AP Environmental Science

Unit Six

Impacts of Population Growth (Part Two)

I. Urbanization

Urbanization

Overview

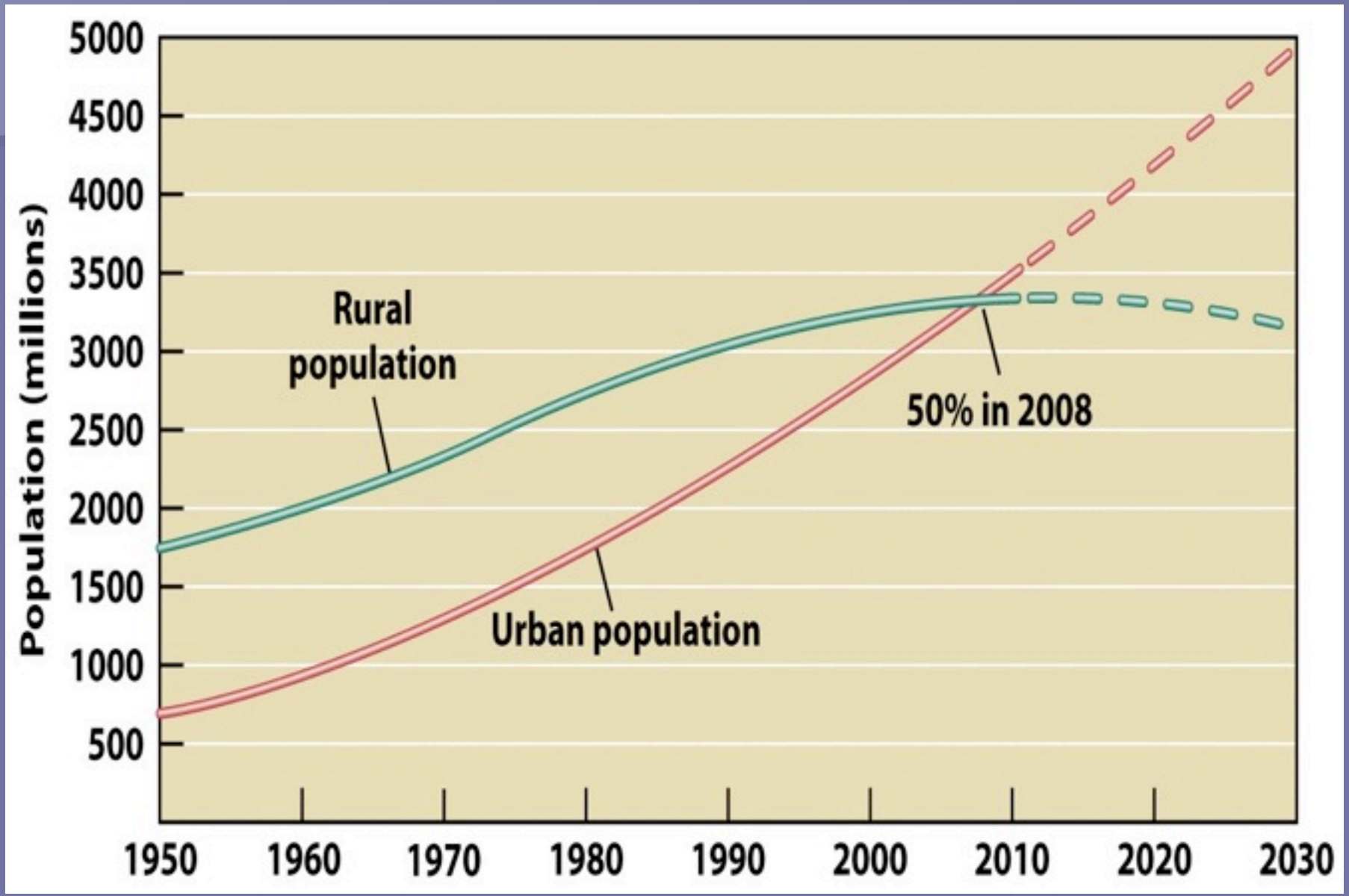
- Population and Urbanization
  - Characteristics of Urban Population
  - Urbanization Trends
- City as an Ecosystem
  - Environmental Problems in Urban Areas
  - Environmental Benefits of Urbanization
- Urban Land Use Planning
  - Transportation and Urban Development
  - Suburban Sprawl
- Making Cities More Sustainable

population and urbanization

Population and Urbanization

- Historically most people by far have lived in rural settings
- Urbanization really takes off after industrial revolution
- Milestone: As of 2008, half of the world's population lives in urban areas

Population and Urbanization



Population and Urbanization

- Urbanization
  - Process in which people increasingly move from rural areas to densely population cities
- Jobs define urban vs. rural, not populations
  - Rural area occupations involve harvesting natural resources
  - Urban area occupations involve jobs not connected with natural resources
- People are moving to cities due to decrease in employment opportunities in rural areas

Population and Urbanization

- People are moving to cities for a variety of factors, the most common is a decrease in employment opportunities in rural areas
- Push Factors- conditions in the place of origin which are perceived by migrants as detrimental to their well-being or economic security
  - Examples:high unemployment and political persecution
- Pull Factors- the circumstances in new places that attract individuals to move there
  - Examples:job opportunities or moving to a better climate

Characteristics of Urban Population

- Basic characteristics of city populations:
  - Diverse population in terms of race, ethnicity, religion and socioeconomic status
  - Younger population than local rural area
  - More males in developing nation cities
  - More females in developed nation cities

Urbanization Trends

- Urbanization is increasing rapidly
  - Especially in developing countries
- World's 10 largest cities are in developing countries

Table 10.1 The World's 10 Largest Cities

1975	*2005*	*2015*
Tokyo, Japan, 26.6*	Tokyo, Japan, 35.2	Tokyo, Japan, 35.5
New York, USA 15.9	Mexico City, Mexico, 19.4	Mumbai (Bombay), India, 21.9
Mexico City, Mexico, 10.7	New York, USA, 18.7	Mexico City, Mexico, 21.6
Osaka-Kobe, Japan, 9.8	São Paulo, Brazil, 18.3	São Paulo, Brazil, 20.5
São Paulo, Brazil, 9.6	Mumbai (Bombay), India, 18.2	New York, USA, 19.9
Los Angeles, USA, 8.9	Delhi, India, 15.0	Delhi, India, 18.6
Buenos Aires, Argentina, 8.7	Shanghai, China, 14.5	Shanghai, China, 17.2
Paris, France, 8.6	Kolkata (Calcutta), India, 14.3	Kolkata (Calcutta), India, 17.0
Kolkata (Calcutta), India, 7.9	Jakarta, Indonesia, 13.2	Dhaka, Bangladesh, 16.8
Moscow, Russian Federation, 7.6	Buenos Aires, Argentina, 12.6	Jakarta, Indonesia, 16.8

*Population in millions.
Source: United Nations Population Division, Urban Agglomerations, 2005

Urbanization Trends

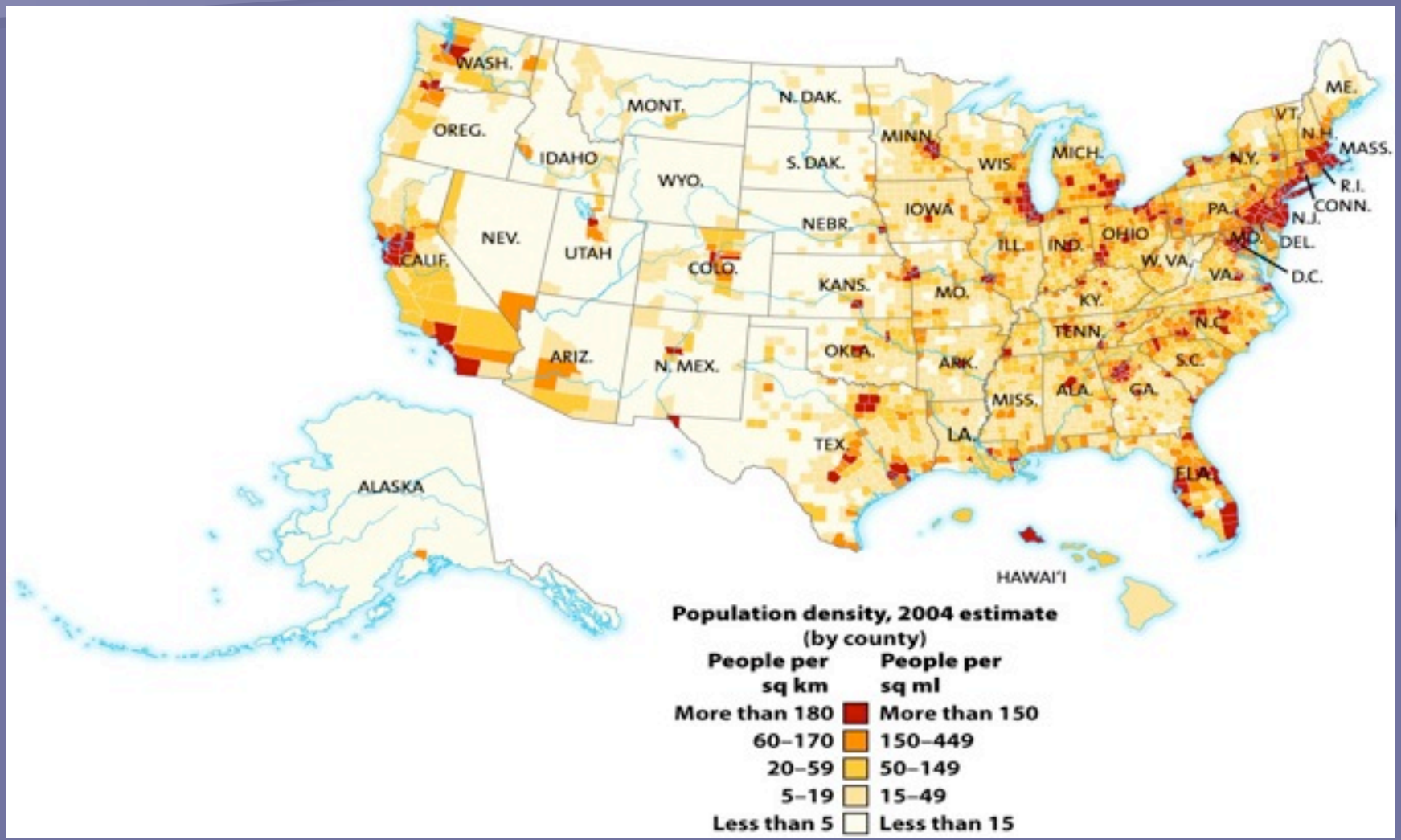
- Urban Agglomeration
  - Urbanized core region that consists of several adjunct cities or megacities and their surrounding developed suburbs
  - Megacity = 10 million or more

United States Urban Agglomerations

(Population of 50,000 or above)

Urbanization Trends

- Urban Agglomeration



Substandard Housing

- Typically occupied by squatters
- No city services
  - Water, sewage, garbage collection, police and fire protection
- 1/3 of urban population in developing countries are squatters

city as a ecosystem

City as an Ecosystem

- Urban Ecosystem: A heterogeneous, studied in the context of a broader ecological system
- Studied based on four variables: POET
  - Population
  - Organization
  - Environment
  - Technology

Cities are dynamic open systems

Natural capital (inputs)

- Energy (fuel)
- Clean water
- Clean air
- Food
- Raw and refined materials for construction and industry
- Business and consumer products

Products and wastes (outputs)

- Waste heat, greenhouse gases
- Wastewater, water pollution
- Air pollution
- Solid waste
- Goods, services

Environmental Problems in Urban Areas

- Main problem that major U.S. cities face is the loss of Tax Dollars and Jobs to the suburbs
- Growing urban areas affect land use patterns
  - Fragment wildlife
  - Encroach wetlands, forests, desert, etc.

