Chapter 19
Global Change
Walking on thin Ice p. 517 ESBK, p.36NB

1/6 Agenda

- CH 19 Warm up, pg. 78
- Stamp vocab for CH 18, 19, 20
- Finish Wanted Posters
- CH 20 Warm up, pg. 80
- HW:
- Notebook check, pg. 74, 76- 80, 81, 83, 85, 87
- Quiz Topic VII tomorrow

1/6 Global Change CH 19
Obj. TSW distinguish between global change, global climate change and global warming. P. 78NB

1. Explain the relationship of the factors in Figure 19.1.
2. Explain the Greenhouse Effect & anthropogenic sources of greenhouse gases.

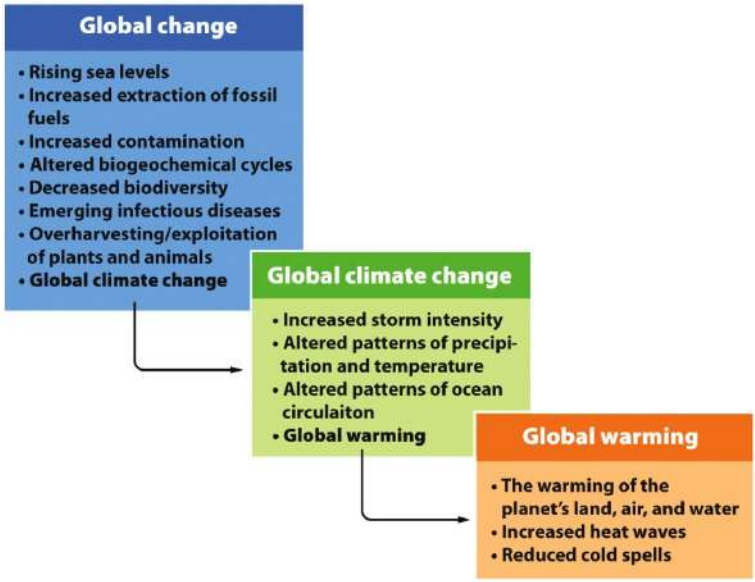


Figure 19.1
Environmental Science

Chapter 19 Opener
Environmental Science

Unnumbered 19 p517
Environmental Science

Global Change

- **Global change-** Any chemical, biological or physical property change of the planet
  - EX: Global temperatures have fluctuated over millions of years, in recent years the rates of change have been much higher than those that have occurred historically
- **Global climate change-** A type of global change; Changes in the climate of the Earth; categorized as either natural or anthropogenic climate change
  - Ex: El Nino vs. Fossil Fuel combustion
- **Global warming-** One aspect of climate change, the warming of the oceans, land masses and atmosphere of the Earth.

The Greenhouse Effect

- When radiation from the sun hits the atmosphere, 1/3 is reflected back.
- Some of the UV radiation is absorbed by the ozone layer and strikes the Earth where it is converted into low-energy infrared radiation.
- The infrared radiation (Heat) then goes back toward the atmosphere where it is absorbed by greenhouse gasses that radiate most of it back to the Earth.

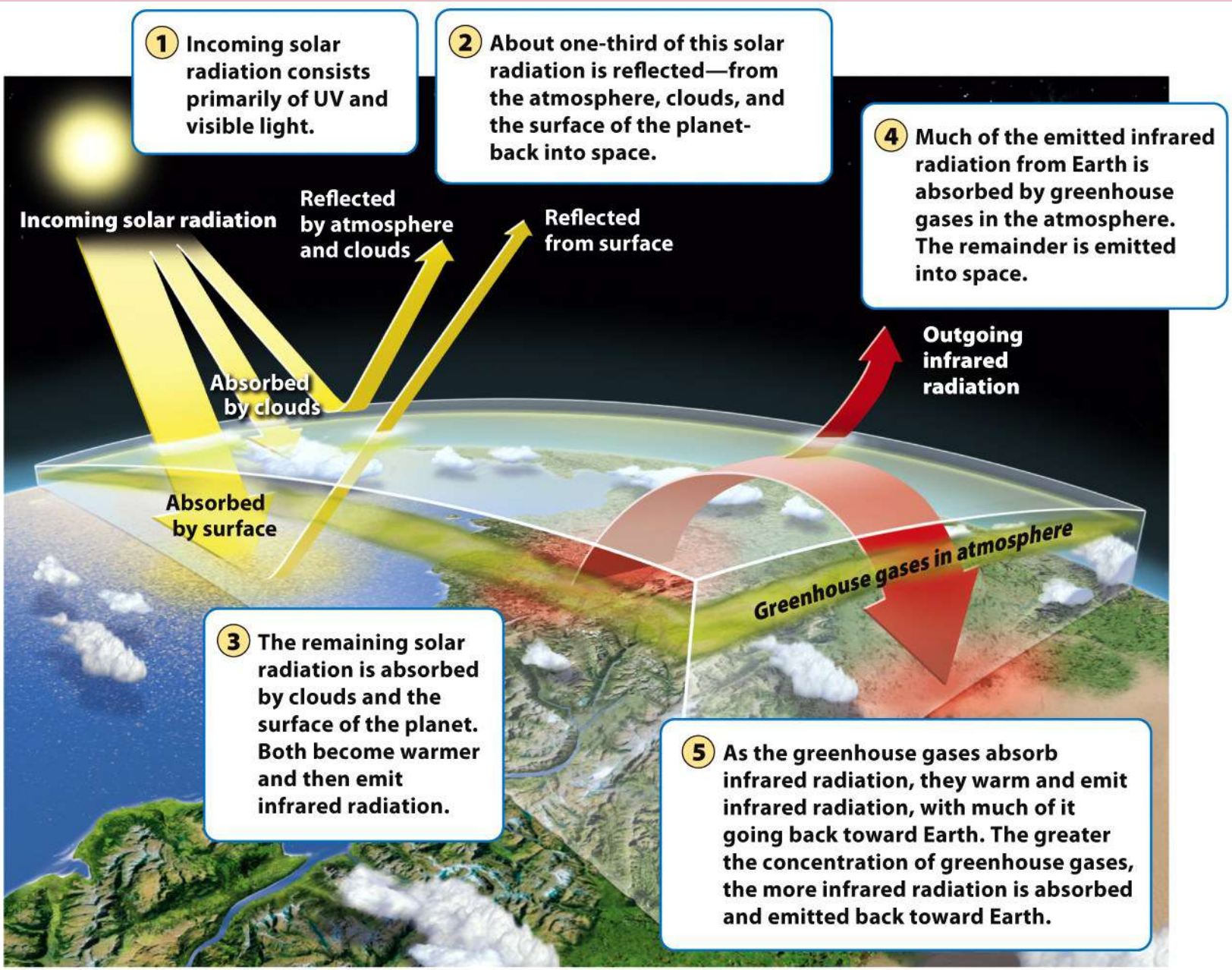


Figure 19.2
Environmental Science

The Greenhouse Effect – Infrared Radiation = Heat

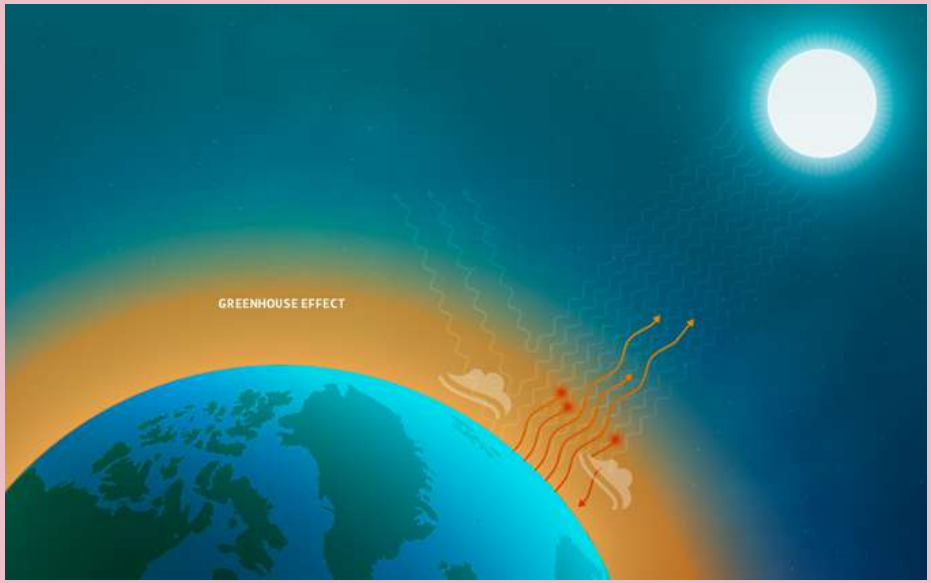
Natural Greenhouse Gases

- Volcanic eruptions- mainly carbon dioxide
- Methane – from decomposition
- Nitrous oxide- from denitrification
- Water vapor

Greenhouse Gases

- Water vapor H_20
- Carbon dioxide CO_2
- Methane CH_4
- Nitrous oxide NOx
- Ozone O_3

- The atmospheric concentration of greenhouse gases has increased over the past two centuries, largely due to human-generated carbon dioxide emissions from burning fossil fuels.



- This increase has amplified the natural greenhouse effect by trapping more of the energy emitted by the Earth. This change causes Earth's surface temperature to increase.

