Wind and Types of Wind Cyclones, Hurricane and Typhoons, Tornadoes

Wind

The winds at the surface of the Earth vary depending on the location. In the stratosphere, the winds are steady. The air is clear and dry there. The consistency of the airflow allows airplanes to fly on regular courses.

What Causes Wind?

Uneven Heating on the earth is the main cause of the wind movement. The uneven heating of the Earth's surface is caused by the sun. This occurs because the Earth is a tilted sphere and the sun does not heat all its surfaces uniformly and because the sun's heat penetrates land and water at different rates.
The Uneven Heating takes place in two situations

1. Uneven heating between land and sea
2. Uneven heating between equator and pole

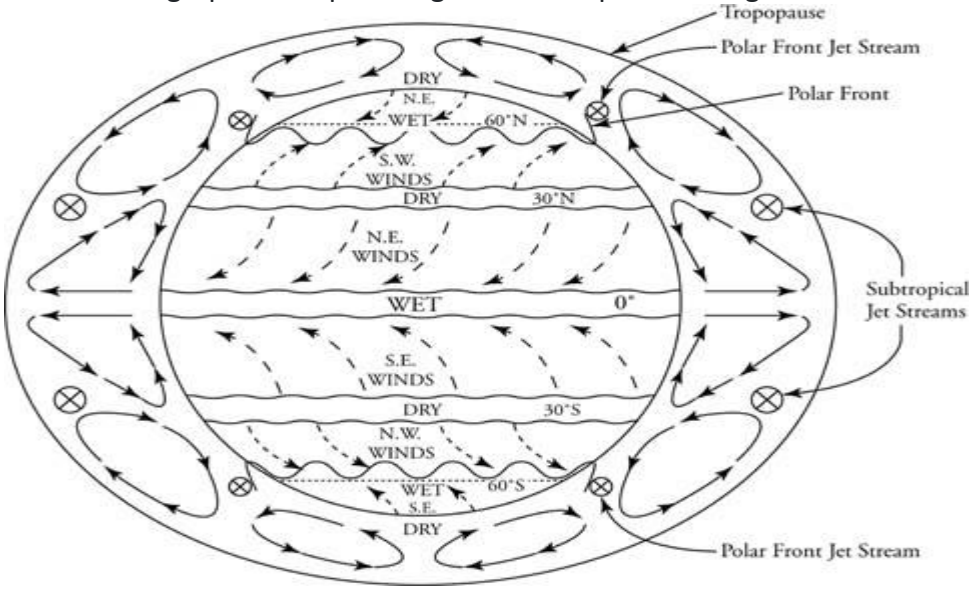
Types of Wind

There are several types of wind and are mentioned below:

1. Planetary Winds
2. Trade Winds
3. The Westerlies
4. Periodic Winds
5. Local Winds

1. Planetary Winds

The winds which are distributed throughout the lower atmosphere are known as Planetary winds. These winds blow throughout the year and are confined within particular latitudinal belts, mainly in northeast and southeast directions or from high-pressure polar regions to low-pressure regions.



2. Trade Winds

Trade winds are also known as tropical easterlies and in the Northern hemisphere, these winds blow from the right, while in the Southern hemisphere, they blow from the left. Due to the Coriolis effect and Ferrel's law, they start blowing towards the equatorial low-pressure belt from the sub-tropical high-pressure areas. In the Southern hemisphere, they blow as southeastern trades and in the Northern hemisphere, they blow as northeastern trades.

The prevailing winds which blow from the west to the east are known as Westerlies. These westerlies flow in the middle latitudes of the earth i.e. between 30 degrees and 60 degrees latitude. These winds are also known as anti-trades. These Westerlies originate from the areas which have high pressure in the horse latitudes and move towards the polar region and generally steer extratropical cyclones.

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4. Periodic Winds

The winds which change their direction periodically as there is a change in the seasons are known as Periodic winds. Types of Periodic winds:

- **Monsoon winds**: Monsoon winds are created due to the temperature difference which is created by the Indian Ocean, the Bay of Bengal, the Arabian Sea, and the Himalayan wall forms the basis of monsoon in the Indian subcontinent.
- **Land Breeze**: The winds that flow from the land towards the sea are known as Land Breeze. These winds carry only dry or warm air. These winds flow often at night.
- **Sea Breeze**: The winds that blow towards land from the direction of a large water body (ocean or river) are known as Sea Breeze. Due to the differences in air pressure created by the differing heat capacities of dry land and water the Sea Breeze is developed.
- **Mountain and valley breeze**: Valley breeze is the hot air blowing up to the slopes of mountains from the valley. In contrast, the mountain breeze is the cold air flowing towards the valley from the mountains.

