6 Weather and Climate

Lesson Plan

Contents

- An overview of weather and climate and their elements
- To understand the manner in which the elements affect the weather and climate of a place during a season

Objectives

- To understand weather and climate and what their elements are
- To learn about the effects of the elements on each other and on the weather or climate of a place
- To know about the climate zones of Earth and how they are created or identified by the components
- To appreciate the methods and scales by which different elements of the climate are measured

Teacher's Aids

- Globe
- Pictures, charts, atlas, wall maps
- Blackboard
- Internet

Tips for Teacher

- Explain the difference between weather and climate clearly.
- Use the students to represent each element, holding a small placard with a pictorial depiction. It will make learning easier for the students.
- Students should be encouraged to know zones, places, locations and their placement on the maps.

Background and Reading

- Read the lesson aloud and explain, sharing the aids, etc., pausing to examine and explain the data in the boxes.
- Particularly focus on the difference between weather and climate, and the effect of each element.

Weather and Climate

- To understand weather and climate – study basic elements: insolation, temperature, atmospheric pressure, humidity, winds, sky conditions.
- Weather: Condition of atmosphere at a definite place at a fixed time – hour to hour, day to day condition – elements change constantly – hence weather too changes and cannot be generalised.
- Climate: Average weather conditions over a long period of time in a region – involves observation, recording and processing.

Temperature

- Solar radiation – Sun radiating heat and light energy in all directions – Earth gets its heat – one unit of energy out of about 2 billion units of the Sun's energy.
- Temperature – not fixed or uniform – changes from place to place, day and night, season to season – depends on insolation, latitude and height and distance of place from sea, wind direction, natural vegetation, humidity, differential heating and cooling of land and sea, etc.
- Insolation – affects the distribution of temperature on Earth – it is the incoming solar radiation that reaches the Earth's surface – total received decreases from Equator to the Poles – maximum in Tropical Zone – decreases towards Poles, which remain covered with snow all year.
- Abnormal increase in temperature – harmful for survival – difficult for crops to grow.
- Cities warmer than villages – because of concrete building that trap warm air, which increases temperature.
- Measurement – Thermometer: two scales – Centigrade and Fahrenheit – standard units we use: Celsius invented by Anders Celsius – In Celsius [Centigrade], Freezing point 0° C; boiling point 100° C [= 32° F and 212° F] – Celsius 100 divisions; Fahrenheit 180 divisions.
- Six's Minimum and Maximum Thermometer – to measure the min. and max. on any one day – record only once in 24 hours to get both.
- Difference between minimum and maximum on one day is daily range of temperature; difference between and hottest and coldest month is the annual range of temperature.

Atmospheric Pressure

- Air a mixture of gases with weight – exerts its weight on Earth's surface – weight of air on a unit area of Earth is called atmospheric pressure or air pressure.
- Air pressure exerted on our body which exerts counter pressure – weight of the column: one kg on one sq cm area.
- Atmospheric pressure highest at sea level – decreases with height.
- Where temperature is high, air on Earth's surface gets heated – expands, becomes light – creates low pressure area – cloudy skies and wet weather.
- Where temperature is low, air on Earth's surface gets cooled – becomes heavy and sinks downwards – creates high pressure area – clear, sunny skies.
- Barometer – used to measure atmospheric pressure – Mercury barometer: Long narrow tube filled with mercury; normal at sea level+weight of 76 cm high mercury column;

Aneroid barometer: No mercury, very handy; Barographs: For automatic and continuous measurements; Unit of measurement – millibars [mb]; Normal pressure at sea level is 1013 mb.

