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Introduction to Weather

Weather affects our daily lives in many ways. This chapter introduces the elements of weather, how they are measured, and how weather forecasts are made. It also explores how people have traditionally predicted the weather using indigenous knowledge.

Weather and Climate

Weather

Weather refers to the day-to-day condition of the atmosphere at a particular place and time. It includes factors like temperature, humidity, rainfall, wind, and air pressure. Weather

can change quickly, even within a single day.

Climate

Climate is the average weather condition of a place for a long period of time – usually taken over 30 years or more. While weather can change daily (sunny today, rainy tomorrow), climate describes the general pattern of weather in a place over many years.

Examples

- A desert like Rajasthan has a hot and dry climate.
- A place like Kerala has a wet and humid climate.
- The Arctic has a cold climate throughout the year.

Exam Question

Q: What is the difference between weather and climate?

A: Weather is the day-to-day atmospheric condition at a place, while climate is the average weather pattern of a place over a long period, usually 30 years or more.

Elements of Weather

The atmosphere is made up of layers of gases surrounding the Earth. Weather phenomena occur in the lowest layer called the troposphere. Elements like temperature, wind, humidity, and pressure change within the atmosphere, creating different weather conditions.

Main Elements

- **Temperature:** How hot or cold it is.
- **Humidity:** The amount of moisture in the air.
- **Precipitation:** Water falling from clouds as rain, snow, sleet, or hail.
- **Wind speed and direction:** Movement of air.
- **Atmospheric pressure:** Weight of air on the Earth's surface.

Mnemonic to Remember

"Tiny Happy Rabbits Walk Around"

- T – Temperature
- H – Humidity
- R – Rainfall
- W – Wind
- A – Air Pressure

Exam Question

Q: Name the five main elements of weather.

A: Temperature, Humidity, Precipitation, Wind speed and direction, Atmospheric pressure.

Weather Instruments

Weather instruments are tools used to measure the elements of weather. They help scientists observe and record weather conditions accurately.

Common Instruments and Their Functions

- **Thermometer:** Measures air temperature in degrees Celsius (°C).

- **Hygrometer:** Measures humidity as a percentage (%).
- **Rain Gauge:** Measures precipitation in millimeters (mm).
- **Barometer:** Measures atmospheric pressure in millibars.
- **Wind Vane:** Shows the direction from which the wind is blowing.
- **Anemometer:** Measures wind speed in miles per hour (mph).

Temperature

Temperature tells us how hot or cold a place is. It is affected by sunlight and usually varies between day and night.

Measurement

Temperature is measured using a thermometer, typically in degrees Celsius ($^{\circ}\text{C}$).

Types of Thermometers

There are liquid-in-glass thermometers containing mercury or colored alcohol, and digital thermometers that use electronic sensors to display temperature readings.

Exam Question

Q: How does a liquid-in-glass thermometer work?

A: The liquid inside expands when heated and rises in the glass tube, and contracts and falls when cooled, indicating temperature changes.

Precipitation

Precipitation is water falling from the atmosphere to the Earth's surface in forms such as rain, snow, sleet, or hail. It occurs when clouds become too heavy with condensed water vapor.

Measurement

Precipitation is measured using a rain gauge, which collects rainwater and shows the amount in millimeters (mm).

Rain Gauge

A rain gauge is a cylindrical device with a funnel that collects rainwater, allowing measurement of rainfall over a period.

Exam Question

Q: What is precipitation and how is it measured?

A: Precipitation is water falling from clouds as rain, snow, sleet, or hail. It is measured using a rain gauge.

Atmospheric Pressure

Atmospheric pressure is the force exerted by the weight of air on the Earth's surface. It decreases with altitude as there is less air above.

Measurement

Atmospheric pressure is measured using a barometer.

Barometer Types

- **Mercury Barometer:** Uses mercury in a glass tube; air pressure pushes mercury up the tube.
- **Aneroid Barometer:** Uses a sealed metal container that expands or contracts with pressure changes, moving a needle on a dial.

Exam Question

Q: How does an aneroid barometer measure atmospheric pressure?

A: It uses a sealed flexible metal container that changes shape with air pressure, moving a needle on a dial to show pressure changes.

Wind

Wind is the movement of air from one place to another caused by differences in atmospheric pressure. Air moves from high-pressure areas to low-pressure areas.

Cause of Wind

The Sun heats the Earth unevenly, causing warm air to rise and cooler air to move in, creating wind.

Measurement

- **Wind Speed:** Measured by an anemometer.
- **Wind Direction:** Measured by a wind vane.

Anemometer

An instrument with cups that spin faster when wind speed increases, measuring how fast the wind blows.

Wind Vane

An instrument with an arrow or pointer that shows the direction from which the wind is coming.

Exam Question

Q: What instruments are used to measure wind speed and direction?

A: An anemometer measures wind speed, and a wind vane measures wind direction.

Humidity

Humidity is the amount of water vapor present in the air.

