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DINOSAURS

Walter E. Boles, Eighth Grade, Roosevelt High School
Illustrated by
Tim Ladwig, Eighth Grade, Roosevelt High School

Dinosaurs! This word brings visions of giant monsters of all shapes, strange animals that flew, swam, or walked. But they weren't all giants. Some were no bigger than a cat. Many prehistoric reptiles weren't even dinosaurs. Many animals of long ago would be left out of books only on dinosaurs. This brings up the question: "What is a dinosaur?" The World Book Encyclopedia Dictionary says: "Dinosaur—any of either of two groups of extinct reptiles, some of which grew to enormous size."

This issue of The Kansas School Naturalist will introduce you to these fascinating fossil reptiles—how we know they lived on earth, when they lived, some examples, and several theories as to why they became extinct. From time to time you will no doubt wish to consult the pronunciation guide, the prefix and suffix list explaining the meaning of dinosaur names, and the geological time table at the end of this paper.

How Do We Know There Were Dinosaurs?

Scientists have found preserved remains of dinosaurs, such as bones and teeth. They have also found their tracks still visible in the rocks, where these ancient reptiles once walked across the soft mud bottoms (now turned to stone) of prehistoric swamps. One print was large enough to hold 18 gallons of water! In a few cases even mummi­fied dinosaurs have been found. Some fossils were formed when the dinosaurs died and were covered with sediment. The soft part of the body decayed and disappeared, but the hard parts were gradually replaced by minerals, a process known as petrifaction.

The first dinosaur to be described was an Iguanodon, discovered in England. The first dinosaur found in the United States was a specimen of Hadrosaurus. The earliest indications of dinosaurs in the United States were footprints found in Connecticut. These were long thought to be the tracks of giant birds. They are now believed to have been made by dinosaurs, since the tracks were formed several million years before the first birds appeared on earth.

Fossilized dinosaur eggs (about three inches long) and newly hatched young of a dinosaur named Protoceratops were discovered some years ago in the Gobi Desert of Mongolia.
Scientists have now discovered enough different kinds of fossil remains to describe more than 100 different kinds of dinosaurs. Many dinosaur skeletons have been carefully removed from where they were found, and assembled in life-like positions in various museums in the United States. At the end of this paper may be found a list of museums with well-prepared and interesting dinosaur displays.

How Did Dinosaurs Get Their Names?

The names of dinosaurs are made up of Greek and Latin words describing them. An example is the name Triceratops. The prefix tri- means three, -cerat- means horn, and -ops means face (three-horn-face). Look at the sketch of this dinosaur and see how well this name fits.

In some cases, though, the names that have been given are quite incorrect. Consider the name Geosaurus, which means earth (geo-) lizard (-saurus). Geosaurus was actually a prehistoric crocodile that lived only in the water.

Although some dinosaurs are so well-known as to have accepted common names, most of them are referred to by their scientific names. These names may appear difficult at first, but when broken down into their prefixes and suffixes, are actually easier to learn and remember than most common names. They also have the advantage of being the same all over the world, which is certainly not true of common names. At the end of this paper is a list of the prefixes and suffixes which make up the dinosaurs' names with the meanings, the words (mostly Greek) from which they came, and an example of a dinosaur name using each prefix or suffix. You will find that learning dinosaur names is both easy and fun. The pronunciation guide on page 14 will assist you in the correct pronunciation of the names.

When Did Dinosaurs Live?

Dinosaurs lived so many years ago that it is difficult for man, who seldom lives to be more than a hundred, to comprehend. Geologists have devised a "Geological Time Table" in which the millions of years of the past have been divided into great "chunks" of time, called eras. Eras are in turn divided into periods. Dinosaurs lived during the Mesozoic era (often called the Age of Reptiles), which is divided into three periods, the Triassic (the oldest), the Jurassic, and the Cretaceous (the youngest). See page 13.

What Were the Two Groups of Dinosaurs?

