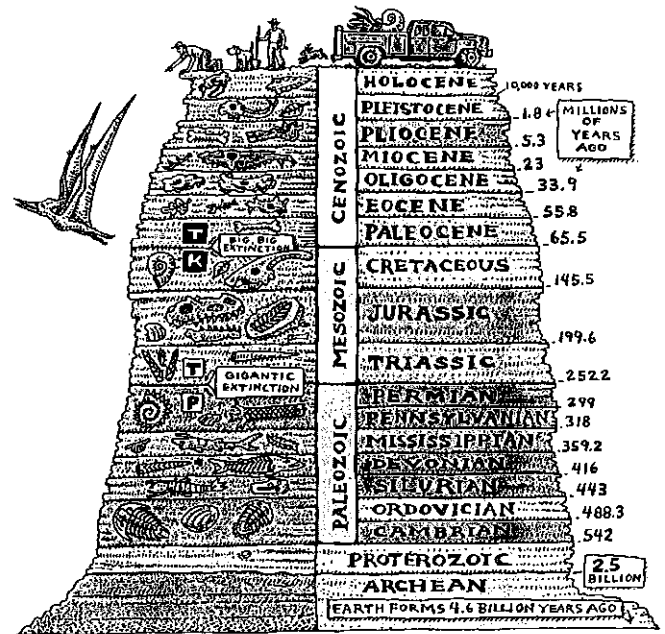


8.E.2.2.

## The Geologic Time Scale

Months, years, or even centuries aren't very helpful for thinking about Earth's long history. Because the time span of Earth's past is so great, geologists use the geologic time scale to show Earth's history. The **geologic time scale** is a record of the life forms and geologic events in Earth's history. The **geologic time scale** is used as a record of the major events and diversity of life forms present in Earth's history.



1. What is the geologic time scale?

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2. Why can't we just use centuries, decades?

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It begins with the formation of Earth and goes on until the present. At the end of each era a **mass extinction** occurred, where many kinds of organisms died out, although there were other extinctions going on during each period of geologic time. Using the fossil record paleontologists created an idea of the different types of common organisms in each geologic period.

Scientists first developed the geologic time scale by studying rock layers and index fossils worldwide. With this information, scientists placed Earth's rock layers in order by **relative age**. Later, **radioactive dating** helped determine the **absolute age** of the divisions in the geologic time scale. As geologists studied the fossil record, they found major changes in life forms at different times. They used these changes to mark where one unit of geologic time ends and the next begins. Therefore, the divisions of the geologic time scale depend on the events in the history of life on Earth, particularly the changes in species.

3. Where does the geologic time scale start?

4. What causes the move from one era to another era?

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5. What did geologist first use to develop the geologic time scale?

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6. What did geologist use to mark where one unit of geologic time ends and the next begins?

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Geologic time begins with a long span of time called **Precambrian Time**, sometimes called the “*PRECAMBRIAN ERA*”, actually consists of three **eons**, the longest units of geological time. They are called the Hadean, Archean, and Proterozoic eons. This span, which covers about **88 percent** of Earth's history, ended 544 million years ago. The next and present eon is the Phanerozoic eon.

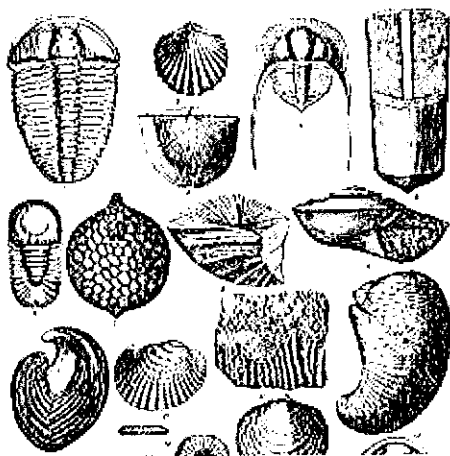
7. What does Precambrian Time consist of? \_\_\_\_\_ Name them.

