EARTH AND ENVIRONMENT THROUGH TIME LABORATORY EES 1005
<table>
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***NOT TO SCALE***
Introduction

**Historical geology** is concerned with reconstructing the history of the Earth. That is, what is the chronology, or sequence of events, that have shaped the Earth since it formed?

Some of the first geologists figured out that the Earth's rocks could be organized by appearance and disappearance of certain fossils. One of the most important initial observations in geology came with Nicolaus Steno's writings in 1669 on a "solid naturally contained within a solid." Although it may sound ridiculously obvious to us now, Steno reasoned out how one solid (a fossil) came to exist within another solid (a rock). He first assumed that the rock had not always been solid.

In the 1790's **William Smith**, an engineer and surveyor, worked out the **principle of faunal succession**. Smith collected thousands of fossils as he worked on a major canal-building project in England, and found that similar looking rock units, or strata, contained distinct assemblages of fossils.

**Question:**
Which came first, the organism preserved as a fossil or the surrounding rock?

These fossil assemblages could be arranged in order of the strata that they came from. It is important to realize that the power of the principle of faunal succession came with the realization that the fossil record is directional (complex life forms appear after less complex ones) and nonrepeating.

During the first half of the 19th century, many geologists work on refining their local stratigraphic successions.
History and Theory of the Time Scale

Most of the divisions of the geologic time scale are based on distinctive rock units and their fossils.

The geologic time scale can be found on page 2. Most of the divisions had been set and named by the 1850's, and occur in the same relative order as they do today. A framework of numerical, or absolute, dates could not be added with any accuracy until the early 1900's. Absolute dates are determined by measuring the decay of radioactive elements, a process which occurs at a predictable linear rate.

As you can see, radiometric dates indicate that the Earth is approximately 4.6 billion years old. One of the most difficult concepts to comprehend in geology is the enormity of time.

Ponder This!
Are specific rock types (i.e. sandstone, limestone, etc..) always associated with the same time period? Can one geologic time period be associated with more than one rock type?

While geologic time is amazingly long, it is not infinite. To put the idea of the vastness of time into perspective, look at the examples below.

In addition to understanding the vastness of time, we also need to understand Earth history within its framework. Often, geologists make statements that seem counterintuitive. For example, we may refer to an event as occurring in a "geologically short period of time" even though the process may have taken millions of years. To better understand the relative lengths of geologic intervals an analogy of the history of the Earth will be created and explored.

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Explore It For Yourself!

One Twinkie = one year
Let the dimensions of a Twinkie be 1"x1"x3". In a 10' row of Twinkies, laid out neatly side by side, you would have 120 Twinkies or 120 years. In a 10' square area (10'x10'), you could fit 40 rows, with 120 Twinkies each, or 4800 Twinkie/years. If you were to stack 10'x10' layers of Twinkies to a height of 10', you would have 576,000 Twinkies, or just over ½ million years. If you were to stack Twinkies to a height of 10', completely covering a football field. (300'x60', no end zones included) you would have 103,680,000 Twinkies. You would have to stack Twinkies on the football field to a height of over 440' to equal 4600 million years, or the approximate age of the Earth.

Imagine the distance of a football field = Earth History (4,600,000,000 years)
Goal line- Formation of the Earth (4.6 billion years ago)
17 yard line- Start of the Archean (3.8 bya)
46 Yard line- Start of the Proterozoic (2.5 bya)
50 Yard line- 2, 300, 000, 000 years of Earth History
12.3 Yard line- Start of Phanerozoic (570 million years ago)
5.3 Yard Line- Start of Mesozoic Era (245 mya)
1.43 Yard Line- start of Cenozoic Period (65myA)
1. Construct an analogy to illustrate the intervals (eons & eras) of the geologic time scale. Also include these important dates in your analogy:

**Pleistocene (200 kya)**
- Homo sapiens appears

**Cenozoic (65 mya-present)**
- Age of mammals

**Cretaceous/Tertiary boundary (65 mya)**
- Mass extinction

**Mesozoic (248-65 mya)**
- Age of the dinosaurs

**Pennsylvanian (320-290 mya)**
- Large extensive swamps lead to widespread coal deposits

**Devonian (400 mya)**
- First abundant land animals

**Earliest Cambrian (540 mya)**
- Marine life "explodes"

2. Use the analogy to explain how large the following numbers are:
   - a. 1,000,000
   - b. 4,600,000,000 (in years, the age of the Earth)

**Materials:**
You will be provided a box containing various items. You may use all or none of these items. You may want to use a calculator to help find the answers to questions 3 and 4.

**Questions:**
1. When considering the Geologic Time Scale, what is apparent about the distribution of our knowledge of Earth history?

2. Why are Precambrian periods undefined?

3. Fossils are rare in rocks older than Cambrian. What percentage of Earth history is the Phanerozoic?

4. Our species, *Homo sapiens*, first appears approximately 200,000 years ago. Over what percentage of Earth history have humans existed?

5. How many years do you think a "geologically instantaneous" period of time could be?

6. Why do geologists use the geologic time scale as opposed to simply using absolute dates?