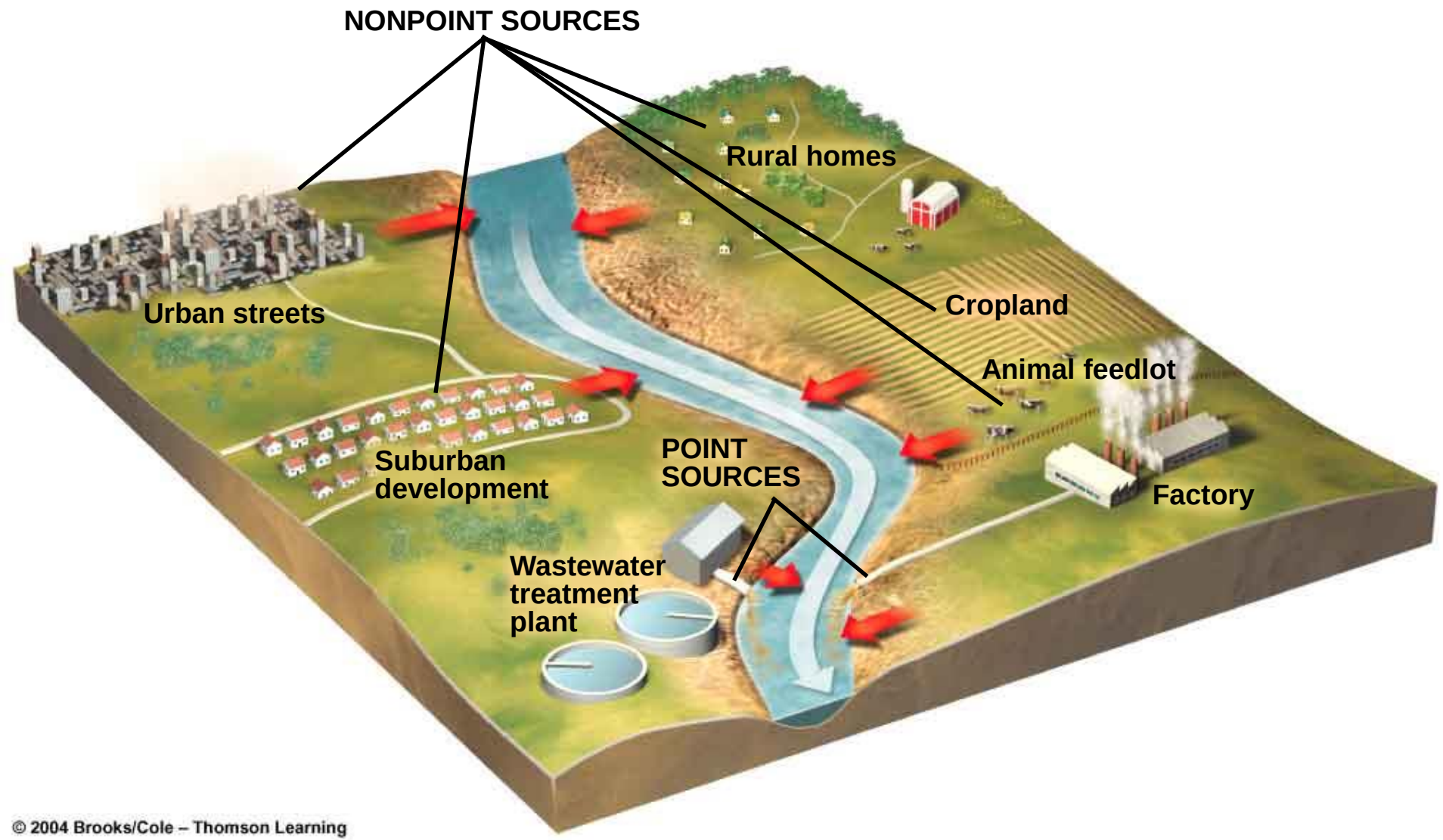
Water Pollution

Types and Sources of Water Pollution

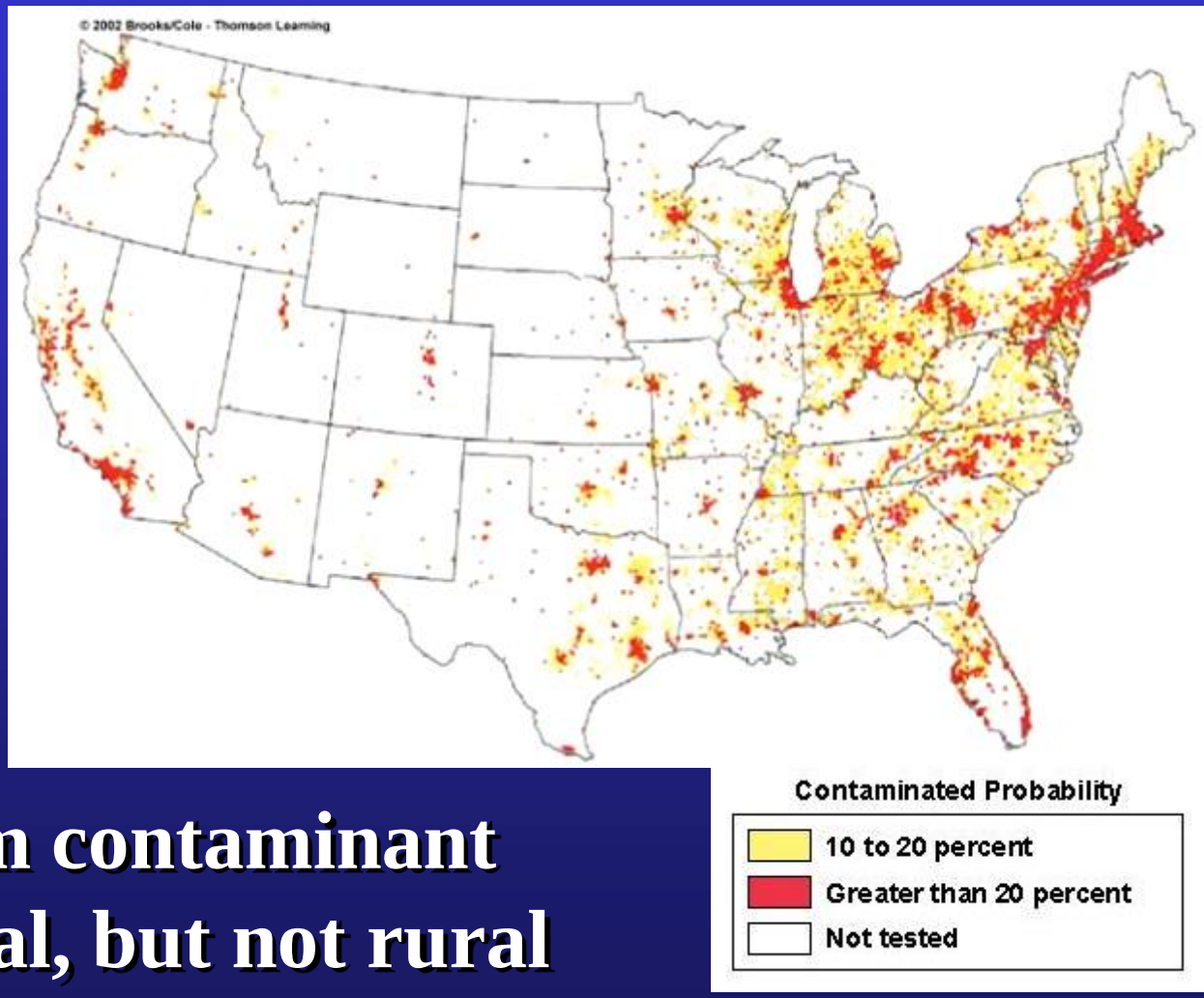
- **#1 problem - Eroded soils**
- **Organic wastes, disease-causing agents**
- **Chemicals, nutrients**
- **Radioactive stuff, heat**

Point and Nonpoint Sources



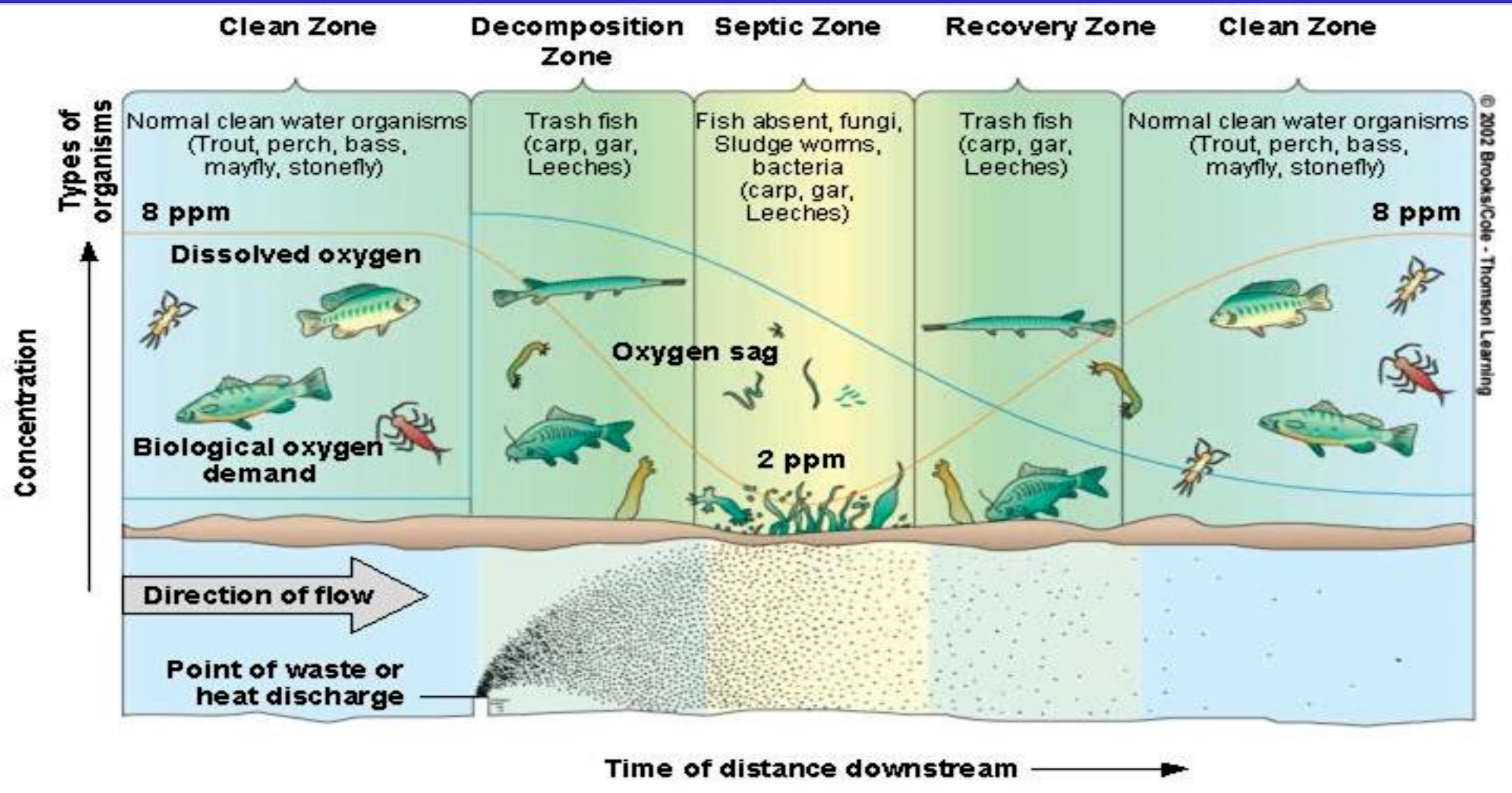
Major Problem: Drinking Water

- 1/2 of world's people drink polluted water
- Safe Drinking Water Act
- EPA: Maximum contaminant levels (municipal, but not rural and private)