8. How much of Earth's history is Precambrian time? \_\_\_\_\_

According to theory, it was during Precambrian time that about 4.6 billion years ago five major events occurred: (1) the formation of the Sun and light, (2) the evolution of the Earth, (3) the evolution of the atmosphere through volcanic out-gassing, (4) the evolution of the oceans, and (5) the evolution of life, beginning with the first living cell, and then simple life forms such as bacteria and simple algae. There was a rise of simple organisms such as jellyfish and sea worms by the end of the time. There were few fossils because the life forms were soft-bodied and had no hard skeleton.

9. Besides the formation of the sun and light, what evolved during Precambrian Time?

10. Why are there no fossils from Precambrian time?



After Precambrian Time, the basic units of geologic time are **eras, periods, and epochs**. Geologists divide the present eon into three long units called **eras**. They are the *Paleozoic Era, the Mesozoic Era, and the Cenozoic Era*.

The **Paleozoic Era** began about 544 million years ago and lasted for about 300 million years. Eras are often given a special name after the organisms that evolved during that time. Many animals without backbones, called **invertebrates**, such as trilobites and brachiopods, dominated the early Paleozoic era making it the **Age of Marine**

**Invertebrates**. Later, within the same era, came the **Age of First Vertebrates**, like the early fish and then insects, followed by the **Age of Amphibians**. Early land plants included simple mosses, ferns, and then cone-bearing plants also evolved. By the end of the era, seed plants were common. The mass extinction that ended the era caused most marine invertebrates as well as amphibians to disappear. The last period in the Paleozoic era then was the Permian.

11. Name three eras of geologic time. \_\_\_\_\_

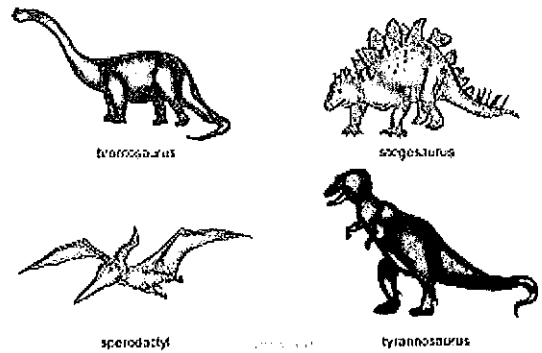
12. What organisms appeared during the Paleozoic Era? \_\_\_\_\_

13. What was the name of the last period of the Paleozoic era and how did it end? \_\_\_\_\_

REPTILES OF THE MESOZOIC ERA

The **Mesozoic Era** began about 245 million years ago and lasted about 180 million years. People often call the Mesozoic- the Age of Dinosaurs, though dinosaurs were only one group of organisms that lived during this time. It is actually known as the **Age of Reptiles**. Small mammals and birds also appeared.

Toward the end of the era, flowering plants appeared and different kinds of mammals increased. The mass extinction that ended the era caused the dinosaurs to become extinct. It is theorized that a giant asteroid hit the Earth or many volcanoes erupted at the same time and caused a giant dust cloud blocking the sun. This would inhibit photosynthesis for plants needed by giant herbivores. Once the food chain was affected in this manner, then the rest would also feel its effect. The last period of the Mesozoic era is the Cretaceous period.



12 What is another name for the Mesozoic Era?

13. What else appeared during this era? \_\_\_\_\_

14. How and when did it end? \_\_\_\_\_

The **Cenozoic Era** began about 65 million years ago and continues to the present day. The Cenozoic is sometimes called the **Age of Mammals**. New mammals appeared while others became extinct. The diversity of life forms increased. Flowering plants became most common. Humans are also part of the most recent period of this era.



