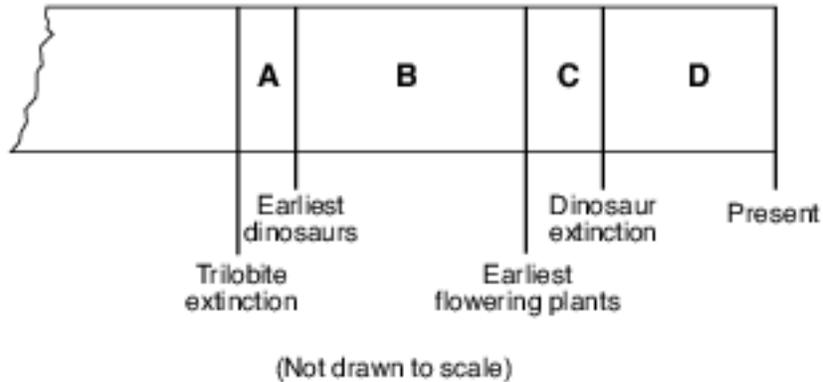


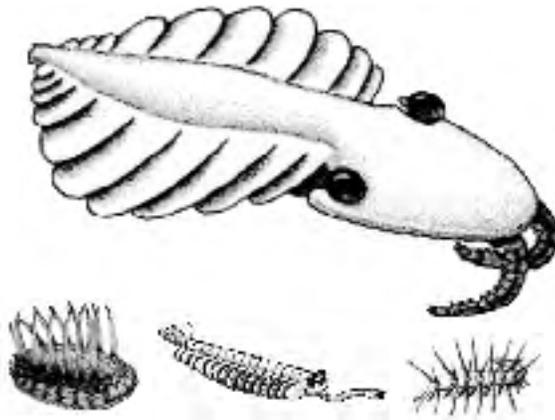
## Geologic Time Units And The Events

- 1 The diagram below is a portion of a geologic timeline. Letters A through D represent the time intervals between the labeled events, as estimated by scientists.



Fossil evidence indicates that the earliest birds developed during which time interval?

- (1) A (2) B (3) C (4) D
- 2 The diagram below represents some fauna (animals) found fossilized in Canada's Burgess shale.



(Not drawn to scale)

During which geologic epoch did these animals live?

- (1) Middle Cambrian (2) Early Pennsylvanian (3) Late Triassic (4) Paleocene
- 3 Which group of organisms survived mass extinctions that marked the ends of both the Paleozoic Era and the Mesozoic Era?
- (1) ammonoids (2) graptolites (3) eurypterids (4) gastropods

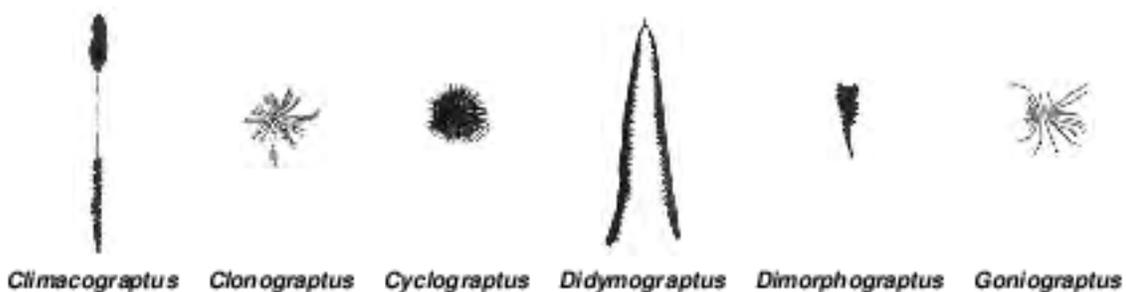
Base your answers to questions 4 on the passage, data table, and diagrams below and on your knowledge of Earth science. The age ranges shaded on the data table show the geologic periods and epochs when six different graptolite fossils existed on Earth. Diagrams of the six graptolites are shown.

Graptolite Fossils

Although graptolite fossils are found in bedrock from the Cambrian Period into the Pennsylvanian Period, their remains are most abundant in Ordovician and Silurian rock layers. During their existence on Earth, graptolites evolved quickly and spread widely due to ocean circulation. These tiny and fragile fossils are usually found in dark shales that formed in marine environments. They are rare in sandstones or other rocks that formed near shore.