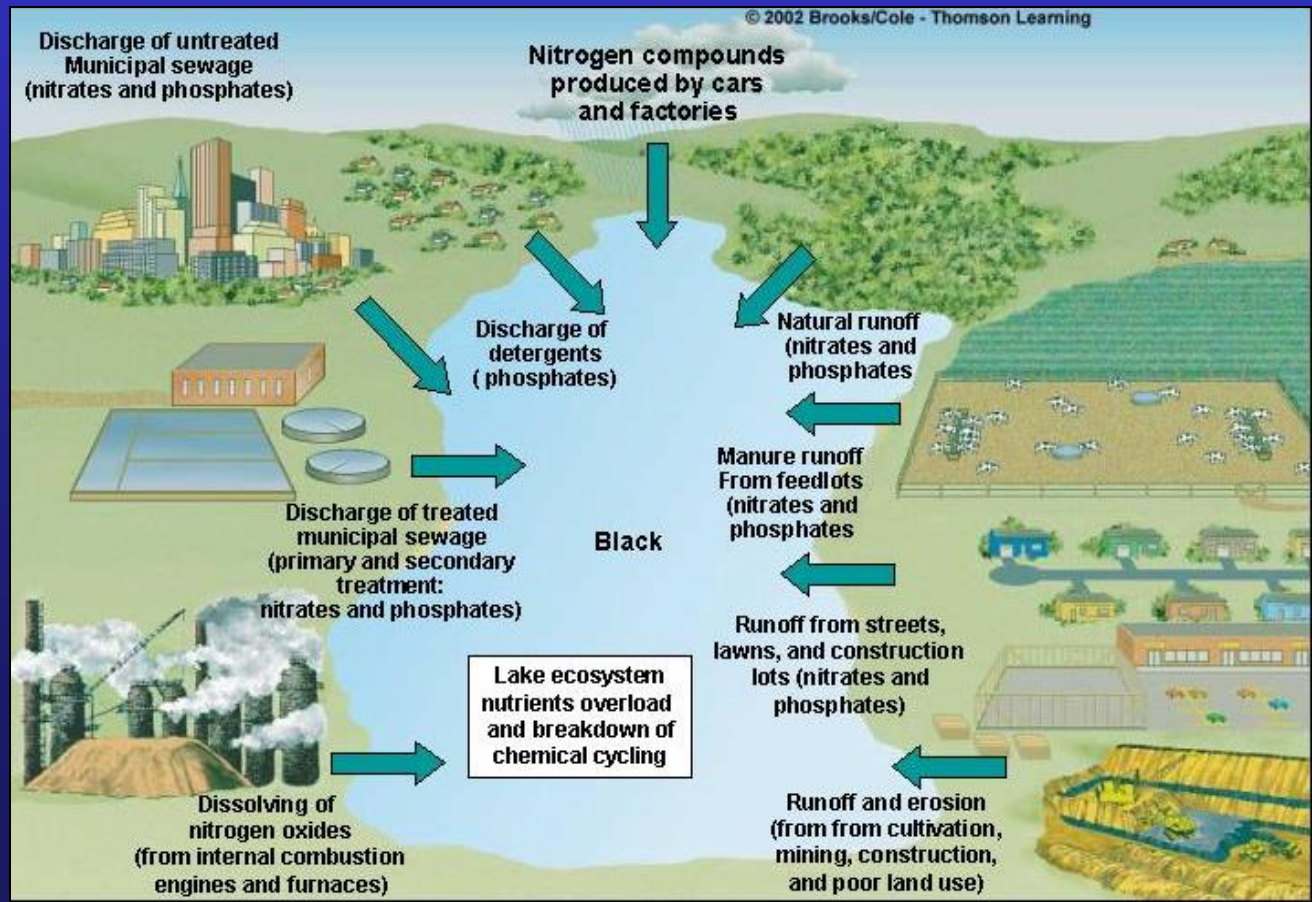
Pollution of Surface Water: Streams

- D.O., B.O.D., fecal coliform bacteria count



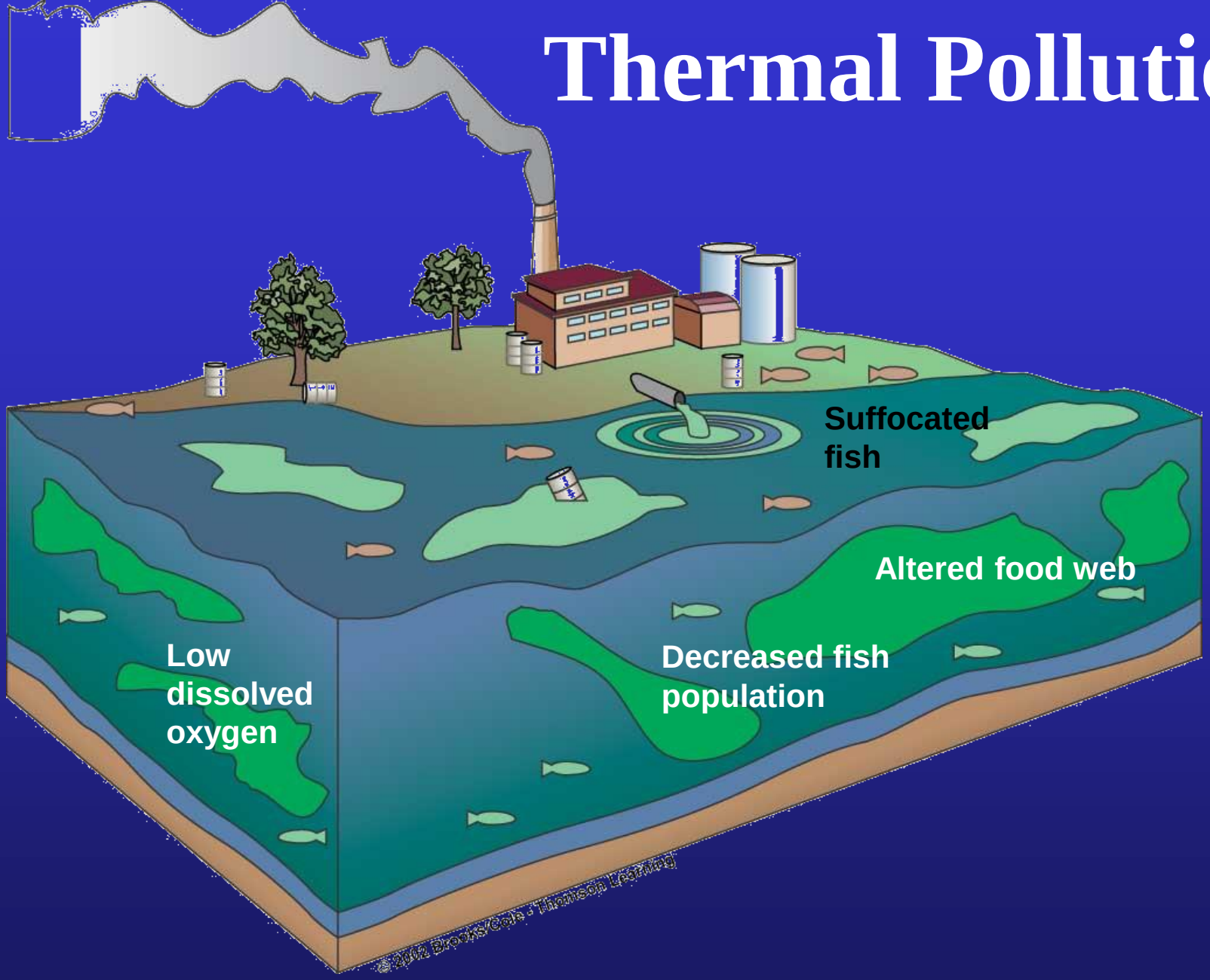
Pollution of Surface Water: Lakes

- **Cultural eutrophication**
  - **Slow turnover**
  - **Accumulation of nutrients, excessive plant growth, algae blooms**



