



Climate Control and Ozone Depletion

Chapter 19

Core Case Study: Studying a Volcano to Understand Climate Change

- June 1991: Mount Pinatubo (Philippines) exploded
 - Airborne pollutants, deaths, and damage
 - Affected climate temperature
 - Climate predictions based on the forecasts of James Hansen of NASA
-

An Enormous Cloud of Air Pollutants and Ash from Mt. Pinatubo on June 12, 1991



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19-1 How Might the Earth's Temperature and Climate Change in the Future?

- **Concept 19-1** *The overwhelming scientific consensus is that the earth's atmosphere is warming rapidly, mostly because of human activities, and that this will lead to significant climate change during this century.*
-

Global Warming and Global Cooling Are Not New (1)

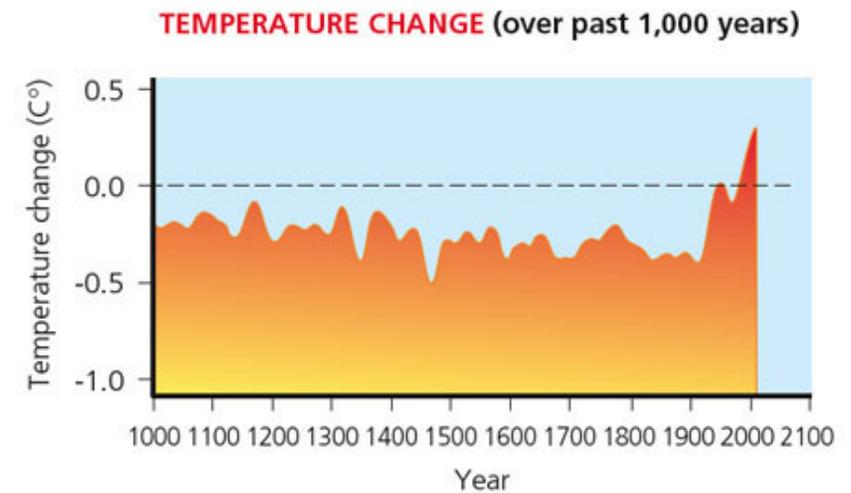
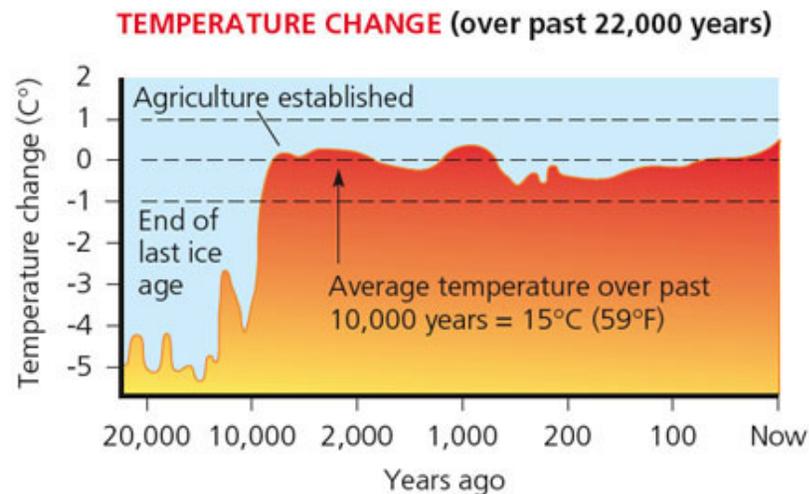
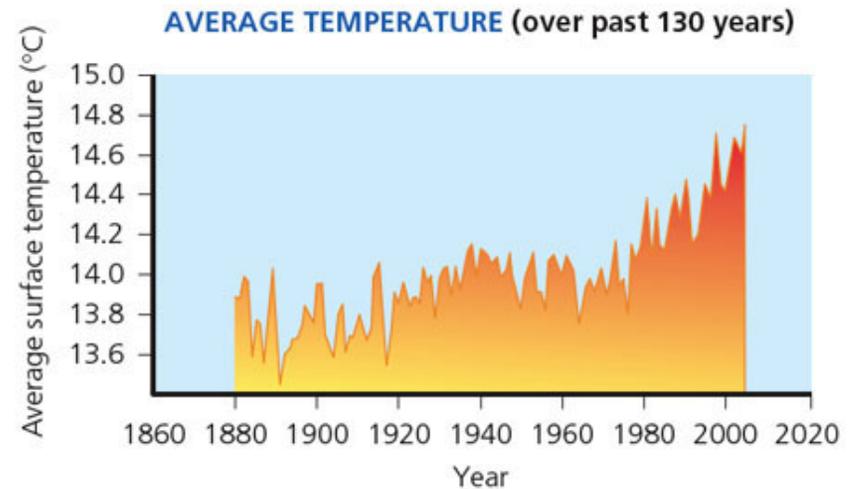
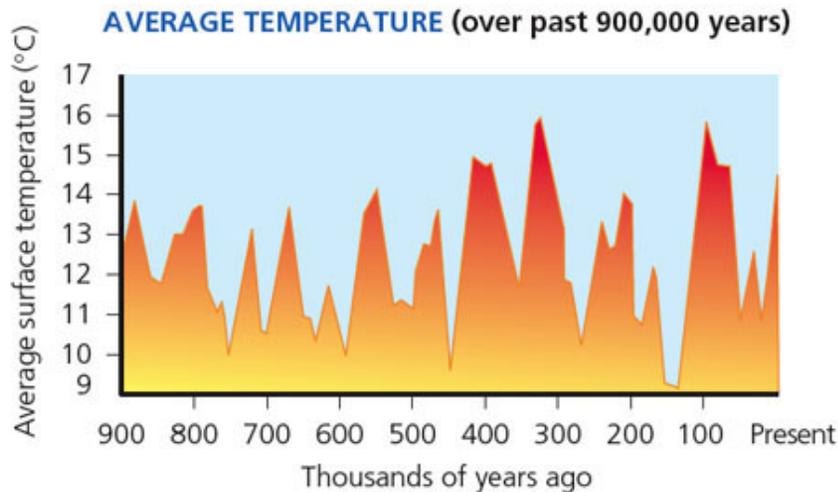
- Over the past 4.7 billion years the climate has been altered by
 - Volcanic emissions
 - Changes in solar input
 - Movement of the continents
 - Impacts by meteors

 - Over the past 900,000 years
 - Glacial and interglacial periods
-

Global Warming and Global Cooling Are Not New (2)

- Over the past 10,000 years
 - Interglacial period
 - Over the past 1,000 years
 - Temperature stable
 - Over the past 100 years
 - Temperature changes; methods of determination
-

Estimated Changes in the Average Global Temperature of the Atmosphere



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Fig. 19-2, p. 498

Science: Ice Cores Are Extracted by Drilling Deep Holes in Ancient Glaciers



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Our Climate, Lives, and Economies Depend on the Natural Greenhouse Effect

- Without the natural greenhouse effect
 - Cold, uninhabitable earth
-

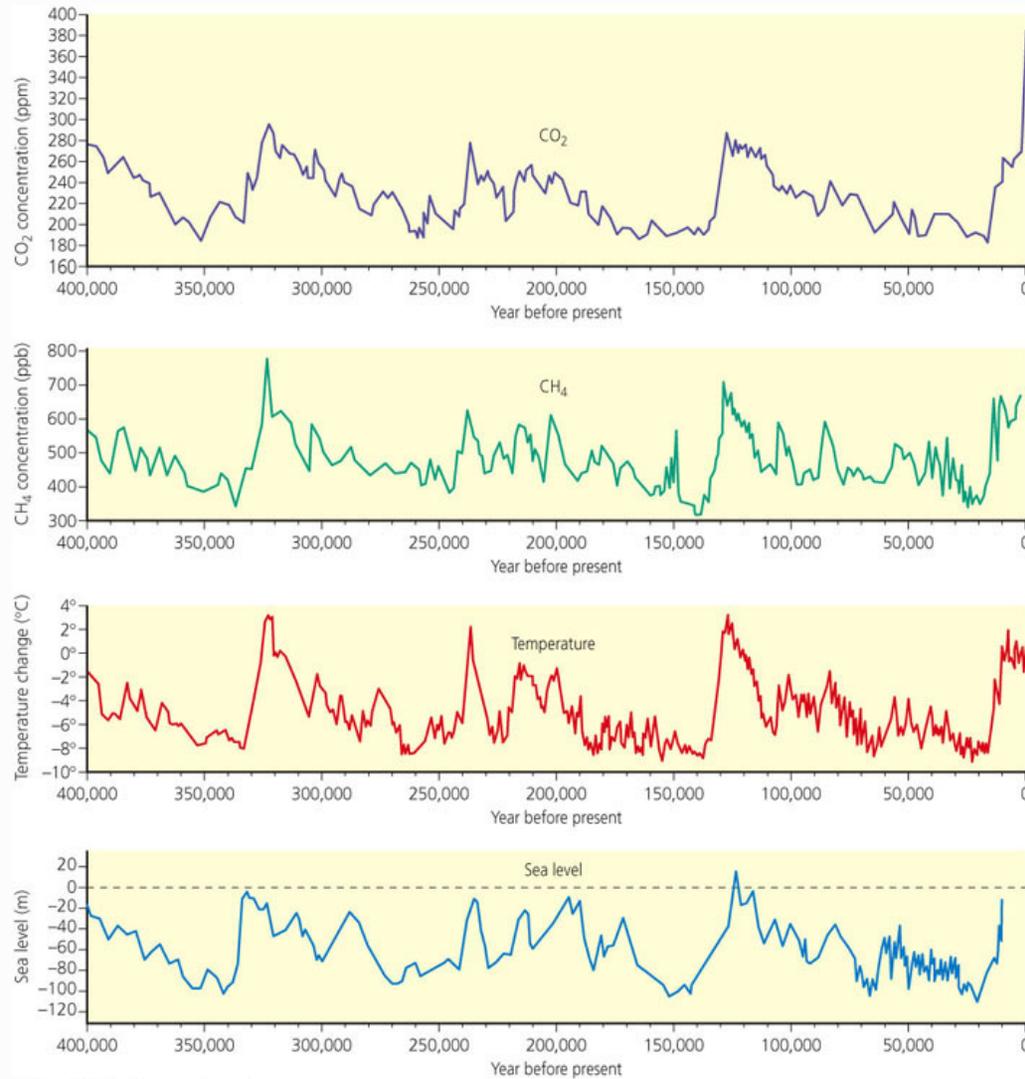
Human Activities Emit Large Quantities of Greenhouses Gases (1)

- Since the Industrial Revolution
 - CO₂, CH₄, and N₂O emissions higher
 - Main sources: agriculture, deforestation, and burning of fossil fuels
 - Correlation of rising CO₂ and CH₄ with rising global temperatures
 - Countries with the largest CO₂ emissions
-

Human Activities Emit Large Quantities of Greenhouses Gases (2)

- Per capita emissions of CO₂
 - Scientific and economic studies
 - 2007: Field and Marland
 - **Tipping point**
 - 2008: Aufhammer and Carson
 - China's CO₂ emission growth may be underestimated
 - Ice core analysis of air pollutants
-

Atmospheric Levels of CO₂ and CH₄, Global Temperatures, and Sea Levels



The Atmosphere Is Warming Mostly Because of Human Activities (1)

- Intergovernmental Panel on Climate Change (IPCC)
 - 90–99% likely that lower atmosphere is warming
 - 1906–2005: Ave. temp increased about 0.74°C
 - 1970–2005: Annual greenhouse emissions up 70%
 - Past 50 years: Arctic temp rising almost twice as fast as the rest of the earth
 - Melting of glaciers and floating sea ice
 - Prolonged droughts: increasing
 - Last 100 years: sea levels rose 10–20 cm
-

The Atmosphere Is Warming Mostly Because of Human Activities (2)

- Al Gore and the IPCC : Nobel Peace Prize
 - What natural and human-influenced factors could have an effect on temperature changes?
 - Amplify
 - Dampen
-

Melting of Alaska's Muir Glacier between 1948 and 2004



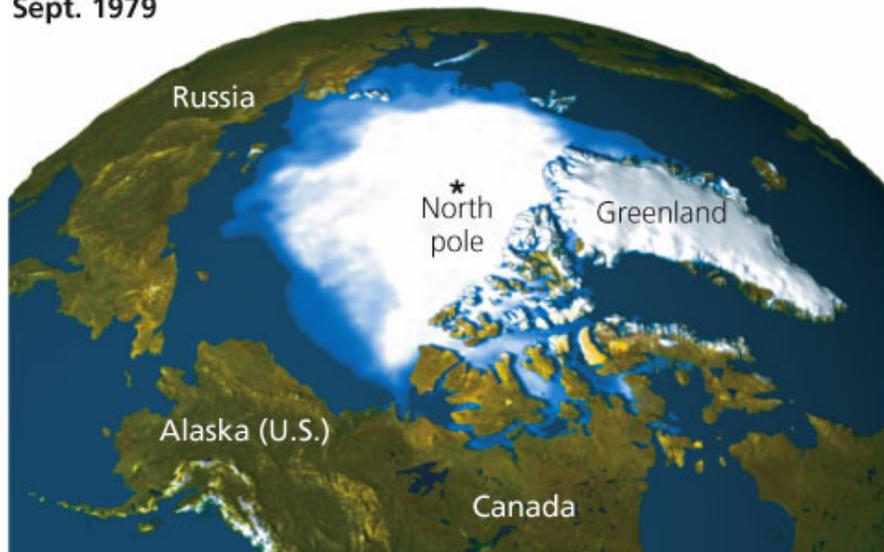
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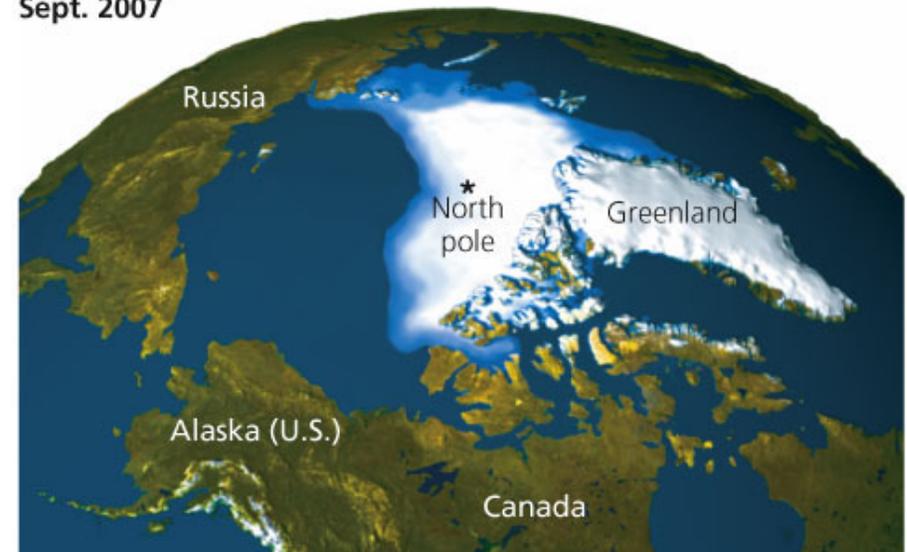
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The Big Melt: Some of the Floating Sea Ice in the Arctic Sea