5. Local Wind

These winds blow only during particular periods of time, day, or year and in some small areas. For example, land and sea breeze. In the northern part of India Loo is the local winds that blow.

How is Wind Measured?

The wind has both speed and direction. To measure these parameters, two different devices are used namely Anemometer and Wind Vane.

1. Anemometers

This instrument is used for measuring the speed of the wind and this is a common weather station instrument. There are different types of anemometers which are known as Cup anemometer, windmill anemometer, hot wire anemometer, sonic anemometer, and laser Doppler anemometer.

2. Wind Vane

The Wind vanes are also known as weathercock. And these devices are used for determining the direction of the wind

Name of Local Wind	Region
Abrolhos	Brazil
Alisio	Caribbean
Alize	Central Africa and the Caribbean
Barguzin wind	Russia
Berg	South Africa
Harmattan	Central Africa
Ghibli	Libya
Loo	India, Pakistan
Pampero	Argentina, Uruguay

Föhn or foehn	Alps, North Italy
Chinook	Rocky Mountains
Roaring Forties	Southern Hemisphere
Southerly Buster	Sydney

CYCLONE

- Cyclones are rapid inward air circulation around a low-pressure area. The air circulates in an anticlockwise direction in the Northern hemisphere and clockwise in the Southern hemisphere.
- Cyclones are usually accompanied by violent storms and bad weather.
- The word Cyclone is derived from the Greek word Cyclos meaning the coils of a snake. It was coined by Henry Peddington because the tropical storms in the Bay of Bengal and the Arabian Sea appear like coiled serpents of the sea.

There are two types of cyclones:

1. Tropical cyclones:

- Tropical cyclones are violent storms that originate over oceans in tropical areas and move over to the coastal areas bringing about large scale destruction caused by violent winds, very heavy rainfall and storm surges.
- Tropical Cyclones are one of the most devastating natural calamities in the world.
- Tropical cyclones originate and intensify over warm tropical oceans. The conditions favourable for the formation and intensification of tropical storms are:
  - Large sea surface with temperature higher than 27° C.
  - Presence of the Coriolis force.
  - Small variations in the vertical wind speed.
  - A pre-existing weak low- pressure area or low-level-cyclonic circulation.
  - Upper divergence above the sea level system.

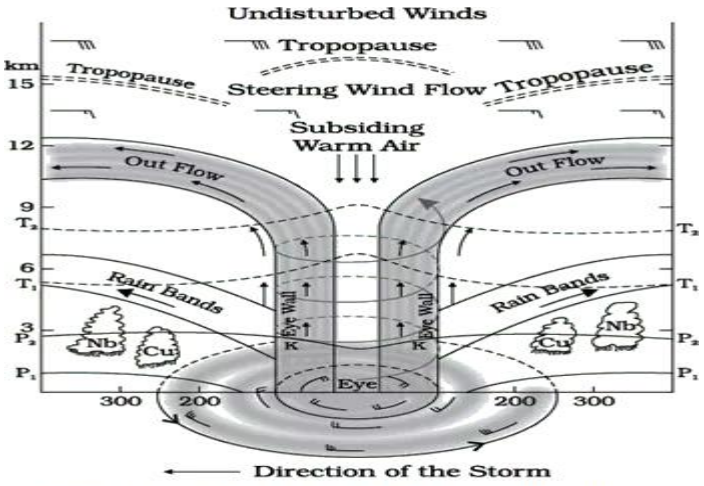


Fig: Vertical section of the tropical cyclone

2. Extra Tropical cyclones:

- Extratropical cyclones are referred to as mid-latitude depressions, temperate cyclones, frontal depressions and wave cyclones.
- These are active above the mid-latitudinal region between 35° and 65° latitude in both the hemispheres. The direction of movement is from west to east and more pronounced in the winter seasons. It is in these latitude zones the polar and tropical air masses meet and form fronts

Anti Cyclones, Humidity, Fog, Dew Point, Smog

Anticyclones

- An anticyclone is the opposite of a cyclone i.e. i.e., it has an outward-spiralling air circulation around a high pressure centre.
- An anticyclone's winds rotate clockwise in the Northern Hemisphere around a center of high pressure.
- In anticyclones, air comes in from above and sinks to the ground. High pressure centers generally have fair weather.