Environmental Problems in Urban Areas

- Impermeable surfaces and urban runoff discharged into waterways
  - Motor oil, lawn fertilizers, heavy metals
- Noise pollution

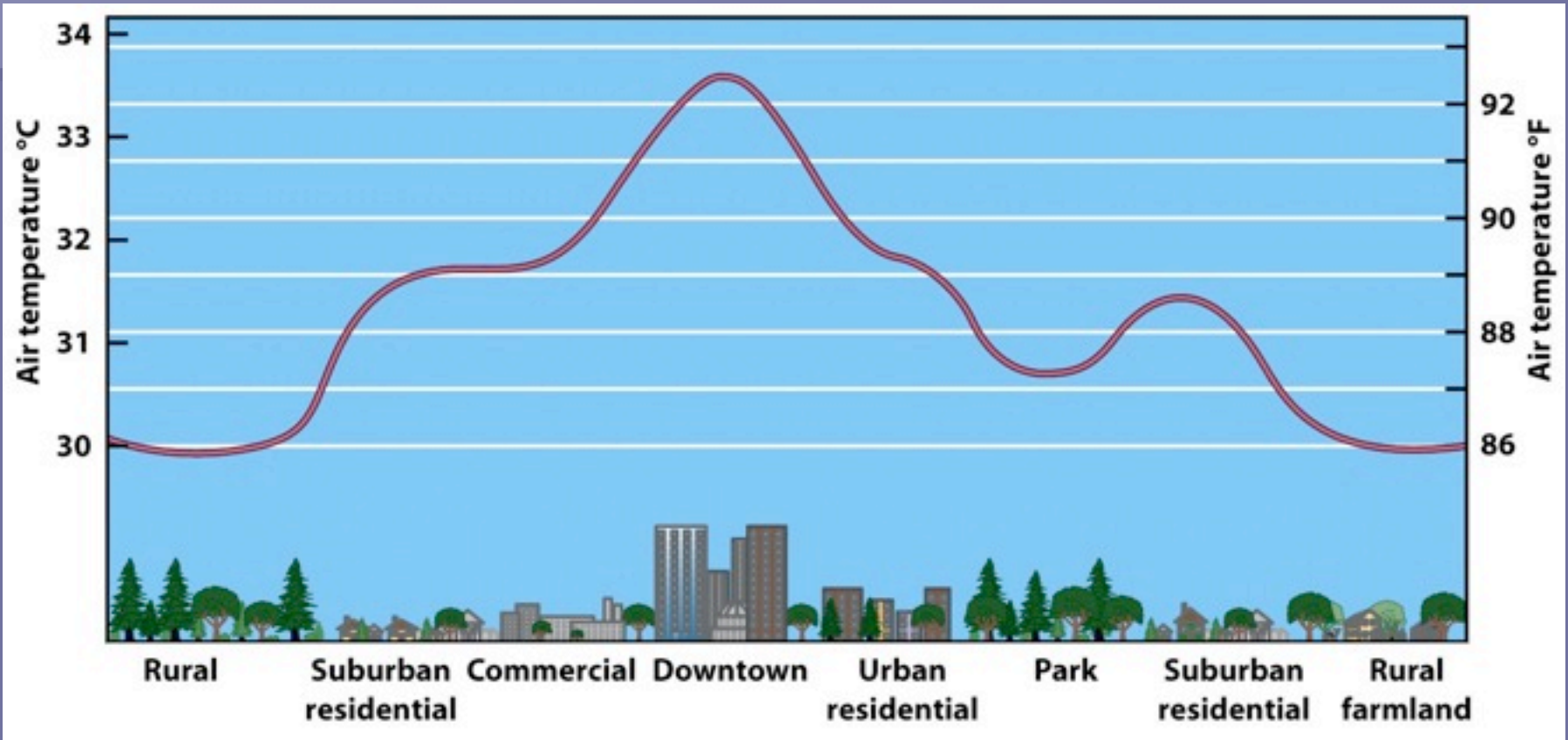
Environmental Problems in Urban Areas

- Brownfields
  - Urban areas of abandoned industrial or residential sites that may be contaminated from past use

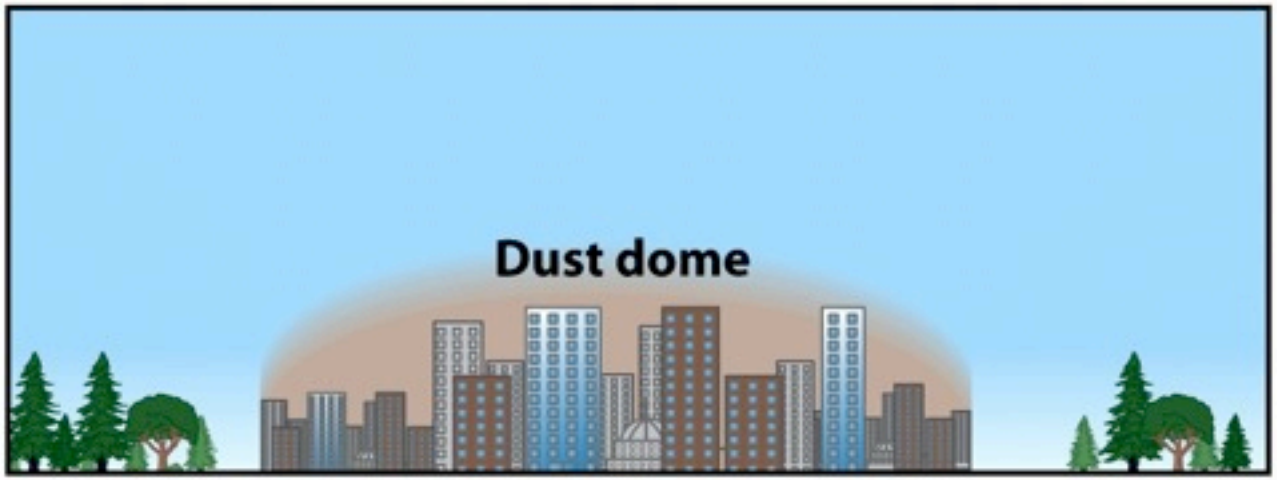
Environmental Problems in Urban Areas

- Long commutes
  - Buildup of emissions due to cars and industry
- Urban heat island
  - Local heat buildup in an area of high population density
  - Affect local air currents and weather conditions
  - Contribute to buildup of pollutants- dust domes

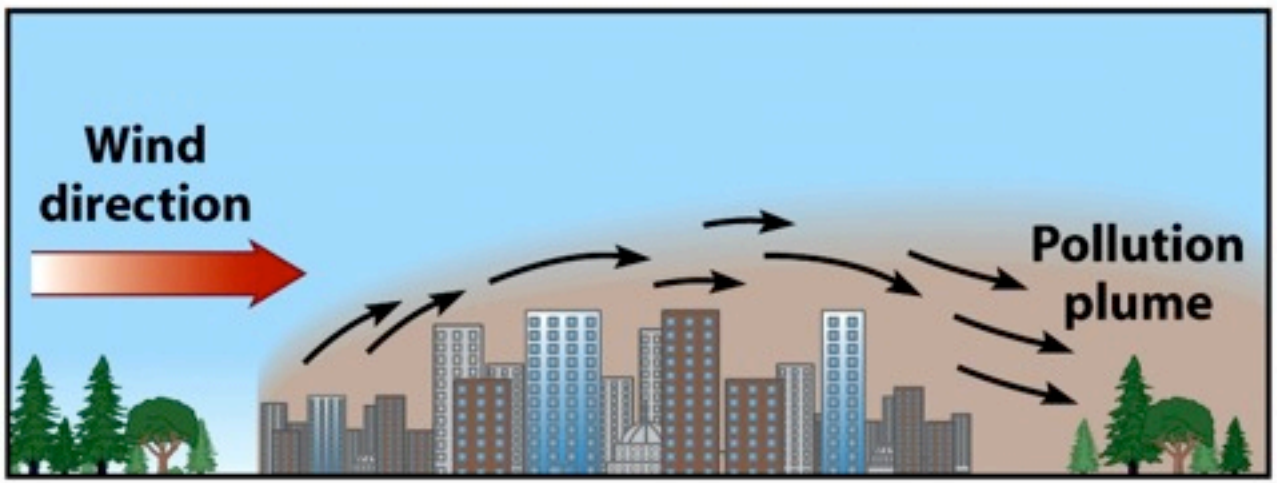
Urban Heat Island



Temperature variations on a summer afternoon



(a) A dust dome of pollutants forms over a city when the air is somewhat calm and stable.



(b) When wind speeds increase, the pollutants move downwind from the city.

Environmental Benefits of Urbanization

- Well-planned city can benefit the environment
  - Reduces pollution
  - Preserves rural areas
- Compact Development
  - Design of cities where residential buildings are close to shopping, jobs and public transportation

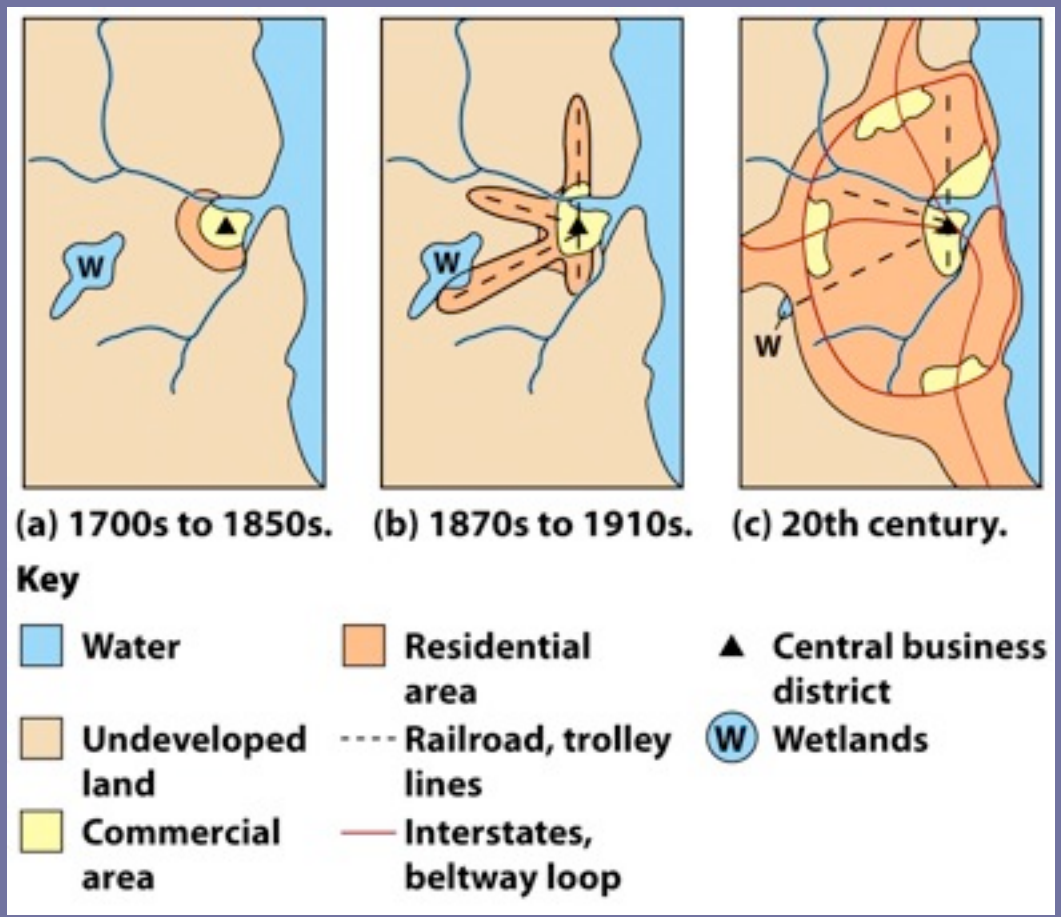
urban land use and planning

Urban Land Use Planning

- Process of deciding the best use for undeveloped land in a given area
- Based on economic concerns
- Influenced by political and economic factors
- Regulated through zoning
  - Commercial
  - Residential
  - Industrial
  - Property owners must meet zoning ordinances

Transportation and Urban Development

- Transportation availability affects city's spatial structure
- Ex: An east coast US city
  - (a) 1700-1850
  - (b) 1850-1910
  - (c) 20th century



Suburbs

- Consists of house lots and streets
- Consists of identical land parcels with no open spaces
- Consists of single family detached homes
- Force long commutes to/from work

Suburbs

- Do not facilitate social interactions
- Does provide affordable housing for minorities
- Lacks a sense of community and identity
- Lacks artistic and cultural opportunities
- Requires the use of car(s)

Suburban Sprawl

- Suburban Sprawl
  - Patchwork of vacant and developed tracts around the edges of cities
- Problems
  - Loss of wetlands
  - Air & water pollution
  - Loss of biological habitat

Suburban Sprawl

- Smart Growth: urban planning and transportation strategy that mixes land uses
  - Commercial
  - Manufacturing
  - Entertainment
  - Housing
- At least 11 states currently using these management laws

