

Name: _____

Date: _____

Geologic Time Scale

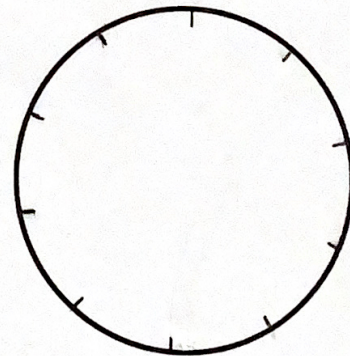
Introduction: The geologic time scale was developed by scientists as a means of representing the evolutionary history of Earth. Geologists in the 1700's and 1800's began to put together a timeline for the order in which different groups of rocks and fossils were formed. This timeline is known as the geologic time scale. Scientists first developed the geologic time scale by studying rock layers and fossils from around the world and putting them in order according to their relative age. When studying rock strata, scientists work on the premise that the oldest rock layers are found on the bottom, and the more recent layers are found closer to Earth's surface. It is assumed that rocks and fossils found in lower strata were formed before those found in the strata above. In relative dating, the age of a fossil is determined by comparing its placement with that of fossils in other layers of rock. More recently scientists have turned to radioactive dating as a means of dating rocks and fossils. In radioactive dating, scientists calculate the age of a rock or fossil based on the amount of remaining radioactive isotope it contains. In this way, scientists can determine the absolute age of a sample.

Take a moment to familiarize yourself with the Geologic Time Scale Reference Table you have been given. It should be noted that the dates used on the table are not "set in stone." Scientists constantly debate and revise the geologic time scale. There is not a definite division between the periods of history. The changes that have occurred on Earth have been slow and gradual. You will refer to this table as you work through the questions and activities in this lesson. By completing this activity you will get an overview of how life evolved from its earliest forms to its present day diversity.

Directions: Use the Geologic Time Scale Reference Table to answer the following questions.

- The history of life on earth takes place over what time span? _____
- All of geologic time is divided into four large units called _____. These larger units are further divided into smaller lengths of time called _____.
- List the four eras from most recent to the oldest. How long did each era last?
 - _____
 - _____
 - _____
 - _____
- Calculate what percent of Earth's history has been spent in each era. Fill in the table below and complete a circle graph to illustrate your answers. Be sure to label each section of your graph.

Name of Era	Length of Era (Years)	% of Earth History



5. What are the periods in the Paleozoic era? _____

6. When did the Devonian period begin? _____
 When did the Triassic period end? _____
7. In what era and period do we currently live? _____
8. Complete the following chart. Identify the era and period that each of the following first appeared.

Life Forms	Era	Period
Earliest fish		
First multicellular life		
First reptiles		
First humans		
First prokaryotic cells		
Earliest mammals		
First colonization of land		
First amphibians		
First eukaryotic cells		
Earliest flowering plants		
Earliest dinosaurs		

9. Referring back to question 4, make marks on the line below to create a scale model of the four eras of Earth's history. Each mark should be placed on the line to make a scale representation of the length of time spent in each era. Be sure to label each section.

10. Do all periods in an era last the same length of time? _____
 Examine the information given in the geologic time scale table. How do scientists decide when one period ends and another period begins? _____

11. Trilobites were arthropods and were dominant during the Cambrian period. As early arthropods, trilobites exhibited the three classic characteristics of arthropods. Label the three identifying characteristics of arthropods on the drawing to the right. If you are unsure of these characteristics they can be quickly found in your text or by an Internet search.