Some of the dinosaurs were carnivores, or meat-eaters, while others were herbivores, or plant-eaters. Scientists, however, usually prefer another classification, based upon the shape of the pelvic or hip bones. They divide them into the reptile-hipped dinosaurs, or saurischians, and the bird-hipped dinosaurs, or ornithischians.

The reptile-hipped dinosaurs were the sauropods, or giant herbivorous forms, and the theropods,
which were meat-eaters. This group included some of the largest and best known dinosaurs that ever lived. The bird-hipped dinosaurs included the stegosaurs, ankylosaurs, ceratopsians or horned dinosaurs, and the ornithopods or duck-billed dinosaurs.

**The Saurischians**

The saurischians are divided into two smaller groups, according to differences in the structures of their bodies. The two are the sauropods and theropods.

**Sauropods**

The sauropods ("lizard-footed") included giant dinosaurs, such as Brontosaurus, Brachiosaurus, and Diplodocus. These are probably the best known of the sauropods, but not the only ones. Others were Apatosaurus, Cetiosaurus, and Camarasaurus. Most sauropods lived in the division of prehistoric time known as the Jurassic period, the middle division of the Age of Reptiles. Some lived in the Cretaceous period, and one, Plateosaurus, a 20-foot forerunner of Brontosaurus, was present during the Triassic period.

*Brontosaurus*, the "thunder reptile"

Paleontologists (men who study fossils) believe that the 70-foot long *Brontosaurus* was a plant-eater, as were all sauropods. Probably the best known of the dinosaurs, *Brontosaurus* has been nick-named the "thunder reptile" because its great weight was believed to have caused the ground to rumble like thunder when it walked. It stood up to 35 feet high and may have weighed as much as 35 tons. *Brontosaurus* spent most, if not all, of its life in the water. The water supported some of the great weight of the body, and also offered protection from the fierce terrestrial predators, such as *Allosaurus*. The long necks of sauropods allowed them to stand in water too deep for their carnivorous enemies. *Brontosaurus* probably gave birth to its young, and so did not have to come onto the land to lay eggs, as did many of the other dinosaurs. *Diplodocus*

*Diplodocus*, though not the heaviest, was the longest of the known dinosaurs; one assembled skeleton measures 87\(\text{\textfrac{\text{\textbar}{\text{\textbar}{\text{\textbar}}}}{\text{\textbar}{\text{\textbar}{\text{\textbar}}}}}{\text{\textbar}{\text{\textbar}{\text{\textbar}}}}\) feet. Its name means the "double-rafter animal," for people thought it would take two sets of rafters or beams to hold up its long body. It was thinner and had a longer neck and tail than its more massive cousins, *Brachiosaurus* and *Brontosaurus*. Its weight was probably about 25 tons. Almost complete skeletons have been found in Wyoming and Colorado.

*Brachiosaurus*

The heaviest known dinosaur was the 40-ton *Brachiosaurus*. Its shoulders were 18 feet off the ground and in all it was 45 feet high. Imagine an animal that could walk up and look over a three-story building! Unlike those of most other huge dinosaurs, such as *Brontosaurus* and *Diplodocus*, the front legs of *Brachiosaurus* were longer than its hind legs. The fact that the nostrils
of this dinosaur were on top of its head, along with the long neck, suggests that it was aquatic in its habitat.

THEROPODS

The second group of reptile-hipped dinosaurs, the theropods (beast footed), were meat-eaters. The best known of these are Allosaurus and Tyrannosaurus. There were many others, such as Ceratosaurus, Gorgosaurus, Megalosaurus, Spinosaurus, as well as some smaller ones, like Ornitholestes ("the bird robber"), Struthiomimus, Compsognathus, and Oviraptor. Compsognathus reached a size no larger than a cat.