15. What organism appeared during thee Cenozoic Era?

\_\_\_\_\_

16. What is the name given to this era?

\_\_\_\_\_

Eras are subdivided into units of geologic time called **periods**. Geologic periods range in length from tens of millions of years to less than two million years. The Paleozoic Era includes six periods: the Cambrian, the Ordovician, the Silurian, the Devonian, and the Carboniferous-which is subdivided by some into the Mississippian and the Pennsylvanian, and lastly, the Permian. The Mesozoic Era includes three periods: *the Triassic, the Jurassic, and the Cretaceous*. The Cenozoic Era includes two periods: the Tertiary- and the Quaternary. The names of the periods come from places around the world where geologists first described the rocks and fossils of each period.

17. Into what sub units are eras divided? \_\_\_\_\_

18. List the periods of each era.

Paleozoic \_\_\_\_\_

Mesozoic \_\_\_\_\_

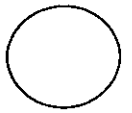
Cenozoic \_\_\_\_\_

Geologists further subdivide the periods of the Cenozoic Era into **epochs**. Why are epochs used in the time scale? The fossil record of the Cenozoic is much more complete than the fossil record of earlier eras. There are a lot more events to place in sequence, and using epochs makes this task easier.

19. What is the smallest unit of geologic time? \_\_\_\_\_

20. Why are epochs only listed in the Cenozoic Era? \_\_\_\_\_

GEOLOGIC TIME SCALE						
Time Units of the Geologic Time Scale				Development of Plants and Animals		
Eon	Era	Period	Epoch			
Phanerozoic	Cenozoic	Quaternary	Holocene	0.01	Earliest <i>Homo sapiens</i>	
			Pleistocene	1.6		
		Tertiary	Pliocene	5.3	Earliest hominids	
			Miocene	23.8		
			Oligocene	33.7	"Age of Mammals"	
			Eocene	55		
			Paleocene	65		
	Mesozoic	Cretaceous	145	"Age of Reptiles"	Extinction of dinosaurs and many other species First flowering plants First birds Dinosaurs dominant First mammals	
		Jurassic	208			
		Triassic	248			
	Paleozoic	Carboniferous	Permian	286	"Age of Amphibians"	Extinction of trilobites and many other marine animals  First reptiles Large coal swamps Amphibians abundant
			Pennsylvanian	320		
			Mississippian	360		
		Devonian	410	"Age of Fishes"	First amphibians First insect fossils Fishes dominant	
		Silurian	438			
		Ordovician	505	"Age of Invertebrates"	First land plants First fishes Trilobites dominant	
		Cambrian	545			
		Vendian	650	"Soft-bodied faunas"	First organisms with shells Abundant Ediacaran faunas	
Proterozoic	2500	Collectively called Precambrian		First multicelled organisms		
Archean		comprises about 87% of the geological time scale				
Hadean		4600 Ma				



Name \_\_\_\_\_ **The Geologic Time Scale**

1. Put the following in order from oldest to most recent by writing a number in the blank beside each.

- \_\_\_\_\_ Mesozoic Era
- \_\_\_\_\_ Precambrian Time
- \_\_\_\_\_ Cenozoic Era
- \_\_\_\_\_ Paleozoic Era

2. Why is the geologic time scale used to show Earth's history?

3. What methods did geologists use when they first developed the geologic time scale?

4. What two methods of dating did scientists use to determine the age of the Earth?

5. How did geologists decide where one division of the geologic time scale ends and the next begins?

6. According to theory, how old is the Earth? \_\_\_\_\_

7. When did the sun form? \_\_\_\_\_

8. When did the first living cell appear? \_\_\_\_\_

9. Why aren't there fossils from the Precambrian Era? \_\_\_\_\_

10. What percentage of Earth's history is Precambrian time? \_\_\_\_\_

11. How many years would that be? \_\_\_\_\_

12. Animals without backbones are called \_\_\_\_\_ and appeared during the \_\_\_\_\_ era followed by \_\_\_\_\_ and then \_\_\_\_\_.

