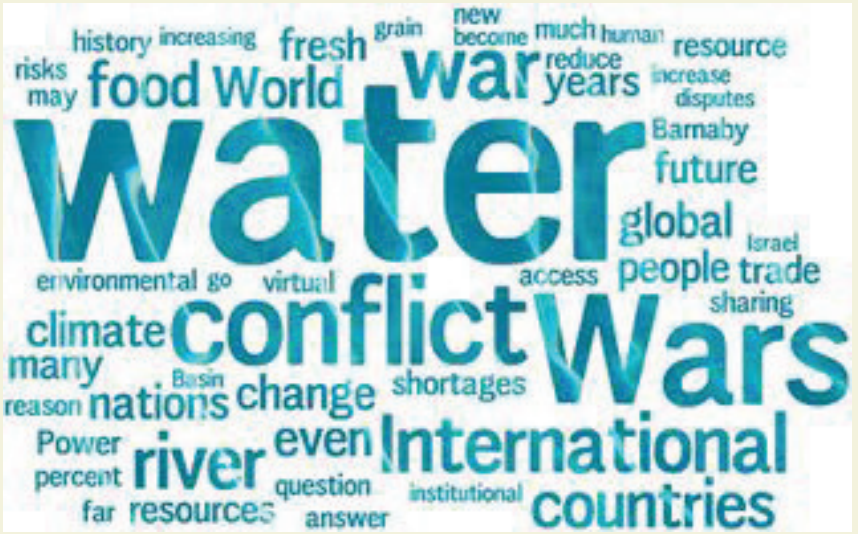
13-1 Will We Have Enough Usable Water?

Concept 13-1A *We are using available freshwater unsustainably by wasting it, polluting it, and charging too little for this irreplaceable natural resource.*

Concept 13-1B *One of every six people does not have sufficient access to clean water, and this situation will almost certainly get worse.*

Freshwater Is an Irreplaceable Resource That We Are Managing Poorly (1)

- Why is water so important?
- Earth as a watery world: 71% of surface
- Poorly managed resource
- Water waste
- Water pollution



Freshwater Is an Irreplaceable Resource That We Are Managing Poorly (2)

- Access to water is
  - A global health issue
  - An economic issue
  - A women's and children's issue
  - A national and global security issue

Girl Carrying Well Water over Dried Out Earth during a Severe Drought in India

Fig. 13-3, p. 319

Most of the Earth's Freshwater Is Not Available to Us

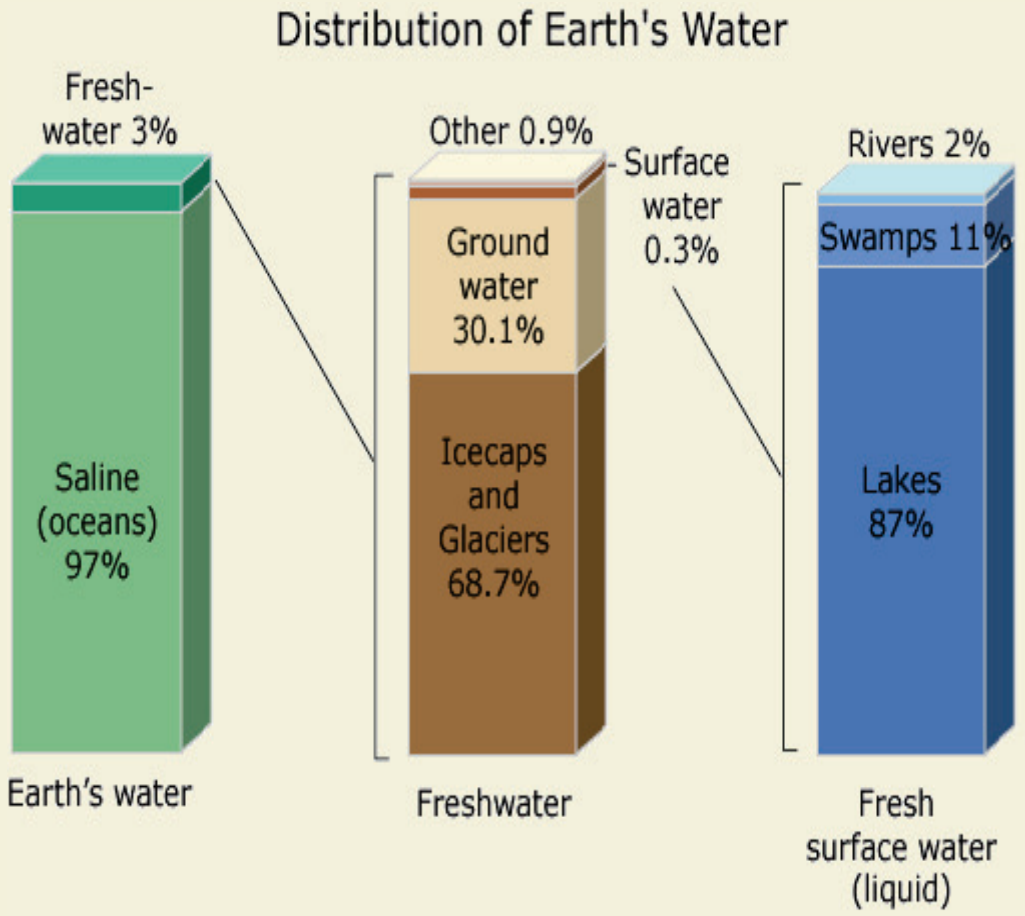
Freshwater availability:

