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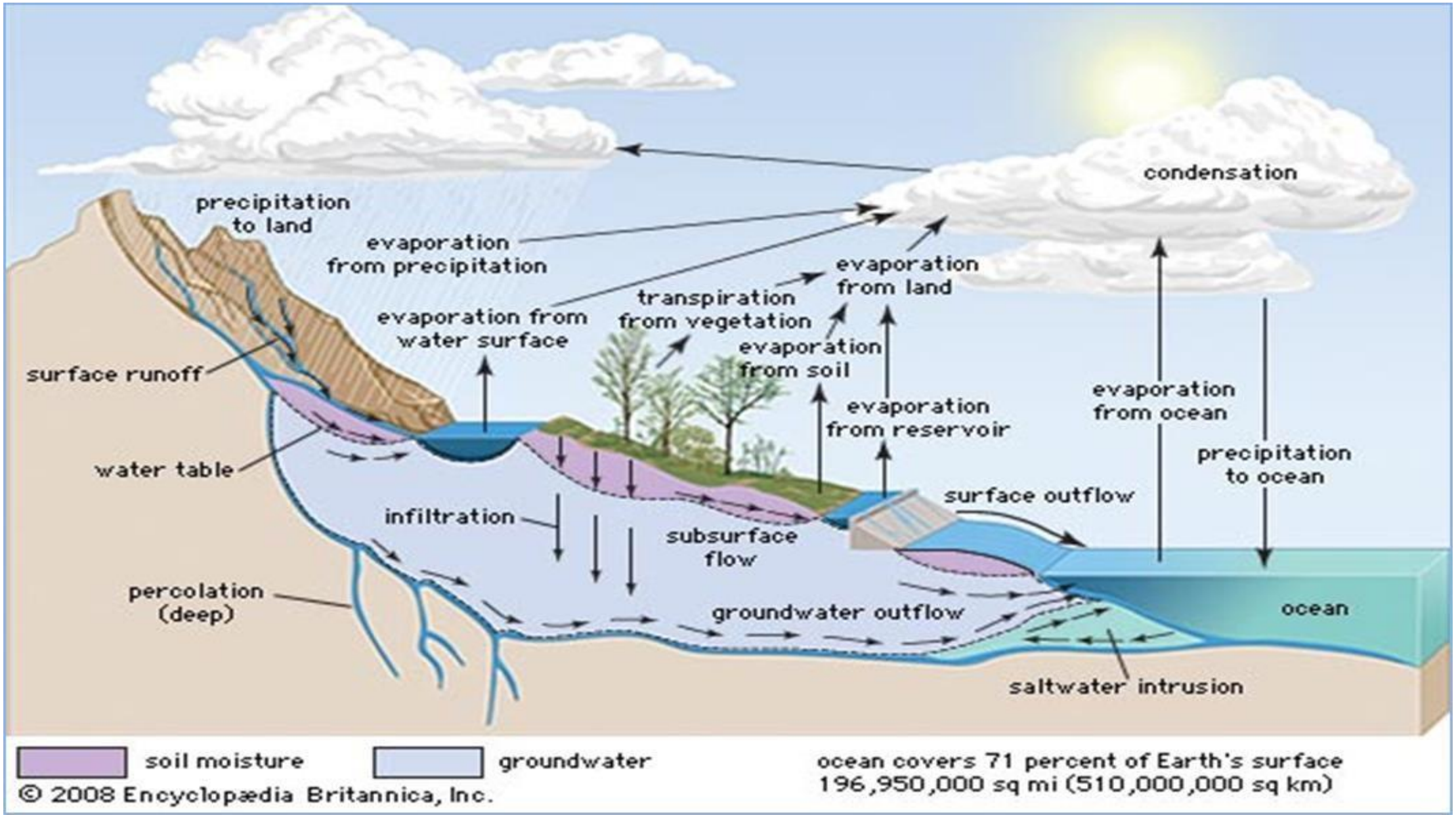
condensation
precipitation to land
evaporation from precipitation
evaporation from land
transpiration from vegetation
evaporation from water surface
evaporation from soil
surface runoff
evaporation from reservoir
evaporation from ocean
precipitation to ocean
water table
surface outflow
infiltration
subsurface flow
percolation (deep)
groundwater outflow
ocean
saltwater intrusion
soil moisture
groundwater
ocean covers 71 percent of Earth's surface
196,950,000 sq mi (510,000,000 sq km)
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Water – an indispensable commodity

Water is essential for life and a universal basic right.

