

## The Greenhouse Effect

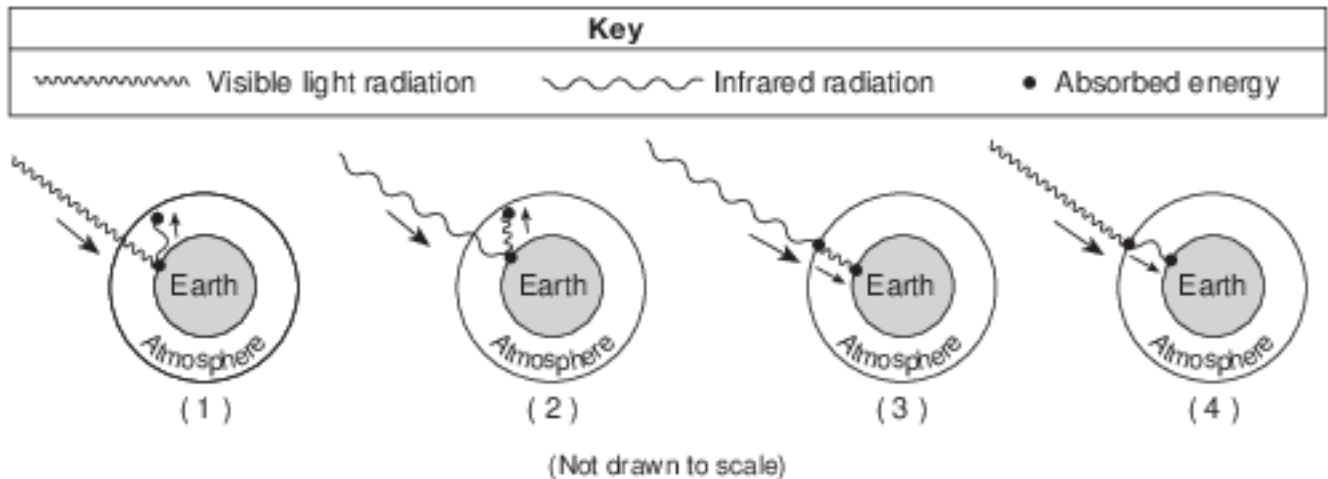
- Which event is inferred by most scientists to be responsible for a climate change that has recently led to a decrease in the size of most glaciers?
  - a decrease in the rate of divergence of lithospheric plates along a mid-ocean ridge
  - a decrease in the amount of insolation reaching Earth's surface
  - an increase in the amount of greenhouse gases in Earth's atmosphere
  - an increase in the amount of vegetative cover in the tropics
- Which gas is considered a major greenhouse gas?
 

(1) methane	(3) oxygen
(2) hydrogen	(4) nitrogen
- Which gas is a greenhouse gas that has increased in Earth's atmosphere partly as a result of deforestation over the last 100 years?
 

(1) ozone	(3) nitrogen
(2) oxygen	(4) carbon dioxide
- Most of the infrared radiation given off by Earth's surface is absorbed in Earth's atmosphere by greenhouse gases such as water vapor, carbon dioxide, and
 

(1) hydrogen	(3) oxygen
(2) nitrogen	(4) methane

- 5 Which diagram best represents how greenhouse gases in our atmosphere trap heat energy?



- |       |       |
|-------|-------|
| (1) 1 | (3) 3 |
| (2) 2 | (4) 4 |
- 
- Which list contains three major greenhouse gases found in Earth's atmosphere?
 

(1) carbon dioxide, methane, and water vapor	(3) hydrogen, oxygen, and methane
(2) carbon dioxide, oxygen, and nitrogen	(4) hydrogen, water vapor, and nitrogen
  - In addition to carbon dioxide, two other major greenhouse gases in Earth's atmosphere are
 

(1) oxygen and nitrogen	(3) water vapor and nitrogen
(2) oxygen and methane	(4) water vapor and methane

Base your answers to questions 8 on the data table below, which shows the average carbon dioxide (CO<sub>2</sub>) concentrations in Earth's atmosphere for specific years from 1930 to 2010. Carbon dioxide is a greenhouse gas in Earth's atmosphere that contributes to global warming. The average carbon dioxide concentrations were measured in parts per million (ppm).