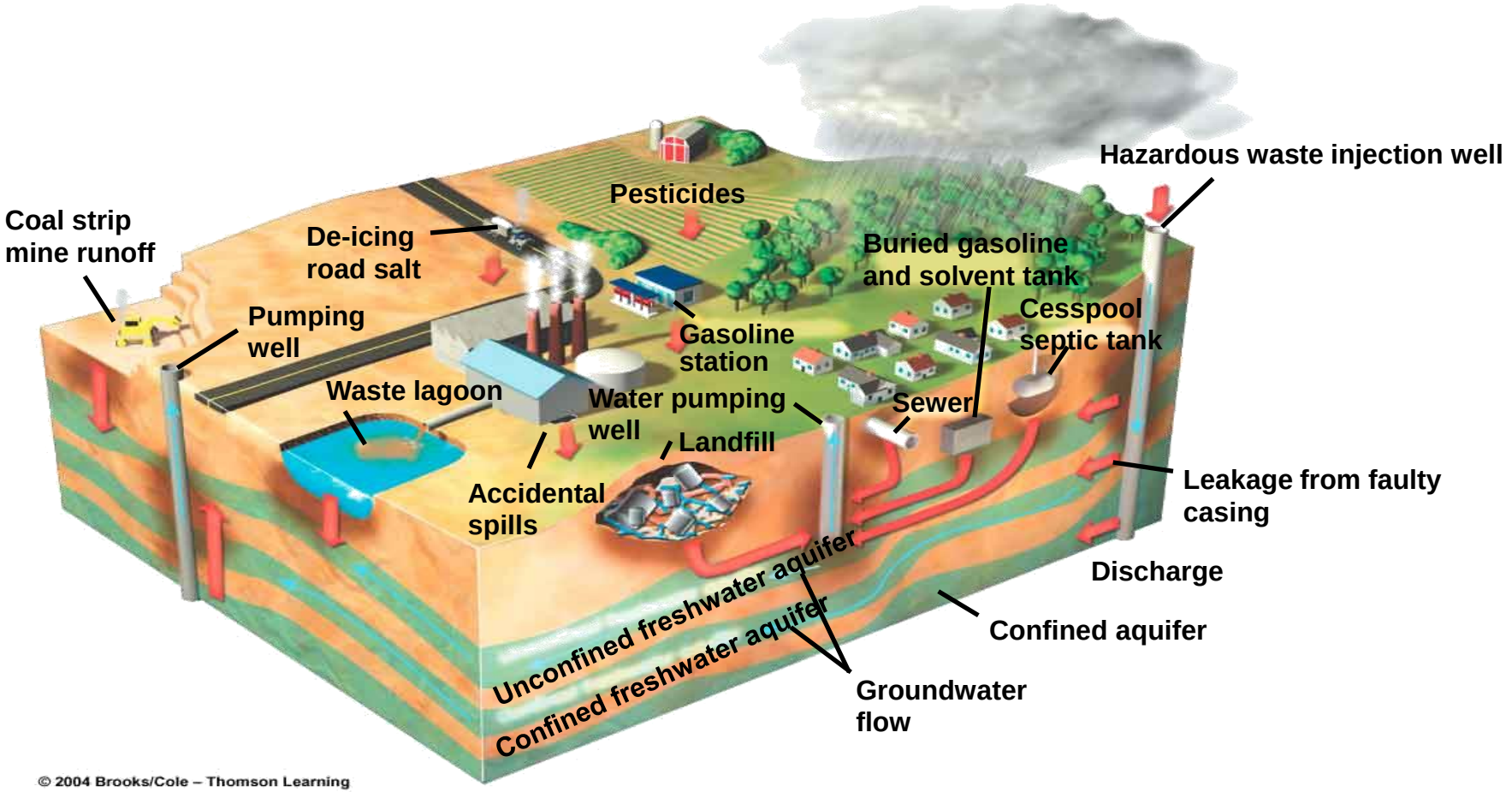
Case Study: The Great Lakes

Thermal Pollution



Groundwater Pollution: Sources

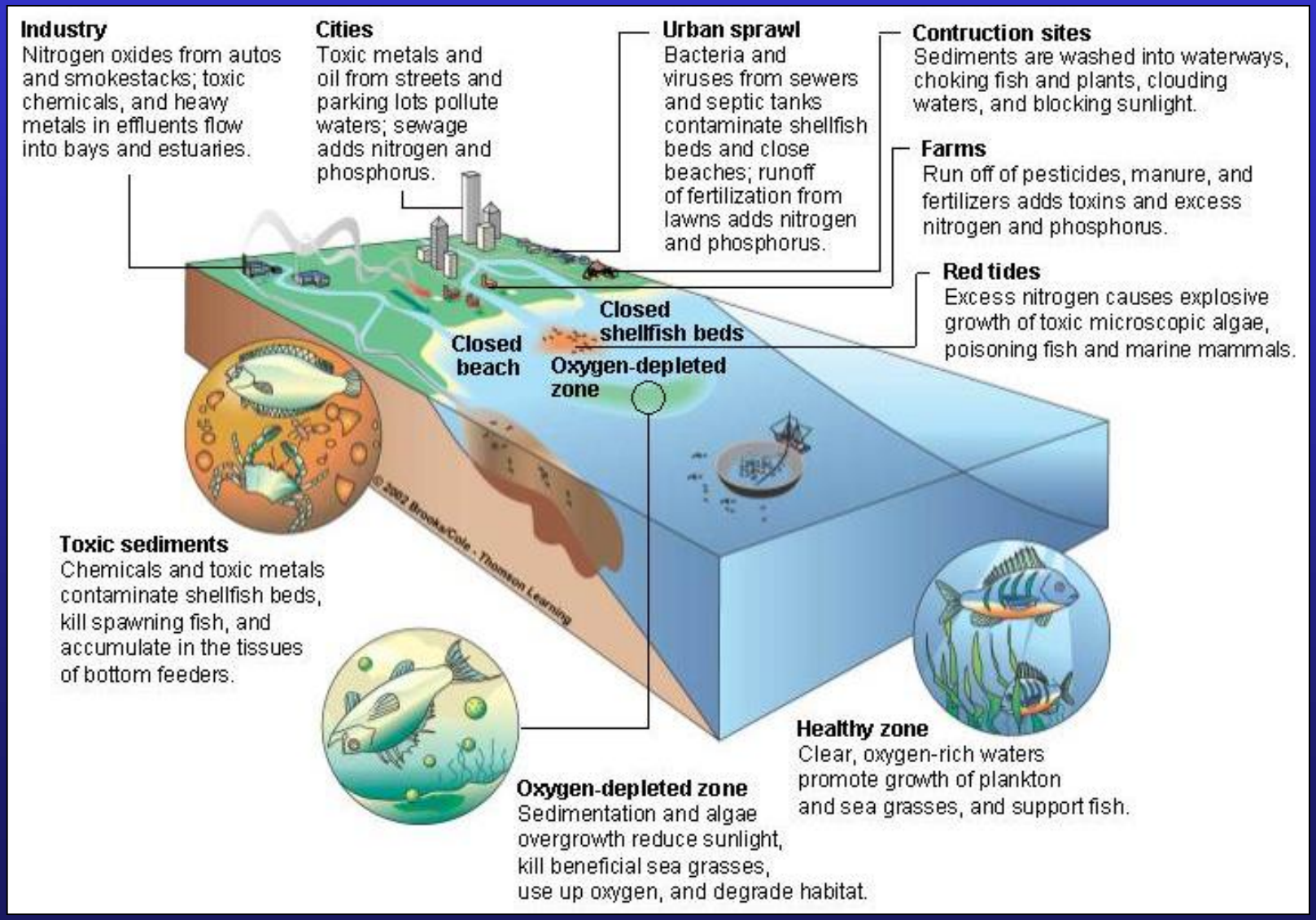
- Low flow rates
- Cold temperatures
- Few bacteria



Groundwater Pollution Prevention

- **Monitoring aquifers - expensive**
- **Leak detection systems**
- **Strictly regulating hazardous waste disposal**
- **Protecting recharge areas**
  - aquifer classifications

Ocean Pollution: dumping and oil



Oil Spills

- Sources: offshore wells, tankers, pipelines and storage tanks
- Effects: death of organisms, loss of animal insulation and buoyancy, smothering
- Significant economic impacts
- Short-term cleanup problems - beaches, wildlife
- Long-term cleanup problem - persistence (decades)

Solutions: Preventing and Reducing Surface Water Pollution

Nonpoint Sources

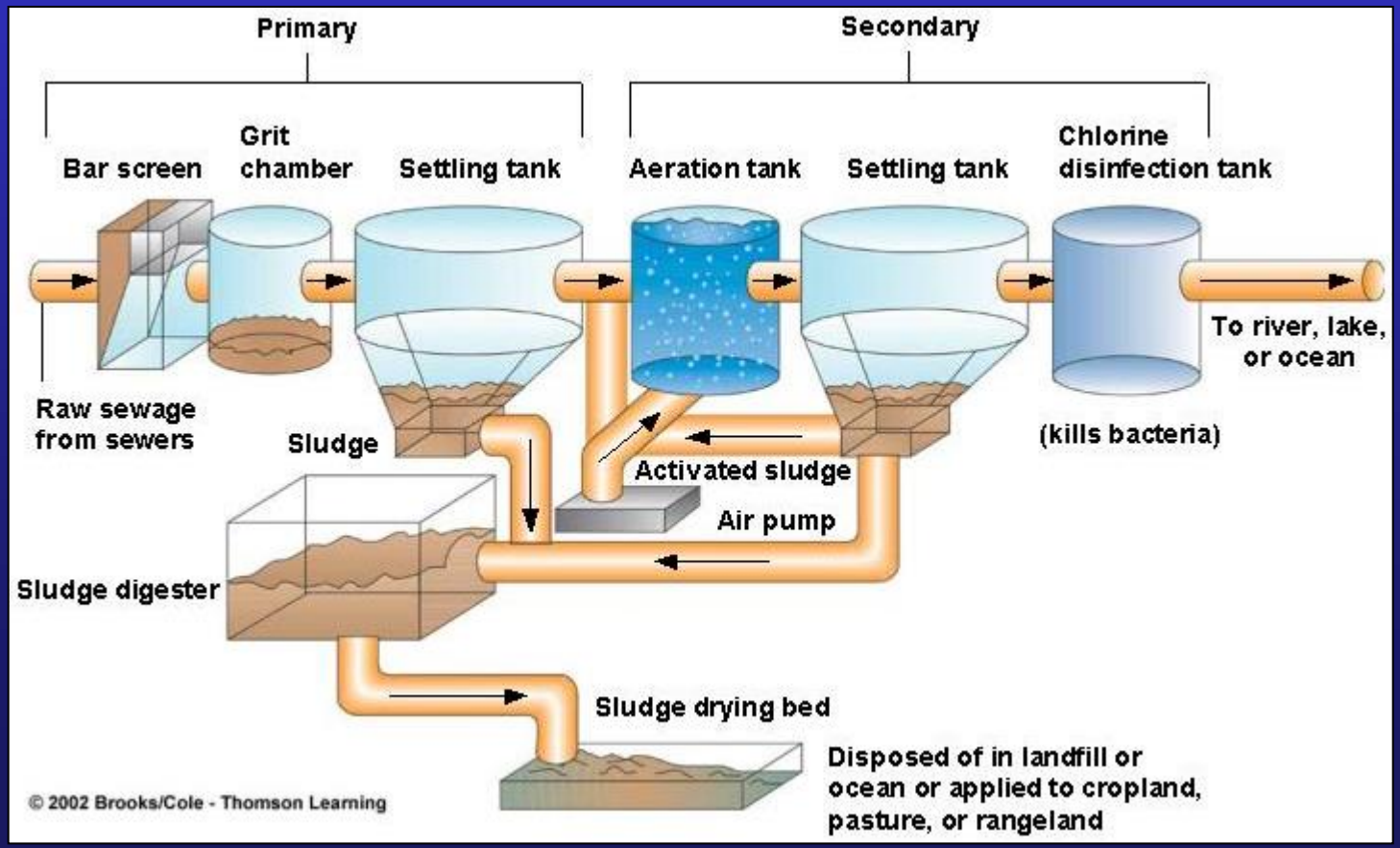
- **Reduce runoff**
- **Buffer zone vegetation**
- **Reduce soil erosion**

Point Sources

- **Water Pollution Control Act (1972)**
- **Clean Water Act (1977)**
  - **- set effluent standards**
  - **- secondary treatment**