13. What happened at the end of the Paleozoic era? \_\_\_\_\_

14. What are the three periods of the Mesozoic era? \_\_\_\_\_, \_\_\_\_\_, and \_\_\_\_\_

15. The Mesozoic Era is also called the Age of \_\_\_\_\_

16. How did the Mesozoic era end? \_\_\_\_\_

17. What is the present era we are in? \_\_\_\_\_

18. The Cenozoic Era is called the Age of \_\_\_\_\_.

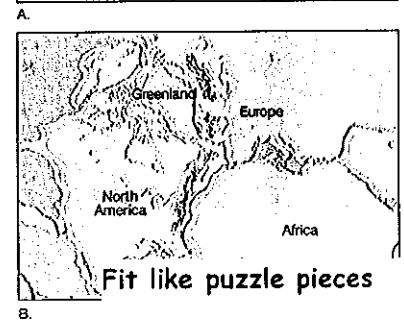
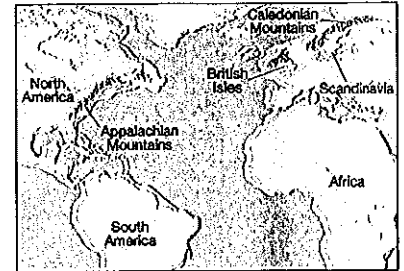
19. Why are periods only divided into epochs in the Cenozoic era? \_\_\_\_\_

20. The record of life forms and geologic events in Earth's history is called the \_\_\_\_\_

21. The divisions of time from biggest to smallest in duration are \_\_\_\_\_, \_\_\_\_\_, \_\_\_\_\_, and \_\_\_\_\_.

# The Theory of Continental Drift

In 1910, a young German scientist named **Alfred Wegener** became curious about why the coasts of several continents matched so well, like the pieces of a jigsaw puzzle. He formed a hypothesis that Earth's continents had moved! Wegener's hypothesis stated **that all the continents had once been joined together in a single landmass and have since drifted apart.** He named this supercontinent **Pangaea**, meaning "all lands."

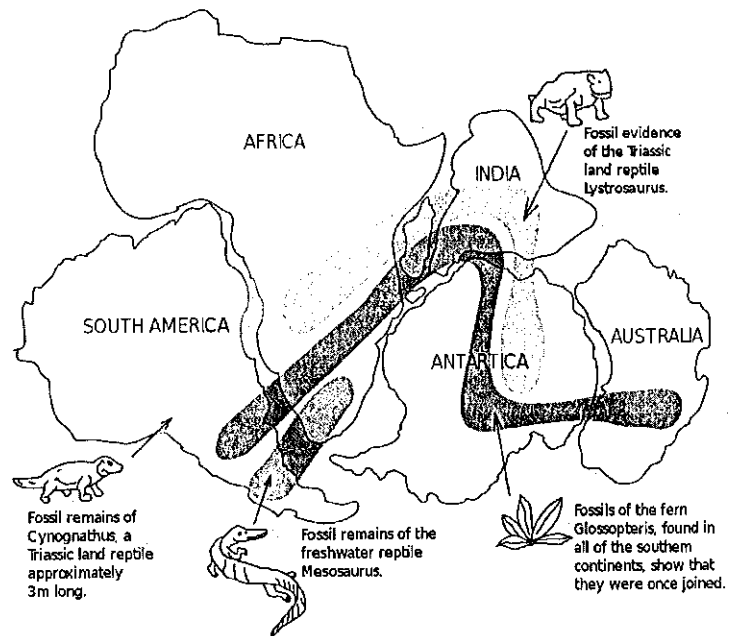


According to Wegener, Pangaea existed about 250 million years ago. Over tens of millions of years, Pangaea began to break apart. The pieces of Pangaea slowly moved toward their present-day locations, becoming the continents of today. The idea that the continents slowly moved over Earth's surface became known as **continental drift**. In a book

called *The Origin of Continents and Oceans*, Wegener presented evidence to support his theory. He used three main evidences.

1. **Evidence from geology**-Mountain ranges and other landforms provided evidence for continental drift. For example, Wegener noticed that when he pieced together maps of Africa and South America, a mountain range running from east to west in South Africa lines up with a range in Argentina. Also, European coal fields match up with coal fields in North America.(Colors on map represent these mountain ranges.)