Data Table of Graptolite Age Ranges

Fossil Graptolite	Ordovician			Silurian	
	Early	Middle	Late	Early	Late
<i>Climacograptus</i>					
<i>Clonograptus</i>					
<i>Cyclograptus</i>					
<i>Didymograptus</i>					
<i>Dimorphograptus</i>					
<i>Goniograptus</i>					



- 4 Which graptolite from the data table would best serve as an Early Ordovician index fossil?
- (1) *Climacograptus* (2) *Clonograptus* (3) *Didymograptus* (4) *Goniograptus*
- 5 Geologic history is divided into eras, periods, and epochs based on the
- (1) type of rock deposited at different times throughout history  
 (2) half-life of radioactive isotopes found in rocks  
 (3) inferred movements of Earth's landmasses  
 (4) fossil evidence found in bedrock
- 6 During which period in geologic history did the uplifting of the Adirondack Mountains begin?
- (1) Quaternary (2) Cretaceous (3) Triassic (4) Cambrian

7 During which geologic epoch do scientists infer that the earliest grasses first appeared on Earth?

- |                 |               |
|-----------------|---------------|
| (1) Holocene    | (3) Oligocene |
| (2) Pleistocene | (4) Eocene    |

Base your answers to questions 8 on the passage below and on your knowledge of Earth science.

### Waimea Canyon

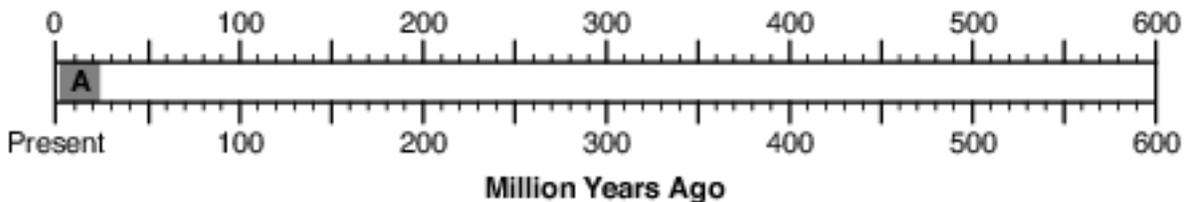
Waimea Canyon is located on the west side of the island of Kauai, Hawaii. Waimea Canyon has been referred to as the “Grand Canyon of the Pacific.” But unlike the Grand Canyon, which was carved through horizontal layers of sedimentary rocks, Waimea Canyon was cut through basalt. The formation of this igneous rock began about 4 million years ago. Numerous lava flows followed as magma rose from deep within Earth. The canyon then was formed over time by erosional agents, causing deep, V-shaped valleys that exposed the basalt layers along the canyon walls.

Over time, the composition of the basalt, where it was exposed at the surface, was changed due to oxidation (rusting) of iron-bearing minerals, such as pyroxene and olivine. The result is a canyon with red rocks and soils.

8 Identify the epoch during which the first basalt lava flows occurred on Kauai. [1]  
Epoch

Base your answers to questions 9 on the timeline in image provided and on your knowledge of Earth science. The timeline represents the last 600 million years of geologic time. Shaded area A represents the Neogene Period.

9 On the timeline in the image below, accurately shade in an area to represent the entire Permian Period. [1]



Base your responses to questions 10 on the passage below.

### Frozen Mammoth

A woolly mammoth was found in 1999 buried in the frozen soil of the Siberian tundra. Carbon-14 dating indicated that it had died about 20,000 years ago. Many fossils represent only the partial remains of organisms. However, a complete mammoth with bones, skin, hair, and internal organs intact represented a unique opportunity for scientists to investigate the lifestyle of this animal and the environment in which it lived.

10 Identify both the period and epoch of geologic time during which the woolly mammoth lived.

[1]

Period

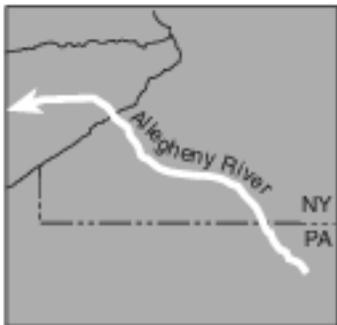
Epoch

Base your answers to questions 11 on the maps below. The southwest corner of the New York State map below is enlarged in maps I, II, and III. Arrows on maps I, II, and III show the location and direction of flow for part of the Allegheny River at different times during the Cenozoic Era. The present boundaries of New York State and Lake Erie are shown on each map. Point A on map III represents a location in New York State.



