any large, and/or unusual, prehistoric, or extinct animal superficially resembling dinosaurs in their appearances, are often simply labeled and considered as such. However, our depictions and interpretations of what “dinosaurs” are in these contexts often are very loose, and often do not play “by the rules”, so to speak. Another part of the reason for this common confusion may have to do with it oftentimes being more challenging or difficult for the general public to “conceptualize” geologic periods of time. According to Riley Black,

freelance science writer in evolution, paleontology, and natural history for the Scientific American, it is “quite common in popular thinking to imagine the past as having happened more or less all at once”, meaning the further back in time we may try to go, the more the lines can become blurred.

So, how do we know, or are better able to tell what may be, or may not actually be a “dinosaur”, while setting aside these oftentimes popular “mis notions”? And while also seeing how they might tie into, or relate to modern day herpetology (or the scientific study of amphibians and reptiles), as well as the mis-perceptions relating to today’s modern herptiles, or reptiles and amphibians, collectively speaking? Although paleontology and the study of dinosaurs, and other prehistoric life, still to this day remains the subject of much continued research and even ongoing debate, which would certainly be far beyond the scope of this article, and without getting too deep into the weeds regarding the evolutionary relationships and classifications of the clade “Dinosauria”, which might very well be its own article in of itself, here are several of the most widely or universally recognized differences between several groups of what we may *think* of as dinosaurs, but actually are not, and “true” dinosaurs!



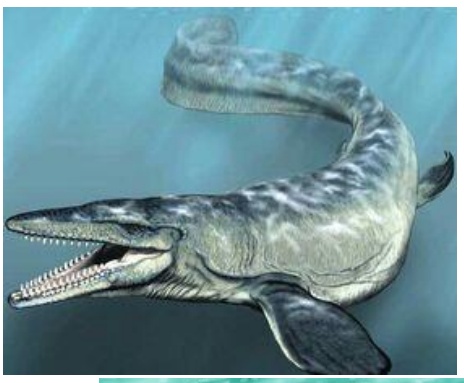
© Natural History Museum.

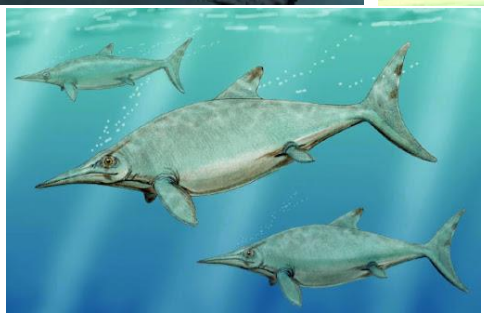
1. Positioning of the Legs. One major differentiating difference between dinosaurs and other reptiles, had to do with evolutionary shifts in the positioning of their legs. While most other closely related reptiles, such as crocodilians and lizards had, or have their legs positioned to the sides of their bodies in a more sprawling stance, most dinosaurs, on the other hand, possessed a more upright, with their legs mostly underneath their bodies. This positioning of their legs acted essentially as “towers” rather than “bridge supports”, enabling “true” dinosaurs to better be able to move about on land, thereby allowing them to devote more energy towards survival and reproduction, which gave dinosaurs a huge evolutionary advantage over other early reptiles. While dinosaurs were ancestrally bipedal, there were also many quadrupedal groups as well, and some dinosaurs were even able to shift between these two stances.

2. Other Differences in Their Skulls And Hip Bones. Dinosaurs also had several other, less distinct or noticeable differences in the skulls and hip bones which set them apart from other Archosaurs (which are a larger and broader group of reptiles that includes crocodilians,

pterosaurs, and birds, but excludes some other groups of reptiles such as snakes, lizards, and tuataras, as well as prehistoric marine reptiles). These differences include an open acetabulum (which is a hole or fenestra in the area where the hip bone meets the femur), as well as an enlarged crest on their upper humerus (known as the deltopectoral crest). Many also had three or more fused sacral vertebra (tail bones near their hip bones), as well.

Other shared features among the Archosaurs include the presence (or absence) of teeth set in sockets, antorbital openings in the skull (openings in front of the eyes), mandibular openings in the jawbones, and a fourth trochanter, which is a specific ridge for attaching muscles on the femur. This key trait may have been an important component to the evolution of the dinosaurs.





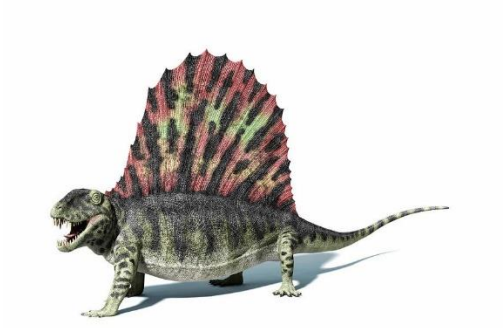
*Mosasaurs, Plesiosaurs, and Ichthyosaurs were all examples of other prehistoric marine reptiles which lived during the same Mesozoic era, but are not “dinosaurs”.