2. **Evidence from fossils**- Fossils also revised evidence to support Wegener's theory. **A fossil is any trace of an ancient organism preserved in rock.** The fossils of a fernlike plant called *Glossopteris* have been found in Africa, South America, Australia, India, and Antarctica. How could this and other fossils be on the different continents which are separated by huge bodies of water? How could they have gotten there? Their occurrence on widely separated landmasses convinced Wegener that the continents had once been united.



Colors represent where similar rock were found

3. **Evidence from climate**-Wegener used evidence from climate change to further support his theory. For example, an island in the Arctic Ocean contains fossils of tropical plants.

According to Wegener, the island once must have been located close to the equator. Wegener also pointed to scratches on rocks made by glaciers.

These scratches show that places with mild climates today once had climates cold enough for glaciers to form. According to Wegener's theory, Earth's climate has not changed. Instead, the positions of the continents have changed.



Scratches from a glacier

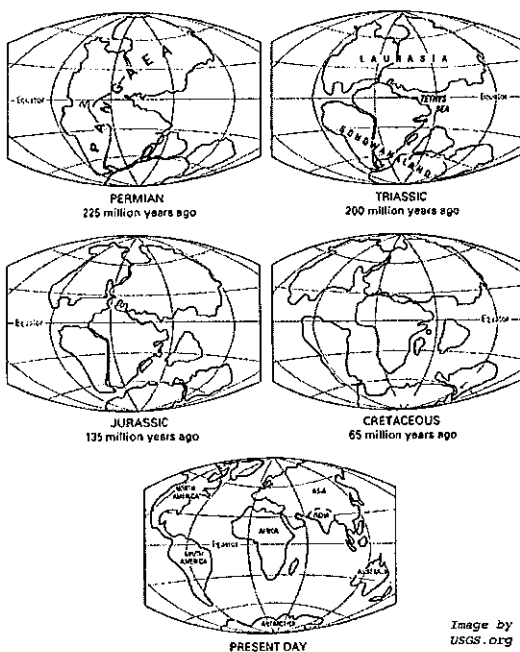
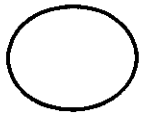


Image by  
USGS.org

Wegener also attempted to explain how the drift of continents took place. Unfortunately, Wegener could not provide a satisfactory explanation for the force that pushes or pulls the continents. Because he could not identify the cause of continental drift, most geologists rejected his theory. For nearly half a century, from the 1920s to the 1960s, most scientists paid little attention to the idea of continental drift. Then new evidence from the ocean floor about Earth's structure led scientists to reconsider Wegener's bold theory.

Name \_\_\_\_\_

## The Theory of Continental Drift



1. State the hypothesis of continental drift. \_\_\_\_\_  
\_\_\_\_\_

2. Who was the person that first researched the theory of continental drift? \_\_\_\_\_

3. What did he notice that made him start thinking about it?  
\_\_\_\_\_

4. What does Pangaea mean?  
\_\_\_\_\_

6. What happened to it?  
\_\_\_\_\_

Besides the shape of the coastlines of the continents and how they fit together, Wegener used three other evidences to support his theory. Complete the list below of why he believed what he did.

Type of Evidence	Example of Evidence
7. Evidence from _____	a. Mountain ranges in South America and 8. _____ line up b. European coal fields match with similar coal fields in 9. _____
10. Evidence from _____	a. Fossils of the plants 11. _____ were found in rocks on widely separated landmasses.
12. Evidence from _____	a. Fossils of 13. _____ plants were found near the Arctic Ocean. b. Scratches in rocks made by _____ 14. were found in South Africa,

15. What is a fossil?  
\_\_\_\_\_

16. Why was Wegener's theory not accepted by scientists during his lifetime?  
\_\_\_\_\_

17. When would scientists start to agree with Wegener's theory?  
\_\_\_\_\_