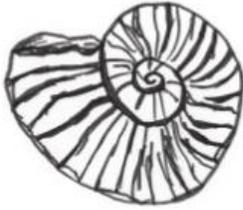


TEACHERS
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Fossil Sorting Kit

FSL-800

Fossil Sorting Guide



Ammonite

Age: Jurassic
(approx. 146-200 million years old)

Class: Cephalopod

Modern Relatives: squid, snails



Brachiopod

Age: Cretaceous
(approx. 65-146 million years old)

Phylum: Brachiopod

Modern Relatives: some Brachiopods still exist today

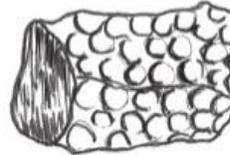


Crinoid Stem

Age: Devonian
(approx. 359-416 million years old)

Phylum: Echinoderm

Modern Relatives: starfish, sea urchins, sea cucumbers



Branch Coral

Age: Devonian
(approx. 359-416 million years old)

Class: Anthozoa

Modern Relatives: many types of coral still exist today

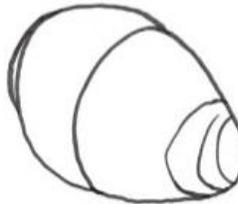


Orthoceras

Age: Devonian
(approx. 359-416 million years old)

Class: Cephalopod

Modern Relatives: squid

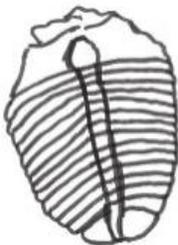


Gastropod

Age: Cretaceous
(approx. 65-146 million years old)

Phylum: Mollusk

Modern Relatives: slugs, snails



Trilobite

Age: Devonian
(approx. 359-416 million years old)

Phylum: Arthropod

Modern Relatives: crabs, spiders, insects



Fossil Clam

Age: Cretaceous
(approx. 65-146 million years old)

Class: Bivalve

Modern Relatives: many types of clams still exist today

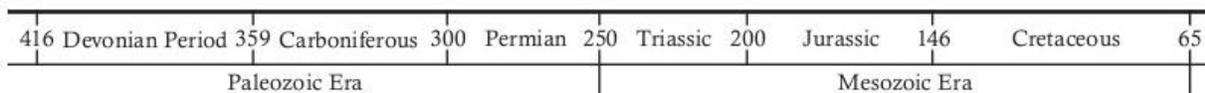


Fossil Snail

Class: Gastropod

Modern Relatives: many types of snails still exist today

Timeline by Millions of Years Ago:



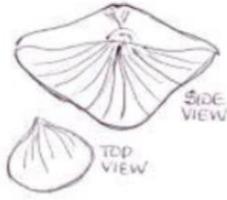
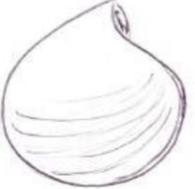
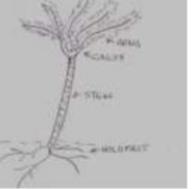
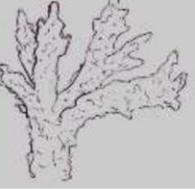
10 Facts about Fossils

- 1.** Fossils are preserved animals, plants, or bacteria found in sedimentary rock—rock that hardens out of mineral deposits (like limestone), sand, or mud.
- 2.** It takes a long time for the fossilization process to occur. A fossil is generally more than 10,000 years old. The oldest fossils date back to the Archaean Era, 4 billion years ago.
- 3.** Fossils form when body parts are buried in sand, mud or soil, or embedded in resins (which eventually turn into amber.) Minerals replace or fill in the spaces of the organism.
- 4.** Fossils can be molds (the shape of an object “printed” into mud or other substances), casts (the shape inside a mold filled in with minerals), or permineralized parts (minerals replace the open spaces in something like bone).
- 5.** Fossils also can preserve footprints, worm tracks, or even feces! (A piece of fossilized poop is called a coprolite.)
- 6.** Some fossils are carbon shadows of the organism between layers of slate-like shale.
- 7.** Not all things that die can form a fossil.
- 8.** Most of the fossils we find are from the “hard parts” of an organism—its teeth, bones, shells, or other parts that already have mineral content, such as bones, which are made of calcium.
- 9.** An organism needs to die and end up in an environment with little oxygen to have the best chance of becoming a fossil. Lack of oxygen slows down the decomposition process and keeps organisms intact.
- 10.** It’s rare to find fossils of soft parts of organisms—for instance, an animal’s skin, feathers, or body organs.



