Shedding Light on the Dinosaur-Bird Connection

This text is provided courtesy of the American Museum of Natural History.

When people think of dinosaurs, two types generally come to mind. There were the huge herbivores, like *Apatosaurus*, with their small heads and long tails. There were also those fearsome carnivores, like *Tyrannosaurus rex*, that walked on two legs and had a mouthful of teeth like kitchen knives.

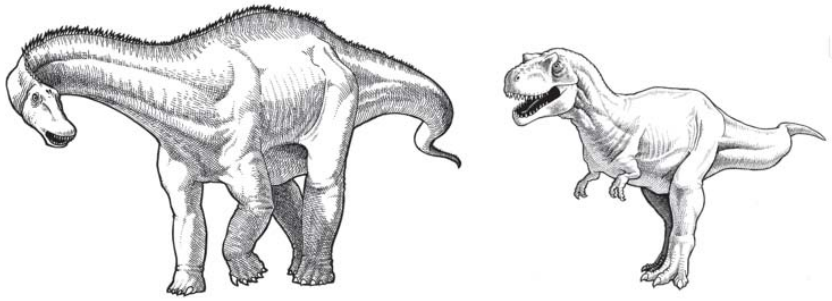
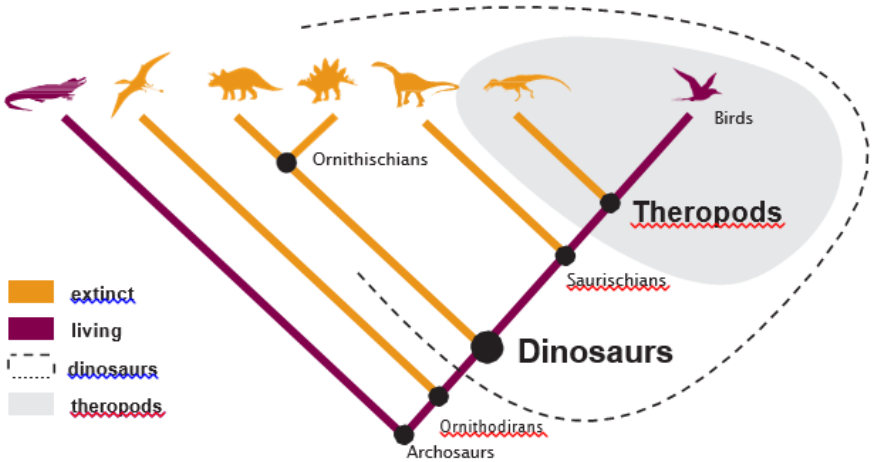


Image Credit: © AMNH

Living Dinosaurs

These large dinosaurs are no longer around, but dinosaurs still live among us today. They are the birds. It's difficult to imagine that a bird on your window sill and a *T. rex* have anything in common. One weighs less than a pound. The other was the size of a school bus, tipping the scales at eight tons. But for all their differences, the two are more similar than you might think. In fact, birds and *T. rex* are close relatives. They all belong to a group of dinosaurs called theropods.



This is a cladogram, a "tree" showing the relationships among organisms. The group called dinosaurs includes the extinct dinosaurs and all their living descendants. All its members, including living birds, descended from the very first dinosaur—their common ancestor. That's why birds are a kind of dinosaur (just as humans are a kind of primate).
Image Credit: © AMNH

