3. HUMIDITY AND CLOUDS

Can you tell ?

Look at the pictures shown in figure 3.1. Discuss the weather conditions shown in these pictures in the class and write the descriptions in the boxes below.

Figure 3.1

Geographical explanation

Generally, we keep talking about the weather conditions. We can identify the weather conditions through the conversations above. We experience the dampness or dryness in the air throughout the year. The changes occurring in the weather conditions in desert areas, coastal areas and mountainous areas is evident from the figures.

- Rajasthan lies in a region with dry and hot air. There is hardly any moisture in the air. People wear loose cotton clothes.
- Kashmir valley lies in a region with cold and dry air. Moisture is minimal in the air. People cover themselves with warm clothes.
- In Mumbai, the air is hot and humid. There the proportion of moisture is very high in the air. In addition, if dark clouds cover the sky, the content of moisture in the air increases.

In the above discussion, the words hot, moist, cool etc. show the condition of the air. They relate to the content of the moisture in the air. Moisture in the air is invisible. But it is the major component of air which is taken into consideration while discussing the weather of any place. For precipitation to occur in any place, presence of moisture in the air is very important.

Think about it.

During winters, when you exhale on the glass of your mirror, what happens. If you try to do this in summer why doesn't this happen?

EVAPORATION :

Evaporation is the process of converting water into steam or water vapour. Because of the sun's heat, the water on the earth gets

converted into water vapour. The process of evaporation is dependent on the dryness, temperature and the speed of the wind.

If the air is dry and hot, the rate of evaporation increases. The process of evaporation continues even in dry and cold air. On the other hand, evaporation occurs very slowly in moist air. If the velocity and temperature of the air is high, then evaporation occurs rapidly. If the wind is blowing slowly and the air is cooler, then evaporation occurs slowly.

Use your brain power !

- In which season do the clothes dry fast?
- In which season do the clothes take time to dry? What could be the reason?

Humidity in the air :

The proportion of water vapour in the air is called its humidity. The dryness or dampness of the air depends on the proportion of water vapour.

Air can hold moisture in specific quantity at specific temperature only. As air cools down, its moisture holding capacity reduces. This implies that warmer air can hold more moisture than cold air.

At a certain temperature, the moisture holding capacity of air becomes equal to the proportion of moisture present in it. This condition of the air is called saturation of the air .

Try this.

(Carry out the following activity in a group).

- ✓ Take a colander/ tray which is deeper in the centre.
- ✓ Take a piece of sponge.
- ✓ On the flat part of the tray, make holes with the help of nails.
- ✓ Keep the sponge on the centre of the tray/ colander.
- ✓ Make sure there is no water in the sponge.
- ✓ Pour water on the sponge with a big spoon.
- ✓ The students in the group should note how many spoons of water have been poured.

Keep pouring water with the spoon till the sponge becomes wet with water. Note what happens if you keep pouring water even after that. Now answer the following questions.