Anthropogenic Sources of Greenhouse gases in US

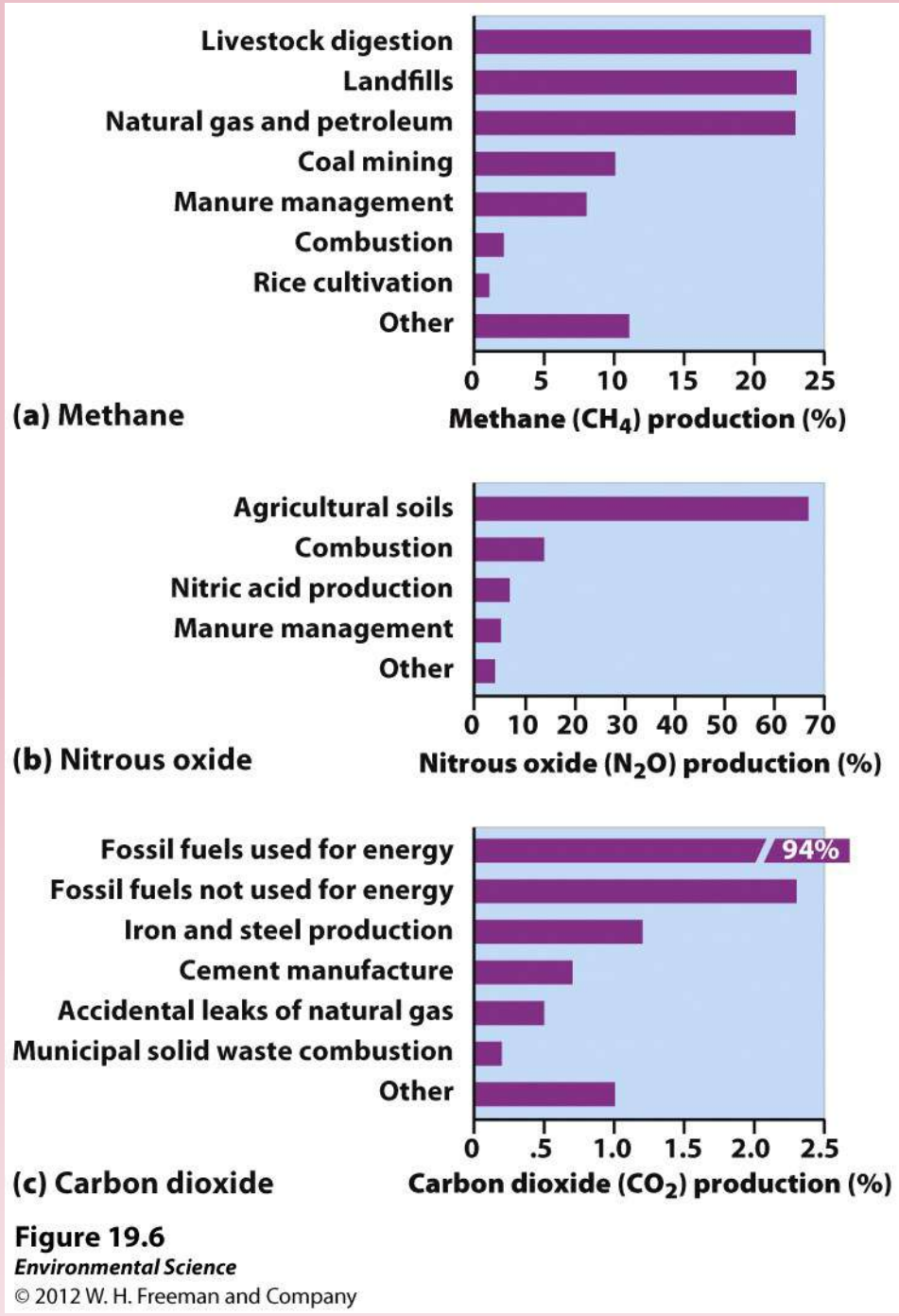


Figure 19.6
Environmental Science

Figure 19.4
Environmental Science

Other sources of Methane are the Bacteria that live in the anaerobic gut of termites.

Anthropogenic Causes of Greenhouse Gases

- Burning of fossil fuels
- Agricultural practices
- Deforestation
- Landfills
- Industrial production- CFC's are an example

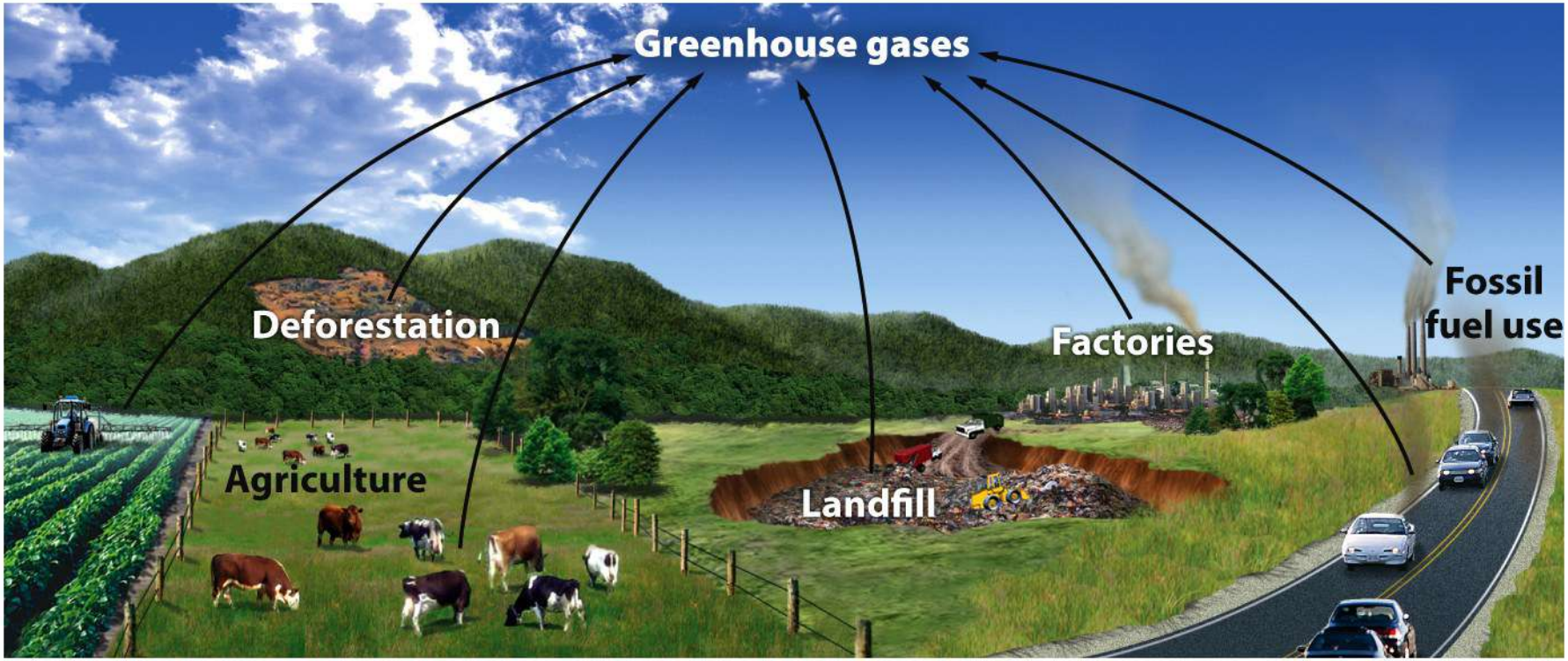


Figure 19.5
Environmental Science

4/ 25 Changes in CO2 & Global Temperatures CH 19

Obj. TSW understand how feedbacks (positive and negative) play a role in how much world temperatures will increase for a given change in greenhouse gases. P. 36 NB

1. 1.What are the differences in CO2 emissions in developed and developing nations?
2. 2.How do scientist know the concentration of atmospheric CO2 or the average global temperature from the distant past?
3. 3.What are positive and negative feedbacks, describe some examples?