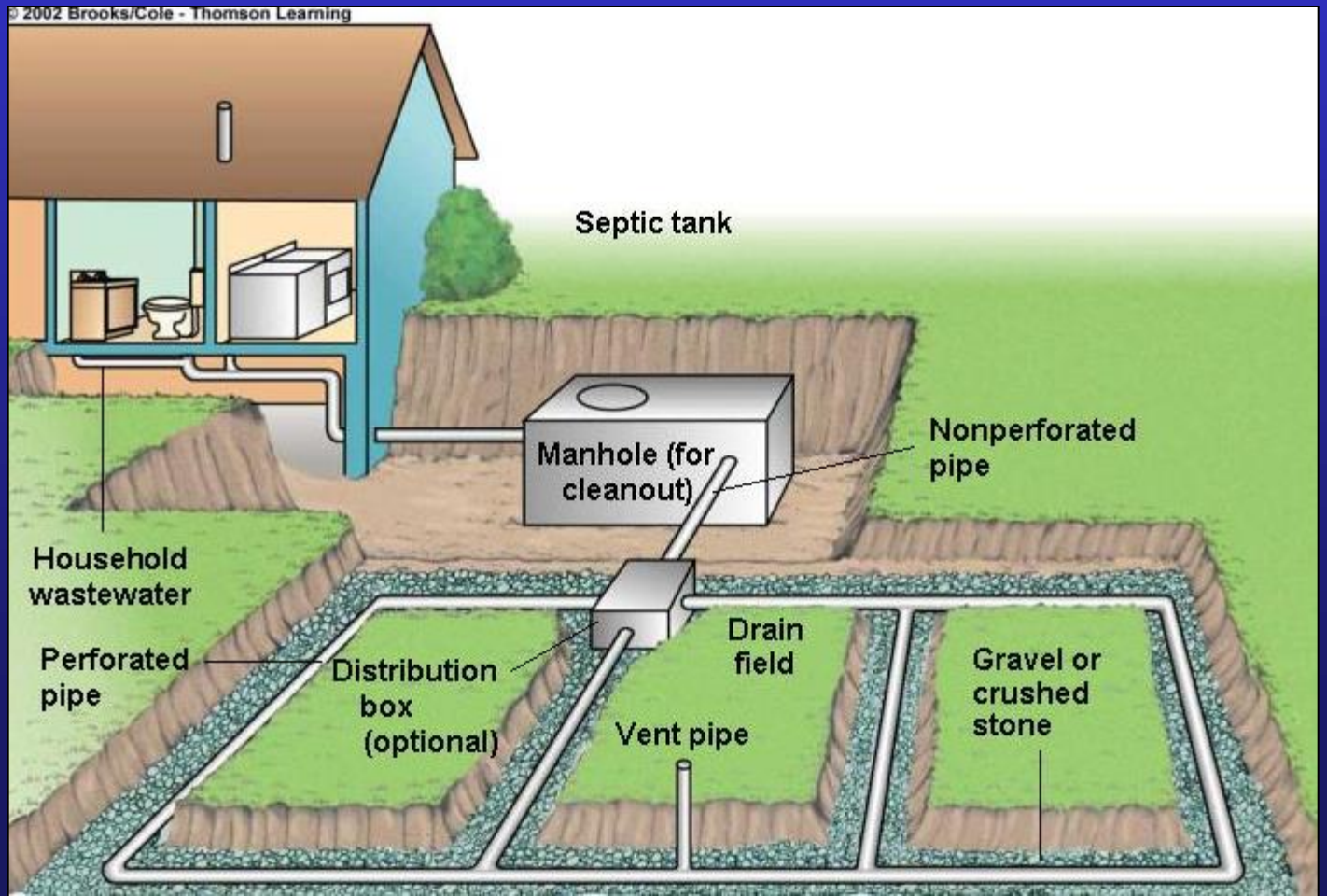
Technological Approach: Sewage Treatment

- Mechanical and biological treatment

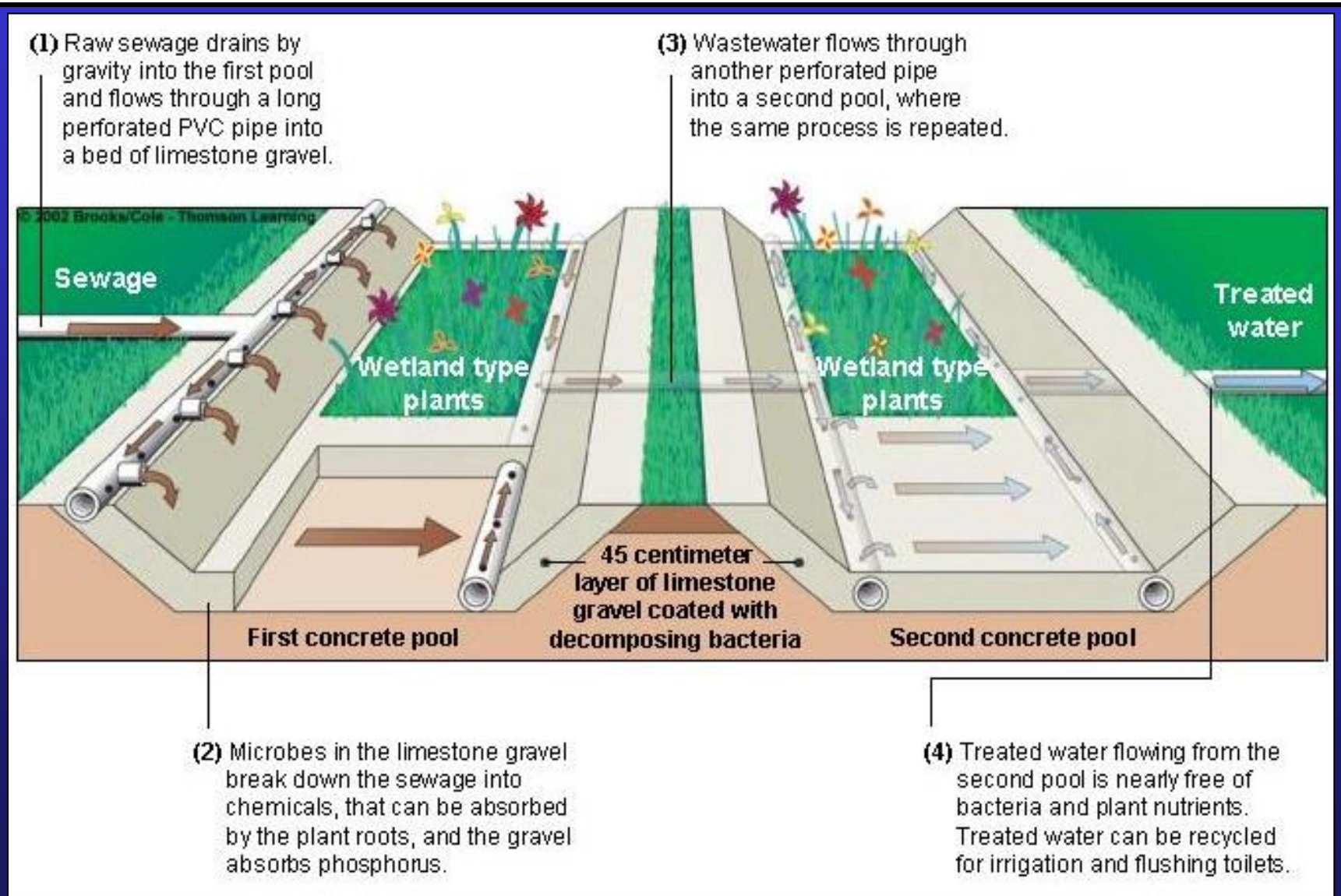


Technological Approach: Septic Systems

- Require suitable soils and maintenance



Technological Approach: Using Wetlands to Treat Sewage

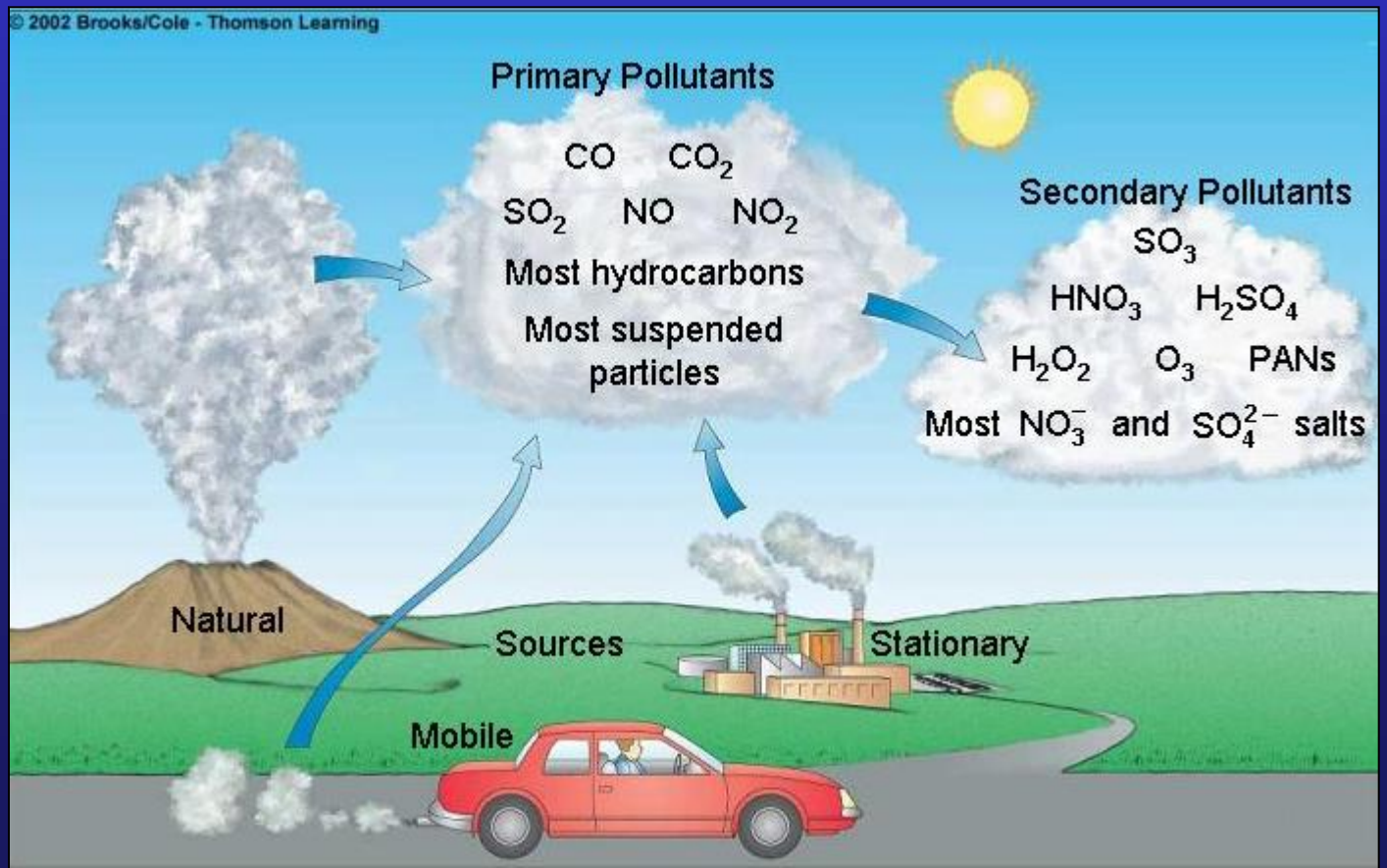


Air Pollution

- Harmful to life or materials
- Materials - soiled, corrosion of metals
- Plants - stunting, damage (crops, forests)
- Animals - respiratory, nervous system damage
- Humans - eye irritation, headache, dizziness, bronchitis, emphysema, cancer
  - young, old, heart and lung patients susceptible