All living things contain about 60-70% of water which act as a medium for metabolic activities.

It is a universal solvent and has a unique properties that promote physical, chemical and biological processes. It should be

1. Aesthetic – free from odour, taste, colour, etc.
2. Safe – free from pathogens, diseases, toxic chemicals, viruses, etc.
3. Economic – should be economical in quantity and quality

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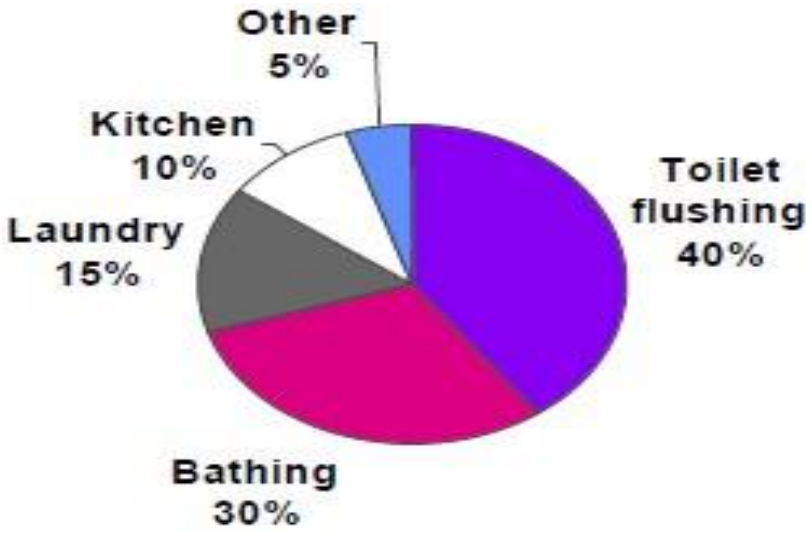
Use of Water Resources

- Agriculture – 70%
- Industry – 20%
- Domestic – 10%

Domestic water usage



Water is also be needed for use in

- Transportation of goods
- Dilute pollution
- Energy generation
- Sustain aquatic life

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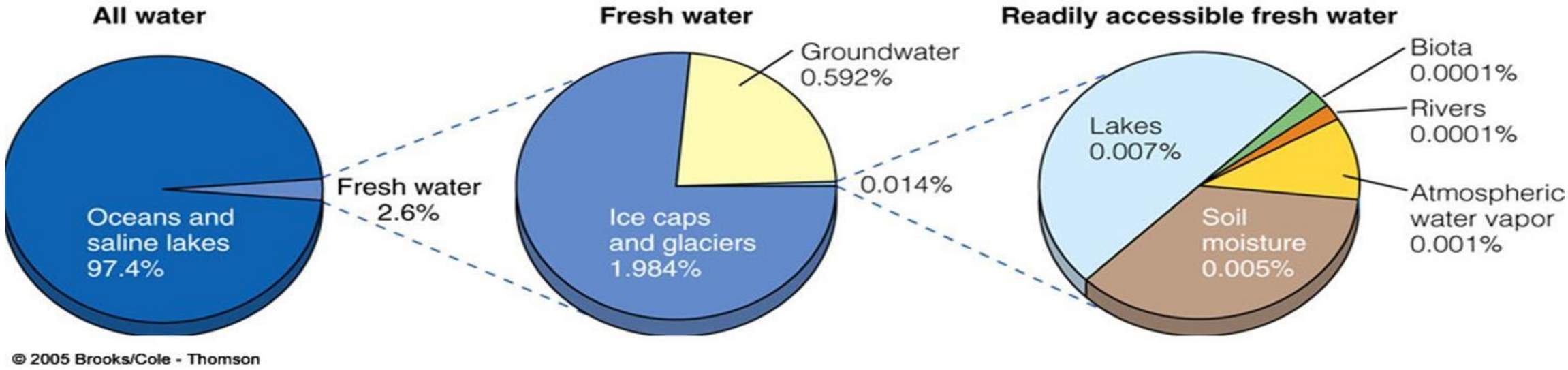
Supply of Water Resources

Small fraction (.014%) is readily available for human use



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Facts about water

1/3 of the world population live in areas of water scarcity which is expected to increase (UNESCO, 2002)

1/3 of urban water supply are operating intermittently during periods of drought in Africa. (UNICEF, 2000)

Between 1900-2004, water withdrawals has increased more than twice the rate of population growth (Enger and Smith, 2008).