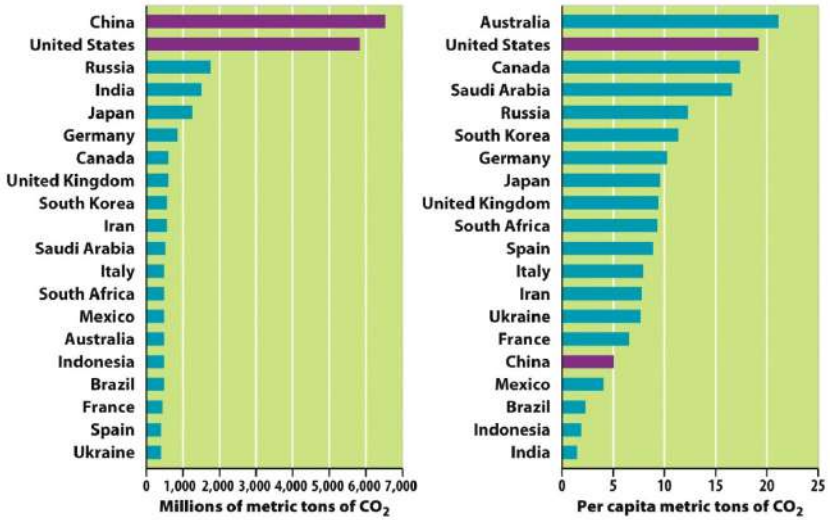


Figure 19.8
Environmental Science

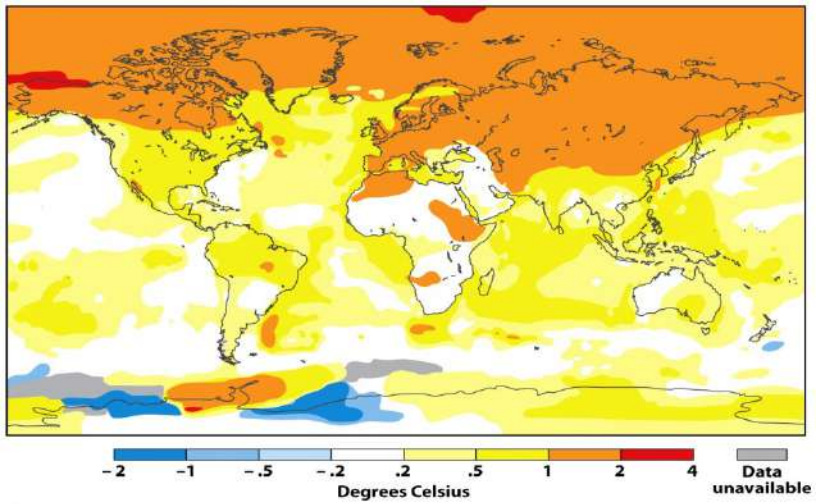


Figure 19.10 part 1
Environmental Science

Why are Chlorofluorocarbons considered a Greenhouse gas?

CFC's bind to O_3 (Ozone) in the Stratosphere. ClO +O2. This allows for more UV- B radiation to enter the Trophosphere, strike the land & water on Earth where it is converted into low –energy infrared radiation (heat).

TABLE 19.1 The major greenhouse gases

The major greenhouse gases differ in their ability to absorb infrared radiation and the duration of time that they stay in the atmosphere. The units "ppm" are parts per million.

Greenhouse gas	Concentration in 2010	Global warming potential (over 100 years)	Duration in the atmosphere
Water vapor	Variable with temperature	<1	9 days
Carbon dioxide	390 ppm	1	Highly variable (ranging from years to hundreds of years)
Methane	1.8 ppm	25	12 years
Nitrous oxide	0.3 ppm	300	114 years
Chlorofluorocarbons	0.9 ppm	1,600 to 13,000	55 to >500 years

Source: Data on concentration are from the National Oceanic and Atmospheric Administration. www.esrl.noaa.gov/gmd/aggi. Data on global warming potential are from the United Nations Framework Convention on Climate Change.

Table 19.1
Environmental Science

Increasing CO_2 Concentrations

- David Keeling began measuring CO_2 in 1958.
- Graph similar to this has appeared on previous APES exams.

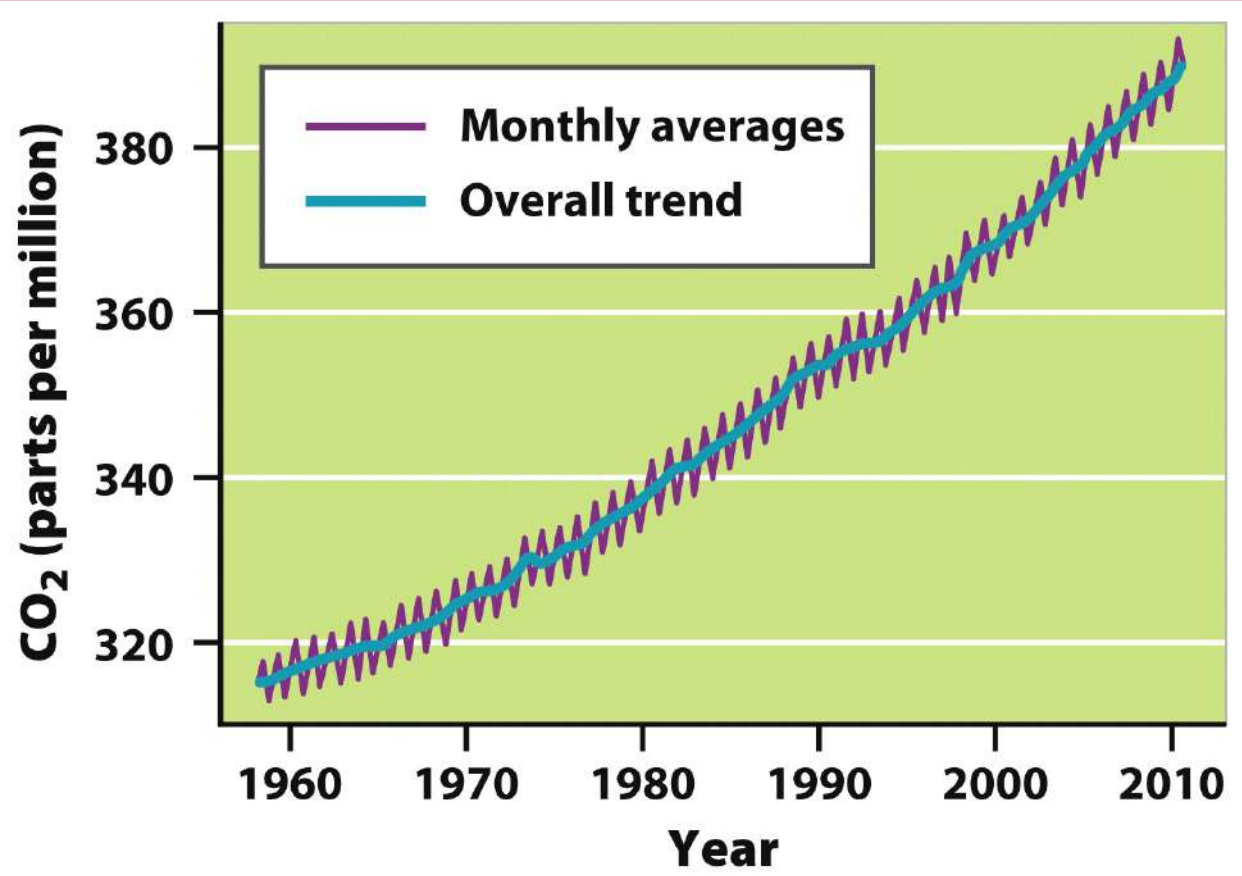


Figure 19.7
Environmental Science

Emissions from the Developed and Developing World

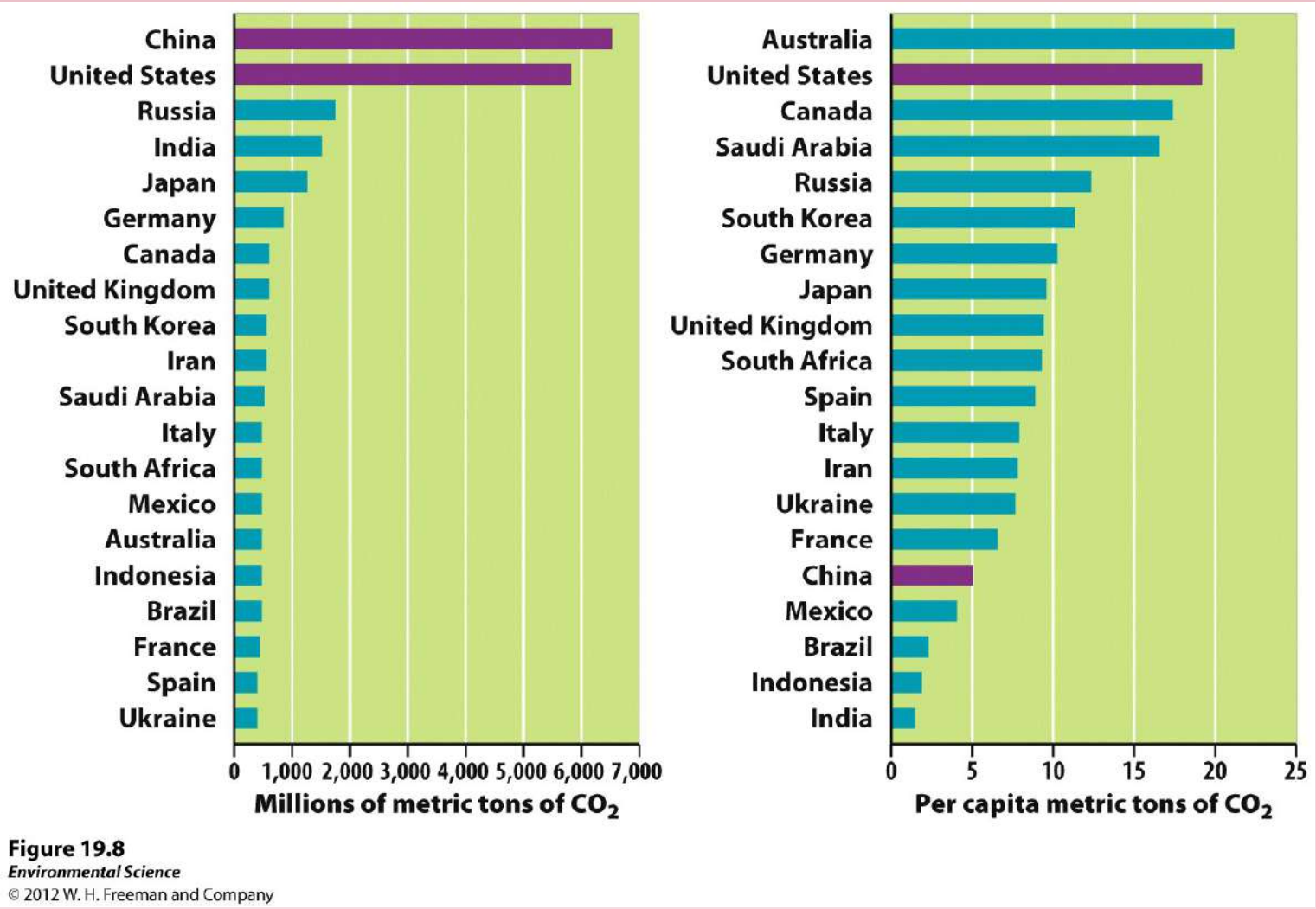


Figure 19.8
Environmental Science

Global Temperatures since 1880

- Since 1880 temperatures have increased 0.8°C.