0.024%

- **Groundwater, lakes, rivers, streams**

Hydrologic cycle

- **Movement of water in the seas, land, and air**
- **Driven by solar energy and gravity**



Groundwater and Surface Water Critical Resources

Zone of saturation

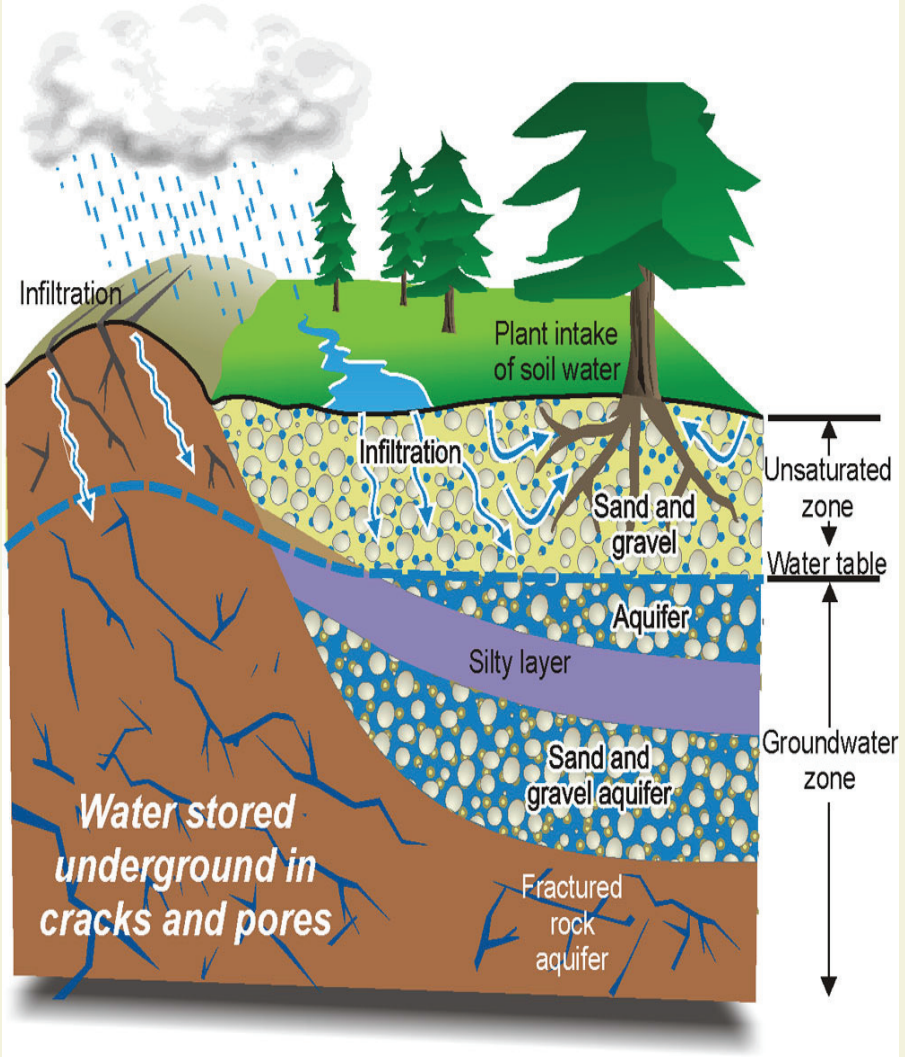
- Spaces in soil are filled with water

