Weather and Climate

You need to know the difference between the weather and the climate.

Weather is the conditions right here, right now. Look out of the window and you will see what the weather is like today. It might be sunny, hot, windy or cloudy, raining or snowing.

The weather takes into account the **temperature** , **precipitation** , **humidity** and **atmospheric pressure** , of the part of atmosphere (air) closest to the surface of the earth.

The weather is constantly changing as temperature and humidity change in the atmosphere. Landmasses, such as the British Isles, experience constantly changing weather conditions.

Climate is the average weather conditions - temperature, pressure, precipitation and humidity - expected for a certain place. Climate is based on the average weather experienced over 30 years or more.

Climate refers to what is expected to happen in the atmosphere rather than the actual conditions. So it is possible for the weather today to be different from that suggested by the climate.

Climatic conditions in an area can be affected by the landscape, relief and activities (human and natural). Climate can alter over time and space.

Within a climatic region, the climate may vary from place to place, e.g. top of hill, sunny side of hill, shaded side of hill and bottom of the hill. These areas with their small variations are called **microclimates** .

Stormy weather, sunny weather: climate is an average of weather conditions over time

The science of monitoring and studying the atmosphere and predicting its weather and climate is called **meteorology** . People who study the weather and climate are known as meteorologists.

You will need to know and understand the different factors that affect weather conditions in a specific time and location.

These factors include:

- **temperature and sunshine**
- **humidity and precipitation**
- **time of day or year**
- **local geography**
- **pressure and winds** , and
- **cloud formations**

Temperature, sunshine, time and geography

1.Temperature
Is how hot or cold the atmosphere is - ie, how many degrees **Celsius** (**centigrade**) it is above or below freezing (0℃).

Temperature is a very important factor in determining the weather, because it influences or controls other elements of the weather, such as **precipitation** , **humidity** , clouds and **atmospheric pressure** .

Temperature is affected by factors such as sunshine, time, geography and wind.

2. Sunshine
The amount of sunshine and strength of the sun influences the temperature of a place.

The number of hours per day that the sun shines in a particular location is known as **sunshine hours** . The number of sunshine hours in a location is determined by the hours of daylight, and how many of these hours are cloud-free. Tourists and people who work in tourism are interested in the number of sunshine hours a location has.

3. Time

The temperature of the atmosphere is affected by the time of day, because of the earth's daily spinning on its axis. As it spins, different parts of it get closer to the sun, so receiving more light and warmth.

Atmospheric temperature is also affected by the time of year. The earth takes a year to revolve around the sun, and as it revolves different parts of it get closer or further away from the sun. It is this which creates different **seasonal climates** which vary according to the time of year.

At the **equator** the hours of daylight and the seasons vary the least. The further away from the equator you go, the greater the fluctuations through the year.

4. Local Geography

The following geographical factors affect temperatures:

Latitude is the distance of a location from the equator. The hottest temperatures are found at the equator. This is because the sun shines directly on it for more hours during the year than anywhere else. As you move further away from the equator towards the polar regions, less and less sun is received during the year and the climates become colder and colder.

Altitude is the height above sea level or the height above the earth's surface. The higher the altitude, the lower the temperature will be. This is because the temperature of air depends on its density. Air is lighter the higher up the hill you go. Winds also tend to be stronger near the top of a hill, adding to the wind-chill factor (see winds below). On average for every 1,000 metres higher you go the temperature will fall about 6.5 ℃.

Aspect is the direction that something is facing. This is important because slopes facing the equator will be warmer. This is why farmers in the northern hemisphere, for example Britain, favour south-facing slopes for growing crops and farmers in the southern hemisphere favour north-facing slopes.

Proximity to the sea affects the temperature of a place because the sea temperature changes slower than land temperature. So the sea will keep coastal areas warmer than inland area during the winter and cooler than inland areas during the summer. This is why islands, such as UK, have more moderate (less severe) climates than countries on continents (such as Germany).

Sea temperature . Different seas are of different temperatures, so it is possible for islands to be warmer on one side than the other. The west coast of Britain is heated up by the warmer waters of the **Gulf Stream** or **North Atlantic Drift** .

Currents exist in all the oceans. Currents are governed by the prevailing winds passing over them. The main ocean currents flow roughly in a similar pattern, anti-clockwise in the southern hemisphere and clockwise in the northern hemisphere. Currents that move water from tropical areas towards the poles (North Atlantic Drift starts in the Gulf of Mexico) are known as warm currents. Those currents moving from northern (or southern) colder seas, nearer the poles towards the equator are known as cool currents, an example is the **Canaries Current** .