Allosaurus

Allosaurus was a 25- to 30-foot long flesh-eater. Its main prey was probably the plant-eating sauropods, and no doubt it did not hesitate to attack animals as large or larger than itself. It was the largest theropod of the Jurassic period, reaching a height of 15 feet. The head was massive, with a great set of jaws armed with many long, sharp teeth. The front legs were quite small, and only served for grasping their prey or scratching. The hind legs, however, were heavy and powerful, allowing it to run down and overtake its slower and weaker prey. The thick muscular tail not only served to help balance the body, but was able to deliver a punishing blow, much as an alligator does to its victim today. Through millions of years Allosaurus slowly developed into Gorgosaurus ("terrible lizard"), which in turn finally evolved into the fearsome Tyrannosaurus. Tyrannosaurus rex, the "king of the tyrant reptiles".

Tyrannosaurus

The most feared creature of the Cretaceous (if not the most feared land carnivore of all time) was the 20-foot tall and 50-foot long Tyrannosaurus. It may have weighed as much as ten tons. Its head was close to five feet long, and
its mighty jaws were lined with rows of six-inch teeth. It resembled a deluxe model of its predecessor, *Allosaurus*. It probably did not hesitate to kill and eat any living creature large enough to satisfy its gluttonous appetite, and feared no animal that roamed the earth. Like most theropods, the tyrant reptile had short, almost useless front legs, but strong, massive hind legs. *Tyrannosaurus* (with the possible exception of *Brontosaurus*) is the most famous of the dinosaurs.

**The Ornithischians**

The ornithischians, though not as large and as well-known as the saurischians we have just discussed, played an important part in the Mesozoic era. Many of the most unusual dinosaurs were ornithischians. Like the saurischians, they are divided into smaller groups, according to differences in their structure.

**Ornithopods**

The feet of ornithopods were bird-like, so are often referred to as ornithopods ("bird-footed ones"). They grew grotesque horns, crests, and spikes on their heads and bodies. *Trachodon*, the best known ornithopod, possessed a strange, duck-like bill, as did *Hadrosaurus*, *Edmontosaurus*, and *Anatosaurus*. Many, like *Parasaurolophus* and *Stephanosaurus*, developed strange crests on top of their heads, while *Kritosaurus* grew a huge nose.

Other ornithopods were *Camptosaurus*, the first known ornithopod; *Iguanodon*, a 35-foot giant; and *Troodon* and *Pachycephalosaurus*, famous for their very thick (9 inch) skulls.

*Trachodon*

*Trachodon* had about 2000 small teeth in its mouth. As mentioned earlier, its mouth was somewhat duck-like in shape, and so it is often called a "duck-billed" dinosaur. It was about 30 feet long and 16 feet high. The feet were webbed for swimming in swamps, where most of the ornithopods lived. A mummified *Trachodon*, found in 1906, showed the skin of this dinosaur to be pebbled, like the cover of a golf ball. They fed upon the soft aquatic plants that grew in the swamps about them.

**Ceratopsians**

This group of bird-hipped dinosaurs, ranging in size from five to 25 feet in length, are called the ceratopsians because of the horns that developed on the heads of several species. This name is not too accurate for the group, as some, such as *Psittacosaurus* and *Protoceratops*, had no horns. *Pentaceratops* and *Styracosaurus*, however, deserved the name, as the first had five horns and the second had seven.

Horns appear to have developed after the ceratopsians had been on the earth for millions of years. The oldest fossil ceratopsian is a hornless form named *Psittacosaurus*. In a newer layer of rocks *Brachyceratops* was found, and above this layer paleontologists discovered *Protoceratops*. This form of dinosaur then evolved into still another form. Fossils may be arranged to show the advances a group of related organisms have made through the ages. Such an arrangement of the horned dinosaurs is shown on page 8.

*Triceratops*, the great horned dinosaur

The best known ceratopsian was probably *Triceratops*, who roamed the earth during the Cretaceous period, over 55 million years ago. Like all ceratopsians, it was a plant-eater. Its head was eight feet long, with two powerful horns and a smaller horn on the nose. A large frill protected the neck from attack. Great scars and gouges in this frill sug-
Triceratops

gest that Triceratops fought savage battles among themselves, perhaps for mates. This dinosaur stood about eight feet high and weighed ten tons. The last and largest of the horned forms, Triceratops, was probably one of the few creatures able to hold its own, and perhaps even to defeat, Tyrannosaurus in battle.