Water table

- Top of zone of saturation

Aquifers

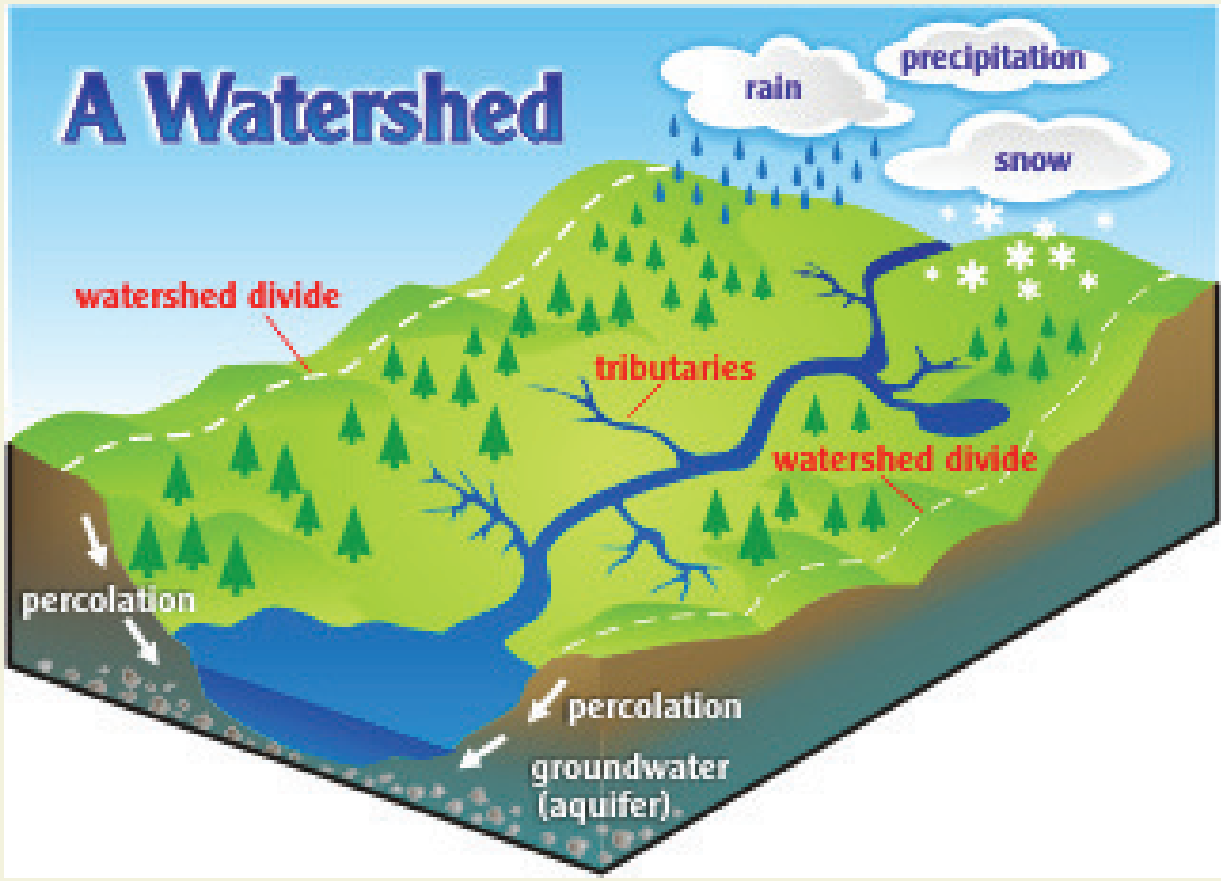
- Natural recharge
- Lateral recharge



Groundwater and Surface Water Critical Resources

Surface Water

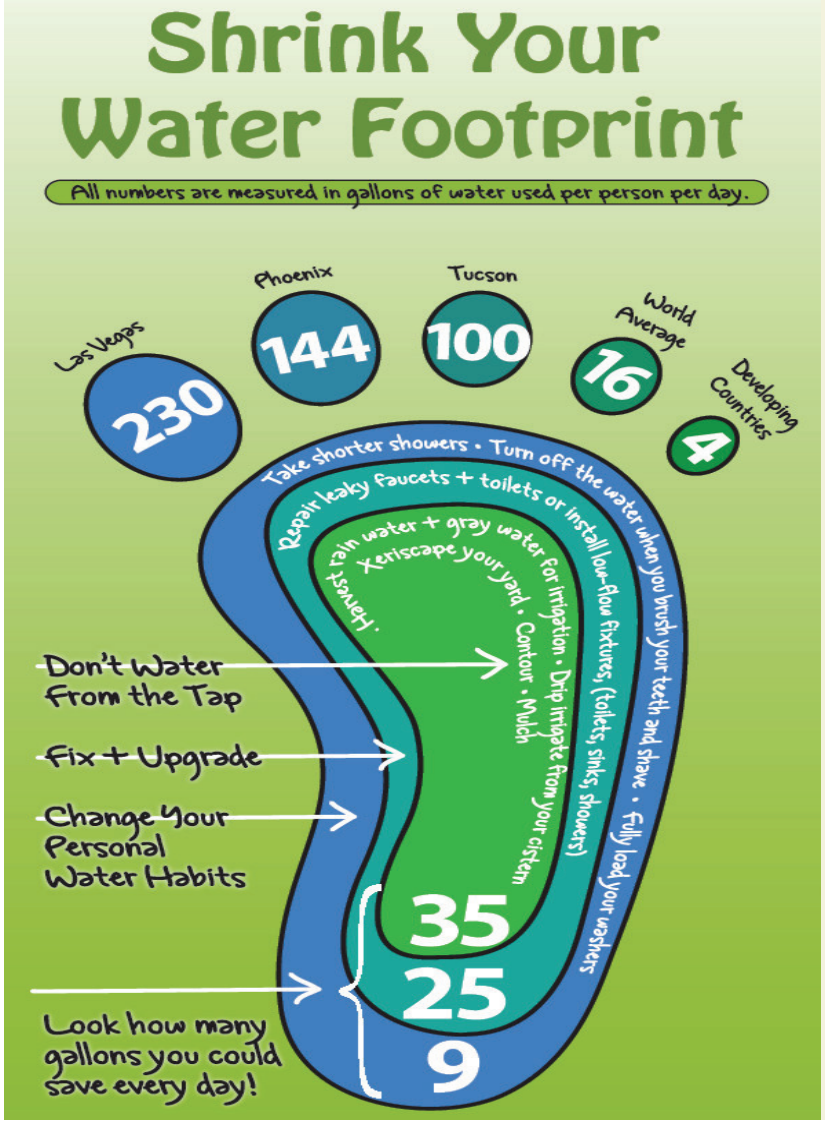
- Surface runoff
- Watershed (drainage) basin



