Geologic Time

Subjects: Geology, Earth Science

Location: Classroom, gymnasium, outdoors

Duration: 45-60 minutes

Vocabulary: Years Before Present (YBP); Geology

Curriculum Standards: MS-LS2-4; MS-LS4-1; MS-ESS1-4; CCSS.ELA-Literacy.RST.6-8.7

Objectives: Students will be able to compare the age of the Earth with human history. They will also be able to explain how the geology of Devils Tower and the Black Hills relates to the history of the Earth.

Materials:

- Table of Geologic Time (provided)
- "Date & Time" and "Event & YBP" cards (provided)

Background: Geologic time is difficult to understand. Human lives are measured in months and years, while the age of Earth is measured in eras and epochs that span millions (or billions) of years. This activity will help your students understand the immensity of geologic time, and how rock formations like Devils Tower fit into the scope of Earth history.

Procedures:

Print out materials from park website. Cut the cards out. Mix "Date & Time" cards randomly before distributing them. The "Event & YBP" (years before present) cards also have a calendar date and time; spread these out on a table/floor so the date and time faces up, and the event is face down.

You can begin this activity by introducing the concept of geologic time and the age of Earth, or you can draw comparisons between students' lives, knowledge and the concept of the lesson. E.g.:

- In your life, what is the oldest thing you can remember? (or: How far back can you remember?)
- In human history, what is the oldest thing you know of? (e.g. Columbus' voyage, or Egyptian empire)
- In Earth history, what is the oldest thing you know of? (e.g. dinosaur age, or rock formation)

Use a reference material to date some of the answers given by the students. Also ask students if they know the age of the Earth (4.6 billion years). Since that number is so big, we are going to do an activity to help us understand when certain events on Earth occurred. This activity will take major events in Earth history and squeeze them into one calendar year.

Pass out "Date & Time" cards (1 for each student; may pair up if you have a large group). Their first task is to put themselves in chronological order. You can ask students which event they think they represent. Where do they think the formation of Devils Tower fits in the calendar; what about people?

Proceeding one student at a time, have them pick up the "Event & YBP" card that matches their "Date & Time" card. After everyone has both cards, go down the line by having students explain their event, how many years before present it occurred, and what date that equals on the calendar. Events related to Devils Tower are marked with an asterisk (*).

Evaluation & Extension:

Ask students about their impressions of the activity. Was anyone surprised? Why? Using the calendar metaphor, ask students how many "days" ago certain events occurred.

- Have students research other events in Earth history and place them on the calendar
- Make an actual paper calendar to demonstrate the concepts of the activity
- In the gym or outside, create a calendar by making 365 squares and have students stand in the correct spot (create a student-sized, visual representation of the activity)

Evaluation & Extension (continued):

Discuss human presence related to the history of the Earth and other life forms. According to our calendar, modern humans (*Homo sapiens*) developed in the final 12 minutes of the year. All of recorded human history fits within the final 82 seconds of the year.

- Which month(s) have most of the events in Earth's history? Why do you think this is?
- Are there life forms that developed before humans but are still alive today?
- Did any of these survive mass extinction events? (yes - sharks, crocodiles, birds)

You can also discuss how human beings have changed the environment and other life forms, even though we have only inhabited the world for a relatively short period of time.

A reference sheet developed by the Kentucky Geological Survey (and used to develop this activity) is included on the park website page where you accessed this activity. You can use this to discuss other major events in Earth history (e.g. when eras and systems began or ended, when certain species developed). Consider including geologic events which are relevant to your area (e.g. when mineral resources were deposited or major changes to the landscape occurred).

Other Notes:

The Spearfish Formation includes the oldest rock layer in the park. It is comprised mostly of reddish sandstone and siltstone sedimentary rock. This formation is visible throughout the outskirts of the Black Hills region.

The Sundance Formation is another layer of sedimentary rock, younger than the Spearfish Formation. It is dominated by a yellow sandstone. Layers of sedimentary rock once buried the Tower, and slowly eroded away to expose the igneous intrusion that today we call Devils Tower.

The dates given for the deposition of these formations, as well as the Tower formation and exposure through erosion, are approximate. They all occurred over a long period of time, and represent the best average or estimate based on geologic science.

Image of Devils Tower and the Belle Fourche River Valley, showing the older sedimentary rocks which form the hill the Tower sits upon. You can find this and other images of the Tower on the park website.