

GIANT SCREEN FILMS PRESENTS

DINOSAURS

Alive!

A GIGANTIC ADVENTURE



Inside: Poster
and Activities!



Major funding provided by the
National Science Foundation



www.dinosaurlive.com/education

KEY CONCEPTS

Use these concepts to help connect the film to your science curriculum. They convey the educational themes in *Dinosaurs Alive!*

1. Science is an Ongoing Process

Scientific knowledge changes over time as new evidence becomes available. Paleontologists are unearthing new fossils all the time, and one find can sometimes change our entire understanding of ancient animals. Recent discoveries have provided startling new clues about how dinosaurs looked, moved, and behaved. Paleontologists also develop new ideas by reexamining fossils that were unearthed long ago.



Paleontologists dig for fossils

ABOUT THE FILM



Dinosaurs Alive is a global adventure of science and discovery. From the sand dunes of Mongolia's Gobi Desert to the sandstone buttes of New Mexico, follow American Museum of Natural History paleontologists (above) as they uncover some of the greatest dinosaur finds in history. Then experience these amazing creatures on the big screen through the power of computer-generated imagery.

2. Tools and Technologies Enable Scientists to Make Observations and Discoveries

Scientists have been using shovels, brushes, and compasses for over 150 years and continue to use them today. In addition, cutting edge technologies provide paleontologists with new ways to find and examine fossils. Global Positioning Systems (GPS) linked to satellites help teams navigate to dig sites and pinpoint exactly where particular fossils were found. Advanced imaging, such as digital x-rays and CAT scans, offer 3D images of fossils without damaging them.

3. Fossils Provide Clues as to How Dinosaurs Live

Paleontologists are like detectives. They examine the evidence that extinct animals left behind, such as fossilized bone, shell, skin impression, and feather evidence. Scientists study jaws and teeth to determine what a dinosaur might have eaten. By studying footprints, scientists can estimate the size of the dinosaur, its speed, and aspects of its behavior. And coprolites (fossilized dung) can provide clues to its maker's diet.



The cliffs of Ghost Ranch, New Mexico display a cross section of time, from the Cretaceous Period down to the Triassic.

4. The Earth Has a Vast History

Scientists estimate the age of the Earth to be about 4.5 billion years. To describe Earth's long history, scientists use a geologic timescale. They divide time into long segments called eras. Each era is further divided into periods. Different Earth events and organisms characterize each period. Dinosaurs appeared roughly 230 million years ago during the Mesozoic Era. Modern humans have only been on Earth for about 150,000 years.

5. Dinosaurs Are Diverse

Dinosaurs are a highly successful group of animals with a vast array of physical features. There were small carnivorous dinosaurs the size of a pigeon and massive herbivorous dinosaurs as long as three school buses. Their diverse body features, such as crests, crowns, and horns, were used for both display and defense. Some walked on four limbs, others walked on two. Their diversity allowed them to live in a range of landscapes, in varied climates, and on every continent.



The armored Tarchia

ACTIVITY CONNECTIONS

- **OBSERVE A DINOSAUR:** Students learn that dinosaurs are not extinct by investigating the relationship between modern birds and ancient dinosaurs. They then observe birds to infer dinosaur behavior, and be reminded that fossils provide clues as to how dinosaurs live. **Time Frame:** 2 class periods
- **SOLVE A SEDIMENTARY LAYERS PUZZLE:** Students experience the ongoing process of science as they analyze fossils. The strategy students use to reconstruct the layers is the same strategy scientists use to reconstruct geologic history from fossils. **Time Frame:** 1 class period
- **CREATE A TIMELINE OF THE EARTH:** Student teams examine Earth's vast history and the diversity of dinosaurs and other life forms by researching major Earth events and organism groups. Teams can then display their poster presentations in chronologic order to illustrate the Earth's history. **Time Frame:** 2 class periods plus outside outreach
- **FLESH OUT A FOSSIL:** Students try their own hand at fleshing out a fossil as they explore how artists create realistic dinosaur drawings from fossil skeletons. **Time Frame:** 1 class period

6. Birds Are Living Dinosaurs

Dinosaurs are not extinct. Birds are descendants of small carnivorous dinosaurs that lived over 140 million years ago. Birds survived the catastrophic extinction event that wiped out almost half of Earth's plant and animal species, among them, the non-avian dinosaurs.