We Use Much of the World's Reliable Runoff

- 2/3 of the surface runoff: lost by seasonal floods
- 1/3 is **reliable runoff** = usable
- World-wide averages
  - Domestic: 10%
  - Agriculture: 70%
  - Industrial use: 20%

Science Focus: Water Footprints



Water footprint

- **Volume of water we directly and indirectly**

Average American uses 260 L per day

- **Flushing toilets, 27%**
- **Washing clothes, 22%**
- **Taking showers, 17%**
- **Running faucets, 16%**
- **Wasted from leaks, 14%**
- **World's poorest use 19 liters per day**

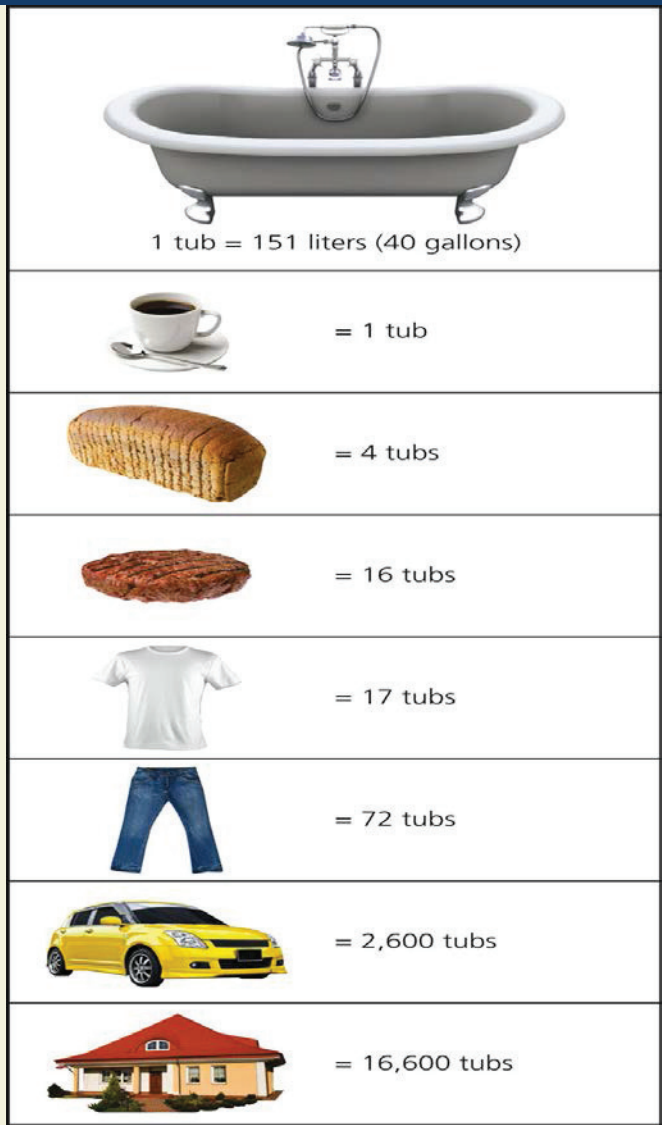
Science Focus: Virtual Water

More water is used indirectly = **virtual water**

