

Bone Detectives

OBJECTIVES

Students assemble model dinosaur skeletons and then draw what they think the original animals actually looked like. They begin to understand the process scientists go through when attempting to reconstruct the past.

The students

- ▶ construct model dinosaur skeletons
- ▶ predict the appearance of the animals represented by the skeletons
- ▶ examine dinosaur models to compare their conclusions with those of scientists

SCHEDULE

About 45 minutes

VOCABULARY

skeleton

MATERIALS

For each student

- 1 Activity Sheet 3, Parts A, B, and C

For the class

- 8 dinosaur models (do not include the plesiosaur or Pteranodon)
- 2 skeleton models, Brachiosaurus
- 2 skeleton models, Stegosaurus
- 2 skeleton models, Triceratops
- 2 skeleton models, Tyrannosaurus

PREPARATION

- 1 Make a copy of Activity Sheet 3, Parts A, B, and C, for each student.
- 2 Prepare one of the eight wooden skeleton models for each team of four by checking that all the pieces are present. Place the pieces on top of the box they came in, leaving the assembly instructions inside the box.
- 3 Remove the dinosaur models from sight for the first part of the class.

BACKGROUND INFORMATION

Most of what is known about dinosaurs has been discovered by reconstructing their **skeletons**. In order to do so, scientists refer to other known dinosaur skeletons and to the skeletons of present-day animals. They also keep careful records of the exact placement of the bones when excavated and use this information to guide their reconstruction.

In order to make any reasonable predictions about the appearance of dinosaurs, scientists must have a good knowledge of the skeletal systems of living animals. This allows them to predict where particular dinosaur bones might belong in the body and how they might be put together.

Knowledge of muscles and tendons in living animals can help scientists decide how the body of the dinosaur would look fleshed out. The bones themselves offer clues to this as well: heavy bones require thick muscles to support them, and often it is possible to detect the actual spots where tendons once attached to the bones, indicating the shape and size of the muscles once overlying the bones.

The skeletons also offer clues about the physiology of the dinosaurs: small skull cavities indicate small brains; widely spaced ribs indicate large lungs and hearts.

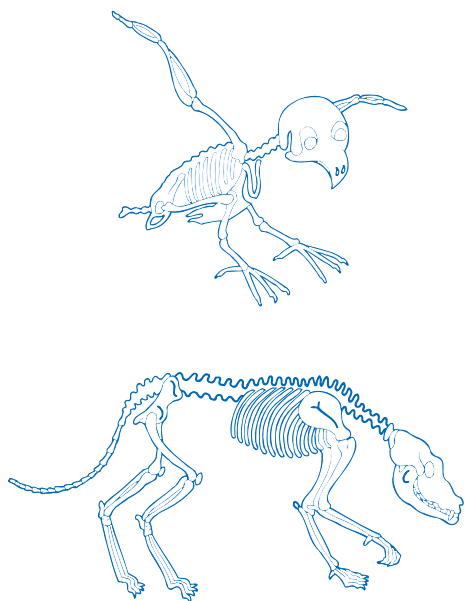
Scientists often have incomplete skeletons from which to work, sometimes only a few bones, and must be masters of detection to predict reasonable reconstructions. Many of the early dinosaur reconstructions have since been proven to be incorrect, and scientists have put together the same bones to form animals with quite different appearances from the original predictions.

▼ Activity Sheet 3, Part A

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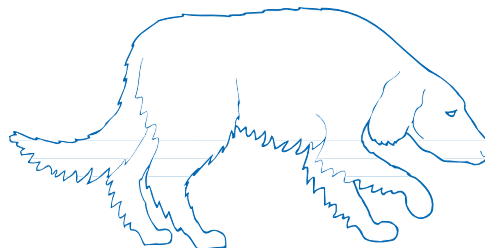
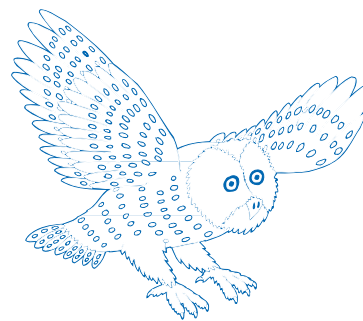
1. Look at these skeletons. Draw the rest of the body around the animal.