Temperature
Temperature is how hot or cold something is, for example the atmosphere or the sea. Use a thermometer to see how many degrees Celsius/centigrade it is above or below freezing point (0 degrees C) .

Precipitation
Precipitation is the term given to moisture that falls from the air to the ground. In the UK, the most common form of precipitation is rain, but snow, hail, sleet, drizzle, fog, and mist are also precipitation.

Humidity
Humidity is the amount of water vapour in the atmosphere. Air can only hold a certain amount of water before condensation and precipitation occurs. Humidity is measured as a percentage, relative to the saturation point where the air can hold no more water vapour (i.e. 100 percent humidity).

Atmospheric Pressure
Atmospheric pressure is the weight of air resting on the earth's surface. Pressure is shown on a weather map with lines called isobars. Low pressure occurs when air is warm and rises. High pressure occurs when air becomes colder and sinks.

Equator
If you draw a line around the middle of the globe, in between the poles, this is the equator. It has a latitude of 0 degrees. This is the hottest part of planet, and temperatures change little between winter and summer. The days and nights are similar length all the year round. It rains virtually every day.

Water Vapour
When water evaporates it becomes a gas called water vapour. Water can exist as a gas at temperatures below the boiling point of water. The amount of water vapour present in air is called humidity.

Atmosphere
layer of gases surrounding the earth

Condensation
A substance condenses when it changes from a gas to a liquid, e.g. from water vapour to water. When this happens it will reduce in size and become more dense.

Dew Point
Dew point air can only hold a certain amount of water vapour. The amount of vapour air can hold is depends on temperature. The colder it becomes, the less water the air can hold. The dew point is the temperature when the amount of water vapour in air is at its limit. If the temperature drops further the water vapour will begin to turn back into water (condense).

Air Masses
Air mass: Air masses: An air mass is a large body of air that shares similar levels of temperature, moisture, and atmospheric pressure. Where different air masses meet it is called a weather front.

Front
Fronts occur where two different air masses meet. An air mass is a large body of air that shares similar levels of temperature, moisture, and atmospheric pressure.

Prevailing Winds
The prevailing wind is the wind direction that occurs most often throughout the year, or occurs most often at this time of year, in a certain geographical region.

Condenses
A substance condenses when it changes from a gas to a liquid, e.g. from water vapour to water. When this happens it will reduce in size and become more dense.

Isobars
A line on map or chart joining up areas of equal atmospheric pressure.

S**ynoptic Charts**

Chart or map with information on weather shown in symbol form.

Tropic of Cancer
Tropic of Cancer is the northern boundary of the tropics. It is found at a latitude of 23.5 degrees North, to the north of the equator. The southern boundary of the tropics is the Tropic of Capricorn. Everything between these two lines is said to be tropical.

Tropic of Capricorn
Tropic of Capricorn is the southern boundary of the tropics. It is found at a latitude of 23.5 degrees South, to the south of the equator. The northern boundary of the tropics is the Tropic of Cancer. Everything between these two lines is said to be tropical.

Biomes
Large-scale ecosystems that can be categorised into one of ten different types. The type of biome is defined mainly by its climate.

Humidity
Is the amount of **water vapour** in the **atmosphere** .
A high humidity means there is a lot of water vapour, and a low humidity means a little.

Air can only hold a certain amount of water before **condensation** occurs.

Condensation will lead to **precipitation** in the form of dew or, if it's very cold, frost.

If condensation occurs higher in the atmosphere (as air is rising) it will form into clouds.

Humidity is measured as a percentage, relative to the saturation point where the air can hold no more water vapour (i.e. 100 percent humidity).

The humidity level varies with **temperature** . The warmer air is, the more moisture the air can hold as vapour. The colder the air is, the less moisture the air can hold.

So on a hot day it can be more humid, than on a cold day.

So in the hottest place, the **equator** , it can be a lot more humid than in the UK.

So when air rises and begins to cool, it gradually loses its ability to hold water.

The point when it becomes too cold for the air to maintain its water level is called the **dew point** . This is when condensation occurs.

Precipitation and the Water Cycle

Precipitation is the term given to moisture that falls from the air to the ground. Precipitation includes snow, hail, sleet, drizzle, fog, mist and rain. In the UK, the most common form of precipitation is rain.