ANKYLOSAURS

Some large ceratopsians were built like army tanks, and some resembled rhinoceroses. The real tanks of the Mesozoic, however, were the ankylosaurs (curve lizard). They had many types of armor.

Ankylosaurus

Ankylosaurus was an 18-foot Cretaceous plant-eater. Its armor protected it from enemy attacks from above. The only way to get to a soft section of its body was to turn it over. The low, squat shape of the body, the spikes along each side, and the club on the end of the tail would have made this both a difficult and dangerous undertaking.

Paleoscincus resembled Ankylosaurus in that it also had bony plates on its back, a bone club on the end of the tail,

Advances in development of horn in ceratopsians
and a row of spikes on each side of the body. *Nodosaurus* had a "coat-of-mail," *Scolosaurus* had small spikes on its back with a double-pointed tail, *Syrmosaurus* had a bony club, and *Polacanthus* had enormous spikes on its back.

**Stegosaurs**

Close relatives of *Ankylosaurus* were the stegosaurs (roof lizard). Some of the best known stegosaurs were *Kentrosaurus*, *Osmosaurus*, *Scelidosaurus*, and *Stegosaurus*. The reptiles of this group had large, bony plates on their backs. *Stegosaurus*, the "roofed lizard.

A 20-foot Jurassic herbivore, *Stegosaurus* had one of the smallest brains in proportion to its body size of any of the dinosaurs. It had a large nerve center near the hips to help control its movements. This condition gave rise to the fable that some dinosaurs had two brains. The double row of large bony plates on its back and the four long sharp spikes on the end of its tail served as weapons of defense.

**Stegosaurus**

**Where Did the Dinosaurs Come From?**

The dinosaurs are believed to have developed from a small type of reptile called a thecodont (box lizard). The diagram of a dinosaur family tree on page 10 shows how these reptiles may have evolved from such an ancestral form. The pterosaurs, or flying reptiles, also probably evolved from thecodont ancestors. The plesiosaurs, ichthyosaurs, and other aquatic dinosaur types appear to have developed from the cotylosaurs, an earlier reptile from which the thecodonts also evolved. Though the flying and aquatic (open water) types of prehistoric reptiles are not discussed in this paper, they are interesting and fascinating. The references listed on page 11 contain information for those who wish to read about these extinct reptiles.

**Why Did the Dinosaurs Become Extinct?**

After roaming the earth for about 100 to 150 million years, the dinosaurs died out about 55,000,000 years ago, not suddenly, as many think, but over a period of millions of years. Why and how they became extinct is one of the major questions of paleontology.

Some of the ways dinosaurs met their deaths can be reasoned out by scientists. Many of them were killed by other dinosaurs for food. Some were drowned, some trapped in quicksand. Earthquakes, volcanoes, and increasing desert-like conditions took their toll, too. An epidemic may have killed many. The appearance of the first tiny mammals may have helped to spell the doom of these mighty creatures by breaking up the nests of the egg-laying forms.

Whatever the causes, dinosaurs are now extinct. Only their remains are left behind. Visit some of the museums listed on page 11 and see the assembled fossils of these interesting prehistoric reptiles, once the great and terrible rulers of the earth.
A Dinosaur Family Tree
SELECTED READINGS


PLACES WHERE DINOSAUR FOSSILS MAY BE SEEN

CHICAGO NATURAL HISTORY MUSEUM, Chicago, Illinois.

COLORADO MUSEUM OF NATURAL HISTORY, Denver, Colorado.

DINOSAUR NATIONAL MONUMENT MUSEUM, Jensen, Utah.

FORT HAYS KANSAS STATE COLLEGE MUSEUM, Hays, Kansas.

HANCOCK-PARK TAR PITS, Los Angeles, California. (Operated by Los Angeles Co. Museum)

MUSEUM OF NATURAL HISTORY, Eugene, Oregon.

