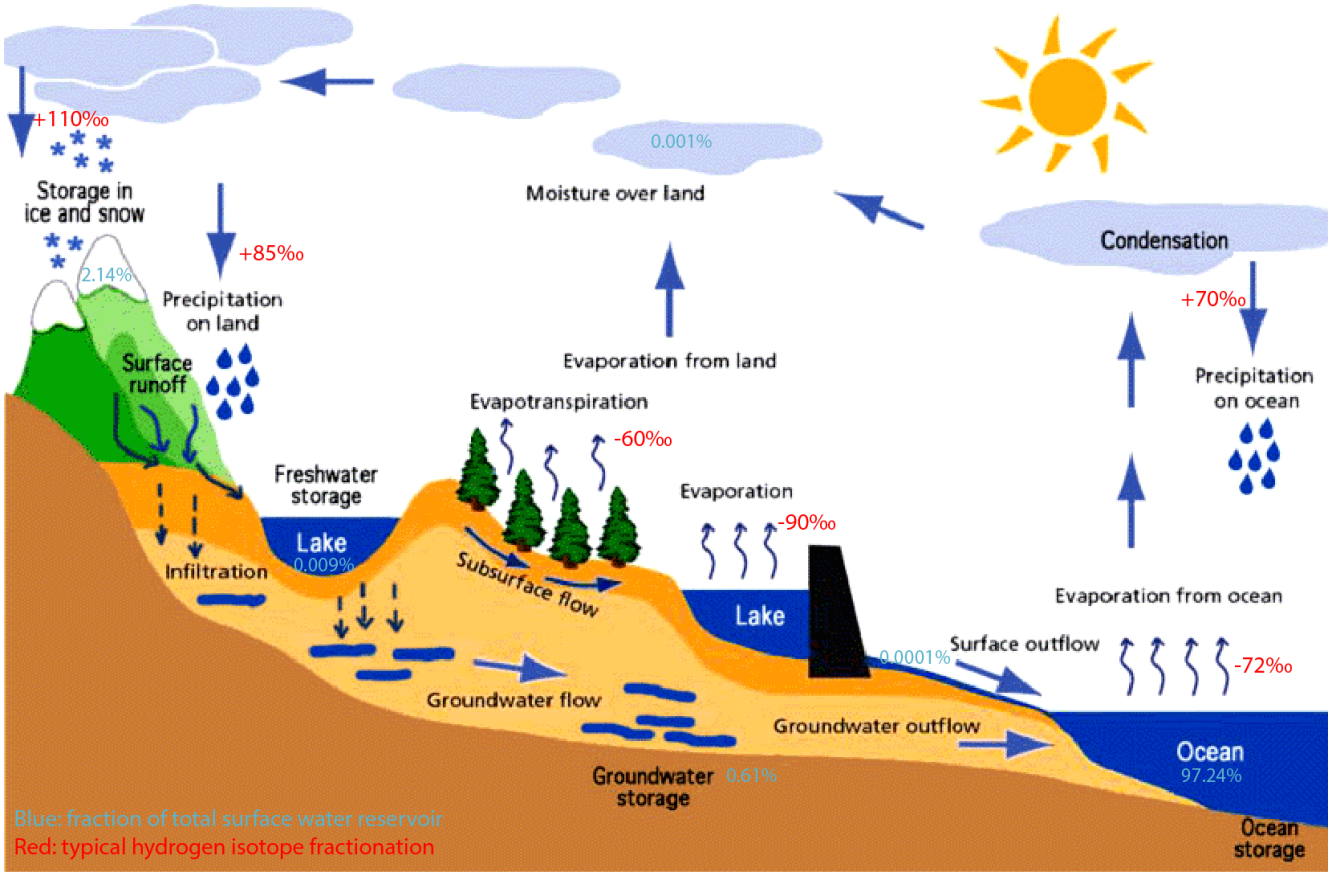
1. Rivers

1.1 Hydrological Cycle

- closed system
- Water is held in number of stores and then moves between them by flows called transfers



Stores

- Atmosphere - water exists either as water vapor
- Land - water is stored on surface of
  - rivers, lakes and reservoirs
  - below ground in the bed rock
  - Taken in by plants and stored in vegetation for short period
  - ground water below ground and aquifer
  - snow and ice as slid form in glaciers and snowfields
- The sea - estimation of over 95 percent of water is stored in sea