The amount of water held between the earth, seas and the atmosphere is constant. There is a continual flow of water between the earth, sea and **atmosphere** called the **water cycle** .

The type of precipitation experienced in a location is influenced by a number of factors including **temperature** and **atmospheric pressure** .

Types of Rainfall

There are three main types of rainfall - convectional rainfall, frontal rainfall and relief rainfall.

1. Convectional rainfall may occur in Britain in the summer, after a long hot day, but is most commonly found in places with warmer climates.
The ground or water in lakes or seas is warmed by the sun, throughout the day.
The air above the land becomes heated.
This makes the air less dense, so it rises.
As the air rises it cools.
Cool air can not hold as much **water vapour** as warmer air, when the air becomes too cold for the amount of water it holds **condensation** occurs. The point where this occurs is called the **dew point** .
These drops of condensation form into clouds, gradually becoming tall thunderstorm clouds, called cumulonimbus.
When these clouds become too big, containing too much water gravity forces them to release the water in a huge downpour.

2. Frontal rainfall is more common in the UK than convectional rainfall.
Frontal rainfall gets its name because it occurs when two **air masses** of warm and cold air meet, causing a **front** .
When they meet, the less dense, light warm air is forced to rise above the denser, heavier cold air.
As the warm air is forced upwards it cools.
When air rises above the dew point, when it can no longer hold all its water, the water starts to condense and form clouds.
Precipitation falls over a wide area.

3. Relief Rainfall or Orographic Rainfall is common in the west of Britain.
The **prevailing winds** blow moist air from the Atlantic Ocean to the west of Britain onshore.
As the air hits higher land, such as the hills and mountains in Wales and the north-west of England, the air is forced to rise.
When air rises above the dew point, it can no longer hold all its water, which starts to condense and form clouds.
This type of "rainfall" is called relief because it is affected by the lie; or "orographic" because it is affected by mountains.

Cloud Types
Clouds form because air cools as it rises and when it cools, the amount of **water vapour** it can hold reduces. When it reaches its **dew point** , the water vapour held within the air **condenses** , into droplets. These droplets group together as clouds.
There are many different types of cloud. Clouds are given different names, depending on their height, size and shape.

The main terms used to describe clouds are as follows:

Cirrus - wispy shaped

Cumulus - heaped or piled up

Stratus - in layers

Nimbus - contains rain

Cirro - high cloud

Alto - medium-level cloud

High-level Clouds start at above 5000m. Clouds at this level usually contain ice, rather than water.

The main clouds here are:
cirrus (white, wispy clouds),

cirrocumulus (separate, white, heaped clouds, that look small because they are so high)

cirrostratus (white, wispy clouds that you can see the sun quite clearly through).

Medium-level Clouds start at between 2,000m and 5,000m above the earth. Clouds at this level usually contain ice and water droplets.

The main clouds here are:
altostratus (medium-to-high level, white-grey, thin layers of cloud through which the sun can be faintly seen)

altocumulus (collection of white, heaped clouds)

nimbostratus (low-medium level, dark, thick, feature-less clouds, that threatens rain or snow).

Low-level Clouds start below 2,000m above the earth. Clouds at this level are usually just carrying water.

The main clouds here are:
stratocumulus (low, white and grey clouds, that are thick at bottom, heaped on top)

stratus (extensive low-level blanket of dull, grey sky, that blocks out the sun, but doesn't necessarily mean rain)

cumulus (big low, white, fluffy, heaped)

cumulonimbus (starting low these clouds will extend very high, sometime bringing thunderstorms, often rain or snow).

Atmospheric Pressure and Wind

Atmospheric pressure (or air pressure) is the weight of air resting on the earth's surface. Pressure is shown on a weather map, often called a **synoptic map** , with lines called **isobars** .

Low pressure occurs when air becomes warmer. The air molecules expand, become lighter and it rises. The pressure numbers on the isobars will be decreasing as it approaches the low pressure zone.

High pressure occurs when air becomes colder. The air molecules contract, become denser, heavier and sink towards the earth. The pressure numbers on the isobars will be increasing as it approaches the high pressure zone.

What is wind?

Wind is the movement of **air masses** from high pressure areas (highs) to low pressure areas (lows). The effect of this movement of air is to rebalance the pressure in the atmosphere.

Note that:

- the greater the difference between the high and the low pressure, the greater the wind speed will be, and

- the closer together the isobars are on the weather map, the stronger the winds will be.