Drawings will vary.



▼ Activity Sheet 3, Part B

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2. How did your drawings differ from the actual animals?

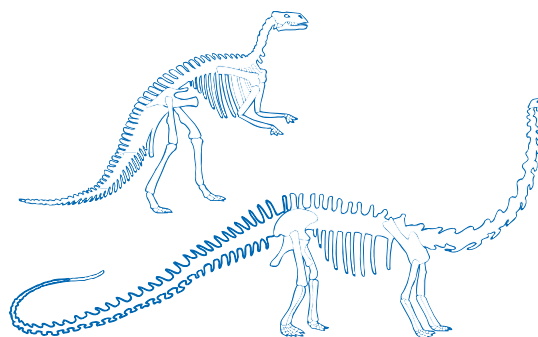
Answers will vary.

▼ Activity Sheet 3, Part C

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3. Sketch around the skeletons to show the dinosaurs' bodies.

Drawings will vary.



4. Compare your dinosaur sketches to the models of Tyrannosaurus and Diplodocus. How are your drawings different from the models?

Answers will vary.

What knowledge would you need to make your drawing look more like the model?

More knowledge of the muscles and soft body parts would be helpful.

Guiding the Activity

- 1 Ask, **If no human being has ever seen a dinosaur, how do we know they existed?**

Write the word *skeleton* on the board. Explain that a **skeleton** is the bony structure inside an animal's body that gives it support.

- 2 Explain that when scientists find fossil dinosaur skeletons, the skeletons are usually in pieces and must be assembled to discover what the dinosaur might have looked like.

Distribute a model skeleton kit to each team of four, and make a note for yourself as to what type of dinosaur each team is receiving. Challenge the students to reconstruct these model dinosaur skeletons (see Figure 3-1).

After a few minutes, distribute the appropriate instructions and illustrated boxes to each group and suggest they use these to help them with their task.

- 3 When all of the groups have assembled their skeletons, ask, **How many of you were confused or frustrated while trying to put the skeletons together?**

Explain that scientists experience the same difficulties when they work with real dinosaur skeletons. Tell them that sometimes the job is made even harder because some bones are missing, or bones from more than one animal are mixed together.

Additional Information

Students may know that fossil skeletons and footprints of dinosaurs that existed have been found.

Do not give them the instructions or the illustrations on the boxes to work from at this point.



▲ *Figure 3-1. Students assembling the skeleton models.*

Many students will probably say they were frustrated.

Guiding the Activity

Ask, **If you did not have the instructions and illustrations, could you be sure you had assembled the skeleton correctly?**

Additional Information

Students should realize that without the directions they could not be sure. Even scientists have made mistakes when assembling new varieties of skeletons, since these do not come with directions or illustrations.

- 4** Point out that the models show only a skeleton form. Ask, **How might you predict what dinosaurs looked like from examining their skeletons?**

Distribute a copy of **Activity Sheet 3, Part A**, to each student. Have the students draw body outlines on the skeleton pictures. When they have had time to do this, distribute a copy of **Activity Sheet 3, Part B**, to each student. Ask them to examine the drawings. Ask, **Did any of you draw bodies around the skeletons that looked like the real animals?**

The students may suggest drawing skin over the bones. Remind them that dinosaurs had muscles, as well.

Distribute a copy of **Activity Sheet 3, Part C**, to each student and ask them to draw bodies around the dinosaur skeletons.

Some students are likely to have done so, and some will have been mistaken.

- 5** Display the dinosaur models. Challenge the students to match their pictures and their skeletons to the dinosaur models (see Figure 3-2).

Give the students time to examine the models and to answer the questions on their activity sheets.

You may want to do this by allowing the students to circulate around the models to observe them closely or by setting up a system of passing the models from group to group.



▲ Figure 3-2. Comparing drawings to dinosaur models.

