

1.1 Systems		
The interrelationship between living and non-living components within an environment		
Input	Material or energy moving into the system from outside	e.g. precipitation
Output	Material or energy moving from the system to outside	e.g. evaporation
Energy	Power or driving force	e.g. heat
Stores / components	The individual elements or parts of a system	e.g. trees
Flows / transfers	The links or relationships between components	e.g. infiltration
Open system	Linked to other systems	e.g. drainage basin
Closed System	Self contained	e.g. global water cycle

1.2 The global water cycle

- Describes the Earth's stores and transfers of water
- The vast majority of water is stored in oceans as salt water
- Most fresh water is stored as ice or groundwater
- Water is unevenly distributed around the world

The **soil water budget** describes the changes in soil water over a year

Water is stored within 4 major systems:

- Lithosphere** (land)
- Hydrosphere** (liquid water)
- Cryosphere** (frozen water)
- Atmosphere** (air)

1.3 Changes in the water cycle

Precipitation	Transfer of water from atmosphere to ground in the form of rain, snow or hail
Evaporation	Transfer of water from a liquid to gas
Condensation	Transfer of water from a gas to liquid
Sublimation	Transfer from a solid to gas or visa versa
Interception	Preventing water from reaching the ground
Overland flow	Transfer of water over the surface
Infiltration	Transfer of water from the surface to the soil
Throughflow	Water flowing through soil towards a river
Percolation	Water soaking into rocks
Groundwater flow	Very slow transfer of water through rocks

Unit 1, Section A, Topic 1 Water & carbon cycles

1.5 The water balance

- Helps to understand the characteristics of **drainage basins**

Drainage basin An area of land that is drained by a river and its tributaries

$$P = O + E \pm S$$

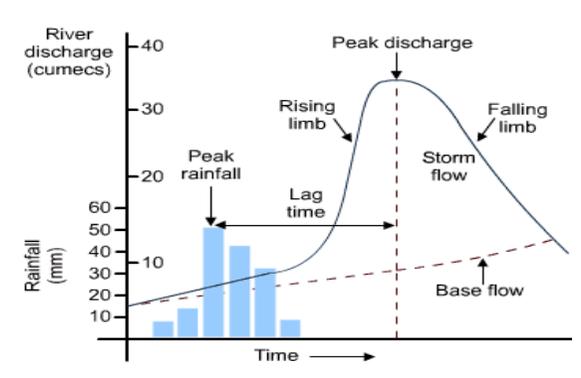
Where P = precipitation, O = total runoff, E = evapotranspiration, S = storage

- Runoff enables comparisons to be made between drainage basins
- The geology, soil moisture and land use all influence runoff
- Higher percentages of runoff are mainly linked to **saturated soils** and **urbanisation**

1.7 Factors influencing change in the water cycle

Physical	Human
Drought Flooding Seasonal variations	Land use change Farming practices Water abstraction

1.6 The flood hydrograph



Lag time	The difference between the peak rainfall and peak discharge
Limb	Shows the change in river discharge

- Shows the response of a river following a storm event
- | | |
|------------------|--|
| Discharge | The volume of water flowing down a river |
| Velocity | The speed of the river's flow |

- The shape of a flood hydrograph reflects the characteristics of the drainage basin

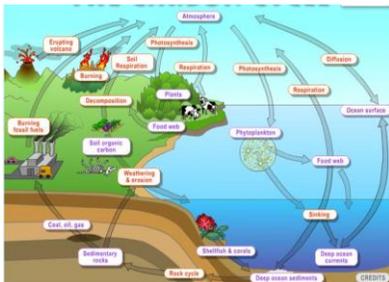
Flashy	Low
Short lag time High peak Small basins Rapid water transfer Impermeable rocks Steep slopes Saturated soils Urbanisation Heavy rainfall	Large lag time Low peak Large basins Slower water transfer Permeable rocks Gentle slopes Dry soils Forests Light rain

1.17 Case study: River catchment

<input type="checkbox"/> Location	<input type="checkbox"/> Relief	<input type="checkbox"/> Geology	<input type="checkbox"/> Land use	<input type="checkbox"/> Climate	<input type="checkbox"/> Recent developments influencing the water cycle
<input type="checkbox"/> Stores	<input type="checkbox"/> Transfers	<input type="checkbox"/> Hydrograph	<input type="checkbox"/> Water balance	<input type="checkbox"/> Human activity	

1.8 The global carbon cycle

- Vital for all life on Earth
- Made up of stores and transfers



Carbon sink When a store that absorbs more carbon than it releases

Carbon source Releases more carbon than it absorbs

1.9 Transfers in the carbon cycle

- Can also be at a local level e.g. a tree

Photosynthesis Where plants use light from the sun to convert CO₂ and water into carbohydrates

Decomposition When living organisms die and break down carbon is returned as CO₂ to the atmosphere.

