

www.ology.amnh.org/paleontology
 THE MUSEUM'S SCIENCE WEB SITE FOR KIDS



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After-School Educator's Guide to OLOGY PALEONTOLOGY

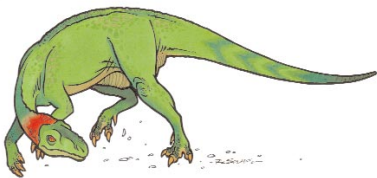


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Introduction

This is a *Content Guide* for after-school educators to the Paleontology section of OLogy, a free, award-winning science Web site for kids (<http://www.ology.amnh.org/>). Please refer to the *Introduction and User's Guide* and *Using OLogy: Methods and Suggestions* sections of the After-School Guide to OLogy for an overview of the complete site, how it works, and what it has to offer.

What Is Paleontology?

Paleontology is the study of ancient life forms. ("Paleo," from the ancient Greek, means very early, and "ancient" is usually defined as "more than 10,000 years ago.") Paleontologists study fossils: the remains of plants, animals, and other organisms typically embedded and preserved in the Earth's rocky crust. (This site focuses on dinosaurs because that's what kids are most familiar with.) The science is closely linked to geology because understanding the age and composition of rock is essential to deciphering the fossil record.

Big Ideas in Paleontology

Paleontologists study fossils to answer questions about early life on Earth. Paleontology is packed with mysteries about organisms that lived thousands, millions, and billions of years ago. Fossils are the evidence that paleontologists use to solve some of these mysteries, such as how communities of prehistoric life were structured, why four major mass extinctions occurred between 440 and 200 million years ago, and how ancient organisms are related to each other and to organisms living today.

Fossils are the remains or traces of ancient life, in the form of bones, teeth, shells, leaf impressions, nests, and footprints. From this evidence, usually locked in rock, paleontologists come up with theories about what the Earth's early inhabitants were like.



Fossils contain the evolutionary record. They reveal how organisms have changed over time, and how different groups are related to one another. Scientists use a tool called a cladogram — a family tree that extends across geologic time — to organize life forms according to shared characteristics. For example, dinosaurs with armor plates in their skin are grouped together, as are those with horns and frills on their skulls.