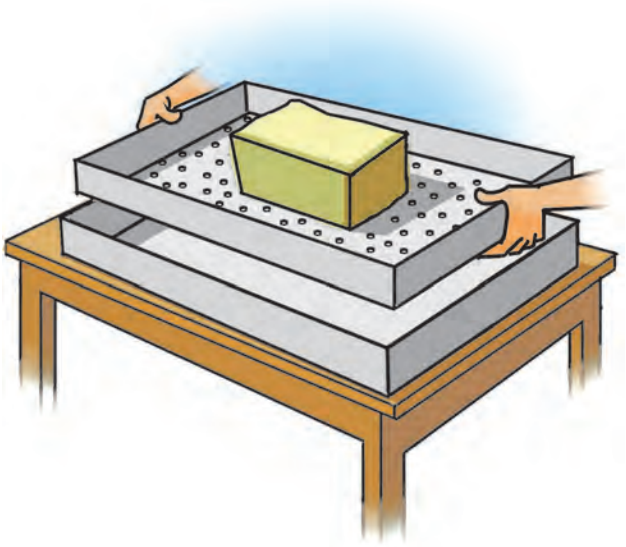

Figure 3.2

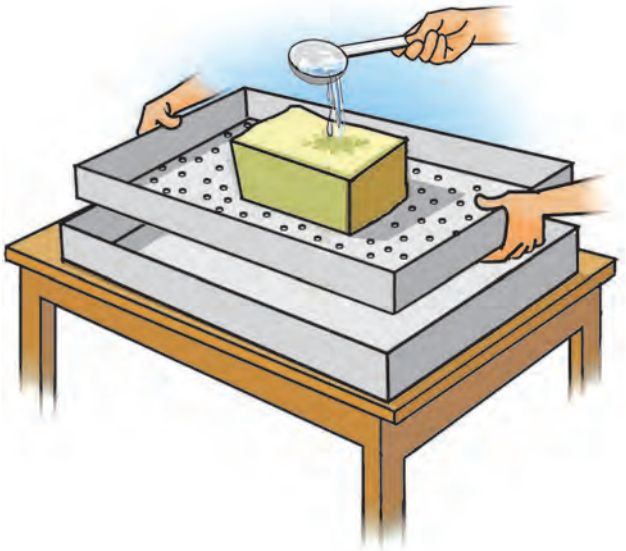

Figure 3.3

- What happened to the water which was poured initially?
- When you were pouring water on the sponge, what did you expect?
- What happened when you poured more water on the sponge?
- What conclusions can you draw from this?

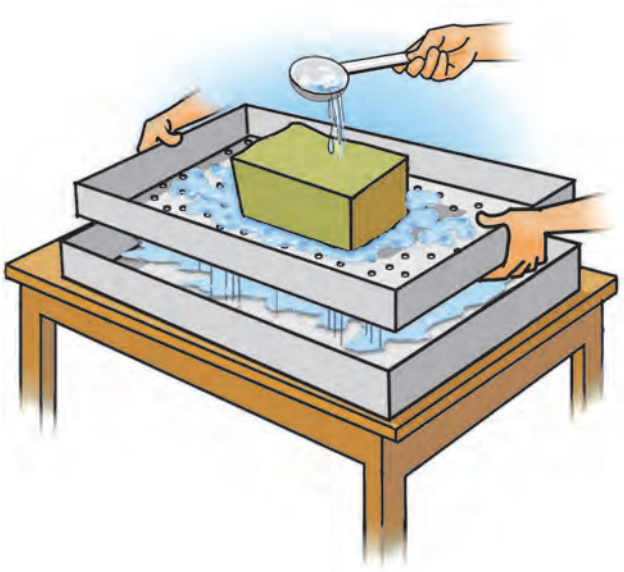

Figure 3.4

Geographical explanation

Let's suppose that the air is like the piece of sponge. How many spoons of water does the sponge absorb? After the sponge is full of water, drops of water start trickling out. One can tell, the number of spoons of water required to make the water trickle down the sponge by observation. This implies that the water-holding capacity of the sponge is fulfilled. This makes it saturated.

Similarly, when the proportion of moisture in the air exceeds its vapour holding capacity, precipitation in the form of rain or snow occurs on the earth.

The moisture-holding capacity of the air depends on its temperature. Higher the temperature, higher is the holding capacity. We have learnt earlier that as we go higher in the sky, the air becomes cooler. So, as per this rule, as we go higher, the vapour holding capacity of the air will decrease. The following table will make it clear.

Always remember -

Generally, humidity of the air is measured in grams per cubic meter. When the humidity in the air is 0 gm/cu.m., the air is said to be dry. If the humidity in the air at 30° C temperature is 37 gms/ cu.m. , then the air is said to be saturated.

Give it a try.

The vapour holding capacity of 1 cu.m. of air in various temperatures is given here. Calculate the difference in the capacities by observing the table.

Temperature of the air (0° C)	Vapour holding capacity (gm/ cu.m.	Difference in the capacities (gm/ cu.m)
-5	3.26	---
0	4.85	1.59
5	6.80	
10	9.40	
15	12.83	
20	17.30	
30	30.37	
40	51.12	

At 15° C, the capacity of 1 cu.m air is to hold 12.8 gm of moisture. If this amount of vapour is present in the air, the air is said to be saturated. This humidity in the air is expressed in different ways.

ABSOLUTE HUMIDITY :

The amount of water vapour in 1 cu.m. of air is the absolute humidity of the air. For example, the absolute humidity of the air near coastal areas is higher than air in the interior. Absolute humidity is higher in the equatorial areas while it reduces as we move towards the

Use your brain power !

- In which season is humidity generally more?
- How does humidity affect the human body?
- Observe how humidity affects the food materials at our home.
- Is there a relation between the formation of fungus and humidity?
- How is the early or late drying up of clothes related to humidity?

poles. The distribution of land and water on earth and the seasons also affect absolute humidity.

RELATIVE HUMIDITY :

The amount of water vapour present in air can be expressed as a percentage of the amount needed for saturation at the same temperature and same volume. It is expressed in percentage.

$$\text{Relative humidity (R.H.) (\%)} = \frac{\text{Absolute humidity}}{\text{Vapour holding capacity}} \times 100$$

- What will be the relative humidity of air whose absolute humidity is 20 gm/m^3 and vapour holding capacity is 30 gm/m^3?
- If the absolute humidity of the air is 15 gm/m^3, and the vapour holding capacity is 15 gm/m^3, then what is the relative humidity of the air?