Air Pollution

- Primary pollutants
- Secondary pollutants



Natural Sources - most primary pollutants

- **Decay processes, winds, volcanic eruptions, sea spray**

- **Widely dispersed**
  - do not reach harmful levels

Human Sources - more important

- Concentrated where the people are

1) Stationary fuel combustion

2) Industry

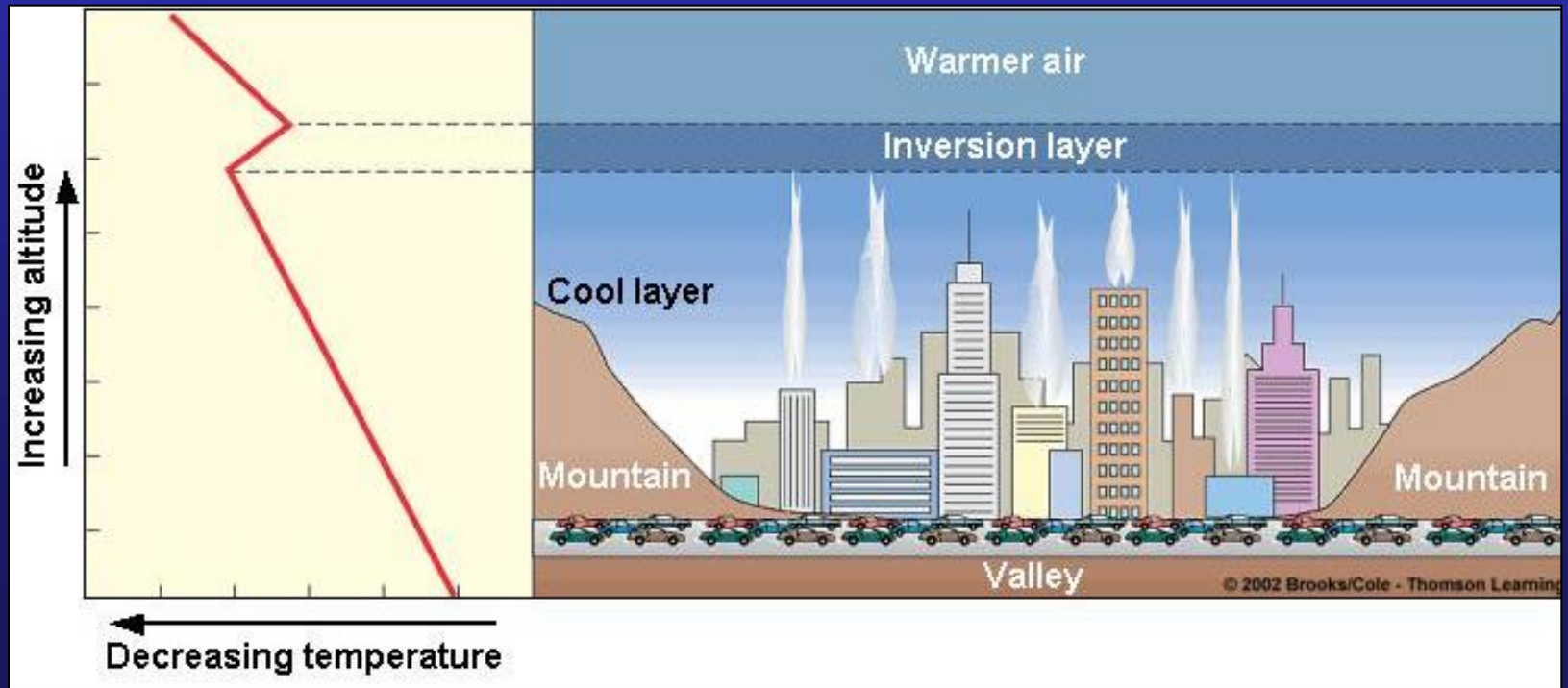
3) Transportation

Air pollution problems influenced by:

- **Topography (thermal inversions)**
- **Climate (cool-moist, warm-dry)**

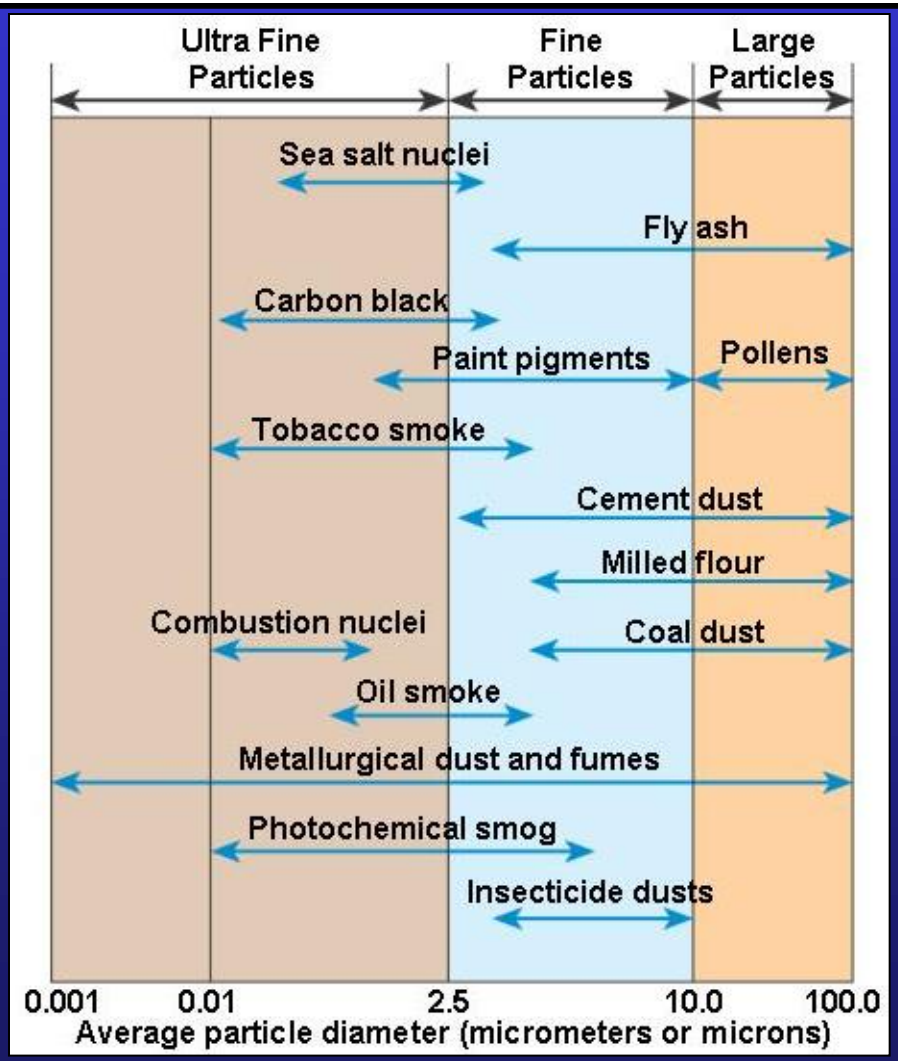
Temperature Inversions

- Especially in valleys
- Los Angeles, Denver, Winona



Industrial Smog

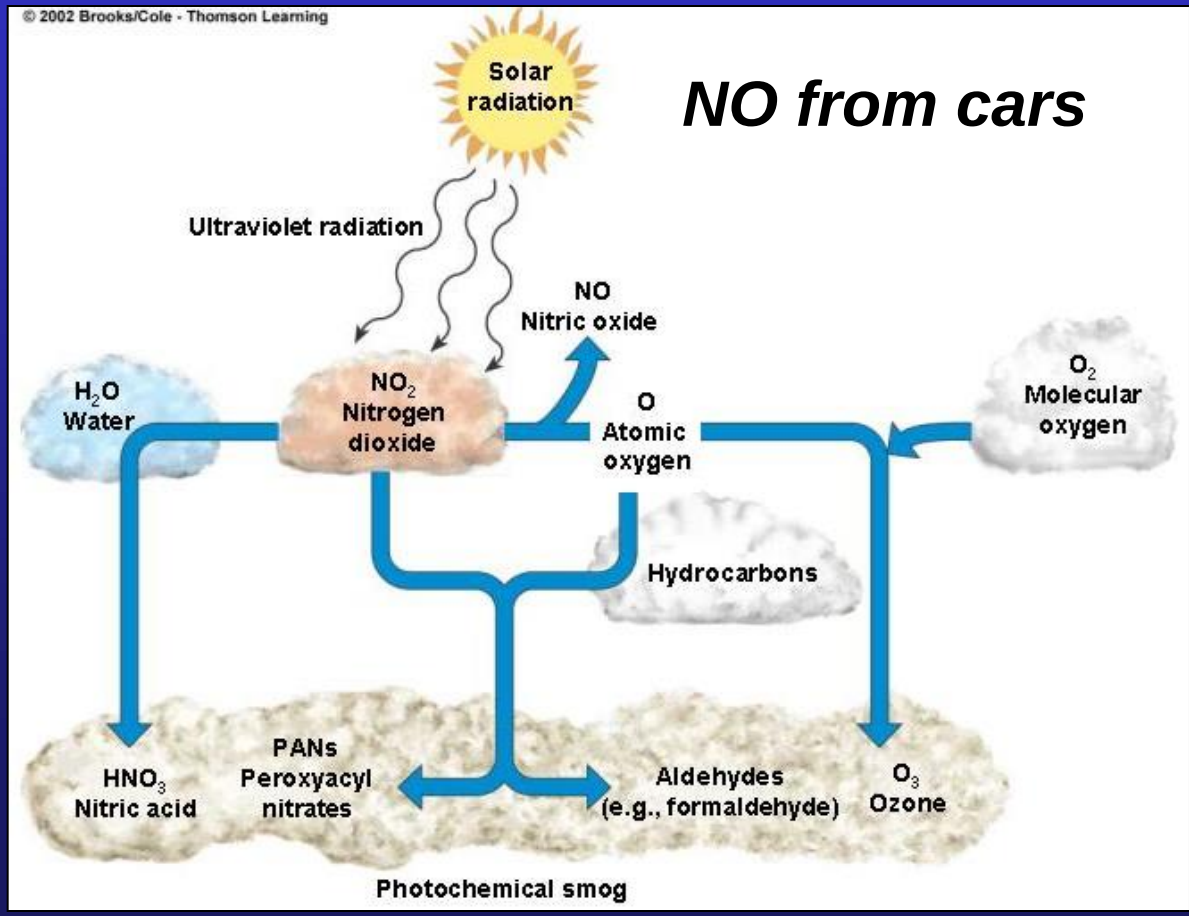
- Cool, moist
- Primary pollutants
- Worst in winter, at night
- Chicago, London