- Hamburger, 2400 liters

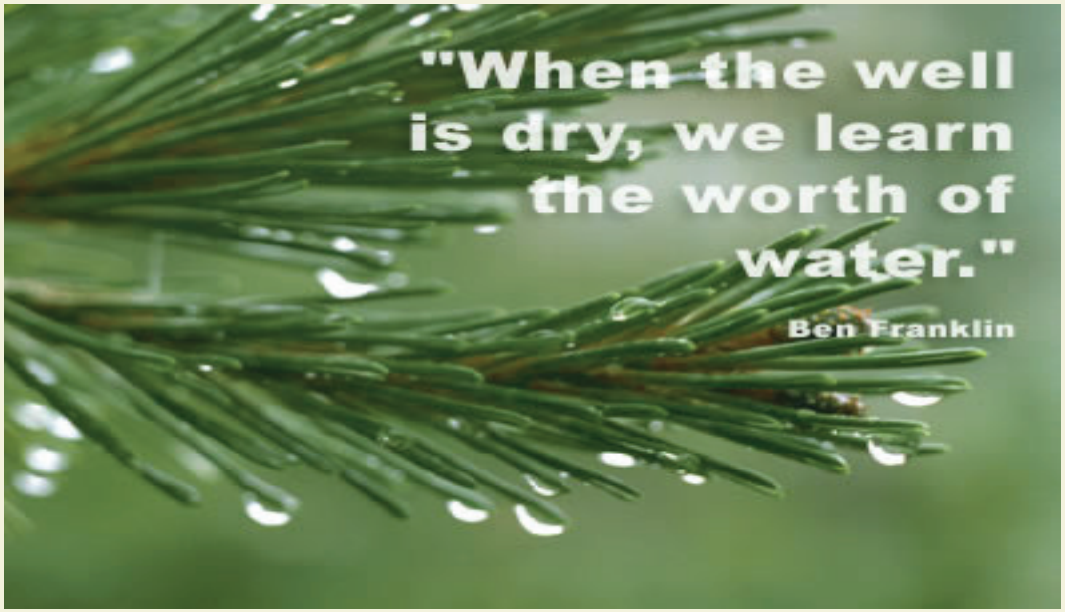
Virtual water often exported/imported

- Grains and other foods



13-6 How Can We Use Water More Sustainably?

Concept 13-6 *We can use water more sustainably by cutting water waste, raising water prices, slowing population growth, and protecting aquifers, forests, and other ecosystems that store and release water.*



Science Focus: The Search for Improved Desalination Technology

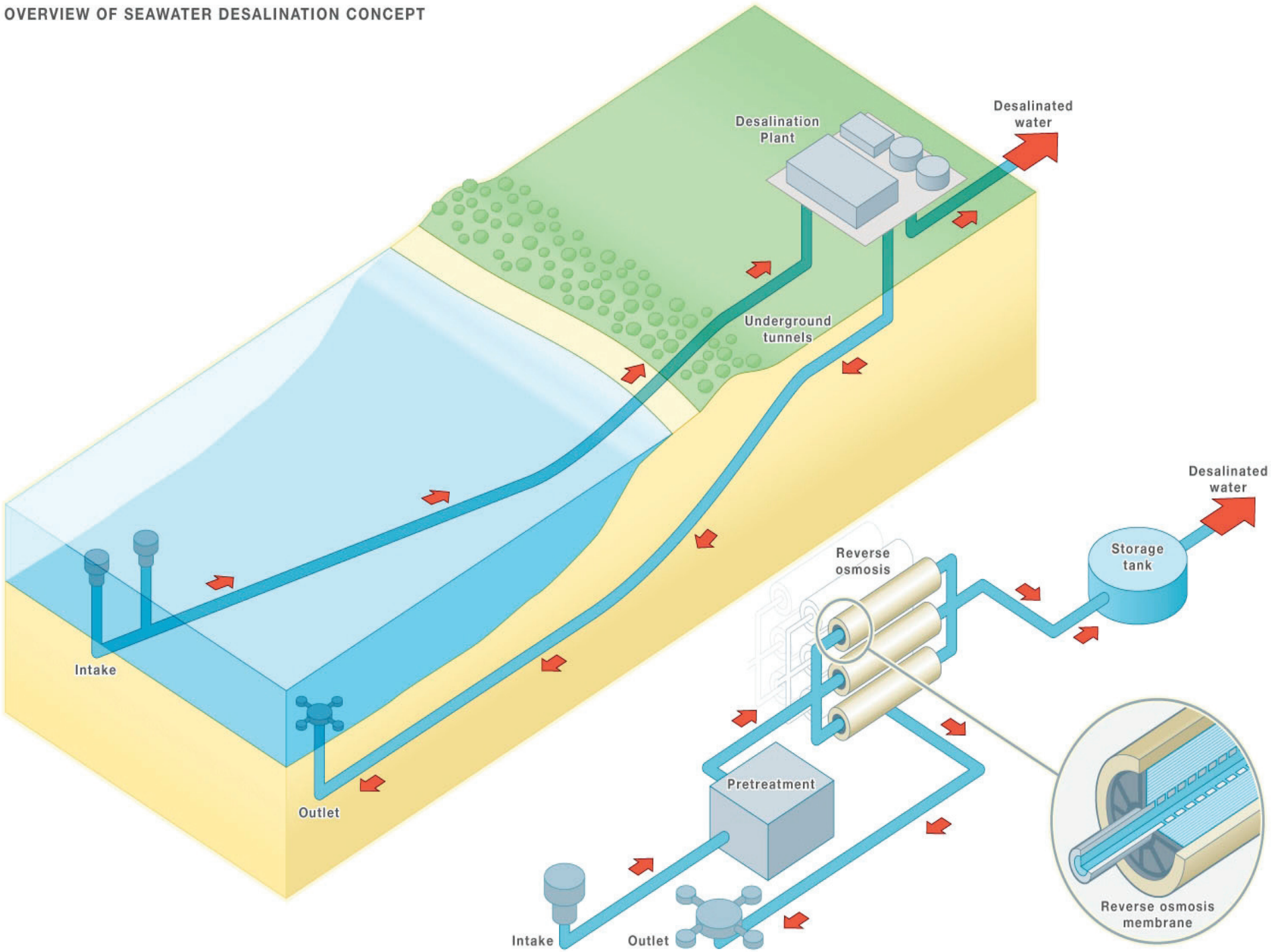
- Desalination on offshore ships
  - Solar or wind energy
- Use ocean waves for power
- Build desalination plants near electric power plants

