

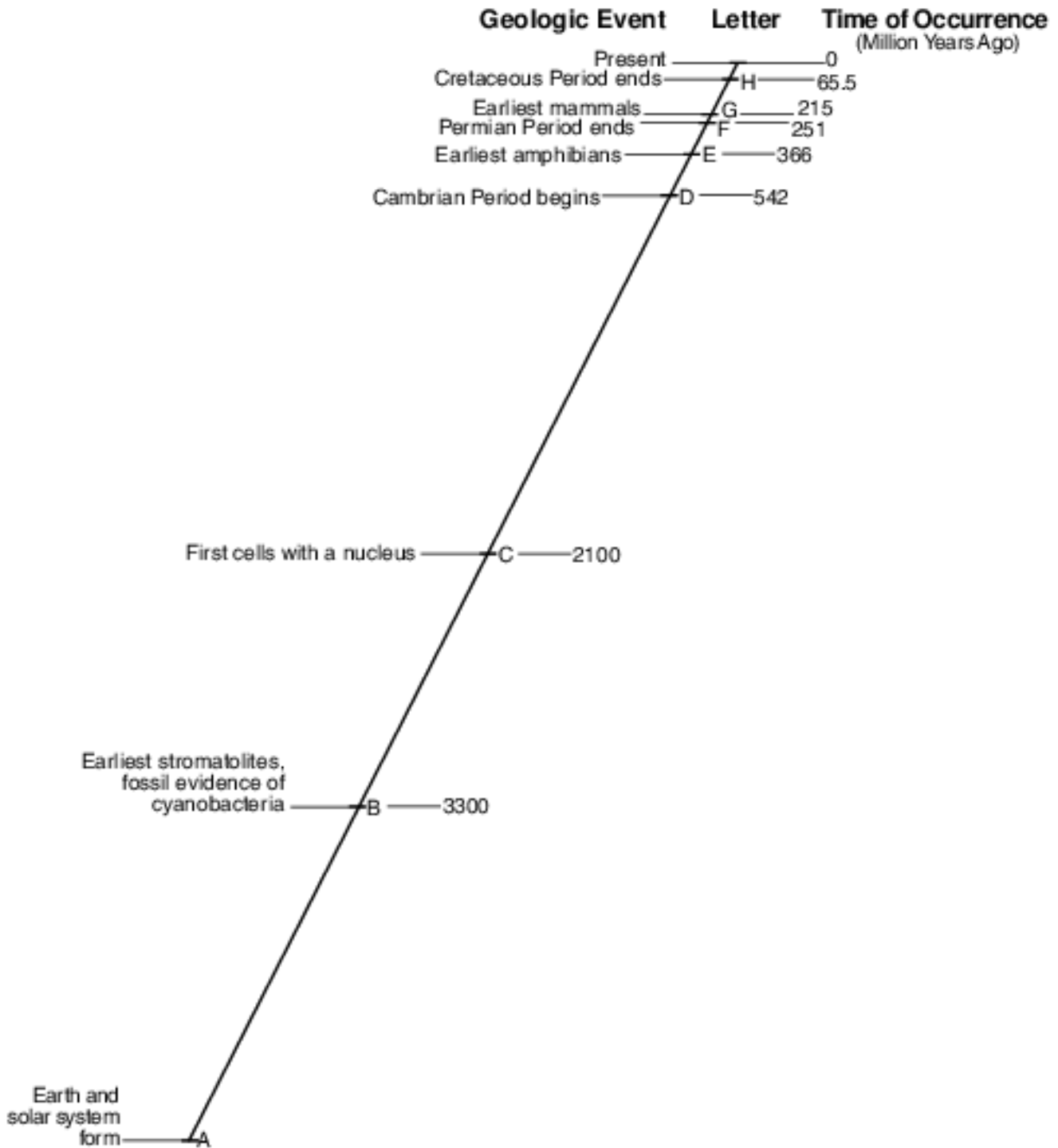
## The Atmosphere

- 1 The accumulation of water vapor, carbon dioxide, and nitrogen in Earth's early atmosphere approximately 4 billion years ago resulted mainly from
  - (1) outgassing from Earth's interior
  - (2) radioactive decay
  - (3) photosynthesis by the earliest land plants
  - (4) convection currents in Earth's outer core
- 2 Earth's early atmosphere contained carbon dioxide, sulfur dioxide, hydrogen, nitrogen, water vapor, methane, and ammonia. These gases were present in the atmosphere primarily because
  - (1) radioactive decay products produced in Earth's core were released from Earth's surface
  - (2) evolving Earth life-forms produced these gases through their activity
  - (3) Earth's growing gravitational field attracted these gases from space
  - (4) volcanic eruptions on Earth's surface released these gases from the interior
- 3 Outgassing of water vapor, carbon dioxide, and nitrogen initially formed Earth's early
  - (1) lithosphere
  - (2) hydrosphere
  - (3) asthenosphere
  - (4) atmosphere
- 4 The major source of oxygen in Earth's Early Proterozoic atmosphere is inferred to have been produced by
  - (1) oceanic cyanobacteria
  - (2) outgassing from volcanic eruptions
  - (3) radioactive decay in Earth's inner core
  - (4) evaporation of ocean water
- 5 Which gas is inferred to have been absent from Earth's atmosphere during the Early Archean Era?
  - (1) carbon dioxide
  - (2) nitrogen
  - (3) oxygen
  - (4) water vapor
- 6 Most of the oceanic oxygen that began to enter Earth's atmosphere in the early Proterozoic Era was probably produced by
  - (1) formation of silicate rocks
  - (2) photosynthesis by cyanobacteria
  - (3) impact events on Earth's surface
  - (4) outgassing from volcanoes
- 7 Scientists infer that oxygen first began to enter Earth's atmosphere after the appearance of
  - (1) the earliest grasses
  - (2) the earliest flowering plants
  - (3) coal-forming forests
  - (4) oceanic cyanobacteria
