

Lesson 3

Age of the Earth

Creating a Timeline to Help Understand The Millions and Billions of Years of Earth's History

Summary

The Earth is around 4.55 billion years old. The oldest known rocks on Earth formed between 4.2 and 3.8 billion years ago and are found in northwest Canada. (The age range reflects a controversy in the geologic community.) The oldest reliable evidence for life comes from 3.0-billion-year old microfossils.

It is very difficult for most people to appreciate the vast amount of time that has passed on Earth. We can easily think of a year, a human lifetime, or the history of an entire civilization as “a long time,” but the history of Earth is on an entirely different scale. It helps to use an analogy to visualize this time scale. One of the greatest challenges in geology is coming to grips with the age of the Earth. Talking in millions and billions of years is not something most of us do on a regular basis but these numbers are essential to geologists and paleontologists for they recognize that in order to understand the essentials of the science, such as evolution, plate tectonics, uplift, erosion, and rock formation, you have to understand that in each situation time, and great periods of it, is the critical factor.

This lesson is a third building block of learning about geology. It complements what was learned in the first two lessons on rocks and minerals and gives the students important background to take them on their path to addressing the central questions raised in this box. How does a specimen go from the field to the museum? And what happened to the dinosaurs and how do scientists know?

For this lesson plan, students will work together as a class to develop a time line that runs around the walls of a classroom. After figuring out when different time periods occurred and labeling the wall with them, they will each have a different geologic event, evolutionary event, or animal to research and figure out where it goes on the timeline.

Objectives

Students will be able to:

1. Identify the four eras of geologic time.
2. Indicate the time spans of each era.
3. List when major events, such as evolution of plants and animals, occurred during Earth's history
4. Create and recognize the importance of making a geologic time line.

Estimated teaching time

Two class periods (one to introduce the topic and start work and the second to finish the time scale and discuss what they discovered)

(Students may have to move desks out of the way in order to access the wall.)

Groups

Class and Individual

Materials

Each student needs:

From the Box:

- *Handout of Geologic Time Scale and Major Events in Earth's History*

Students will need to provide from their own supplies:

- Pencil, paper
- Ruler
- Calculator

For the whole class:

Teachers will need to provide from their own supplies:

- Tape Measure
- Roll of paper (perhaps paper towels) or string that can be run around the length of the room. Students will add material to this such as dates, time periods, drawings, etc.

Teacher background

See document labeled **Paleontology Background for Montana DIG Box.**

Student background

None specifically needed

Set up

1. Read the Teacher background document "Paleontology Background for Montana DIG Box."
2. Copy Geologic Time Scale onto overhead.
3. Copy Geologic Time Scale and Major Events in Earth's History back to back (one per student).

Introducing the activity

1. One of the greatest challenges in geology is coming to grips with the age of the Earth. Talking in millions and billions of years is not something most of us do on a regular basis. Ask the students how often they use these terms. In what context do they use them? When they think of something really, really old, what do they think of? How old is their oldest family member? What's the oldest thing they can think of?
2. These are all relatively small numbers to geologists. Ask the students "How old is the Earth?" How old do you think the rocks are in this region?
3. Show students the geologic time scale overhead and discuss how the Earth is divided into different time eras, periods, epochs, and ages.
4. Ask the students:

- ⇒ Why would it be important to know the age of the Earth? (To understand evolution, to better understand geologic processes)
 - ⇒ How would scientists determine the age of the Earth or of different rocks? (They could first try relative dating. For example, if you have several layers of rock, the oldest would be on the bottom but to determine absolute age requires a more complicated method. See handout on absolute age dating for more information.)
5. Ask the students “How could you create a timeline that would show the age of the Earth in a way that you could understand it?”
 6. Explain that they are going to make a timeline showing the age of the Earth in a way that they can relate to.

Facilitating the activity

Part One

1. Hand out Geologic Time Scale and list of Major Events in Earth’s History.
2. Ask student to use the tape measure to figure out the dimensions of the classroom walls in feet.
3. Have students create a time scale relating inches to millions of years.
 - a. They can use the following mathematical formula to figure out how many years an inch equals. (See Teacher’s Background for more information.)
 - i. $4,600,000,000 \text{ (age of earth)} = DX$
 $D = \text{Total Distance around Room in Feet}$
 $X = \text{Millions of years}$
 - ii. For example if the room is 84 feet long the formula would be:
 - iii. $4,600,000,000 = 84X$
 - iv. $X = 4,600,000,000/84$
 - v. $X = 54,761,904 \text{ years (which can be rounded to 55 million years)}$
 Therefore each foot equals 55 million years.
4. Ask students to figure out what 6”, 3”, and 1” equal in millions of years.
5. Ask students to come up and figure out where to place the different eras and periods of Earth’s history. You might want to begin with the three eras (Paleozoic, Mesozoic, and Cenozoic) and the Precambrian. They could then plot the periods.