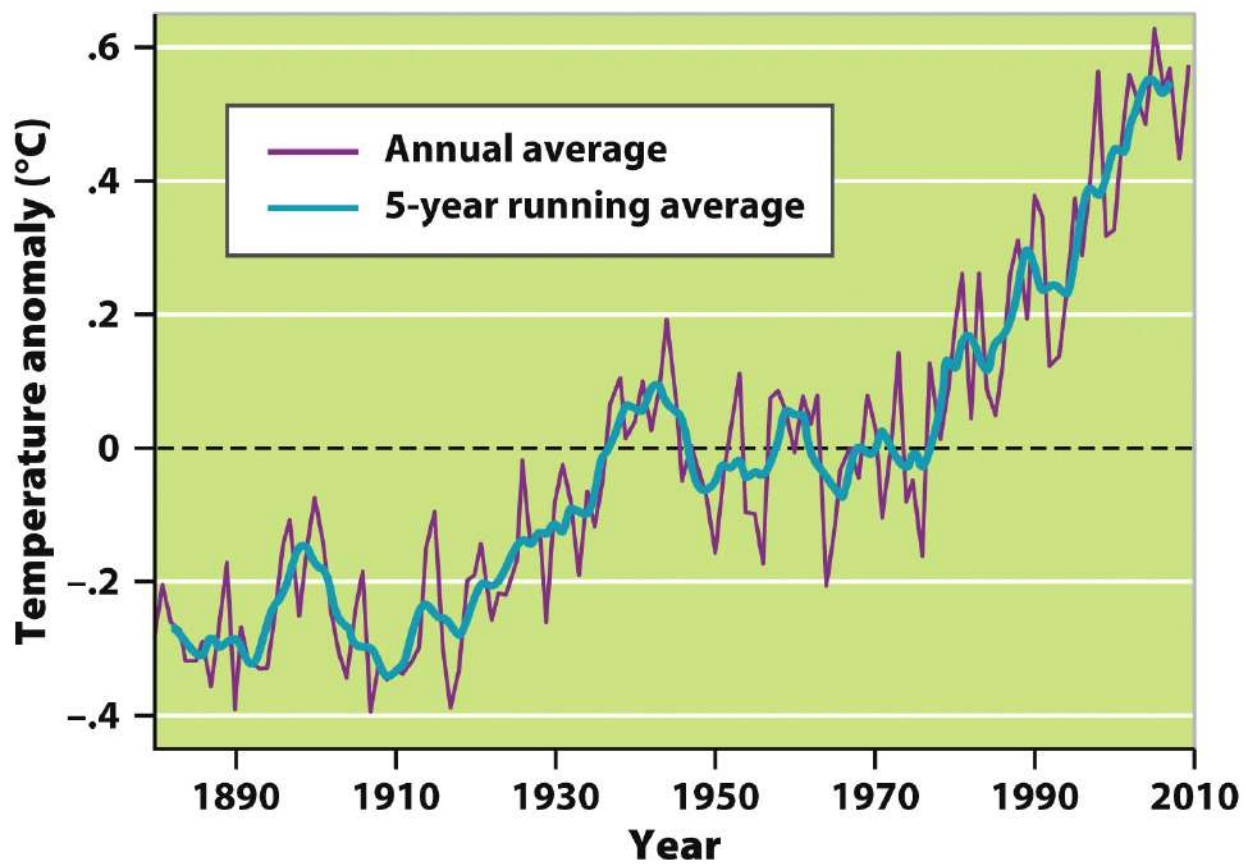
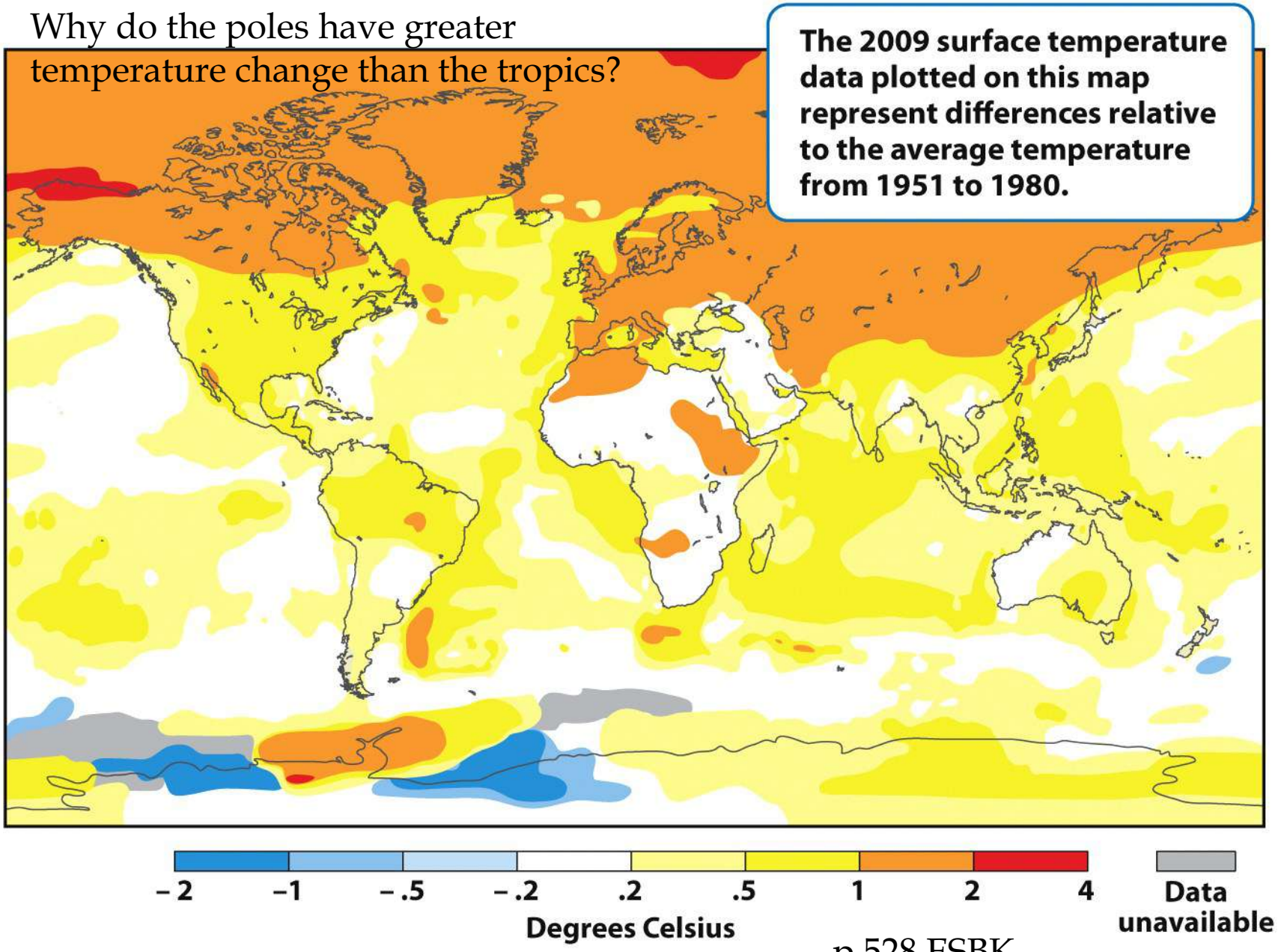


Figure 19.9
Environmental Science

Why do the poles have greater temperature change than the tropics?



p.528 ESBK

Figure 19.10
Environmental Science

Why do the poles have greater temperature change than the tropics?

- Increase in Global Warming due to Increase in [CO2] would prevent or reduce heat loss & it would have a bigger impact on scenarios with colder temperatures

Look for:

- Higher temperatures in winter than in summer
- At night rather than during the day
- In the Arctic rather than in the warmer latitudes

Global temperatures since 1880

- Global temperatures have increased .8° C or 1.4°F form 1880 to 2009.
- 2000 – 2009 warmest decade on record.
- Average global temperature is not evenly distributed on planet.
- Indirect measurements help determine changes in ocean temperatures over 100,000's yrs.- Foraminifera
- Ice core samples – Himalayas & Antarctica, melt the ice and measure [CO_2] in air bubbles.
- Measuring heavy O_2 – 2+ neutrons, more in warmer temperatures.

