



4 Water and its management

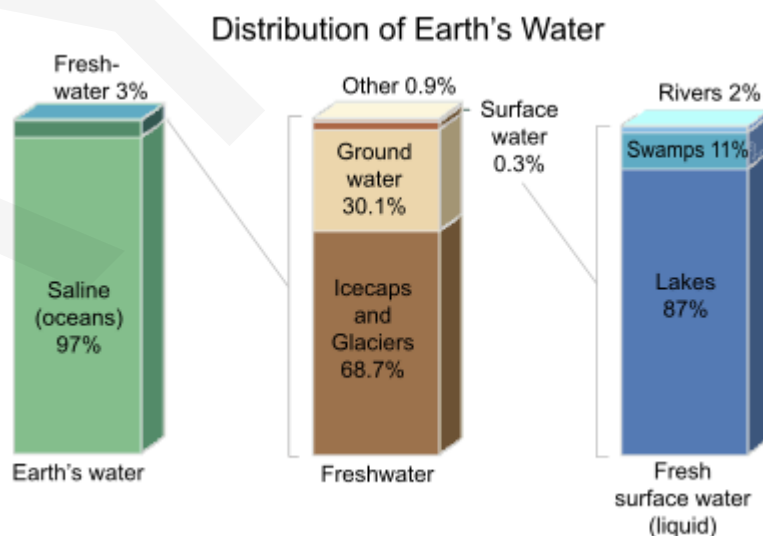
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4 Water and its management

4.1 Global water distribution



Global water distribution

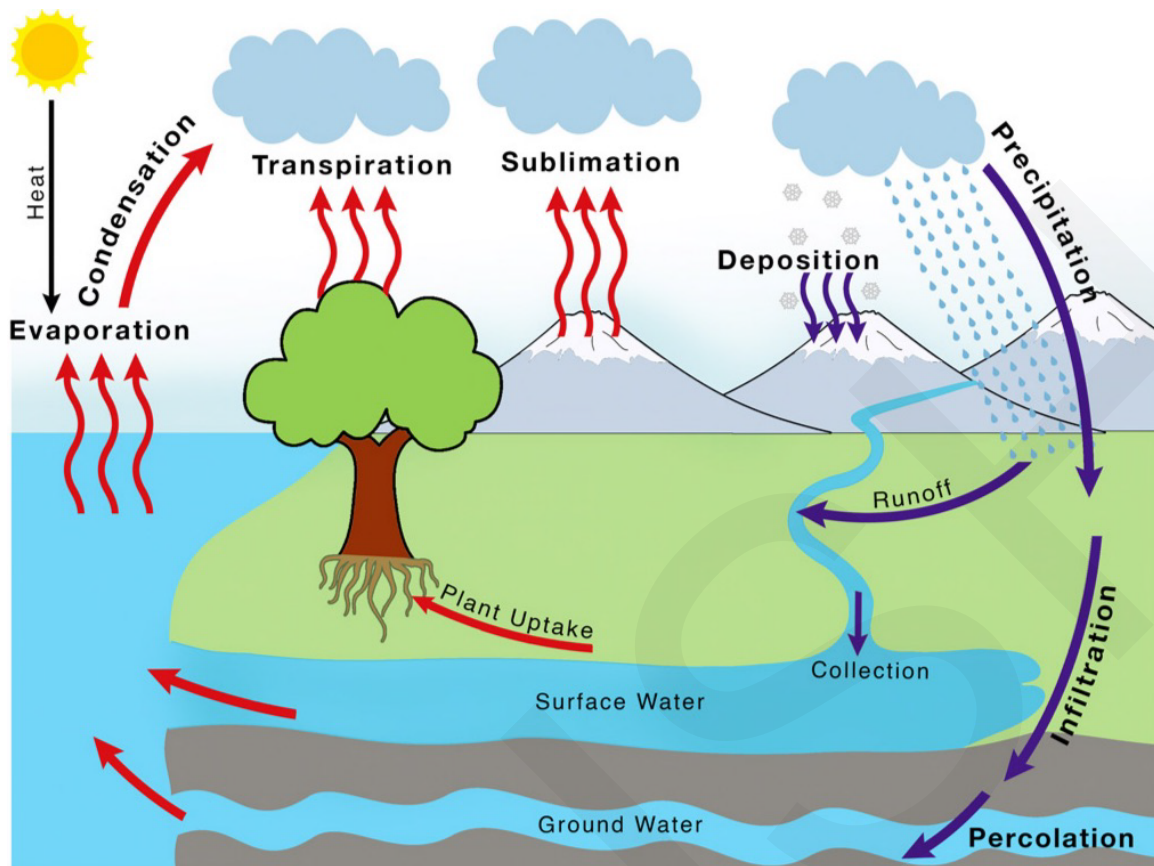
- 97.2% in oceans and seas
- 71% Oceans
- 3% Freshwater
- 0.6% ground water
- 2.1 % snow and ice
- 0.1% in rivers and lakes

Nearly two thirds (65%) of this 3% fresh-water is in the 'deep freeze' in the ice sheets.