**Average Carbon Dioxide Concentrations  
in Earth's Atmosphere**

Year	Average CO <sub>2</sub> Concentration (ppm)
1930	306
1940	308
1950	310
1960	316
1970	326
1980	338
1990	354
2000	370
2010	390

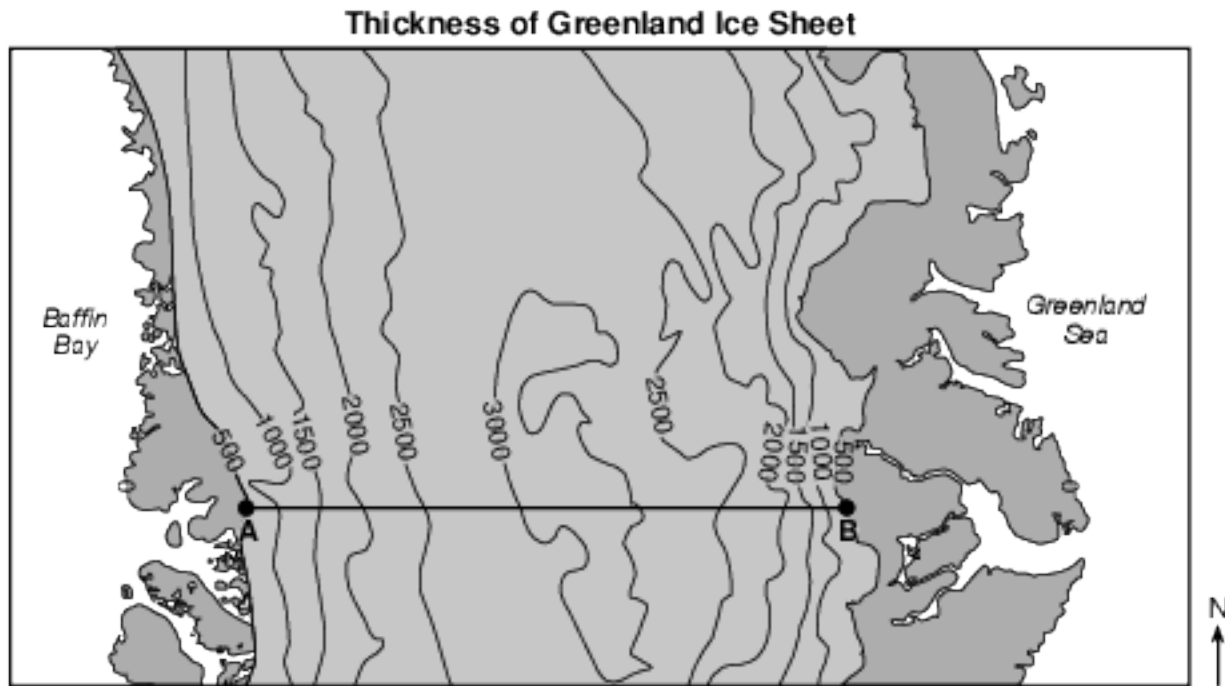
8 Identify one greenhouse gas, other than carbon dioxide, that contributes to global warming. [1]

Base your answers to questions 9 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

9 Identify one major greenhouse gas, other than carbon dioxide. [1]

Base your answers to questions 10 on the map and passage below and on your knowledge of Earth science. The map shows isolines that represent the thickness of a portion of the Greenland Ice Sheet in meters (m). Letters A and B represent points on the ice sheet's surface.



Greenland Ice Sheet

The Greenland Ice Sheet is a vast body of ice covering roughly 80 percent of the surface of Greenland. The ice sheet is almost 2400 kilometers long in a north-south direction. The ice sheet, consisting of layers of snow compressed over more than 100,000 years, contains a valuable record about Earth's past climates. The ice sheet glaciers continue to flow seaward and deposit sediment, but global warming has affected them. Warmer air temperatures have caused increased melting, resulting in a thinning of the ice sheet and faster glacial movement at the ice sheet edges.

- 10 Identify two major greenhouse gases that are inferred to contribute to global warming and increased temperatures in Greenland. [1]  
and \_\_\_\_\_

Base your answers to questions 11 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.