25% of the population in Africa are presently having extreme water stress (Boko et al., 2007).

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At least 48% of the world projected population will live under water-stressed conditions with 2.4 billion living under high water stressed conditions (UN-Water, 2012).

Why should we be concerned

1. Water Scarcity in Ghana
2. Dwindling water supply
3. Institutional weakness
4. Major problem being pollution

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Thus the need for integrated water management.

Wastewater treatment could be one of the alternatives.

Growth of population

Water Supply & demand can result in conflict

Increases demand/use of water

Increases land use and changes vegetation and permeability

Increases demand for agriculture and construction

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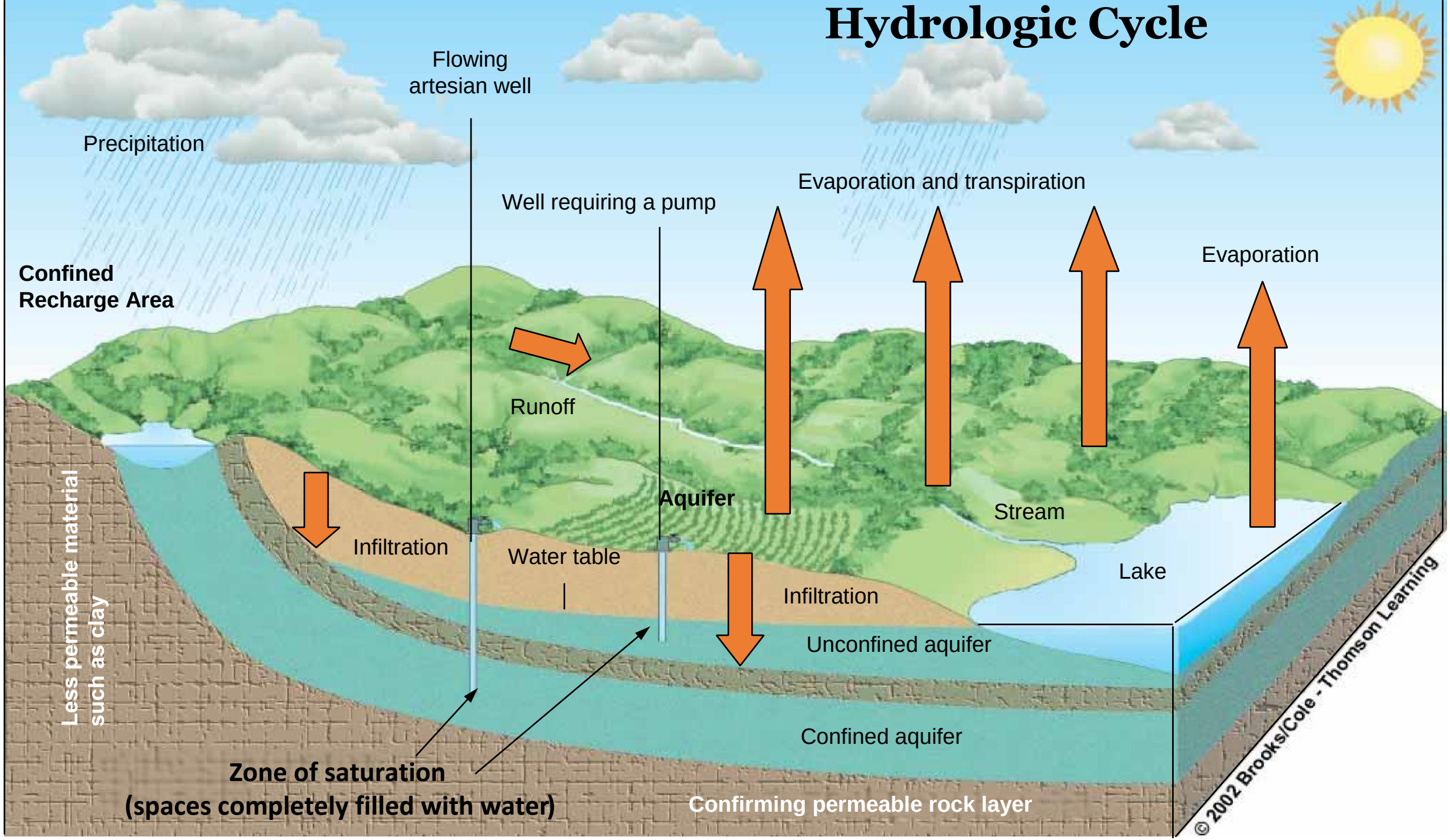
Hydrologic Cycle
Flowing artesian well
Precipitation
Well requiring a pump
Evaporation and transpiration
Evaporation
Confined Recharge Area
Runoff
Aquifer
Stream
Infiltration
Water table
Lake
Infiltration
Unconfined aquifer
Less permeable material such as clay
Confined aquifer
Zone of saturation (spaces completely filled with water)
Confirming permeable rock layer
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Water Sources