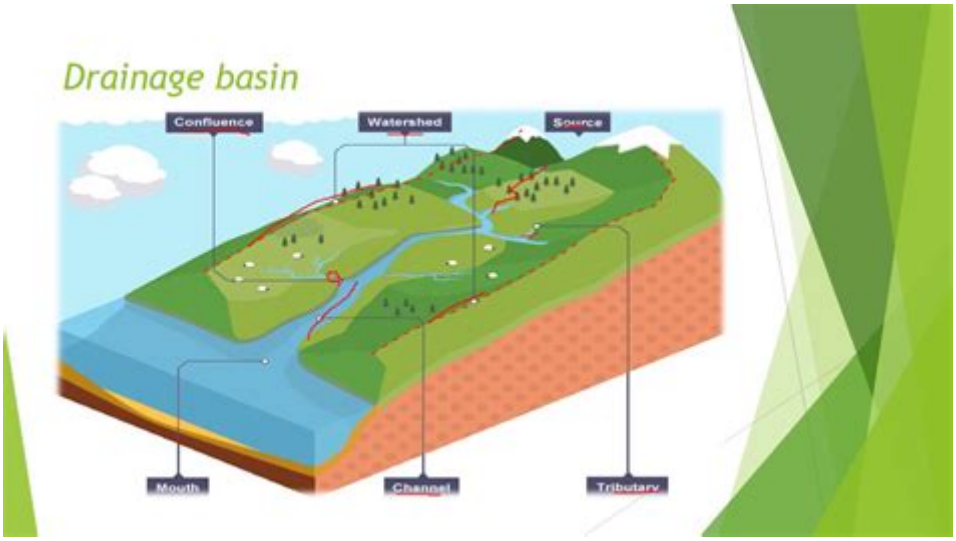
** the water in the hydrological cycle cannot change but the proportions held in different locations can caused by sun's energy

Flows (transfers)

- Evaporation - starts with evaporation due to the heat of the sun
- transpiration - plants take up liquid water from the soil and released as vapor
- Evapotranspiration- the loss of moisture from the ground by direct evaporation from water bodies and the soil, plus transpiration from the plants
- Condensation - change in atmosphere when water vapor cools to become liquid
- Precipitation - rain, hail or snow from atmosphere to the land or sea surface
- Overland flow - most precipitation flows into stream, river or lake, known as run off
- Infiltration and percolation - downwards through the soil and rock into aquifer or groundwater store
    - infiltration happens on surface and percolation happens afterwards
- Throughflow - between the ground surface and the top of the ground water store
- Groundwater flow - in the rocks of the aquifer and transfer water to rivers, lakes and sea underground

1.2 Drainage Basin

open system and small scale hydrological cycle



inputs:

- energy from the sun
- precipitation formed from moisture picked up outside the basin
- water from tributary drainage basins

outputs:

- river's discharge
- water in basin from evaporation and transpiration happen
    - (water falls as precipitation in another drainage basin)

Def:

- Watershed: tops of the hills that separate drainage basins
- Tributaries - smaller streams
- Confluences - where smaller river merge or enter the main river channel
- mouth/estuary - where water flows into the sea
- Channel network - system of surface and underground channels that collect and transports the precipitation falling on the drainage basin

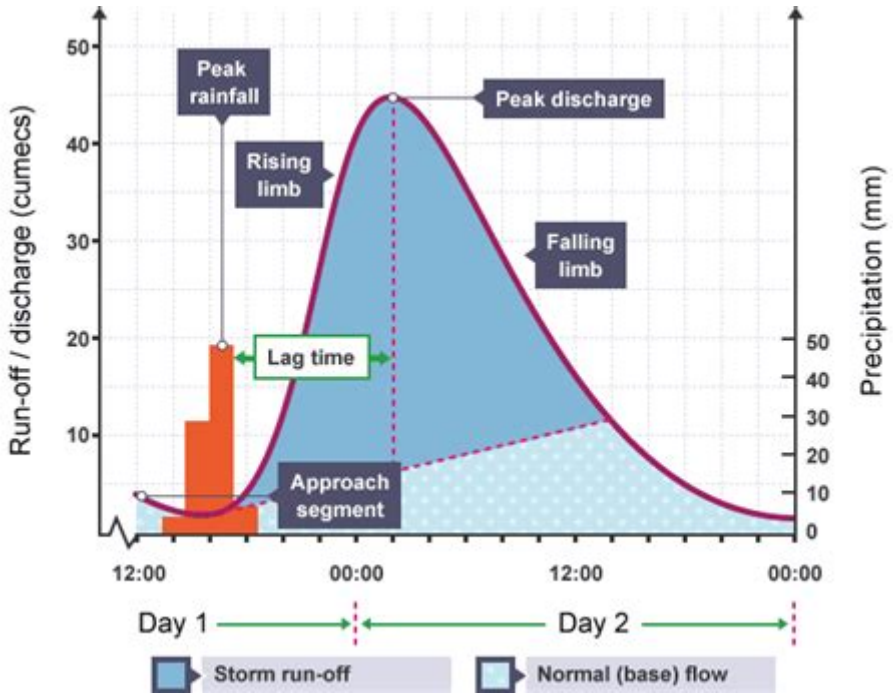
types of drainage basin:

