Fossil Timeline: Construction of a Planetary Calendar

for 3rd- 5th Grade

Math Learning Goals

- Practice measurement by creating a timeline to illustrate the history of Earth.
- Assess the lengths of different time periods.
- Apply knowledge about the conversion of centimeters to meters.
- Compare different lengths representing different periods of time.

Materials Needed

- 2 pieces of paper per student
- A pencil and a pen
- Scissors
- Glue
- Unit 1 – Fossils power point – Part 1 (slides 72-90) (this can be found at www.bio.utk.edu/biologyinbox/available.htm)
- Copies of pictures from the power point to cut and paste onto timeline

Introduction:

Engage students by asking them how old they think the earth is. (Student guesses will vary) Have they heard about some very large animals that were around a very long time ago that aren't anymore? (Hopefully dinosaurs will come up!) How long ago was that? (More guesses!) Tell them that the earth is so old that it is hard to imagine. The amount of time is so large that scientists have a special term for earth's history: geological time. To help understand it, tell students that they will construct a planetary calendar, or timeline, that is scaled to a single page. Eras, or time periods, of geological time will be represented by segments of the timeline.

If students are unfamiliar with a timeline, you might draw an example timeline on the board – maybe one for your own life, with your birth, when you started school, when you graduated, when you started teaching, the present day, etc. Explain that points on a timeline represent events. Ask students questions about which events occurred first (Did I start teaching before or after I went to school? How do you know?) Point out that events on the timeline are ordered from left to right or from bottom to top. For example, on the planetary calendar students will make, the point that marks the extinction of the dinosaurs should be before the point that marks the first appearance of humans on your timeline.

A timeline contains much more information than an ordered list of events, because a timeline allows you to visualize the length of time between events. In order for this timeline to give an accurate representation of the past, longer line segments should represent longer-lasting eras, and shorter line segments should represent shorter-lasting eras. You might ask students to estimate from your

timeline if the time you spent in school is longer than the time you've been teaching, for example. How do they know? For more information of the different time periods, look in the more information section.

As a means of introducing young students to the concept of a million, a suggested activity is to read How Much is a Million by David Schwartz. The concept of a million is challenging for very young students so this book helps define the magnitude of the number prior to beginning their investigation of age of fossils and the geologic time scale. An alternative to reading How Much is a Million is using familiar objects and ideas to help students understand the concept of a million. Show students an inch on a ruler and tell them that one million inches is about 16 miles, or one million inches is about the length of four trips from home to school (adjust as appropriate for specific student groups and distances they may travel to and from school). One million hours ago would be before K – 4 students' great, great grandparents were born. One million seconds is about 11.5 days.

Fossil Activity: Constructing a Timeline/ Planetary Calendar

The students should do the following steps:

(1) Make a 20.5 cm line down the length of a sheet of paper.

(2) Let the upper end be current time.

(3) Make a mark at .3 cm down from the top of the line.

(4) Make another mark at 1.1cm down from the top of the line.

(5) Make another mark at 2.2 cm down from the top of the line

(6) Make a another mark at 2.5 cm from the top of the line.

You have marked off the eras of the geological time scale. Your time line represents a period of 4,500,000,000 years (4.5 billion years, the age of the Earth).

Students should label the following time information to their timelines:

(1) Formation of the earth = 4,500 million years ago (this point is represented by the lower end of your line).

(2) Start of Paleozoic Era and the Start of the Cambrian period = 542 million years ago (this point is represented by the mark 2.5 cm from the top of your line.)

(3) End of Cambrian Period within Paleozoic Era = 488 million years ago (this point is represented by the mark 2.2 cm from the top of your line.)

(4) Start of Mesozoic Era = 251 million years ago (this point is represented by the mark 1.1 cm from the top of your line.)

(5) Start of Cenozoic Era = 65.5 million years ago (this point is represented by the mark .3 cm from the to of your line.)
(6) First life (prokaryotes) become abundant in the fossil record at about 3.5 billion years ago – denoted by a point about 16.0 cm from the top of the line. Mark this point as "1st life- prokaryotes" on your calendar.

The following questions should be answered by the students:
1.) Which era was the longest: the Paleozoic Era or the Cenozoic Era?
2.) Which occurred first, the beginning of the Mesozoic Era, or the beginning of the Cenozoic Era?