Guiding the Activity

When they are ready, ask each group to explain its decisions. Continue the discussion by asking, **What other information could help you decide what a dinosaur may have looked like?**

Ask, **Since there are no dinosaurs left on Earth, how might you get this information?**

Additional Information

Students will probably understand that it would be helpful to know about the arrangement of muscles and other soft body parts of the dinosaur.

Some students will understand that one can study the muscles of living animals and make educated guesses about how the dinosaurs might have looked.

REINFORCEMENT

Obtain a poultry carcass from a butcher, including head and feet, if possible. Remove the meat from the bones by boiling, then dry the bones and give them to the students to assemble. Explain that one bone—the wishbone—distinguishes a bird skeleton from those of mammals, reptiles, amphibians, or fish. The thick strong muscles that drive the wings of a bird are attached to the wishbone.

SCIENCE JOURNALS

Have students place their completed activity sheets in their science journals.

CLEANUP

Return the model dinosaurs and skeletons to their display or storage area. Have the students pick up and discard all extra wooden pieces.

SCIENCE AT HOME

Have the students save any bones they can obtain and try to predict from which species and in what part of an animal the bones originated.

Connections

Science and Careers

Arrange a class visit to a natural history museum for a guided tour with a staff paleontologist. If a museum visit is not possible, invite a paleontologist to visit the class to describe his or her work and the education and training it requires. Encourage the visitor to bring some of the tools that he or she uses, slides showing the cleaning and reconstruction process, or other visuals.

Science and Language Arts

Write the term *paleontology* on the board and draw lines to separate it into its three parts: *pale*, *onto*, and *logy*. Explain that the suffix *-logy* means “study of.” Ask students to use a dictionary to find the meanings of the other two parts. (*pale* from the Greek *palaios*, “ancient”; *onto* from the Greek *onta*, “to be, existing things”) Paleontology is the study of ancient life from fossil remains.

Science and Social Studies

Encourage students to research fossil hunters who made important discoveries that contributed to our present understanding of dinosaurs (see list below). Have students use this information to construct a time line.

Gideon Mantell made the first reported find of a dinosaur fossil, a tooth, in 1822; named the creature *Iguanodon*

Richard Owen first to realize that dinosaurs were not simply giant lizards; created the term *dinosauria* in 1842

Thomas H. Huxley first to suggest that birds are related to dinosaurs

Othniel Marsh discovered many new kinds of fossil dinosaurs in the central and western United States in the 1800s

Edward Drinker Cope also found new kinds of fossil dinosaurs in the western United States

John Ostrom in 1964, discovered and named a new fossil dinosaur (*Deinonychus*, “terrible claw”) with a claw suited to a fast-moving predator, which led Ostrom to suggest, in 1969, that dinosaurs were not “cold-blooded” but *homoiothermic*—capable of maintaining a constant body temperature

Robert Bakker first to suggest, in 1968, that dinosaurs had a fast metabolism, were agile and energetic, and may have been *endothermic* (“warm-blooded”)

Jack Horner discovered the nest of a new type of dinosaur in Montana in 1978; besides eggs, the nest contained the remains of baby dinosaurs, suggesting that they stayed in or near the nest while they were cared for by adults; Horner named the new dinosaur *Maiasaura*, “good mother lizard”

Edwin H. Colbert discovered the first remains of dinosaurs in Antarctica in 1986

Paul C. Sereno in 1994, discovered fossils in Africa of two previously unknown types of dinosaurs that seem to be related to dinosaurs found earlier in North America, suggesting a later connection between Africa and northern continents than previously thought

Science, Technology, and Society

► To continue the STS research begun in Activity 2, have students find out how dinosaur bones are completely cleaned and the skeleton reconstructed in a museum. Reconstructing the skeleton is a complex task. It requires extensive knowledge of anatomy, familiarity with existing skeletons of known dinosaurs, and meticulous attention to detail.

► As appropriate, encourage supervised use of the Internet for research projects related to dinosaurs and fossils. A list of related websites is provided in the References and Resources section.