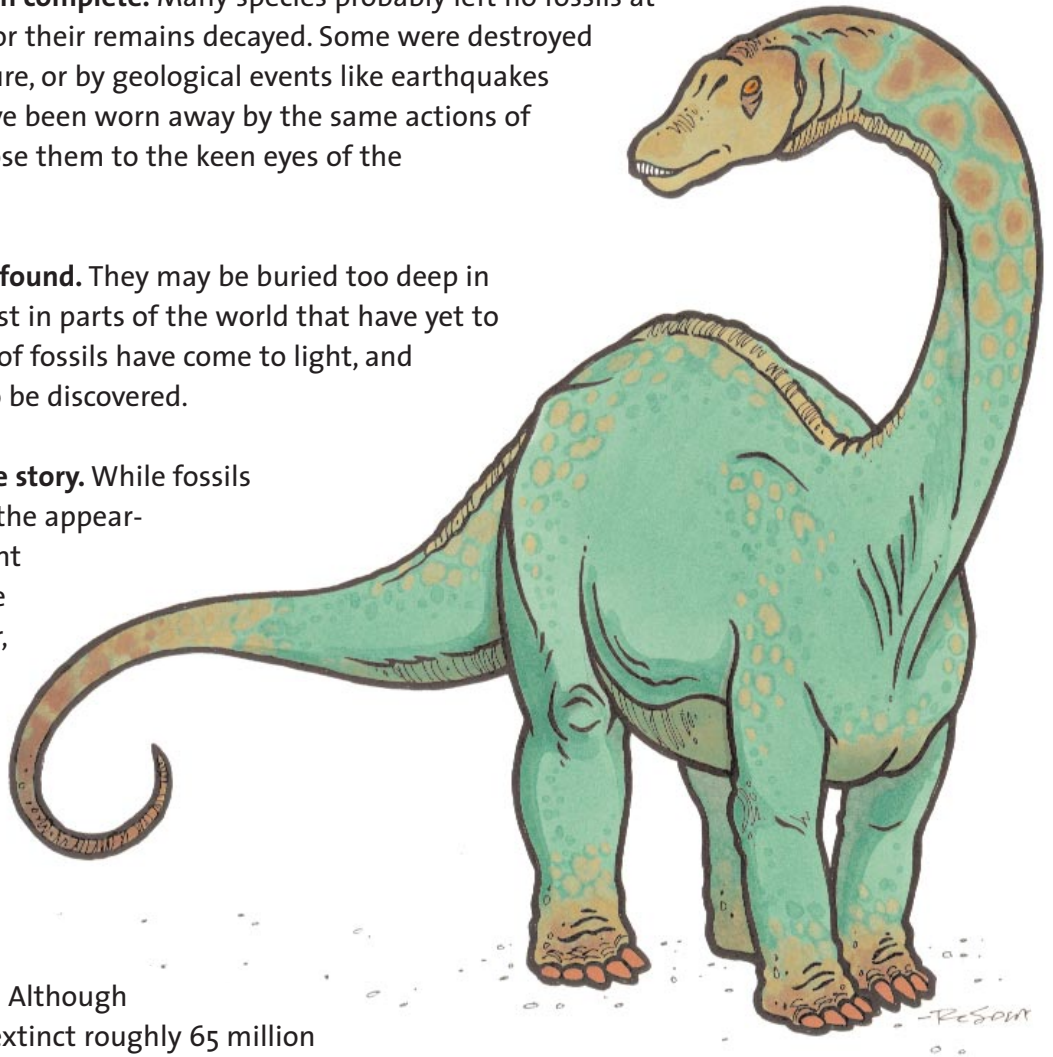


The fossil record is far from complete. Many species probably left no fossils at all. Scavengers ate them, or their remains decayed. Some were destroyed by Earth's heat and pressure, or by geological events like earthquakes and volcanoes. Others have been worn away by the same actions of wind and water that expose them to the keen eyes of the fossil-hunters.

Most fossils will never be found. They may be buried too deep in the Earth, or they may exist in parts of the world that have yet to be excavated. Still, plenty of fossils have come to light, and many more are waiting to be discovered.

Fossils tell only part of the story. While fossils reveal a great deal about the appearance and habitat of ancient organisms, they offer little insight into their behavior, or what sounds they made, or what color they were. Every year paleontologists work to find new clues that help them piece together the stories of the past.

Dinosaurs are not extinct. Although many dinosaurs became extinct roughly 65 million years ago, one group survived — birds. Birds are dinosaurs because they share certain unique characteristics with some other dinosaurs, such as feathers, a wishbone, and a three-toed foot.



Paleontology Site Map

Are you looking for a drawing activity, or would you like your kids to read about how fossils go from underground to a museum display? Would an online question-and-answer game fill the bill? Do you need an online activity, or something to do away from the computer? How about a learning experience that addresses a key word or concept? The Site Map on page 3 will help you find the resources that suit your after-school group.

Site Map - PALEONTOLOGY: The BIG Dig



A photo gallery documents the Museum's annual fossil-hunting trip to Mongolia, including expedition planning, a day in the field, and memorable specimens



Locate strange and familiar dinosaurs and see how they relate to each other on this interactive "family tree," or cladogram



Deena Soris conducts an interview with a Proto-ceratops fossil to find out what it was like when this dinosaur was alive and how it became a fossil



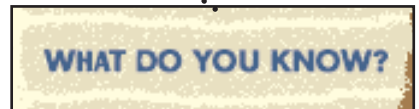
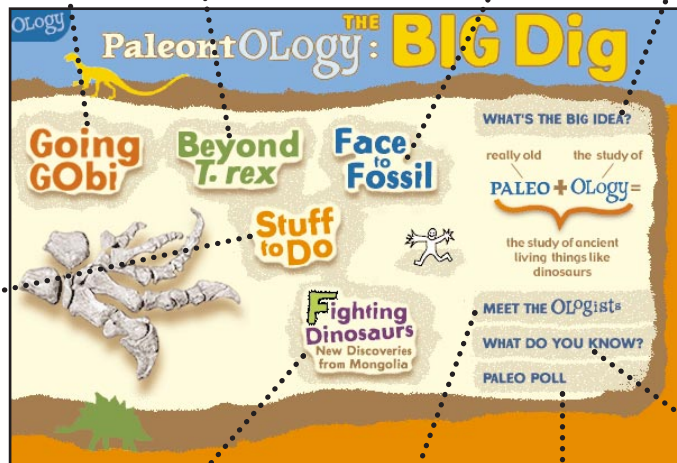
An introduction to the study of fossils and what they tell us about the plants and animals that lived thousands, millions, and billions of years ago