A Closer Look at Biodiversity in Geological Time:
You probably have noticed that all of your organisms have been crowded into a very small part of the geological time line. Make a new scale on another sheet of paper. Draw a line 20.5 cm down the length of the paper. Let the upper end be the current time and the lower end be the start of the Cambrian period of the Paleozoic Era at 542 million years ago.
Measure out and mark off the following lengths from the top of the line: 18.5 cm, 16.8 cm, 15.7cm, 13.6 cm, 11.3 cm, 9.5 cm, 7.6 cm, 5.5 cm, 2.5 cm, 0.1 cm. These marks denote the beginnings and ends of the periods listed on the Geological Periods from Cambrian to Present slide. Use the information to label the segments of the expanded time line with period names. To help the students visualize the different time periods better, take the photos from the slides 80-90 and match the photos with the correct time period.

The following question should be answered by the students:
Life has been around on Earth for about 3.5 billion years, but multicellular life (organisms made up of more than one cell) has only been around for a little over half a billion years (542 million), which is the time depicted in your abbreviated geological time line?
The following question is for 5^{th} grade students:
How would changing the measuring length from centimeters to meters change the time line? Show your work.

More Information on Geological Time
The lower section below the 2.5 cm mark is referred to as the Precambrian Era. It is clear that the Precambrian Era takes up to majority on the time line. In fact, the Precambrian Era makes up about 88% of the total time – almost all of it! The Cenozoic Era is the one we currently are in, and it is located above the 0.3 cm mark.

Precambrian time lasted for almost 4 billion years. During most of this time, the Earth was gradually cooling and chemical compounds containing carbon were building up in the seas. Carbon is the basic building block of living organisms and compounds that contain carbon are referred to as organic compounds. Representatives of the first living organisms, prokaryotes that had DNA loose in the cell first appeared in the fossil record at about 3.5 billion years ago.

The Paleozoic Era as a whole is known as the “Age of Invertebrates,” as invertebrate organisms dominated during this time, or the “Age of Trilobites,” because invertebrates called trilobites were common and diverse during this era. Reptiles dominated the Mesozoic, which is termed the “Age of Reptiles,” or the “Age of Dinosaurs,” and the Cenozoic is referred to as the “Age of Mammals”. Human history in geologic time isn't big enough to be seen at the end of the calendar/timeline.

All of the major body plans or phyla of animals appeared at the very beginning of the Paleozoic Era, during the first period called the Cambrian. The Cambrian period had rapid diversification and is often referred to as the “Cambrian Explosion.” Invertebrates, including arthropod predators, the trilobites (now extinct) appeared, are abundant. Most currently existing major body plans of animals appear, as well as many bizarre organisms. The Burgess Shale in Canada is famous for lots of Cambrian fossils. This period ended 488 million years ago.

The next period is the Ordovician period. Marine invertebrates diversify even further. Jawless, armored fish known as ostracoderms, the first vertebrates, appear. Possible first non-vascular plants (without specialized tissues to transport water and nutrients) on land. End of period, 444 million years ago, was marked by the second largest extinction of marine life in Earth's history.

After the Ordovician period ends, the Silurian period begins. Jawless fish diversify rapidly. The first jawed fishes (acanthodians) appear. First vascular land plants appear. Forests of mosses lined streams and lakes. Signs of early terrestrial food webs, including the first arachnids and centipedes, indicating that arthropod prey was present. The period ended 416 million years ago.

Then the Devonian Period begins with reefs of corals and red algae, with lots of invertebrates. Coil-shelled cephalopods called ammonoids appeared. Fish diversified, including lobe-finned fishes that evolved into amphibians near end of the period. Giant mosses and ferns, early seed plant on land appeared. Another major extinction wiped out lots of invertebrates (including most trilobites) and jawless fish. This period ended 359 million years ago.

Next, the Carboniferous Period begins. Bony fish and sharks similar to modern groups appear. First freshwater clams. There are humid, tropical climates with no well-defined seasons. Swampy forests of ferns and their relatives. Winged insects (cockroaches, mayflies, dragonflies) attained huge sizes. There were numerous amphibians and the first lizard-like reptiles. This period ended 299 million years ago.

Then, the Permian Period begins. Earth's landmasses drifted together to form Pangaea. Diversification of terrestrial fungi, arthropods, and plants occurs. Early conifers (similar to modern pines) appear. Reptiles are exposed to radiation. At the end of the period, largest extinction of marine life in Earth's history occurs, with around 96% of marine life (including all trilobites) being wiped out. This period ended 251 million years ago.

Next, the Triassic Period begins. Sea life began to recover. On land, seed plants and insects diversified further. Many reptiles, including plant eaters, meat eaters, flying reptiles (pterosaurs), giant aquatic reptiles (ichthyosaurs, plesiosaurs, pliosaurs, and giant sea turtles) appeared. By the end of Triassic, representatives of all modern tetrapods (with birds represented by dinosaurs) were present. This period ended 201.6 million years ago.

