

Flash Notes - Wind, Storms & Cyclones

What is it that makes various objects or things to move around it.

This air is called Wind. So, **Moving air is called Wind.**

-Winds are caused by heating difference between different parts of the world and the movement of the earth.

Before moving to the different disasters it is important to first understand what all things cause them...

AIR

AIR EXERTS PRESSURE

Air pressure or atmospheric pressure is the weight of air acting on a unit area of surface. Air exerts pressure in all directions.

- When we swim underwater, we feel a pressure exerted by water on our body. Similarly atmospheric air also acts on us from all directions. It is just that we don't feel it because the fluids in our body exert as much pressure outwards as the air pressure outside exerts on us. (This is because air molecules keep bombarding continuously on the bodies.)
- In fact, air pressure pushes in all directions – up, down and sideways.

Pressure on Earth varies with the altitude of the surface; so air pressure on mountains is usually lower than air pressure at sea level.

This is why when we are on a hill station, our nose bleeds at times. Since at heights the air pressure drops while our body being at a higher pressure tries to react by the blood moving out to equalize the pressure.

Some examples of Air Pressure:

- When we ride a cycle in the direction of the air /wind, it is easier to ride it whereas, when the wind blows in an opposite direction to the direction of your cycling you have difficulty in riding the cycle as the wind pushes back.
- When you drink through a straw, you suck the air in the straw, since the air in the straw decreases, the air outside the liquid is more and this air at higher pressure

exerts a force on the liquid which then pushes liquid into the straw with a lower pressure. Hence, the liquid comes up and we drink it.

- When we press a rubber sucker against any smooth surface, say a wall,

HIGH SPEED WINDS RESULT IN REDUCED AIR PRESSURE AND AIR MOVES FROM HIGH PRESSURE TO LOW PRESSURE

- Wind has the ability to lift things. When high speed winds blow they reduce the air pressure which results in movement or lifting up of things.
- (So, increase in wind speed will lead to decrease in air pressure as all the particles of air would move away quickly. However, decrease in wind speed will lead to increase in air pressure as all the particles of air would get more time to stay at the same place and would exert a greater pressure.)
- Air moves from a region of high pressure to a region of low pressure. The greater the pressure difference the faster will be the movement of air AND greater will be the speed of wind.

e.g. When high winds blow above houses with weakly attached roofs, the roofs often get blown away. (This is because a low pressure is created due to strong winds above the roof. Hence there is a lift of air from below the roof since here air is at a high pressure).

e.g. Covers of overhead water tanks also fly away in stormy winds. (This is because due to high speed winds a low pressure area gets created above the tank lid. The air in the tank being at a higher pressure exerts an upward pressure on the lid and the lid flies away.)

Q. Atmospheric pressure at Mumbai higher or lower than the atmospheric pressure on the top of Mt. Everest. Explain?

Ans. we will find more atmospheric pressure at Mumbai. The reason is that as we go higher the air cover decreases and so decreases the atmospheric pressure. Mt Everest being at a higher height has a low atmospheric pressure. So, atmospheric pressure is higher at Mumbai

AIR EXPANDS ON HEATING & CONTRACTS ON COOLING

- **Air expands on heating and becomes lighter thereby rising.**
- e.g. When air in a balloon is heated, it expands and becomes lighter. Hence it tends to rise up thereby taking the balloon upwards.
- e.g. Smoke coming out of a chimney is hot and thereby lighter than the surrounding cool air. Hence it rises up in the air.

HOW ARE WIND CURRENTS GENERATED : WIND GENERATION IN NATURE

Winds blow or are generated due to difference in pressure between 2 areas.

If the earth's surface in a region is heated up by the strong sun, the air over it becomes lighter and rises up. This produces a region of low pressure on the earth's surface. Cooler air from surrounding areas rushes in to take its place. This causes winds to blow. The heated air that rises up gets cooled and sinks. This causes convection currents to be set up in the air.

Winds get generated due to two things:-

(i) Uneven heating of Earth's surface between Equator & Poles

(ii) Uneven heating of land & water surfaces.

(i) Uneven heating of Earth's surface between Equator & Poles

- The sun shines directly over the equator and hence the region closer to the equator gets maximum heat from the sun.
- Hence the air in this region gets heated up and rises up. This creates a region of low pressure in their area.
- Due to this, the cooler air from either sides of the equator up to a latitude of 30° rushes to take its place. Hence winds blow towards the equator from the North and South directions.
- As the warm air rises in the atmosphere it moves away from the equator, cools and comes down in areas around 30° North and 30° South of the equator. Since this area of 30° N and 30° S is at a higher pressure therefore winds blow from here towards the equator and also towards the poles.
- At latitude of about 60° north and south, this air meets cold dense air from the poles. As it is warmer than the polar air, it rises again.