- simply connect and deliver water directly to the sea
- parts of much larger drainage basins
- lead to 'inland' seas or lakes such as Caspian Sea

factors affecting run off:

- rapid run off - steep slopes; impermeable rock
- little run off - permeable rock: rivers have disappeared underground
- woodland - slow rate of run off
- urban area - speeds up rate of run off

1.3 River Regimes and Hydrographs



Def:

- River regime - Variation of discharge throughout the year
- hydrograph - graph with the variation of river discharge

Storm Hydrographs

def - records the changing discharge of a river after a rainstorm

- bar graph - shows rainfall
- line graph - shows discharge of river
- base flow - 'normal' discharge of river
- storm flow - additional discharge of the river as a result of the rainstorm

Factors Affecting River Regimes

- Amount and intensity of rain.
  - heavy rain will not sink into the ground and become overland flow
- Temperature affect the form of precipitation
  - if temperature is below freezing, precipitation will be snow and take slower to melt
- Steep slows cause rapid surface run off
- Rock type - impermeable rocks will not allow rainwater to sink into
- Vegetation and land use - trees and other plants intercept and delay the rain reaching the ground
- Human intervention - dams and reservoirs are interventions in river regimes

1.4 Fluvial Processes

Three processes that shape land forms erosion, transport and deposition
These partner with two other processes - weathering and mass movement

Def:

- Physical weathering - breaks rocks down into smaller and smaller pieces
  - done by changes in temperatures and by rainfall freezing and thawing in rock cracks
- Chemical Weathering - Causes rocks to decay and disintegrate
  - Largely done by slightly acidic rain seeping into porous rocks
- Biological weathering - roots of plants, especially trees, growing into cracks in the rocks gradually split the rock apart
- Slumping - occurs when
  - bottom of valley slide slope is cut away by the river flowing at its base.
  - makes the slope unstable and weathered material slumps down towards the river
  - also happens when slope is saturated by heavy rain
- Soil Creep - weathered material moves slowly down slope under the influence of gravity

Erosion:

Def:

- Hydraulic action - Water hits the river bed and banks with force that material is dislodged and carried away. (most likely to happen when river discharge is high)
- Abrasion - Material being carried by river is rubbed against the side and floor of the channel. (sandpaper action widens and deepens the channel)
- Corrosion/Solution - Minerals in the rock forming the sides of the river channels are dissolved by the water flowing past them
- Attrition - Particles of material being carried by a river, and becoming rounder and smaller as they collide with each other

Transport

def: movement of material (load) by the river

Def:

- Solution - material dissolved in the water
- Traction - Large boulders rolled on the bed
- Saltation - Small boulders bounded along the bed
- Suspension - lighter material carried along by river flow

Deposition:

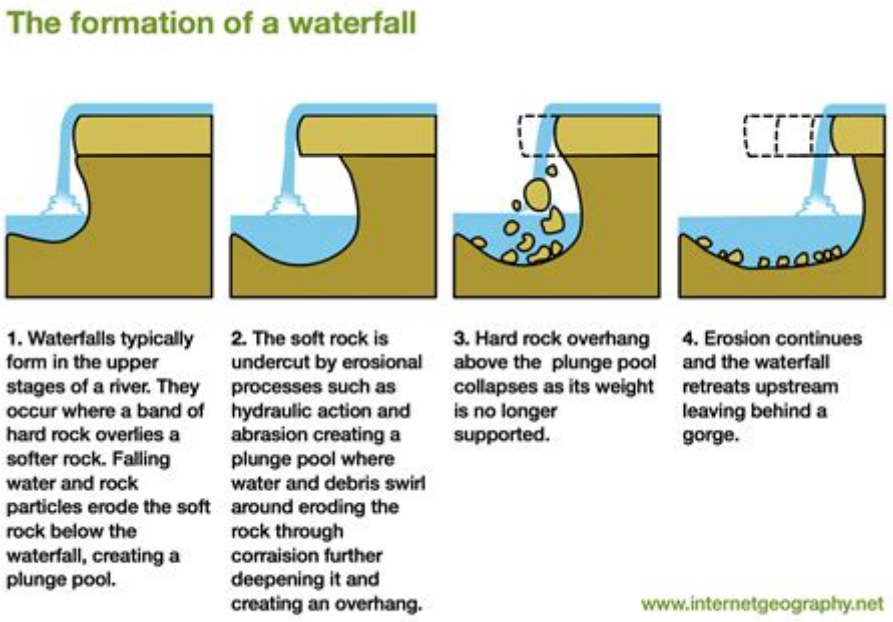
def: laying down of material previously transported by the river. Happens when there is a decrease in the energy, speed and discharge of the river
(mostly like to happen when a river enters a lake or the sea)