Removing Salt from Seawater Environmental Costs

Problems

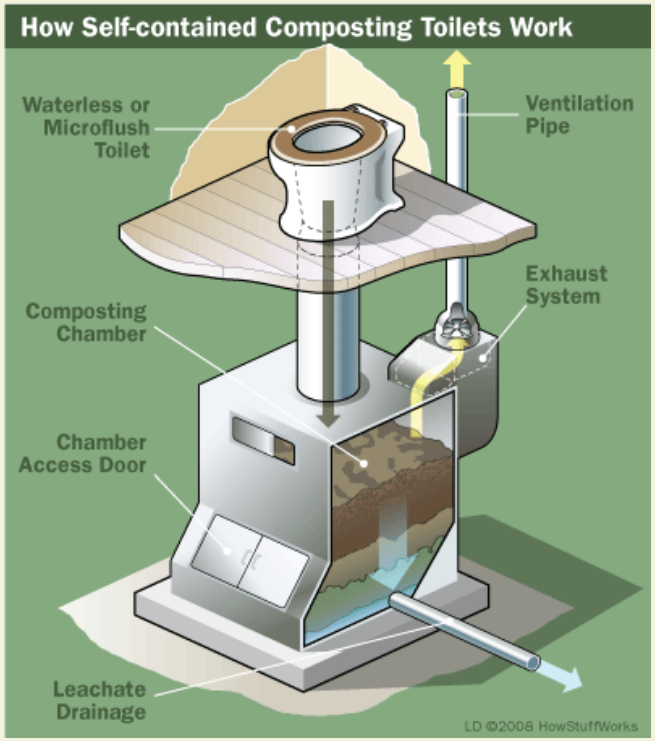
1. High cost and energy footprint
2. Keeps down algal growth and kills many marine organisms
3. Large quantity of brine wastes

OVERVIEW OF SEAWATER DESALINATION CONCEPT



We Can Use Less Water to Remove Wastes

- Can we mimic how nature deals with waste?
- Use human sewage to create nutrient-rich sludge to apply to croplands
- Waterless composting toilets



Solutions: Sustainable Water Use

Solutions

Sustainable Water Use

- Waste less water and subsidize water conservation
- Do not deplete aquifers
- Preserve water quality
- Protect forests, wetlands, mountain glaciers, watersheds, and other natural systems that store and release water
- Get agreements among regions and countries sharing surface water resources
- Raise water prices
- Slow population growth

Fig. 13-23, p. 339

What Can You Do? Water Use and Waste

Fig. 13-24, p. 339

13-7 How Can We Reduce the Threat of Flooding?

Concept 13-7 *We can lessen the threat of flooding by protecting more wetlands and natural vegetation in watersheds, and by not building in areas subject to frequent flooding.*