Sept. 1979



Sept. 2007



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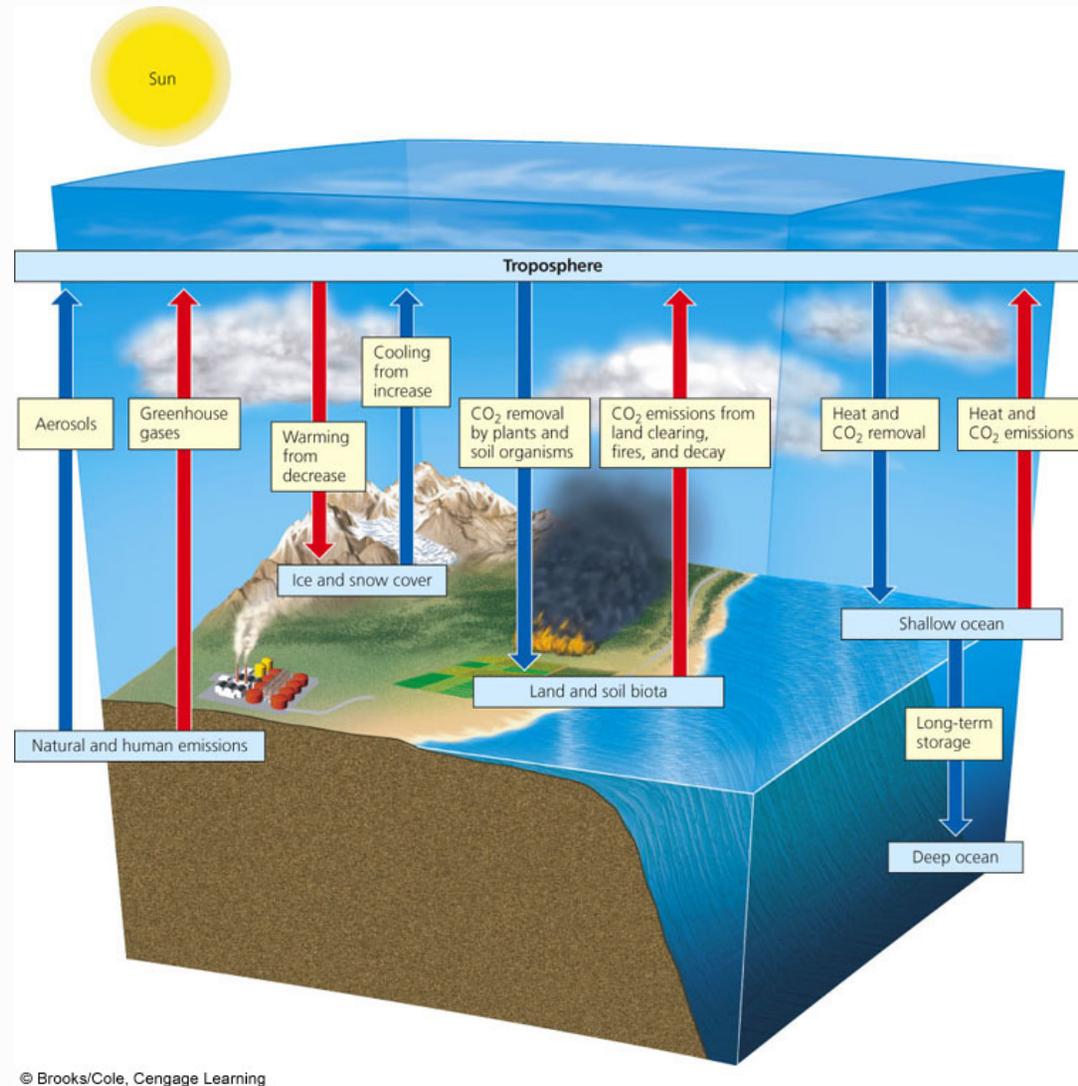
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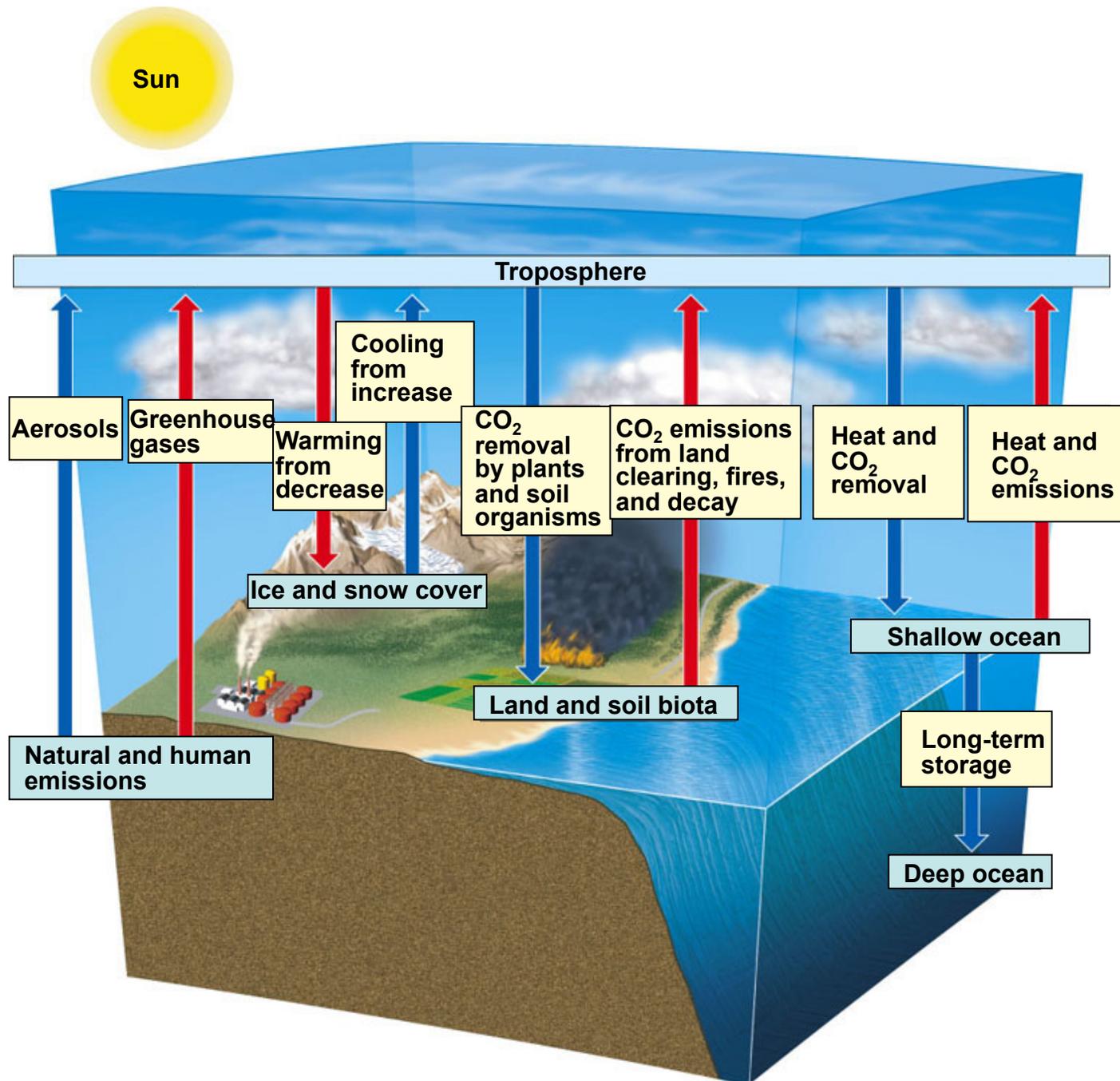
Fig. 19-6, p. 501

What Is the Scientific Consensus about Future Temperature Change?

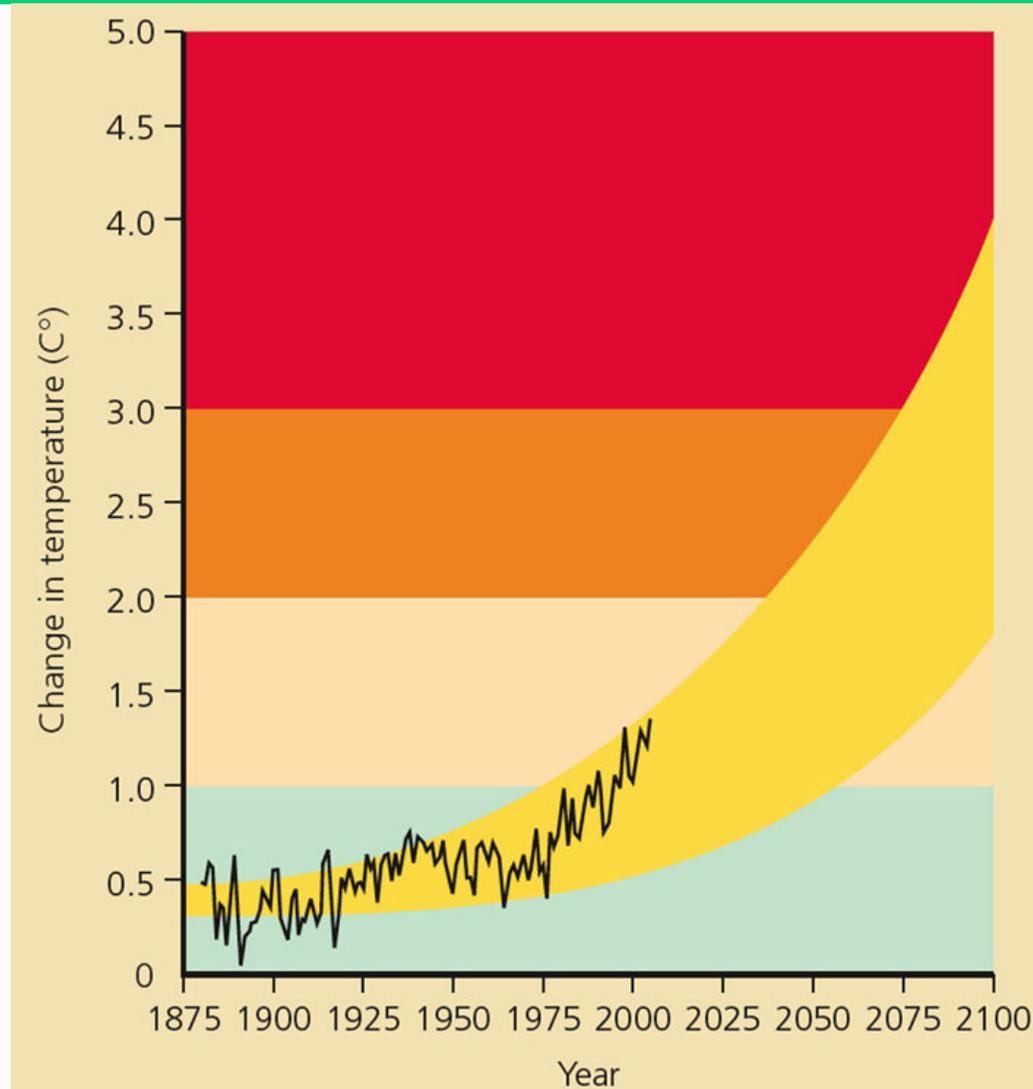
- Mathematical models used for predictions
 - Global warming: rapid rate
 - Human factors are the major cause of temperature rise since 1950
 - Human factors will become a greater risk factor
-

Simplified Model of Some Major Processes That Interact to Determine Climate





Comparison of Measured Temperature from 1860–2007 and Projected Changes



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Is a Hotter Sun the Culprit?

- Since 1975
 - Troposphere has warmed
 - Stratosphere has cooled
 - This is not what a hotter sun would do
-

Can the Oceans Save Us?

- Solubility of CO₂ in ocean water
 - Warmer oceans
 - CO₂ levels increasing acidity
 - Effect on atmospheric levels of CO₂
 - Effect on coral reefs
 - Antarctica's Southern Ocean and the North Atlantic Ocean
 - Decrease in CO₂ uptake
 - Significance on global CO₂ levels
-

There Is Uncertainty about the Effects of Cloud Cover on Global Warming

- Warmer temperatures create more clouds
 - Thick, light-colored low altitude clouds: decrease surface temperature
 - Thin, cirrus clouds at high altitudes: increase surface temperature
 - Effect of jet entrails on climate temperature
-

Outdoor Air Pollution Can Temporarily Slow Global Warming

- Aerosol and soot pollutants
 - Will not enhance or counteract projected global warming
 - Fall back to the earth or are washed out of the lower atmosphere
 - Reduction: especially in developed countries
-

19-2 What Are Some Possible Effects of a Warmer Atmosphere?

- **Concept 19-2** *The projected rapid change in the atmosphere's temperature during this century is very likely to increase drought and flooding, shift areas where food can be grown, raise sea levels, result in intense heat waves, and cause the premature extinction of many species.*
-

Enhanced Global Warming Could Have Severe Consequences

- Tipping point and irreversible climate change

 - Worst-case scenarios
 - Ecosystems collapsing
 - Low-lying cities flooded
 - Wildfires in forests
 - Prolonged droughts: grasslands become dust bowls
 - More destructive storms
 - Glaciers shrinking; rivers drying up
-

Projected Effects of Global Warming and the Resulting Changes in Global Climate

2°C (3.6°F) Warming with 450 ppm CO₂ (now unavoidable effects)

- Forest fires worsen
- Prolonged droughts intensify
- Deserts spread
- Major heat waves more common
- Fewer winter deaths in higher latitudes
- Conflicts over water supplies increase
- Modest increases in crop production in temperate regions
- Crop yields fall by 5–10% in tropical Africa
- Coral reefs affected by bleaching
- Many glaciers melt faster and threaten water supplies for up to 100 million people
- Sea levels rise enough to flood low-lying coastal areas such as Bangladesh
- More people exposed to malaria
- High risk of extinction for Arctic species such as the polar bear

3°C (5.4°F) Warming with 550 ppm CO₂ (potentially avoidable effects)

- Forest fires get much worse
- Prolonged droughts get much worse
- Deserts spread more
- Major heat waves and deaths from heat increase
- Irrigation and hydropower decline
- 1.4 billion people suffer water shortages
- Water wars, environmental refugees, and terrorism increase
- Malaria and several other tropical diseases spread faster and further
- Crop pests multiply and spread
- Crop yields fall sharply in many areas, especially Africa
- Coral reefs severely threatened
- Amazon rainforest may begin collapsing
- Up to half of Arctic tundra melts
- Sea levels continue to rise
- 20–30% of plant and animal species face premature extinction

4°C (7.2°F) Warming with 650 ppm CO₂ (potentially avoidable effects)