Dinosaurs among us today!

OBSERVE A DINOSAUR

How did ancient dinosaurs move and behave? To find out, paleontologists look for clues in fossils, such as fossilized footprints, eggs, and even dung. They also observe and analyze the movement and behavior of living dinosaurs and other animals. These data help paleontologists interpret the fossil evidence.

You can also observe living dinosaurs. Go outdoors to find birds in their natural habitat. (Or you can use online bird videos, such as the Cornell Lab of Ornithology's video gallery at www.birds.cornell.edu/AllAboutBirds/BirdGuide/VideoGallery.html)

1. Record Your Observations

In a notebook, first record information about the environment:

- Date and Time
- Location and Habitat
- Weather and temperature

Then observe a bird and record:

- How does the bird move?
- What does the bird eat?
- Is the bird alone or in a group?
- How does the bird behave with members of its species?
- How does the bird behave with members of other species?

Tips:

- Weather conditions can affect how animals behave. Try observing birds in different conditions and different times of day.
- To collect good data, try to observe similar groups of birds two or three times.

2. Analyze Your Data

What can you conclude about bird behavior? What clues to this behavior might be preserved in the rock record (e.g. footprints)?



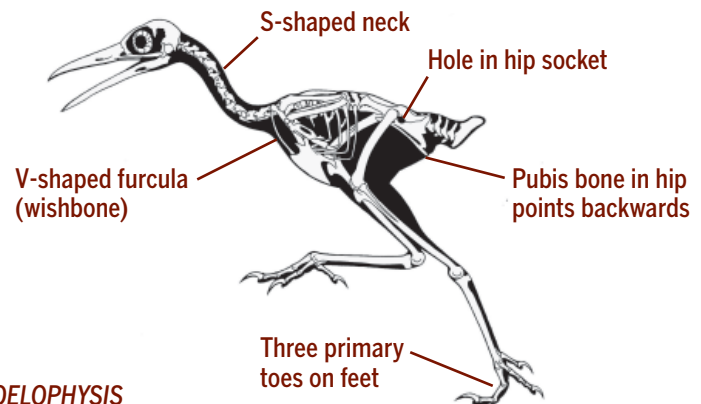
The heaviest dinosaurs, such as *Argentinosaurus*, may have weighed up to 100 tons. That's as heavy as 15 elephants! The lightest dinosaur, the hummingbird, weighs about 4 grams. That's less than the weight of a nickel!

WHAT EVIDENCE INDICATES THAT BIRDS ARE DINOSAURS?

Over 125 years ago, paleontologists made a startling discovery. They recognized that the physical characteristics of modern birds and a species of small carnivorous dinosaur were alike.

Take a look at the skeletons of roadrunner (a modern bird) and *Coelophysis* (an extinct dinosaur) to explore some of these shared characteristics. Check out the bones labeled on the roadrunner. Can you find and label similar bones on the *Coelophysis*?

ROADRUNNER



COELOPHYSIS



SOLVE A SEDIMENTARY LAYERS PUZZLE

Did you know that the history of life on Earth is told through rocks?

Over millions of years, sediments such as sand and silt were laid down and compressed to form sedimentary rock layers. They preserve a record of ancient landscapes, climates, and organisms.

Scientists often determine the correct sequence of sedimentary rock layers using the fossils found within them. They compare the fossils to figure out if two layers are from the same geologic time period, or if one layer is older than the other.