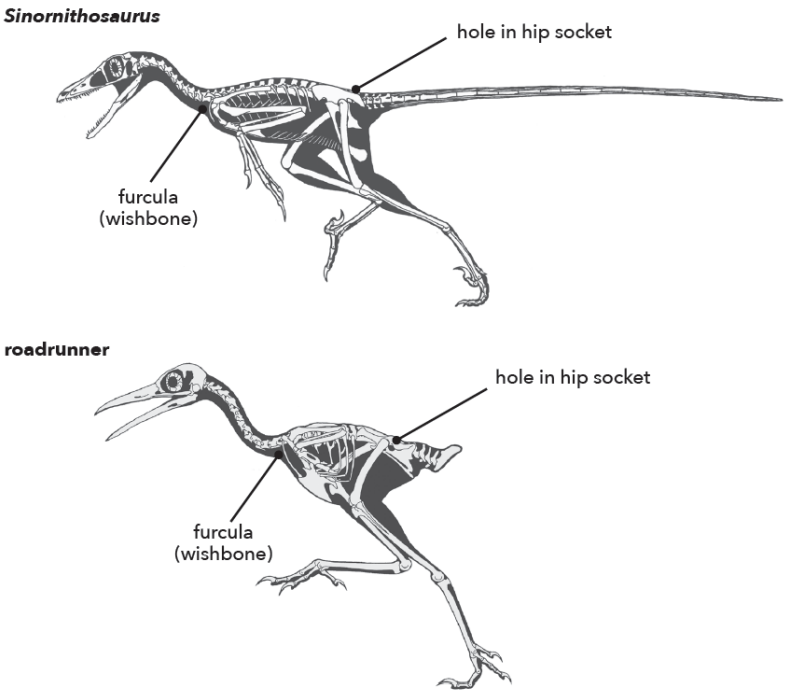
Finding the Evidence

Photo Credit: © Pamala Wilson

To better understand the link between non-bird dinosaurs and birds, scientists look for features they share. When studying living birds, they can observe their behavior and study their anatomy. It's a different story altogether when it comes to long-extinct dinosaurs. Behavior cannot be observed, and all that's left of these animals are the clues found in ancient rocks. This evidence includes fossilized bones, teeth, eggs, footprints, teeth marks, and even dung.

Skeletal Evidence

When paleontologists compare a skeleton of a living bird to the fossilized skeleton of a non-bird theropod, like *Sinornithosaurus*, they see many similarities. They both have a hole in the hipbone, a feature that distinguishes most dinosaurs from all other animals. This feature allows an animal to stand erect, with its legs directly beneath its body. All theropod dinosaurs, including birds, have a furcula, also known as a wishbone. Another shared characteristic is the presence of hollow bones. Hollow bones reduce the weight carried by an animal. This feature enables the animal to run faster. It probably also played a role in the evolution of flight.



Sinornithosaurus and the roadrunner are both theropod dinosaurs.
Image Credit: © AMNH / Sean Murtha

Behavioral Evidence

Birds build nests, lay eggs, and brood their nests. When scientists look at some non-bird theropod fossils, they see evidence of these same behaviors. The first discovery of this evidence was in 1993 in the Gobi Desert in Mongolia. Scientists unearthed a *Citipati* fossil brooding a cluster of eggs. Its limbs were folded back against its body. It is one of the few fossils ever found that demonstrates behavior. In this case, parental care. It shows that the behavior of brooding the nests that we see in living birds was already present in the non-bird ancestors of birds.

Photo Credit: © AMNH / Mick Ellison

Citipati, like many other non-bird dinosaurs, had feathers. Yet it could not fly. Feathers were once thought to have evolved for flight. The discovery of more and more non-flying dinosaurs with feathers disproved that explanation. For these dinosaurs, feathers may have served other functions, like gliding, insulation, protection, and display. Feathers play that same role in many bird species today.

Based on the evidence of shared characteristics, scientists have concluded that birds are a type of theropod dinosaur.

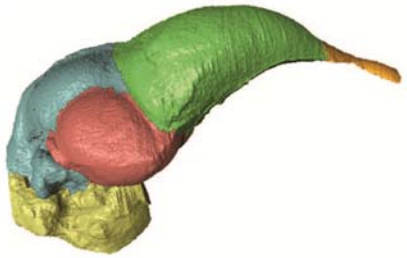
Sinornithosaurus had feathers similar to those of modern birds—even though it could not fly.
Photo Credit: © AMNH / Mick Ellison

Brain Evidence

Birds are the only dinosaurs with the ability to fly. This is very interesting to scientists who want to know when the capability of flight

emerged. To find out, some scientists study the brains of bird and non-bird dinosaurs. Soft tissue, such as brains, is almost never preserved in the fossil record. What is preserved is the imprint the brain left on the inside of the skull. Now scientists are using computed tomography (CT) scanners to create endocasts. These are detailed, three-dimensional reconstructions of the interiors of fossilized skulls.