Temperatures and Greenhouse Gas Concentrations in Past 400,000 Years

- No one was around thousands of years ago to measure temperatures so we use other indirect measurements. Some of these are
  - Changes in species compositions
  - Chemical analyses of ice

Figure 19.12a
Environmental Science

Figure 19.12b
Environmental Science

Global warming & Ozone depletion are **NOT** the same thing. GW – increase in greenhouse gases ie. CO_2, NO, & CH_4. Ozone Depletion due to CFC's released into atmosphere.

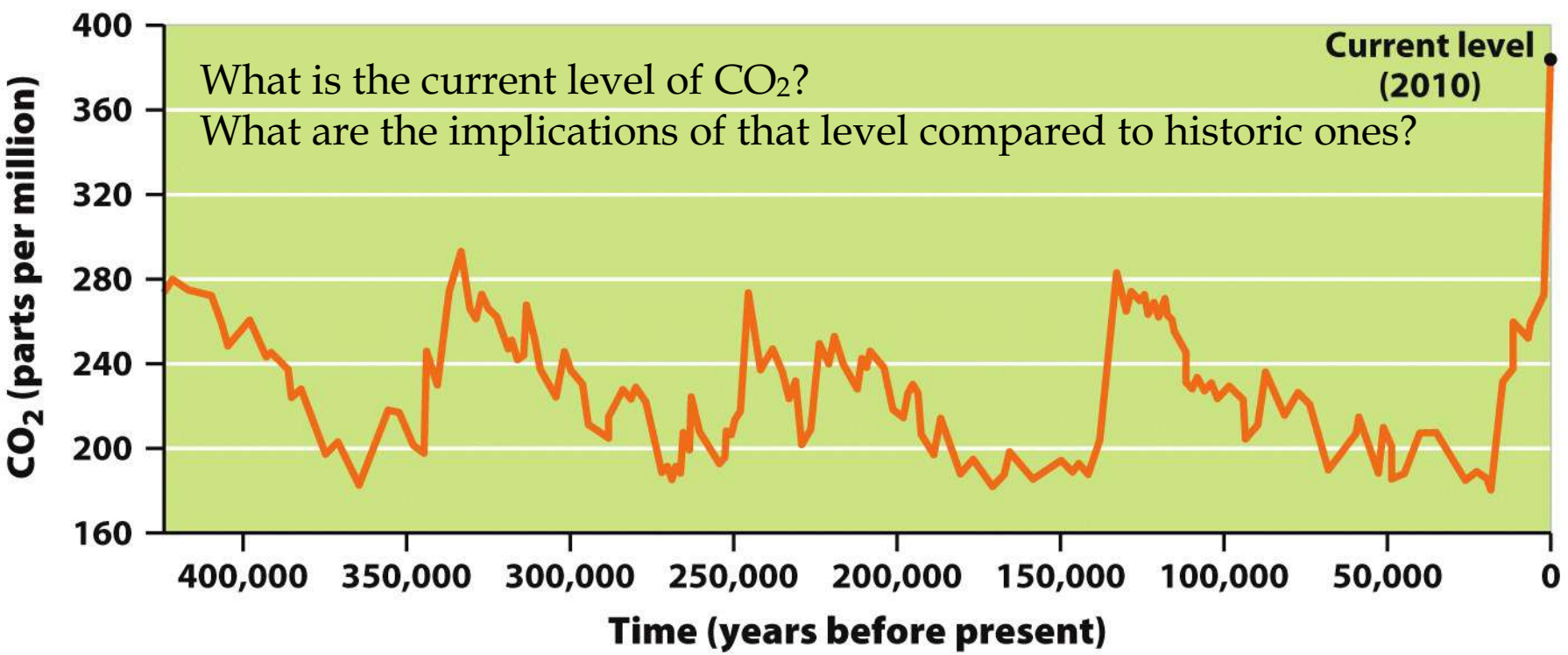


Figure 19.13
Environmental Science

P.530 ESBK

Global Warming & Ozone Depletion p. 39NB

	Global Warming	Ozone Depletion
Chemicals Involved	Water Vapor, NO_X, Methane, Ozone, CO_2	CFC's
Human Causes	Burning of fossil Fuels, Deforestation, Landfills, Industrial Production, Agricultural Practices	Release of CFC's through Industrial Products: Aerosols, Foam cushions, solvents, Air-conditioning units
Layer of Atmosphere	Troposphere	Stratosphere
Environmental Effects	Increase in Global Warming, Global Climate Change, Melting Glaciers, Warming H_20, ATM	Hole in the Ozone
Human Health Effects	Asthma, illness, disease	UV Radiation – Cancer, Cataracts

Putting It Together

- We know that an increase in CO_2 in the atmosphere causes a greater capacity for warming through the greenhouse effect.
- When the Earth experiences higher temperatures, the oceans warm and cannot contain as much CO_2 gas and, as a result, they release CO_2 into the atmosphere.
- Repeat Step 1
- Warmer Oceans also can not contain as much O_2, effects overall health of marine ecosystems and organisms that live within them.