MUSEUM OF PALEONTOLOGY, University of California, Berkeley, California.

NATIONAL MUSEUM, Ottawa, Canada.

PALEONTOLOGICAL MUSEUM, Fort Peck, Montana.

PEABODY MUSEUM OF NATURAL HISTORY, Yale University, New Haven, Connecticut.


SOUTH DAKOTA STATE COLLEGE OF APPLIED SCIENCE, Rapid City, South Dakota.

THE AMERICAN MUSEUM OF NATURAL HISTORY, Central Park West at 79th Street, New York, New York. This museum has one of the world’s greatest collections of dinosaurs.

UNIVERSITY OF KANSAS MUSEUM, Lawrence, Kansas.

UNIVERSITY OF NEBRASKA MUSEUM, Lincoln, Nebraska.

UNIVERSITY OF UTAH GEOLOGICAL MUSEUM, Salt Lake City, Utah.
The above represents the artist's conception of how a large aquatic dinosaur of the sauropod family might have looked in an early or middle Mesozoic landscape.

**THE COVER PICTURE** shows Tim Ladwig, left, and Wally Boles, right. Like most active eighth-grade youngsters, they have many interests. The two boys combined Wally's interest in herpetology and writing and Tim's artistic ability to produce this issue of The Kansas School Naturalist, the first issue written and illustrated by junior high school students. The small reptile in the center of the picture is a pet collared lizard, while the *Tyrannosaurus* is one of several excellent reproductions to be seen at Renfro's Miniature Golf Course in Emporia, Kansas.

Both boys are sons of faculty members. Wally's father is Dr. Robert J. Boles, of the Department of Biology, who has appeared in several previous issues of the Naturalist, both as author and as illustrator. Tim's father is Mr. Tom Ladwig, Director of Publicity, KSTC.
### GEOLOGIC TIME TABLE

<table>
<thead>
<tr>
<th>Era</th>
<th>Period</th>
<th>Estimated time since beginning of Era or period in millions of years</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CENOZOIC</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Age of Mammals)</td>
<td>Quarternary</td>
<td>Glacial conditions, with great ice sheets coming down from the north and then slowly retreating. 1</td>
</tr>
<tr>
<td>(Age of Reptiles)</td>
<td>Tertiary</td>
<td>Warm climates, gradually cooling. The shallow seas and probably disappeared from Kansas and surrounding states. Some mountains, such as the Alps, were formed. 55</td>
</tr>
<tr>
<td></td>
<td>Cretaceous</td>
<td>Great swamps were present at the first of the period. The Rocky Mountains and the Andes Mountains were then pushed up, and the climates became cooler. 120</td>
</tr>
<tr>
<td><strong>MESOZOIC</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Age of ancient life)</td>
<td>Jurassic</td>
<td>Much of the continent was near sea-level, with many swamps and shallow seas. The climate was warm and humid. 155</td>
</tr>
<tr>
<td></td>
<td>Triassic</td>
<td>Much of the land was dry and arid. Desert conditions were wide-spread. 190</td>
</tr>
</tbody>
</table>

*This table is arranged the way the layers of rock have been formed on the earth, with the oldest layers being on the bottom. Fossils found in the deeper layers are considered to be older than those found in the layers above them.*

### THE GEOLOGIC TIME SCALE

All of geologic time, beginning four or five billion years ago, has been divided into intervals known as eras. The eras are, in turn, subdivided into periods. No two eras have the same number of periods nor are any of the periods of equal duration.

About 500 million years ago the Paleozoic era was ushered in with the beginning of a continuous fossil record. From this time to the present, most of the rocks that were deposited contain some fossils, and some rocks are composed almost entirely of fossil shells. The fossils found in the rocks of the lower part of the Paleozoic are shells of invertebrate animals. Similar animals dominated the Upper Paleozoic, but there is evidence that fishes, amphibians, and reptiles were all in existence by the end of this era.