Flood Plains: Too Much Water

Flood plains

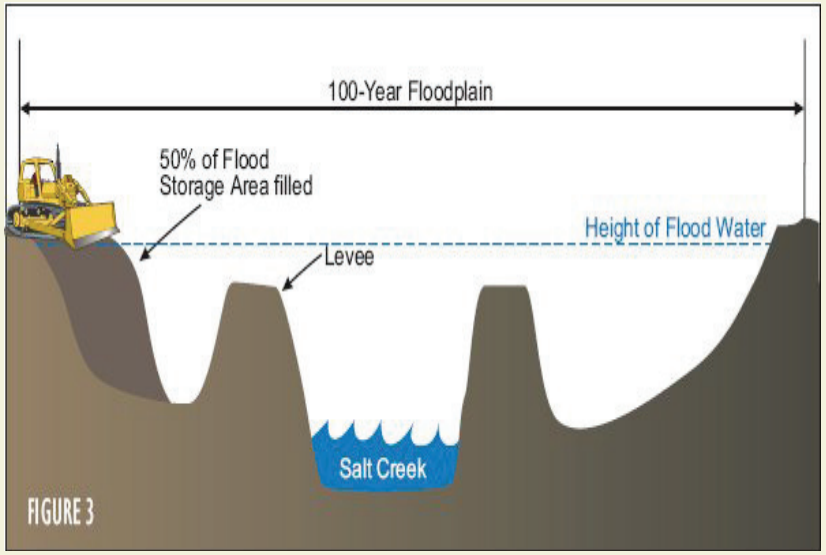
- Highly productive wetlands
- Provide natural flood and erosion control
- Maintain high water quality
- Recharge groundwater

Benefits of floodplains

- Fertile soils
- Nearby rivers for use and recreation
- Flatlands for urbanization and farming

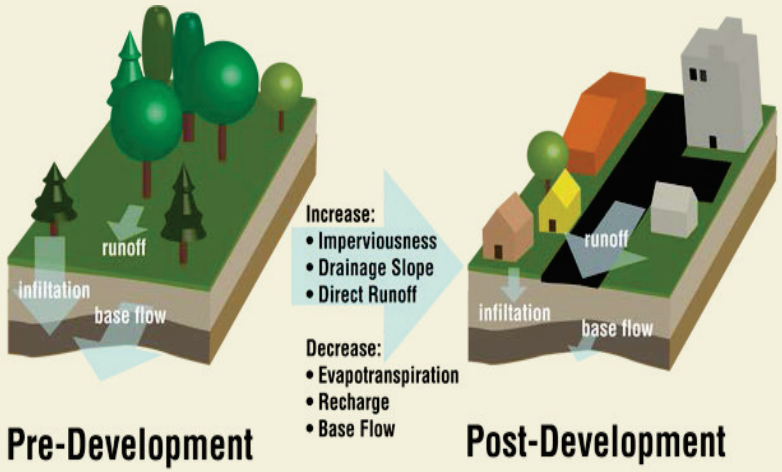
Human Activities Make Floods Worse

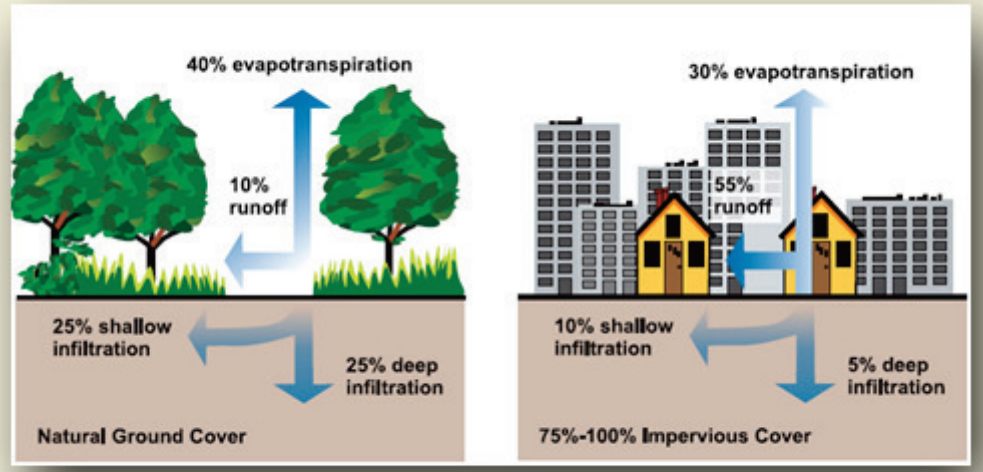
- Levees can break or be overtopped



Human Activities Make Floods Worse

- Paving and development increase runoff





Human Activities Make Floods Worse

- Removal of water-absorbing vegetation
- Draining wetlands and building on them
- Rising sea levels from global warming means more coastal flooding