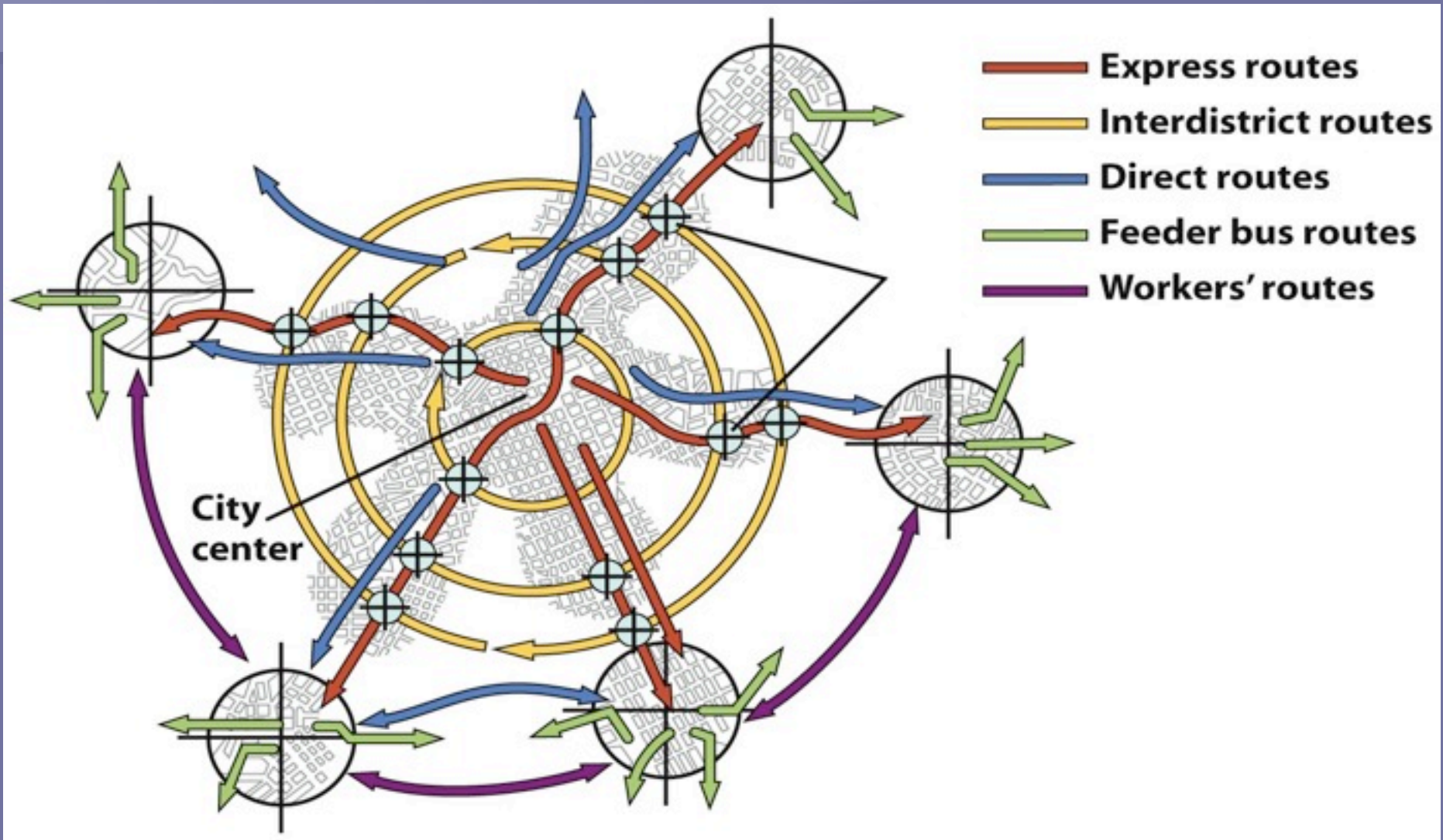
making cities more sustainable

Making Cities More Sustainable

- Characteristics of a sustainable city
  - Clear, cohesive urban growth policies
  - Efficient use of energy and other resources
  - Reduction of pollution and waste
  - Large areas of green space
  - Designed to be people-centers, not car-centered
  - Food grown IN the city (rooftop gardens)
  - Compact development

Copenhagen, Denmark
A People-centered City

Sustainable Cities -Curitiba, Brazil (creative solutions to environmental problems



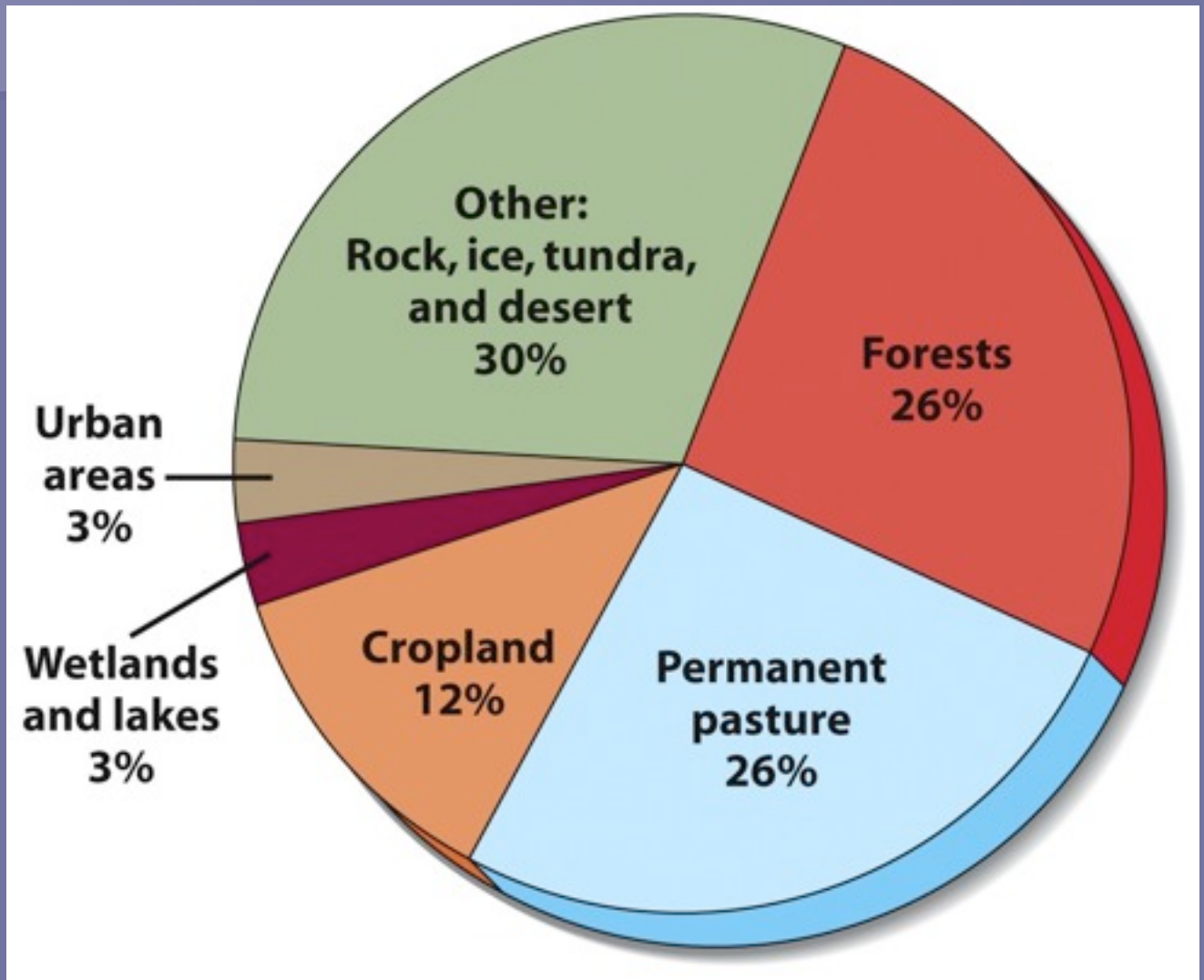
II. Land Resources

Land Resources

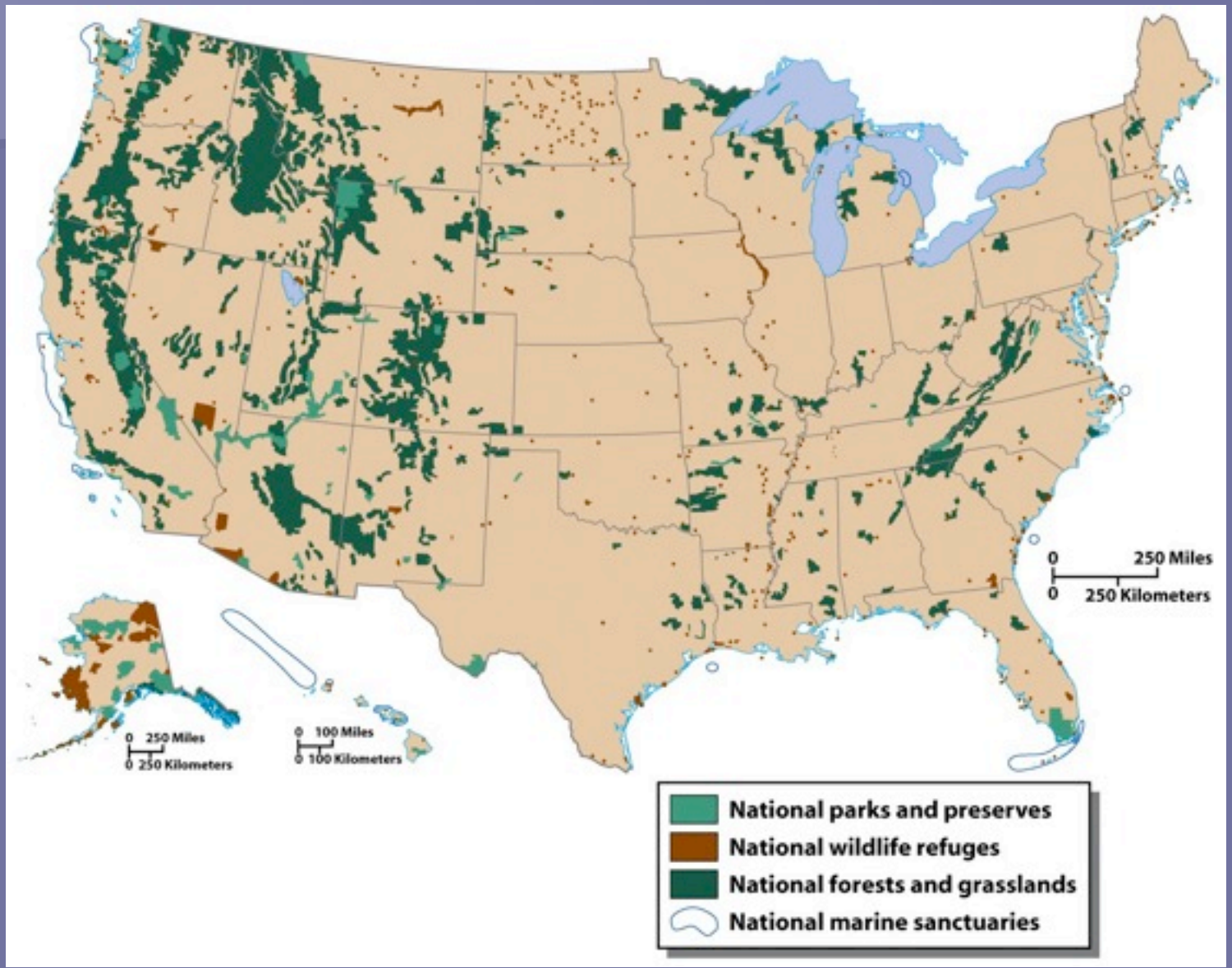
Overview of Chapter 18

- Land Use
- Wilderness Park and Wildlife Refuges
- Forests
- Rangeland and Agricultural Land
- Wetlands and Coastal Areas
- Conservation of Land Resources

Land Use - Worldwide



Land Use- United States



Land Use - United States

- 55% of US land is privately owned
- Remainder of land is owned by government
  - Most federally owned land is in Alaska and 11 western states

Table 18.1 Administration of Federal Lands

Agency	*Land Held*	*Primary Uses*	*Area in Millions of Hectares (Acres)*
Bureau of Land Management (Dept. of Interior)	National resource lands	Mining, livestock grazing, oil and natural gas extraction	109 (270)
U.S. Forest Service (Dept. of Agriculture)	National forests	Logging, recreation, conservation of watersheds, wildlife habitat, mining, livestock grazing, oil and natural gas extraction	77 (191)
U.S. Fish and Wildlife Service (Dept. of Interior)	National wildlife refuges	Wildlife habitat; also logging, hunting, fishing, mining, livestock grazing, oil and natural gas extraction	38 (95)
National Park Service (Dept. of Interior)	National Park System	Recreation, wildlife habitat	34 (84)
Other—includes Department of Defense, Corps of Engineers (Dept. of the Army), and Bureau of Reclamation (Dept. of Interior)	Remaining federal lands	Military uses, wildlife habitat	29 (72)

Source: U.S. Dept. of Interior, U.S. Dept. of Agriculture, and U.S. Dept. of Defense.