At the close of the Paleozoic, the Mesozoic Era began, with the rapid domination of the earth by the reptiles. Invertebrates still existed as well as fishes and amphibians, but throughout the Mesozoic the reptiles flourished. The abrupt extinction of many forms of reptiles and the rapid takeover by mammals ended the Mesozoic. We are now living in the Cenozoic Era, which has been dominated by the mammals since its beginning.
### A GUIDE TO ASSIST IN THE PRONUNCIATION OF DINOSAUR NAMES

**ALLOSAURUS**
- AL-LO-SAWR'-US

**ANATOSAURUS**
- A-NAT-O-SAWR'-US

**ANKYLOSAURUS**
- ANK-E-LO-SAWR'-US

**APATOSAURUS**
- AP-A-TO-SAWR'-US

**BRACHIOSAURUS**
- BRAK-E-O-SAWR'-US

**BRACHYCEPHALOSAURUS**
- BRAK-E-SEF-A-LO-SAWR'-US

**BRONTOSAURUS**
- BRONT-O-SAWR'-US

**CAMELTOOTH**
- KAM-AR-A-SAWR'-US

**CAMPTOSAURUS**
- KAMP-TO-SAWR'-US

**CENTRASAURUS**
- SEN-TRO-SAWR'-US

**CERATOSAURUS**
- SER-AT'-O-SAWR'-US

**CELIOSAURUS**
- SEE-T-O-SAWR'-US

**COMPYSNAUTHUS**
- COMP-SOC-NATH'-US

**CORYTHOSAURUS**
- KOR-ITH-O-SAWR'-US

**DINOSAUR**
- DIN'-O-SAWR

**DILODOSAURUS**
- DIP-LO'-DOC-US or DI-PLOD'-O-CUS

**EDMONTSOARUS**
- ED-MONT-O-SAWR'-US

**GORGOSAURUS**
- GOR-GO-SAWR'-US

**HADROSAURUS**
- HAD-RO-SAWR'-US

**IGUANODON**
- I-GWAN'-O-DON

**KENTRASAURUS**
- KEN-TRO-SAWR'-US

**KRITOSAURUS**
- KRIT-O-SAWR'-US

**LAMBOSAURUS**
- LAMB-E-O-SAWR'-US

**MEGASAURUS**
- MEG-A-LO-SAWR'-US

**MONOCEROS**
- MON-O-KLON'-E-US

**NODOSAURUS**
- NO-DO-SAWR'-US

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**OMOSAURUS**
- OM-O-SAWR'-US

**ORNITHOLESTES**
- ORN-I-THO-LES'-TEEZ

**OVIRAPTOR**
- O-VI-RAP'-TOR

**PACHYCEPHALOSAURUS**
- PAK-E-SEF-A-LO-SAWR'-US

**PALAEOSCINCUS**
- PAL-E-O-SKINK'-US

**PENTACERATOPS**
- PEN-TA-SER'-A-TOPS

**PHLEBOPHON**
- PHLE-BOP-THON

**POTEKOSaurus**
- PRO-TO-SER'-A-TOPS

**PETRACERATOPS**
- PETRA-SEF-A-LO-SAWR'-US

**PHRENOLOGY**
- PHRE-NO-LOG'-EE

**PSEUDOSAURUS**
- PSEU-DO-SAWR'-US

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### A LIST OF THE PREFIXES AND SUFFIXES USED IN THE NAMES OF DINOSAURS

<table>
<thead>
<tr>
<th>PREFIX-SUFFIX</th>
<th>MEANING</th>
<th>ORIGINAL WORD(S)</th>
<th>LANGUAGE</th>
<th>EXAMPLE</th>
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<td>ProtoCERATops</td>
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<td>chasma</td>
<td>Greek</td>
<td>CHASMOsaurus</td>
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<tr>
<td>Term</td>
<td>Meaning</td>
<td>Origin</td>
<td>Greek Term</td>
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<td>DIonoSaur</td>
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<td>DiploDOCUS</td>
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Patricia Bailey Witherspoon, Stepping Stones to Australia, November 11, 1965.


Robert C. Hermes, Between the Tides, April 22, 1966.

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