HANDS-ON ACTIVITIES



- Drawing Dinosaurs
- Buried Bones
- Finding Fossils
- Mesozoic Museum
- Paleontology Books
- Make Your Own Stationery

Kids can have fun away from the computer with projects that use easy-to-find materials



A multiple-choice quiz that tests your grasp of fundamental concepts in paleontology



See a fossil of two dinosaurs locked in combat through a paleontologist's eyes, examine clues to figure out how they died, and play a fossil matching game



Meet paleontologist Mark Norell and three kids who think fossils are cool



Answer a question and find out how your answers match up against other visitors' opinions

Paleontology Units

You can use the PaleontOlogy Web site in ways that fit your particular after-school program. The sample units below — “**How to Find, Excavate, and Read Fossils,**” “**Scientific Expeditions,**” and “**Protoceratops — The Dinosaur Caught in Combat**” — offer examples of how to combine different types of resources. Depending on time constraints and your kids’ abilities, you can divide the units into two or more sessions. Using the resources in the order provided within each unit is recommended, but you can also mix and match resources to create your own paths through the site.

You will find two levels of skill question. (See “Skills” in the *Using OLogy: Methods and Suggestions* section of the Guide for a complete listing of the skill type associated with each unit.) First, **Comprehension Questions** ask students to explain what they think the text or pictures mean in order to find out if they understand what the text says. The next level, **Challenge Questions**, invites students to use the facts, ideas, and skills they have learned to figure out a puzzle, solve a problem, or imagine an intriguing possibility. Keep in mind that direct answers to these questions will not necessarily be found on the OLogy site, and that children will be asked to predict and extrapolate.

Tips:

- If time is short, you may want to put the respective URL’s into your browser’s Favorites or Bookmarks menu to help kids navigate more efficiently.
- As your kids go through the site, ask them to read and collect OLogy cards by clicking on the red asterisks scattered all over. They can form the basis of a culminating event when you’ve finished a unit or explored the entire PaleontOlogy site. (See “Wrap-Up Paleo Projects” on p. 6.)
- Print out the Site Map on page 3 and keep it handy by the computer. This will help you to get oriented and locate things quickly.

UNIT 1: How to Find, Excavate, and Read Fossils

#1 Read “Paleo+Ology”

<http://www.ology.amnh.org/paleontology/paleodefinition.html>

Click on “Paleo+Ology” on the homepage for an introduction to how fossils form and what they tell us.

#2 Do “Buried Bones”

<http://www.ology.amnh.org/paleontology/stuff/buriedbones.html>

Design a make-believe dig by doing this activity in the “Stuff to Do” section. Kids learn about paleontology’s tools and techniques by “excavating” chicken bones from plaster of Paris.

#3 Read “Ah Uhkaa!”

http://www.ology.amnh.org/paleontology/gobi/ukhaa_1.html

This section, which is under “Going Gobi,” contains text and pictures about how paleontologists in the Gobi Desert search, excavate, and prepare the fossils they find.

#4 Play “Bone Up on Your Fossils”

<http://www.ology.amnh.org/paleontology/fightingdinosaurs/matchinggame/index.html>

In this online game in the “Fighting Dinosaurs” section, kids match eight fossils with descriptions of what these remains reveal.

UNIT 1: How to Find, Excavate, and Read Fossils Cont'd

Comprehension Questions: What do paleontologists do? What are fossils and what do they (and don't they) tell us about animals? Describe how a living animal becomes a fossil found 80 million years later.

Challenge Questions: How do paleontologists figure out what kind of animal's remains they have found when they discover a fossil? What, specifically, do they have to analyze in order to solve the puzzle? [Note: Encourage students to identify the various characteristics of a fossil that suggest what kind of animal it was: teeth, body parts (size and shape), and environment (e.g. nest and the ages of rocks).]

UNIT 2: Scientific Expeditions

#1 Read "Meet the OLogists: Mark Norell"

<http://www.ology.amnh.org/ologist/norell/index.html>

This interview with paleontologist Mark Norell tells what it's like to go on fossil-hunting expeditions and describes the work that follows back in the lab.

#2 Go on an Expedition with "Finding Fossils" as Your Guide

<http://www.ology.amnh.org/paleontology/gobi/index.html>

This comprehensive guide in the "Stuff to Do" section explains where and how to look for fossils, including safety tips and how to keep a field journal. Using what you've learned, plan your own field trip. (You can refer to Connecting to Local Resources on page 17 of the OLogy Educator's Guide to select a destination.)