An archaeological dig on the site of the discovery of a Columbian mammoth. Photo: Library of Congress

More Facts about Fossils

	<p>Ammonite Age: Jurassic (approximately 200-146 million years ago) Class: Cephalopod Modern Relatives: Squid, Nautilus</p>	<p>Ammonites were marine animals. They were named after the Greek god Ammon who had a ram’s head. There were many different Ammonites, some with smooth shells, and some with ridges or bumps on their shells. The animal lived inside the shell in the last chamber.</p>
	<p>Brachiopod Age: Cretaceous (approximately 146 to 65 million years ago) Phylum: Brachiopod Modern Relatives: Brachiopods still exist today</p>	<p>Brachiopods were marine animals. They had two hard shells with different shapes on the top and the bottom. The shells are mirror image on the right and left. Brachiopods held onto the ocean floor with a foot stalk called a pedicle. The animal lived inside the shell like clams and mussels that you see today.</p>
	<p>Fossil Clam Age: Cretaceous (approximately 146 to 65 million years ago) Class: Bivalve Modern Relatives: Clams still exist today</p>	<p>Fossil Clams are marine animals. Clams are bivalves, with two symmetrical shells—the shells are mirror images of each other. Fossil clams range in size from a few millimeters to up to 2 meters (about 6 feet) in diameter. Clams lived inside their shells and had a muscular foot they used to burrow and move around. They lived in colonies on the ocean floor. Some clams had smooth shells, while some were rough.</p>
	<p>Gastropod Age: Cretaceous (approximately 146 to 65 million years ago) Phylum: Mollusk Modern Relatives: Snails, slugs, and whelks</p>	<p>Gastropods were marine animals. There were many different species of gastropods. All had coiled shells, but some were tightly coiled while some were loosely coiled. They had many different shapes and surface textures. The animal lived inside their shell, taking up the whole inside of the long shell. They could retract into their shells, covering the opening with their foot.</p>
	<p>Orthoceras Age: Devonian (approximately 416 to 359 million year ago) Class: Cephalopod Modern Relatives: Squid and Nautilus</p>	<p>Orthoceras was an invertebrate (no backbone). It was a marine animal. Orthoceras was a genus of nautiloid cephalopods. Its name means “straight horn.” Modern relatives of Orthoceras include the Chambered Nautilus. Orthoceras was sort of a Nautilus without the curling shell! The animal lived in the last chamber of the long shell, at the open end. It has a tube that ran the length of the shell that it moved water through to move about.</p>
	<p>Crinoid Age: Devonian (approximately 416 to 359 million year ago) Phylum: Enchinoderm Modern Relatives: Star fish, sea urchins, sea cucumbers</p>	<p>Crinoids were marine animals. Its name means “lily”. It is in the same phylum (Enchinoderm) as star fish and sea urchins. Crinoids lived fixed in place. Most of its modern relatives now move around, but there are some modern crinoids, too. Crinoids ate by filtering food out of the water with its arms. Its mouth and anus were next to each other in the calyx. It “rooted” in place with a holdfast. When Crinoids die, their stems quickly break apart. The most common fossils of crinoids are the stem which is sometimes broken into little “Cheerio” like pieces.</p>
	<p>Trilobite Age: Devonian (approximately 416 to 359 million year ago) Phylum: Arthropod Modern Relatives: Crabs, spiders, insects</p>	<p>Trilobites were marine arthropods. The first trilobites show up in the fossil record dating back to about 525 million years ago. There were many different types of trilobites, ranging in size from 1 mm to 72 mm (28 inches long!) Trilobite species all went extinct by 250 million years ago. Trilobite fossils are formed from their exoskeletons. These were made of chiton, like some insects and other organisms like lobsters. They split apart and shed their shells as they grew, just like lobsters do.</p>
	<p>Branching Tabulate Coral Age: Devonian (approximately 416 to 359 million year ago) Class: Anthozoa Modern Relatives: Corals still exist today</p>	<p>Branching Tabulate Coral is a marine animal. Corals are multicellular organisms that often live in colonies. The individual animal is called a polyp. There are many different species of coral, with different forms, shapes, and sizes.</p>

NGSS Correlations

4-ESS1-1 - Students can use the fossils in the Fossil Sorting Kit to identify evidence, to identify patterns in rock formations and fossils in rock layers to support an explanation for changes in the landscape over time.