Part Two

6. Have students pick a specific event or animal or plant to place on the timeline. (You could come up with a list before hand and assign them or let the students pick themselves. A good list to consult is <http://www.uky.edu/KGS/education/timeline2.htm>)
7. Have students research their particular geologic event or species.

8. Ask them to plot it on the classroom timeline.

Assessment

Ask students to consider the following questions. This can be done as a group activity or as a writing assignment.

- What does this timeline show you about life on Earth?
- Is it what you expected?
- Were you surprised by it?
- Can you think of other ways to show the great numbers involved in the age of the Earth?
- What was challenging about this activity?
- What does the timeline show you about how long the dinosaurs were on Earth?
- Put the following modes of travel in chronological order: flight, swim, and walk.
- What can you say about humans specifically: how long have they been on the planet? What has been their impact on the planet? (We have been here for but a blink of time. We have had a huge impact on the planet for such a short residence here. Many groups of animals, such as the dinosaurs had a much longer reign of the planet. And even dinosaurs went extinct: nothing lives forever. (Technically dinosaurs are still around, in the form of birds; geologists refer to non-avian dinosaurs and avian-dinosaurs (birds).)

Going further:

Students could create other timelines based on well-known scales, such as a single year, single day, 12-hour clock, or football field. (Two blank scales included.) (For an example of how to do this with a roll of toilet paper go to: www.nthelp.com/eer/HOAtimetp.html)

References

NA

Teaching standards

Science Content Standard 4. Students, through the inquiry process, demonstrate knowledge of the composition, structures, processes and interactions of Earth's systems and other objects in space.

Benchmark Grade 8, Number 3 -Use fossils to describe the geological timeline

Glossary

- Cenozoic - The most recent of the three major subdivisions of animal history, covering the last 66 million years of Earth history. Often called the "Age of Mammals", because this is when mammals became the largest land animals, though many other groups are more diverse, more common, and more abundant. In addition, fundamental evolution of mammals occurred during the Mesozoic.
- Epoch – A length of geological time longer than an age and shorter than a period.
- Era - A length of geological time longer than a period and shorter than an eon.
- Mesozoic – 251 million years ago (mya) to 66 mya - Mesozoic means "middle animals," and is the time during which the world fauna changed drastically from that which had been seen in the Paleozoic. Dinosaurs were the most dominant animals of this period. The non-avian dinosaurs went extinct at the end of the Mesozoic.

- Paleozoic – 542 mya to 251 mya. Began with a great burst of evolution called the “Cambrian explosion” and ended with the greatest extinction on Earth, the Permian-Triassic, when more than 90% of life on land and 70% of life in the seas went extinct.
- Period - A length of geological time longer than an epoch and shorter than an era.

The Age of the Earth

Short List of Major Events in Earth's History

History of Life: (mya = million years ago)

First evidence of life – 3500 mya

Oldest fossils in Montana (Stromatolites) – 1600 mya to 800 mya -

<http://formontana.net/cabbage.html>

First multicellular organisms – 1200 mya

First animals – 590 mya

Burgess Shale fossils – 505 mya

Early land plants – 438 mya

First animal on land – 420 mya

First insect and first flight – 400 mya

First amphibians – 370 mya

Great Fish Fossils from Montana – 318 mya - http://www.sju.edu/research/bear_gulch/

First reptiles – 310 mya

First dinosaurs – 240 mya

First mammals – 225 mya

Stegosaurus – 155 mya

First birds – 150 mya

First flowering plants – 140 mya

Tyrannosaurus rex – 67 mya

Extinction of non-avian dinosaurs – 66 mya

Early horses and other familiar animals – 37 mya

Earliest hominids – 2 mya

Physical Geology: (mya = million years ago)

Formation of Earth – 4600 mya

Oldest rocks yet discovered – 4280 mya

Oldest rocks in Montana – 3300 mya -

<http://mathscience.mt.gov/files/RoadSignPDF/beartoothplateau.pdf>

Start of formation of Appalachian Mountains – 450 mya

Start of supercontinent Pangaea (all continents pushed together) – 360 mya

Break-up of Pangaea begins – 225 mya

Formation of Rocky Mountains – 60 mya

Major deformation of Alps and Himalayas – 50 mya

Yellowstone Volcano starts erupting – 1.8 mya

Beginning of Ice Ages – 1.6 mya

Eruption of Mount St. Helens – 0 mya (May 1980)