Pressure System	*Pressure Condition at the Centre*	*Pattern of Wind Direction*	
		Northern Hemisphere	*Southern Hemisphere*
Cyclone	Low	Anticlockwise	Clockwise
Anticyclone	High	Clockwise	Anticlockwise

Table: Pattern of Wind Direction in Cyclones and Anticyclones

Humidity

Humidity is the general term which describes the invisible amount of water vapour present in the air. It is a highly variable climatic factor which forms only a small proportion. Water vapour in the atmosphere comes through evaporation from the oceans, lakes, rivers, ice-fields and glaciers, through transpiration from plants and respiration from animals.

Several factors influence the rate of evaporation:

1. Amount of water available:

Rate of evaporation is greater over the oceans than over the continents.

2. Temperature:

A high temperature implies greater availability of energy for evaporation; thus, the rate of evaporation is directly proportional to the temperature of the evaporating surface.

3. Relative humidity:

Since the moisture-holding capacity of air at a given temperature is limited, drier, air (or air with lesser relative humidity) evaporates more water than moist air. Thus, evaporation is greater in summer and at mid-day than in winter and at night.

4. Wind speed:

A high wind speed removes the saturated air from the evaporating surface and replaces it with dry air which favours more evaporation. Whenever there is a combination of high temperature, very low relative humidity and strong winds, the rate of evaporation is exceptionally high. This leads to dehydration of soil to a depth of several inches.

5. Area of evaporating surface:

A larger surface area exposed to heat implies enhanced evaporation.

6. Air Pressure:

Evaporation is also affected by the atmospheric pressure exerted on the evaporating surface. Lower pressure over open surface of the liquid results in a higher rate of evaporation.

7. Composition of water:

Evaporation is inversely proportional to salinity of water. Rate of evaporation is always greater over fresh water than over salt water. Under similar conditions, ocean water evaporates about 5% more slowly than fresh water.

8. More evaporation by plants:

Water from plants generally evaporates at a faster rate than from land.

Dew Point

- The air containing moisture to its full capacity at a given temperature is said to be saturated.
- It means that the air at the given temperature is incapable of holding any additional amount of moisture at that stage.
- The temperature at which saturation occurs in a given sample of air is known as **dew point.**
- **Dew point occurs when Relative Humidity = 100%.**

Fog

Fog is special type of thin cloud consisting of microscopically small water droplets which are kept in suspension in the air near the ground surface and reduces horizontal visibility. According to Byers fog is defined 'as almost microscopically small water drops suspended in the atmosphere and reducing the horizontal visibility to less than one kilometre'. It may be pointed out that clouds are formed due to ascent, expansion and cooling of air while fogs are formed due to radiation, conduction and mixing of warm and cold air masses near the earth's surface.

Fogs are classified in 4 types on the basis of visibility:

(i) Light fog (visibility upto 1100 metres)

(ii) Moderate fog (visibility 1100 m-550 m)

(iii) Dense fog (550 m-300 m)

(iv) indtense dense fog (less than 300m)

Cloud, Monsoon

What is a cloud?

- A cloud is an accumulation or grouping of tiny water droplets and ice crystals that are suspended in the earth atmosphere.
- They are masses that consist of huge density and volume and hence it is visible to naked eyes.
- There are different types of Clouds. They differ from each other in size, shape, or colour.
- They play different roles in the climate system like being the bright objects in the visible part of the solar spectrum, they efficiently reflect light to space and thereby helps in the cooling of the planet.
- Clouds are formed when the air becomes saturated or filled, with water vapour. The warm air holds more water vapour than cold air.
- Being made of the moist air and it becomes cloudy when the moist air is slightly cooled, with further cooling the water vapour and ice crystals of these clouds grew bigger and fall to earth as precipitation such as rain, drizzle, snowfall, sleet, or hail.

What causes clouds to form?

There are five factors that can lead to air rising and cooling and clouds forming.