- Forest fires and drought increase sharply
- Water shortages affect almost all people
- Crop yields fall sharply in all regions and cease in some regions
- Tropical diseases spread even faster and further
- Water wars, environmental refugees, terrorism, and economic collapse increase sharply
- Methane emissions from melting permafrost accelerate
- Ecosystems such as coral reefs, tropical forests, alpine and Arctic tundra, polar seas, coastal wetlands, and high-elevation mountaintops begin collapsing
- Glaciers and ice sheets melt faster
- Sea levels rise faster and flood many low-lying cities and agricultural areas
- At least half of plant and animal species face premature extinction

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Fig. 19-7, p. 507

Severe Drought Is Increasing: The Browning of the Earth

- Accelerate global warming, lead to more drought
 - Biodiversity will decrease
 - NPP will decrease
 - Dry climate ecosystems will increase
 - Other effects of prolonged lack of water
-

Ice and Snow Are Melting (1)

- Why will global warming be worse in the polar regions?
 - Important climate role of floating sea ice
 - Mountain glaciers affected by
 - Average snowfall
 - Average warm temperatures
-

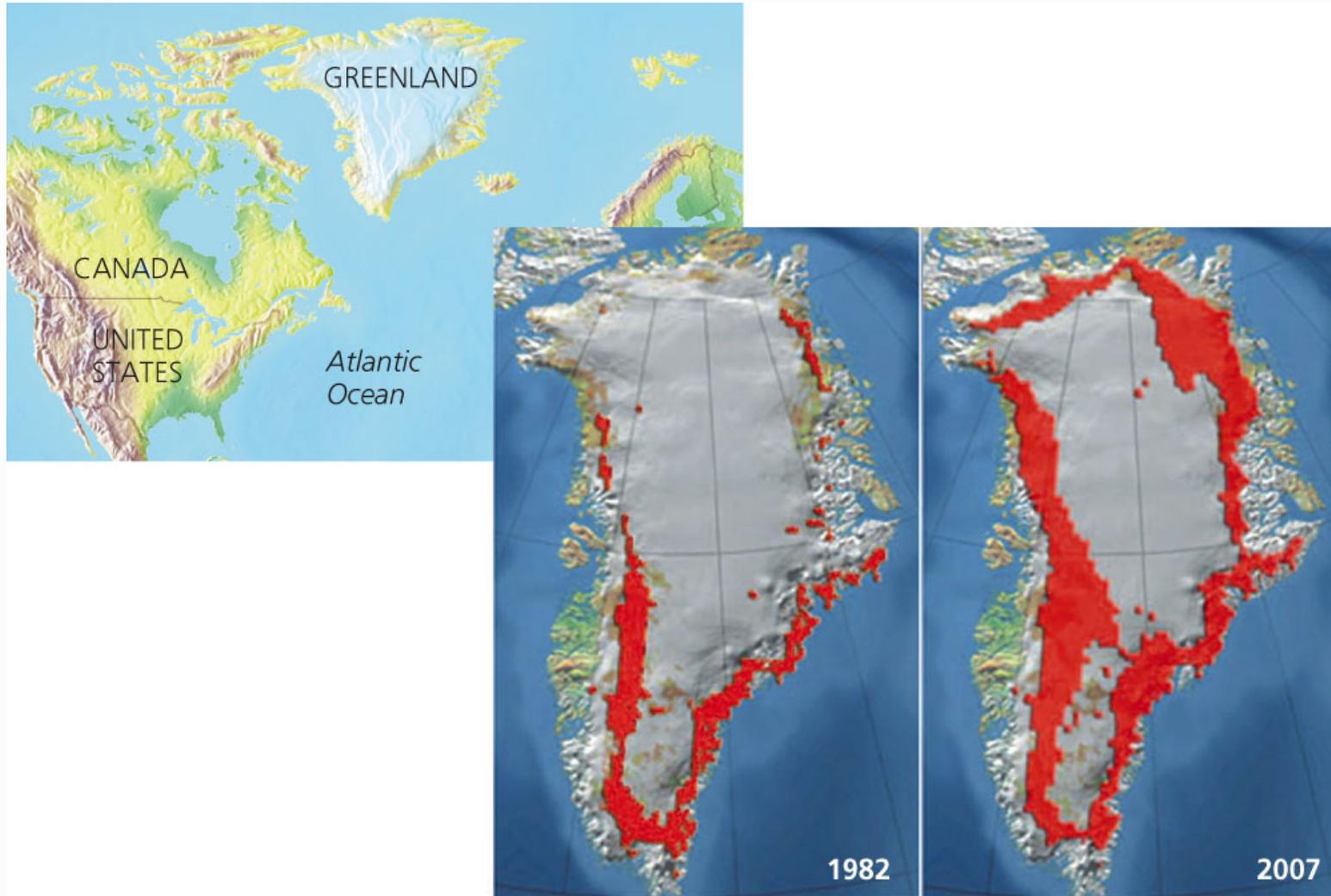
Ice and Snow Are Melting (2)

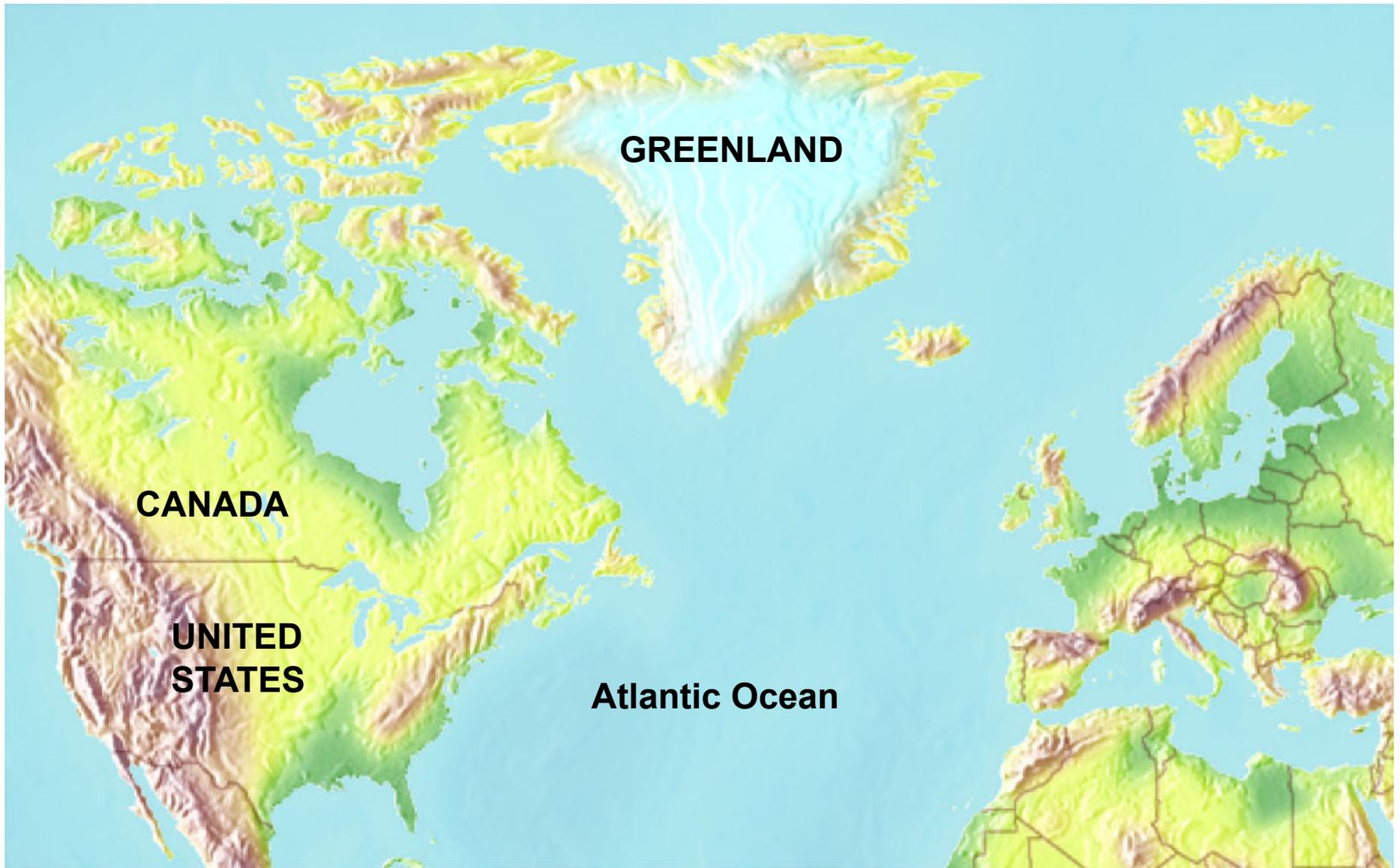
- Europe's Alps
 - Glaciers are disappearing
 - South America
 - Glaciers are disappearing
 - Greenland
 - Warmer temperatures
-

Science Focus: Melting Ice in Greenland

- Largest island: 80% composed of glaciers
 - 10% of the world's fresh water
 - 1996–2007: net loss of ice doubled
 - Effect on sea level if melting continues
-

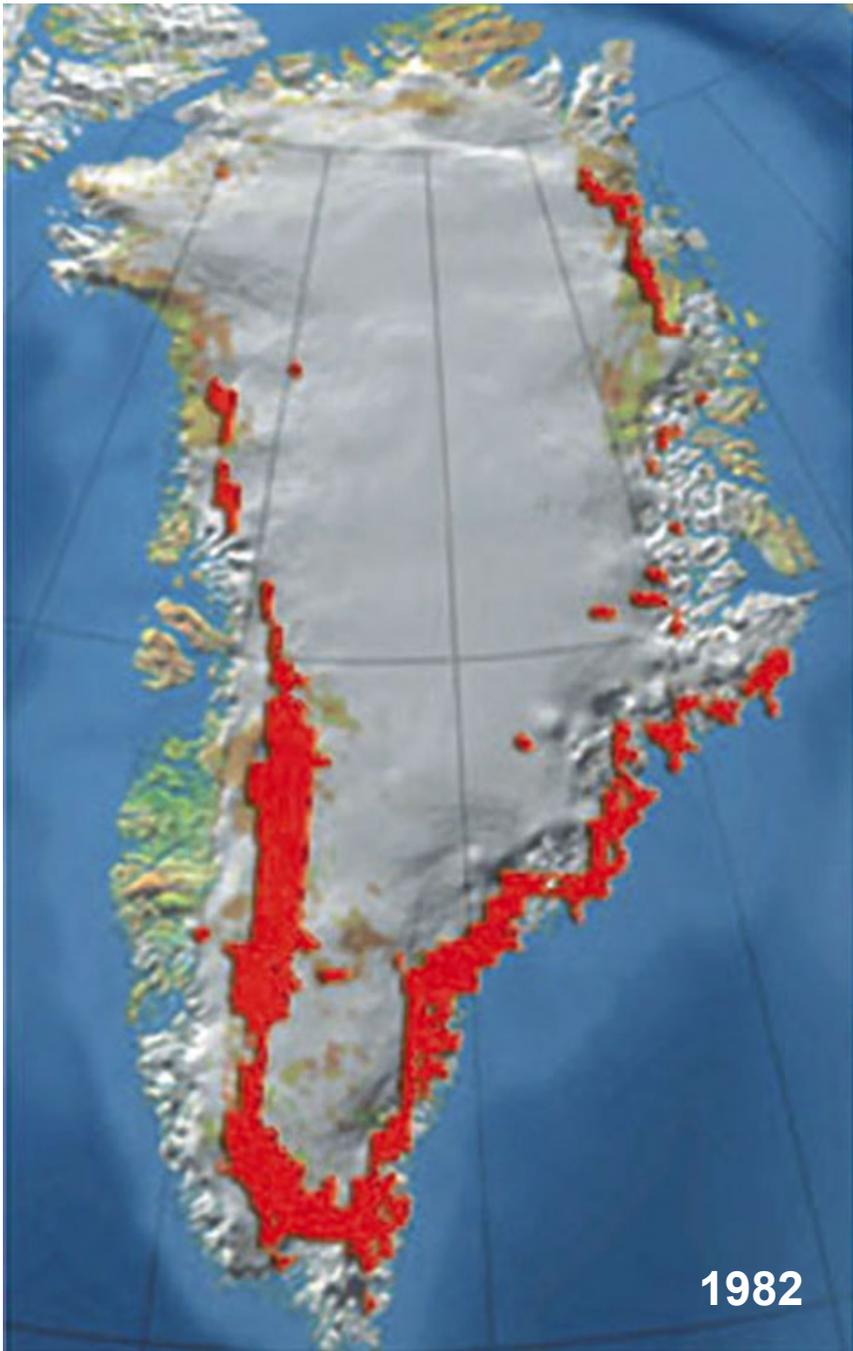
Areas of Glacial Ice Melting in Greenland during Summer 1982–2007 Increased





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Fig. 19-C (1), p. 508



Sea Levels Are Rising (1)

- Expansion of warm water
 - Melting of land-based ice
 - What about Greenland?
-

Sea Levels Are Rising (2)

- Projected irreversible effect
 - Degradation and loss of 1/3 of coastal estuaries, wetlands, and coral reefs
 - Disruption of coastal fisheries
 - Flooding of
 - Low-lying barrier islands and coastal areas
 - Agricultural lowlands and deltas
 - Contamination of freshwater aquifers
 - Submergence of low-lying islands in the Pacific and Indian Oceans and the Caribbean
-

Areas of Florida, U.S., to Flood If Average Sea Level Rises by One Meter





Low-Lying Island Nation: Maldives in the Indian Ocean



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Permafrost Is Likely to Melt: Another Dangerous Scenario

- Carbon present as CH₄ in permafrost soils and lake bottoms
 - 2004: Arctic Climate Impact Assessment
 - 10–20% of the permafrost might melt this century
 - Effect on global warming
-

Projected Decline in Arctic Tundra in Portions of Russia from 2004 to 2100



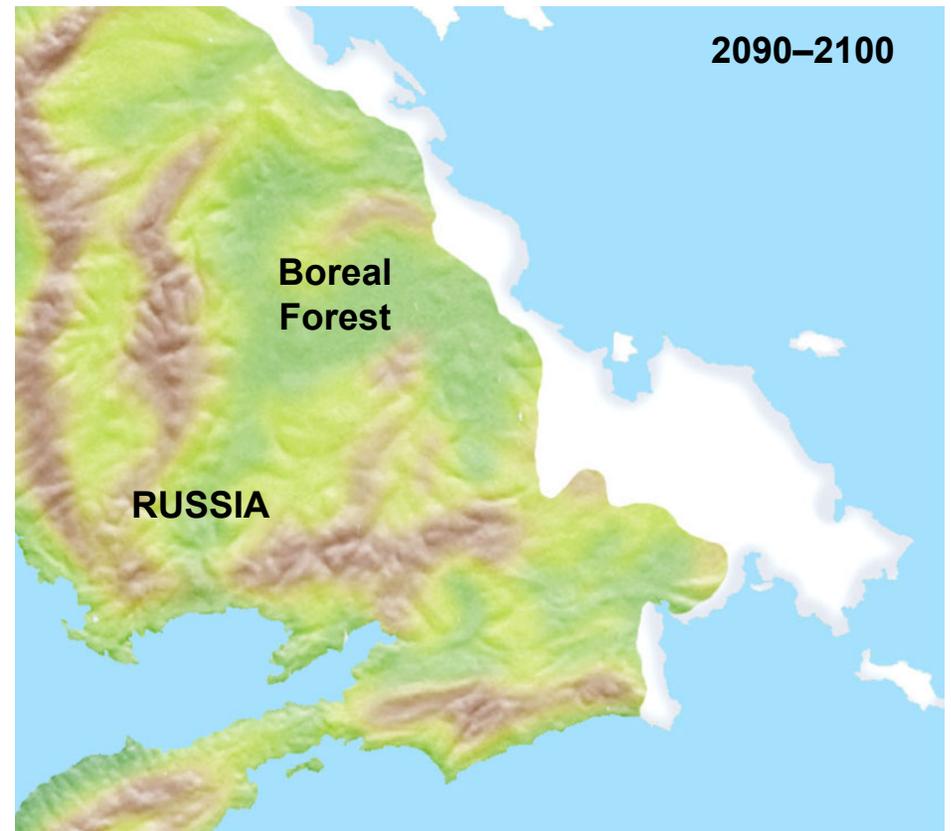
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Fig. 19-10a, p. 510