Course of the Allegheny River

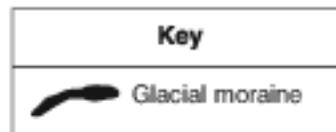
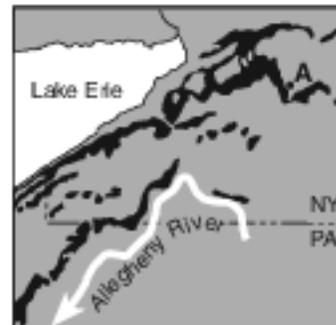
Map I  
During the Neogene Period



Map II  
22,000 Years Ago



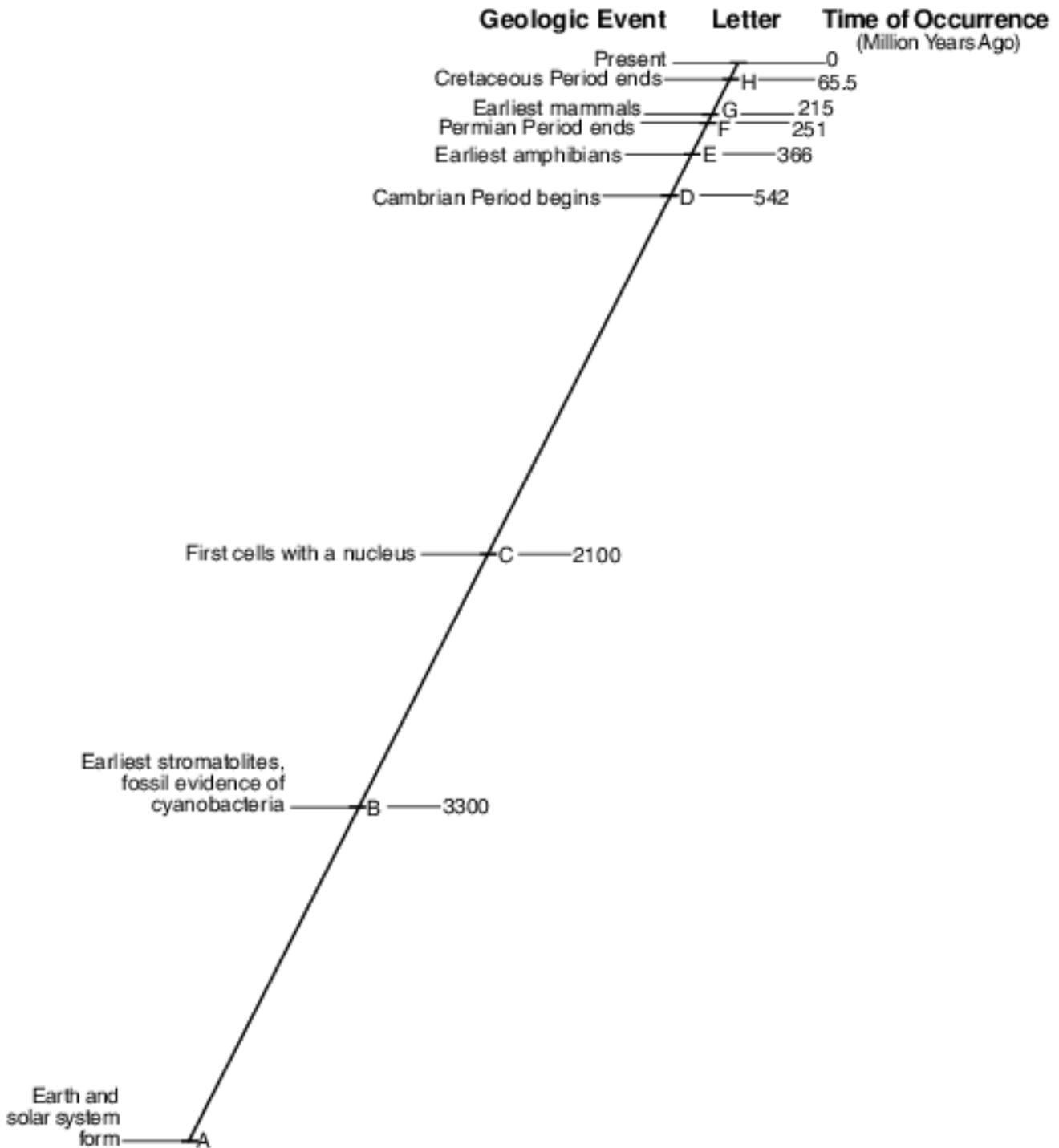
Map III  
Present Day



11 Map II shows the course of the Allegheny River during a specific part of a geologic time period. State the name of this geologic time period. [1]