1. **Surface heating –** This happens when the ground is heated by the sun which heats the air in contact with it causing it to rise. The rising columns are often called thermals. Surface heating tends to produce cumulus clouds.
2. **Topography or orographic forcing –** The topography – or shape and features of the area – can cause clouds to be formed. When air is forced to rise over a barrier of mountains or hills it cools as it rises. Layered clouds are often produced this way.
3. **Frontal –** Clouds are formed when a mass of warm air rises up over a mass of cold, dense air over large areas along fronts. A 'front' is the boundary between warm, moist air and cooler, drier air.
4. **Convergence –** Streams of air flowing from different directions are forced to rise where they flow together, or converge. This can cause cumulus cloud and showery conditions.
5. **Turbulence –** A sudden change in wind speed with height creating turbulent eddies in the air.

What are the different types of cloud?

Clouds are classified primarily based on – their shape and their altitude**.**

1. Classification of clouds – based on their shape:

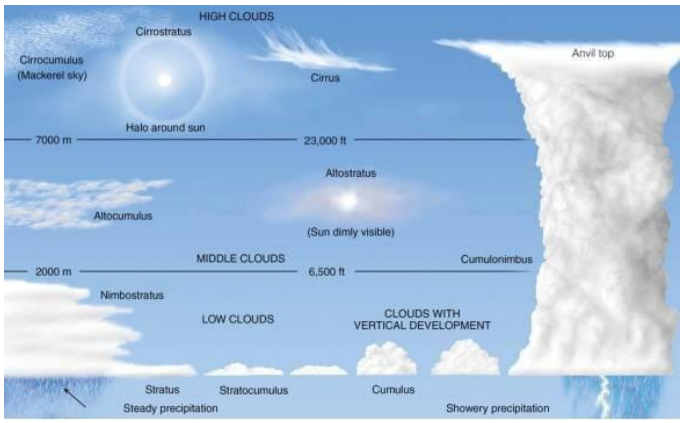
1. Cirrus
2. Cumulus
3. Stratus

2. Classification of clouds – based on their altitude (height):

1. High Clouds
2. Middle Clouds
3. Low Clouds

Classification of clouds	Types of clouds
High clouds	Cirrus, Cirrostratus, Cirrocumulus
Middle clouds	Altostratus, Altocumulus
Low clouds	Stratocumulus, Stratus, Nimbostratus

Clouds with extensive vertical development	Cumulus, Cumulonimbus



High Altitude clouds: These are found 20,000ft or higher above the land surface. Cirrus, Cirrostratus, and Cirrocumulus are the cloud types found here.

Middle Altitude Clouds: These are found between 6,500ft to 20,000ft above the land surface. Altostratus and Altocumulus are the cloud types found here.

Low Altitude Clouds: These cloud types can be found from ground level to about 6,500ft above it. They include Stratus, Stratocumulus, and Nimbostratus clouds.

Vertical Clouds: These are clouds that extend from the lower to the higher altitude s of the atmosphere. They form by thermal convection or frontal lifting, sustained by the powerful convectional current that holds and pushes the moisture in the clouds further upward. An example of a vertical cloud is the Cumulonimbus cloud.

Foggy Clouds: These form close to the ground. Sometimes they make visibility very poor such that you can hardly see more than 60 away.

Cirrus

- Detached clouds in the form of **white**, delicate filaments, mostly white patches or narrow bands.
- They may have a **fibrous (hair-like) and/or silky sheen appearance.**
- Cirrus clouds are always **composed of ice crystals**, and their transparent character depends upon the degree of separation of the crystals.
- As a rule, when these clouds cross the sun's disk they hardly diminish its brightness. When they are exceptionally thick they may veil its light and obliterate its contour.
- Before sunrise and after sunset, cirrus is often colored bright yellow or red. These clouds are lit up long before other clouds and fade out much later; sometime after sunset, they become gray.
- At all hours of the day, Cirrus near the horizon is often of a yellowish color; this is due to distance and to the great thickness of air traversed by the rays of light.

Cirrostratus

- Transparent, whitish veil clouds with a fibrous (hair-like) or smooth appearance.
- A sheet of cirrostratus which is very extensive, nearly always ends by covering the whole sky.
- A milky veil of fog (or thin Stratus) is distinguished from a veil of Cirrostratus of a similar appearance by the halo

phenomena which the sun or the moon nearly always produces in a layer of cirrostratus.