1.5 Downstream Changes in River Characteristics

Factors	Upstream	Downstream
Discharge	Less	More
Occupied Channel Width	Less	More
Channel Depth	Less	More
Average Velocity	Less	More
Load Quantity	Less	More
Load Particle Size	More	Less

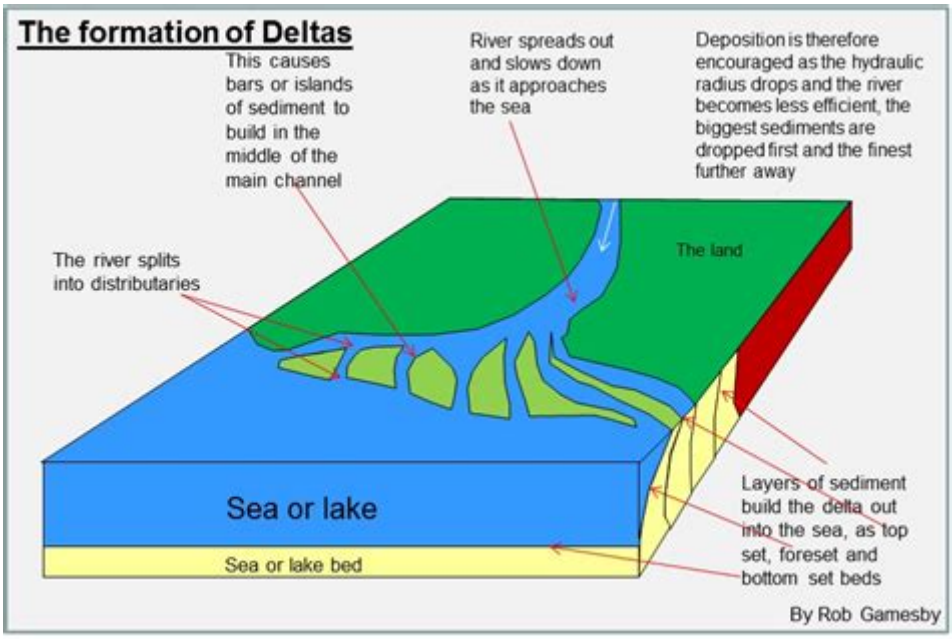
Factors	Upstream	Downstream
Channel Bed Roughness	More	Less
Slope Angle (Gradient)	More	Less

Upper stream Landforms (mainly formed by erosion)



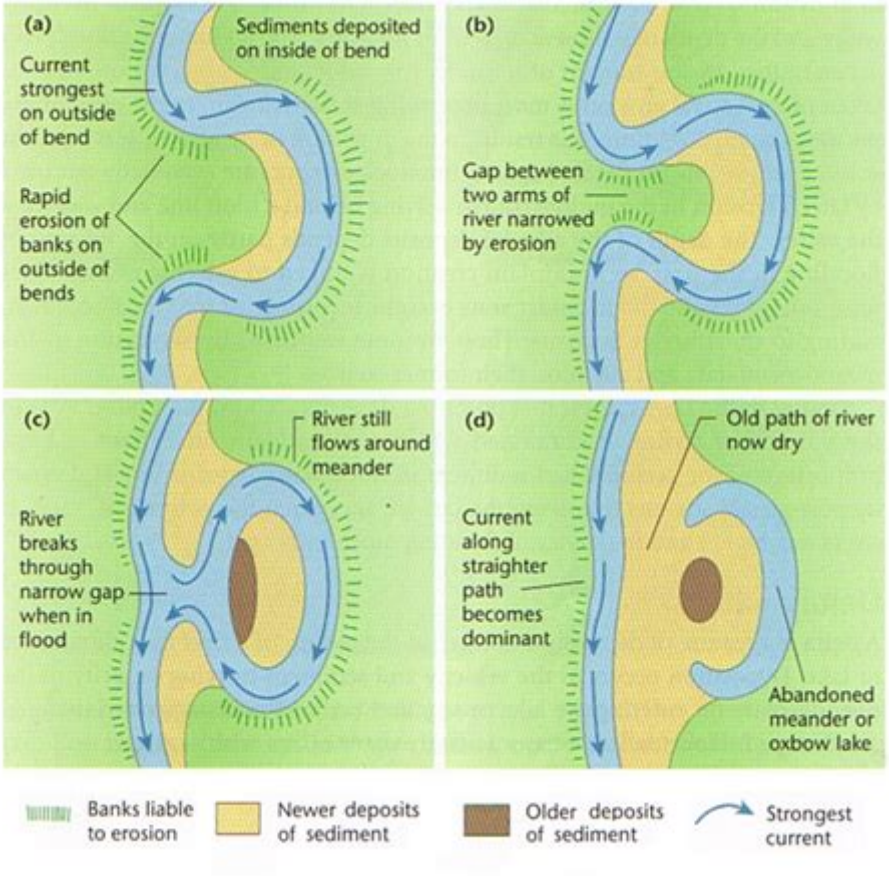
- steep V-shaped valleys - river has cut down by vertical erosion
- waterfalls - vertical erosion and falls back, soft rock and hard rock, makes plunge pool
- gorges - made when waterfalls retreat
- steep and river flows fast (not fastest)
- Hydraulic action and abrasion erode the bed rocks
- Valley floor is narrow
- Interlocking spurs - formed where the river swings from side to side