- 8 Approximately 2.2 billion years ago, which gas was first added in large amounts to Earth's atmosphere from life-forms that evolved in the oceans?
  - (1) carbon dioxide
  - (2) water vapor
  - (3) oxygen
  - (4) nitrogen
- 9 Scientists infer that oxygen in Earth's atmosphere did not exist in large quantities until after
  - (1) the first multicellular, soft-bodied marine organisms appeared on Earth
  - (2) the initial opening of the Atlantic Ocean
  - (3) the first sexually reproducing organisms appeared on Earth
  - (4) photosynthetic cyanobacteria evolved in Earth's oceans
- 10 Oxygen in Earth's early atmosphere was first produced during the Precambrian from
  - (1) cyanobacteria in Earth's oceans
  - (2) volcanic activity along plate boundaries
  - (3) the absorption of sunlight by plants
  - (4) evaporation of ocean water

11 In which two Earth regions is oxygen the second most abundant element by volume?

- (1) crust and hydrosphere
- (2) hydrosphere and troposphere
- (3) troposphere and core
- (4) core and crust

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 Describe the major change in Earth's atmosphere that was occurring at the time when the first cells with a nucleus appeared on Earth. [1]

Base your answers to questions 13 on the data table below and on your knowledge of Earth science. The data table shows the average level of atmospheric carbon dioxide (CO<sub>2</sub>), measured in parts per million (ppm), for the month of February at the Mauna Loa observatory in Hawaii from 2008 to 2014.

Year	Average February Atmospheric CO <sub>2</sub> Levels (ppm)
2008	386
2009	387
2010	390
2011	392
2012	394
2013	396
2014	398

- 13 These measurements of atmospheric carbon dioxide were collected at an altitude of 3.4 kilometers. Identify the temperature zone of the atmosphere where these data were collected. [1]

Base your answers to questions 14 on the data table below and on your knowledge of Earth science. The data table shows how the destruction of the ozone layer in Earth's atmosphere has affected the amount of ultraviolet radiation reaching Earth's surface beneath the areas of ozone destruction.

