

## Section 1: The Water Cycle

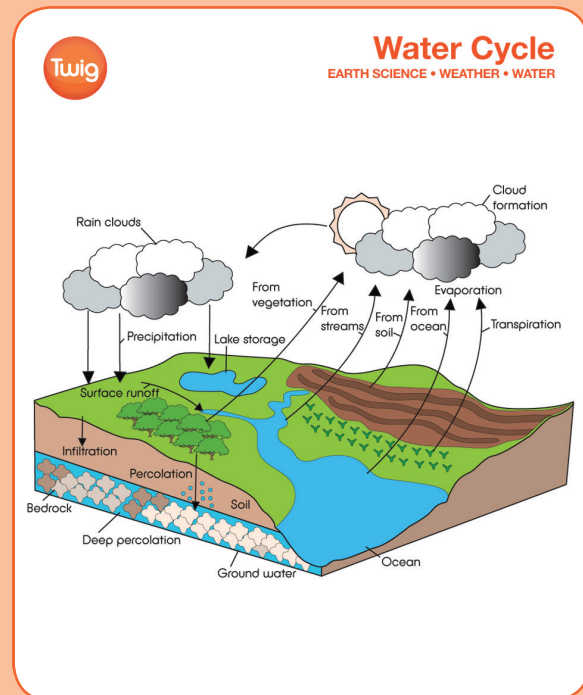
### • What is the water cycle?

The water cycle means that any droplet of water will circulate in a non-stop cycle between the ocean, the atmosphere and the land. Water can be moved in many different forms, as vapour, rain, snow or hail. Water within the oceans, lakes and seas is warmed by the Sun's energy, turning it into water vapour. This rises into the atmosphere in a process called evaporation. Water within plants is also lost to the atmosphere in a process called transpiration. As this vapour rises, the air cools and the water vapour condenses into tiny water droplets, forming clouds. The water droplets eventually become so large that they fall as precipitation. The water will then either move through or over the land, or be stored before reaching the rivers, seas and oceans and starting the cycle again.



**The water you use every day  
is billions of years old**

### DIAGRAM 01:



### • Suggested Film - The Water Cycle

#### Extension Questions

**Q1. How many times has the water on Earth been through a complete turn of the water cycle?**

It is difficult to tell, though scientists estimate anything up to 8 million times.

**Q2. What is evaporation?**

Evaporation is the change of liquid water, either in the ocean or on land, into gaseous form, as water vapour through heating. The warming effect of the Sun's energy is the driving force behind this process, and during warmer weather there is more evaporation.

**Q3. What is transpiration?**

Transpiration is the transfer and change of water from plants into water vapour in the air.

**Q4. What is interception?**

Vegetation prevents precipitation from reaching the ground. When the leaves catch some of the rain as it falls, this is called interception. Extensive deforestation in some parts of the world is greatly reducing this natural process and having a variety of negative results, including soil erosion and river flooding.

• Why is the water cycle described as a closed system?

The water cycle is a closed system because the amount of water on Earth is constant. Even though the water changes from liquid, to gas, to solid, there is no additional input or output to the Earth's system. The same water droplet would have been through a complete cycle anything up to 8 million times. An open system may exist in a single river's drainage basin, where additional water can be added in an event such as a heavy storm, or water is extracted from the system in an irrigation program.