Lower Stream Landforms



- River Velocity and discharge increase
- Gentler gradient
- Floor occupied by a flood plain
- valley cross section wider and flatter
- Flood plain spreads out to become a delta or an estuary
- Levees Thickness of sediment in river from flooding and sediment movement
- Delta - vast areas of alluvium at the mouths of rivers
- Distributaries - Smaller channels made from river flow blocked by deposition

Mid Stream Landforms



- Meanders - Erosion and deposition due to swinging of river. Difference in speed of outer and inner part of the river
- Ox Bow Lake - Meanders flood and the river shortcuts to isolate part of the river

1.7 Water Uses, Demand and Supply

Uses

Although only 3 percent of water on earth is fresh water, fresh water is:

- essential to all life
- vital to economic
- Unevenly distributed, with some areas 'water-rich' and 'water-poor'

Fresh water is needed for:

- Domestic use - bathing and showering
- Industrial use - producing goods from beer to steel, generating electricity
- leisure use - sport fishing on rivers

All forms of water use revolve around two key elements:

- Demand - need for water for range of uses: also often referred as consumption

- Supply - meeting the demand for water by tapping various sources, such as ground water, lakes and rivers

For any area, comparison of water demand and water supply is water balance

Demand

water demand and consumption have increased in the last 100 years with global demand more than trebling over the last 50 years.

This is because of

- growth of world's population, houses use piped water, toilets, and showers.
- rise in agricultural productivity needed to fee a growing population increases the use of water, particularly for irrigation
- Industrialization require water to cool machinery

Supply

- Rivers and lakes - source used by the earliest humans
- Reservoirs - artificial lakes created by building a dam across a valley allowing it to flood
- Aquifers and wells - much of the world's fresh water supply lies underground

Water Surplus and Defect

We can have three types of areas:

- area where the water balance is negative - water demand exceeds supply
- area where the water balance is positive - water surplus areas where the supply or availability of water exceeds demand
- areas where water demand and supply are roughly the same - water neutral areas

Sources of water pollution

Agriculture

- Liquid from farms silage and slurry from farm animals enter rivers
- Fertilizers and pesticides seep into the ground water
- Deforestation - run off carries soil and slit into rivers, with serious effects on aquatic life and humans who drink the water

Industry

- Taking cooling water for an electric power station and returning it at a higher temperature damages ecosystems
- Spillage from industrial plants such as oil refineries can enter rivers
- Working on metallic minerals can produce toxic substances

Domestic

- The discharge of untreated sewage from houses - even treated sewage pollutes
- User of river for washing and bathing contaminates water
- Emptying highly chlorinated water from swimming pools

Access to Safe Water

def:
Safe Water - water fit for human consumption, it is not contaminated by pollutants and is free from disease.

*** Estimated that more than 1 billion people do not have access to safe water

Managing The supply of Clean Water

Three Stages

- Collection
- Treatment
- Delivery

Collection - main sources of water are rivers, reservoirs and lakes, aquifers and wells

Treatment - rivers are often highly polluted. Important to remove suspended solids, bacteria, algae, viruses, fungi and chemical pollutants. The process include:

- chlorination - to control any biological growth
- aeration - to remove dissolved iron and manganese
- sedimentation - to remove very fine sediments
- disinfection - to kill bacteria

Delivery

In developed countries, water is delivered by standpipes in the streets.
In villages, water from wells are often used untreated

Case Study