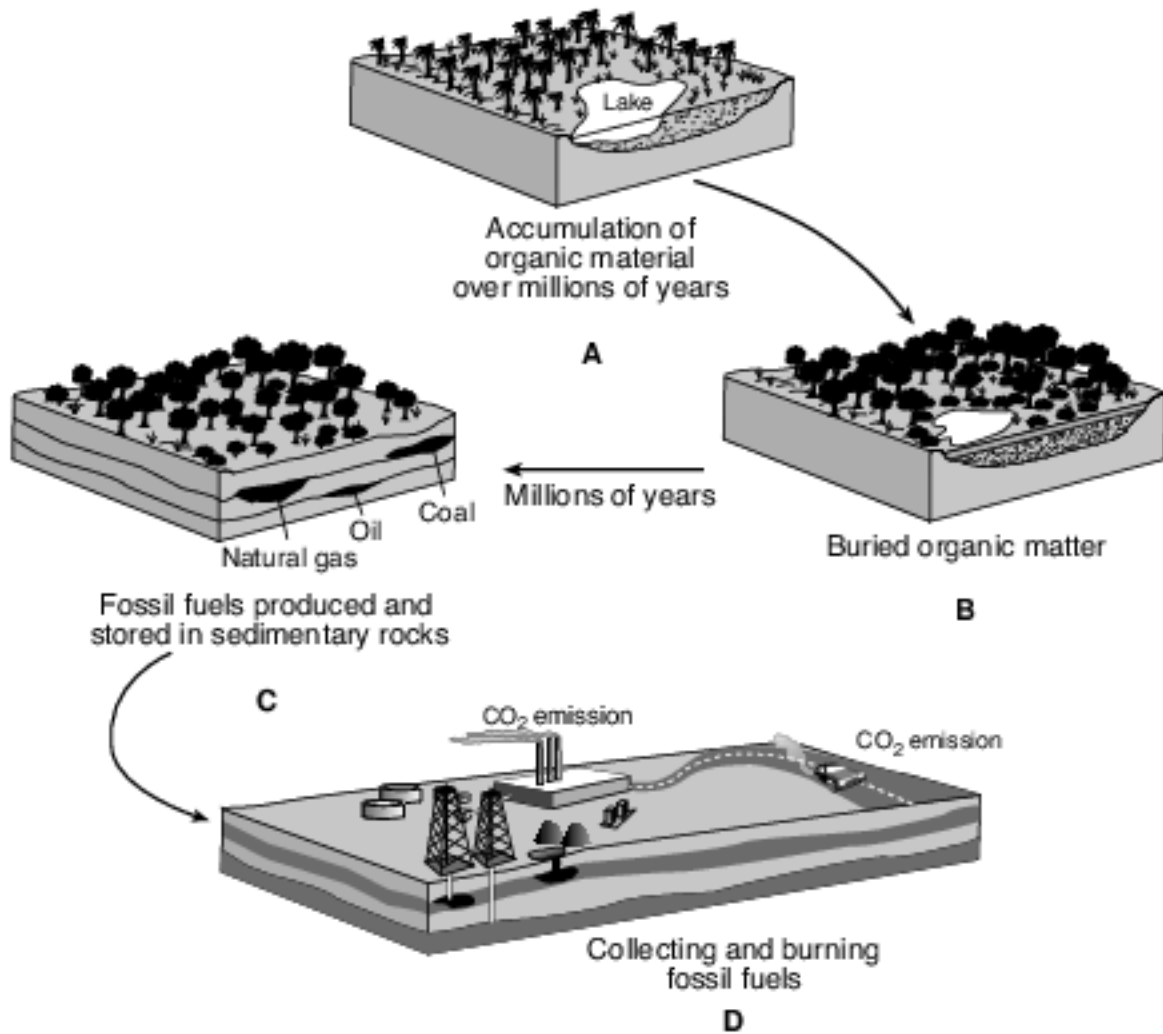
**Ozone Loss and Ultraviolet Radiation**

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

- 11 Ozone closer to Earth's surface has been identified as a greenhouse gas. Identify two other gases in Earth's atmosphere that are considered major greenhouse gases. [1]

\_\_\_\_\_ and \_\_\_\_\_

Base your answers to questions 12 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*

- 12 The burning of fossil fuels, represented in D, produces the greenhouse gas carbon dioxide (CO<sub>2</sub>), which is associated with air pollution and global warming. Other than CO<sub>2</sub>, identify one other major greenhouse gas. [1]

Base your answers to questions 13 on the data table below and on your knowledge of Earth science. The table shows the area, in million square kilometers, of the Arctic Ocean covered by ice from June through November. The average area covered by ice from 1979 to 2000 from June to November is compared to the area covered by ice in 2005 for the same time period.