Ocean Currents Are Changing but the Threat Is Unknown

- Melting glaciers, particularly in Greenland
 - Increased rain in the North Atlantic
 - Not thought to be an immediate problem on the ocean currents
-

Extreme Weather Will Increase in Some Areas

- Heat waves and droughts in some areas
 - Prolonged rains and flooding in other areas
 - Will storms get worse?
 - More studies needed
 - Hurricanes Katrina and Rita
-

Global Warming Is a Major Threat to Biodiversity (1)

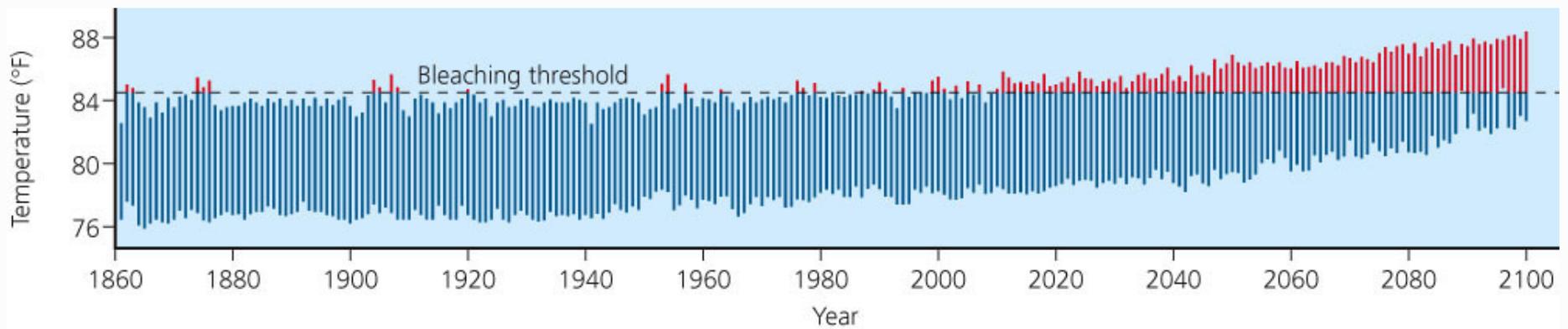
- Most susceptible ecosystems
 - Coral reefs
 - Polar seas
 - Coastal wetland
 - High-elevation mountaintops
 - Alpine and arctic tundra
-

Global Warming Is a Major Threat to Biodiversity (2)

- What about
 - Migratory animals
 - Forests

 - Which organisms could increase with global warming? Significance?
 - Insects
 - Fungi
 - Microbes
-

Changes in Average Ocean Temperatures, Relative to Coral Bleaching Threshold



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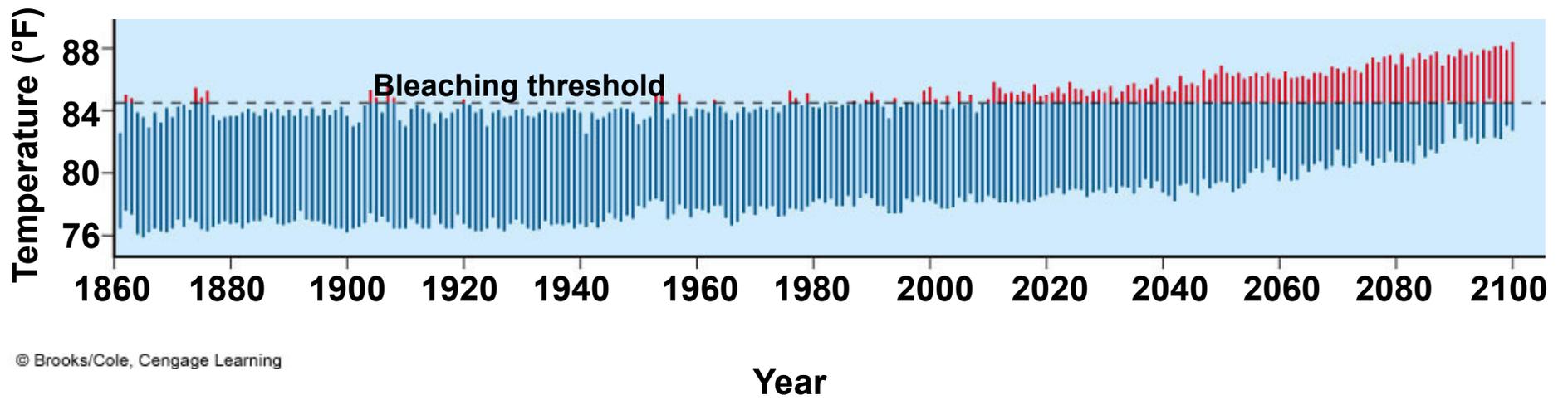


Fig. 19-11, p. 512

Exploding Populations of Mountain Pine Beetles in British Columbia, Canada



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Climate Change Will Shift Areas Where Crops Can Be Grown

- Regions of farming may shift
 - Decrease in tropical and subtropical areas
 - Increase in northern latitudes
 - Less productivity; soil not as fertile
 - Genetically engineered crops more tolerant to drought
-

Climate Change Will Threaten the Health of Many People

- Deaths from heat waves will increase
 - Deaths from cold weather will decrease
 - Higher temperatures can cause
 - Increased flooding
 - Increase in some forms of air pollution, more O₃
 - More insects, microbes, toxic molds, and fungi
-

19-3 What Can We Do to Slow Climate Change? (1)

- **Concept 19-3A** *To slow the rate of global warming and climate change, we can increase energy efficiency, sharply reduce greenhouse gas emissions, rely more on renewable energy resources, and slow population growth.*
-

19-3 What Can We Do to Slow Climate Change? (2)

- **Concept 19-3B** *Governments can subsidize energy efficiency and renewable energy use, tax greenhouse gas emissions, set up cap-and-trade emission reduction systems, and help to slow population growth.*
-

Dealing with Climate Change Is Difficult

- Global problem
 - Long-lasting effects
 - Long-term political problem
 - Harmful and beneficial impacts of climate change unevenly spread
 - Many proposed actions disrupt economies and lifestyles
-

What Are Our Options?

- Two approaches
 - Drastically reduce the amount of greenhouse gas emissions
 - Devise strategies to reduce the harmful effects of global warming
 - Will we reach a **political tipping point** before we reach irreversible **climate change tipping points**?
-

Avoiding Catastrophe: We Can Reduce the Threat of Climate Change (1)

- Input or prevention strategies
 - Improve energy efficiency to reduce fossil fuel use
 - Stop cutting down tropical forests
 - Output strategy
 - Capture and store CO₂
-

Avoiding Catastrophe: We Can Reduce the Threat of Climate Change (2)

- Socolow and Pacala
 - **Climate stabilization wedges**
 - Keep CO₂ emissions to 2007 levels by 2057
 - Brown: need to do more
 - Cut CO₂ emissions by 80% by 2020
 - 2008 book: *Plan B 3.0: Mobilizing to Save Civilization*
-

Avoiding Catastrophe: We Can Reduce the Threat of Climate Change (3)

- Output solutions
 - Massive global tree planting; how many?
 - Wangari Maathai
 - Great Wall of Trees: China and Africa
 - Plant fast-growing perennials on degraded land
 - Capturing and storing CO₂
-

Solutions: Global Warming, Methods for Slowing Atmospheric Warming

SOLUTIONS

Global Warming

Prevention

Cut fossil fuel use (especially coal)

Shift from coal to natural gas

Improve energy efficiency

Shift to renewable energy resources

Transfer energy efficiency and renewable energy technologies to developing countries

Reduce deforestation

Use more sustainable agriculture and forestry

Limit urban sprawl

Reduce poverty

Slow population growth



Cleanup

Remove CO₂ from smokestack and vehicle emissions

Store (sequester) CO₂ by planting trees

Sequester CO₂ deep underground (with no leaks allowed)

Sequester CO₂ in soil by using no-till cultivation and taking cropland out of production

Sequester CO₂ in the deep ocean (with no leaks allowed)

Repair leaky natural gas pipelines and facilities

Use animal feeds that reduce CH₄ emissions from cows (belching)

SOLUTIONS

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Fifteen Ways to Cut CO₂ Emissions

Energy Efficiency and Conservation



Increase the average fuel economy of the 2 billion cars projected to exist by 2057 to 26 kpl (60 mpg).



Cut the average distance traveled by all cars in 2057 to no more than 8,000 kilometers (5,000 miles) per year.



Cut electricity use in homes, offices, and stores by 25%.



Increase efficiency of 1,600 large coal-fired power plants from 40% to 60%.

Renewable Energy



Increase solar power 700-fold to displace coal-fired plants.



Increase wind power 25-fold to displace coal-fired plants.

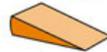


Increase wind power 50-fold to make hydrogen for fuel-cell cars.

Lower Carbon Emitting Fuels



Increase ethanol biofuel production 50-fold by growing crops on one-sixth of the world's cropland.



Replace 1,400 coal-fired plants with natural-gas-fired plants.



Displace coal-fired plants by tripling electricity production from nuclear power plants.

Forestry and Agriculture



Stop all deforestation.



Use conservation tillage on all cropland.

Carbon Capture and Storage (CCS)



Install Carbon Capture and Storage (CCS) at 800 large coal-fired plants



Install CCS at enough large coal-fired plants to produce hydrogen for 1 million fuel-cell cars.



Install CSS at enough coal-to-syngas plants to produce 30 million barrels of synfuels per day.

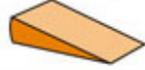
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Forestry and Agriculture

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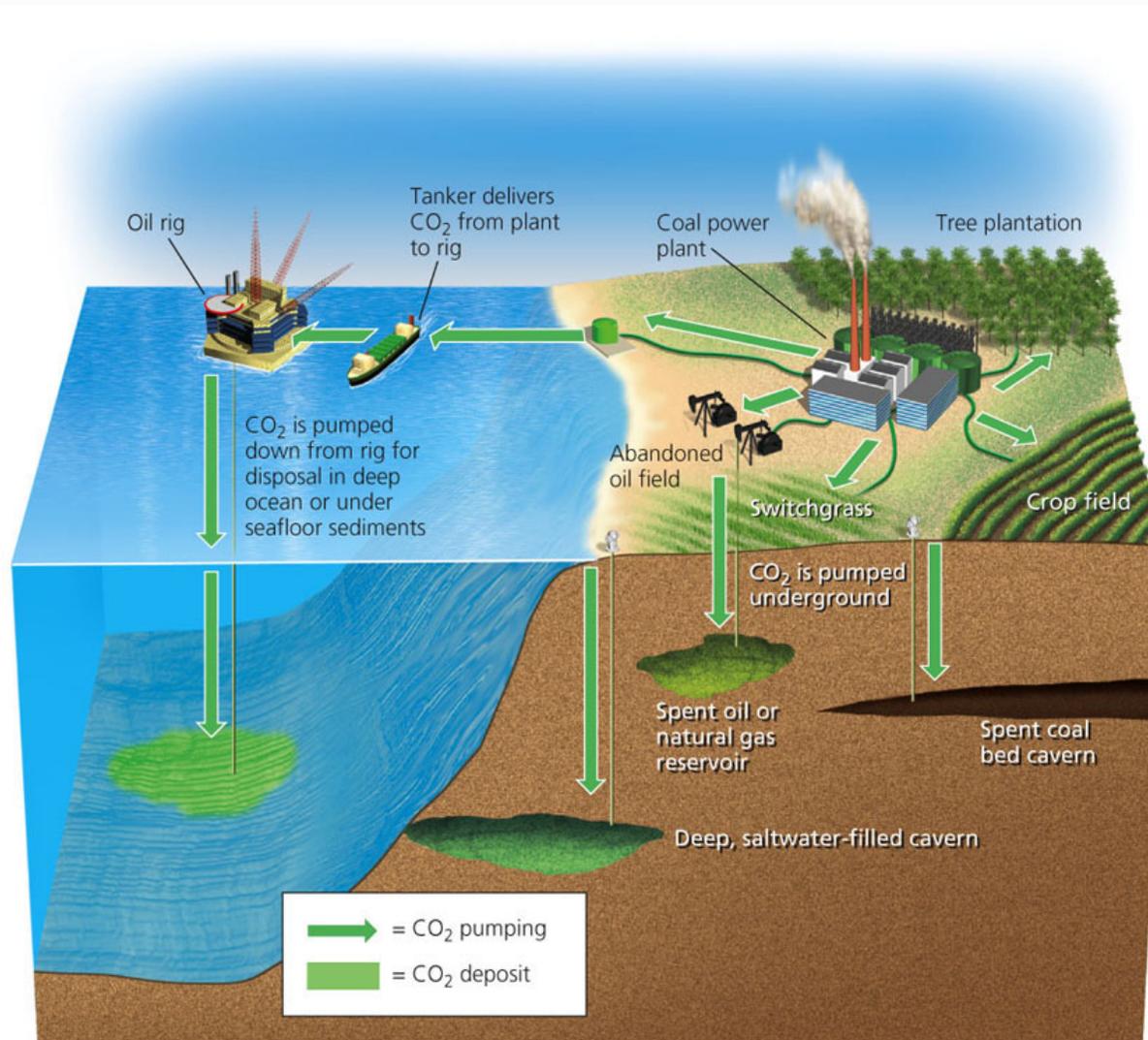
Carbon Capture and Storage (CCS)