Managing Public and Private Land

- Public Planning and Land Use
  - Land use decisions are complex with multiple effects
  - Must take into account
    - All repercussions of proposed land use
    - Ecosystem services of undeveloped land
- Management of Federal Land
  - Wide-Use Movement
  - Environmental Movement

Wilderness Parks and Wildlife Refuges

- Wilderness
  - A protected area of land in which no human development is permitted
- Wilderness Act (1964)
  - Set aside federally owned land
- Managed by NPS, USFS, FWS & BLM

National Park System

- Created in 1916
- Currently includes 58 parks
- Primary goal
  - Teach people about the natural environment, management of natural resources and history of a site

Yellowstone National Park

National Park System

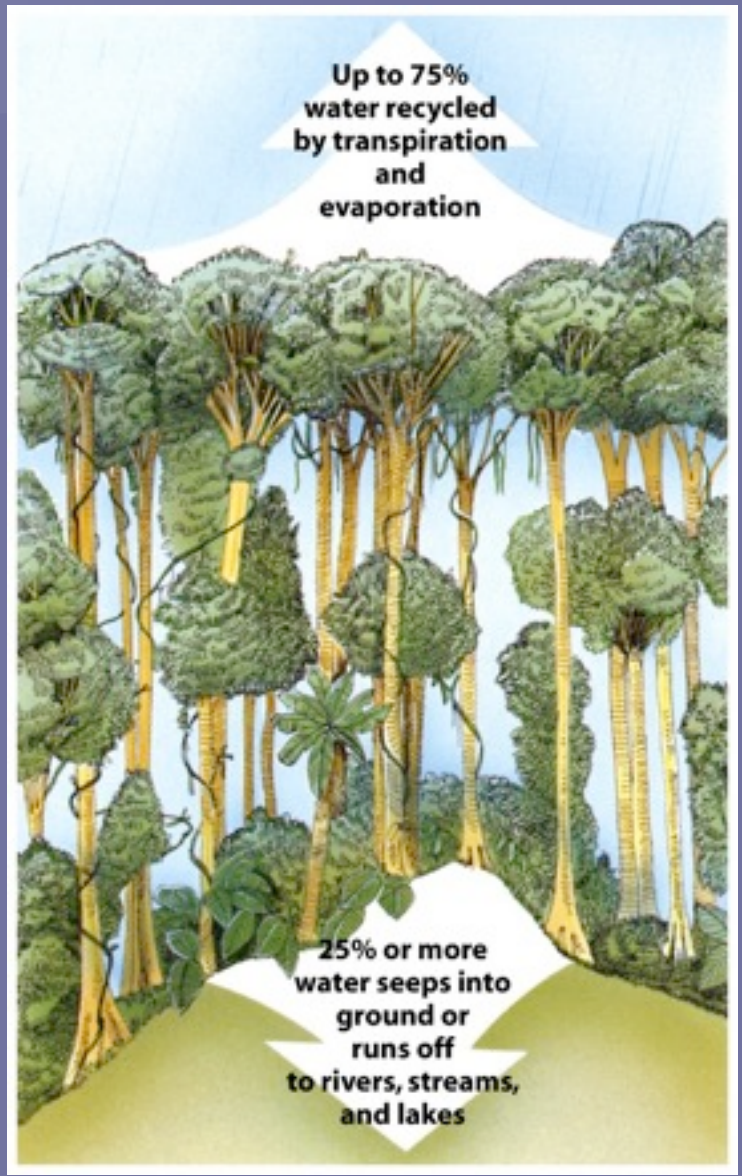
- Threats to U.S. Parks
  - Crime & Vandalism
  - Traffic jams
  - Pollution of the soil, water and air
  - Resource violations
- Natural Regulation
  - Policy to let nature take it course
  - No culling wildlife or suppressing wildfire

Wildlife Refuges

- National Wildlife Refuge System
  - 1903, Theodore Roosevelt
- Represent all major ecosystems founds in the US
- Mission
  - To preserve lands and waters for the conservation of fishes, wildlife and plants of the US

Forests

- Role in Hydrologic Cycle (right)
- Forest Management
- Deforestation
- Forest Trends in the US
- Trends in Tropical Forests
- Boreal Forests



Forest Management

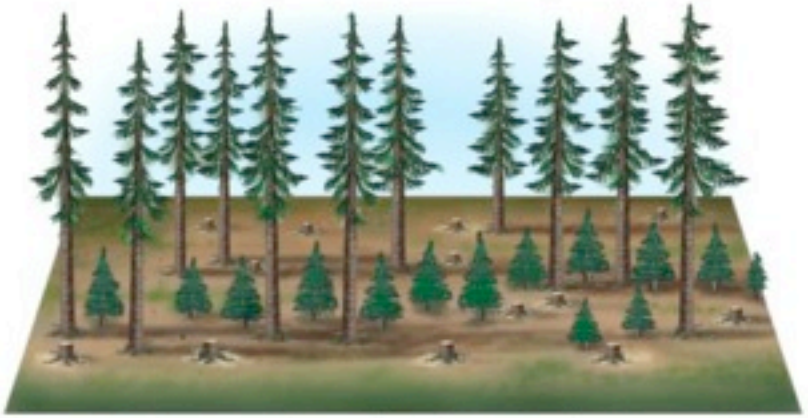
- Traditional Forest Management
  - Low diversity - monocultures
  - Managed for timber production

Forest Management

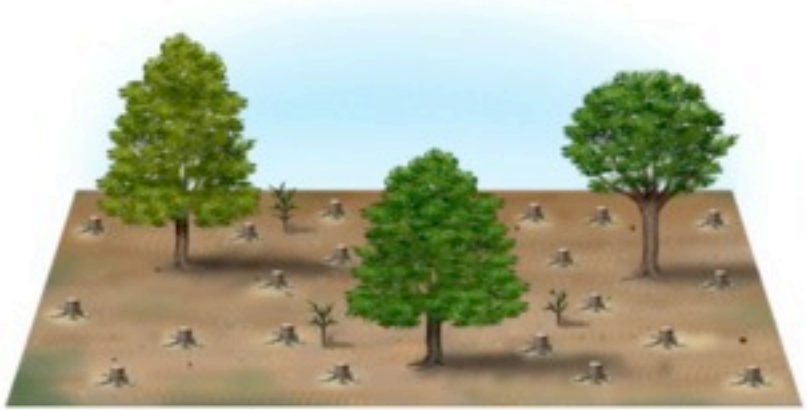
- Forest Management-
  Ecological Sustainable Forest Management
  - Environmentally balanced
  - Diverse trees
  - Prevent soil erosion
  - Preserve watersheds
  - Wildlife corridors - unlogged

Harvesting Trees

(a) In selective cutting, the older, mature trees are selectively harvested from time to time, and the forest regenerates itself naturally.



(b) In shelterwood cutting, less desirable and dead trees are harvested. As younger trees mature, they produce seedlings, which continue to grow as the now-mature trees are harvested.



(c) Seed tree cutting involves the removal of all but a few trees, which are allowed to remain, providing seeds for natural regeneration.

Harvesting Trees

- Selective Cutting
  - cuts "some" of mature trees every 10-20 yrs.
  - less profitable in the short run
  - less negative environmental impacts
- Shelterwood Cutting
  - first harvest removes undesirable, dead or diseased trees, allows new seedlings to form
  - every ten years some mature trees are cut in way that some remain to shelter the new seedlings, this process continues
  - little soil erosion occurs with this method

Harvesting Trees

- Seed Tree Cutting
  - removes almost all of trees in area but leaves a few scattered remaining trees
  - the remaining trees provide seeds to regenerate the forest
- Clear Cutting
  - removes all trees in an area
  - fastest, cheapest and most efficient
    - clear cutting small patches actually is beneficial for some species but cutting huge tracts has severe environmental consequnces

Harvesting Trees-

Developed countries produce less than 50% of all industrial wood but consume 80%

Deforestation

- Temporary or permanent clearance of large expanses of forest for agriculture or other use
- World forests shrank 89 million acres from 2000–2005
- Biologists are very concerned about the loss of tropical forests because they contain such biodiversity

Old Growth Forests

- Less than 10% remain compared to the amount prior to European settlement
- In 1989 the Spotted Owls became subject to a national controversy
  - The Forest Service was forced to limit logging to save their habitats

Deforestation

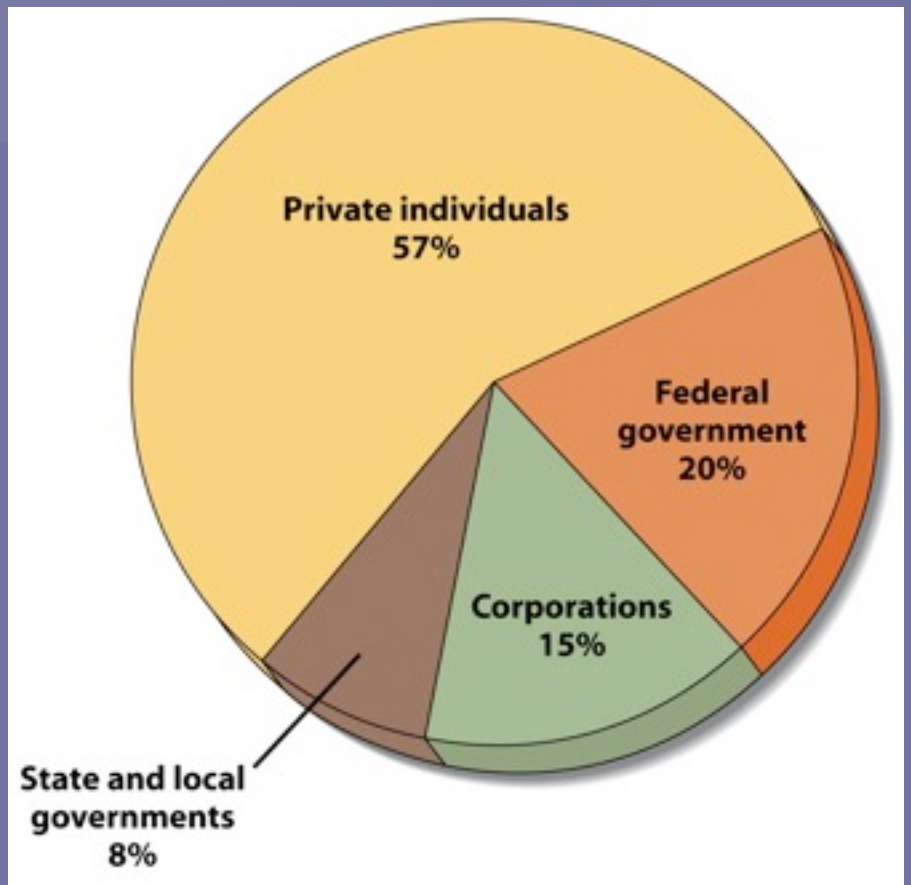
- Causes of Deforestation
  - Fire
  - Expansion of agriculture
  - Construction of roads
  - Tree harvest
  - Insect and disease

Deforestation

- Results of Deforestation
  - Decreased soil fertility
  - Uncontrolled soil erosion
  - Production of hydroelectric power (silt build up behind dams)
  - Increased sedimentation of waterways
  - Formation of deserts
  - Extinction of species

Forest Trends in US

- Most temperature forest are steady or expanding
- Returning stands lack biodiversity of original forests
- More than half of US forest are privately owned (right)
  - Forest Legacy Program



US National Forests

- Managed for multiple uses
  - Timber harvest
  - Livestock forage
  - Water resource and watershed protection
  - Mining, hunting, fishing, etc.
- Road building is an issue
  - Provides logging companies with access to forest
- Clearcutting is an issue

Case-In-Point Tongass National Park

- One of world's few temperate rainforests
- Prime logging area
- Modified 1997 Forest Plan
- Roadless Area Conservation Rule (2000)
- Politics rules government agencies

Trends in Tropical Forests

- Tropical rainforests (below) and tropical dry forests

Disappearing Tropical Rain Forests

- Immediate causes
  - Subsistence agriculture
  - Commercial logging
  - Cattle ranching
- Other causes
  - Mining
  - Hydroelectric power

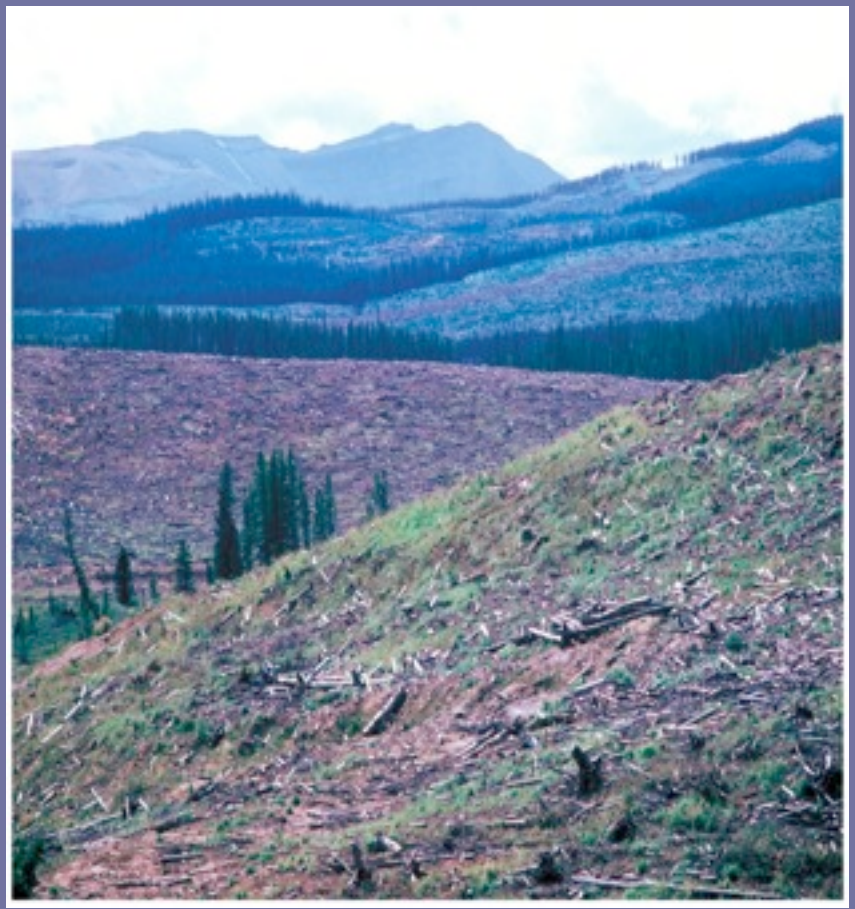
Human Settlement in a Brazilian Tropical Rain Forest

Disappearing Tropical Dry Forests

- Primarily destroyed for fuelwood
  - Used for heating and cooking
- Led to fuel crisis in many countries
  - Increase in waterborne diseases (cooking water is not boiled)

Boreal Forests

- World's largest biome
- Extensive clearcutting
  - Primary source of world's industrial wood and wood fiber
  - Developed countries produce less than 50% of all industrial wood but consume 80%



Rangeland

- Rangelands- grasslands in both temperate and tropical regions
- Rainfall is scarce or at best seasonal