**Data Table**

<b>Month</b>	<b>Average Area Covered by Ice 1979–2000 (million km<sup>2</sup>)</b>	<b>Area Covered by Ice 2005 (million km<sup>2</sup>)</b>
June	12.2	11.3
July	10.1	8.9
August	7.7	6.3
September	7.0	5.6
October	9.3	8.5
November	11.3	10.5

13 Identify one greenhouse gas that is believed to cause global warming. [1]

Base your answers to questions 14 on the table below and on your knowledge of Earth science. The table lists the average surface temperature, in kelvins, and the average orbital velocity, in kilometers per second, of each planet of our solar system.

**Data Table**

<b>Planet</b>	<b>Average Surface Temperature (K)</b>	<b>Average Orbital Velocity (km/s)</b>
Mercury	440	47.87
Venus	737	35.00
Earth	288	29.78
Mars	208	24.13
Jupiter	163	13.07
Saturn	133	9.69
Uranus	78	6.81
Neptune	73	5.43

14 Approximately 97% of Venus’s atmosphere is carbon dioxide. Describe how carbon dioxide contributes to the unusually high average surface temperature of Venus. [1]

Base your answers to questions 15 on the data table below and on your knowledge of Earth science. The table shows air temperatures recorded under identical conditions at 2-hour intervals on a sunny day. Data were recorded 1 meter above ground level both inside and outside of a glass greenhouse.

**Data Table**

<b>Time</b>	<b>Inside Air Temperature (°C)</b>	<b>Outside Air Temperature (°C)</b>
8 a.m.	15	15
10 a.m.	18	16
12 noon	21	17
2 p.m.	24	18
4 p.m.	24	17

15 Most atmospheric scientists infer that global warming is occurring due to an increase in greenhouse gases. State the names of two greenhouse gases. [1]

- (1)
- (2)

## Answer Keys

1 3

2 1

3 4

4 4

5 1

6 1

7 4

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

- — methane or  $\text{CH}_4$
- — water vapor or  $\text{H}_2\text{O}$
- — nitrous oxide or  $\text{N}_2\text{O}$
- — ozone or  $\text{O}_3$
- — chlorofluorocarbons/CFCs

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

- — water vapor/ $\text{H}_2\text{O}$
- — methane/ $\text{CH}_4$
- — nitrous oxide/ $\text{N}_2\text{O}/\text{N}_x\text{O}$
- — ozone/ $\text{O}_3$
- — chlorofluorocarbons/CFCs

10 Allow 1 credit if both gases are correct. Acceptable responses include, but are not limited to:

- — carbon dioxide or  $\text{CO}_2$
- — methane or  $\text{CH}_4$
- — water vapor or  $\text{H}_2\text{O}(\text{g})$
- — ozone or  $\text{O}_3$
- — nitrous oxide or  $\text{N}_2\text{O}$
- — chlorofluorocarbons/CFCs

11 Allow 1 credit for two correct responses. Acceptable responses include, but are not limited to:

- — carbon dioxide/ $\text{CO}_2$
- — water vapor/ $\text{H}_2\text{O}$
- — methane/ $\text{CH}_4$
- — nitrous oxide/ $\text{N}_2\text{O}$
- — chlorofluorocarbons/CFC

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

- —  $\text{CH}_4$ /methane
- —  $\text{H}_2\text{O}$  gas/water vapor
- —  $\text{N}_2\text{O}$ /nitrous oxide
- —  $\text{O}_3$ /ozone
- — CFCs/chlorofluorocarbons



- 13 Allow 1 credit. Acceptable responses include, but are not limited to:
- — carbon dioxide or  $\text{CO}_2$
  - — methane or  $\text{CH}_4$
  - — water vapor or  $\text{H}_2\text{O}$  gas
  - — nitrous oxide or  $\text{N}_2\text{O}$
  - — ozone or  $\text{O}_3$
  - — chlorofluorocarbons or CFCs
- 14 Allow 1 credit. Acceptable responses include, but are not limited to:
- — Carbon dioxide traps heat in the atmosphere.
  - — Carbon dioxide absorbs infrared and reradiates it back to Venus.
  - — Carbon dioxide is a greenhouse gas.
- 15 Allow 1 credit if both responses are acceptable. Acceptable responses include, but are not limited to:
- — carbon dioxide/ $\text{CO}_2$
  - — methane/ $\text{CH}_4$
  - — water vapor/ $\text{H}_2\text{O}$
  - — chlorofluorocarbons/CFCs
  - — nitrous oxide/ $\text{N}_2\text{O}$
  - — ozone/ $\text{O}_3$