DCI-4/ESS1.C: *The History of Planet Earth* - Local, regional, and global patterns of rock formations reveal changes over time due to earth forces, such as earthquakes. The presence and location of certain fossil types indicate the order in which rock layers were formed.

MS-ESS1-4 - Students can use the fossils in the Fossil Sorting Kit as evidence to construct a scientific explanation based on the fossil record from rock strata for how geologic time scale is used to organize Earth's 4.6-billion-year-old history.

MS-LS 4-1 - Students can use the fossils in the Fossil Sorting Kit to analyze and interpret data for patterns in the fossil record that document the existence, diversity, extinction, and change of life forms throughout the history of life on Earth under the assumption that natural laws operate today as in the past.

MS-LS 4-2 - Students can use the fossils in the Fossil Sorting Kit to apply scientific ideas to construct an explanation for the anatomical similarities and differences among modern organisms and between modern and fossil organisms to infer evolutionary relationships.

DCI-MS/ESS1.C: *The History of Planet Earth* - The geologic time scale interpreted from the rock strata provides a way to organize Earth's history. Analysis of rock strata and fossil record provide only relative dates, not absolute scale.

DCI-MS/LS4.A: *Evidence of Common Ancestry and Diversity* - The collection of fossils and their placement in chronological order is known as the fossil record. It documents the existence, diversity, extinction, and change of many life forms throughout the history of life on Earth. Anatomical similarities and differences between various organisms living today and organisms in the fossil record, enable the reconstruction of evolutionary history and interference of lines of evolutionary descent.

HS-ESS1-4 - Students can use the anatomical structures of the fossils in the Fossil Sorting Kit as evidence to communicate scientific information that common ancestry and biological evolution are supported by multiple line of empirical evidence.

HS-LS 4-5 - Students can use the fossils in the Fossil Sorting Kit and information about the fossil record to evaluate the evidence supporting claims that changes in environmental conditions may result in the extinction of species.

DCI-HS/LS4.C: *Adaptation* - Species become extinct because they can no longer survive and reproduce in their altered environment. If members cannot adjust to change that is too fast or drastic, the opportunity for the species' evolution is lost.

Identify Your Fossil

This activity will help students practice their observation, data collection, measuring and written reflection skills. It is appropriate for middle school students—or for high school students with added research and reflection.

1. Choose a piece to identify by reaching into a container holding the fossils. If you have difficulty identifying your fossil, first ask a friend for help and suggestions. If your fossil is still difficult to identify (and some of them really are difficult!) then you can choose a new piece to identify.
2. Observe your fossil carefully. Draw your fossil in your science notebook. Draw at least two different views of your fossil. Measure your fossil and provide a scale bar in your drawings. Weigh your fossil with a mass scale if one is available. Make careful notes about many of your fossil's characteristics.
3. Answer these questions in your science notebook:
 - Was your fossil easy to identify? Why or why not? What made your fossil easy or difficult to identify?
 - Are there pieces missing from your fossil or hidden in the rock that your fossil is stuck in (the matrix)?
4. Research your fossil on the internet or in books from your library. Does your fossil look like pictures you found in your research? Why or why not?



Extension Ideas:

5. After you have identified and drawn your fossil, put it in a small paper or plastic cup. Write your name on the bottom of the cup.
6. Your teacher will mix up the cups for each fossil type, keeping the types together. You and your classmates will then identify the type of fossil you identified. Try to identify your own fossil piece by matching your drawing information to the samples.
7. Discuss in your science notebook the steps that you took to find your specimen.
8. As a group, see how close you all came to identifying your own samples.

What Is an “Average” Fossil?

The activity allows students to measure and calculate averages for size and weight of fossil specimens. It is appropriate for middle school students—or for high school students with added research and reflection.

1. Identify how many of each fossil type are in your two-pound bag. For example, an average bag might have:

*23 Branch Coral • 22 Gastropods • 16 Clams
15 Crinoid Stems • 14 Brachiopods • 7 Ammonites
6 Orthoceras • 2 Trilobite (pieces) • 4 difficult to ID*



Ammonite sample

2. What pieces are best represented in your sample bag?
3. What types are easiest or hardest to identify?
4. Divide the class to work with the most represented specimens.