• Suggested Films

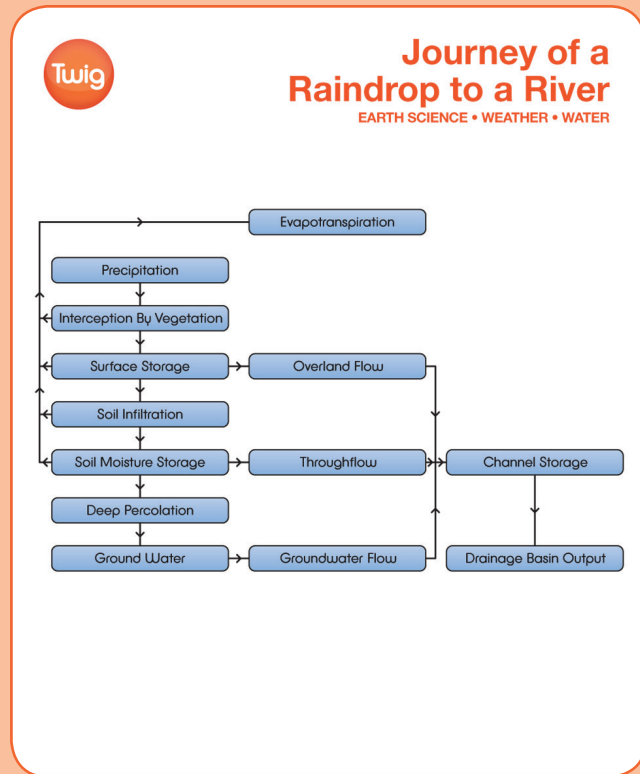
- The Water Cycle
- How the Oceans Formed

Extension Question

Q5. What is a groundwater store?

Where the water is stored beneath the surface, it is called groundwater. When this moves it is called groundwater flow. Many natural spaces and water stores exist beneath the surface of the land that have been created by historic geological processes. For example, under London there is a vast natural aquifer which is responsible for storing some of the city's water needs.

DIAGRAM 02:



• What are the key elements of the water cycle?



Around this hot spring we can see all three states of water: solid ice, liquid water and gaseous steam

Water can exist in three states: as a solid, a liquid, or a gas.

Water will move through the cycle as transfers. These include: evaporation, transpiration, groundwater flow, surface runoff, and precipitation

The water can be locked in stores, as ice in a glacier or ice sheet, on the surface as lakes, puddles or even the sea, under the ground in groundwater stores, and in plants and animals.

The state and activity of the water depends on a web of interrelating human and physical factors at any one place.

• Suggested Film

- The Water Cycle

### Extension Questions

#### Q6. What is condensation and precipitation?

Condensation occurs when water vapour in the air changes back into liquid. It forms small droplets which are visible as cloud. Precipitation is water in any form being transferred from the atmosphere to the Earth's surface; this includes rain, snow, hail, frost and dew.

#### Q7. What is surface water?

Surface water is the transfer of water back to the sea over the ground, which is called surface runoff. It is easiest to see where it forms rivers.

#### Q8. What is Infiltration?

Rain soaks into the ground as infiltration. Its ability to do this is dependent on the permeability of the ground, for example, how porous the rocks beneath are.

#### Q9. What is throughflow?

Below the surface, some water will flow horizontally through the soil, downhill towards the river or nearest store.

## Section 2: Rain

### • What is convectional rainfall?



**Convectional rainfall often occurs after periods of persistent sunshine, such as here in the Namib desert**

After periods of persistent sunshine, typical in the Tropics, the ground heats up. The air rises in warm currents, called convection currents, and as the air rises, it cools and the water vapour in it condenses and falls as rain. Convectional rainfall leads to heavy, but short-lived downpours, sometimes with thunder and lightning. It is typical of the tropic regions because of their persistent sunshine. Convectional rainfall is responsible for the showery weather during a summer in Britain, it occurs inland, far away from the cooling effect of the sea.

### • Suggested Films

- Types of Weather: Rain
- Deserts
- The Lost City of Peru
- Secret of the Sahara

### Extension Questions

#### Q10. What causes rain?

When moist air rises, it cools. The water vapour in the air condenses to form a cloud. A cloud gives rain after these tiny cloud droplets coalesce. Once they are thousands of times larger they become too heavy to float in the air, so they fall to the ground as rain.

#### Q11. What is sleet?

Sleet is snow which is almost melted. It is half way between being a snowflake and a raindrop.