Rangeland and Agricultural Lands

- Rangeland
  - Land that is not intensively managed and is used for grazing livestock

Rangeland Degradation

- Overgrazing
  - (biggest factor in public rangeland degredation)
    - leaves ground barren
    - first sign is loss of palatable herbs
    - Animals exceed land's carrying capacity
- Land degradation
  - Natural or human-induced process that decreases future ability of land to support crops or livestock
- Desertification

Rangeland Degradation

- Desertification
  - Degradation of once fertile land into nonproductive desert
- Desertification
  - world wide deserts are increasing due to logging and grazing

Rangeland Trends in US

- Make up 30% of total US land area
- Pressure from developers to subdivide
- Public rangeland managed by:
  - Taylor Grazing Act (1934)
  - Federal Land Policy and Management Act (1976)
- Conditions of public rangeland are slowly improving

Agricultural Land

- US has 300 million acres of prime farmland
- Suburban sprawl
  - Parking lots
  - Housing developments
  - Shopping malls

Wetlands

- Lands that are usually covered with water for at least part of the year
- Have characteristic soils, and water-tolerant vegetation
- Benefits
  - Habitat for migratory waterfowl and wildlife
  - Recharge groundwater
  - Reduce damage from flooding
  - Improve water quality
  - Produce many commercially important products

Human Threats to Wetlands

- Drainage for agriculture or mosquito control
- Dredging for navigation
- Construction of dams, dykes or seawalls
- Filling in for solid waste disposal
- Road building
- Mining for gravel, fossil fuels, etc.
- Shrinking 58,500 acres per year

Protection of Wetlands

- Clean Water Act (1972)
  - No clear definition of wetland
- Emergency Wetlands Resource Act (1986)
- Corp of Engineers Manuals
- Opponents of wetland protection find it infringes on use of privately-owned land

Coastlines

- Coastal wetlands
  - Provide food and habitat for many aquatic animals
  - Historically regarded as wasteland
- US starting to see importance of protecting this environment
  - Retaining seawalls (right)

Coastal Demographics

- Many coastal areas overdeveloped
  - 3.8 billion people live within 150km of coastline
  - 6.0 billion people will likely live there by 2025
- United States
  - 14 of 20 largest US cities along coast
  - 19 of 20 most densely populated countries along coasts

Conservation and Land Resources

- Four criteria of importance of conservation:
  - Areas lost or degraded since European colonization
  - Number of present examples of a particular ecosystem (or the total area)
  - Estimate of the likelihood that a given ecosystem will lose significant area or be degraded in next 10 years
  - Number of threatened and endangered species living in the ecosystem

Conservation and Land Resources

Table 18.2 The 10 Most Endangered Ecosystems in the United States

Ecosystems (in order of priority)
South Florida landscape
Southern Appalachian spruce-fir forests
Longleaf pine forests and savannas
Eastern grasslands, savannas, and barrens
Northwestern grasslands and savannas
California native grasslands
Coastal communities in lower 48 states and Hawaii
Southwestern riparian communities
Southern California coastal sage scrub
Hawaiian dry forest

Source: From Noss, R.F., et al.

III. Other Natural Resources

Minerals

Mineral Resources

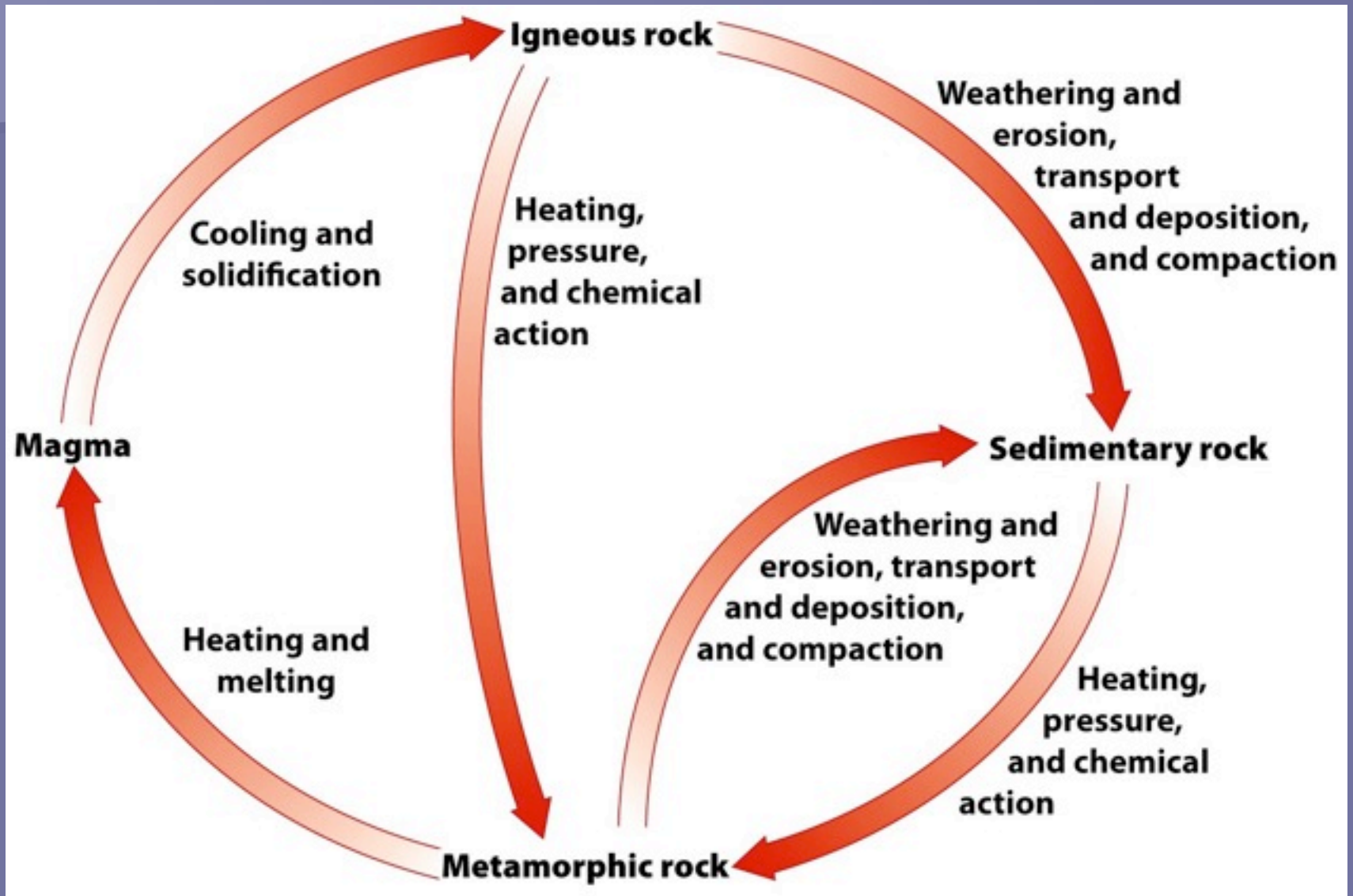
Overview of Mineral Resources

- Introduction to Minerals
- Environmental Impact of Minerals
- An International Perspective
- Increasing the Supply of Minerals
- Substitution and Conservation

Introduction to Minerals

- Minerals
  - inorganic solid, occurring naturally in or on the earth's crust with characteristic chemical and physical properties
- Rocks
  - Naturally formed aggregates of minerals
- Examples of Minerals
  - Concrete (mixture of sand, gravel and limestone)

Rock Cycle


Igneous rock
Weathering and erosion, transport and deposition, and compaction
Heating, pressure, and chemical action
Cooling and solidification
Magma
Sedimentary rock
Weathering and erosion, transport and deposition, and compaction
Heating and melting
Heating, pressure, and chemical action
Metamorphic rock

Important Minerals and Their Uses

Table 16.1 Some Important Minerals and Their Uses.*

Aluminum	Chromium	Cobalt	Gold
			
Aircraft, motor vehicles, packaging (cans, foil), water treatment	Chrome plate, dyes and paints, steel alloys (cutlery)	Corrosion and wear-resistant alloys, pigments (cobalt blue)	Jewelry, money, restorative dentistry
Iron	**Magnesium**	**Mercury**	**Molybdenum**
			
Steel (alloy of iron) buildings and machinery	Beverage cans, electronic devices, firecrackers, flares	Industrial chemicals, electric and electronic applications, batteries	High-temperature alloys for aircraft, industrial motors

Mineral Distribution and Formation

- Abundant minerals in crust
  - Aluminum and iron
- Scarce minerals in crust
  - Copper, chromium, and molybdenum
- Distributed unevenly across globe
  - If found in low abundance, mining is not profitable

Formation of Mineral Deposits

- Result of natural processes
  - Magmatic concentration
    - As magma cools heavier elements (Fe and Mg) settle
    - Responsible for deposits of Fe, Cu, Ni, Cr
  - Hydrothermal processes
    - Minerals are carried and deposited by water heated deep in earth's crust
  - Sedimentation
    - Weathered particles are transported by water and deposited as sediment on sea floor or shore
  - Evaporation
    - Salts are left behind after water body dries up

Evaporites

- Formed from sedimentary rocks
- Economically important
- Often times very pure
- Easy to recover

Discovering Mineral Deposits

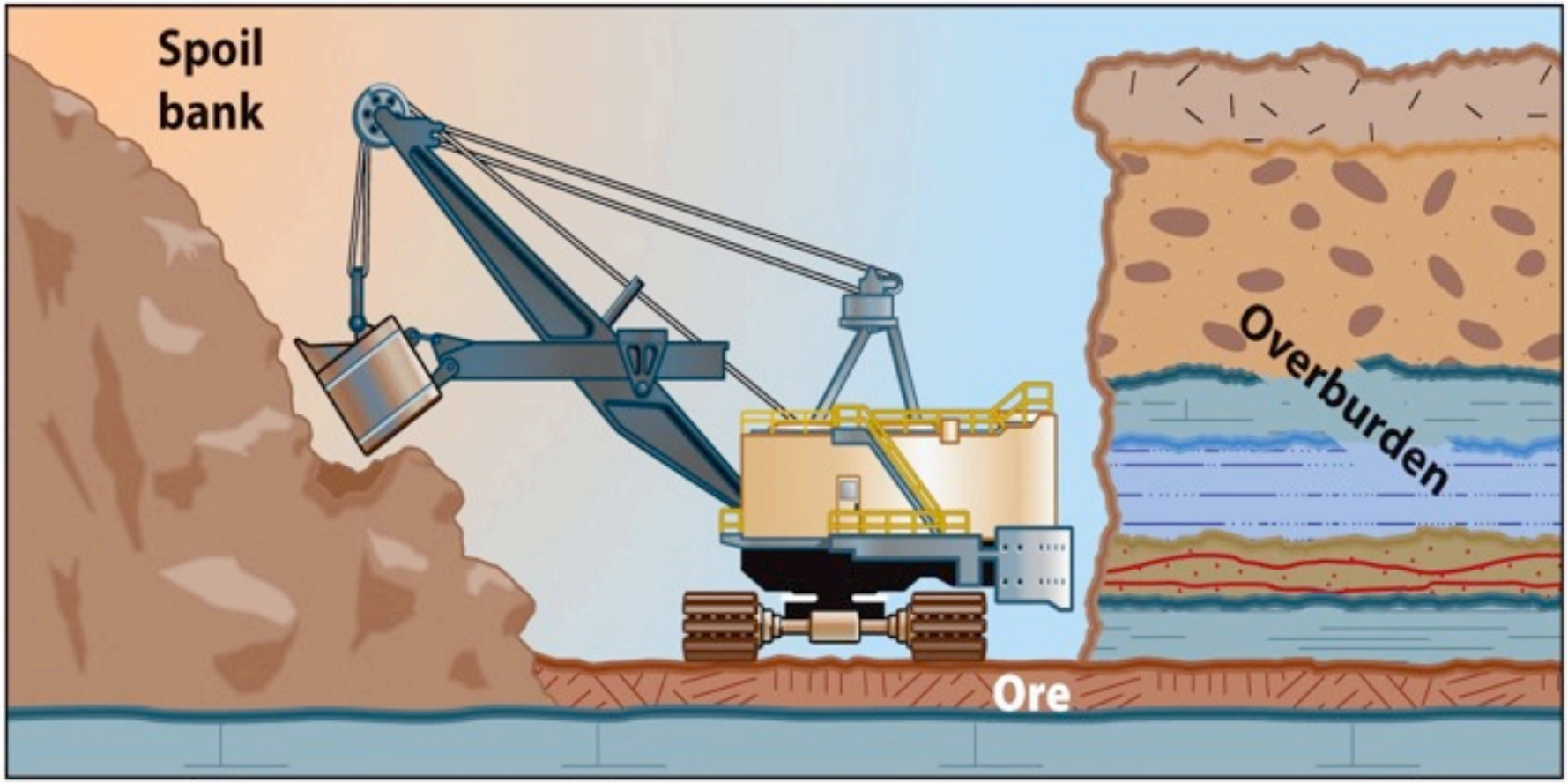
- Scientists (geologists) use a variety of instruments and measurements
  - Aerial or satellite photography
  - Seismographs
- Combine this with knowledge of how minerals are formed

Extracting Minerals

- Surface Mining
  - Mineral and energy resources are extracted near Earth's surface by removing soil, subsoil and over-lying rock strata
  - More common because less expensive
  - Two kinds: open pit and strip mining
- Subsurface Mining
  - Mineral and energy resources are extracted from deep underground deposits
  - Two kinds: shaft mine and slope mine