Surface water such as oceans, lakes, rivers, glaciers, polar ice caps

Subsurface water such as ground water, soil moisture of the continents

Atmospheric water in the form of water vapour (gas), rain drop or cloud or fog (liquid), snow or ice (solid)

Types of aquifer

What is an aquifer?

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It is a geological formation or a group of formations or part of a formation that contains sufficient saturated permeable material to yield significant quantities of water to wells and springs

1. Unconfined aquifer?

It is one in which a water table serves as the upper surface of the zone of saturation where the pressure is 1 atm.

2. Confined aquifer?

It is one in which a water table serves as the upper surface of the zone of saturation where the pressure is more than atmospheric pressure.

Tapping Groundwater

Advantages

- Year-round use
- No evaporation losses
- Often less expensive

Potential Problems:

- Water table lowering – too much use
- Depletion
- Saltwater intrusion – near coastal areas
- Chemical contamination

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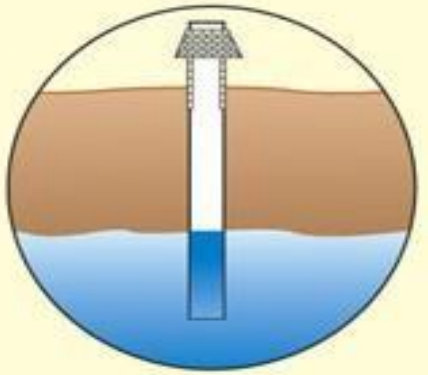
- Reduced stream flows

Solutions Sustainable Water Use



- Not depleting aquifers
- Preserving ecological health of aquatic systems
- Preserving water quality
- Integrated watershed management

- Agreements among regions and countries sharing surface water resources
- Outside party mediation of water disputes between nations
- Marketing of water rights
- Raising water prices
- Wasting less water

- Decreasing government subsides for supplying water
- Increasing government subsides for reducing water waste
- Slowing population growth

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WATER POLLUTION

Pollution Source terminology

Point source

Pollution comes from single, fixed, often large identifiable sources Examples: smoke stacks, discharge drains, tanker spills, etc.

Non-point source

Pollution comes from dispersed sources

Examples: agricultural runoff, street runoff, etc.