3. Primarily Terrestrial. With the exception of some birds, such as penguins, and perhaps some other dinosaurs found to be semi-aquatic (such as Spinosaurus), which also fall under the Archosaurs group, all “true” dinosaurs were terrestrial, living their lives mostly on land. This excludes all other marine reptiles that lived during the same, or similar times during the Mesozoic era, such as Plesiosaurs, Mososaurs, and Ichthyosaurs. The evolutionary relationships between these groups of marine reptiles remains under review and reconsideration to this day; however, they all fall under the diapsid family tree. Mosasaurs may have been more closely related to squamates (or the snakes and lizards), than to the Archosaurs, while Pleisiosaurs may have been more closely related, evolutionarily, to chelonians (turtles and tortoises). Ichyosaurs

are certainly diapsids, although their evolutionary origins and relationships remain under study.

*Quetzelcoatalus and Pteranodon were examples of Mesozoic flying reptiles, that also were technically not “dinosaurs”.

4. Flying Reptiles. Other groups of flying reptiles, better known as the Pterosaurs, were another group of animals which are commonly called “dinosaurs”, but actually are not. These flying reptiles were more closely related to dinosaurs in that they were both Archosaurs; however, they also had several key differences as well. These flying reptiles flew with membranous wings attached to their elongated fourth fingers, and many may have been covered in a short, hair-like coating known as pycnofibers. None of the “true” dinosaurs had these membranous wings, or the capability of flight, making these groups of Mesozoic reptiles, including the well known Pteranodon, Dimorphodon, and Quetzelcoatalus (which had up to a 33 foot wingspan, making them among the largest known flying animals).



*Dimetrodon sp. Were another genus of extinct prehistoric reptiles commonly and erroneously called “dinosaurs”, but actually are not, and even existed earlier than most other “true” dinosaurs.

5. Other Prehistoric Reptiles. A few other well-known prehistoric animals are also commonly and erroneously considered, or lumped into the groups we know of as "dinosaurs", even though they are, yet again, also not. Dimetrodon sp., which were the large and iconic sail-backed lizard-like reptiles actually occurred approximately 40 million years ago before dinosaurs, some 295 to 272 MYA. These animals actually belong to a group of animals known as the synapsids (or "single arch"), which also includes modern, present day mammals. This means that Dimetrodon sp., as well as a few other prehistoric reptiles with a "sprawling leg structure" previously mentioned, were more closely related to mammals than they were to dinosaurs! Rather than having two temporal openings in their skulls, as in diapsids, their defining characteristic was having only a single temporal opening behind each eye orbit.

Evolutionary Relationships and Origin of Birds

Perhaps no evolutionary or ancestral take on paleontology, or the distinction between what are, and are not dinosaurs would be complete without us also examining the evolutionary origins and relationships between dinosaurs and birds. The possibility of dinosaurs being ancestral to birds was first suggested in 1868 by Thomas Henry Huxley; however, following the work of Gerhard Heilmann of the early 20th century, this theory was abandoned in favor of dinosaurs simply being descendants of more generalized thecodonts, with the key piece of evidence, then, being the supposed lack of clavicles in dinosaurs. However, later discoveries found this not to be the case, as single, fused wishbones, having been derived from separate clavicles), and perhaps previously overlooked or misidentified, began to be found.

**Archaeopteryx, an early bird-like dinosaur falling within the clade "Dinosauria". Archaeopteryx was believed to have been an early transitional fossil between non-avian dinosaurs and birds. © American Museum of Natural History.*

These features, which had been begun to have been found as early as 1924, were found in bird-like species of dinosaurs such as Oviraptor, but were misidentified as interclavicles. During the 1970's, this theory of dinosaurs being the ancestral forms of birds was revived, and which gained momentum due to the increase and advent of better cladistics analysis, as well as the discoveries of many small further small therapod dinosaurs and early birds. Of particular note in this regard, were the variety of fossils of such small therapod dinosaurs and other early birds with evidence of feathers of the Yixian Formation.

Now, birds have been discovered to share over one hundred distinct anatomical features with theropod dinosaurs, now generally accepted as being their closest ancient relatives according to present day scientific consensus. In other words, birds are currently recognized as a group of maniraptoran therapod dinosaurs originating from the Mesozoic era. From the discovery of the first primitive, early bird in the early 19th century, Archaeopteryx in Germany, to other small, very bird-like early theropods such as Microraptor, Anchiornis, Pedopenna, and others, having long and vaned arm and leg feathers which form the wings. Overall, the evidence of feathers, similarities in skeletal structures, complex four chambered hearts, sleeping posture, reproductive biology, brooding and caring for their young, gizzard stones, and other molecular evidence are now all of the features used by the current, majority consensus linking dinosaurs to modern day birds. So, in all essence, "all birds are technically dinosaurs, but not all dinosaurs are, or were birds".

*Microraptor and Anchiornis were other examples of early, "bird-like" therapod dinosaurs.

Sources:

1. Rae, Sam and Lisa Hendry. What are Dinosaurs? Natural History Museum. https://www.nhm.ac.uk/discover/what-are-dinosaurs.html

2. What Makes a Dinosaur a Dinosaur? National Park Service. Fossils and Paleontology. https://www.nps.gov/subjects/fossils/what-makes-a-dinosaur-a-dinosaur.htm

3. ScienceAlert Staff. What Are Dinosaurs? ScienceAlert.com

https://www.sciencealert.com/dinosaurs

4. What is a Dinosaur? Science Museum of Virginia. 27 Aug. 2021. https://smv.org/learn/blog/what-is-a-dinosaur/

5. Black, Riley. What Makes a Dinosaur a Dinosaur? Ask Smithsonian. 8 Dec. 2017. https://www.smithsonianmag.com/science-nature/ask-smithsonian-what-is-dinosaur-180967448/