Natural Capital Degradation: Hillside Before and After Deforestation

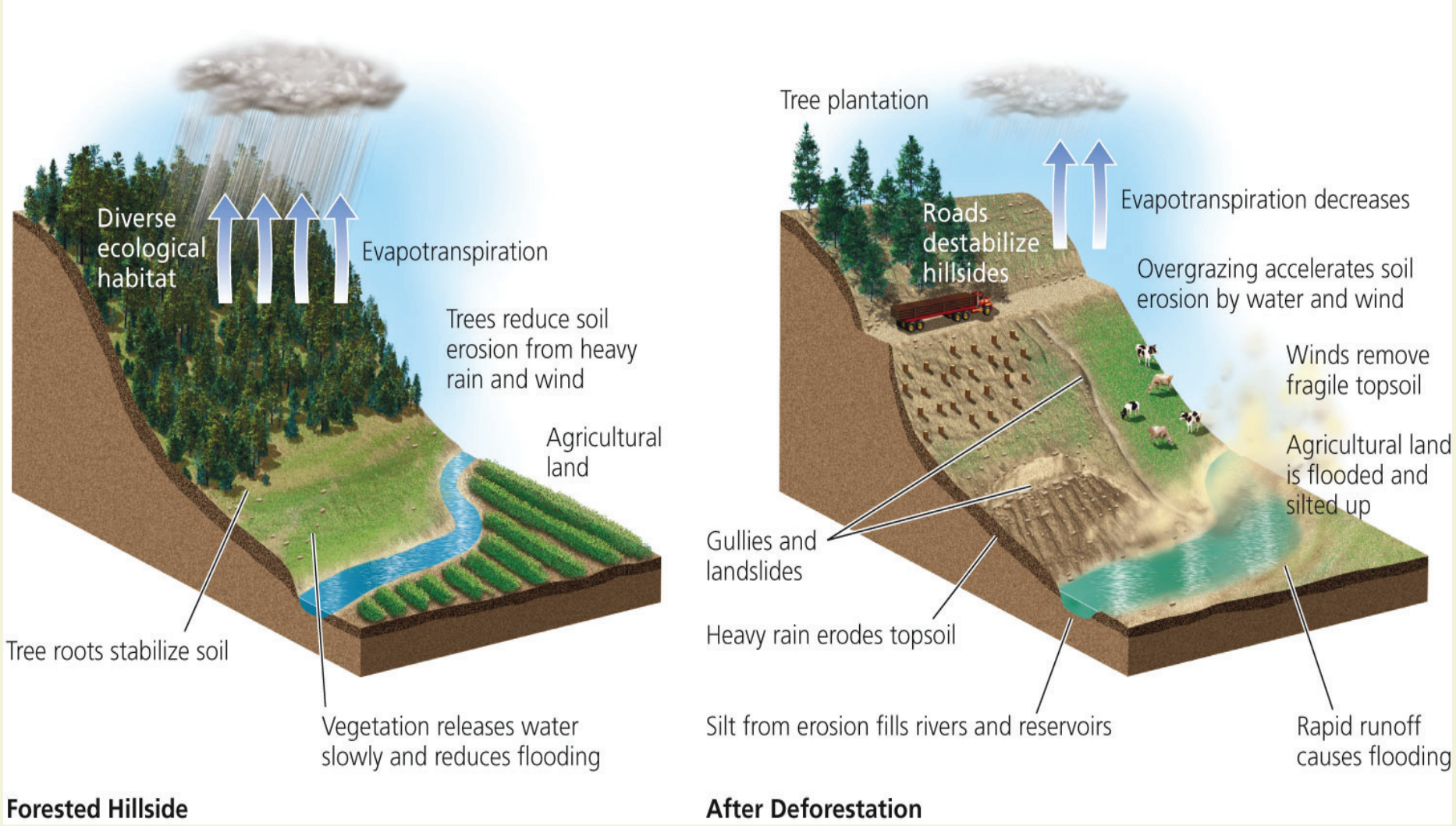


Fig. 13-25, p. 340

We Can Reduce Flood Risks

- Rely more on nature's systems
  - Wetlands
  - Natural vegetation in watersheds

- Rely less on engineering devices
  - Dams
  - Levees
  - Channelized streams

Solutions: Reducing Flood Damage

Solutions

Reducing Flood Damage

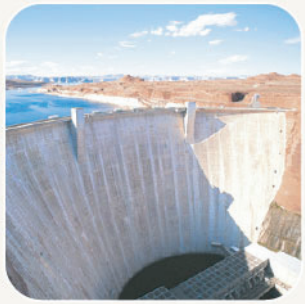
Prevention

Preserve forests on watersheds

Preserve and restore wetlands in floodplains

Tax development on floodplains

Use floodplains primarily for recharging aquifers, sustainable agriculture and forestry



Control

Straighten and deepen streams (channelization)

Build levees or floodwalls along streams

Build dams

Fig. 13-27, p. 342

Three Big Ideas

1. One of the world's major environmental problems is the growing shortage of freshwater in many parts of the world.

2. We can increase water supplies in water-short areas in a number of ways, but the most important way is to reduce overall water use and waste by using water more sustainably.

Three Big Ideas

3. We can use water more sustainably by cutting water waste, raising water prices, slowing population growth, and protecting aquifers, forests, and other ecosystems that store and release water.