4.2 The water cycle

Water cycle

1. Sun heats earth surface including oceans , rivers and lakes so water is evaporated from them
2. Plants do transpiration so water evaporates from plant leaves
3. Warm air rise above
4. Condensation happens
5. Precipitation when water vapor cools and droplets get bigger and heavier



- Precipitation - moisture that reaches the surface in the form of rain or snow
- Surface run off - precipitation that flows over the ground surface , eventually finding its way into stream and rivers
- Interception - precipitation that doesn't reach the earth surface due to being obstructed by trees
- Infiltration - precipitation soaks into sub surface soils and moves into rocks through cracks and pore spaces
- Through flow - infiltrated water flows through soil
- Ground water flow - infiltrated water flows through the rocks

4.3 Water supply

sources of fresh water used by people

- Surface water - water in lakes , rivers and swamps
- Ground water - water in soil and rocks under the ground
- Portable water - safer to drink

- Aquifers - water stored in porous rocks under ground
- Desalination plants - removal of salt from seawater by distillation or reverse osmosis
- Reservoirs - artificial lake used as a source of water supply , created behind dam

How water is gained from aquifers

- layers of permeable and impermeable rocks trap the water in permeable rocks
- Permeable rocks on the surface receive new supplies of rain water
- Water is stored in the limestone and sandstone rocks below the water course
- Mechanical pumps or human labor are used to raise water to the surface

Artesian aquifer

- water is under pressure
- Water from well sunk into artesian aquifer will rise to the surface without pump

Distillation

- water is boiled and released as vapor leaving salt behind
- Vapor is condensed as liquid water and can be used
- Require a lot of energy

Reverse osmosis

- pumping water at a high pressure through a fine membrane
- It requires less energy than distillation

Advantages of desalination

- reduces the risk of water borne diseases
- Provide job opportunity
- Well known technology
- Huge supply as salty water cover 97% of earths water
- It is safe as there are no heavy metals or water pollution

Disadvantages of desalination

- very expensive
- Process needs a lot of energy
- Requires skilled workers
- Greenhouse gas emission happens if fossil fuel is used
- Some marine species are killed in desalination plants

4.4 Water usage

Domestic use

- at home for drinking and cooking
- Washing and flushing toilets
- Washing clothes
- Gardening

Industrial use

- power generation
- Cooling
- Mixing and making products

Agricultural use

- mainly for irrigation
- For domestic animals

4.5 Water quality and availability

Water rich countries

- countries with plentiful fresh water supplies
- High precipitation
- Low population so low demand for water
- Countries with big areas are really usually rich as they have plenty of land for rain to fall

Water poor countries

- lack of rain
- Water might be frozen
- High population so high demand on water
- Rocks maybe impermeable so no ground water
- Drought

Unlike rural areas , urban areas have higher access to safe drinking water because

- cities are more wealthy places with factories and offices
- On average peoples's income are higher
- Wealthy people are more likely to live in cities
- Tourists are more likely to visit if clean water is available
- Population density in urban areas are high so water pipes are easier and cheaper to build when a lot of people live close together

4.6 Multipurpose dam projects

Dams

Multipurpose dam - constructed for multiple use eg : irrigation and electricity

Single purpose - constructed for particular use might be irrigation or electricity

Choice of site

- high precipitation to provide sufficient water
- Low temperature to prevent evaporation
- Rivers and lakes nearby to provide water
- Built high up to have good potential for hydroelectric power

impacts of dam

Advantages

- generation of electricity in hydroelectric power plants which is renewable source of energy and doesn't produce green house gas
- Flood control
- More job opportunity
- Sustainable irrigation
- Creates land for tourism

Disadvantages

- relocating people
- Dam may break causing flooding
- Noise , air , visual pollution when being built
- Loss of habitat so loss of biodiversity
- Very expensive to build

Sustainability of dams

- alternative for burning of fossil fuels as no green house gases are produced
- Have negative effect on fish population
- Dam structure under a lot of pressure so may deteriorate and eventually fail
- Reservoir can become silted due to material carried into it by rivers

4.7 Water pollution and its sources

Water pollution

Domestic waste

- untreated sewage
- sewage carries many pathogenic micro organisms
- Detergents , metals and manufactured products containing traces of toxic chemicals

Industrial processes

- use of chemicals
- Processing of metal ores
- Gases from factories enter the atmosphere where they dissolve in water forming acid rain
- Leaching of metals from waste heaps and dumps causes the presence of metals in water course

Agricultural practices

- surpluses of phosphorus and nitrogen
- Pesticides , herbicides and fertilizer will be washed from the land into ground water

4.8 Impacts of water pollution

- risk of water borne diseases which are caused by drinking contaminated water
- Accumulation of toxic substances from industrial processes in lakes and rivers cause death of fish
- Nutrient enrichment leading to eutrophication
- Bioaccumulation of toxic substances in food chains will cause increase in concentration of toxic substance in tissues of organisms causing illness
- Global inequalities in sewage and water treatment
- Formation of acid rain