Photochemical Smog

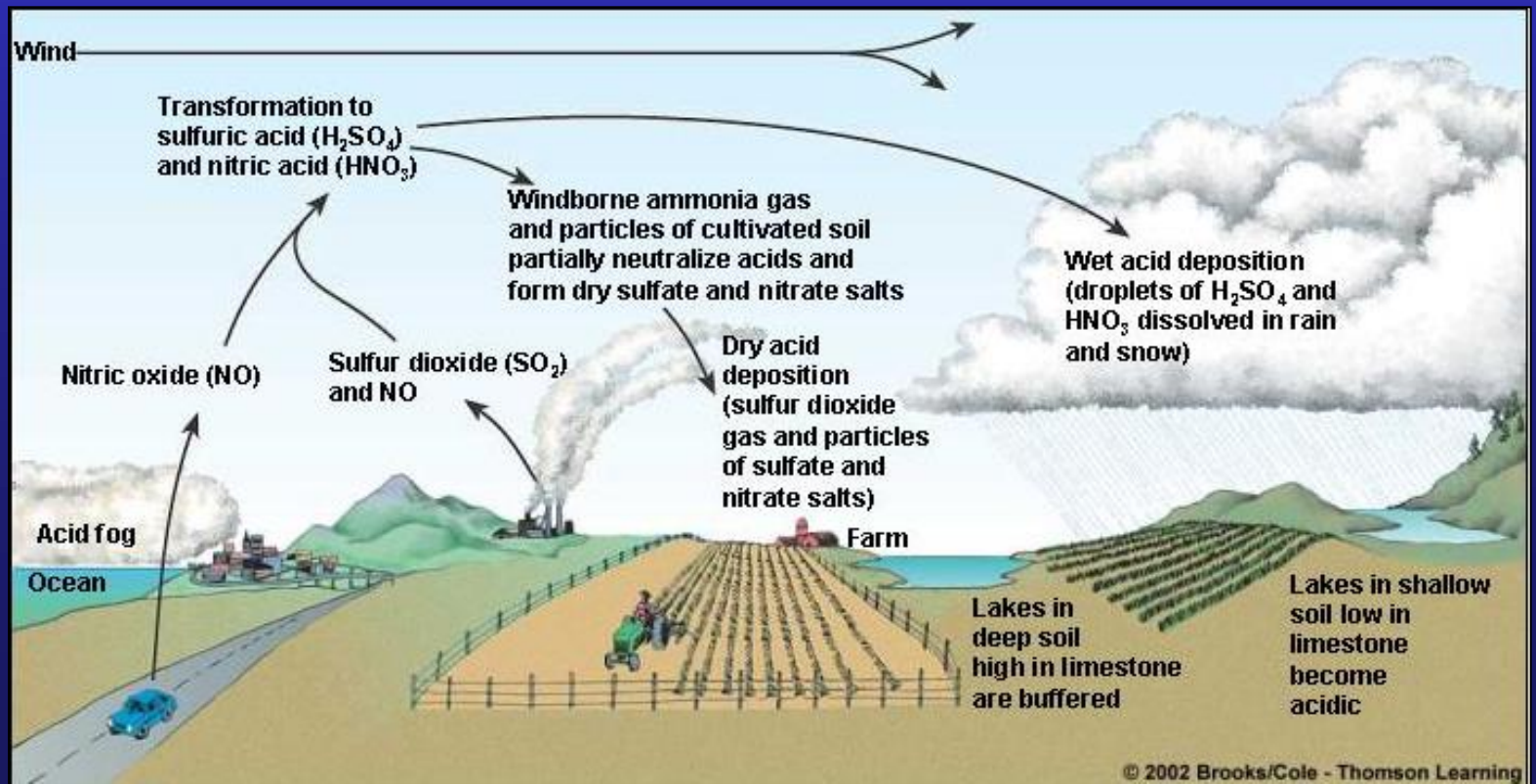
- Warm, dry
- Secondary pollutants
- Worst in summer, midday

Los Angeles

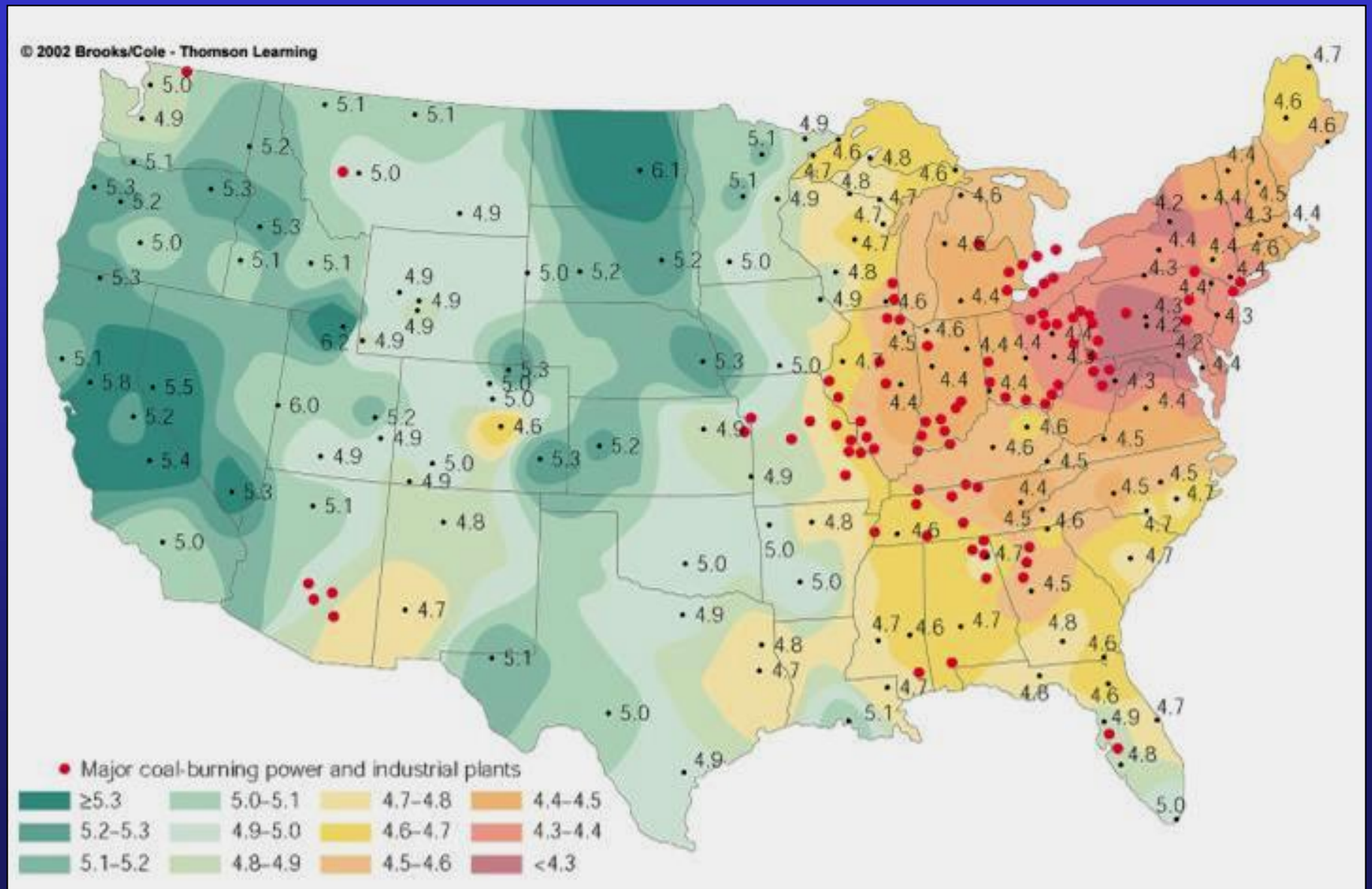


Widespread Secondary Air Pollution: Acid Deposition

- Wet deposition
- Dry deposition

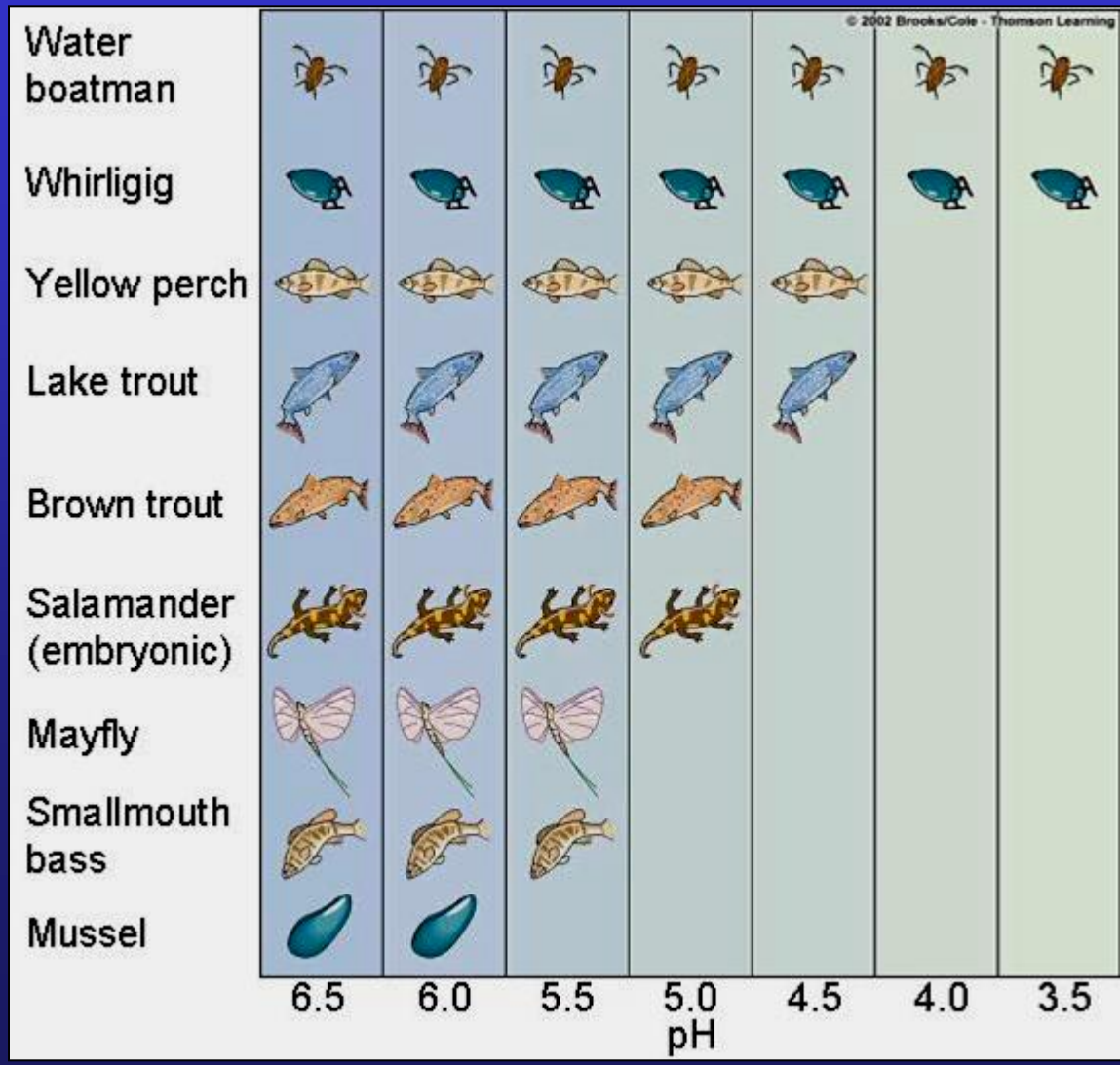


Acid Deposition in the U.S.