Think about it.

What will happen if the temperature of saturated air at 20° C drops down to 10° C abruptly?

- On the basis of the examples given above, tell which air is saturated?

The amount of water vapour changes according to difference in temperature. Similarly, relative humidity also changes. Generally, relative humidity is more in the mornings and nights. In the afternoon, as temperature increases, relative humidity decreases. Near coastal areas, the relative humidity is more and so the air is moist . In desert areas, relative humidity is less.

Try this.

The teacher should make two groups of the students in the class. The first group should do the following activity under the supervision of the teachers carefully. See fig. 3.5

- ✓ Take water in a pressure cooker
- ✓ Take off the whistle of the pressure cooker
- ✓ Now heat the cooker
- ✓ Take a lid with a handle
- ✓ After the water starts boiling, hold the lid at a distance from where the steam is coming out.

Figure 3.5

- ✓ Observe what happens.

You must have observed that water changed into water vapour after it was heated.

Figure 3.6 (A)

This vapour turns into water droplets when it touches the cooler lid. We can see the water droplets deposited on the lid.

The other group should carry out the following activity. See fig. 3.6 (A)

- ✓ Take a glass with flat bottom.
- ✓ Put some ice cubes in it.
- ✓ Keep this glass in a room for 2-3 minutes
- ➢ What did you see?

Figure 3.6 (B)

In sometime, you will see droplets of water on the outer surface of the glass. See fig 3.6 (B)

When the water vapour in the air comes in contact with the cold surface, condensation take place. These droplets form on the outer surface of the glass.

In the first activity, the steam from the cooker cooled and condensed into water droplets. In the second activity, the vapour in the air condensed into water droplets.

Condensation/Densification /Sublimation :

The process of changing of water vapour in the air into water is called condensation or densification. Also, the process of vapour (gas) changing into solid state is called sublimation. If the temperature of the air reduces, its vapour holding capacity also reduces. When relative humidity of the air becomes 100%, vapour starts condensing. At this time, the temperature of the air should be at dewpoint. It implies that for condensation, temperature should be low and relative humidity must be high. In the free environment, condensation of the vapour in the air occurs around fine particles (dust, salt, etc.) in the air.

Dew, frost and fog are the forms of condensation at ground level while clouds are a form of condensation at higher elevation.

Clouds and Types of Clouds :

- Clouds are a form of condensation at higher elevation.

Always remember -

There is a difference between fog and smog . Fog is made of vapour in the air only. Smog is a combination of dust particles of polluted air in the region and fog.

- Condensation occurs around minute particles in the atmosphere. Condensed water or snow particles in the clouds are very fine and almost weightless. And so, clouds float in the air. See fig 3.7

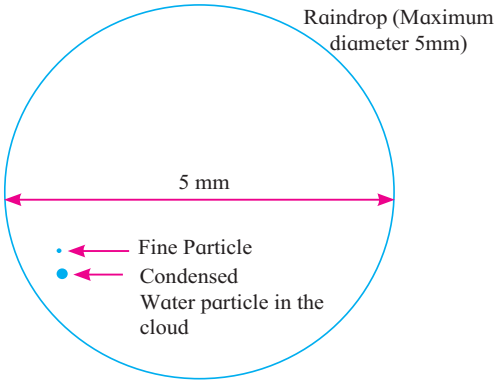

Figure 3.7 : Raindrop

Land and water get heated because of the heat of the sun. Air near the surface heats up, rises and becomes less dense. Hot air rises up. As it goes higher, the temperature of the air reduces and the moisture holding capacity of the air reduces. Relative humidity keeps increasing. The water vapour in the atmosphere turns into water and snow. This is the dewpoint level of that air. The level of condensation is determined by the water vapour in the air. Keep in mind that the freezing point is also dependent on the altitude and water vapour.

Because of condensation, fine particles of ice and water float in the air at a greater height. They accumulate around dust particles in the air and become larger in size. Their accumulation together is called a cloud. Because of vertical flow of the wind, they float in the atmosphere. Like a kite which floats in the air as it moves higher and higher, the clouds too float in the atmosphere because of vertical flow.