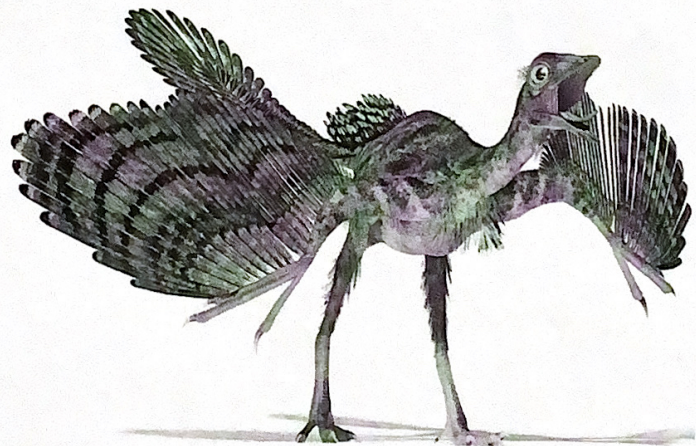
12. Which era is referred to as "The Age of Fishes"? Why does this era have this distinction? _____

13. Which era is referred to as "The Age of Reptiles"? _____

14. Which era is referred to as "The Age of Mammals"? _____

15. A transitional fossil is a fossil that shows the evolution from an ancestral group to a descendent group. It shows characteristics of both groups of organisms. One possible transitional fossil is that of Archaeopteryx. From fossils discovered of this organism, scientists deduce that it may have looked like the animal seen in this picture.

What two groups are represented in this fossil? List the characteristics of each group that you can see in this picture.



16. Fossils from the Precambrian time are extremely rare. List several reasons why no fossils have been found from this time. _____

17. Over millions of years, a flowing river cut a canyon through a mountain exposing many different layers of rock. Upon examining the strata, paleontologists discovered an amazing assortment of fossils! Locate the page called "Images for Questions 17 and 18." At the top of the page of images you will find pictures of 7 different living organisms. These organisms lived at different times in Earth's history. Using the "Geologic Time Scale Reference Table", determine where each of the 7 organisms would be found in the rock strata and the approximate time each organism first appeared on Earth. Cut out the 7 images, then tape or glue each picture into the correct square below. In the rectangular boxes to the right of the picture, write the approximate time (in millions of years) to indicate the age of each organism.

Time Scale:
Millions of years ago

18. Five additional fossils were also found by scientists. (See the page called "Images for Questions 17 and 18.") Use your deductive reasoning skills to determine where to best place these five organisms, in relation to the 7 organisms found in the squares. Cut out the images, then tape each image where you think it best fits in Earth's history. Using the dates you listed in the rectangular boxes above, estimate the approximate age of each fossil.

Estimated age of human bone: _____

Estimated age of Plesiosaur: _____

Estimated age of Ostracoderm: _____

Estimated age of Jellyfish: _____

Estimated age of Whale: _____

19. In question 18, you used a method of dating called relative dating. What is relative dating?

20. What is the assumption being made when scientists date objects by relative dating? How might this assumption lead to the inaccurate dating of a sample? _____

21. Two types of dating methods are used to establish the age of a rock or fossil. What is the difference between relative dating and radioactive dating? _____

22. What major event occurred at the end of the Cretaceous period? _____
How did this event affect the evolution of life in the Tertiary period? _____
This is an example of adaptive radiation. In your own words, define the term "adaptive radiation."

23. How do you suppose the super-continent, Pangaea, affected the evolution of life of Earth?

24. Locate the two-page diagram showing the blank geologic time scale. Follow the instructions below to complete this activity:

- a) Tape the two pages together so that the table is lined up across the two pages.
- b) Locate your Geologic Time Scale Reference Table. You will refer to this table repeatedly in order to complete this activity.
- c) Along the bottom of your two-page blank geologic time scale diagram, you will notice three rows. On these rows you will place information for the era, the periods, and the time frame that each occurred in millions of years.
- d) Write the names of the four eras, in order from earliest to latest, along the bottom row.
- e) Each era, except for the Precambrian time, is divided into smaller periods. Write the names, in order from earliest to latest, of the periods in each of the three eras.
- f) When did each time period occur? Write the dates in the row labeled "Millions of Years."

g) Next, you will insert pictures into the rectangular boxes to show the order of events in Earth's history. Please note that the diagram is not a scaled diagram. Locate the page called, "Images for Question 24." Cut out each of the rectangular boxes on this page. Use your geologic time scale reference table to determine where each cutout should be placed on your two-page diagram. Tape each picture to your two-page diagram.