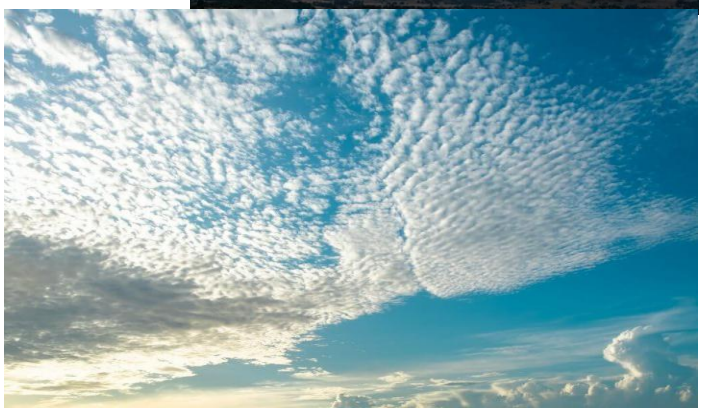
Cirrocumulus

- Thin, white patch, sheet, or layered of clouds without shading.
- They are composed of very small elements in the form of more or less regularly arranged grains or ripples.

Altostratus

- Grey or bluish cloud sheets or layers of striated or fibrous clouds that totally or partially covers the sky.
- They are thin enough to regularly reveal the sun as if seen through ground glass.
- Altostratus clouds do not produce a halo phenomenon nor are the shadows of objects on the ground visible.

Altocumulus

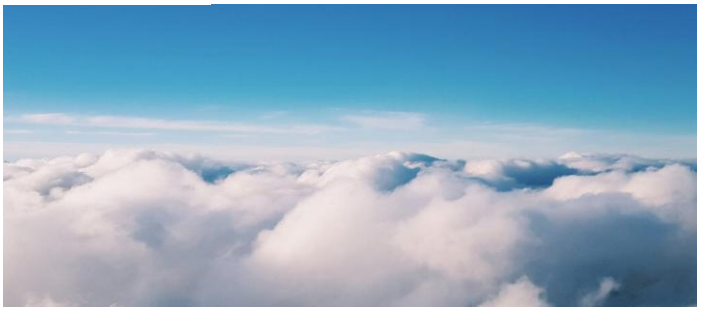


- White and/or grey patch, sheet or layered clouds, generally composed of laminae (plates), rounded masses or rolls.
- They may be partly fibrous or diffuse.
- When the edge or a thin semi-transparent patch of altocumulus passes in front of the sun or moon a corona appears.
- This colored ring has red on the outside and blue inside and occurs within a few degrees of the sun or moon.

Nimbostratus

- The continuous rain cloud. Resulting from thickening Altostratus, This is a dark grey cloud layer diffused by falling rain or snow.
- It is thick enough throughout to blot out the sun.
- The cloud base lowers into the low level of clouds as precipitation continues.

Stratocumulus



- Grey or whitish patch, sheet, or layered clouds which almost always have dark tessellations (honeycomb appearance), rounded masses or rolls.
- Except for virga they are non-fibrous and may or may not be merged.

Stratus

- A generally grey cloud layer with a uniform base which may, if thick enough, produce drizzle, ice prisms, or snow grains.
- When the sun is visible through this cloud, its outline is clearly discernible.
- Often when a layer of Stratus breaks up and dissipates blue sky is seen.

Cumulus

- Detached, generally dense clouds and with sharp outlines that develop vertically in the form of rising mounds, domes, or towers with bulging upper parts often resembling a cauliflower.
- The sunlit parts of these clouds are mostly brilliant white while their bases are relatively dark and horizontal.