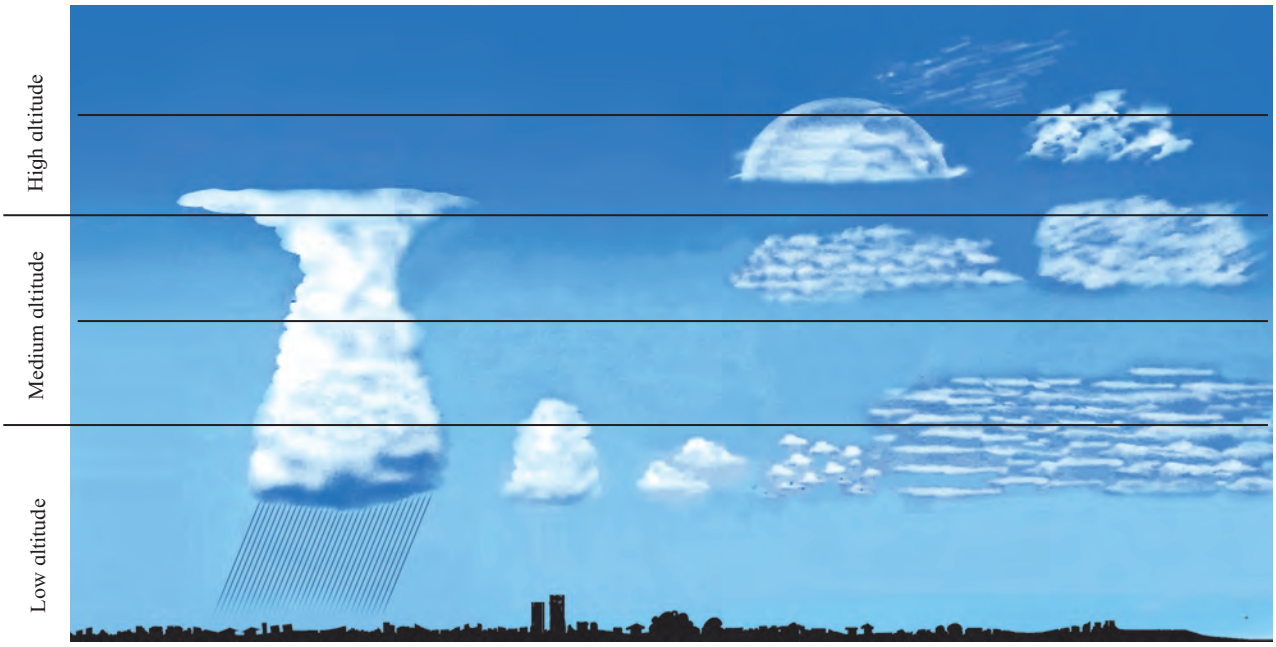

Figure 3.8 : Types of Clouds

Clouds are found at different altitudes above mean sea level. Clouds which form at greater altitudes are formed from very fine snow particles. The process of evaporation and condensation occur consecutively in the clouds. Specific type of clouds cause rainfall on earth. The proportion of vapour is more near the earth's surface. As we go higher away from the sea level, the amount of vapour decreases. Hence, the clouds at a lower altitude are larger in size while the clouds a higher altitude are smaller.

Cloud types according to international classification

No.	Types of Clouds	General Altitude (meters)
1.	Cirrus	7000 to 14000
2.	Cirro-Stratus	
3.	Cirro-Cumulus	
4.	Alto-Stratus	2000 to 7000
5.	Alto-Cumulus	
6.	Strato-Cumulus	Less Than 2000
7.	Stratus	
8.	Nimbostratus	
9.	Cumulus	The extent could be variable
10.	Cumulonimbus	

Clouds are formed at different altitudes in the atmosphere. After observation, we can divide these clouds into 3 main types on the basis of their altitude. The height from the base of the clouds is taken into consideration. If the clouds are at an altitude of 7000-14000m, then they are considered as very high clouds. If they are at an altitude of around 2000-7000m, then they are considered to be medium clouds. If they are at an altitude of less than 2000m, then they are low clouds. See fig 3.8.

High Clouds :

These clouds are containing large amount of snow cristals. They can be classified into cirrus, cirrocumulus and cirrostratus. Cirrus clouds are mainly wispy. Cirro-Cumulus clouds look like groups of small waves. Cirrostratus are like a bedsheet with wrinkles. They generally have a halo around them.

Medium Clouds :

These include alto-cumulus and alto-stratus. Alto-cumules are in the form of layers and have a wave-like structure. They are mostly white in colour and have a grey shade. Alto-stratus are not very thick. The sun can be seen through them as if seen through a milky glass.