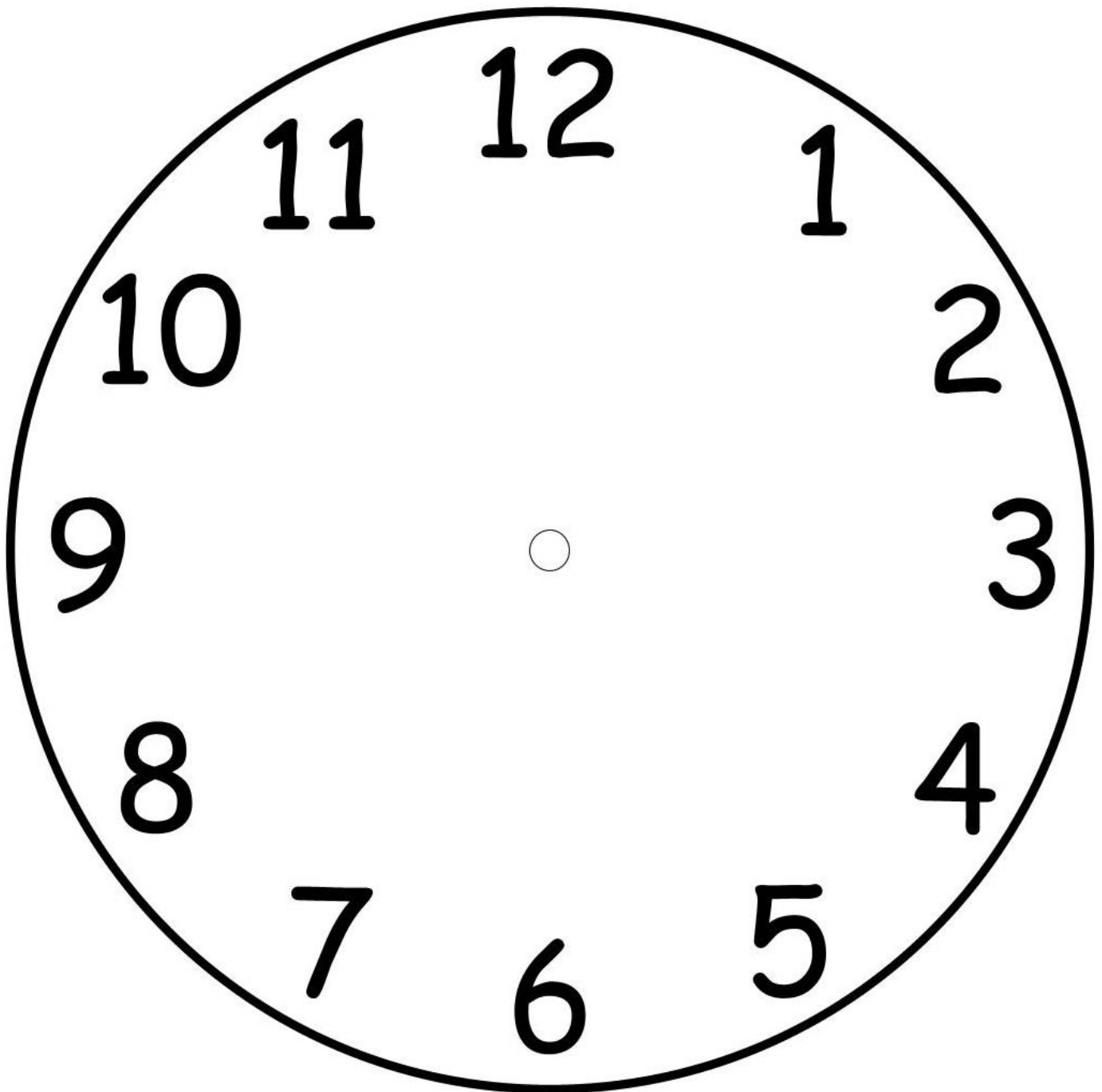
For a more complete list go to:

www.uky.edu/KGS/education/about_time.htm

Clocking In GEOLOGIC TIME AS ILLUSTRATED ON A CLOCK FACE

12 hours = 4.6 billion years • 1 hour = 383,333,333 years

1 minute = 6,388,889 years • 1 second = 106,482 years



End Zone											End Zone
	10	20	30	40	50	05	40	03	20	01	

GEOLOGIC TIME ON A FOOTBALL FIELD

1 YARD = 46 MILLION YEARS ••• 1 FOOT = 15.33 MILLION YEARS