Fossil Kit Laboratory Investigation 2: Using Fossils to Date the Rocks

Investigation Summary: Students observe that while fossils are useful to understand past life and how it has changed or evolved over time, fossils can also be used to determine the relative ages of rocks and to temporally correlate rock units that occur in geographically distant areas.

Enduring Understandings

- Identifying how long a fossil species lived (i.e., its age range) enables us to determine the age of the rocks.
- Fossils can also help us correlate rock units that are located in different areas. To correlate means to demonstrate a chronological association between two geographically separate rock units on the basis of their similar fossils. If two widely separated rock units correlate, it means they are the same age.

Essential Questions

- How can we tell when different organisms lived at the same time (or were contemporaneous)?
- How can that information tell us the age of the rock in which they were preserved?

Students will know…

- Comparing the age ranges of different fossil species enables us to date the rock in which they were preserved.
- Different groups of organisms existed at different times in Earth's History.
- The age ranges of different fossil organisms can be measured and compared.

Students will be able to…

- Observe that groups of animals do not live forever, but rather they exist over spans of geologic time that can be measured by geologists.
- Use the Geologic Time Scale to compare the time ranges over which different animals lived.
- Estimate the age of rocks by identifying the age range of the fossils found in the rocks.
- Compare their work to the work of paleontologists and geologists.

Assessment Evidence

Completion of Investigation Worksheet
Science Notebook Entries (as applicable)

Evidence Outcomes
Students can:

a. Use evidence to develop a scientific explanation for:
    1. What fossils tell us about a prehistoric environment
    2. What conclusions can be drawn from similarities between fossil evidence and living organisms
b. Analyze and interpret data to generate evidence about the prehistoric environment
c. Evaluate whether reasoning and conclusions about given fossils are supported by evidence

Vocabulary:

Age range	Biostratigraphy	Extinct
First appearance	Fossil record	Geologic Time Scale

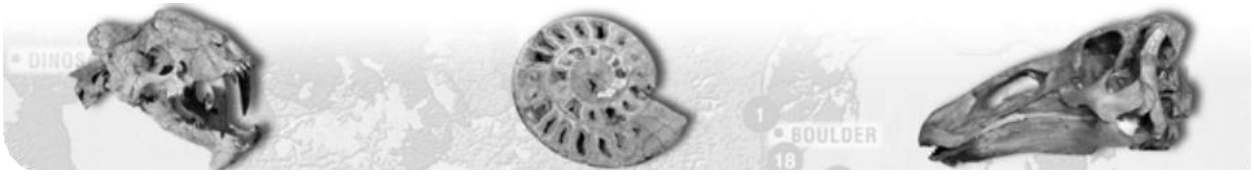
Before You Teach

The science of **biostratigraphy** is one way paleontologist estimate the age of rocks. By using the first appearance of a fossil in the fossil record or the co-occurrence of several fossils in the same rock, the rock's age can be approximated. This was one of the first ways that geologists were able to identify and correlate rock units across long distances and how the Geologic Time Scale was developed way back in the 1800s.

Organisms do not live forever. Rather, new groups are continually appearing in the fossil record while others are going extinct (disappearing forever). So, the presence of a particular fossil species or a group of fossils can be used to narrow down the age of the rock.

Fossils with a very narrow age range are very useful for determining the age of the rocks in which they occur, but even fossils with a wide range, when found with other fossils, can be useful. For example, if a rock unit contains two kinds of fossils, one that was alive from 100 million years ago to 50 million years ago and the other that lived from 55 million years ago until today, then we know that the age of the rock containing them both is probably between 55 and 50 million years ago because that is the amount of time during which they were both alive (or it's when their age ranges overlapped).

In this investigation, students will examine the age ranges of several kinds of fossil organisms. They will first use the identification key to identify the fossils and how old they are (i.e., their age range). They will then be asked to answer questions about the ages of various rock units based upon the fossil(s) present. Students will also be asked to identify the ages of rock units in parts of Colorado based upon the fossils present in the rocks.



Additional Teacher Resources

Vocabulary:
Age range – The amount of time that a fossil organism is present in the fossil record. For instance, trilobites (which are extinct, marine animals) first appeared in the Cambrian Period and went extinct at the end of the Permian Period (see the Geologic Time Scale in the notebook for the names of the Geologic Periods). That is their age range in terms of geologic time. Most fossil organisms lived for millions of years.

Biostratigraphy – The science of describing and organizing rock units (also called formations) using the fossils contained in them. Even though the rocks can look different in different locations, the presence of the same fossils tells us that the rocks are the same age (which means they *correlate* with one another). Each stage of life on Earth and each Period in the Geologic Time Scale have a unique set of fossil species.

Extinct - When every single member of a species of organism is dead and disappears from the Earth forever. The last appearance of a fossil species tells us when it went extinct.

First appearance – The first time a species of organism appears in the fossil record.

Fossil record – The name given to the history of life on Earth as shown by fossils preserved in the rocks.

Geologic Time Scale – A worldwide time scale that records the geologic history of Earth, from its physical formation over 4.5 billion years ago to the present-day. Since the 1800s, the Geologic Time Scale has been divided into blocks of time (Geologic Periods) that are defined mainly by their fossil content.