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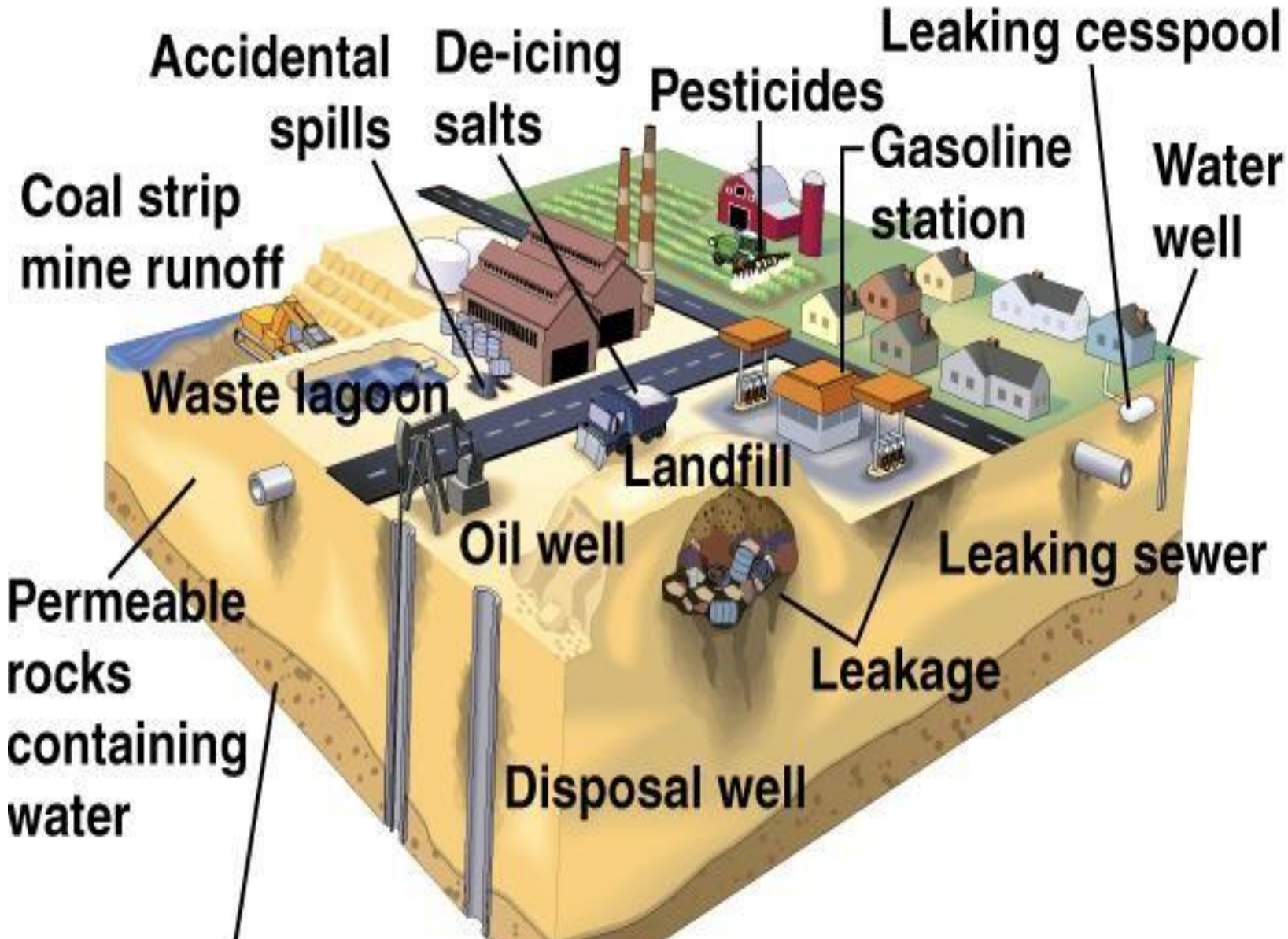
Groundwater



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Pollution

- Agricultural products
- Underground storage tanks
- Landfills
- Septic tanks
- Surface impoundments

Causes of Water Pollution

- Sediment from runoff and erosion

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- Human waste, animal droppings, etc.
- Nutrient enrichment = Eutrophication
- Untreated sewage, runoff from feed lots

Causes of Water Pollution

- Pesticides, fertilizers, industrial chemicals
- Dissolve heavy metals

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- Elevated temperatures - thermal pollution

- Disease-causing organisms

Effect of water pollution

1. Reduction of numbers of species and quantity of microorganisms
2. Affect economic development
3. Costs for water treatment will increase

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4. Service life of equipment is will be shorter

Effect of water pollution

5. Valuable raw materials and products are lost 6.

Oxygen depletion and odor production in water bodies.

7. Negative effects on human health.

8. Sludge and scum accumulations affect aquatic lives

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Prevention of contamination

1. Controlling Commercial and Industrial Sources
2. Residential and Municipal Sources
3. Storm Water Runoff
4. Agricultural and Rural Sources

Management approach

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1. Regulatory Approach
2. Land-Use / Land Acquisition
3. Education