In a recent study, researchers were able to peer inside the braincases of more than two dozen specimens. "Technology allows us to look inside these specimens without destroying them," says Dr. Amy Balanoff, a Museum research associate. "It's a non-destructive way to basically slice up a dinosaur brain. We look inside and see what it can tell us about the evolution of the brain within dinosaurs. Most of us grew up thinking that dinosaurs had tiny brains, but actually some had really big brains."



Scientists use computed tomography (CT) scans of dinosaur skulls to create detailed, 3-D reconstructions of their interiors. This one shows the space inside the skull of *Archaeopteryx*. *Image Credit: © AMNH / Amy Balanoff*

The endocasts allow Balanoff and other researchers to explore the outer shape of the brain in more detail. In addition, the casts also provide new information about the volume and shape of different regions of the brain. For example, scientists looked at a detailed view of the dinosaur cerebrum, a region of the brain related to cognition and coordination. They found that this region was very large in non-bird dinosaurs closely related to birds. Dr. Balanoff's research suggests that these dinosaurs developed big brains long before flight and that these bigger brains prepared the way for them to fly.

When examining skeletal, behavioral, and brain evidence, scientists see that birds and non-bird dinosaurs share many features. This helped them conclude that dinosaurs aren't extinct after all. They're living among us today.

Name: _____ **Date:** _____

1. What dinosaurs still live among us today?

A) herbivores like *Apatosaurus*
B) carnivores like *Tyrannosaurus rex*
C) birds
D) reptiles

2. To organize this text, the author has divided it into sections. One of the sections has the subheading "Living Dinosaurs." What does the author contrast with a bird in this section?

A) an *Apatosaurus*
B) a *T. rex*
C) a *Sinornithosaurus*
D) a *Citipati*

3. The skeletons of birds and non-bird theropods are similar.
What information in the text supports this claim?

A) The skeletons of birds and non-bird theropods both include wishbones.
B) The skeletons of birds and non-bird theropods both have tiny skulls.
C) Many skeletons of birds and non-bird theropods have been found in the Gobi Desert.
D) Scientists have used computed tomography scans to create endocasts of the skeletons of non-bird theropods.

4. Read this sentence from the text.
“In fact, birds and *T. rex* are close relatives.”

Based on the information in the text, what is another dinosaur that is probably a close relative of birds?

A) *Apatosaurus*
B) *Stegosaurus*
C) *Citipati*
D) *Triceratops*

5. What is the main idea of this text?

A) Some dinosaurs, such as *Apatosaurus*, were huge herbivores with small heads and long tails.
B) Scientists can learn about extinct dinosaurs by studying fossilized teeth, footprints, and dung.
C) Scientists are using endocasts to learn about the volume and shape of dinosaurs' brains.
D) Based on a variety of evidence, scientists have concluded that birds are a type of dinosaur.

6. Read these sentences from the text.
"When paleontologists compare a skeleton of a living bird to the fossilized skeleton of a non-bird theropod, like *Sinornithosaurus*, they see many similarities. They both have a hole in the hipbone, a feature that distinguishes most dinosaurs from all other animals. This feature allows an animal to stand erect, with its legs directly beneath its body. All theropod dinosaurs, including birds, have a furcula, also known as a wishbone. Another shared characteristic is the presence of hollow bones."

What does the word "characteristic" mean here?

A) quality or trait
B) opinion or belief
C) fossil or skeleton
D) animal or dinosaur

7. Read these sentences from the text.
"Feathers were once thought to have evolved for flight. The discovery of more and more non-flying dinosaurs with feathers disproved that explanation. For these dinosaurs, feathers may have served other functions, like gliding, insulation, protection, and display."

What word or phrase could replace "like" in the last sentence without changing the sentence's meaning?

A) after
B) never
C) instead of
D) such as

8. By examining different kinds of evidence, scientists saw that birds and non-bird dinosaurs share many features. One kind of evidence that scientists examined was skeletal evidence. What was another kind of evidence they examined?

9. What is a feature shared by birds and non-bird dinosaurs?

10. Imagine that scientists have just discovered a non-bird dinosaur skeleton. They want to know whether the dinosaur was closely related to birds. What features in the skeleton might help them decide? Support your answer with information from the text.