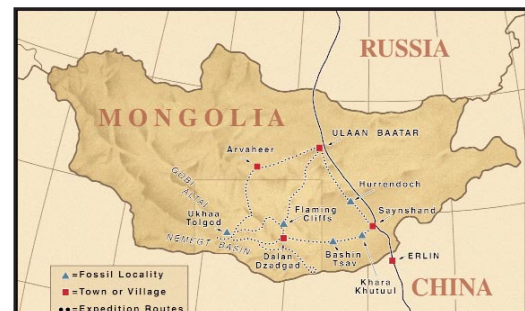
#3 Read "Going Gobi — The Hunt for Fossils in Mongolia"

<http://www.ology.amnh.org/paleontology/stuff/findfossils.html>

This section describes ongoing expeditions by Museum paleontologists to the Gobi Desert. Start with the "Introduction" and read as many of the other stories as time allows.

Comprehension Questions: What aspects of Mark Norell's job seem exciting? Would you like to do what he does for a living? Why/why not?

Challenge Questions: Do you think we will find (or have found) fossils at the bottom of the ocean or in Antarctica? (On the moon? Mars? Europa?) Why/why not?



UNIT 3: Protoceratops: The Dinosaur Caught in Combat

#1 Play the Cladogram Game in "Beyond T. rex"

<http://www.ology.amnh.org/paleontology/cladogram/index.html>

Roll over the 19 dinosaurs on this "tree of life" to see how Protoceratops is related to other dinosaur species. (Note: All of the dinosaur OLogy cards are available in this game so kids can collect them as they play.)

UNIT 3: Protoceratops: The Dinosaur Caught in Combat Cont'd

#2 Read and Act Out “Face to Fossil”

<http://www.ology.amnh.org/paleontology/facetofossil/index.html>

This is an interview with a Protoceratops fossil about his life and times, and how he ended up in New York City. Print it out and have kids act it out in skit form, taking turns playing Deena and Proto Andy.

#3 See “Through a Paleontologist’s Eyes”

<http://www.ology.amnh.org/paleontology/fightingdinosaurs/paleoeyes/rollover.html>

Click on “Fighting Dinosaurs” for a close-up view of a fascinating fossil. Roll your mouse over the image to learn what paleontologists have figured out about how these two dinosaurs might have died.

Comprehension Questions: What is a cladogram and why do you think it is important in conducting science? What is this process of organizing and comparing like in your own experience? Does it resemble comparing sports teams and their performances, your grades at school? Please explain your thoughts.

Challenge Questions: Identify the major characteristics of any two dinosaurs. Compare and contrast the similarities and differences between them on the cladogram. What conclusions can you draw about all dinosaurs? Support your conclusions with evidence from the cladogram.

Wrap-up Paleo Projects:

You can do a culminating project to wrap up any of these units and celebrate your new “Paleontologists.”

• Create an online project

Use your card collection to create one of the online projects in OLogy’s Projects section. [This requires your students to become OLogy members. Refer to pages 5 and 6 of the OLogy *Introduction and User’s Guide* for easy-to-follow instructions.] With their cards, your kids can:

- Choose a “Digging into the Past “ story starter.
- Make a “stumper” about fossils to quiz their friends.
- Create a group of favorite dinosaurs based on card collections, and describe how they are connected.

• Start a Paleontology Club

Celebrate away from the computer by starting a Paleontology Club. Encourage kids to:

- Choose a dinosaur to study, draw, and make the subject of an online project.
- Design club membership badges.
- Go on a fossil-hunting expedition or make a field trip to the nearest fossil collection. Find a location near you using the links on page 6 of *Using OLogy: Methods and Suggestions*.

• Have a Paleo Party

Celebrate the conclusion of your Paleontology OLogy by organizing a party with a dinosaur theme. Your kids could:

- Decorate the classroom with pictures and drawings of their favorite dinosaurs
- Present Paleontology Club membership badges to these full-fledged paleontOLOGists
- Make a diorama or an exhibition of all the “Stuff to Do” activities completed by the class.
- Bake dino-shaped cookies.
- Ask the kids to talk about what they’ve learned, and present their online and hands-on projects to friends, family, and program staff.

Related Links and Resources

Books for Educators

Discovering Dinosaurs: Evolution, Extinction, and the Lessons of Prehistory

by Eugene S. Gaffney, Lowell Dingus, and Mark A. Norell (New York: Alfred A. Knopf, 1995). A discussion of what the fossil record tells us about the evolution and extinction of dinosaurs, their relationship to the rest of the organic world, and the place of *Homo sapiens* in the history of life on our planet.