Extracting Minerals - Open Pit Surface Mining

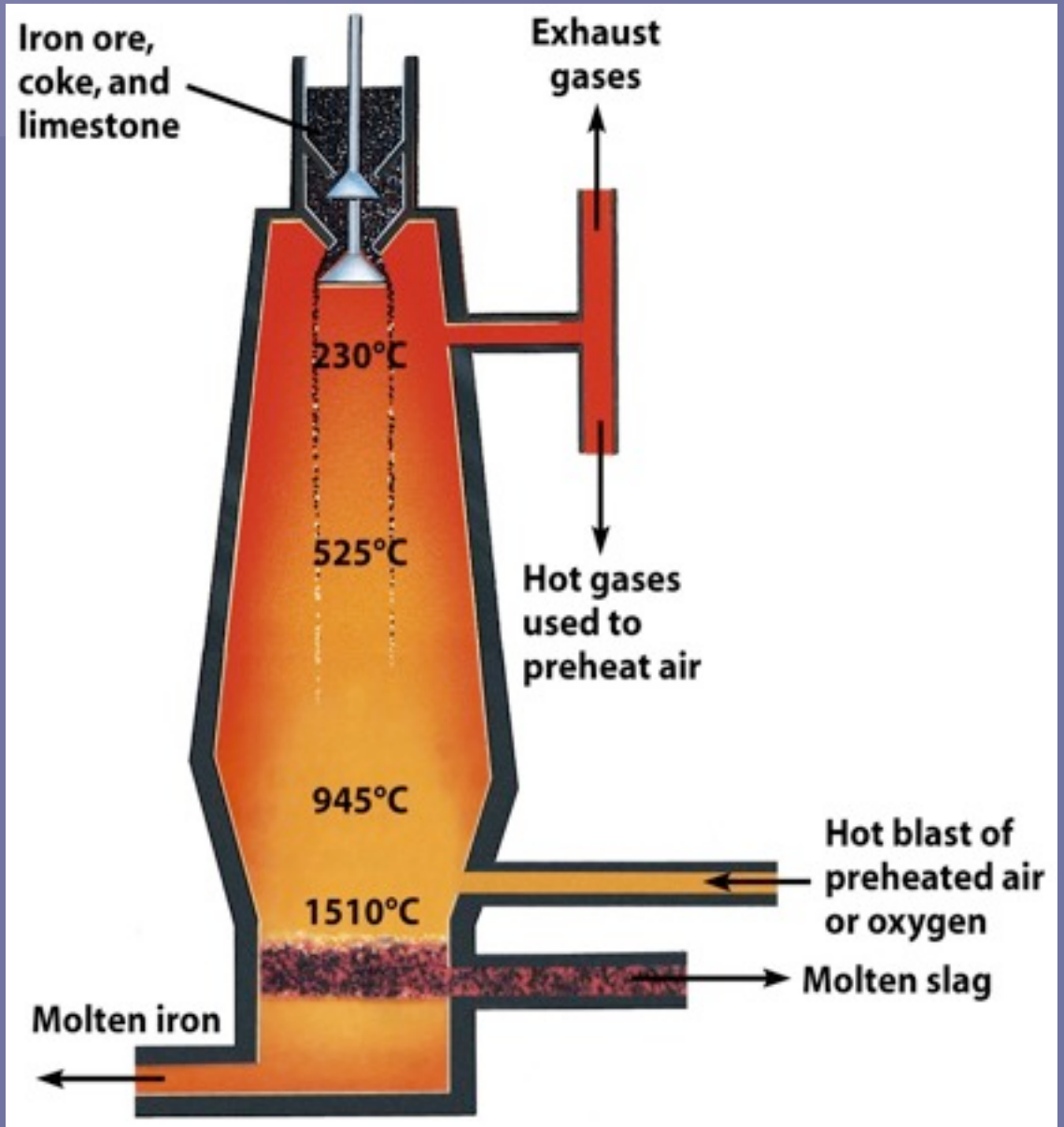
Extracting Minerals - Strip Mining



Strip mining removes overburden along narrow strips to reach the ore beneath.

Processing Minerals

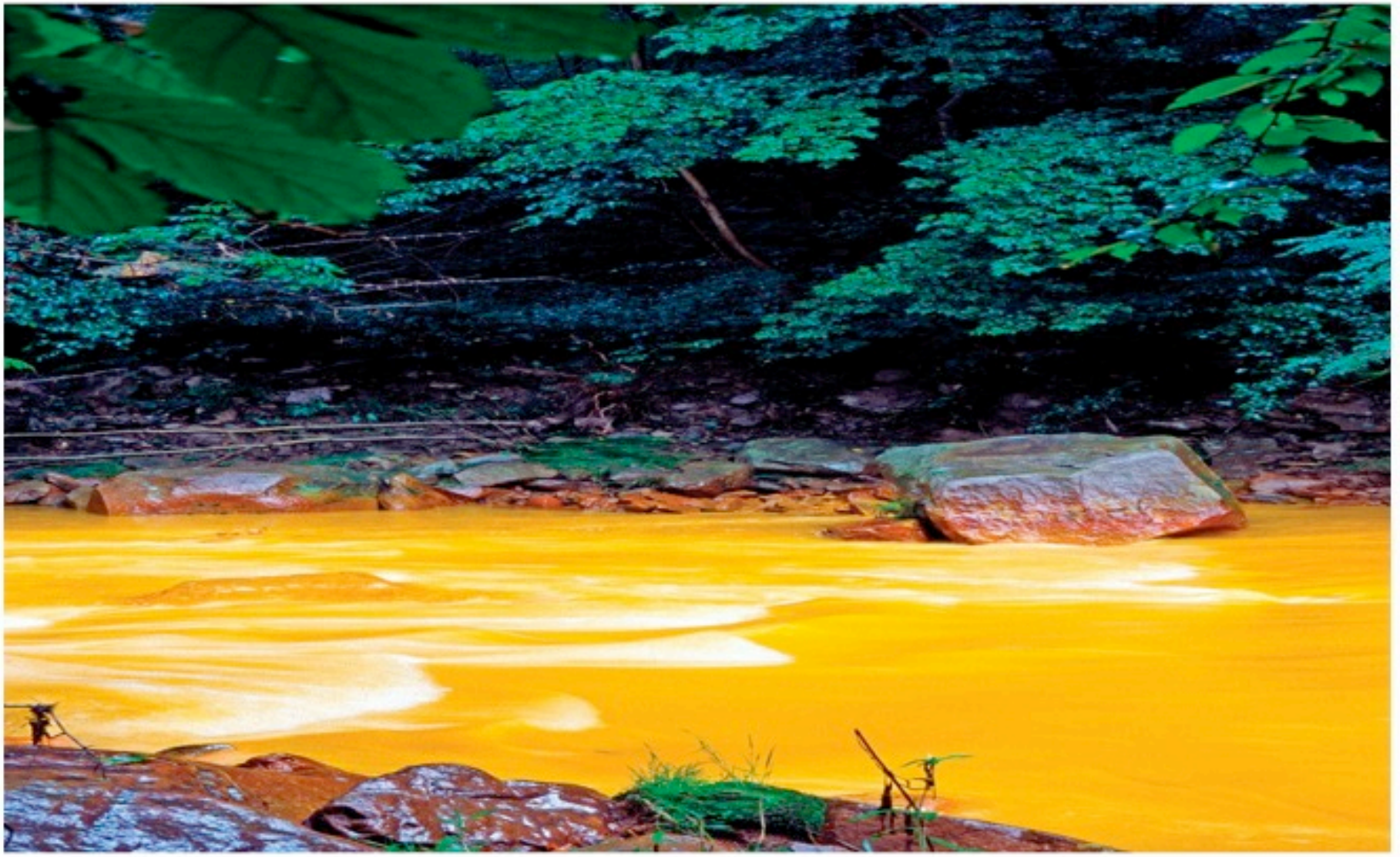
- Smelting - process in which ore is melted at high temps to separate impurities from the molten metal



Environmental Impacts of Mining

- Disturbs large area
  - Prone to erosion
- Uses large quantities of water
  - Must pump water out of mine to keep it dry
- Acid Mine Drainage (AMD)
  - Pollution caused when sulfuric acid and dissolved lead, arsenic or cadmium wash out of mines into nearby waterways

Acid Mine Drainage



Gold Mining

- Today gold is being extracted from low-grade ores
  - 2200 pounds of mined rock yields 0.8 grams of gold
  - Requires a lot of energy (fossil fuels combustion)
  - Digging deeper hits water table and depletes the wells and groundwater in the area
  - Affects water quality as well
    - rainwater leaches sulfur compounds from the ores which in turn pollute nearby bodies of water
    - Heap Leach Extraction- removes gold by spraying Cyanide on a pile of ore gravel
    - Controversial and Banned in some states/countries

Environmental Impacts of

Table 16.2 Ore and Waste Production for Selected Minerals

Mineral	Amount of Mined Ore (Million Tons)	Percentage of Ore That Becomes Waste During Refining*
Iron ore	2958	60
Copper	1663	99
Gold	745	99.99
Lead	267	97.5
Aluminum	128	81

*Data do not include the overburden of rock and soil that originally covered the ore deposits.
Source: Adapted from Gardner, G. et al. *State of the World,* 2003.

Environmental Impacts of Refining Minerals

- 80% or more of mined ore consists of impurities - called tailings
  - Contain toxic materials
- Smelting plants emit large amounts of air pollutants
- Requires a lot of energy (fossil fuels combustion)

Case-In-Point Copper Basin, TN

Case-In-Point Copper Basin, TN

- Once a lush forest, now a red, barren hills devoid of life
- Mining companies in the mid 19th century cut down all the trees and burned them in smelters to extract copper
  - (gaseous waste)sulfur dioxide was released into the air which resulted acid precipitation
  - erosion degraded the land further
  - acid precipitation run off polluted the Ocoee River killing the entire aquatic community
- Reclamation procedures began in the 1920's

Restoration of Mining Lands

- Goals: prevent further degradation and erosion of land, eliminate local sources of toxins and make land productive for another purpose
- Challenging and difficult because topsoil is often buried and it takes considerable time for it reform

Reclaimed Coal-Mined Land

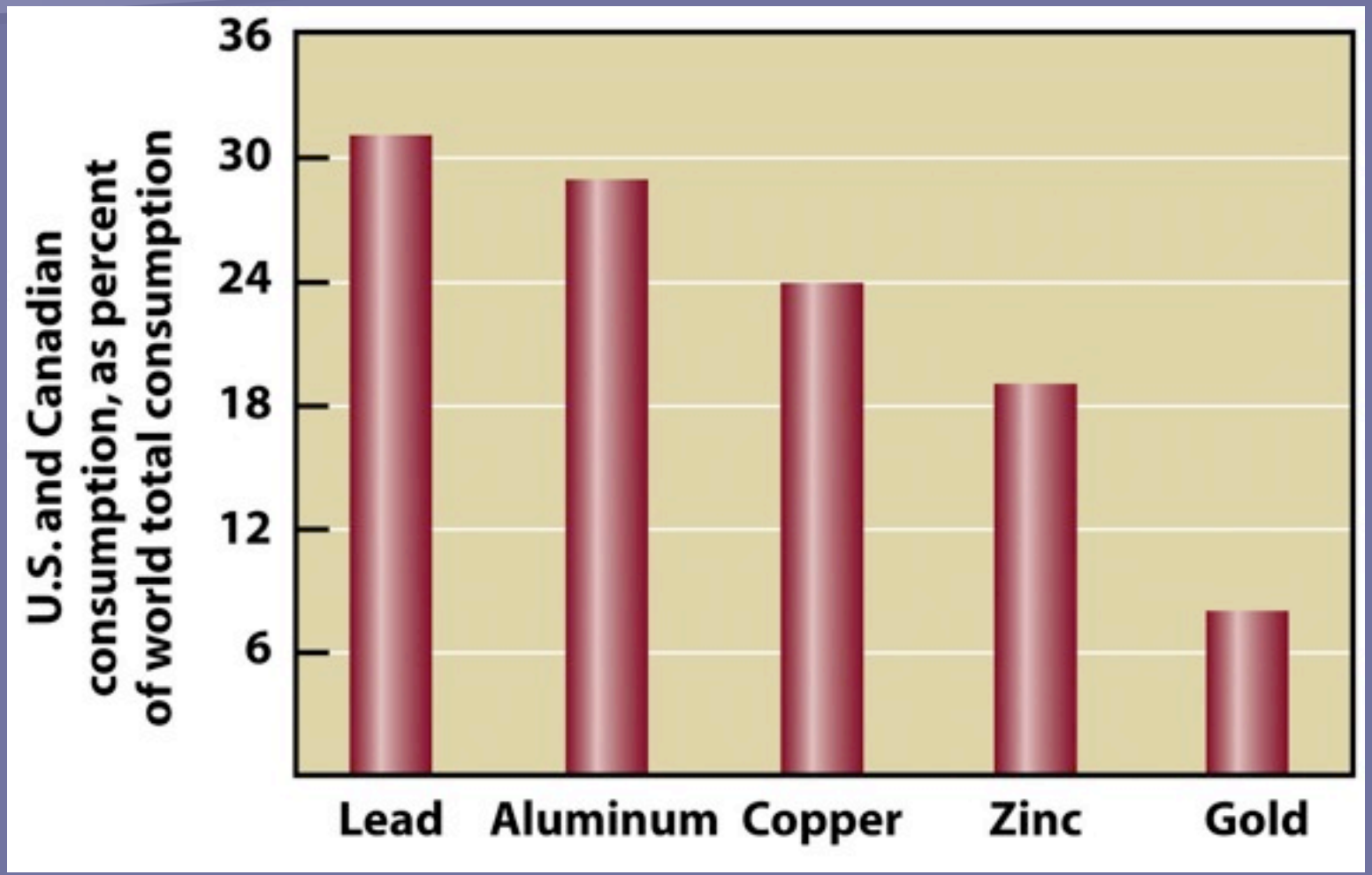
Restoration of Mining Land

- Creative Approaches
- - Wetlands
  - Trap and filter pollutants before they get into streams
  - Initially expensive, but cost effective compared to using lime to decrease acidity
- - Phytoremediation
  - Use of specific plants to absorb and accumulate toxic materials in soil

Minerals: An International Perspective

- Highly developed countries
  - Rely on mineral deposits in developing countries
  - They have exhausted their own supplies
- Developing countries
  - Governments lack financial resources to handle pollution
  - Acid mine drainage, air and water pollution

North American Consumption of



Will We Run Out of Important Metals?

