

You Are a Paleontologist

Observing and Comparing Fossilized Bones

Question How can fossilized bones suggest information about the evolutionary history of species?

Lab Overview In this investigation you will take on the role of a paleontologist researching the history of birds, as you examine and piece together part of a skeleton from duplicate fossilized bones. Then you will compare the partial skeleton to skeletons of a modern-day alligator and bird.

Introduction Paleontologists observe skeletal features and make inferences about an animal's behavior, such as how it moved and how it obtained food. As you may recall from Chapter 14, paleontologists also compare similar skeletal structures of organisms to hypothesize the evolutionary relationships of species. In this lab, you will examine a partial skeleton of a dinosaur that shows several bird-like characteristics.

Background In 1964 scientist John Ostrom discovered the fossil skeleton that you will study in an area called the Cloverly Formation in Bridger, Montana. The area that Ostrom and his team prospected that field season had not yielded as many fossils as they had hoped. However, on the last day of the season, Ostrom discovered some bones he could not identify. The next year he returned to search for more of the skeleton. Eventually this newly discovered, extinct animal was named *Deinonychus*.

Deinonychus lived during the early Cretaceous period, approximately 100 million years ago. It belonged to a group of dinosaur species called *theropods*, relatively small meat-eating dinosaurs that walked on two legs. The animal received its name, which means "terrible claw," because the second toe on each of its hind feet had a large, sharp claw that probably was used to tear the flesh from prey. The claws were held up off the ground as the animal moved about, possibly preventing the claws from wearing down.

As you will observe, *Deinonychus*'s skeleton shares many features of the skeletons of both modern alligators and birds. Many researchers hypothesize that the ancestor of birds was a feathered theropod. However, other researchers hypothesize that theropods and birds share common features because they had a common ancestor from which both lineages evolved separately. Much further research is needed to evaluate these two hypotheses. In this lab, you will model the work performed by paleontologists as you examine *Deinonychus* and identify the reptilian characteristics its skeleton retains as well as the bird-like features it displays.

In the Prelab Activity, read about how fossils are removed from the ground and how they are transported. Then answer the Prelab Questions that follow.

Prelab Activity Removing fossils from rock is a long process that requires skill and a lot of patience. First, the rock surrounding the top and bottom of the fossils is removed with large earth-moving equipment. Scientists use smaller equipment such as shovels, picks, and brushes when working close to a fossil. Before removing a fossil from the ground, workers must encase it in a plaster “jacket” to prevent it from crumbling during transport to the laboratory. After treating a fossil with glue to harden it, paleontologists cover the top of the fossil with tissue paper or foil to protect it from the plaster. The plaster is allowed to harden on the top and sides of the fossil. Then the paleontologist climbs under the fossil and frees it from the ground. The fossil is removed from the rock and flipped over so that plaster can be applied to the bottom side.

In the lab, a person called a “preparator” begins the long process of removing the plaster jacket and the small bits of rock still surrounding the fossil. The preparator may use a microscope and tools as fine as needles to clean the fossils literally one grain of sand at a time. Once the bones are free from the rock, paleontologists may make casts (plastic duplicates) of the bones to send to other paleontologists so they can collaborate in studying them.

Prelab Questions

1. Describe the process by which paleontologists and their team remove fossils from rock.

2. Fossil skeletons are rarely complete. How do you think casts and collaboration help paleontologists create more complex skeletal models?

3. What role do you think inferences play in the work of a paleontologist?

Materials

- replica fossilized bone “casts” (see the end of the lab)
- scissors
- paper
- tape or glue

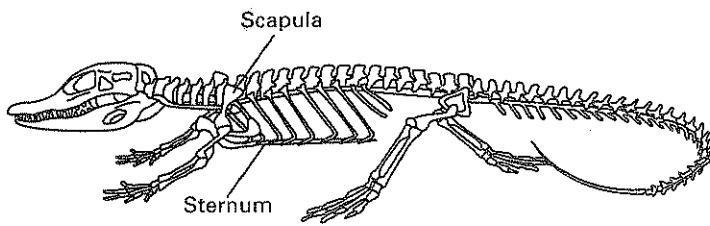
Procedure

Part A: Piecing Together *Deinonychus* 

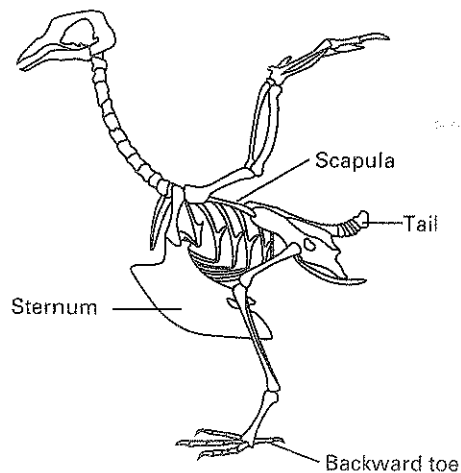
1. Cut out the “casts” and spread them out on a flat surface.
CAUTION: *Handle scissors with care to avoid injury.* Note that this is only a partial skeleton. Very seldom does a fossil dig produce a complete skeleton. In this fossil dig, for example, paleontologists were only able to obtain the limbs from the left side of the animal’s body. Try to fit the bones together. First, locate recognizable bones such as the skull and backbone.
2. Use the reference skeletons in Part B below to guide you in the placement of the other bones. Collaborate with other groups if you cannot decide where to place a bone.
3. Once you have decided how the bones should be connected, tape or glue them in place on a piece of paper.

Part B: Comparing *Deinonychus* to a Modern-Day Alligator and Bird

Look closely at the scapula, sternum, tail, and feet of all three skeletons. Note that both *Deinonychus* and the bird have an extra toe that points backward. Fill in the data table on the next page by checking off which features you observe in each skeleton.



Modern-day alligator



Modern-day bird

Data Table

Characteristic	Alligator	Bird	<i>Deinonychus</i>
Narrow scapula (shoulder blade)			
Wide scapula (shoulder blade)			
Prominent sternum (breastbone)			
Three primary toes on hind feet			
Four primary toes on hind feet			
Extra toe that points backward			
Hind legs underneath the body rather than to the sides			
Long tail			
Short tail			
Claws on front feet			
Claws only on hind feet			
Bipedal (walks on 2 legs)			
Quadrupedal (walks on 4 legs)			
Teeth			

(NOTE: This data table includes only a small subset of the characteristics paleontologists examine when comparing dinosaur skeletons to those of modern-day animals.)

Analysis and Conclusions

1. Which part of the *Deinonychus* skeleton did you find the most difficult to identify and put in place? Explain.

2. Describe the features you observed that the *Deinonychus* skeleton has in common with that of a modern-day alligator.

3. Describe the features you observed that the *Deinonychus* skeleton has in common with that of a modern-day bird.

4. Scientists ask the following two questions when inferring whether some dinosaurs may have been the link between ancestral reptiles and modern-day birds:

- Are there any fossil birds that retain more reptilian features than birds that are now living?
- Are there any fossil reptiles that show more bird-like features than any reptiles now living?

Does *Deinonychus* provide an answer to either of these questions? Explain.

Extension

On a separate sheet of paper, sketch an example of what you think the earliest bird may have looked like. Write a paragraph explaining the features of the bird in your sketch.