Types of Humidity

- **Absolute Humidity:** Actual amount of water vapor in grams per cubic meter.
- **Relative Humidity:** Percentage of moisture in the air compared to the maximum it can hold at a given temperature.

Measurement

Humidity is measured using a hygrometer.

Exam Question

Q: What is relative humidity?

A: Relative humidity is the percentage of moisture in the air compared to the maximum amount the air can hold at a given temperature.

Weather Stations

Weather stations are places where scientists observe and record weather conditions using special instruments.

Measurements Taken

- Temperature (thermometer)
- Humidity (hygrometer)
- Rainfall (rain gauge)
- Wind speed and direction (anemometer and wind vane)
- Air pressure (barometer)

Importance of Weather Stations

- Help forecast weather and warn about storms, floods, or heatwaves.
- Assist farmers, travelers, and others in planning activities.

Exam Question

Q: Why are weather stations important?

A: They provide data to forecast weather, warn about severe weather, and help people plan their activities safely.

Automated Weather Stations

Automated weather stations are machines that automatically measure and record weather data like temperature, humidity, rainfall, and wind without human help.

Exam Question

Q: What is an automated weather station?

A: It is a machine that automatically records weather data without human intervention.

Weather Prediction

Weather prediction means forecasting what the weather will be like in the coming hours or days to help people prepare for changes.

How Is Weather Predicted?

- **Observation:** Meteorologists collect data from weather stations, satellites, balloons, radar, and computers.
- **Measurements:** Include temperature, wind speed and direction, humidity, air pressure, and rainfall.
- **Weather Models:** Data is fed into computer models to predict future weather conditions.

Importance of Weather Prediction

- Helps people plan daily activities.
- Warns about storms or floods.
- Supports farmers, pilots, and sailors.

Mnemonic to Remember

"C-T-A-M-P"

- C – Collect data
- T – Use tools
- A – Analyse by experts (meteorologists)
- M – Model on computer
- P – Predict weather

Exam Question

Q: What are the steps involved in weather prediction?

A: Collect data, use tools, analyse by meteorologists, model on computer, and predict weather.

India Meteorological Department

The India Meteorological Department (IMD) is a government agency responsible for observing, studying, and forecasting weather and climate in India.

Key Functions

1. Collects weather data from stations across India.
2. Prepares weather forecasts to help people plan activities.
3. Issues warnings and alerts for severe weather like cyclones and heatwaves.
4. Studies long-term climate trends important for agriculture and ecosystems.
5. Uses advanced technology like satellites and radar for accurate forecasting.
6. Conducts public awareness programs and collaborates internationally.
7. Has a rich history since 1875, playing a vital role in safeguarding lives.

Exam Question

Q: What is the role of the India Meteorological Department?

A: The IMD observes and forecasts weather, issues warnings, studies climate, uses advanced technology, educates the public, and helps protect lives and property.

Solved Examples

Example 1

Q: What instrument would you use to measure humidity and why?

A: A hygrometer is used to measure humidity because it shows the amount of moisture in the air as a percentage.

Example 2

Q: How does a rain gauge help in weather observation?

A: A rain gauge collects and measures the amount of rainfall, helping to understand precipitation levels over time.

Practice Set

Easy

- Define weather.
- What does a thermometer measure?

Moderate

- Explain the difference between absolute and relative humidity.
- Describe how wind direction is measured.

Challenging

- Discuss the importance of weather stations in forecasting and safety.
- Explain how atmospheric pressure changes with altitude and its effect on weather.

Answer Key

- **Define weather:** Weather is the day-to-day condition of the atmosphere at a particular place and time.
- **What does a thermometer measure?** It measures air temperature.
- **Difference between absolute and relative humidity:** Absolute humidity is the actual amount of water vapor in the air, while relative humidity is the percentage of moisture compared to the maximum air can hold at a given temperature.
- **How is wind direction measured?** Using a wind vane that points to the direction from which the wind is coming.
- **Importance of weather stations:** They provide data for weather forecasts, warn about severe weather, and help people plan activities safely.
- **Atmospheric pressure and altitude:** Atmospheric pressure decreases with altitude because there is less air above, affecting weather patterns.

Quick Reference

- **Weather:** Day-to-day atmospheric conditions.
- **Climate:** Average weather over 30 years or more.
- **Temperature:** Measured by thermometer in °C.
- **Humidity:** Measured by hygrometer as % moisture.
- **Precipitation:** Rain, snow, sleet, hail measured by rain gauge.
- **Wind:** Movement of air measured by anemometer (speed) and wind vane (direction).
- **Atmospheric Pressure:** Weight of air measured by barometer.
- **IMD:** India Meteorological Department responsible for weather forecasting.

Glossary

- **Sleet:** Frozen or partly frozen rain.
- **Hail:** Small, hard balls of ice falling like rain.
- **Water vapor:** Water in gaseous form.
- **Forecast:** Prediction of future weather.
- **Meteorology:** Study of weather and its changes.
- **Ambient:** Surrounding environment.
- **Statistics:** Methods to collect and analyze data.
- **Seasons:** Parts of the year with distinct weather patterns.