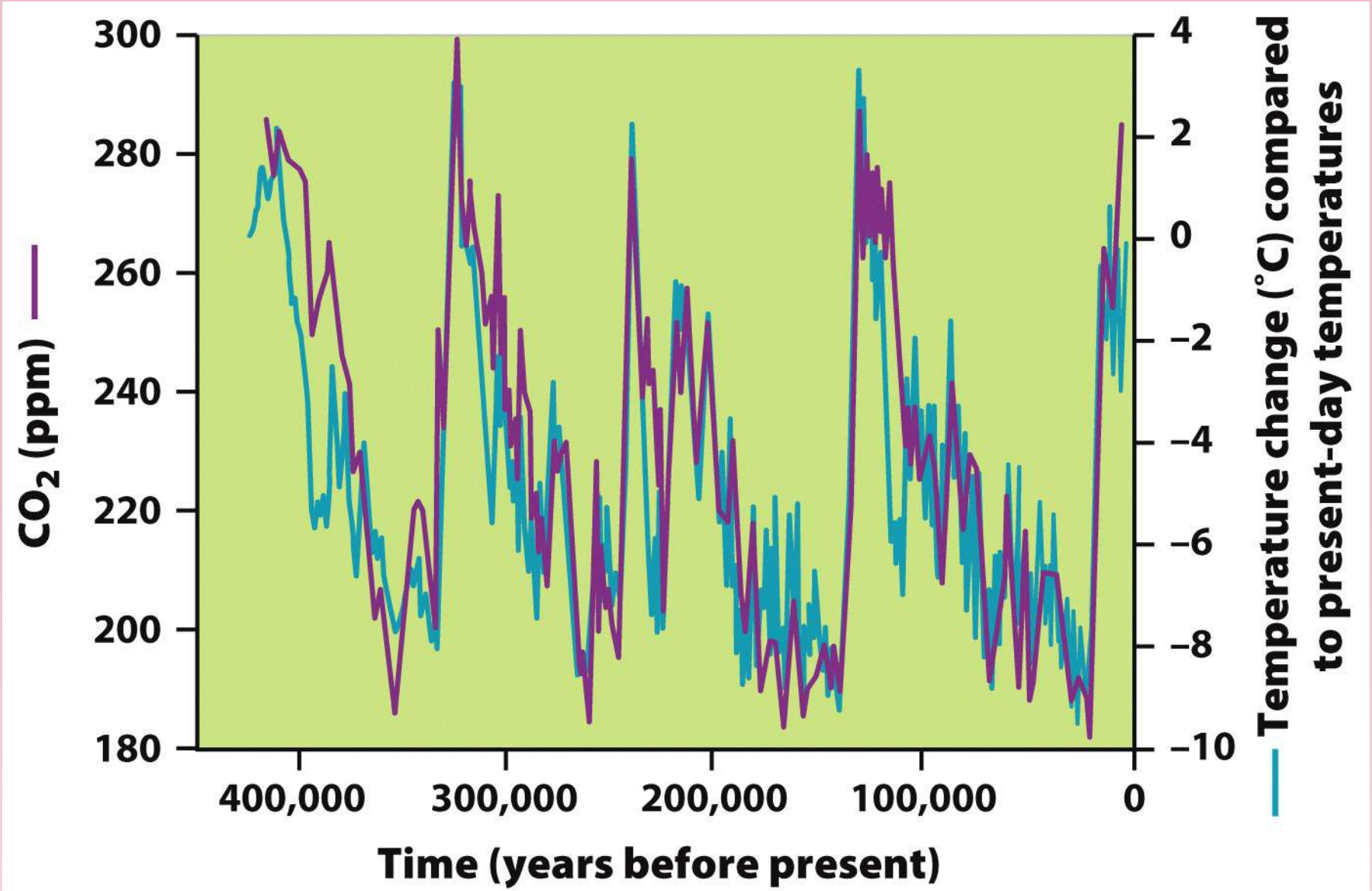


Figure 19.15
Environmental Science

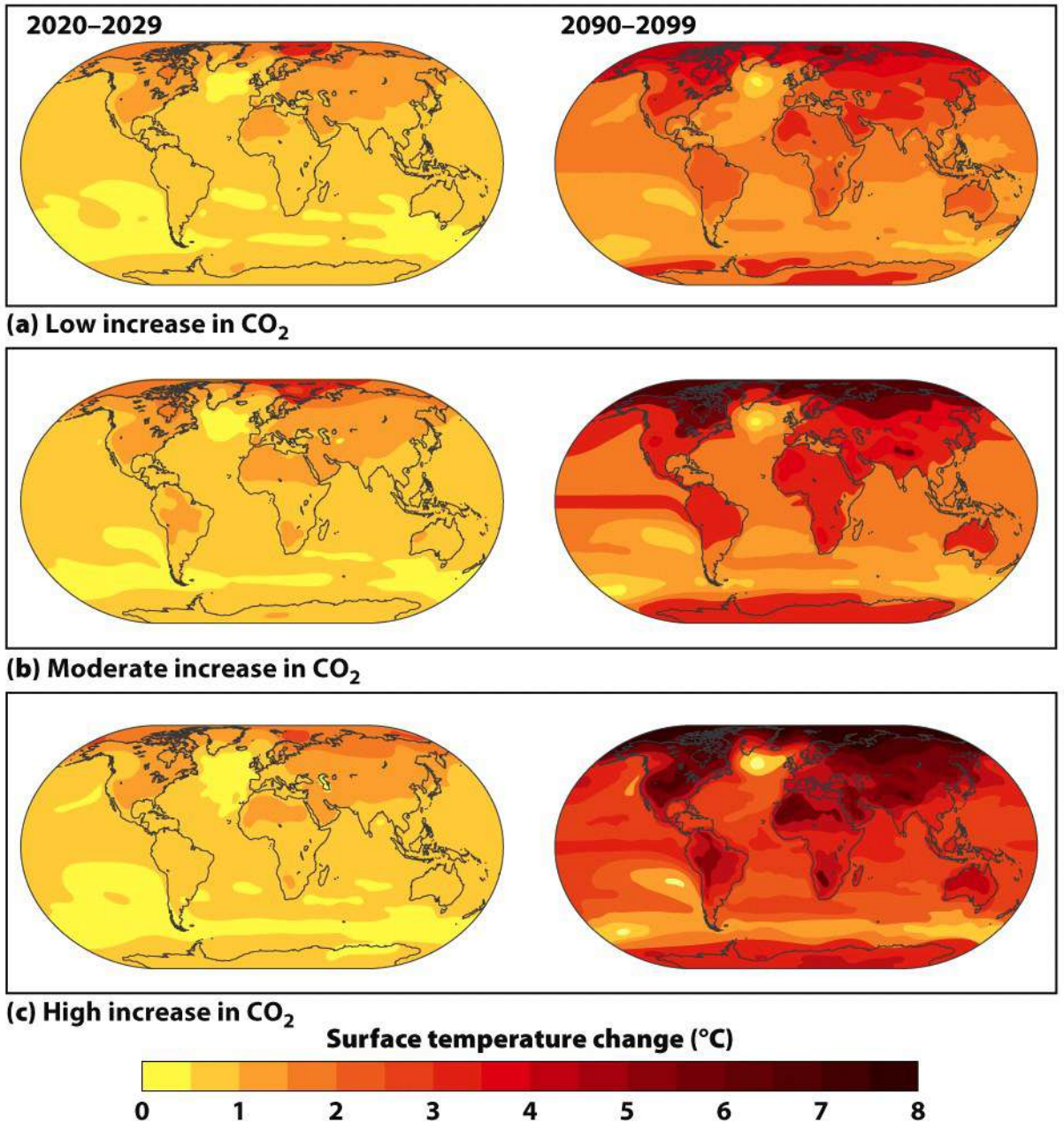


Figure 19.17
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Feedbacks

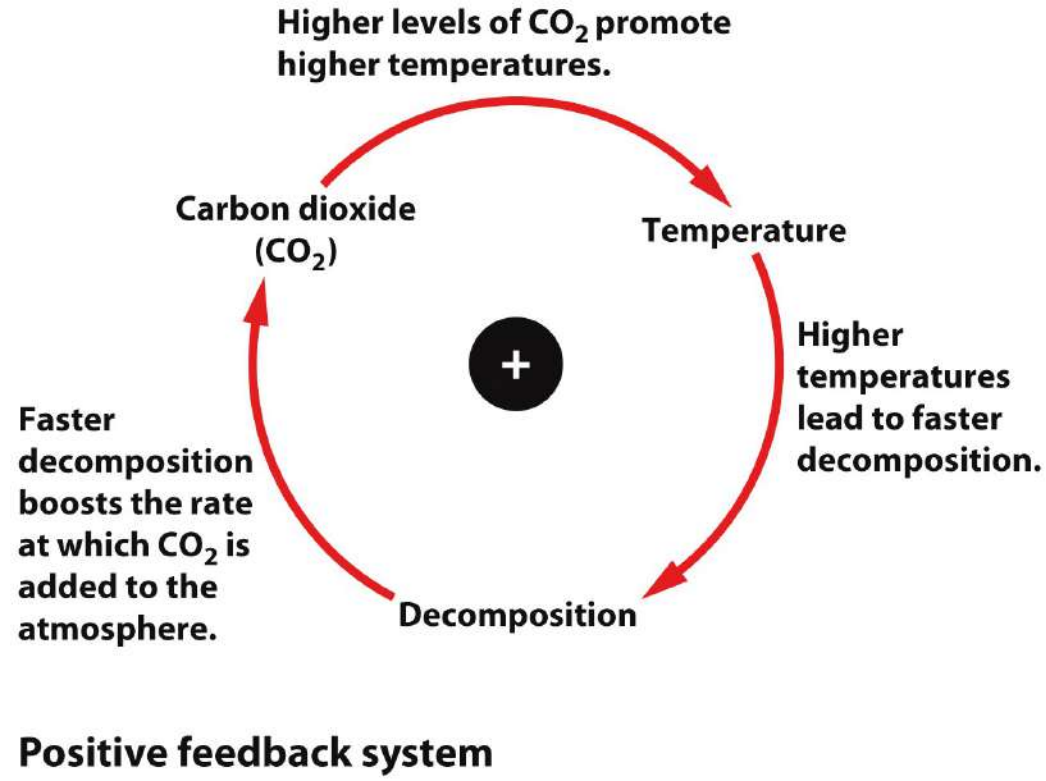

Figure 19.18a
Environmental Science

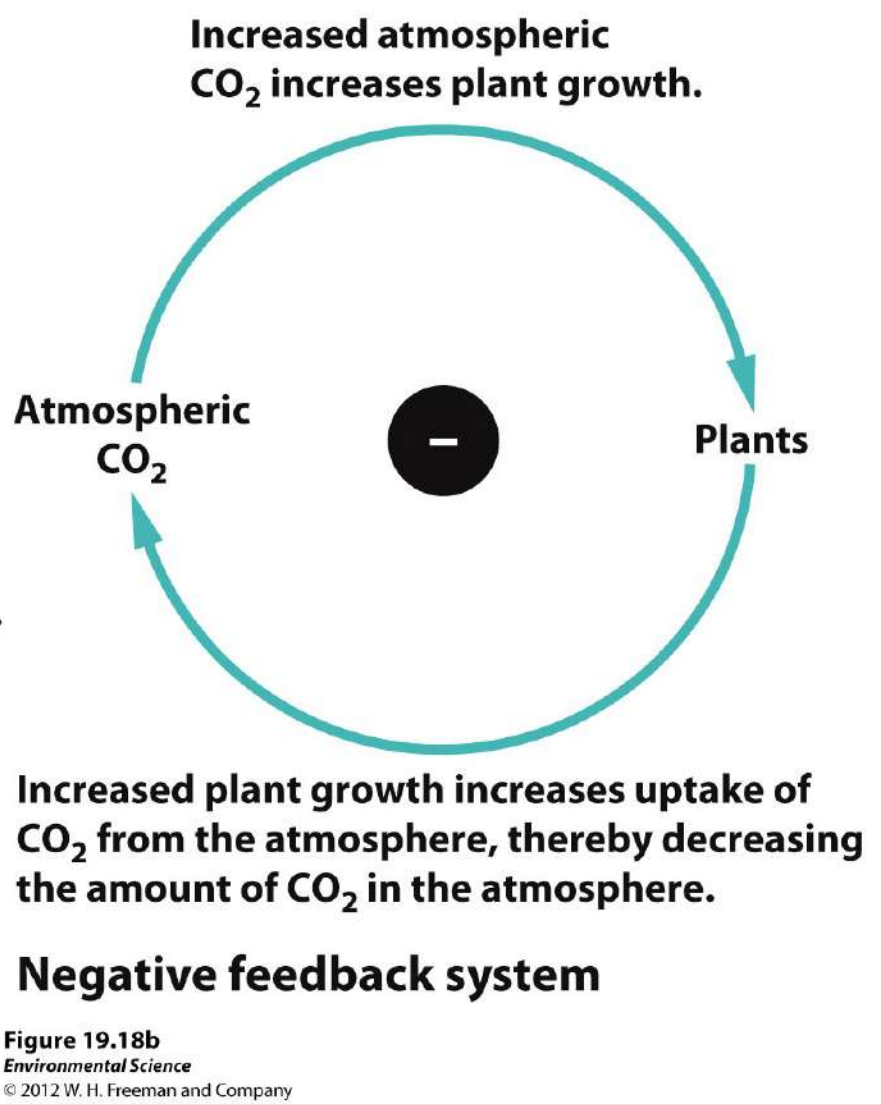

Figure 19.18b
Environmental Science

Consequences to the Environment Because of Global Warming

- Melting of polar ice caps, Greenland and Antarctica
- Melting of many glaciers around the world
- Melting of permafrost
- Rising of sea levels due to the melting of glaciers and ice sheets and as water warms it expands
- Heat waves
- Cold spells
- Change in precipitation patterns
- Increase in storm intensity
- Shift in ocean currents