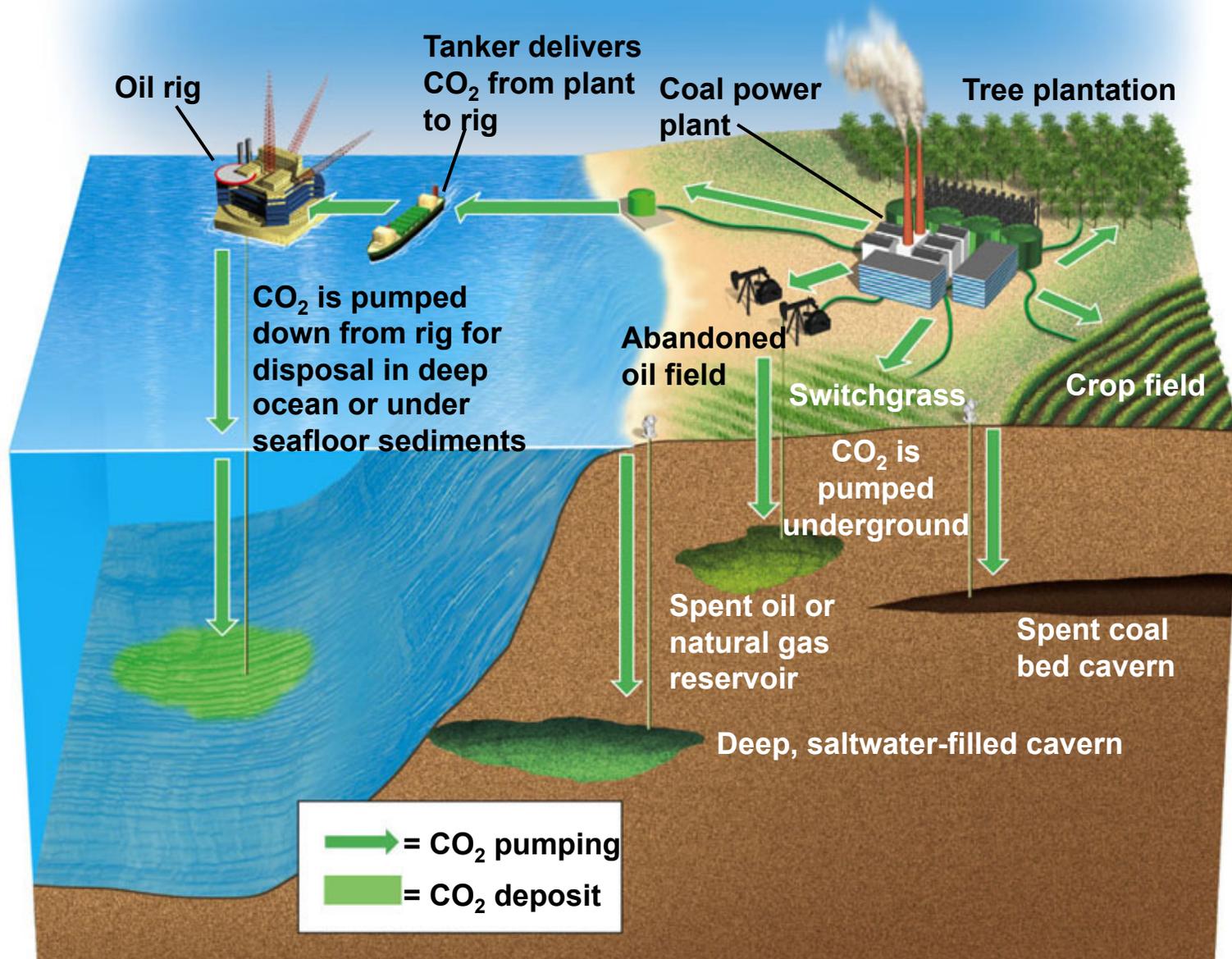
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Stepped Art

Fig. 19-14, p. 515

Some Output Methods for Removing CO₂ from the Atmosphere and Storing It





Case Study: Is Capturing and Storing CO₂ the Answer? (1)

- **Carbon capture and storage (CCS)**
 - Several problems with this approach
 - Power plants using CCS
 - More expensive to build
 - None exist
 - Unproven technology
 - Large inputs of energy to work
 - Increasing CO₂ emissions
-

Case Study: Is Capturing and Storing CO₂ the Answer? (2)

- Problems with carbon capture and storage cont...
 - Promotes the continued use of coal (world's dirtiest fuel)
 - Effect of government subsidies and tax breaks
 - Stored CO₂ would have to remain sealed forever: no leaking
-

Should We Use Geo-Engineering Schemes to Help Slow Climate Change? (1)

- **CCS**
 - Injection of sulfate particles into the stratosphere
 - Would it have a cooling effect?
 - Would it accelerate O₃ depletion?
-

Should We Use Geo-Engineering Schemes to Help Slow Climate Change? (2)

- Remove HCl from seawater
 - Effects on ecology?
 - Pump up nutrient-rich deep ocean water and cause algal blooms
 - Re-ice the Arctic
 - If any of these fixes fail, what about a rebound effect?
-

How Much Will It Cost to Slow Climate Change?

- Short-term costs lower
 - Local and global economies may be boosted
-

Governments Can Help Reduce the Threat of Climate Change

- Strictly regulate CO₂ and CH₄ as pollutants
 - Cap-and-trade approach
 - Increase subsidies to encourage use of energy-efficient technology
 - Technology transfer
-

Governments Can Enter into International Climate Negotiations: The Kyoto Protocol

- 1997: Treaty to slow climate change
 - The Kyoto Protocol
 - Reduce emissions of CO₂, CH₄, and N₂O by 2012 to levels of 1990
 - Trading greenhouse gas emissions among countries
 - Not signed by the U.S.
 - President G.W. Bush's reasons
-

We Can Move Beyond the Kyoto Protocol

- 2004: Stewart and Wiener
 - New treaty needed
 - Should be led by the U.S.
 - Include the developing countries
 - Cap-and-trade emissions program
 - Set up 10 year goals
-

Some Governments Are Leading the Way

- Costa Rica: goal to be **carbon neutral** by 2030
 - Norway: aims to be carbon neutral by 2050
 - China and India must change energy habits
 - U.S. cities and states taking initiatives to reduce carbon emissions
-

Case Study: Reducing Greenhouse Gas Emissions in California

- Use of energy-efficient appliances and buildings
 - Incentives for consumers to use less energy
 - Why is California suing the federal government?
-

Some Companies and Schools Are Reducing Their Carbon Footprints (1)

- Major global companies reducing greenhouse gas emissions
 - Alcoa
 - DuPont
 - IBM
 - Toyota
 - GE
 - Wal-Mart
 - Fluorescent light bulbs
 - Auxiliary power units on truck fleets
-

Some Companies and Schools Are Reducing Their Carbon Footprints (2)

- Colleges and universities reducing greenhouse gas emissions
 - Oberlin College, Ohio, U.S.
 - 25 Colleges in Pennsylvania, U.S.
 - Yale University, CT, U.S.
 - What is your carbon footprint?
 - What can you do?
-

What Can You Do? Reducing CO₂ Emissions

WHAT CAN YOU DO?

Reducing CO₂ Emissions

- Drive a fuel-efficient car, walk, bike, carpool, and use mass transit
- Use energy-efficient windows
- Use energy-efficient appliances and lights
- Heavily insulate your house and seal all air leaks
- Reduce garbage by recycling and reusing more items
- Insulate your hot water heater
- Use compact fluorescent lightbulbs
- Plant trees to shade your house during summer
- Set your water heater no higher than 49°C (120°F)
- Wash laundry in warm or cold water
- Use a low-flow showerhead
- Buy products from, or invest in, companies that are trying to reduce their impact on climate

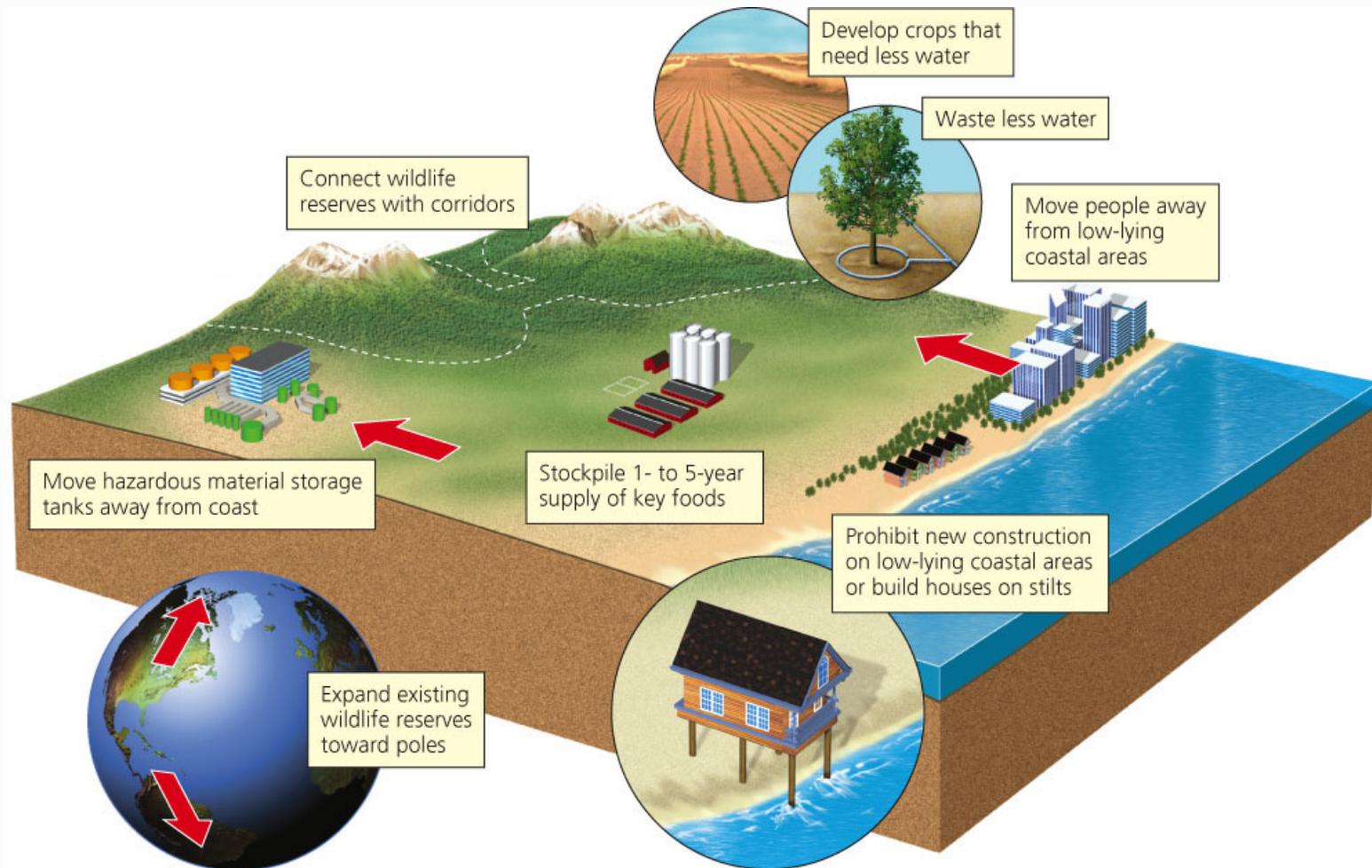
We Can Prepare for the Harmful Effects of Climate Change (1)

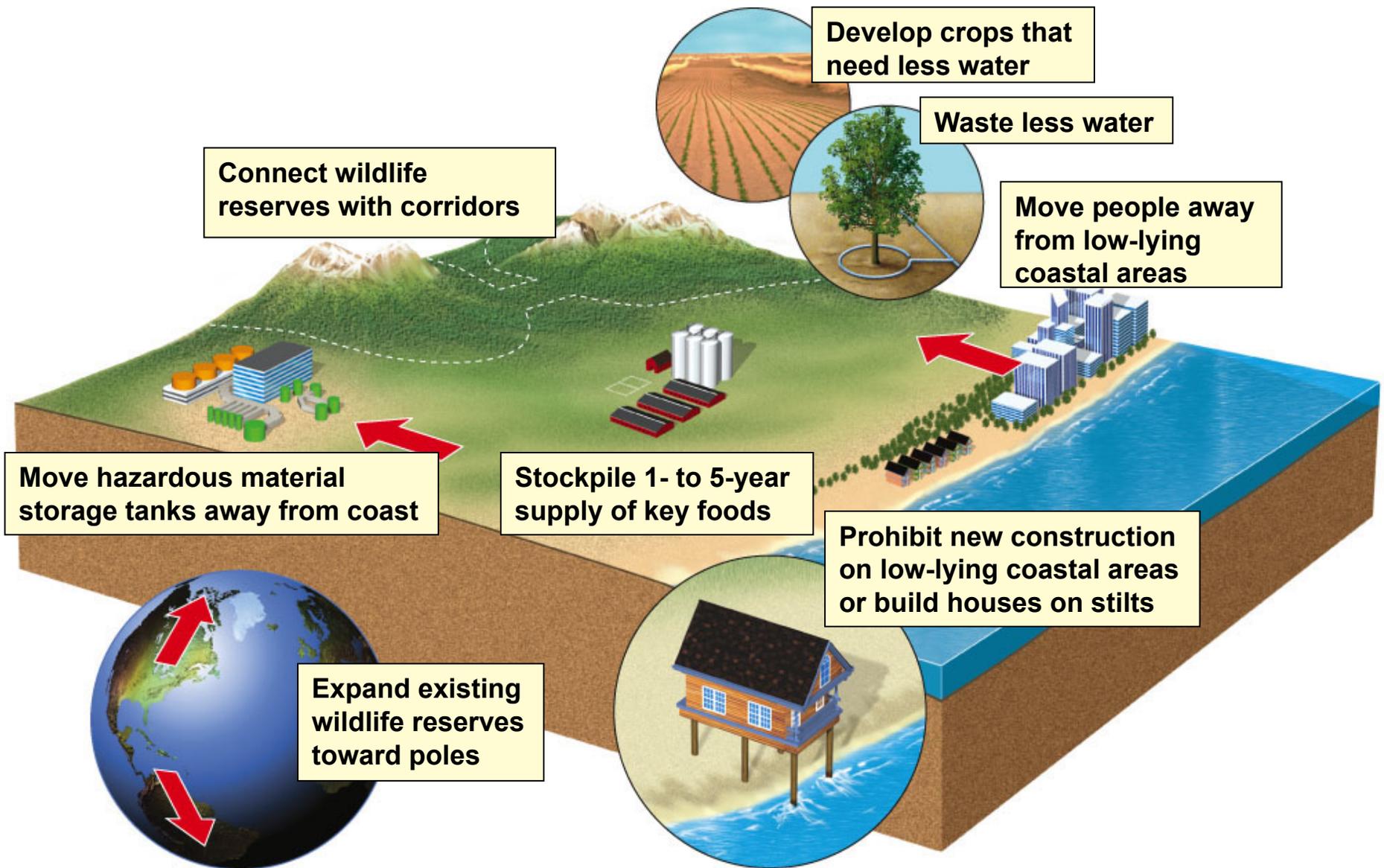
- Reduce greenhouse gas emissions as much as possible
 - Move people from low-lying coastal areas
 - Limit coastal building
 - Remove hazardous material storage tanks away from the coast
-

We Can Prepare for the Harmful Effects of Climate Change (2)