- Thus a low pressure area is created at 60° latitude. The cold, dense air from the polar regions rushes to take its place.
- In this way a pattern of wind circulation is set up on the earth.
- If the earth had stood still, these winds would have blown directly from north to south and from south to north.
- But as the earth rotates, the winds in the northern hemisphere swerve to the right, and the winds in the southern hemisphere swerve to the left.

(ii) Uneven heating of land and water surfaces

The unequal heating of land and water surface gives rise to Sea Breeze & Land Breeze.

These breezes work on the principle that ..

-land gets hotter faster than air and also gets cooler faster than air

SEA BREEZE

- Land is a better conductor of heat than water.
- Due to this land gets hotter than the sea during daytime.
- Hence the warm air from land rises up creating a low pressure area.
- The water in the sea which does not get so hot is cooler and hence cool winds blow from sea to the land so as to occupy the empty space.
- This movement of air from sea to the land during the day is known as Sea Breeze.

LAND BREEZE

- Land cools faster than the sea at night & hence becomes cooler than the sea.
- Warm air over the sea is lighter & rises, creating a low pressure area above the water. Hence the cooler air over the land rushes to take its place.
- This gives rise to land breeze at night.

IN THE INDIAN CONTEXT:

- During summer land over India becomes warmer than the sea around it.
- This causes winds to blow from the sea into land.
- These winds come from the southwest direction and bring moisture with them from the Indian Ocean. They bring rain to almost all parts of India.
- In winters, the direction of the winds is reversed, and they flow from land to sea.
- Hence, they carry a little moisture and so cause small amount of rain in winter.

- Only a part of these winter winds which flows from eastern India over the Bay of Bengal is able to absorb moisture from the bay and bring rain, to western region of southern India.
- These winds are known as **monsoon winds**.

MONSOON

Winds blowing from the sea towards the land are laden with moisture and bring rain. These winds that bring rain are called monsoon.

Winds can cause massive disasters. Some natural effects of wind are thunderstorm, cyclones & tornadoes.

THUNDERSTORM:-

Thunderstorm is a kind of weather characterized by heavy rain, thunder and lightning.

It frequently occurs in hot and humid tropical areas like India.

HOW IT OCCURS:

- As the air near the earth's surface heats up, it rises.
- This produces strong upward rising winds, which carry moisture with them.
- In the cooler upper regions of the atmosphere, the moisture rapidly condenses into droplets of water, which may fall as rain, or freeze and fall as hail.
- The water droplets and ice crystals collide with each other due to the swift rising air.
- These collisions produce static electricity and the clouds get charged.
- Huge sparks are produced between clouds or between a cloud and the ground.
- This is the lightening we see.
- The lightening heats the air in its path so quickly that a loud booming sound is produced.
- This is the thunder we hear along with the lightning.

So there are 3 important factors that cause thunderstorms: (HUL)

Humidity – This is the moisture. This causes formation of clouds and this leads to rainfall.

Unstable Air – This is the warm air that is light and rises up. At times air in the lowest layers near the land gets heated up. However air in the upper layers is cool. So there is a huge temperature difference which leads to thunderstorms.

Lift - This constitute upward rising winds. When the warm air rises up rapidly it tends to be very unstable and the clouds get charged up creating possibility of thunderstorm along with light and sound.

Precautions to be taken:

- Do not take shelter under an isolated tree.
- Do not lie on the ground.
- Don't take shelter under metal sheds.
- Don't sit near a window.
- If in water, go out and take shelter in a building.
- If in a car/ bus, rollup the windows and stay in.
- Don't use an umbrella with a metal end

CYCLONES AND TORNADOES

Cyclone:-

This is nothing but a severe form of thunderstorms.

It is a system of closed rotating winds around a low pressure area.

Here the winds move at a high speed in a rotational motion.

- Fast moving air, towards a centre, usually with heavy rain, is known as a cyclone.
- Cyclones are high speed winds which arise due to difference in air pressure.
- Wind speed, direction, temperature & level of humidity are some of the factors that affect the development of a cyclone.
- It is the formation of a very low pressure system, with very high speed winds, revolving around it.
- They normally occur in regions close to and on either side of the equator.