Relative age - establishing the temporal sequence (or order) of events, from oldest to youngest. Relative Age (i.e., whether a rock unit is older, younger, or the same age as another rock unit) can be contrasted with Absolute Age, which is how old the rocks actually are, in thousands, millions, or even billions of years.

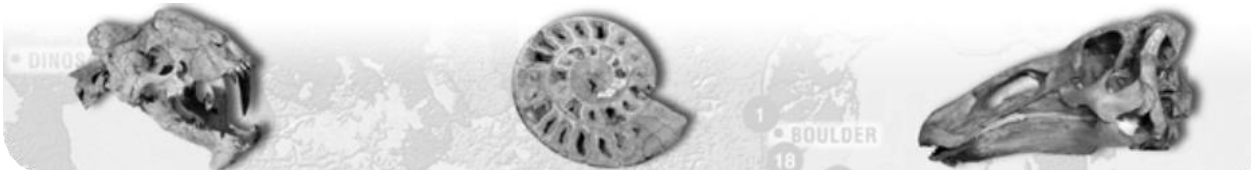
Online Resources

https://stratigraphy.org/chart is a website where you can download a global Geologic Time Scale as ratified by the International Commission on Stratigraphy.

http://www.newyorkscienceteacher.com/sci/esl/es/spanish-es.pdf is a website that lists Spanish translations of Earth Science Terms.

http://puzzlemaker.discoveryeducation.com/ is a website where you can easily create your own crossword puzzles or word searches using the listed vocabulary words.

http://earthobservatory.nasa.gov/Features/WilliamSmith/ is a website that discusses the first person to use fossils for determining the relative ages of rocks – William Smith, an English surveyor and canal-digger in the early 1800s. William Smith also built the first geologic map.



Laboratory Investigation 2: Using Fossils to Date the Rocks

Materials:

1 set of fossils:

Trilobite, Graptolite, Fern, Dinosaur Bone, Petrified Wood, Fish

1 set of fossil labels

10 hand lenses

10 Rulers

Geologic Time Scale

Geologic Map of Colorado

Investigation Worksheet

Conducting the Investigation:

1. Introduce the Geologic Time Scale and age ranges.

Introduce students to the Geologic Time Scale. Show/explain that it is a way for geologists to refer to different time periods in Earth history. Tell students that the fossil record shows us that different fossil organisms lived at different times in Earth's History.

Life has changed a lot over the course of geologic time. When we look at the Geologic Time Scale, many of the units of time (or Geologic Periods) are defined by the different animals and plants that lived during those times. Also, the boundaries between the different time units are based on the first appearance of particular fossils and/or the extinction of particular organisms.

For example, one of the ways of identifying the Cretaceous-Paleogene boundary is by the extinction of the dinosaurs.

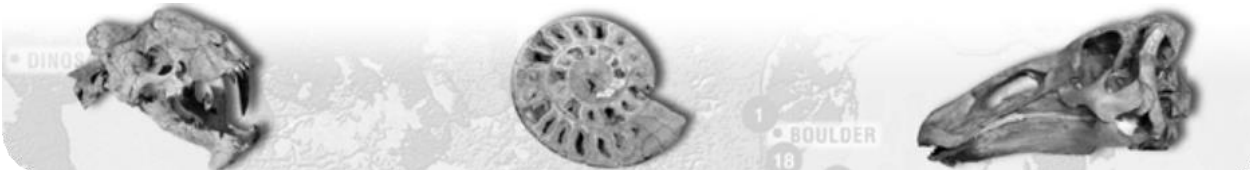
2. Introduce biostratigraphy.

Biostratigraphy is the science (or sub-discipline of paleontology) that describes rocks based upon their fossil content. The presence of certain fossils can help determine the age of the rock.

3. Re-introduce the fossils. A fossil is any evidence of past life.

Tell students that they are going to estimate the age ranges of a variety of fossil organisms. These organisms occurred during different time periods on the Geologic Time Scale.

Tell students that their challenge is to determine the age ranges of the different fossils and to see if there is a time when they were all alive together (e.g., Is there a time when their age ranges overlap?). The students will also be challenged to correlate rock units using the fossils.



4. Introduce the Investigation Worksheets and begin the investigation.

Working in small groups, students should take turns examining the fossils. Some of these fossils (e.g. graptolite and fish) will be new to the students.

Have the students make a quick sketch of these fossils and a few observations in their science notebooks.

5. Introduce identification cards.

Working in small groups, students should use their observations to identify the fossils and to record the age ranges of each of them.

6. Find the age range of the fossil group.

Using the Geologic Time Scale, students should illustrate or draw the age range of each fossil on their activity sheet using a line to indicate when a group began and ended.

Students should then identify if any of the fossils existed during the same time period and record this on their activity sheet.