**Ozone Loss and Ultraviolet Radiation**

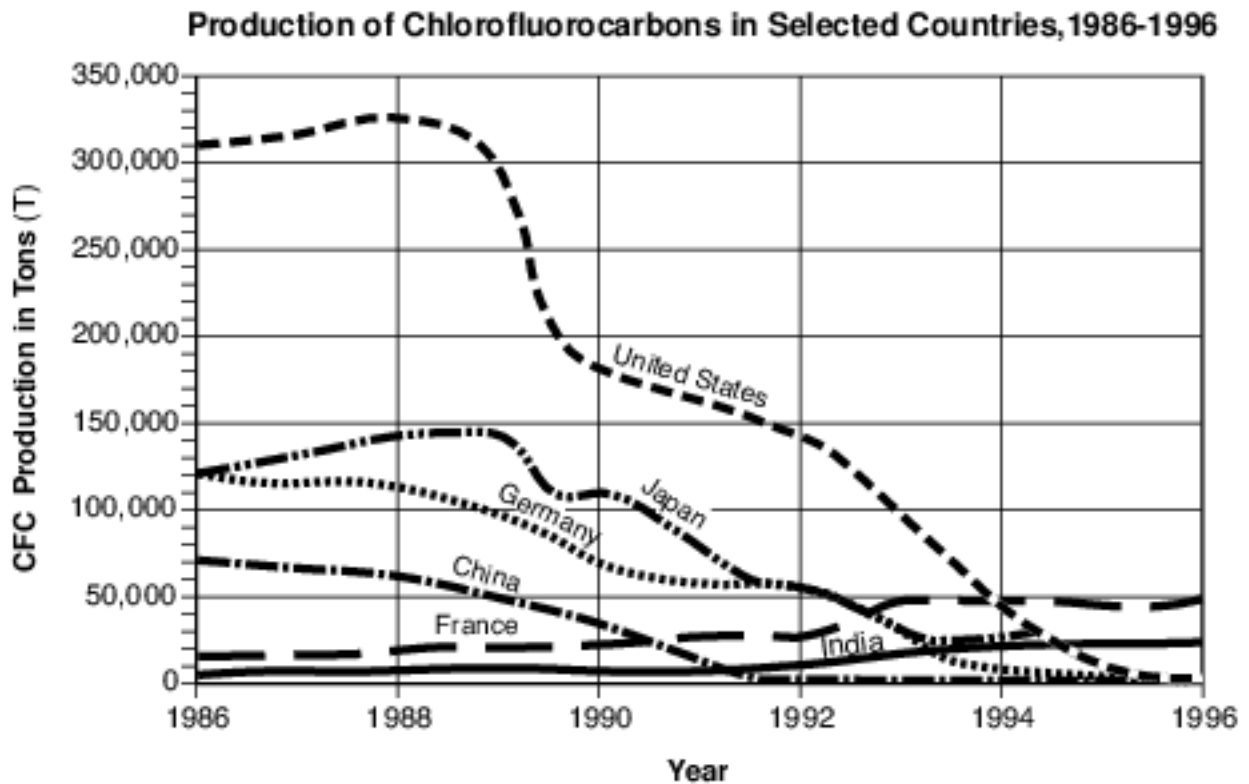
Ozone Destruction (%)	Average Increase in Ultraviolet Radiation Reaching Earth's Surface (%)
0	0
5	5
10	12
15	20
20	28
25	36
30	47
35	60
40	76

- 14 The ozone layer is mostly concentrated between 20 and 25 kilometers above Earth's surface. State the name of the atmospheric temperature zone layer where this ozone concentration can be found. [1]

Base your answers to questions 15 on the passage and graph below and on your knowledge of Earth science. The graph shows changes in the amount of chlorofluorocarbon production, in tons per year (T/y), by some countries over a 10-year period.

CFCs and Ozone

CFCs (chlorofluorocarbons) are chemicals that threaten to destroy stratospheric ozone. CFCs were first manufactured in 1928 to be used as chilling agents in refrigerators. In later years, they were used for cleaning electrical circuit boards and to make foam for insulation. Unfortunately, scientists found that these chemicals escaped into the atmosphere and rose to the stratosphere. In the stratosphere, intense ultraviolet (UV) radiation broke the CFCs down, producing chlorine, a gas that reacts with and destroys ozone. In 1974, two scientists identified the depletion of stratospheric ozone from the release of CFCs. After this discovery, 27 countries agreed to reduce production of CFCs, because ozone in the stratosphere protects all life from the Sun's most damaging UV rays.



Adapted from: Gore, Al. *An Inconvenient Truth*

- 15 Write the chemical symbol for the element produced by the breakdown of CFCs. Describe one environmental impact that results from this element being released into Earth's stratosphere.

[1]

Chemical symbol:

Environmental impact:

## Answer Keys

1 1

2 4

3 4

4 1

5 3

6 2

7 4

8 3

9 4

10 1

11 2

12 Allow 1 credit. Acceptable responses include, but are not limited to:

- — Oceanic oxygen began to enter the atmosphere.
- — Excess oxygen in the oceans escaped into the atmosphere.
- — A buildup of oxygen began.
- — Photosynthetic bacteria released oxygen.

13 Allow 1 credit for troposphere.

14 Allow 1 credit for stratosphere.

15 Allow 1 credit for the symbol Cl and a correct environmental impact. Acceptable responses include, but are not limited to:

- — reacts with and destroys ozone
- — Chlorine breaks down ozone molecules.
- — increases the amount of UV rays reaching Earth's surface
- Note: Do not allow credit for "chlorine" for the chemical symbol because this is the name of the element not the chemical symbol.
- Do not allow credit for "CL" for the chemical symbol because this is not the correct format for writing chemical symbols.