- Mineral Reserves
  - Mineral deposits that have been identified and are currently profitable to extract
- Mineral Resources
  - Any undiscovered mineral deposits or known deposits of low-grade ore that are currently unprofitable to extract
- Estimates of reserves and resources fluctuate with economy

Increasing Supply of Minerals – Locating and Mining New Deposits

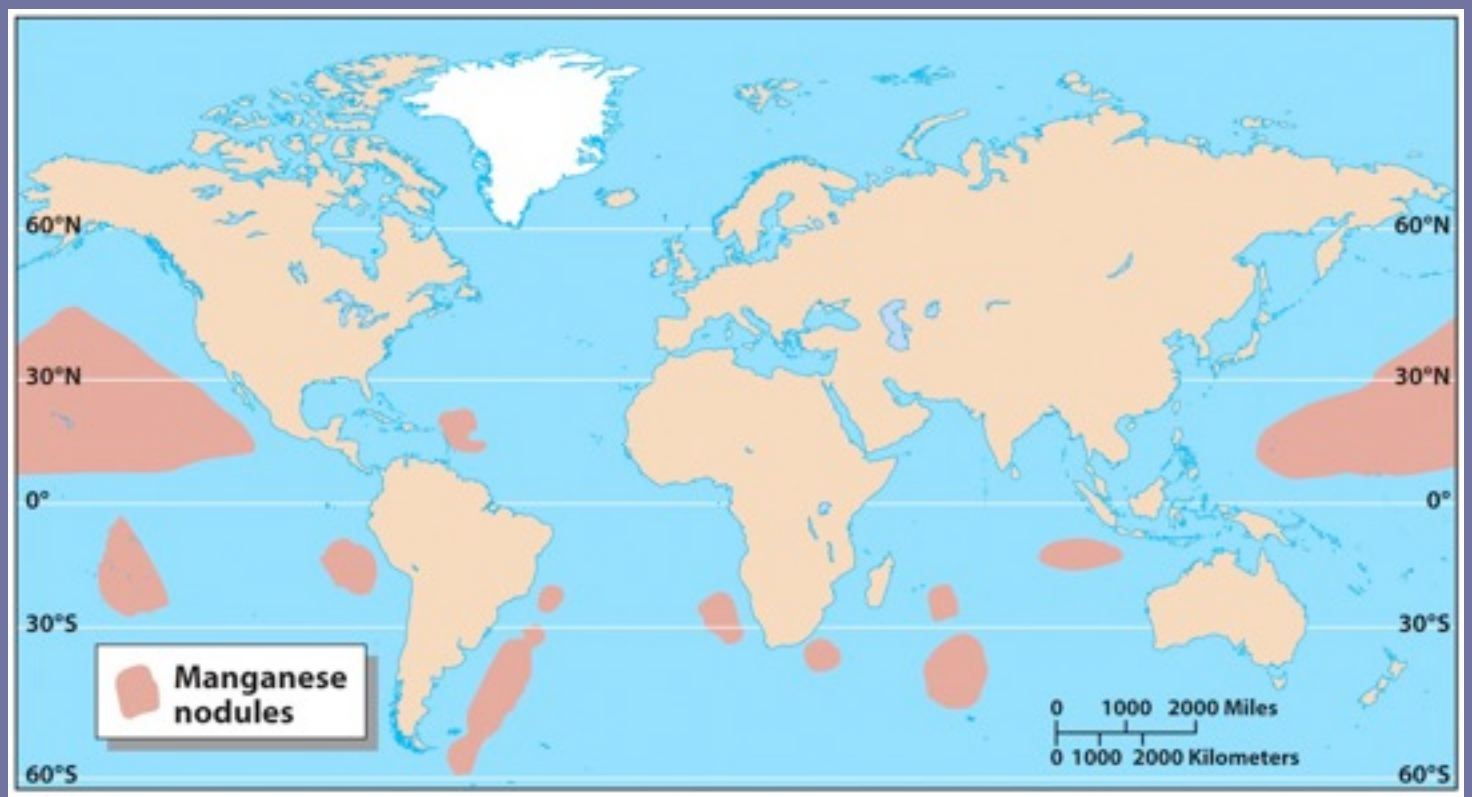
- Many known mineral deposits have not yet been exploited
  - Difficult to access
  - Insufficient technology
  - Located too deep
    - Ex: 10 km or deeper

Minerals in Antarctica

- No substantial mineral deposits identified to date
- Antarctica Treaty (1961)
  - Limits activity to peaceful uses (i.e., scientific studies)
- Madrid Protocol (1990)
  - Moratorium on mineral exploration and development for minimum of 50 years

Minerals from the Ocean

- May provide us with future supplies
  - Extracting minerals from seawater
  - Mining seafloor - Manganese nodules



Advance Mining and Processing Technologies

- Special techniques to make use of large, low-grade mineral deposits world-wide
- Biomining
  - Using microorganisms to extract minerals from low-grade ores

Finding Mineral Substitutes

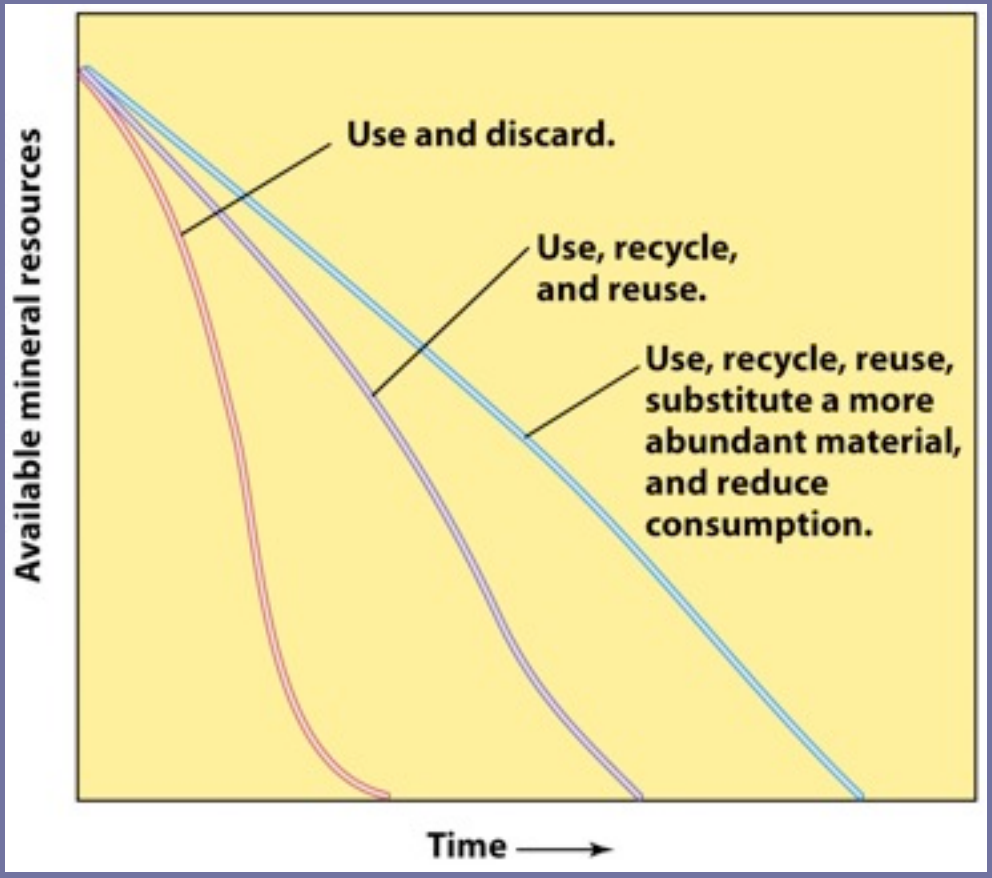
- Important goal in manufacturing
- Substitute expensive/scarce mineral resources for inexpensive/abundant ones
- Examples:
  - Using plastic, glass or aluminum in place of tin
  - Using glass fibers instead of copper wiring in telephone cables

Mineral Conservation

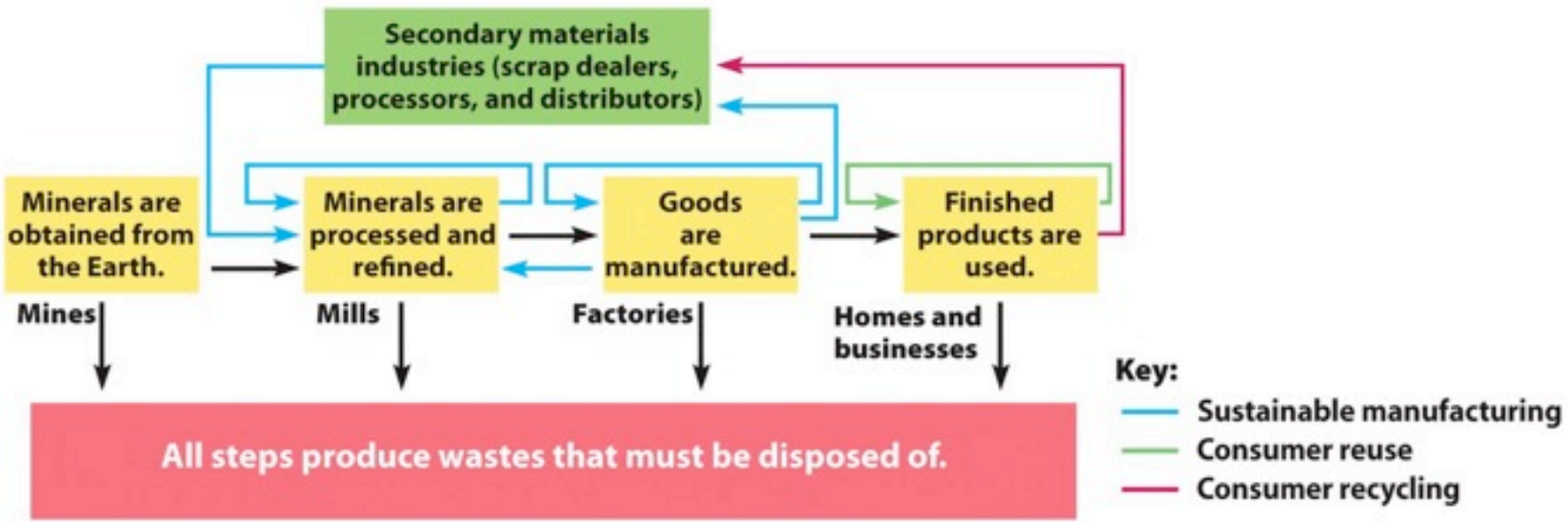
- Includes reuse and recycling of existing mineral supplies
  - Reuse - using items over and over again
    - Reduces both mineral consumption and pollution
  - Recycling - converting item into new product
    - Reduces land destruction from mining
    - Reduces solid waste
    - Reduces energy consumption
      - 1/20 the energy is used to recycle aluminum cans compared to extracting new aluminum from bauxite
      - 1/2 the energy is used to recycle steel products
  - Recycling - is slowing growing in popularity

Changing Our Mineral Requirements

- Must change our "throw away" mentality



(a) Massive amounts of solid waste are produced at all steps in the traditional flow of minerals, from mining the mineral to discarding the used-up product.



(b) The flow of minerals in a low-waste society is more complex, with sustainable manufacturing, consumer reuse, and consumer recycling practiced at intermediate steps.