HOW THEY OCCUR

- When warm water from the seas / oceans evaporates it changes into water vapor and rises up in the air.
- This creates a low pressure area in the region.
- When the warm air rises in the upper layers, it cools down and the water vapour present in it condenses to form clouds. (When this water vapour upon cooling, condenses to water it gives out its heat which is also called the latent heat)
- As the warm air (loaded with moisture) above the sea rises and reaches the upper cooler regions of the atmosphere, it condenses to form rain drops, which then gather together to form massive thunder clouds.
- As the water vapour cools down and condenses, it releases heat and warms up the air around it.
- This warm air then again being light and rises up further causing a low pressure region to develop. More air then again rushes towards the center of this low pressure region. However instead of moving straight into the center of this low pressure region the cooler air circles / revolves around it in a spiral at a very high speed. This happens because the spinning of the earth always pushes the winds to one side.
- This process continues with a very low pressure in the centre with very high speed winds revolving around it.
- The swirling winds rotate faster and faster, forming a huge circle which can be up to 200 km across.
- This weather condition is called a cyclone.
- Hence, a cyclone consists of a low pressure region with a higher pressure all around and winds circulating violently around the center.
- At the center of the storm is a calm, cloudless area called the eye.
- The diameter of the eye may vary from 10km – 30km.
- There is no rain in the eye and the winds are fairly light.
- The eye can be clearly seen in the center of the cyclone.
- The strongest winds (normally blowing at 150 – 250 km/hr) and the heaviest rains are formed in the thick clouds around the eye.
- These thick clouds of a diameter of 80 – 200 km or more and can be as high as 10 - 15 km.
- As a cyclone begins to build up, it also begins to move with a great speed and is laden with warm moist air from the sea.

Damages caused by Cyclones –

- The high speed of tropical cyclones is accompanied by heavy rains and huge sea waves.
- The sea waves may be several meters high and are very destructive causing floods, uprooting of trees, collapsing of structures and heavy loss to life and property.
- lift the water in the seas high up and the sea water can enter low lying areas near the coast, hence causing damage to life and property. This also reduces the fertility of soil.
- If coastal areas are thickly forested, they act as natural wind breakers and reduce the destructive impact of the cyclonic storm.
- After reaching the land mass of the coastal areas, the cyclone becomes steadily weaker due to friction with land and shortage of moisture. The eastern coastline of India is very vulnerable to cyclones.

Wind speed, direction, temperature and level of humidity are some of the factors affecting the development of a cyclone.

CYCLONES ARE CALLED BY DIFFERENT NAMES IN DIFFERENT PARTS OF THE WORLD: - HURRICANE IN AMERICA, TYPHOON IN JAPAN & PHILIPPINES AND CYCLONE IN ASIA.

TORNADOES

A tornado is a violent, twisting funnel of wind.

- They are formed in thunderstorms when a funnel-like column of cold air sinks down from a storm cloud.
- It is formed when the pressure difference between hot air from the ground & the cool air of the atmosphere is very high.
- Warm, unstable air from the surface of the earth rises up and meets this cooler air above.
- It starts whirling around this cold column at a very high speed
- The tornado is seen to come from the top and reaches at the earth's surface with very high speed which causes huge destruction.
- The wind speed in tornadoes in extreme cases can reach up to 500km/hr.
- Their funnel at the base sucks up everything and can causes extensive damage to life and property as it destroys and sucks in various things into its hole at the base.
- Tornadoes are not common in India.

- It is important to point out that tornadoes are only forming over land.
- And these tornadoes unlike hurricanes / cyclones (which occur over hundreds of miles) occur only around half a mile wide.

Precautions

If living near areas close to cyclones, thunderstorms etc. one should:-

- Keep torches, batteries, battery-powered radio.
- First – Aid box.
- Store water in air tight containers.
- Some essential food items for emergency.
- Turn off electricity and gas / water supply, if you need to leave home.
- Cooperate and help others.
- Don't touch a wet electrical appliances, switch or cable.
- Don't go out just for the sake of fun.
- Don't make any undue demands on the rescue forces but cooperate with them.
- Beware of loose electrical cables, pool of water and other loose hanging objects from trees.
- Beware of snakes that may come out due to flooding of their holes.
- Don't drink contaminated water.

Safety measures to be taken by Government

- A tornado shelter is often built in buildings of areas that are prone to tornadoes.
- It is room situated underground or deep inside a building with no windows.
- Have an efficient cyclone forecast and warning system.
- Arrangement of rapid communication of the warning to ports, fishermen and the general public.
- Fast and effective way of evacuating people to safe places in the event of an approaching cycle.
- Construction of cyclone shelters in areas prone to cyclone and developing awareness about them in people.

Use of Advanced Technology

- The Indian Meteorological Department studies the development and movement of cyclones.
- This is done with the help of the INSAT Satellite and chain of Cyclone Detection Radars (CDRs) installed along the coastal belt of India.
- These radars can locate and track an approaching cyclone within a range of 400km.
- With the help of modern technology it is possible to issue a cyclone alert 48 hrs advance and a cyclone warning 24 hours in advance.
- The messages are transmitted quickly and widely with the help of TV and radio.
- It is done as a Disaster Warning System (DWS) to cover seaports, fishermen, aviation department, etc. Anemometer: An instrument that monitors wind speed and duration.