Distribution of Atmospheric Pressure

- Insolation not uniform across the Earth – therefore, atmospheric pressure not uniform – no fixed pattern of distribution – but pattern of high and low pressure belts.
- Seven Belts: Equatorial Low [1]; Sub-Tropical High [2]; Sub-Polar [2] and Polar High [2] – in Northern and Southern Hemispheres.
- Equatorial Low Pressure Belt: 10° N to 10° S – intense heating → air expands → lightens → rises as convection currents → low pressure area called doldrums [absolute calm].
- Sub-Tropical High Pressure Belts: 30° N and S of Equator – rising Equatorial air currents move down → high pressure area called Horse Latitudes. Winds blow from here to Equator as Trade Winds and towards the Sub-Polar Lows as Westerlies.
- Sub-Polar Low Pressure Belts: Between 60° and 70° N and S – Sub-Tropical and Polar regions converge → rise upwards → due to rotation and centrifugal forces low pressure area created – violent storms during winters.
- Polar High Pressure Belts: North and South Poles 70 degrees to 90 degrees N and S – temperature extremely low throughout the year → cold descending air → develop high pressure – permanent ice caps.

Winds

- Air moves from high to low pressure areas – horizontal movement: wind; vertical: air current – wind always named after direction from which it comes.
- Direction and speed controlled by:
  - (i) Pressure Gradient – The difference in atmospheric pressure between two places gives us the pressure gradient – greater the difference, steeper the gradient and higher wind speed.
  - (ii) The Coriolis Force – Earth rotating on inclined axis – rotation produces Coriolis force that deflects wind – to the right in Northern Hemisphere and to the left in the Southern Hemisphere – minimum deflection at Equator and Poles.
  - (iii) The Frictional Force – Irregularities of Earth's surface hinder winds – causes friction – reduces wind speed and changes direction of wind – friction less on water surface – hence, wind blows smooth and fast on oceans.

Types of Wind

(i) Permanent Winds – regular and constantly in a particular direction:
   (a) Trades – from sub-tropical high pressure belts to Equatorial low pressure belt – Northern Hemisphere: Northeast to southwest – Southern Hemisphere: Southeast to northwest – cooler to warmer areas so dry winds.
   (b) Westerlies – from sub-tropical high pressure belts to sub-polar low pressure belts – Northern Hemisphere: Southwest to northeast – Southern Hemisphere: Northwest to southeast – warmer to cooler areas so bring rainfall – Due to high velocity also called Roaring Forties.

(c) Polar Winds – from polar high pressure belts to sub-polar belts – Northern Hemisphere: From northeast – Southern Hemisphere: From southeast – very cold but warm up over oceans.
(d) Seasonal Winds – caused due to unequal heating and cooling of landmasses and water bodies – can change directions with change of seasons – main winds:
(e) Monsoon winds – derived from Arabic 'Mausim' meaning season – from sea to land during summer and from land to sea in winter – divided into summer and winter monsoons – Summer: Land hot; low pressure area; adjoining sea cooler and high pressure; therefore, winds from sea to land bringing rain from June to September. Winter: Conditions reversed with low pressure over sea and high on landmass; so winds from land to sea bring cool, dry months from November to February.
(f) Land and sea breezes – in narrow coastal regions – caused by unequal rate of heating of land and sea – Daytime: Land heats faster; low pressure on land and high on sea; Sea Breeze. Night: Conditions reversed – land cool; sea warm; so Land Breeze.

(ii) Local Winds – restricted to small area and blow only during a particular period of day or year – warm or cold depending on area:
(a) Loo: Northern Indian plains – very hot and dry; afternoons in May and June.
(b) Foehn: Strong, dry, hot wind on leeward side of Alps.
(c) Harmattan: Strong dry wind over northwest Africa from northeast.
(d) Chinook: Dry south-westerly wind down the eastern slopes of the Rockies in USA and Canada.

Moisture

- Found in all water bodies and even in soil – heat → evaporation → water vapour amount in atmosphere varies with place and time.
- Evaporation: Process of heating by which water vapour enters atmosphere.
- Condensation: Process of cooling by which water vapour forms droplets.
- Precipitation: Process by which water droplets fall to the ground in liquid, solid or frozen form.
- Humidity: The amount of water vapour/moisture present in the atmosphere at a particular time and place; expressed as absolute or relative humidity.
- Absolute humidity: Actual amount of moisture present.
- Relative humidity: The ratio between the actual amount of moisture at a given temperature and the maximum capacity of air to hold moisture at that temperature; always expressed as a percentage.
- Hygrometer: Also called the wet and dry bulb thermometer; used to measure humidity in atmosphere.
- Condensation: Reverse process of evaporation – converting water vapour to water or ice – due to loss of heat – takes form of dew, frost, fog, mist, clouds, etc. – not to be confused with forms of precipitation like rain, drizzle, snow, sleet and hail.
- Clouds most important form of condensation: Formed when condensation occurs far above the ground and around tiny solid particles of soil or smoke – tiny droplets suspended in air – form clouds that rise upwards, growing as droplets added – when fully saturated – may fall down as rain – not all clouds provide rain.