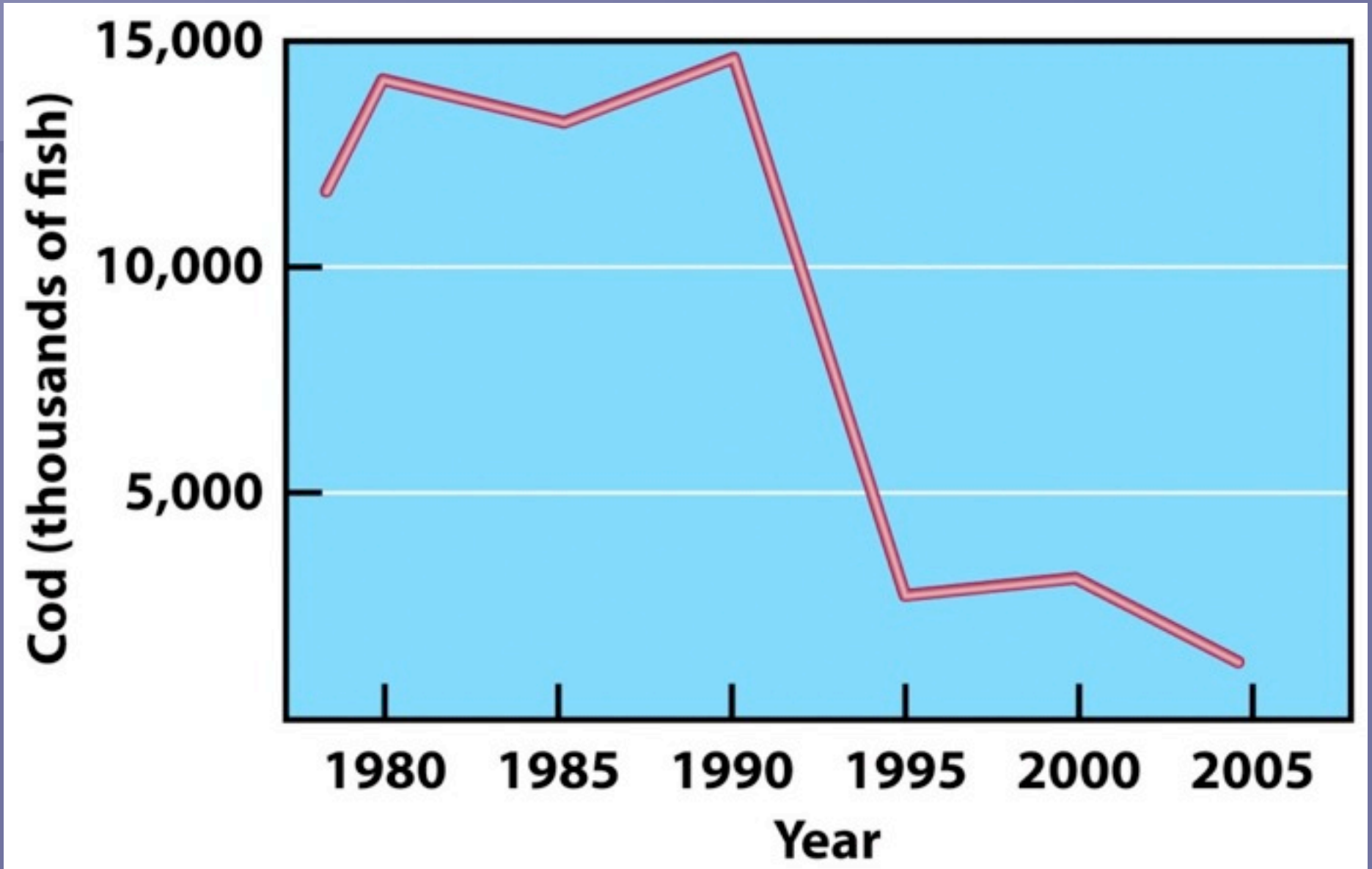
Biological Resources

Fisheries

Fisheries of the World - Problems

- Overharvesting
  - Many species are at point of severe depletion
  - 62% of world's fish stock are in need of management action
  - Sophisticated fishing equipment
  - By catch killed has decreased world fish stocks
  - Magnuson Fisheries Conservation Act

Fisheries of the World - Problems



Fisheries of the World - Problems

- No nation lays claim to open ocean
  - Resource susceptible to overuse and degradation
- Ocean Pollution - dumping ground
  - Oil, Heavy metals, Deliberate litter dumping, Stormwater runoff from cities and agricultural areas
- Habitat Destruction- threatens fisheries

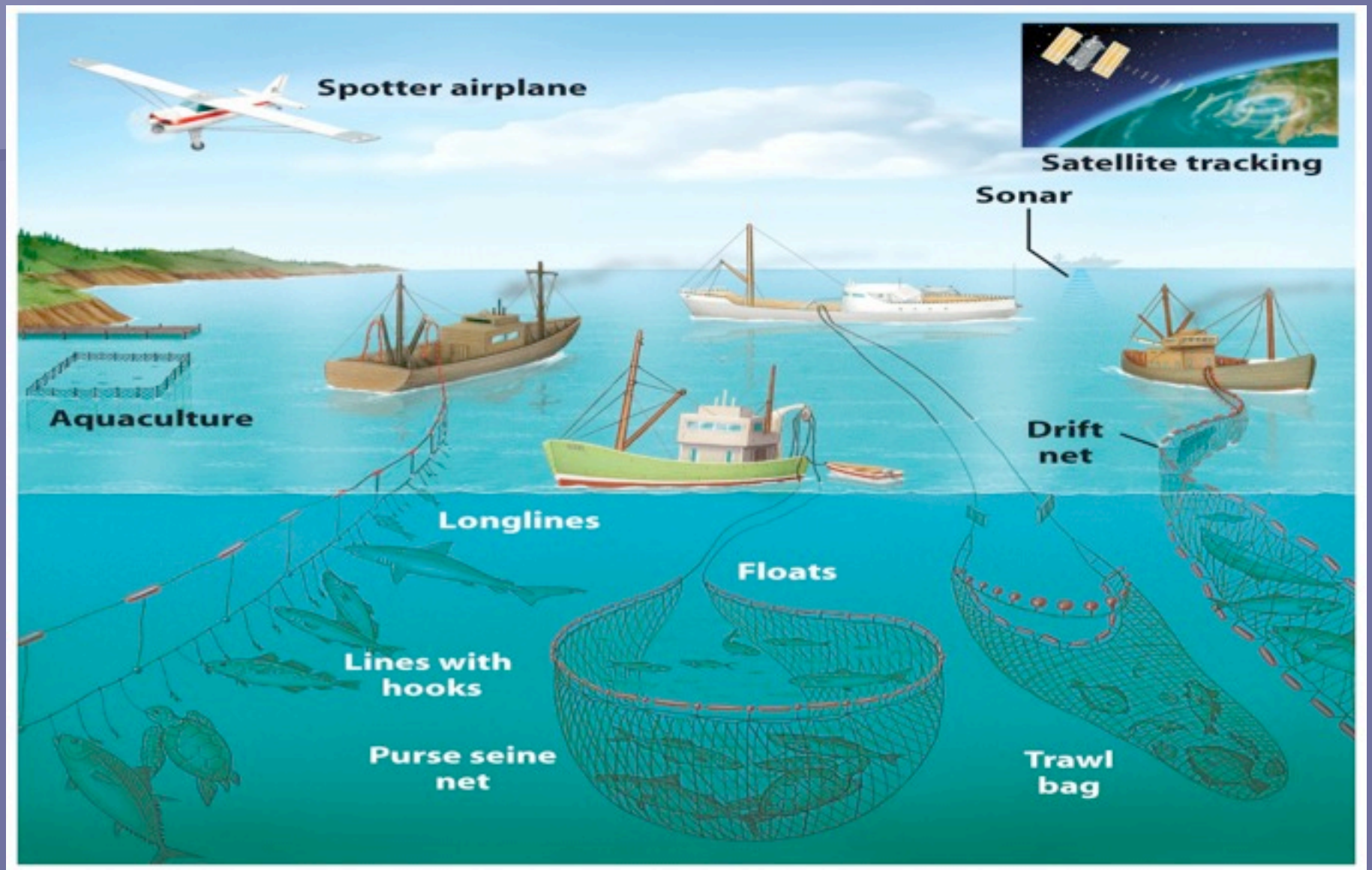
Fisheries of the World - Problems

- Aquaculture
  - Growing of aquatic organisms for human consumption
  - Great potential to supply food
  - Has NOT helped or allowed world fish stocks to recover
  - subsidies are necessary to make fisheries profitable
  - Locations of fisheries may hurt natural habitats
  - Produce waste that pollutes adjacent water

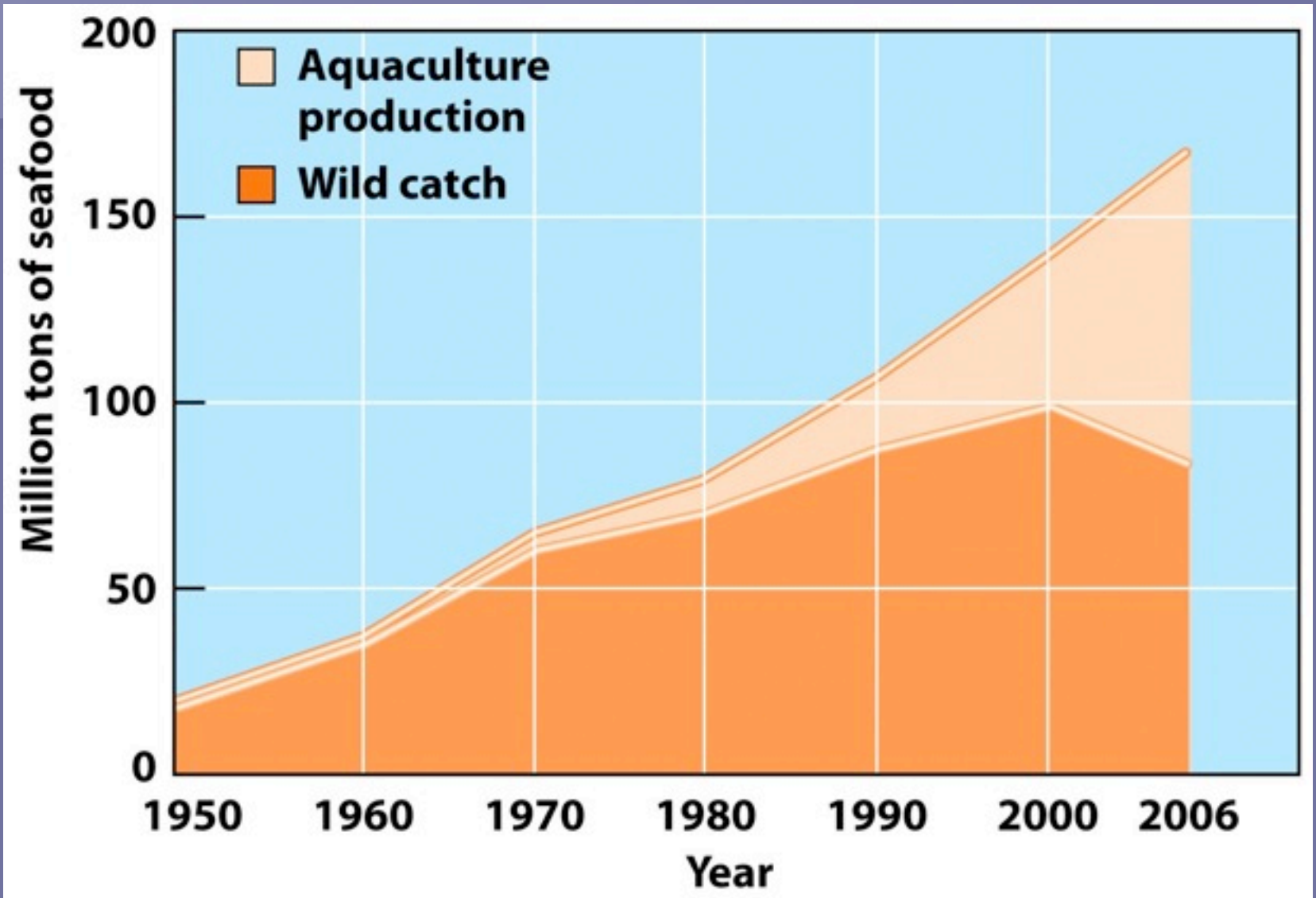
Fisheries of the World - Problems

- Aquaculture

Fisheries of the World - Problems



World Seafood Harvest



Biodiversity

Biological Resources

Biological Diversity

- Biological Diversity
  - Number, variety and variability of Earth's organisms
- Consists of three components:
  - Genetic diversity (below)
  - Species richness
  - Ecosystem diversity

The single unduplicated chromosome below each tiger represents the genetic diversity among individuals within a population.

Why We Need Organisms

- Example contributions to human life:
  - Food
  - Clothing
  - Shelter
  - Pollination of crops
  - Antibiotics and medicines
  - Biological processes (nitrogen fixation)
- Biological Diversity represents an untapped resource for future uses

Ecosystem Services and Species Richness

- All organisms are interrelated
- Ecosystem services
  - Important environmental benefits that ecosystems provide to people
  - Removal of a species from a community can decrease ecosystem services

Scientific Importance of Genetic Diversity

- Genetic Engineering
  - Incorporation of genes from one organism into a different species
  - Provided:
    - New vaccines
    - More productive farm animals
    - Agricultural plants with desirable characteristics
- Depends on genetic diversity (cannot create genes)
  - Important to protect this diversity

Medical Importance of Organisms

- Genetic Resources are important to pharmaceutical industry
- Examples
  - Rosy Periwinkle – Cancer drug (right)
  - Aquatic sponge – AIDS drug

Importance of Organisms

- Agricultural Importance
  - Numerous species that are nutritionally superior to the food we eat
- Industrial Importance
  - Industry depends on products from organisms
    - Oils and lubricants
    - Paper and lumber
- Ethical and Aesthetic Importance