Formation of acid rain

- when volcanos erupt or fuels burn , sulphur dioxide and oxides of nitrogen are released
- They are blown long distances and react with water in atmosphere
- SO₂ dissolve in water forming sulfuric acid and oxides of nitrogen dissolve in water forming nitric acid
- Falls in the form of rain having low pH this is called acid rain

Impacts of acid rain

- acidification of water bodies
- Causes damaging of crops
- Causes damaging of buildings
- lower pH makes the environment intolerable for aquatic life so reduce fish population

How fertilizers can lead to eutrophication

- excess water containing dissolved fertilizers drain into nearby lakes and rivers leading to eutrophication

- Which causes the increase of algae growth so sunlight is blocked and photosynthesis is reduced
- This causes algae to die and cause increase in bacterial count to decompose the dead algae
- This bacterial increase uses up oxygen so aquatic organisms die due to lack of oxygen

4.9 Managing pollution of fresh water

Strategies for improving water quality

- improve sanitation by separating human wastes from water source and it can be removed by connection to a system of sewer pipes that collects human wastes
- Sewage treatment
- Pollution control and legislation

Treatment of sewage

- waste water is taken to sewage treatment plant
- In a screening tank large objects are removed from the waste
- Solid organic matter settles at the bottom of the tank
- water is pumped into a tank where oxygen is bubbled through it
- This encourages the growth of bacteria and microbes that break down organic matter
- chlorination of water

4.10 Managing water-related disease

Life cycle of malaria

- female anopheles mosquito that is infected with malaria parasite
- The mosquito bites human
- The human gets infected with malaria that targets liver cells
- Another mosquito bite the infected human
- The second mosquito becomes vector

Life cycle of malaria

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Cholera caused by

- person infected with the bacterium the sewage from this infected person is leaked into water supply
- Water supply gets contaminated
- People drink this contaminated water so they get infected

Factors increase the risk of getting infected with cholera

- poor sanitation
- Contamination of water and food
- Disruption of piped water after a natural disaster

Strategies to control cholera

- do not use contaminated water to wash food
- Water should be treated before delivered to homes
- Boiling water and chlorination
- Vaccination to allow human to fight the infection
- Ensure sewage and drinking water are kept separate to ensure safety of potable water

Why is it difficult to eradicate malaria

- mosquitos have large population and breed rapidly
- Many sources of stagnant water
- High population makes the spreading faster
- Need money to apply control methods

CONTENT OUTLINE

4 Water and its management

4.1 Global water distribution

Candidates should be able to:

- describe the distribution of the Earth's water

Further guidance and exemplification:

- oceans
- fresh water: ice sheets and glaciers, ground water, atmosphere, lakes and rivers

4.2 The water cycle

Candidates should be able to:

- describe and interpret the water cycle

Further guidance and exemplification:

- precipitation, surface run-off, interception, infiltration, through-flow, ground water flow, transpiration, evaporation and condensation

4.3 Water supply

Candidates should be able to:

- describe the sources of fresh water used by people

Further guidance and exemplification:

- aquifers, wells, rivers, reservoirs, desalination plants

4.4 Water usage

Candidates should be able to:

- describe the different ways in which fresh water can be used

Further guidance and exemplification:

- domestic, industrial, agricultural

4.5 Water quality and availability

Candidates should be able to:

- compare the availability of safe drinking water (potable water) in different parts of the world

Further guidance and exemplification:

- between water-rich and water-poor regions and the potential for water conflict
- access to safe drinking water in urban and rural areas

4.6 Multipurpose dam projects

Candidates should be able to:

- describe and evaluate multipurpose dam projects

Further guidance and exemplification:

- choice of site
- environmental, economic and social impacts
- sustainability

4.7 Water pollution and its sources

Candidates should be able to:

- describe the sources of water pollution

Further guidance and exemplification:

- domestic waste, including sewage from urban and rural settlements
- industrial processes
- agricultural practices

4.8 Impact of water pollution

Candidates should be able to:

- describe and explain the impact of pollution of fresh water on people and on the environment

Further guidance and exemplification:

- global inequalities in sewage and water treatment
- risk of infectious bacterial diseases, typhoid and cholera
- accumulation of toxic substances from industrial processes in lakes and rivers
- bioaccumulation of toxic substances in food chains
- the effect of acid rain on organisms in rivers and lakes
- nutrient enrichment leading to eutrophication

4.9 Managing pollution of fresh water

Candidates should be able to:

- describe and explain strategies for improving water quality

Further guidance and exemplification:

- improved sanitation
- treatment of sewage
- pollution control and legislation

4.10 Managing water-related disease

Candidates should be able to:

- describe the life cycle of the malaria parasite
- describe and evaluate strategies to control malaria
- describe strategies to control cholera

Further guidance and exemplification:

- antimalarial drugs, vector control, eradication
- safe drinking water (potable water) supply
- boiling and chlorination