With the sample bag listed above, we suggest using the branch coral, gastropods, clams, crinoids, brachiopods, ammonites and orthoceras for this exercise. You need to have a good number of easily identified specimens for the specimen type.

5. Each group is assigned to measure and weigh one specimen type. This will include rows for each specimen, and columns for measurement and weight.
6. Set up your specimens on a piece of paper with a grid of marked boxes for each piece. These can be numbered or lettered boxes. This will help students to organize and track their specimens. Try ranking your specimens in order from smallest to largest (or lightest to heaviest.)



Trilobite sample

7. The group should discuss how to measure their specimen to have a uniform measurement. (Choices might include longest length, across the brachiopod shell, the diameter of the orthoceras, etc.) Provide millimeter scale measures for each group. Make sure that each person in the group gets to practice measuring and recording. The group might have different people measure and compare measurements for each specimen before deciding on the correct data.

What Is an “Average” Fossil?

continued

- 8.** Provide a gram scale for each group. The group should weigh and record each specimen.
- 9.** Calculate the average measurement and weight for your specimens. Average is the total of all the measures divided by the number of specimens measured (or weighed). Record the group’s calculation.
- 10.** Look at all of the specimens laid out on the numbered boxes—which one do you think is the average for size? The average for weight? Check your data sheet—does your estimate agree with the actual measure or weight for those specimens?
- 11.** How much variation is represented by the fossils in your group—how much bigger was the largest vs. the smallest? The heaviest vs. the lightest? Discuss this question in your science journals.
- 12.** Create a graph that shows your fossils by specimen (on the X axis) and by size or weight (on the Y axis). Remember to give your graph a clear title. Also, give each axis a title and identify the units measured. Identify average measurements on your graph. How many specimens were close to, above, or below the average line? How did you decide what could be considered “close to” your average?
- 13.** Compare your data to the data collected by the class. Which fossils showed the most variation in size or weight? Which type had the smallest and largest averages?

Lesson written by Laurel Kohl, Educational Consultant

Take Your Lesson Further

As science teachers ourselves, we know how much effort goes into preparing lessons. For us, “*Teachers Serving Teachers*” isn’t just a slogan—it’s our promise to you!

Please visit our website
for more lesson ideas:

www.TeacherSource.com/lessons

Check our blog for classroom-tested
teaching plans on dozens of topics:

<http://blog.TeacherSource.com>

To extend your lesson, consider these Educational Innovations products:

Fossil Shark Teeth (RM-11A)

Our fossil shark teeth collection is a fantastic chance for your students to own a piece of history at an amazing price. Each bag is unique. You will find various types of shark teeth in sizes ranging from juvenile sharks to adults. There are well over 300 fossils in each half-pound bag. You'll also likely find a few fossilized sting ray teeth, small vertebrae, and fragments of bone. Ideal for sorting and predicting activities.



PerfectCast Casting Medium (FSL-310)



Far better than ordinary plaster, PerfectCast casting medium is the professional's choice for casting complex fossil replicas. Simply add water, PerfectCast dries as quickly as plaster of Paris and is five times as strong. It is AP non-toxic and it reproduces intricate detail identical to the original mold. This is our first choice for all of our casting workshops and lessons. One container will make about twenty large 4" T-Rex Teeth.

FossilWorks Fossil Molding Kit (FSL-250)

This award-winning kit comes complete with 6 high-quality, reusable seamless rubber molds (ammonite, crinoid, trilobite, cave bear tooth, shark tooth, and raptor claw), 2 bags of PerfectCast casting medium, extensive background information on each fossil and suggested activities for students. Introduce the Earth's history in a thrilling fashion with authentic fossil replicas your students can take home! Approx. 3-5 inches long each.



Tooth and Claw Molds (FSL-150)



These professional quality Latex rubber molds can be used to make hundreds of fossil replicas. Choose a Tyrannosaurus Rex tooth, shark tooth, Oviraptor claw, or Deinonychus claw—or get them all! Use a rubber band to hold the two halves of the mold together, pour in some plaster of Paris (or even better, our PerfectCast casting medium, FSL-310) and in about 30 minutes your students will have a perfect fossil replica of a tooth from the most famous carnivore of all times! Our molds are durable and use only a few cents in casting medium per mold. Instructions included.