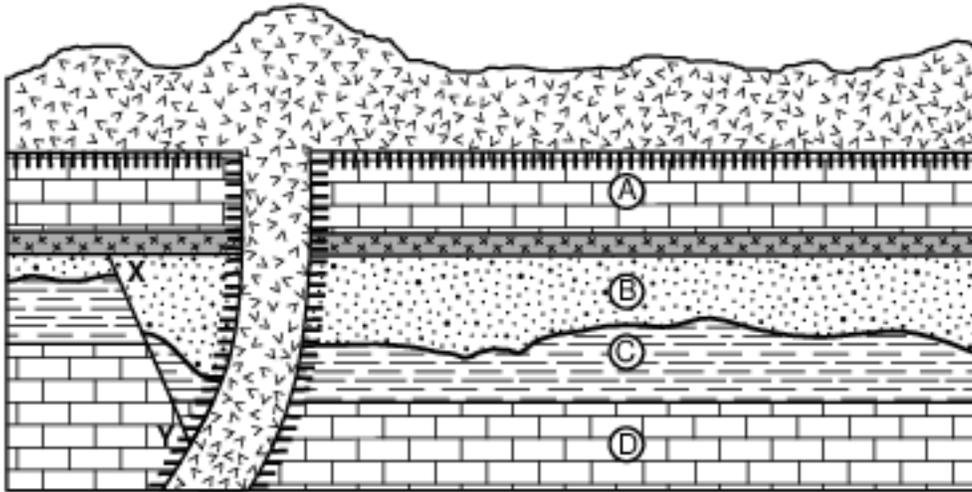
Period

Base your answers to questions 12 on the geologic timeline below and on your knowledge of Earth science. The geologic timeline, drawn to scale, represents Earth's geologic history. The letters A through H on the timeline represent the times of occurrence for specific, labeled geologic events. The time of occurrence for letter A has been omitted.



12 Identify the geologic eon during which event letter B occurred. [1]

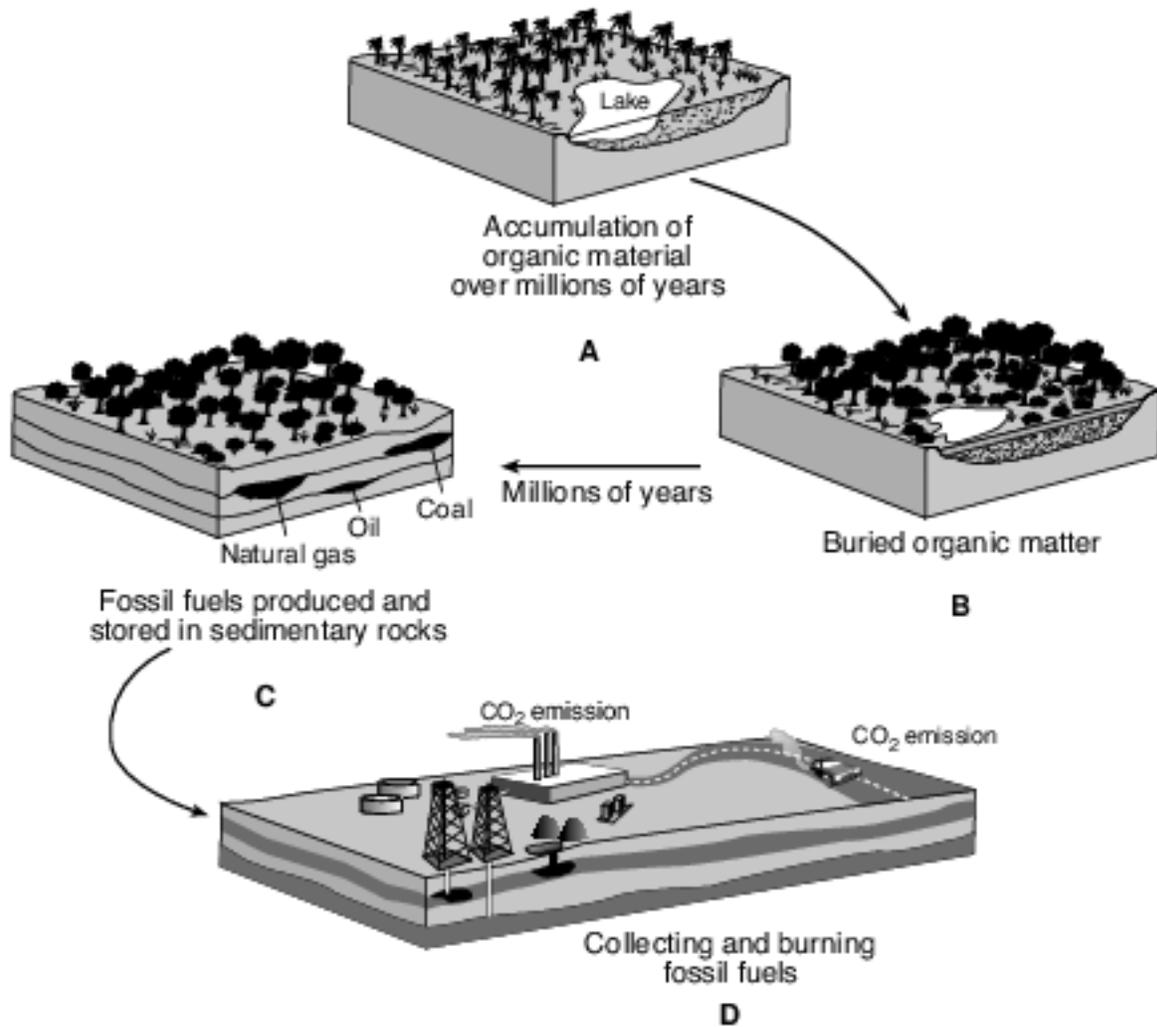
Base your answers to questions 13 on the geologic cross section below and on your knowledge of Earth science. The cross section represents sedimentary rock units labeled A through D, a layer of volcanic ash deposits, and a basalt extrusion. An unconformity is present between rock units B and C. Line XY represents a fault. The rock layers have not been overturned.