Then, the Jurassic Period begins. Giant herbivorous dinosaurs, and smaller predators appear. Pterosaurs abundant in the skies, and Archaeopteryx, the first bird, appeared. Large marine reptiles at their most abundant, as well as sharks and rays similar to modern forms. Terrestrial mammals diversified, but still relatively sparse. The earliest known aquatic mammal appeared. This period ended 145.5 million years ago.

After the Jurassic Period, the Cretaceous Period begins. Earliest deciduous trees and flowering plants appear. There is a rapid increase in insect diversity (including first butterflies and ants). T. Rex and mosasaurs appear. First marsupials (mammals that carry young in mother's pouch) appear. There is diversification of birds. Dinosaurs (except birds) and large marine reptiles all went extinct at the end of the period, perhaps due to one or more meteor impacts, though increased volcanic activity and falling sea levels may have played a role. This period ended 65.5 million years ago.

Then, the Tertiary Period begins. With dinosaurs gone, mammals became the dominant vertebrates. Monotremes (egg-laying mammals), odd-toed ungulates (relatives of horses, deer, and rhinos), even-toed ungulates (relatives of sheep, goats, camels, etc.), first elephants with trunks, and early

horses appeared. Nearly all modern flowering plant families represented by middle of the period. Global cooling begins towards the end of the period, with ice sheets at the poles. This period ended 2.6 million years ago.

Finally, the Quaternary Period begins. Earth experienced multiple glaciations (ice ages from the early part of this period, until about 10,000 years ago, when more modern climates came into play. More mammals appeared, including many now extinct ones (saber-toothed tigers, woolly mammoths and mastodons, glyptodonts (giant armadillos), and giant ground sloths). Modern man appears. We are currently in this period.

TN Math Standards:

3rd Grade:

Measurement and Data:

3.) Draw a scaled picture graph and a scaled bar graph to represent a data set with several categories. Solve one- and two-step "how many more" and "how many less" problems using information presented in scaled bar graphs.

4th Grade:

Measurement and Data:

2.) Use the four operations to solve word problems involving distances, intervals of time, liquid volumes, masses of objects, and money, including problems involving simple fractions or decimals, and problems that require expressing measurements given in a larger unit in terms of a smaller unite. Represent measurement quantities using diagrams such as number line diagrams that feature a measurement scale.

5th Grade:

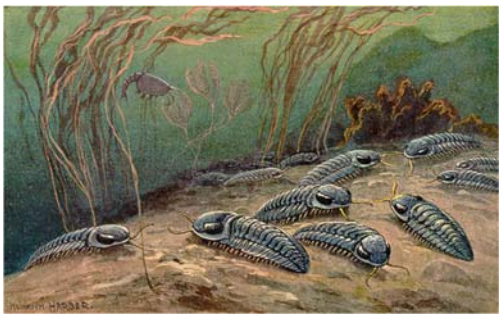
Measurement and Data:

1.) Convert among different-sized standard measurement units within a given measurement system, and use these conversions in solving multistep, real world problems.

Source:

Biology in a Box, Unit #1 – Fossils, the University of Tennessee.

Adapted by: Virginia Parkman, Kelly Sturner, and Suzanne Lenhart

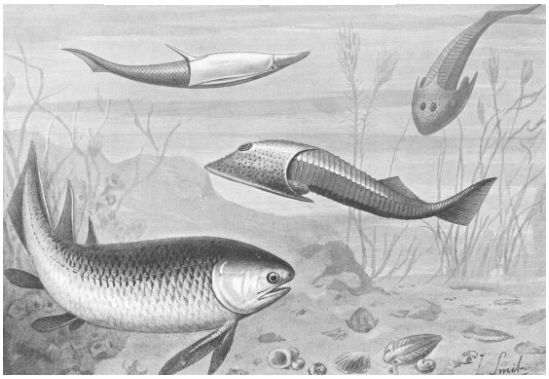


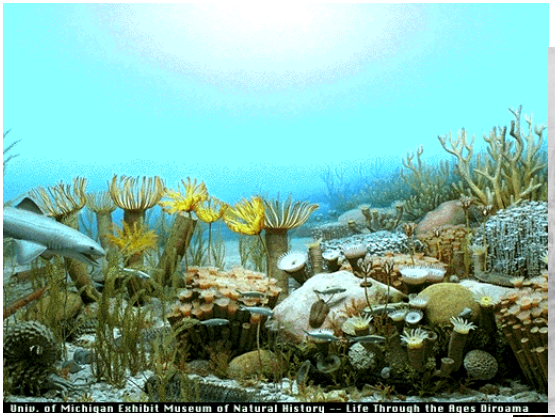

Univ. of Michigan Exhibit Museum of Natural History -- Life Through the Ages Diroama