- Shapes of clouds: Cirrus [fleecy like wool, high altitude]; cumulus [cauliflower-like]; stratus [layered]. [Clouds that cause precipitation are nimbus clouds – cumulonimbus or stratonimbus.]
- Precipitation: Droplets of water, ice crystals, etc., that fall to the ground – droplets joining together fall as drizzle, rain, snow, sleet, hail, etc.
- Drizzle: Small raindrops with low intensity.
- Snow: Water droplets that rise higher and freeze at low temperature.
- Sleet: Mixture of rain and ice.
- Hail: Vertical air current push droplets higher; they freeze into solid ice and fall as hail.
- Rain: Most important and common form of precipitation – rainfall useful for bringing fresh water on Earth's surface, for survival of all life – too much causes floods; too little causes drought – occurs only when cloud droplets change to rain droplets – average diameter of raindrop about 5mm and one raindrop has about 5 million cloud droplets. Depending on how condensation and cooling of warm moist air takes place, rainfall can be:
  (a) Convectional – heated air with moisture rises as a convectional current → clouds develop at about 10km height → ascending hot, humid air causes condensation of cloud → heavy rainfall for short duration accompanied by thunder and lightning; mostly in equatorial region.
  (b) Orographic – relief rainfall – occurs from cooling of warm moist air → ascends above mountain barrier lying in direction of prevailing winds – ascent causes cooling of air → condensation → precipitation; most precipitation in the world is orographic.
  (c) Cyclonic – associated with tropical and temperate cyclones – warm and cold air masses confront each other → warmer, lighter air climbs above the colder, heavier air [boundary called fronts] → rising air cooled → precipitation. Tropical cyclones also called typhoons, hurricanes, tornadoes, etc.

Case Study – Cyclone

- Derived from Greek Kyklos meaning 'the coil of snake'.
- A low pressure system in lower part of atmosphere –movement of wind anticlockwise in Northern Hemisphere and clockwise in Southern Hemisphere.
- Occur in tropical [east to west] and temperate regions [west to east] – tropical regions usually August to October with violent destructive winds.
- Centre of cyclone low pressure, surrounded by high pressure – centre known as eye of the storm – surrounded by hurricane force winds, usually over 100 km per hour – outer areas cloudy, heavy rains, violent thunderstorms.
- Tropical storms in Bay of Bengal can reach far inland – uprooting trees, destroying houses, bringing down electricity and communication poles, loss of life, property and crops.
- Odisha – 29 October 1999 – supercyclone hit 5 coastal districts – damage due to wind velocity, heavy rains and tidal surge – wind at the speed of 250 km per hour for 36 hours – tidal wave swept 20 km inland – destroyed houses, communication networks, crops, damage to life – originated in the Gulf of Thailand affected Bhubaneshwar, Cuttack and 25 other towns – livestock killed – saline water made fields infertile – sal, teak, bamboo plantations and mangrove forests disappeared – 15 million people affected.
- Cyclones in 2013 and 2014 also in Odisha.

Assessment Corner

Oral Assignment

A. Ask for answers at random from the students. Confirm the right answers. Let them write down the correct answers if they like in their books.

Written Assignment

B–F. The teacher has two options – (i) Either do these exercises orally first and then ask the students to write them down. OR (ii) Ask the students to write the answers on their own. Then the teacher can announce the correct answers to the students and ask their partners to cross-check them.

In either case, the answers can be written as homework and the teacher can check them in the class.

Think Tank

G. **HOTS questions:** Discuss the questions in the class and let the students write the answers to G and H as homework. Teacher should assess individual work.