Greenhouse Effect

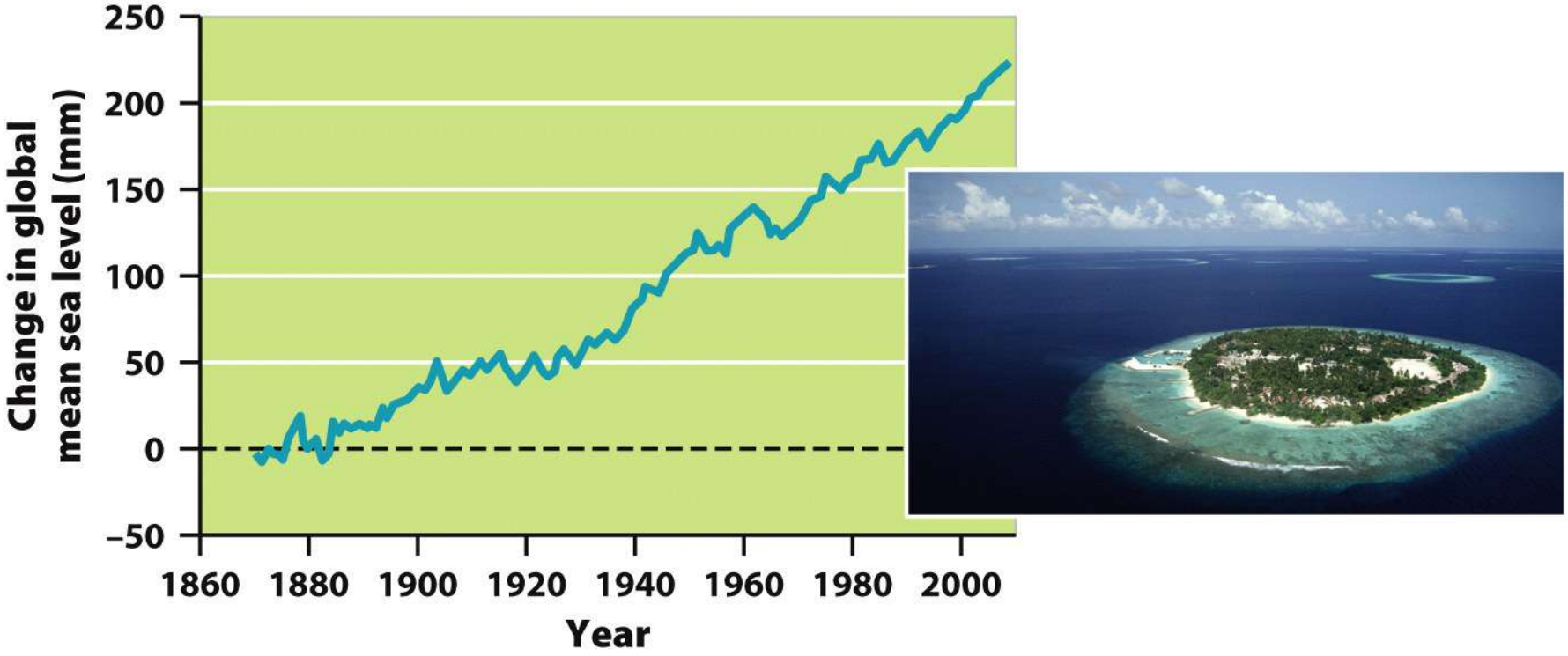

Figure 19.20
Environmental Science

Consequences to Living Organisms

- Wild plants and animals can be affected. The growing season for plants has changed and animals have the potential to be harmed if they can't move to better climates.
- Humans may have to relocate, some diseases like those carried by mosquitoes could increase and there could be economic consequences.

The Controversy of Climate Change

- The fundamental basis of climate change- that greenhouse gas concentrations are increasing and that this will lead to global warming is not in dispute among the vast majority of scientists.
- What is unclear is how much world temperatures will increase for a given change in greenhouse gases, because that depends on the different feedback loops.

TABLE 19.2 The 2007 assessment of global change by the Intergovernmental Panel on Climate Change (IPCC)

The scientists considered the likelihood that specific changes have occurred, the likelihood that humans contributed to the change, and the likelihood that current trends will continue.

Definitions: More likely than not = more than 50% certain; Likely = more than 60% certain; Very likely = more than 90% certain; Virtually certain = more than 99% certain.

Phenomenon and direction of trend	Likelihood that trend occurred in late 20th century (typically post-1960)	Likelihood of a human contribution to observed trend	Likelihood of future trends based on projections for 21st century from *Special Report on Emissions Scenarios*
Warmer and fewer cold days and nights over most land areas	Very likely	Likely	Virtually certain
Warmer and more frequent hot days and nights over most land areas	Very likely	Likely (nights)	Virtually certain
Warm spells/heat waves. Frequency increases over most land areas	Likely	More likely than not	Very likely
Heavy precipitation events. Frequency (or proportion of total rainfall from heavy falls) increases over most areas	Likely	More likely than not	Very likely
Area affected by droughts increases	Likely in many regions since 1970s	More likely than not	Likely
Intense tropical cyclone activity increases	Likely in some regions since 1970	More likely than not	Likely
Increased incidence of extreme high sea level (excludes tsunamis)	Likely	More likely than not	Likely

Table 19.2
Environmental Science

Volcanic Eruptions

- Mount Pinatubo in Philippines 1991, sent millions of tones of ash into the atmosphere and absorbed incoming solar radiation, reradiating it back into space and causing a cooling of Earth.

Figure 19.3
Environmental Science

The Kyoto Protocol

- In 1997, representatives of the nations of the world went to Kyoto, Japan to discuss how best to control the emissions contributing to global warming.
- The agreement was that emissions of greenhouse gases from all industrialized countries will be reduced to 5.2% below their 1990 levels by 2012.
- Developing nations did not have emission limits imposed by the protocol.

Carbon Sequestration

- An approach involving taking CO_2 out of the atmosphere.
- Some methods include storing carbon in agricultural soils or retiring agricultural land and allowing it to become pasture or forest. Increase in national Forests/ Preserves & Parks.
- Researchers are looking at cost-effective ways of capturing CO_2 from the air, from coal-burning power stations, and from other emission sources.
- This captured CO_2 would be compressed and pumped into abandoned oil wells or the deep ocean.