DIAGRAM 03:

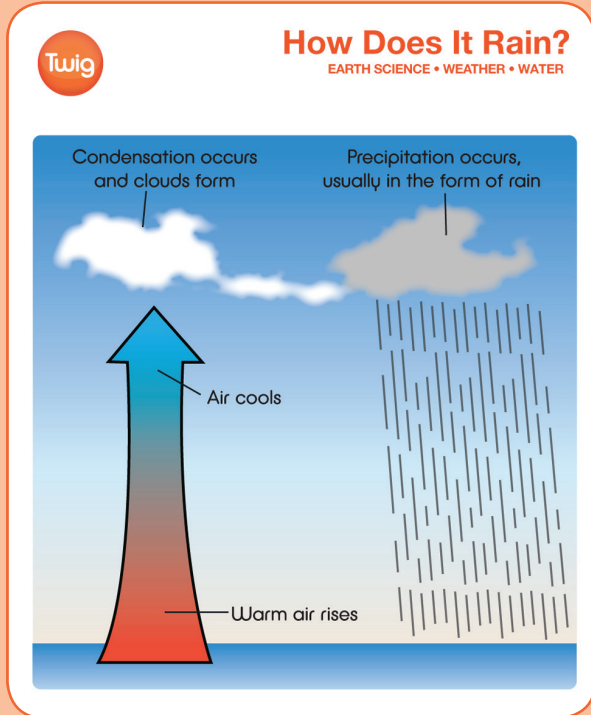
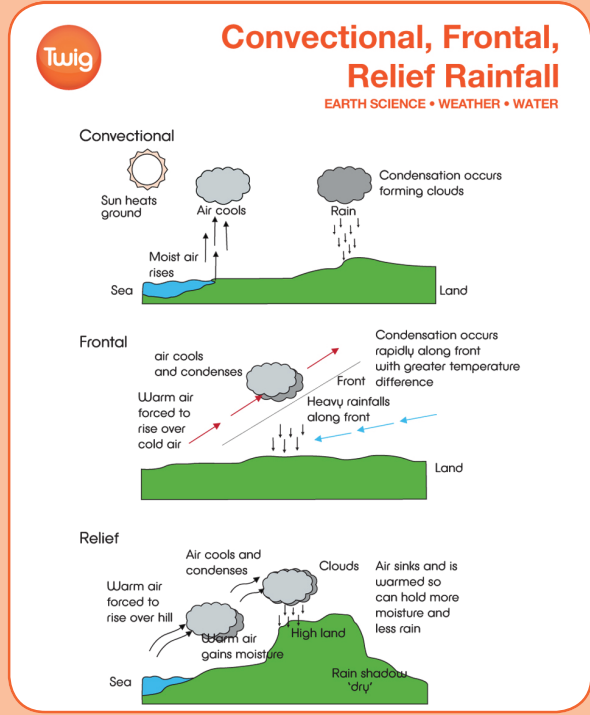
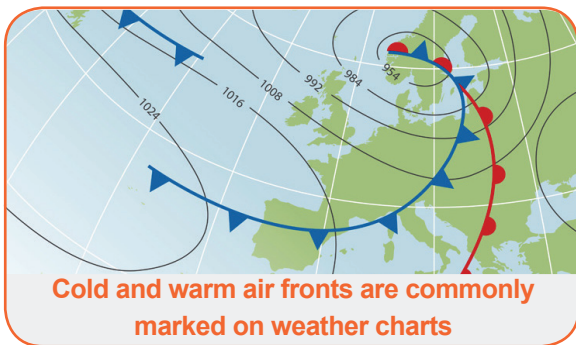


DIAGRAM 04:



• What is frontal rainfall?



When a mass of warm air meets air at a lower temperature, it rises up over the colder, denser air. Once it is made to rise, cloud and rain will follow. The initial uplift will cause light rain and gentle wind, as this front passes through, the rain will get heavier and the winds stronger. The passage of a front can last from a few hours to a few days. Frontal rainfall is formed in a depression.