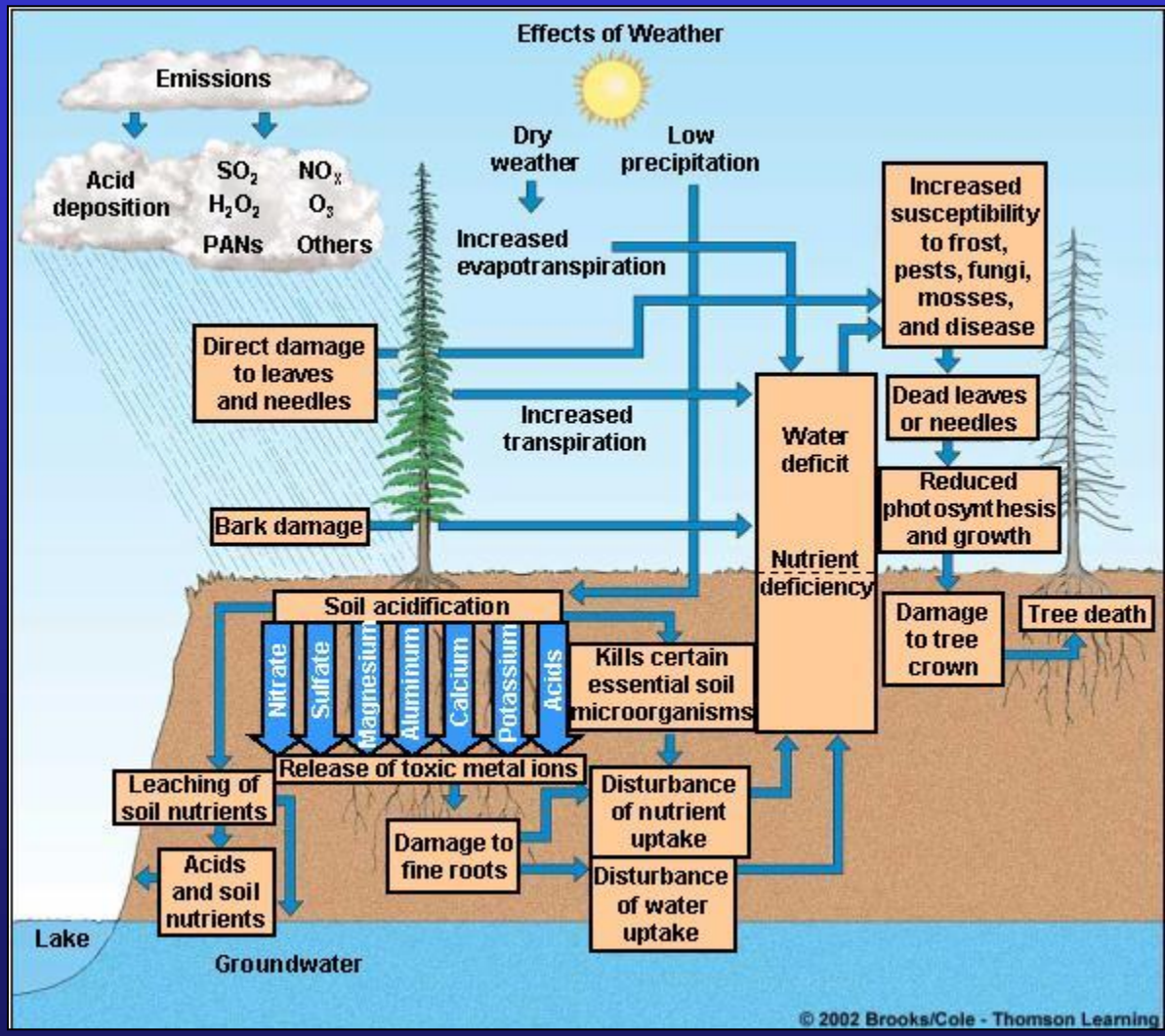
Acid Deposition and Aquatic Systems

- Fish declines
- Undesirable species
- Aluminum toxicity
- Acid shock



Acid Deposition, Plants, and Soil

- Nutrient leaching
- Heavy metal release
- Weakens trees



Industrial Smog Control - sulfur dioxide and particulates

- **Burn less fossil fuels**
- **Use alternative energy sources**
- **Burn low-sulfur coal**
- **Remove sulfur from coal (chemicals)**
- **Stack scrubbers, electrostatic precipitators**

Photochemical Smog Control - nitrous oxide emissions

- **Use mass transit**
- **Develop new engines**
- **Develop new fuels**
- **Develop new emission controls**

Solutions: Preventing and Reducing Air Pollution

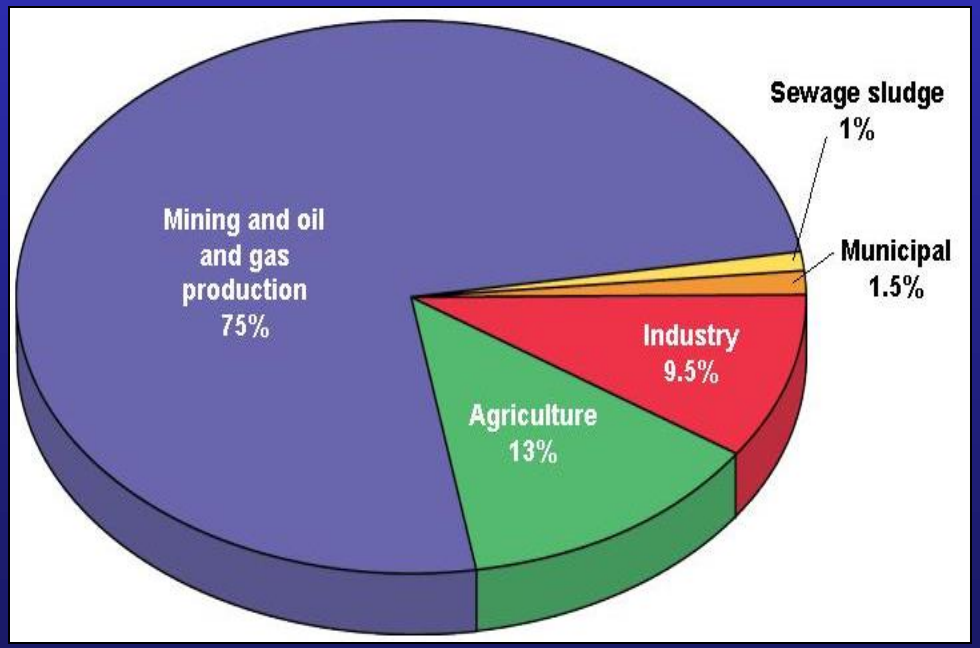
- **Clean Air Acts (1970, 1977)**

1) **Industrial emissions standards**
2) **Automotive emissions standards**
3) **Deadlines for meeting standards**

- **Standards becoming stricter, requests to extend deadlines**
  - better technology needed

Waste Management

- Industrial and agricultural waste
- Municipal solid waste



- Hazardous wastes

Solid Waste in U.S. >300 lbs/person/day

- **Agriculture - 13%**
- **Mining wastes - 75%**
- **Industries - 9.5% (fly ash)**
- **Municipal - 1.5% (4.6 lbs. per person, 70% paper, food, yard wastes)**
- **Sewage sludge - 1%**

U.S. Municipal Wastes

- Multi-billion dollar industry

- Resource Conservation and Recovery Act - 1976
  - outlawed open dumping

Managing Today's Wastes

- Sanitary landfill - 54%
- Recycling and composting - 30%
- Incineration - 16% (dioxin)