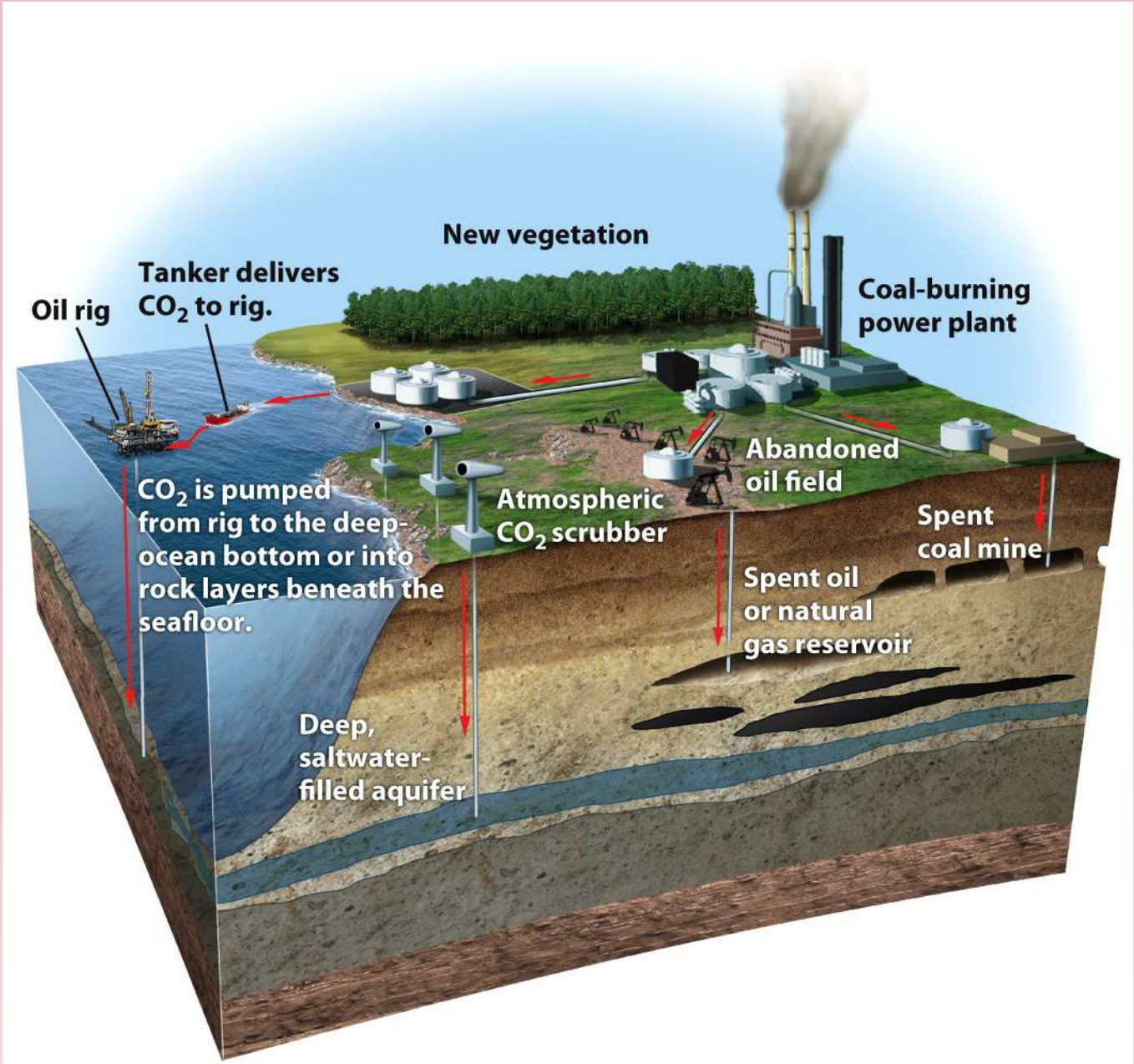

Figure 19.23
Environmental Science

Doing the Math p.87 NB

- In recent year many scientific studies have shown the relationship between the global mean atmospheric temperature at Earth's surface and rising sea levels. The increases in the global mean atmospheric temperature during the past two hundred years have been accompanied by the gradual increase in sea level. The average rate of increase in sea level over the past 200 years is 2.5 mm/yr.
- Calculate the expected increase in sea level, in **meters**, for the following lengths of time: 10 years, 100 years, 200 years.

Doing the Math

- 10 yrs: 2.5 mm/yr x 10 yrs = 25 mm
  - 25mm x 1m/1000mm = .025m
- 100 yrs: 2.5mm/yr x 100 yrs = 250 mm
  - 250mm x 1m/1000mm = .25m
- 200 yrs: 2.5mm/yr x 200 yrs = 500 mm
  - 500 mm x 1m/1000mm - .5m

Doing the Math Figure 19.13 P. 530

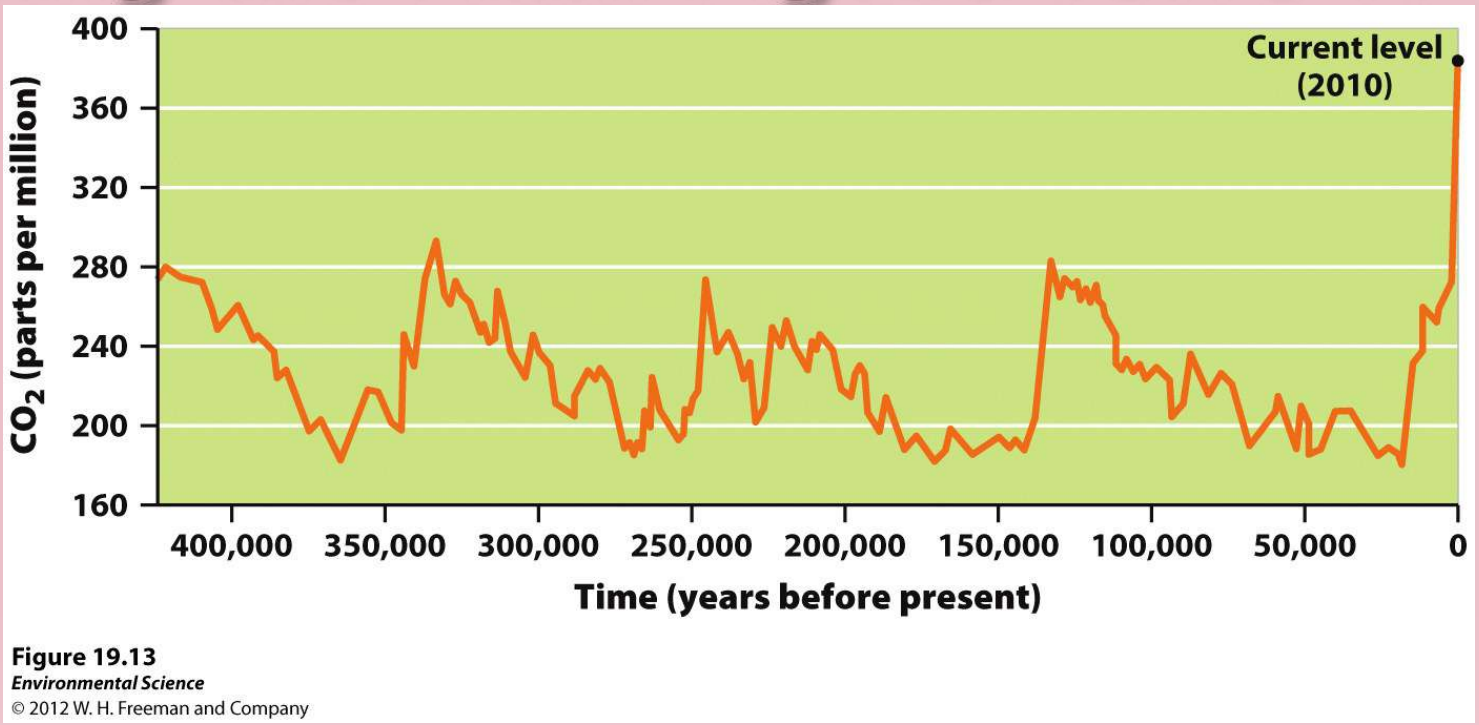

Figure 19.13
Environmental Science

Use the graph to determine the **net change** in atmospheric Carbon Dioxide concentration between 100,000 years ago and the present day levels.

Doing the Math

- Read the graph for values from 100,000 years ago and for the present day.
- 100,000 yrs. Ago: CO_2 lever were about 230 ppm
- Present Day: CO_2 levels are about 390 ppm
- Subtract the quantity for 100,000 years from the present day: 390 ppm– 230ppm = 160 ppm increase in [CO_2] over the past 100,000 years.

Doing the Math
Predicting future increases in CO_2

Since Charles David Keeling and his colleagues began measuring CO2 in 1958, we have an excellent record of how CO2 concentrations have changed in the atmosphere over time. From 1960 to 2010, the concentrations of CO2 in the atmosphere increased from 320 ppm to 390 ppm. Based on these two points in time, what has been the average increase of CO2 in the atmosphere?

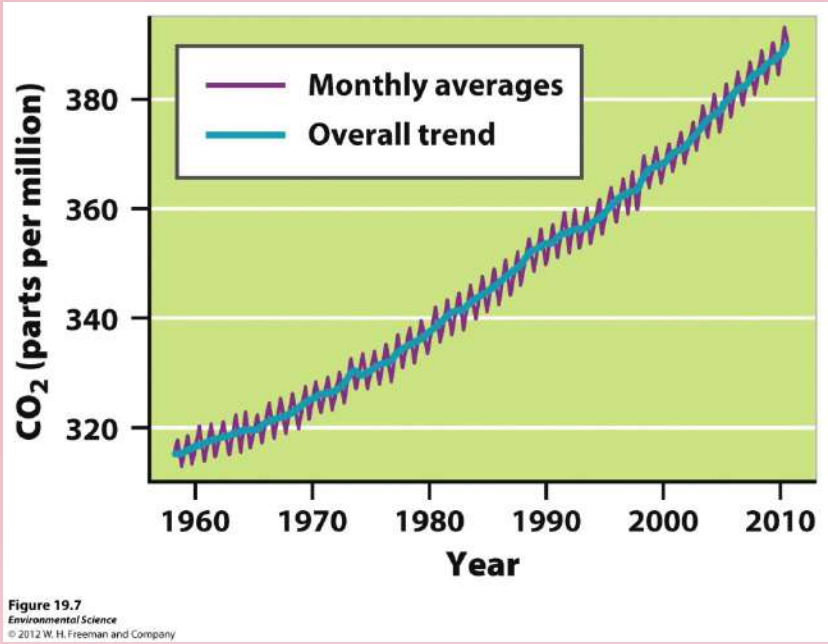

Figure 19.7
Environmental Science

Doing the Math

- P.526 ES BK P. 85 NB
- Time = 2010 – 1960 = 50 years
- Increase in CO@ = 390 – 320 = 70 ppm
- Average annual increase in CO2 = 70ppm/50 year= 1.4 ppm/year

Global change Activity

- Research another animal that is endangered or is extinct due to Climate change.
- One web site is Red List .orghttp://iucnredlist.org/
- Golden Toad of Costa Rica - not been seen since 1989, and is believed to be extinct due to climate change.
- Show video:

Working Toward Sustainabiltiy

- Local Governments & Businesses Lead the Way on Reducing Greenhouse Gases P. 543 ESBK