Wind and temperature

The place where the air mass is coming from will determine whether it brings warmer or colder temperatures. In Britain the **prevailing wind** comes off the ocean from the south west.

In winter this will bring warmer temperatures, as the sea cools down slower than the land. In summer it will bring cooler temperatures for the same reason.

Winds can also make the temperature feel cooler than it really is. This is called the **wind-chill factor** .

Higher winds will remove the warmer air around a human (for example) more quickly, so the body will cool more quickly than usual.

Fronts
Fronts occur where two different **air masses** meet.

1. Warm Fronts exist when warm air is rising over a mass of cold air. As the air lifts into regions of lower pressure; it expands, cools and condenses the water vapour as wide, flat sheets of cloud.

Warm fronts are shown on **synoptic charts** by a solid line with semicircles pointing towards the colder air and in the direction of movement. On coloured weather maps, a warm front is drawn with a solid **red** line with red semicircles.

2. Cold Fronts are usually associated with depressions. A cold front is the transition zone where a cold air mass is replacing the warmer air mass. The cold air is following the warm air, and is gradually moving underneath the warmer air. As the warm air is pushed upwards it will rain heavily. Often more rain will fall in a few minutes as the cold front passes than during the whole passage of a warm front. As the cold front passes, the clouds roll by and you may notice that the air temperature is cooler.

Cold fronts are shown on synoptic (weather) charts by a solid line with triangles along the front pointing towards the warmer air and in the direction of movement. On coloured weather maps, a cold front is drawn with a solid **blue** line with blue triangles.
Image: part of a UK weather map showing a warm front, cold front and, where they join, an occluded front.

3. Occluded Fronts occur at the point where a cold front takes over a warm front or vice versa. If a cold front undercuts a warm front it is known as a cold occlusion, if the cold front rises over the warm front it is called a warm occlusion. All occluded fronts bring changeable weather conditions.

On a synoptic chart occluded fronts are represented by semi-circles and triangles positioned next to each other, the triangles in blue, the semicircles in red, or both are purple (mixing both red and blue colours together).

Global Weather Patterns

At a global level, there are patterns of wind and pressure. There are huge bands of high and low pressure around the earth. These bands run parallel with the **equator** . There is a low pressure band over the equator (at 0° latitude) and two more low pressure bands one bordering the cold region around the Arctic (at a latitude of 60° North) and another bordering the Antarctic (at a latitude of 60° South). In between there are two high pressure bands, one in each hemisphere found around a latitude of 30°North and 30°South, to the north of the **Tropic of Cancer** and to the south of **Tropic of Capricorn** .

Air is constantly moving from high pressure areas to low pressure areas. This movement of air produces **prevailing winds** , called trade winds as they used to help trading ships sail around the world. The winds are strongest in between the zones of high and low pressure, and are weak and changeable around the bands themselves. Sailors call the lack winds around the equator the doldrums.

The trade winds are also influenced by the movement of the earth. This means that instead of going due north or due south, they are blown slightly off course. In the northern hemisphere winds are blown to the right. In the southern hemisphere they are blown to the left. This is why the prevailing wind in the UK comes from the south west.

These prevailing winds also influence the directions that the great currents move in the oceans. The animation shows the main areas of high and low pressure on the globe, and winds blowing (slightly off course) from high to low pressure bands.

Atmospheric Circulation

At the area around the **equator** the weather is always very hot, causing hot air to rise, taking with it evaporated water as water vapour. This rising air causes the low pressure band around the equator - and is the engine of global wind patterns:

As the warm air rises, it cools until it hits the dew point, when it releases the water vapour, creating clouds and tropical rain. The low pressure sucks in cool air from either side of the equator.

As this air is warmed, it too rises. As it does so it pushes the cooler, dryer air (much of its water has now been lost as rain) above it away to the north and south of the equator.

This dry air heading north sinks back to the ground to the north of the Tropic of Cancer, while the dry air heading south sinks to ground south of the Tropic of Capricorn. This sinking air helps to create high pressure zones.

The sinking, dry air contributes to a much drier climate to the north and south of the tropics - creating the desert and savannah **biomes** typical of this zone.

These circulating currents of air - along the surface of the earth from the high pressure zone to the equator, then up into the atmosphere, then horizontally through the atmosphere, and finally back down to the ground in the high pressure zone - are called **Hadley cells** .