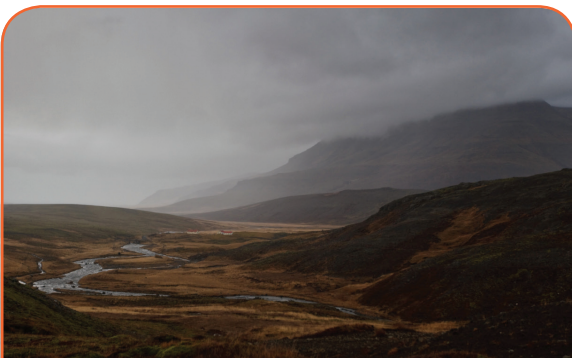
• Suggested Films

- Types of Weather: Rain
- Thunder and Lightning

• What is relief rainfall?

When a band of moist air meets high ground, it is forced upwards. As it rises, the air cools and the water vapour in it condenses. Once these cloud droplets join with each other they fall to Earth as relief rainfall. As that air then travels beyond the high ground, it descends and warms, giving a drier climate. This drier zone is called a rain shadow. Relief rainfall results in a wet climate, and rain persists throughout much of the year.





**Relief rainfall often occurs in areas with a year-round wet climate**

• **Suggested Films**

- Cloud Seeding
- What Is a Rainbow?

• **Suggested Activity**

- Discuss: Which type of rainfall do you think is most typical in the area where you live? Is this the same all year round?

**Extension Question**

Q12. What does 'relief' mean?

In geography, the word 'relief' refers to the shape of the land.

**Section 3: Snow**

• **What is snow?**

Snow is precipitation because it is water that is being transferred from the atmosphere to the Earth's surface. It is made up of tiny ice crystals that have formed together to become a snowflake. The temperature in the cloud must be below freezing for snow to form. Because temperature reduces with altitude, much of the rain we get in northern latitudes during winter will have started as snow, but then warms on its passage down to Earth, thus becoming rain.

• **Suggested Films**

- Types of Weather: Rain
- FactPack: Weird Weather

**Extension Question**

Q13. Why do people get sunburnt when skiing?

Because of the albedo effect of the snow, the Sun's energy is reflected back into the atmosphere, or on to the exposed skin of the skier.



**Snow is composed of many tiny and intricate individual snowflakes**

• **What are the effects of snow on the physical environment?**

Snow has many effects on the physical environment. As snow accumulates it becomes compacted and turns to ice. This process is called nivation, and the frozen product is called firn. The snow has greatest impact on the land surface when it is in the form of ice, as a moving, eroding glacier. The snow's albedo, or capacity to reflect sunlight, is very high, which means that the solar radiation is reflected, thus reducing the temperature of the air around. This lower temperature is likely to produce more snowfall, and so the cycle continues.

- At what point does snow become a natural hazard?



Where there is heavy snowfall there can be a risk of an avalanche, such as this avalanche in Mt Rainier National Park

- Suggested Films

- Avalanches
- Galtür: The Perfect Storm

Communities and individuals are likely to suffer the impact of snow after extended periods of snowfall, and if they are ill prepared. In mountainous regions where snowfall is normal, the greatest snow hazard lies in an avalanche event. An avalanche is when an unstable accumulation of snow breaks away and runs down the mountainside at great speed, driven by gravity. This fast moving body of snow has the strength and speed to flatten woodland and buildings, and then possibly bury them; it will destroy anything in its path. The avalanche will eventually spread out, losing energy and eventually slow down.

- Suggested Activities

- Discuss: How do resorts manage the risk of avalanches?
- Discuss: What impact could an unexpected and extended period of snowfall have on the economy?

### Extension Questions

#### Q14. At what speed can an avalanche travel?

The speed of an avalanche depends on the density of the snow and the gradient of the land, but speeds can reach over 300km/h. Dry snow avalanches can reach 400km/h, as dry snow travels much faster than wet snow. The blast of air in front of the avalanche can be as devastating as the avalanche itself.