Life: A Natural History of the First Four Billion Years of Life on Earth

by Richard Fortey (New York: Alfred A. Knopf, 1998). The story of life on Earth, from the first single-celled organisms to prehistoric humans, recounted by a senior paleontologist at London's Natural History Museum.

Books for Kids:

The Fossil Factory: A Kid's Guide to Digging Up Dinosaurs, Exploring Evolution, and Finding Fossils

by Gregory, Niles and Douglas Eldridge (New York: Addison-Wesley, 1989). A scientist and his teenage sons lead a fascinating tour of evolution, from the earlier one-celled creatures to *Homo sapiens*.

The Ultimate Dinosaur Book

by David Lambert (New York: Dorling Kindersley, 1993). This full-color illustrated book describes different dinosaurs, including behavior and diet, and gives the proper pronunciations for names.

Web Resources for Educators:

Dinosauria

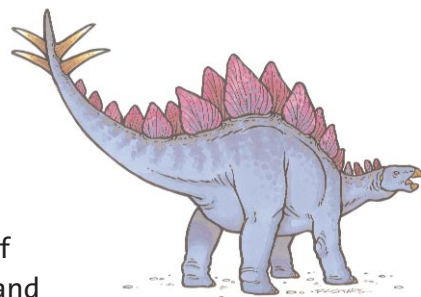
<http://www.ucmp.berkeley.edu/diapsids/dinosaur.html>

Dinosaur facts from the Museum of Paleontology at the University of California at Berkeley.

Fossil Halls

http://www.amnh.org/exhibitions/Fossil_Halls/

Information about the famous Fossil Halls of the American Museum of Natural History, with links to personalities in paleontology, timelines, and exhibitions.



Additional Web Resources for Kids

The Ultimate Fossil and Dino Page!

<http://library.thinkquest.org/J002507/index.html>

A Web site from ThinkQuest that's all about different kinds of fossils, including fun facts, a timeline, a quiz, and lots of beautiful images.

Academy of Natural Sciences Homepage for Kids

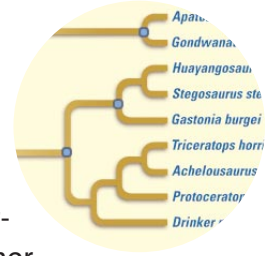
<http://www.acnatsci.org/kids/>

This site links to their Dino Hall, an interview with a vertebrate paleontologist, and paleontology projects.

Glossary of Paleontology Terms for Educators

cladistics – A method of organizing life forms according to shared features, like having four limbs, or watertight eggs.

cladogram – A visual reconstruction of the evolutionary history of a group of animals — a “family tree” — based on the distribution of newly evolved features.



dinosaur – You may think of dinosaurs as extinct, often gigantic reptiles that thrived during the Mesozoic Era (248 to 65 million years ago). In fact, dinosaurs are neither extinct nor reptiles, because birds are dinosaurs. Museum paleontologists define a dinosaur as any of a group of animals with a hole in the hip socket that allows them to stand with their legs directly under their bodies.

evolution – A gradual change in the characteristics or features of organisms or populations across successive generations.

excavation – The process of exposing and extracting fossils by digging out the earth.

fossil – Any evidence of life from a past geologic age, such as bones, teeth, shells, resin, leaf impressions, nests, and footprints.

fossilization – The process during which the whole or partial remains of dead life forms are transformed into fossils over timescales of 10,000 years or more.

geology – The study of the Earth’s history, composition, structure, and the dynamic processes that shape it.

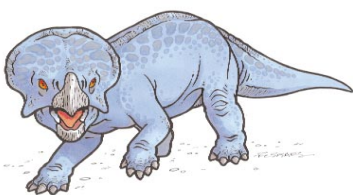
Gobi Desert – A large desert in Mongolia and northern China where many fossils have been found.

mass extinction – The death of every member of a number of diverse groups of organisms due to global ecological circumstances. The fifth mass extinction, about 65 million years ago, eliminated most dinosaur species — except for birds!

organism – A living being such as an animal, plant, or fungus.

paleontology – The study of life forms of the past through the use of fossils.

prehistoric – Referring to a time before history was written or formally documented.



Protoceratops andrewsi – A plant-eating dinosaur of the Cretaceous Period, related to the Triceratops. About the size of a large pig, Protoceratops had a curved beak and a bony frill on the back of its head.