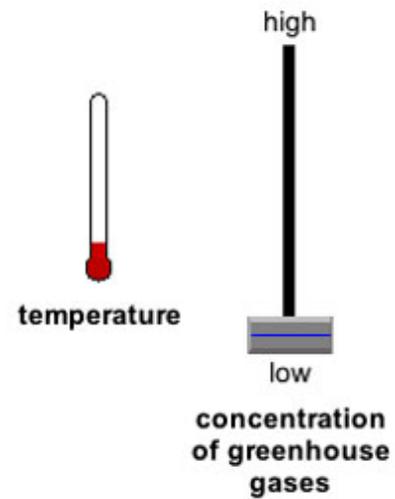
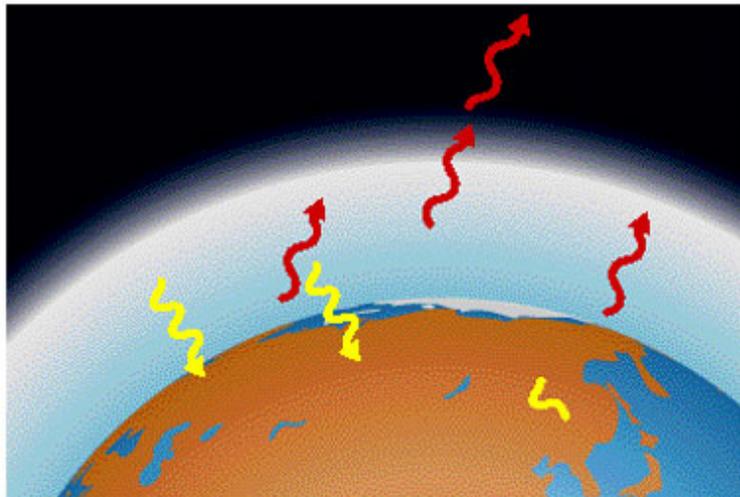
- Genetically engineer crops more tolerant to drought
 - Stockpile 1–5 years of key foods
 - Waste less water
 - Connect wildlife reserves with corridors
-

Ways to Prepare for the Possible Long-Term Harmful Effects of Climate Change

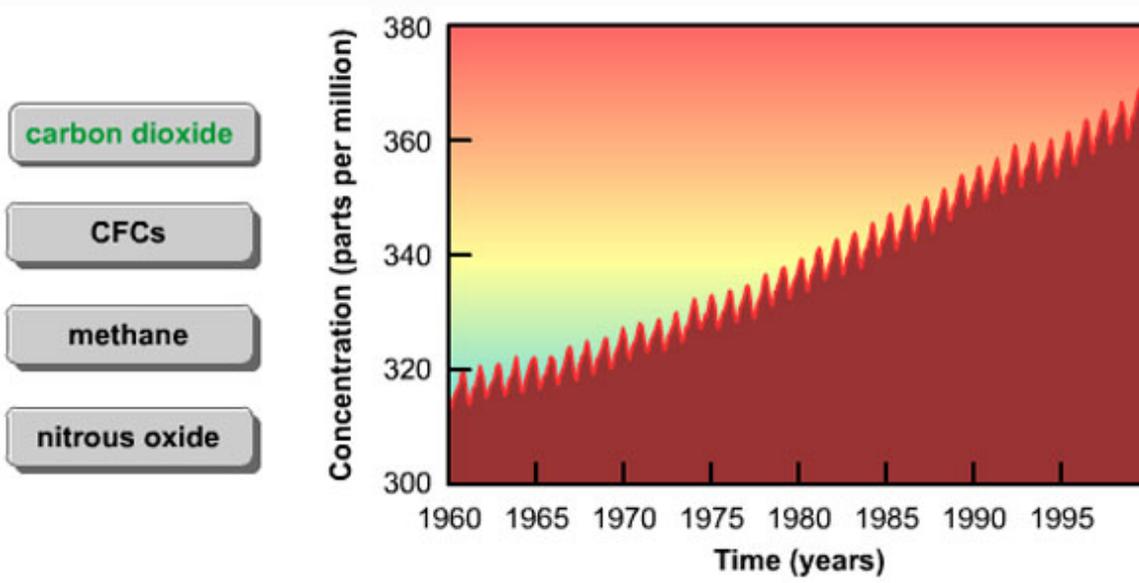




Animation: Greenhouse effect



Animation: Increasing greenhouse gases



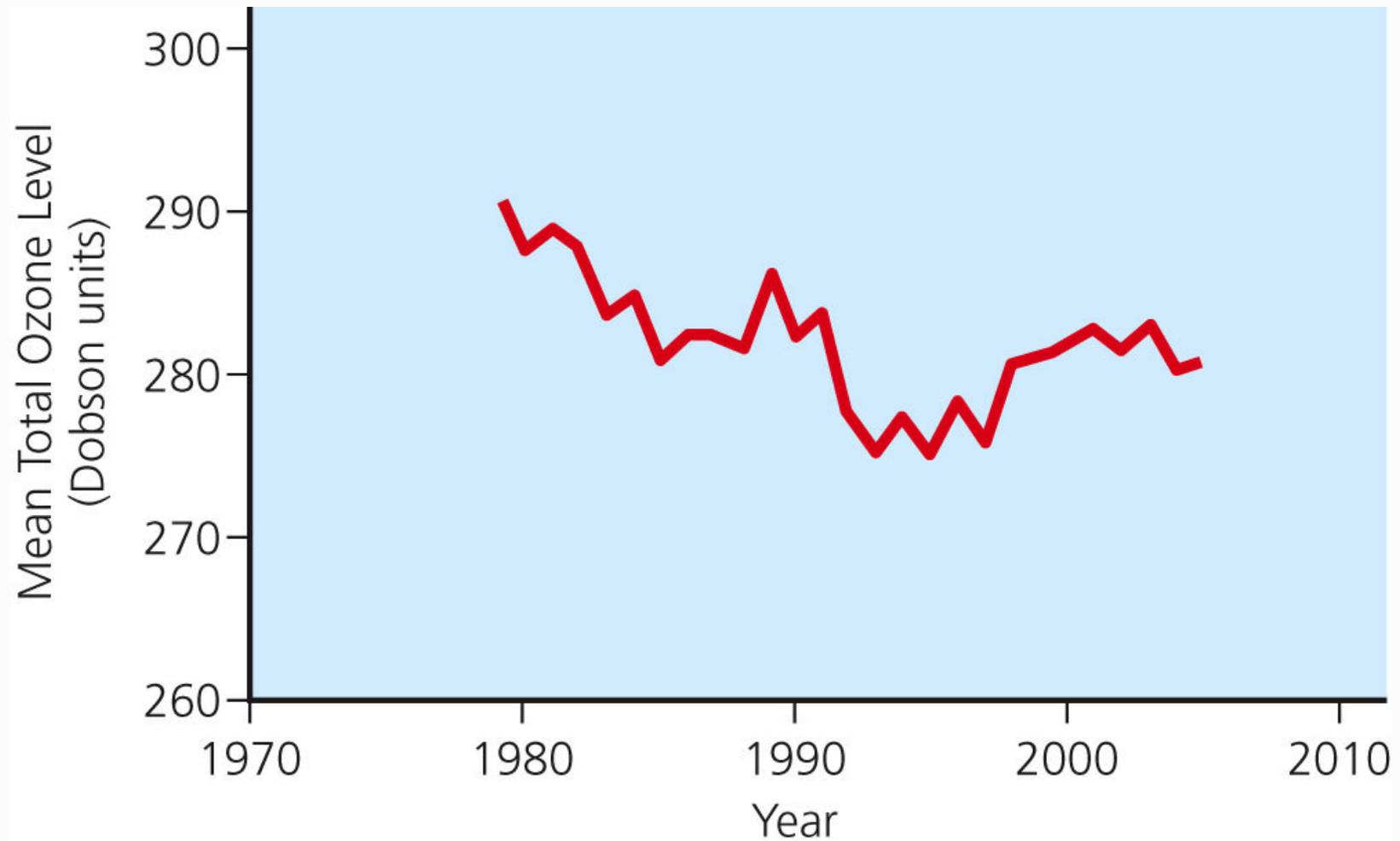
19-4 How Have We Depleted O₃ in the Stratosphere and What Can We Do?

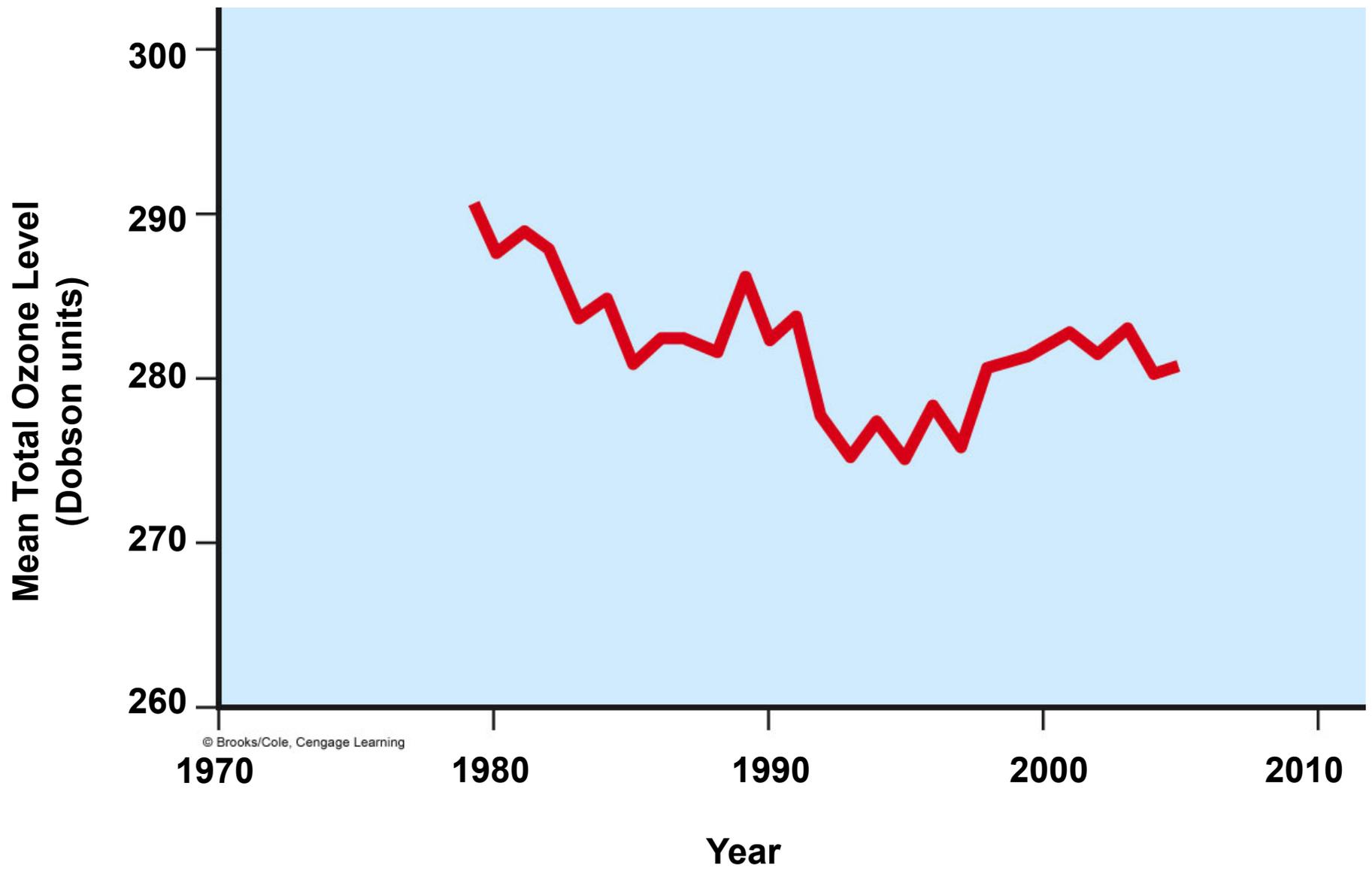
- **Concept 19-4A** *Widespread use of certain chemicals has reduced ozone levels in the stratosphere, which allows for more harmful ultraviolet radiation to reach the earth's surface.*
 - **Concept 19-4B** *To reverse ozone depletion, we must stop producing ozone-depleting chemicals and adhere to the international treaties that ban such chemicals.*
-

Our Use of Certain Chemicals Threatens the Ozone Layer

- **Ozone Thinning**
 - Seasonal depletion in the stratosphere
 - Antarctica and Arctic
 - 1930: Midgely
 - Discovered the first CFC
 - 1984: Rowland and Molina
 - CFCs were depleting O₃
 - Other ozone-depleting chemicals
-