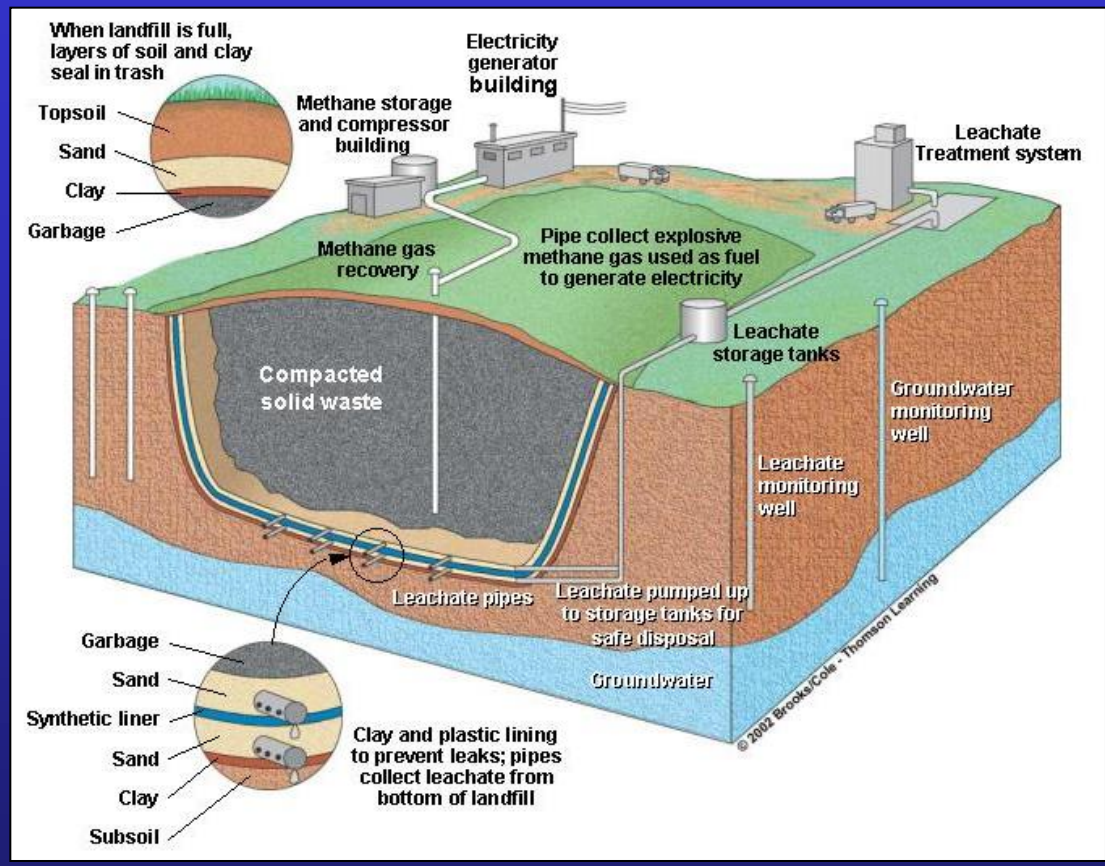
Sanitary Landfill

1) Synthetic liner

2) Earth cover

3) Leachate collection system

4) Methane venting



Changing Landfills

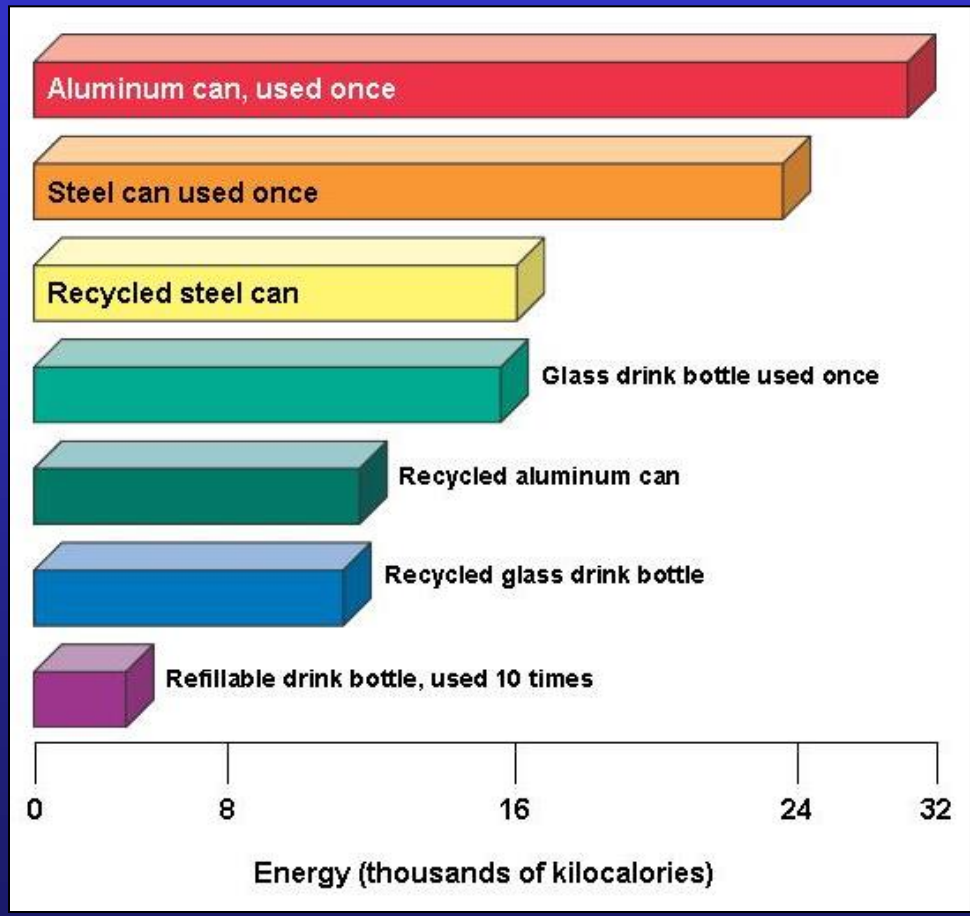
- **Filling up rapidly**
- **Difficult finding new sites**

  - restrictions

  - NIMBY - NOT IN MY BACK YARD!

Recycling

- Easily isolated from other wastes
- Large quantities (60-80% of wastes)
- Valuable

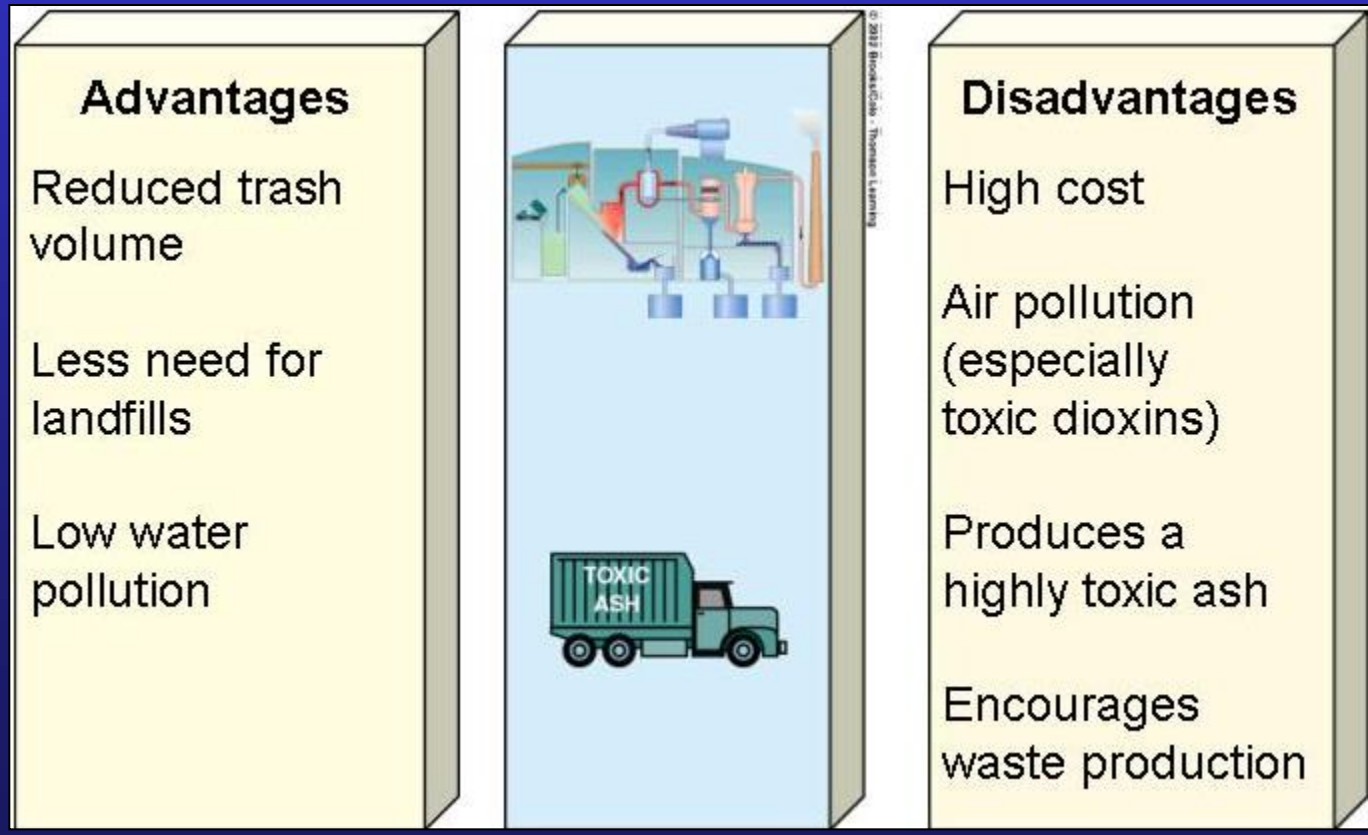


Recycling Aluminum, Wastepaper, and Plastics

- **40% of aluminum recycled in US**
- **Recycled aluminum uses over 90% fewer resources**
- **Paper: preconsumer vs. postconsumer recycling**
- **10% or less of plastic recycled in US**
- **Plastics can be very difficult to recycle**

Burning Wastes

- Mass burn incineration
- Air pollution
- Waste to energy



Hazardous Wastes

- U.S. - >1 ton/person/year

Today's Management

1) reduce, reuse, recycle (5%)

Today's Management

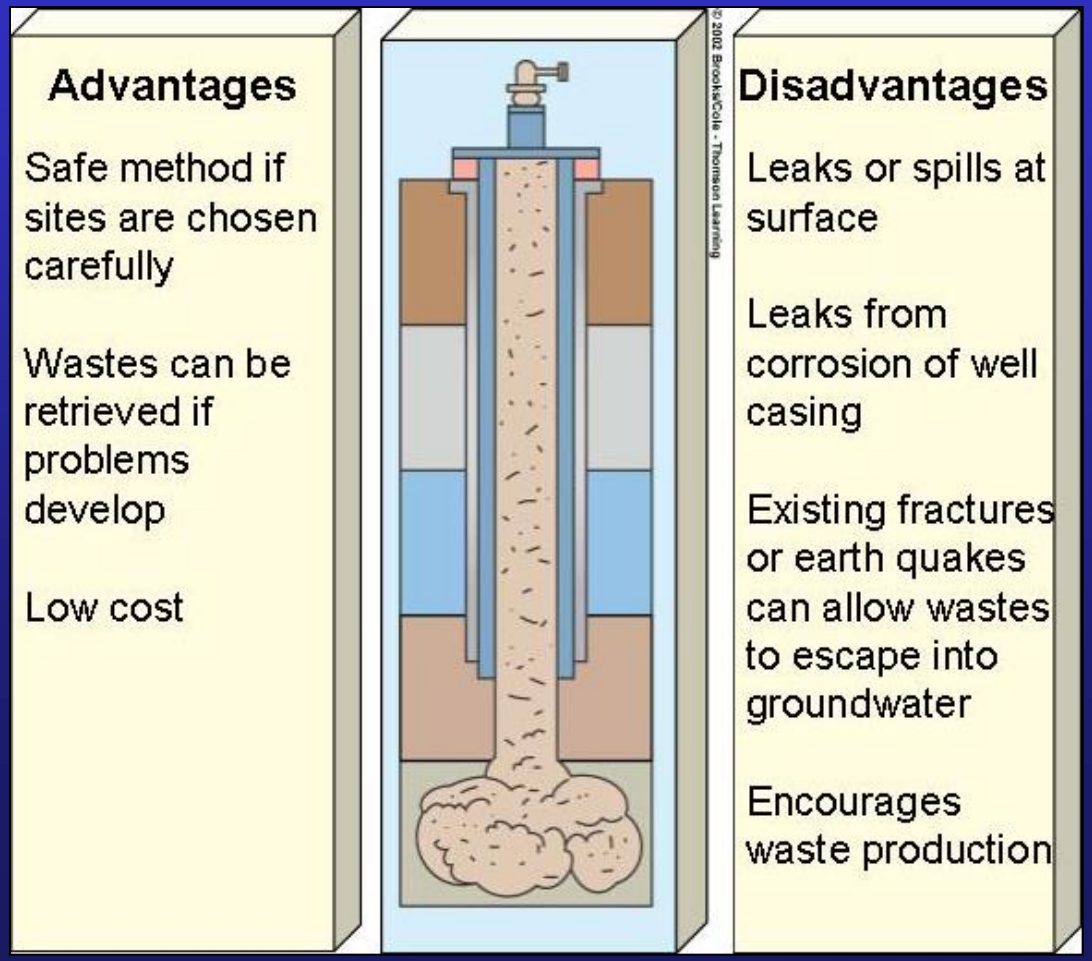
2) detoxification, incineration (5%)

- **Physical reactions**
- **Chemical reactions**
- **Landfarming**
- **Burning**

Today's Management

3) Land disposal (90%)

- Landfills, pits, lagoons, injection wells, "midnight dumping", sewage systems, surface waters



Hazardous Waste Regulation in the United States

- **Resource Conservation and Recovery Act**
- **EPA identifies hazardous wastes, sets standards for management**
- **Superfund - established to clean up hazardous waste sites**
- **Love Canal - Hooker Chemical plant in suburban Niagara Falls, NY**