Try reconstructing the layers below using the same strategy!

1. Photocopy and cut out the five strips of paper

Each strip represents a sedimentary rock layer formed during a certain time period.

2. Put the layers in correct order

Begin by placing B, the “oldest layer,” on the bottom. Then decide which layer comes next. It will have some of the same organisms as the older layer and some new ones. (Hint: Organisms do not disappear for a layer and then reappear.) Place it above. Continue until the layers are in order, with the youngest at the top. Check your answers and write the time period on each layer.



Dinosaur fossils have been discovered on every continent, even Antarctica.

Explore More!

Look at the fossils within each layer. What plants and animals lived during the same time period? Then compare the layers to explore the changing plant and animal groups throughout Earth’s history. Which organisms survived from one time period to the next? Which ones went extinct? Could *Tarbosaurus* have hunted *Seismosaurus*? What organisms survived the mass extinction at the end of the Cretaceous Period?

A	gingko	dragonfly	sharks	dyrosaurs	birds	flowering plants	horses			
B	gingko	dragonfly	sharks	ammonites	ichthyosaurs	Postosuchus	pterosaur	Coelophysis	Effigia	OLDEST LAYER
C	gingko	dragonfly	sharks	ammonites	dyrosaurs	birds	ichthyosaurs	flowering plants	pterosaur	Tarbosaurus bataar
D	gingko	dragonfly	sharks	birds	flowering plants	horses	Homo sapiens			
E	gingko	dragonfly	sharks	ammonites	birds	ichthyosaurs	pterosaur	Seismosaurus	Stegosaurus	

Answers: Order of layers from top to bottom: D (Quaternary Period, 2 million years ago to present), A (Tertiary Period, 65-2 mya), C (Cretaceous Period, 145-65 mya), E (Jurassic Period, 200-145 mya), and B (Triassic Period, 250-200 mya).

CREATE A TIMELINE OF THE EARTH

Our planet Earth formed about 4.5 billion years ago. That's a really, really long time ago! To help picture it, imagine the entire history of the Earth squeezed into just twelve hours, from noon to midnight. When we think of time in this way, humans have only been around for about a minute!



Dinosaurs did not all live during the same geologic period. *Stegosaurus* became extinct 66 million years before *Tyrannosaurus rex* walked the Earth.



12:00 PM
4.5 billion years ago the Earth formed



11:23 PM
230 million years ago the first dinosaurs appeared



11:59 PM
150,000 years ago modern humans appeared

To describe Earth's vast history, scientists use a geologic timescale. They divide it into long segments of time called eras. Each era is further divided into periods.

Earth events and organisms characterize each era and period. For example, the Mesozoic Era starts after an extinction event that wiped out almost 90% of species on Earth. Dinosaurs then flourished until the end of the Mesozoic Era, which is marked by another major extinction event. Most dinosaurs went extinct but one group of dinosaurs—birds—survived.

Working in a small team, you will create a poster presentation about one of the periods. You can use classroom and library resources, as well as the Internet to research the following information:

1. Landmasses

What did the surface of the Earth look like? Illustrate the arrangement of landmasses and/or continents.

2. Climate

What was the climate like? Was there an ice age? Was it very warm?

3. Earth Events

What major Earth events occurred during the period? Was there widely distributed volcanic activity, an asteroid impact, or the formation of large mountain belts?

4. Organisms

What plant and animal groups lived during the period? What organisms became extinct?

Tips

- As a part of your presentation, illustrate a 12-hour clock and mark the span of the period on the clock. Hint: Each hour corresponds to 375 million years.
- Include photographs of plant and animal fossils or artist renditions of organisms that lived during the period.