Low Clouds :

These consist of five types of clouds. Strato-cumulus have layers. Their colour is white to earthy. Round clusters of clouds can

be here. Stratus clouds also have layers. They are ash coloured and their base is uniform. Nimbo-stratus has thick layers. They are grey--ash in colour and cause continuous rainfall and even snowfall.

Give it a try.

Look at figure 3.8 first. Now go out of the classroom in the ground. Observe the clouds in the sky. Discuss the following points in the class and write answers in your notebook.

- What was the colour and size of the clouds?
- What type of clouds did you observe? (Take help from fig 3.8)
- Can these clouds bring rain? Give reasons.

Cumulus Clouds : These clouds are formed extensively from 500 m to 6000 m altitude. The vertical flow of the air adds to the formation of these clouds. These are huge and dome-shaped. They are grey in colour. Cumulus clouds are an indicator of pleasant weather. The vertical expanse of these clouds increases so much that they turn into cumulonimbus clouds and bring rain.

Cumulonimbus Clouds : These are characterstic clouds which are indicators of thunderstorm. These look like huge mountains. These are dense and dark in colour. There is thunder accompanied by lightening. They bring rain with storm and may sometime bring hailstones. But such a type of rain does not last long. See fig 3.9

The largest of these clouds bring rainfall accompanied with lightning. The top portion of these clouds has an anvil like shape. The clouds have a positive charge at the upper end and negative charge at the lower end. The land below them always has negative charge. Due to difference in the charges, electric chargers are formed and lightning occurs lighting up the sky for a moment. The air around the lightning rises up because of the heat and this leads to a large thundering sound.

As compared to other clouds, the rain drops of these clouds are larger because they move up and down a lot of times and accumulate more and more water. Drops become larger and larger and are unable to float in the clouds because of their weight. They fall in the form of rain. Sometimes, the air in the clouds is very cold. As a result, these drops freeze and fall in the form of hail. We call them hailstones.

Figure 3.9 : Cumulonimbus Clouds

Use your brain power!

Find where the adjacent symbols are used while showing the weather of a place. Write their meanings in the boxes given below

Do you know ?

Cloudburst is a type of precipitation. Raindrops coming towards the earth are stopped in the clouds itself because of strong vertical winds. These drops change into hail. This makes the clouds heavier. The vertical winds are unable to bear this weight. This leads to heavy rainfall with large-sized hail. This is called cloud-burst. It leads to a rainfall of more than 100mm in a small area or particular region. This type of precipitation mainly occurs in mountainous regions. The states through which the Himalayan ranges pass experience such a type of rainfall.

Exercises

Q 1. Match the column and complete the chain:

A	B	C
(A) Cirrus	(i) Vertical extent in the sky	(a) Roaring clouds
(B) Cumulonimbus	(ii) higher altitude	(b) Floating clouds
(C) Nimbostratus	(iii) Medium altitude	(c)continuous rainfall
(D) Alto-cumulus	(iv) Low altitude	(d) snow flake clouds

Q 2. Choose the correct word from the brackets and complete the sentence:

(Cumulonimbus, Relative humidity, Absolute humidity, Condensation, Vapour-holding capacity)

(a) The ---------- of air is dependent on the temperature of air.
(b) The amount of vapour in 1 cu.m. of air shows the ----------.
(c) As ---------- is less in desert areas, the air is dry there.
(d) ----------type of clouds are indicators of storm.
(e) In a free environment, the ---------- of the vapour present in the atmosphere takes place around dust particles.

Q 3. Differentiate between:

(a) Humidity and clouds
(b) Relative humidity and Absolute humidity
(c) Cumulus clouds and cumulonimbus clouds

Q 4. Answer the following questions:

(a) Why is the air in a region dry?
(b) How is humidity measured?
(c) What are the prerequisites for condensation?
(d) What is a cloud? Write its types.
(e) Which type of clouds give rain?
(f) On what does the percentage of relative humidity depend?

Q 5. Give geographical reasons:

(a) Clouds float in the sky.
(b) The proportion of relative humidity changes according to altitude.
(c) Air becomes saturated.
(d) Cumulus clouds change into cumulonimbus clouds.

Q 6. Solve the following:

(a) When the temperature of the air is 30° C, its vapour-holding capacity is 30.37 gms/ cu.m. If absolute humidity is 18 gms / cu.m. then what would be the relative humidity?
(b) What would be the absolute humidity of air if 1 cu.m. air contains 4.08 gms of vapour at 0°C temperature? .

Q 7. Collect the weather related information from newspapers for the month of July. Relate the difference in the maximum and minimum temperatures with humidity.

ACTIVITY :

Make a table showing the types of clouds. Use various photographs.

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