Global Average Total Ozone Values in the Stratosphere from 1979–2005

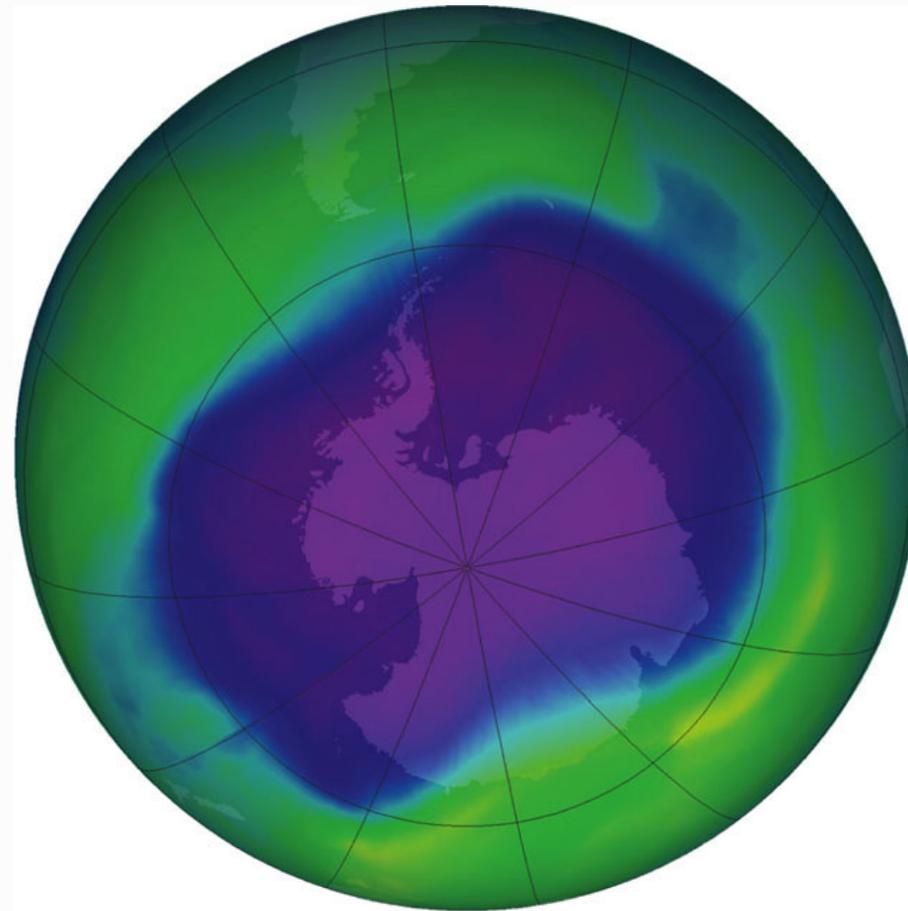




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Fig. 19-18, p. 523

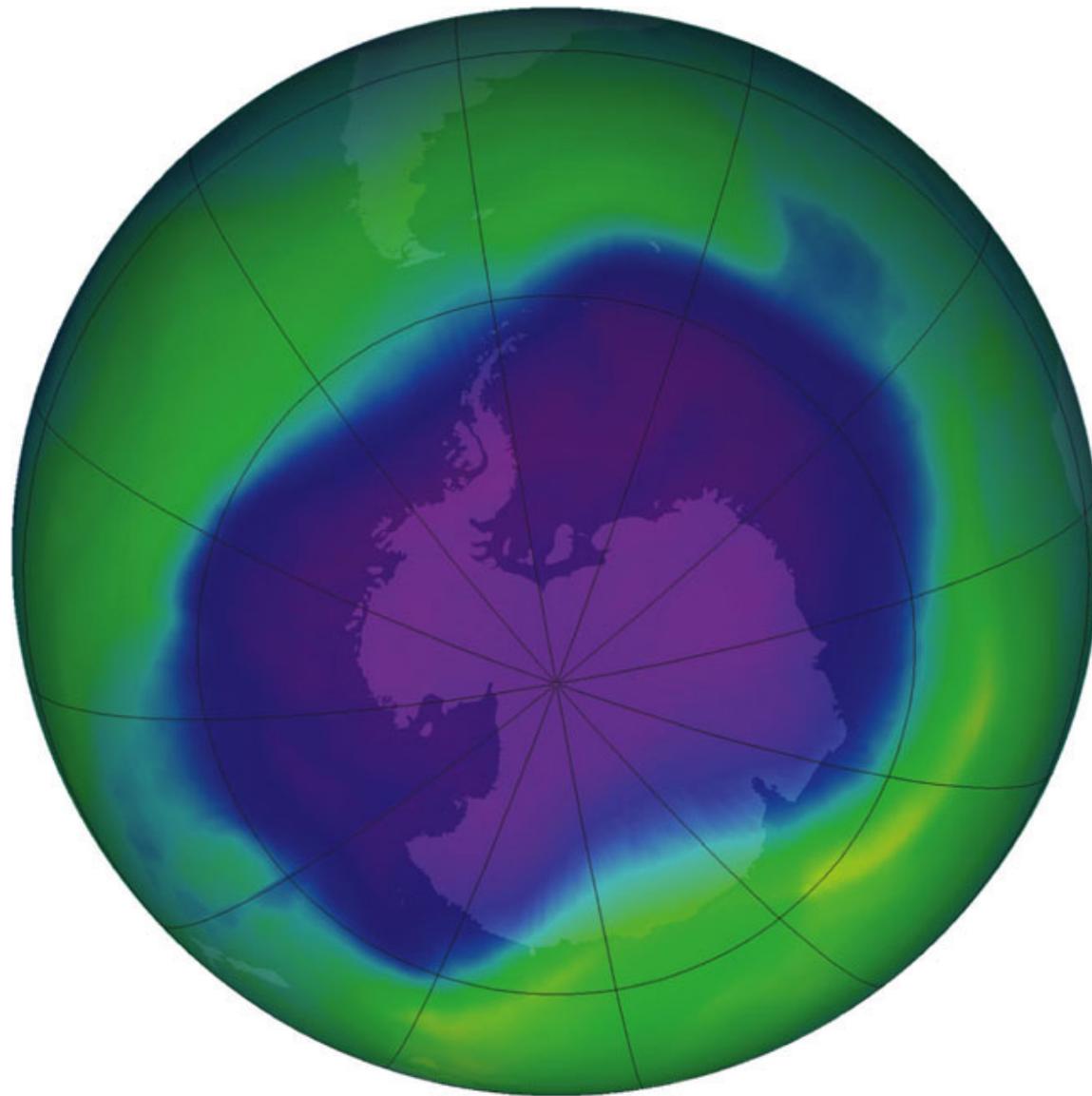
Natural Capital Degradation: Massive Ozone Thinning over Antarctica in 2007



Total ozone (Dobson units)



© Brooks/Cole, Cengage Learning



Total ozone (Dobson units)



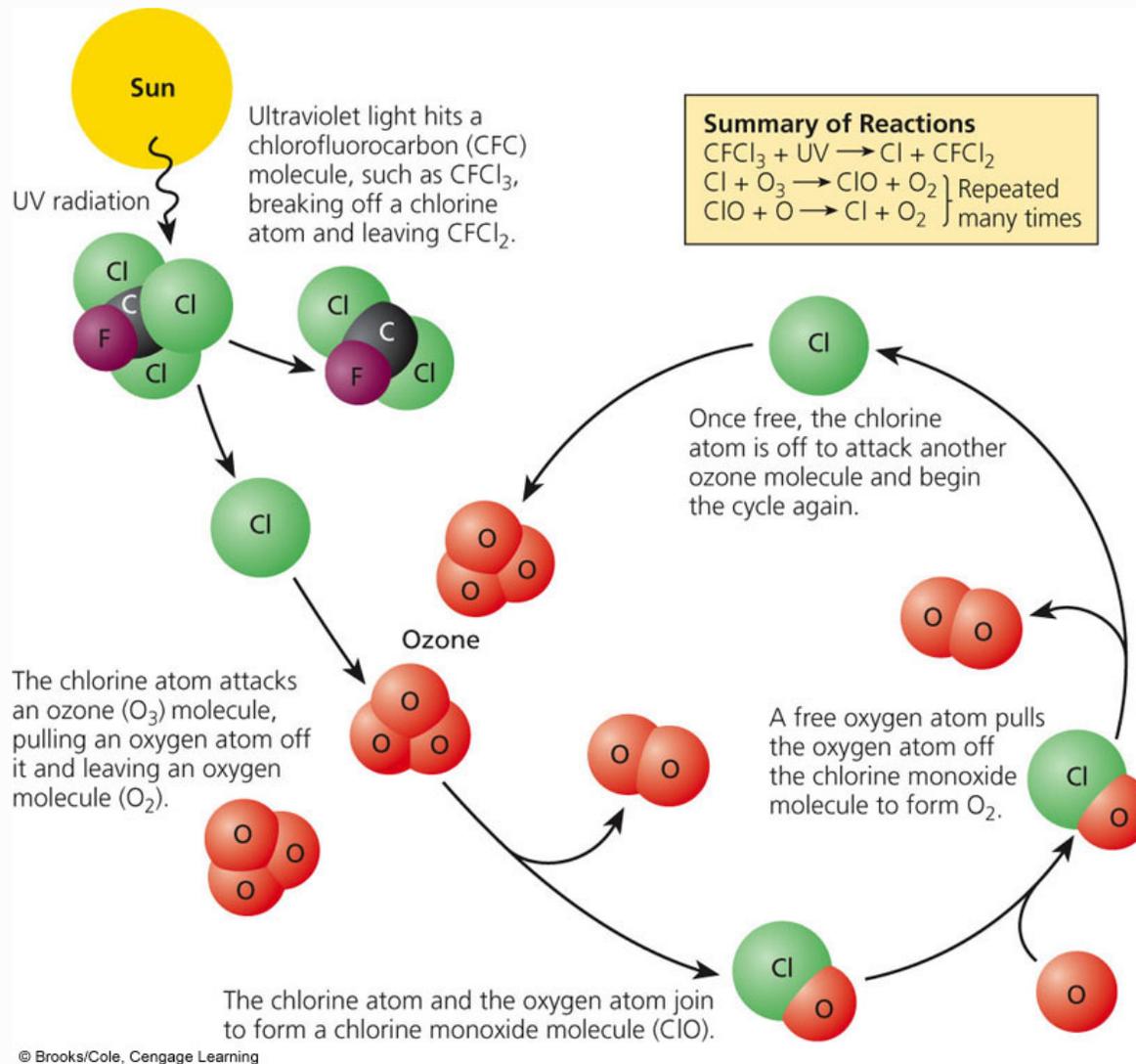
© Brooks/Cole, Cengage Learning

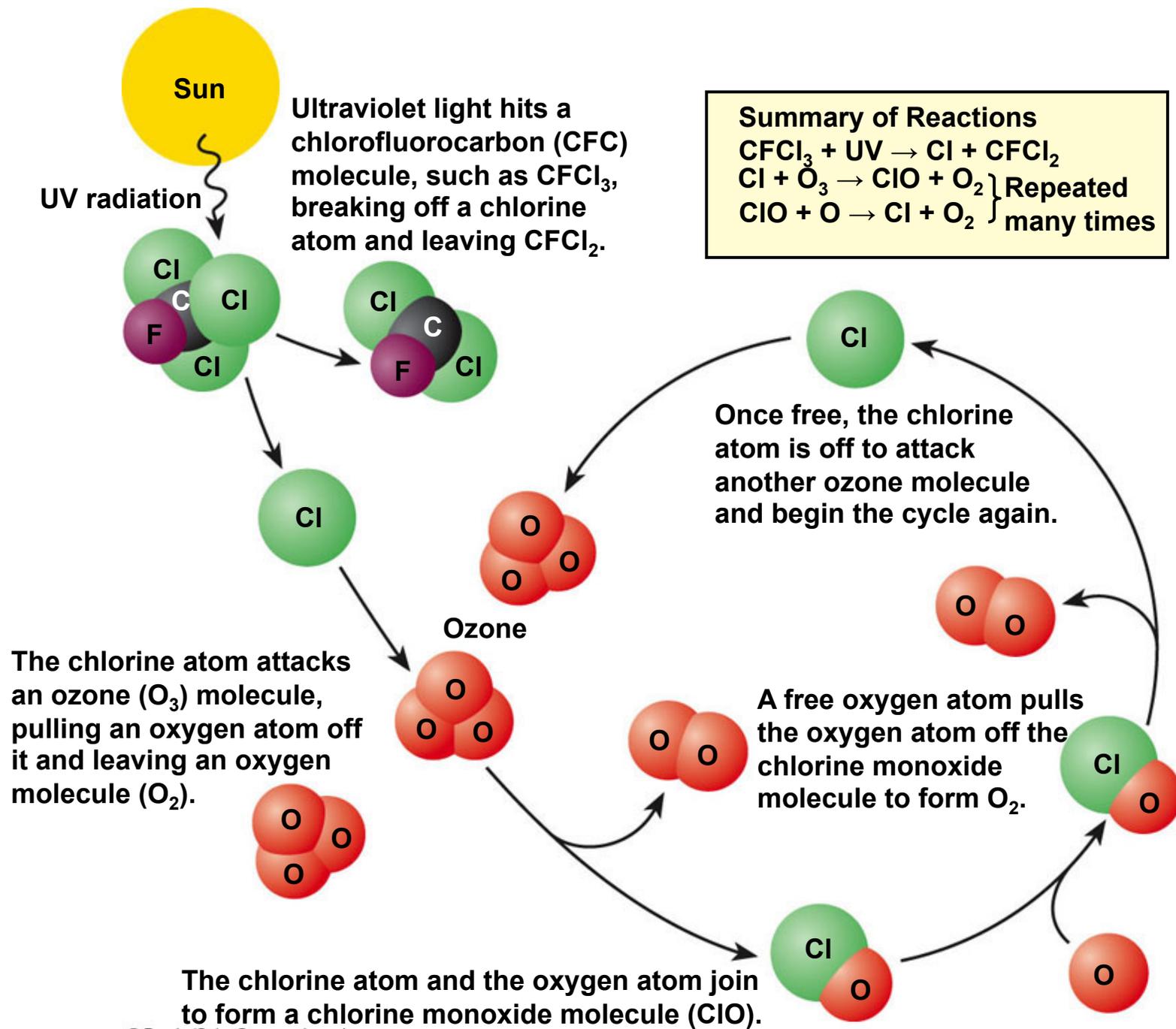
Fig. 19-19, p. 524

Science Focus: Rowland and Moline—A Scientific Story of Courage and Persistence

- Research
 - CFCs are persistent in the atmosphere
 - Rise into the stratosphere over 11-20 years
 - Break down under high-energy UV radiation
 - Halogens produced accelerate the breakdown of O_3 to O_2
 - Each CFC molecule can last 65-385 years
 - 1988: Dupont stopped producing CFCs
 - 1995: Nobel Prize in chemistry
-

Summary of CFCs and Other Chlorine-Containing Compounds that Destroy Ozone





Why Should We Worry about Ozone Depletion?

- Damaging UV-A and UV-B radiation
 - Increase eye cataracts and skin cancer
 - Impair or destroy phytoplankton
 - Significance?
-

Natural Capital Degradation: Effects of Ozone Depletion

NATURAL CAPITAL DEGRADATION

Effects of Ozone Depletion

Human Health

- Worse sunburns
- More eye cataracts
- More skin cancers
- Immune system suppression

Food and Forests

- Reduced yields for some crops
- Reduced seafood supplies from reduced phytoplankton
- Decreased forest productivity for UV-sensitive tree species

Wildlife

- Increased eye cataracts in some species
- Decreased populations of aquatic species sensitive to UV radiation
- Reduced populations of surface phytoplankton
- Disrupted aquatic food webs from reduced phytoplankton

Air Pollution and Materials

- Increased acid deposition
- Increased photochemical smog
- Degradation of outdoor paints and plastics

Global Warming

- While in troposphere, CFCs act as greenhouse gases

NATURAL CAPITAL DEGRADATION

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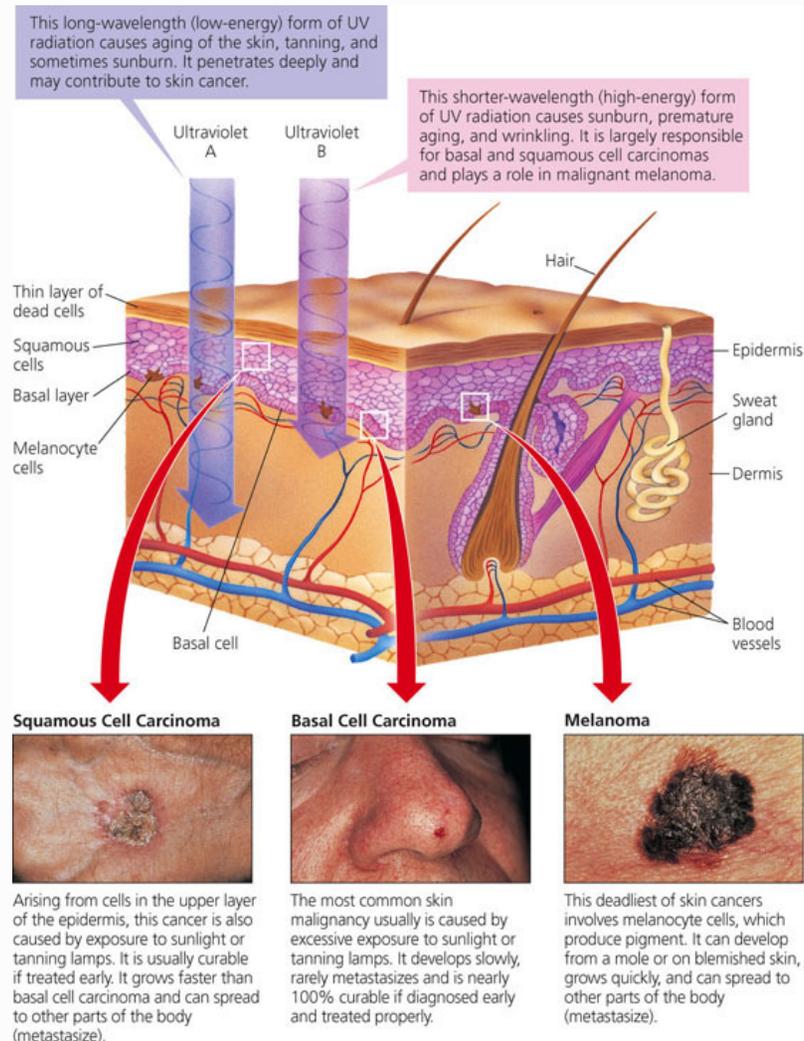
Stepped Art