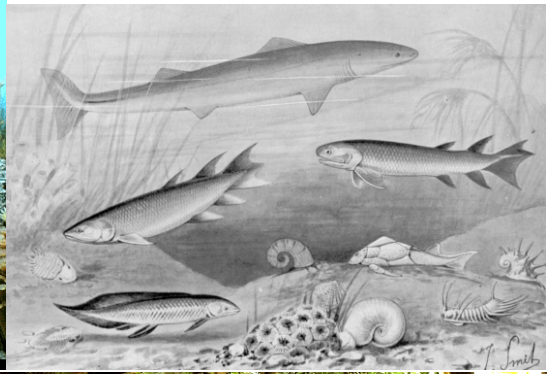

Univ. of Michigan Exhibit Museum of Natural History -- Life Through the Ages Diroama


COOKSONIA


BARAGWANATHIA

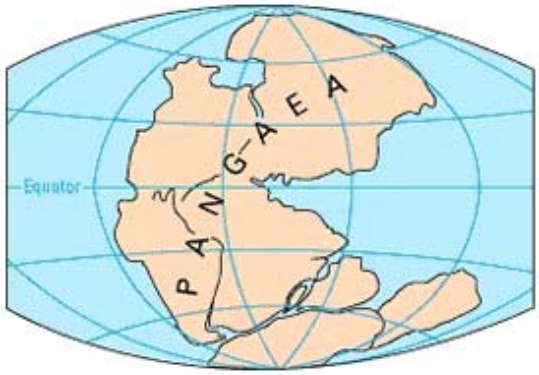



Univ. of Michigan Exhibit Museum of Natural History -- Life Through the Ages Diroama

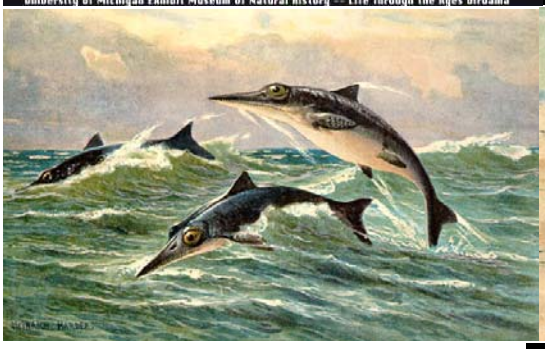



Univ. of Michigan Exhibit Museum of Natural History Diroama

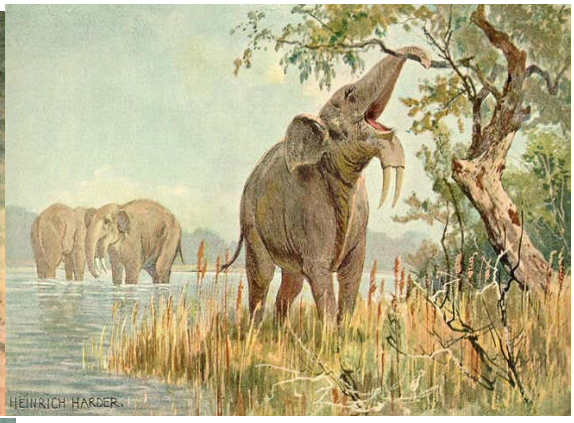

Univ. of Michigan Exhibit Museum of Natural History Diroama



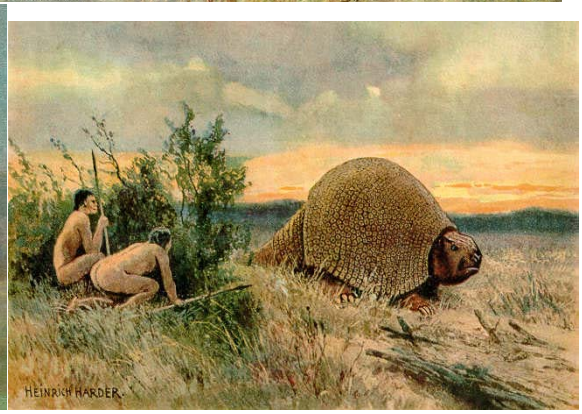
PERMIAN
225 million years ago




HEINRICH HARDER


HEINRICH HARDER.


HEINRICH HARDER.


HEINRICH HARDER.