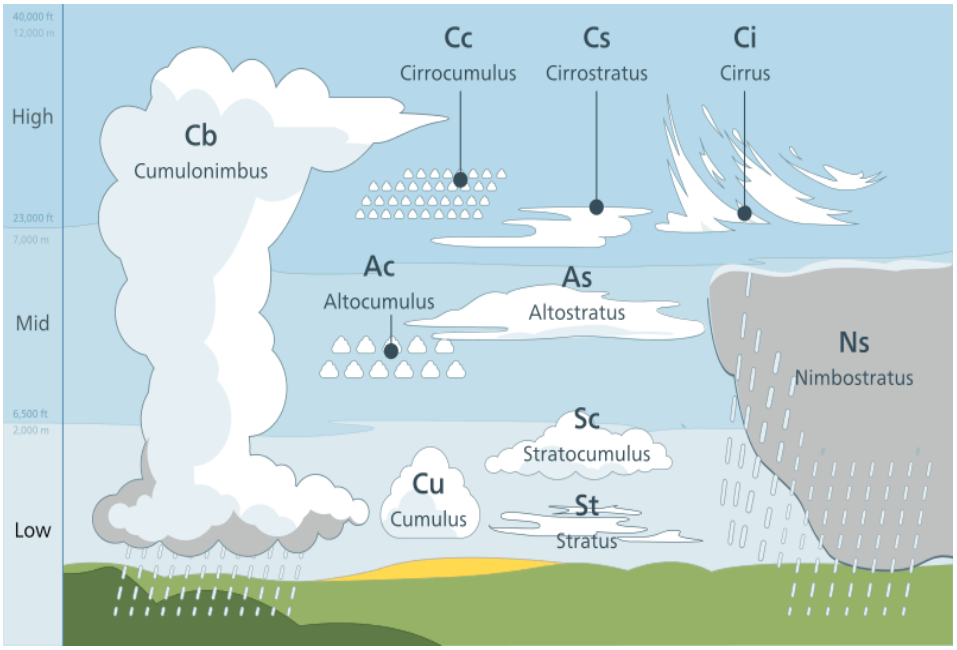
Cumulonimbus

- The thunderstorm cloud, this is a heavy and dense cloud in the form of a mountain or huge tower. The upper portion is usually smoothed, fibrous or striated and nearly always flattened in the shape of an anvil or vast plume.
- Under the base of this cloud which is often very dark, there are often low ragged clouds that may or may not merge with the base.
- Cumulonimbus clouds also produce hail and tornadoes.

Precipitation

Precipitation is any liquid or frozen water that forms in the atmosphere and falls back to the Earth. It comes in many forms, like rain, sleet, and snow. Along with evaporation and condensation, precipitation is one of the three major parts of the global water cycle.

Water vapor, droplets of water suspended in the air, builds up in the Earth's atmosphere. Water vapor in the atmosphere is visible as clouds and fog. Water vapor collects with other materials, such as dust, in clouds.



Precipitation condenses, or forms, around these tiny pieces of material, called cloud condensation nuclei (CCN). . These particles provide a surface for water vapor to condense upon. This helps water droplets gather together and become large enough to fall to the Earth.

Clouds eventually get too full of water vapor, and the precipitation turns into a liquid (rain) or a solid (snow).

Precipitation is part of the water cycle. Precipitation falls to the ground as snow and rain. It eventually evaporates and rises back into the atmosphere as a gas. In clouds, it turns back into liquid or solid water, and it falls to Earth again. People rely on precipitation for fresh water to drink, bathe, and irrigate crops for food.

The most common types of precipitation are rain, hail, and snow.

Rain

- Rain is precipitation that falls to the surface of the Earth as water droplets. Raindrops form around microscopic cloud condensation nuclei, such as a particle of dust or a molecule of pollution.
- Rain that falls from clouds but freezes before it reaches the ground is called sleet or ice pellets.
- Even though cartoon pictures of raindrops look like tears, real raindrops are actually spherical.

Hail

- Hail forms in cold storm clouds. It forms when very cold water droplets freeze, or turn solid, as soon as they touch things like dust or dirt.
- The storm blows the hailstones into the upper part of the cloud. More frozen water droplets are added to the hailstone before it falls.
- Unlike sleet, which is liquid when it forms and freezes as it falls to Earth, hail falls as a stone of solid ice. Hailstones are usually the size of small rocks, but they can get as large as 15 centimeters (6 inches) across and weigh more than a pound.

Snow

- Snow is precipitation that falls in the form of ice crystals. Hail is also ice, but hailstones are just collections of frozen water droplets. Snow has a complex structure. The ice crystals are formed individually in clouds, but when they fall, they stick together in clusters of snowflakes.
- Snowfall happens when many individual snowflakes fall from the clouds. Unlike a hail storm, snowfall is usually calm. Hailstones are hard, while snowflakes are soft.
- Snowflakes develop different patterns, depending on the temperature and humidity of the air.
- When snow falls in the form of a ball instead of soft flakes, it is called graupel. This happens when snow is melted and precipitation forms around the snow crystal.
- Snow requires temperatures at the ground to be near or below freezing—less than 0 degrees Celsius (32-degrees Fahrenheit). Snow that falls on warmer ground melts on contact.