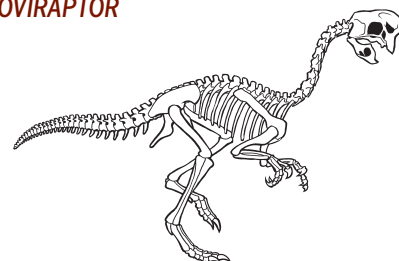
ERAS	PERIODS
Cenozoic	Quaternary 2 mya to present
	Tertiary 65-2 mya
Mesozoic	Cretaceous 145-65 mya
	Jurassic 200-145 mya
	Triassic 250-200 mya
Paleozoic	Permian 300-250 mya
	Carboniferous 360-300 mya
	Devonian 420-360 mya
	Silurian 445-420 mya
	Ordovician 490-445 mya
	Cambrian 540-490 mya
Precambrian	Precambrian 4,500-540 mya

FLESH OUT A FOSSIL

How do artists start with a skeleton and turn it into a realistic animal drawing?

After finding and reconstructing a dinosaur skeleton, scientists often work with artists to recreate what the animal may have looked like in real life. **Take a look at the steps that artists use to create a lifelike dinosaur.**

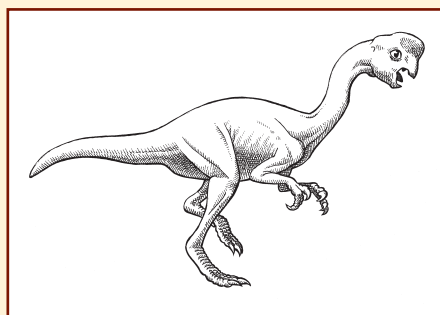
OVIRAPTOR



1. Add a body

Using a pencil and tracing paper, outline where you think the dinosaur's muscles and flesh might have been. Show the shape of the arm and thigh and how they attach to the body.

Tip: Think about whether some areas on the dinosaur's body have more flesh than others. Also think about living animals with a similar body form, like a chicken or ostrich.



2. Add shading

Use short, light strokes to create shadows to make your dinosaur look more lifelike. Use firmer strokes to refine the dinosaur's outline, eyes, nostrils, and claws.

Tip: Pretend a light is shining from the upper left corner. Where would the shadows be?



3. Add details

Add skin texture, feathers, or scaly skin. Then color your dinosaur.

Tip: Use your imagination! Some dinosaurs had scaly skin; some had feathers. Fossils don't tell us anything about skin color or patterns, so pick a color (or colors) you think this animal may have had.

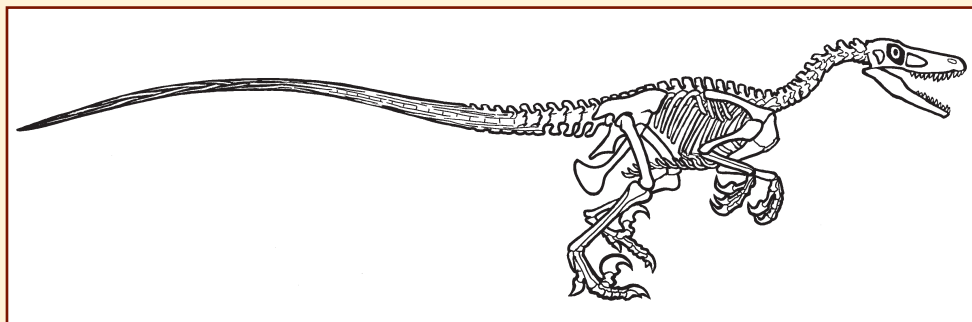


Fossilized feathers have been found on several species of extinct carnivorous dinosaurs. These feathers were not used for flight, but for show and warmth.

Now It's Your Turn!

Follow the steps to flesh out this *Velociraptor* skeleton.

Visit www.dinosalive.com/education to download larger skeletons of *Velociraptor* and other dinosaurs.



DINOSAURS *Alive!*

Join paleontologists as they hunt for dinosaur fossils around the world. Then experience these fascinating creatures on the big screen through the power of computer-generated imagery!

www.dinosalive.com

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