Fig. 19-20, p. 524

Science Focus: Skin Cancer

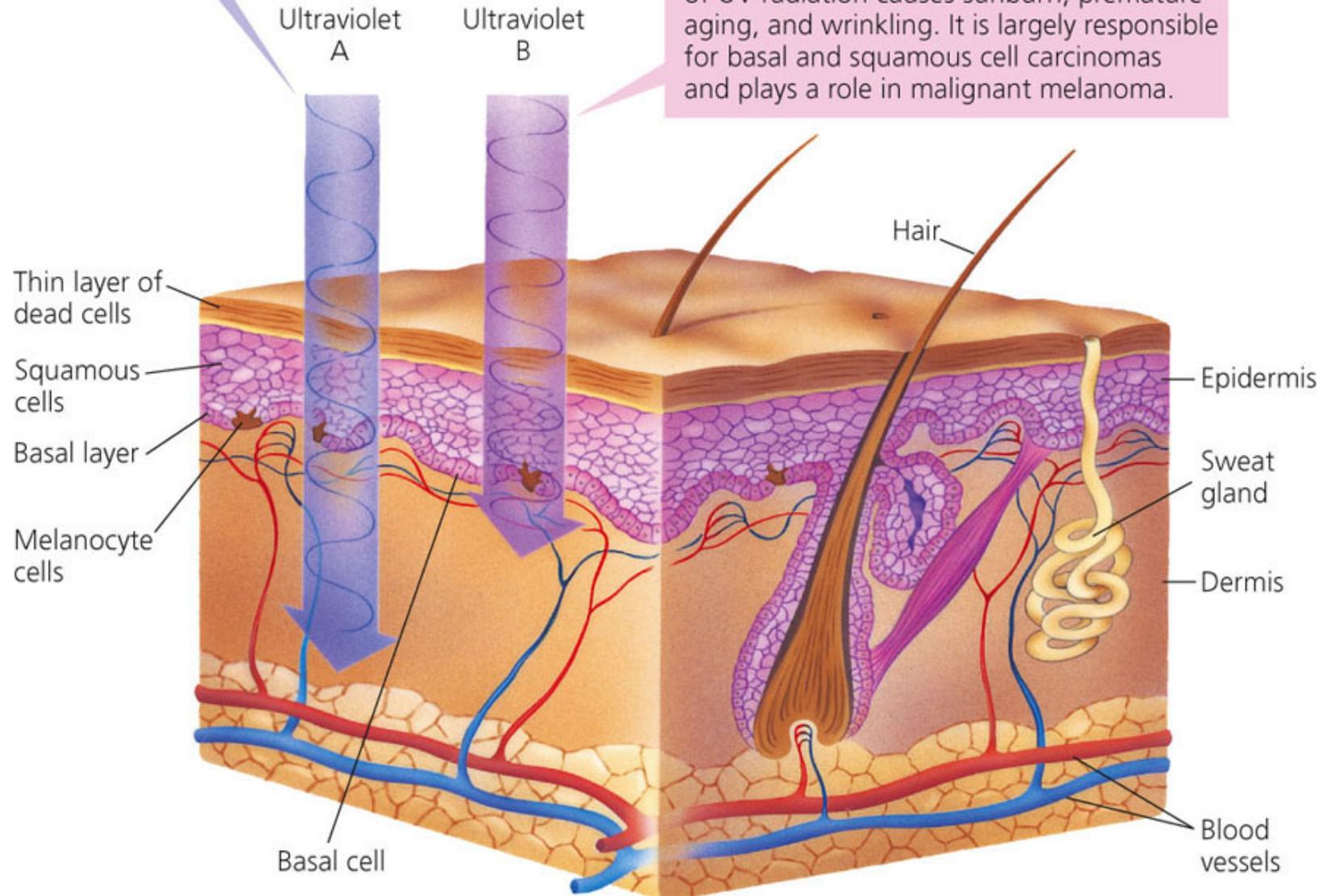
- **Squamous cell carcinoma**
 - **Basal cell carcinoma**
 - **Melanoma**
 - Effect of UV-B radiation
 - How safe are tanning salons?
-

Structure of the Human Skin and the Relationship between UV and Skin Cancer



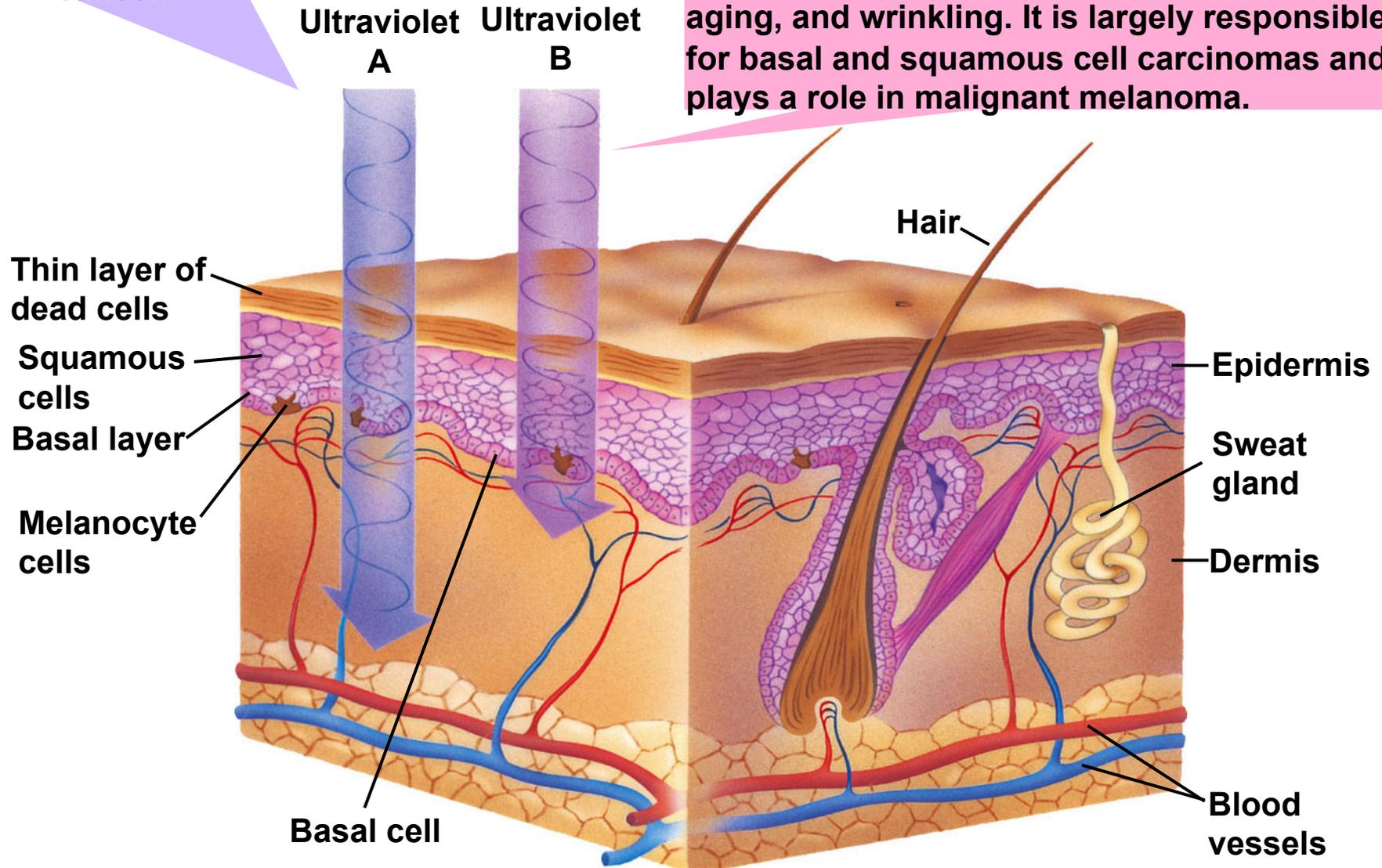
This long-wavelength (low-energy) form of UV radiation causes aging of the skin, tanning, and sometimes sunburn. It penetrates deeply and may contribute to skin cancer.

This shorter-wavelength (high-energy) form of UV radiation causes sunburn, premature aging, and wrinkling. It is largely responsible for basal and squamous cell carcinomas and plays a role in malignant melanoma.



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Squamous Cell Carcinoma



Arising from cells in the upper layer of the epidermis, this cancer is also caused by exposure to sunlight or tanning lamps. It is usually curable if treated early. It grows faster than basal cell carcinoma and can spread to other parts of the body (metastasize).

Basal Cell Carcinoma



The most common skin malignancy usually is caused by excessive exposure to sunlight or tanning lamps. It develops slowly, rarely metastasizes and is nearly 100% curable if diagnosed early and treated properly.

Melanoma



This deadliest of skin cancers involves melanocyte cells, which produce pigment. It can develop from a mole or on blemished skin, grows quickly, and can spread to other parts of the body (metastasize).

Squamous Cell Carcinoma



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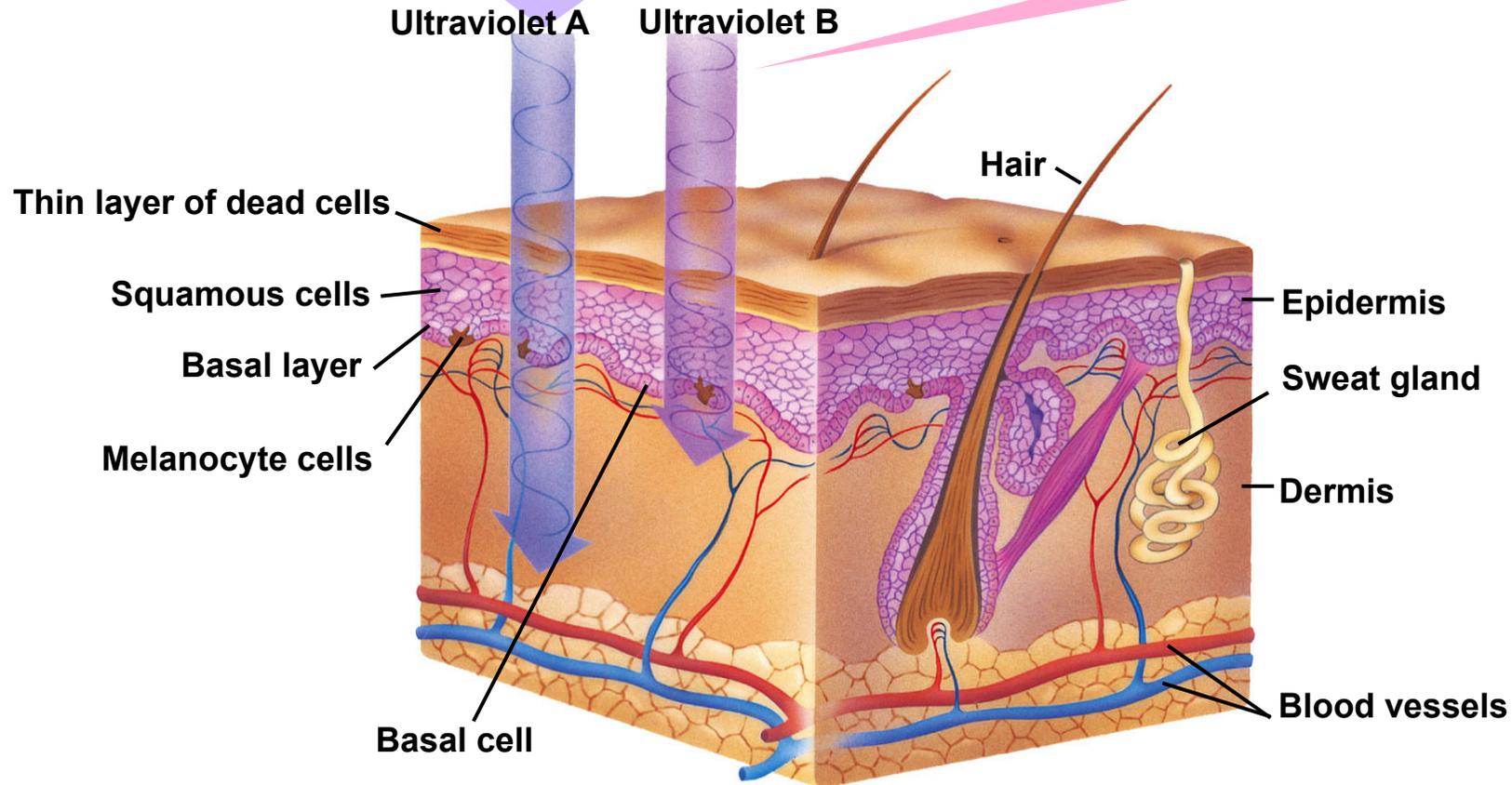
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Squamous Cell Carcinoma



Basal Cell Carcinoma



Melanoma



Stepped Art

Fig. 19-E, p. 526

What Can You Do? Reducing Exposure to UV Radiation

WHAT CAN YOU DO?

Reducing Exposure to UV Radiation

- Stay out of the sun, especially between 10 A.M. and 3 P.M.
- Do not use tanning parlors or sunlamps.
- When in the sun, wear protective clothing and sunglasses that protect against UV-A and UV-B radiation.
- Be aware that overcast skies do not protect you.
- Do not expose yourself to the sun if you are taking antibiotics or birth control pills.
- When in the sun, use a sunscreen with a protection factor of at least 15.
- Examine your skin and scalp at least once a month for moles or warts that change in size, shape, or color and sores that keep oozing, bleeding, and crusting over. If you observe any of these signs, consult a doctor immediately.

We Can Reverse Stratospheric Ozone Depletion (1)

- Stop producing all ozone-depleting chemicals
 - 60–100 years of recovery of the O₃ layer
 - 1987: Montreal Protocol
 - 1992: Copenhagen Protocol
 - Ozone protocols: prevention is the key
-

We Can Reverse Stratospheric Ozone Depletion (2)

- Substitutes for CFCs are available
 - More are being developed
 - HCFC-22
 - Substitute chemical
 - May still be causing ozone depletion
-

Animation: How CFCs destroy ozone