7. Discuss how the age range of the fossils could help determine the age of rocks.

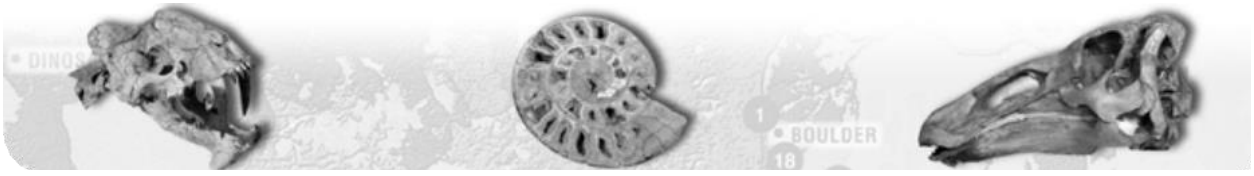
Ask the students:

“If we found dinosaur bone in a rock, how old would we estimate that rock to be?”

“Do any of the fossils occur during the same time period?” (That is, do their age ranges

overlap?)

“What would that tell us about how old the rock is?”



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Laboratory Investigation 2 – Investigation Worksheet

Part A. Determine the age of each fossil using the identification cards:

1.

2.

3.

4.

5.

6.

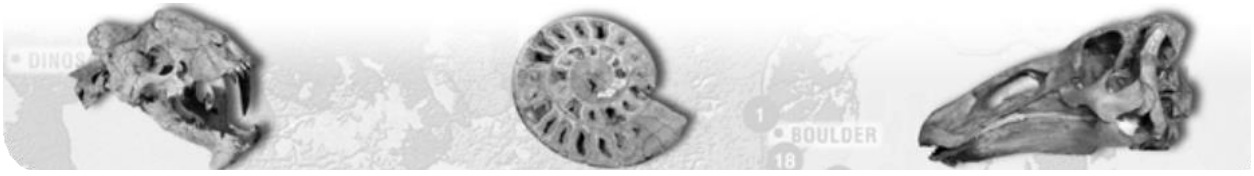
Part B.

1. If you found a dinosaur bone in a rock, how old would the rock be?

2. If you found just the trilobite in a rock, how old might we think that rock is?

3. What if you found both fossil wood and the dinosaur bone in the same piece of rock? How old would that rock be?

4. Look at the Geologic Map of Colorado. If we were in Morrison, Colorado and found a dinosaur bone, how old are the rocks in that area?



Laboratory Investigation 2: Vocabulary for Using Fossils to Date the Rocks

Age range – The amount of time a fossil organism is present in the fossil record.

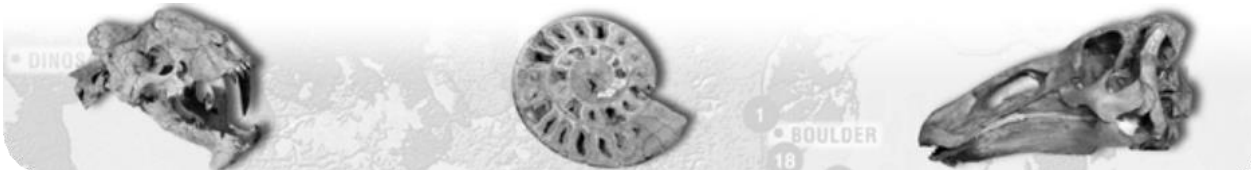
Biostratigraphy – The science that describes rocks based upon their fossils. Even though the rocks can look different in different locations, the presence of the same fossils tells us that the rocks are the same age.

Extinct – When every single member of a species of organism is dead. For example, we know that the dinosaur *Tyrannosaurus rex* is extinct because we have no living *T. rex* running around on Earth today.

First appearance – The first time a particular kind (or species) of organism appears in the fossil record.

Fossil record – The history of life on Earth as shown by fossils preserved in the rocks.

Geologic Time Scale – Geologists use this to record the sequence of important events in the history of the Earth, starting with Earth's formation over 4.5 billion years ago and ranging to the present day. The Geologic Time Scale is divided into blocks (or Geologic Periods) mostly based upon fossils. For example, rocks that formed during the Silurian Period contain a different set of fossils than rocks that formed during the Devonian Period.



Laboratory Investigation 2- Investigation Worksheet – Answer Key

Part A. Determine the age of each fossil using the identification cards:

1. *Petrified Wood- Triassic to Pleistocene*

2. *Graptolite- Ordovician*

3. *Trilobite- Ordovician*

4. *Fern- Carboniferous*

5. *Dinosaur Bone- Jurassic*

6. *Fish-Eocene*

Part B.

1. If you found a dinosaur bone in a rock, how old would the rock be? *Dinosaurs were alive from the Triassic through the Cretaceous. This particular dinosaur bone is Jurassic in age.*

2. If you found just the trilobite in a rock, how old might we think that rock is? *Trilobites were alive from the Cambrian through the Permian. This particular trilobite lived during the Ordovician.*

3. What if you found both fossil wood and the dinosaur bone in the same piece of rock? How old would that rock be? *The fossil wood could be anywhere in age from Triassic to Cretaceous. If we found it with a dinosaur bone that is Jurassic in age then we would infer that the wood is also from the Jurassic.*

4. Look at the Geologic Map of Colorado. If we were in Morrison, Colorado and found a dinosaur bone, how old are the rocks in that area? *Jurassic.*