25. Look at the pictures you placed on your two-page diagram. From these pictures, determine the difference between gymnosperms and angiosperms. _____

26. Gymnosperms and angiosperms are considered to be "true land plants." How do the adaptations you listed in the above question make these plants well suited to a life on land? _____

27. Your two-page diagram is not a "scaled" diagram. What changes would have to be made in order for the diagram to be a "scaled" diagram? (Refer to your answer in question 4.) _____

28. How does the length of time the dinosaurs roamed the Earth compare to the amount of time humans have existed on Earth? _____

29. Use your textbook or dictionary to define the term "placental" mammal. _____

30. It is difficult to visualize the scale of Earth's history. One analogy that is often used is to scale down all of Earth's history into one calendar year. This allows you to "see" how long one era is in comparison to another.

a) If Earth's history has lasted 4.6 billion years (4600 million years), and one calendar year has 365 days, how many years would be represented by one calendar day? _____

b) The Precambrian period lasted 4060 million years. If the Precambrian period started on January 1 of our calendar, how many calendar days did it last? _____

c) The Paleozoic era would last how many days? _____

d) The Mesozoic era would last how many days? _____

e) The Cenozoic era would last how many days? _____

f) When would the first humans appear on our one-year calendar? _____



The Geologic Time Scale Reference Table

Millions of Years Ago	Era	Period	Major Events
4600 - 540	Precambrian		Fossils extremely rare. Anaerobic heterotrophic prokaryotes appear 3.5 billion years ago. Photosynthetic prokaryotes appear 3.0 billion years ago. First aerobic eukaryotic cells appear 2.0 billion years ago. Multicellular algae appear 1.2 billion years ago. Additional multicellular forms quickly follow. Life existed only on the seas.
540 - 245		Cambrian	The "Cambrian Explosion" brings great diversity in invertebrate life. Life includes: (1) Soft-bodied jellyfish, worms, and sponges, (2) Brachiopods with two-shells similar to clams, and (3) Trilobites (arthropods) are dominant.
		Ordovician	Diverse marine invertebrates are dominant. Ancestors of modern octopi and squid appear. First primitive jawless fish are present.
		Silurian	Jawless fish are abundant. Jawed fish appear. First colonization of land by arthropods and vascular plants, such as ferns.
	Paleozoic	Devonian	Called the "Age of Fishes" because of abundant and diverse forms in the seas. Ferns and horsetails are present on land, as well as wingless insects and arachnids. First amphibians appear.
		Carboniferous	Rich deposits of coal are formed. First seed plants appear. Appearance of amniote egg in early reptiles. Abundant sharks, amphibians, and winged insects.
		Permian	Largest mass extinction in Earth's history. 95% of marine species disappear. On land, gymnosperms and conifers are dominant.
245 - 65	Mesozoic	Triassic	Survivors of the largest mass extinction spread and colonize new areas. The super-continent Pangaea alters climates and ocean circulation. Earliest dinosaurs appear. Cycads and conifers are dominant plant life. Early rodent-like mammals are present in late Triassic.
		Jurassic	Dinosaurs rule the Earth as the dominant animal life on land. Some reptiles develop bird-like characteristics leading to the evolution of birds. Pangaea begins to break apart. First angiosperms appear on land.
		Cretaceous	Dinosaurs are dominant early in this period, but in another mass extinction at the end of this period, 50% of all plant and animal species become extinct, including the dinosaur. Angiosperms are dominant. Break up of Pangaea continues.
65 - present	Cenozoic	Tertiary	Angiosperms and insects flourish. Earliest placental mammals. Rapid evolution seen in mammals includes large grazing mammals and marine mammals. Earth's climate is warm and mild.
		Quaternary	Climate cools leading to a series of ice ages at the beginning of this period. Mastodons, mammoths, and large carnivores appear. Earliest humans appear 4.5 million years ago, and <i>Homo sapiens</i> appear 200,000 years ago. 20,000 years ago Earth's climate began to warm.