#### Q15. Can you survive an avalanche?

If you are lucky, yes. It depends on how long and how deep you are buried beneath the snow and the amount of air available to you. Avalanches kill more than 150 people worldwide each year, and the survival rate for avalanche victims is generally very low.

• Quizzes

The Water Cycle

Basic

• What are the largest natural reservoirs of water?

- A – the oceans
- B – the Arctic ice sheets and glaciers
- C – the seas

• When sunlight warms the surface of the oceans, the Sun's energy changes the liquid water to gas. What is this process called?

- A – evapotranspiration
- B – condensation
- C – evaporation

• Groundwater eventually finds its way back into the atmosphere. Which of these is not one of the processes whereby the groundwater returns to the atmosphere?

- A – evapotranspiration
- B – interception
- C – evaporation

• What is groundwater?

- A – water that is stored in chambers below houses and municipal buildings
- B – water that is stored in plants on the ground
- C – water that is stored under the ground in permeable rocks

• Which of these is not a store in the water cycle?

- A – precipitation
- B – groundwater
- C – lake

Advanced

• The water cycle is a closed system. Why?

- A – like any system, it has inputs, outputs and processes
- B – there are no external inputs or outputs, so the content within the system is constant
- C – because man cannot influence it, it will still continue to happen

• Which of these is not a store within the water cycle?

- A – plants and animals
- B – lakes and rivers
- C – groundwater flow

• What impact do cold temperatures have on the water cycle?

- A – it halts the whole process
- B – water will become frozen, and be stored as ice
- C – more water will be lost through evaporation

• What impact do high temperatures have on the water cycle?

- A – increased evaporation and transpiration
- B – increased groundwater flow and evaporation
- C – increased groundwater flow and transpiration

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**Types of Weather: Rain****Basic****• What are clouds?**

- A – a swirling mass of rain
- B – a swirling mass of water vapour
- C – a swirling mass of ice crystals and thermal currents

**• Water molecules are attracted to the surface of what, within the atmosphere?**

- A – pollen and dust particles
- B – particles of volcanic ash
- C – particles of oxygen

**• How many of these droplets of vapour does it take to make one rain droplet?**

- A – 1 million
- B – 1000
- C – 100

**• What are the three types of rainfall?**

- A – convectional, relief and thermal
- B – condensation, frontal and relief
- C – convectional, frontal and relief

**Advanced****• Which statement is NOT true for the formation of clouds?**

- A – warm air rises, the water vapour cools and condenses, forming water droplets
- B – warm air rises, air particles cool and condense, forming water droplets
- C – cold air rises, the water vapour cools and condenses, forming water droplets

**• What type of rainfall is typical in hot equatorial climates?**

- A – convectional rainfall, because the Sun's rays heat the land and the air above it, causing the air to rise and cool and the water vapour to condense
- B – convectional rainfall, because the Sun heats the lakes and seas near the equator, and this evaporated water will form rain clouds
- C – relief rainfall, because there is high relief at these latitudes

**• What is frontal rainfall?**

- A – where a mass of warm air and cold air meet, and the warm air is forced upwards and cools
- B – where a weather front moves across the ocean, picking up moisture and then depositing it when it reaches the land
- C – where two masses of warm air meet, forming a chemical reaction which results in rain



## Types of Weather: Rain

### Basic

- Which of these is not true for frontal rainfall?

A – mass of warm air and cold air meet

B – cold air forces warm air downward, whilst the cold air rises

C – cold air forces warm air upward

### Advanced

- Relief rainfall generally occurs in what type of regions?

A – high latitudes

B – coastal regions

C – lowland regions

- What is relief rainfall?

A – rainfall that occurs because the air mass is forced from the sea, upwards over upland areas

B – rainfall that occurs because the air mass is heavy with moisture after travelling across the sea

C – rainfall that occurs because the air mass is channelled through a river valley in a mountainous region

• Answers

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