Combustion When organic matter is burnt releasing CO₂ from stores

Carbon sequestration The transfer of carbon from the atmosphere to plants, soils, rocks and oceans

1.13.1 The links between water and carbon cycles

- There are important links between the two cycles
- The ability of water to store and transfer water is key

1.13.2 Links to climate change

- Feedback loops have significant impacts on climate change

Water cycle feedback loop

- Absorption of heat from the sun warms oceans
- Reducing polar ice
- Ice reflects radiation
- Less ice = more heat is absorbed
- Creating a **positive feedback loop**
- Affecting transfers between stores

Carbon cycle feedback loop

- Warmer temperatures in polar regions have two opposite effects:
 1. An extended plant growing season
 2. Melting permafrost

Water/carbon cycle feedback loop

- Phytoplankton promote the formation of clouds over the ocean
- Warmer temperatures increase the population of phytoplankton
- Increasing cloud cover
- Leading to global cooling
- Creating a **negative feedback loop**

1.14 Mitigating the impacts of climate change

- Human intervention in carbon transfers can mitigate the impacts of climate change

Modifying industrial combustion

- Use carbon capture and storage technology
- Store CO₂
- Reduce global CO₂ emissions by 19%

Modifying deforestation

- FSC timber certification
- Carbon payments to offset carbon emissions
- Selective management approach to logging

Modifying land use

- Carbon farming

Modifying photosynthesis

- Plantation forests

Political initiatives: The Paris Agreement

- Adopted in 2015
- 195 countries
- Sets out a global action plan to limit global temperature increase
- Focus on reducing carbon emissions

1.15 Tropical rainforests: the carbon cycle

- Photosynthesis is enhanced by the lush vegetation
- Reduces atmospheric CO₂
- Huge carbon stores
- Important carbon sinks

Impacts of deforestation

- Photosynthesis ceases
- No longer a carbon sink
- Rain washes ash into the soil increasing the carbon content
- Low respiration
- Increased carbon in runoff

Reducing the impacts

- Replacing rainforest
- Afforestation
- Strict logging regulations
- Restrictions on fires to clear land

1.10 Factors influencing change in the carbon cycle

1.10 Physical

Natural climate change
Glacial conditions
Interglacial conditions
Wild fires
Volcanic activity

1.11 Human

Urbanisation
Deforestation
Burning fossil fuels
Changing land use
Changing farming practices

1.12 The carbon budget

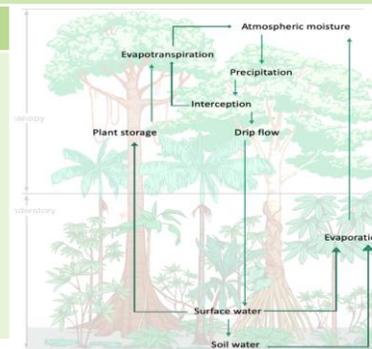
- Describes the amount of carbon stored and transferred within the carbon cycle
- Most carbon is stored in the Earth's crust
- Photosynthesis is the major carbon transfer
- Important for land, oceans and the atmosphere

1.15 Tropical rainforests: the water cycle

- Have a distinctive water cycle as a result of their high levels of precipitation, extensive canopy and plant growth

Impacts of deforestation

- Evapotranspiration is reduced
- Increased overland flow
- Increased soil erosion
- Very little interception
- Little evaporation
- Little transpiration
- Increased runoff
- Risk of flooding
- Reduced atmospheric humidity
- Reduced rainfall



1.16 Case study: Tropical Rainforest

<input type="checkbox"/> Location	<input type="checkbox"/> Climate	<input type="checkbox"/> Geology	<input type="checkbox"/> Land use	<input type="checkbox"/> Recent developments influencing the water cycle and carbon cycles	<input type="checkbox"/> Local impacts
<input type="checkbox"/> Stores	<input type="checkbox"/> Transfers	<input type="checkbox"/> Human activity	<input type="checkbox"/> Sustainable management		<input type="checkbox"/> Global impacts