Name:

**Geologic Timeline Activity**

To understand evolution, humans must think in units of time much larger than those we use to define our lives. After all, evolutionary change occurs too slowly to be measured in days, months, or years. Instead, it is documented in layers upon layers of rock deposited over the course of 4.6 billion years.

The earth has been significantly altered during this time by climate swings, volcanism, drifting continents, and other "earth shattering" events. These dynamic conditions, in turn, have influenced every living thing that has inhabited the planet. Because of this, biology alone cannot fully explain the evolution of life on our planet. It's necessary to include the physical sciences -- geology, chemistry, and physics -- in order to understand the conditions in which life arose and evolved.

**The story of life is told primarily by its victims**. Scientists say that only one in a thousand species that have ever lived survives today. The other 99.9 percent are extinct, gone forever. With few exceptions, the lifespan of individual species is short by geological standards, on average between 2 and 10 million years. No matter how well adapted a creature is to its environment, history has shown that even the most dominant can be wiped away. Ironically, extinction is a springboard to other life. Even in the most catastrophic of events, species survive and continue to evolve, often filling niches left by the victims. Extinction is by and large a natural process in which species, groups, and even whole families of organisms disappear. Background extinctions, which are ongoing throughout the history of life, eliminate one family every million years or so. The more destructive and relatively sudden kind of extinction -- the mass extinction event -- is caused by environmental influences and has a global impact on diversity. All extinctions identified in this timeline are mass extinction events.

The geologic time scale we use to study the history of the earth and of it life forms is commonly referred to as "deep time," and it's a concept perhaps as difficult to conceive as deep space. Can humans measure deep time? Yes. Will we ever truly comprehend such immensity of time? Probably not. But to develop a better understanding of evolutionary change in its proper historical context, we must try. This timeline provides a framework for doing so.

**HHMI Click and Learn: Deep History of Life on Earth**

Go to the following site to access an interactive geologic timeline in order to answer the questions: <http://media.hhmi.org/biointeractive/click/deeptime/?_ga=1.222584979.928960184.1468703330>

1. Name and give an example of two types of evidence scientists use to recreate the history of life:
2. Geologists divide the geologic time scale into large spans of time known as *eons*. List the four eons of geologic time (shown along the bottom of the timeline), starting with the earliest and ending with the present eon.
   1. approximate time range:
   2. approximate time range:
   3. approximate time range:
   4. approximate time range:
3. Eons are subdivided into *eras.*  On this timeline, only the eras in the most recent eon are shown. Name the eras, from earliest to present day: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
4. Geologic eras are further subdivided into *periods*. For the Phanerozoic Eon, fill in the missing geologic periods and their corresponding dates. (Hint, read the descriptions of the various events.)

time (mya)

541

485

443

\_\_\_\_

360

\_\_\_\_

\_\_\_\_

200

155

\_\_\_\_

23

2.6

0

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Ordovician |  |  |  | Permian |  | Jurassic |  | Paleogene | Neogene | Quaternary |
| Paleozoic Era | | | | | | Mesozoic Era | | | Cenozoic Era | | |

1. While the Proterozoic, Archean, and Hadean Eons are technically still divided into eras and periods, they are often simply referred to as “Precambrian Time” by many scientists. Based on the events featured on this timeline, why do you think this is the case?

\_\_\_\_\_\_\_\_\_\_\_

1. How do scientists mark the end of one geologic era and the beginning of the next?
2. What major event(s) happened in the Hadean eon?
3. What major event(s) happened in the Archean eon? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
4. How do the number and types of events that happen during the Proterozoic and Phanerozoic eons differ from the events that happened earlier? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
5. How long has life existed on Earth?
   1. Briefly describe the earliest *chemical evidence* for life on earth: \_\_\_\_\_
   2. Briefly describe the earliest *visible evidence* for life on earth: \_\_\_\_\_\_\_
6. What allowed animals to evolve into larger, multicellular organisms?  
    \_\_\_\_\_\_
7. Which came first, the earliest forms of life or oxygen in the atmosphere? Explain why.   
    \_\_\_\_\_\_\_\_\_\_
8. What kind of organism was the oldest eukaryote according to the fossil record? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
9. What type of organism is *Bangiomorpha pubescens* and what why is it significant?   
    \_\_\_\_\_\_\_\_\_\_
10. Along the tree of life located in the bottom half of the timeline, symbiosis (indicated by dashed lines) occurs twice. According to the corresponding timeline events and the position of these symbioses in the tree of life, explain what happened at each of these symbiotic events.

1. How long ago did the first dinosaurs appear on Earth?
2. When did the dinosaurs go extinct?
3. What do scientists think caused the extinction of the dinosaurs?
4. What type of animals became dominant after the extinction of the dinosaurs?
5. For about how many years have modern humans existed on Earth?
6. What was the greatest extinction event in Earth’s history?   
   What percentage of Earth’s species went extinct during this event?
7. Why do scientists consider *Dimetrodon* to be more related to mammals than dinosaurs?

1. Are the fossil fuels we use today really the remains of dead dinosaurs? Why or why not?

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