Key	
	Basalt
	Volcanic ash
	Contact metamorphism

- 13 Fossils of the first multicellular, soft-bodied marine organisms were found in rock unit D. Identify the eon that indicates the geologic age of this rock unit. [1]  
Eon

Base your answers to questions 14 on the diagram below and on your knowledge of Earth science. The diagram represents the formation of coal and other fossil fuels in the environment.



Adapted from: Wright, Richard and Nebel, Bernard. *Environmental Science, Learning System Edition*

- 14 Identify the geologic time period in which the extensive coal-forming forests represented in diagram A were most abundant. [1]  
Period

Base your answers to questions 15 on the passage below.

#### Dinosaur Skull Offers Hints About Africa's Past

A fossil skull was found in Africa among many dinosaur bones from the Late Cretaceous Epoch. This skull came from a dinosaur named *Rugops primus*, or “first wrinkle face.” This meat eater, believed to have been about 30 feet long and to have lived 95 million years ago, belonged to a group of dinosaurs called abelisaurids.

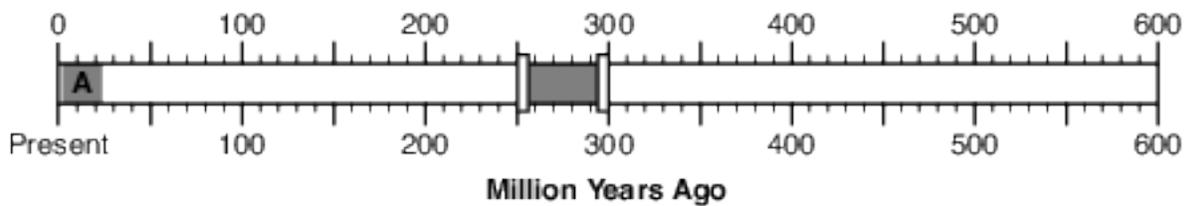
This fossil skull, unearthed in the Sahara Desert in 2000, provides new evidence that Africa split from other southern continents at a later time than previously thought. Before this discovery, abelisaurids from that period had been found only in South America, Madagascar, and India, but not in Africa. This new fossil, *Rugops primus*, found only in Africa, indicates that Africa was still connected to the other southern landmasses, at least by a land bridge, 100 million years ago.

15 During which geologic era is *Rugops primus* inferred to have lived? [1]

Era

## Answer Keys

- 1 2  
2 1  
3 4  
4 4  
5 4  
6 2  
7 3  
8 Allow 1 credit for Pliocene Epoch.  
9 Allow 1 credit for a shaded bar that begins and ends within or is touching the clear rectangles shown below.



- Note: It is recommended that an overlay of the same scale as the student answer sheet be used
  - to ensure reliability in rating.
- 10 Allow 1 credit if both responses are correct: Quaternary Period and Pleistocene Epoch.  
11 Allow 1 credit for Quaternary Period.  
12 Allow 1 credit for Precambrian or Archean.  
13 Allow 1 credit for Precambrian Eon or Proterozoic Eon.  
  - Note: Do not allow credit for “Late Proterozoic” or “Late Precambrian” because these are eras,
  - not eons.  
14 Allow 1 credit for Carboniferous or Pennsylvanian Period.  
  - Note: Do not allow credit for “Early Pennsylvanian” or “Late Pennsylvanian” because these terms
  - denote epochs not periods.  
15 Allow 1 credit for Mesozoic Era.