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SOLUTIONS BOOK

CLASS 9

Social Science · Understanding Society

CHAPTER 3

Atmosphere and Climate

Complete Questions and Activities Solutions

In-text Questions

Questions and Activities

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Every question is followed by its answer. Question numbers above are clickable and the PDF bookmarks panel lets you jump to any exercise set or question. Figures are reproduced from the NCERT textbook (© NCERT) for educational use.

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3.1

CLASS 9 SOCIAL SCIENCE · CHAPTER 3

In-text Questions

Solutions · 16 questions

Directions (Questions 1–16): These are the questions that appear inside the chapter (The Big Questions, Think About It, Let's Recall, Let's Explore, Let's Analyse and Classroom Discussion), numbered in the order in which they appear. Many are open-ended; model answers based on the chapter are given, and you may add examples from your own surroundings.

QUESTION 1 *The Big Questions · p. 39*

What is the composition of the atmosphere?

ANSWER

The atmosphere is a blanket of air around the Earth, held by gravity. It is a mixture of gases in various proportions, together with water vapour and tiny dust particles.

a Gases in the atmosphere

Gas	Share	Note
Nitrogen	78%	Primary and most abundant gas; essential to life
Oxygen	21%	Second most abundant gas; essential to life
Argon	0.93%	Found in lesser quantity
Carbon dioxide	0.04%	Found in lesser quantity; a greenhouse gas
Others	0.03%	Helium, neon, krypton, xenon, ozone, hydrogen, etc.

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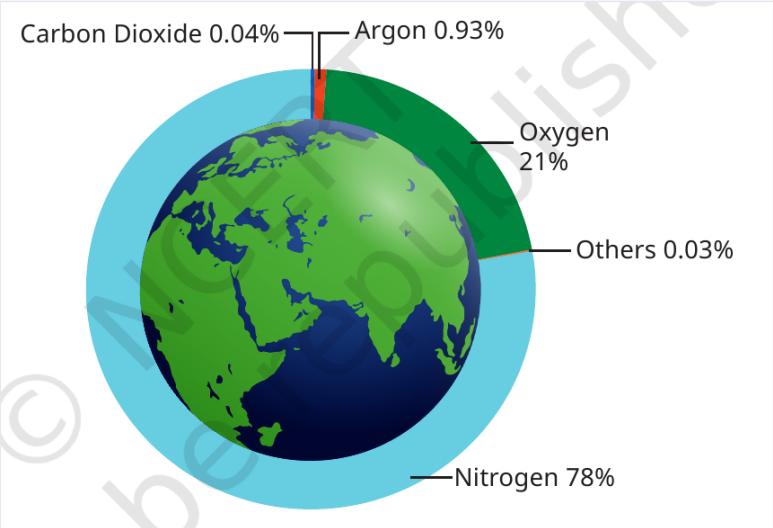


Fig. 3.2. Composition of the atmosphere

b Other components

- **Water vapour** varies, but generally ranges from 0.1 per cent to 0.4 per cent. It plays a significant role in cloud formation and precipitation.
- **Tiny dust particles** are also present, and the composition of the atmosphere varies with altitude.

Therefore, the atmosphere is mainly nitrogen (78%) and oxygen (21%), with small amounts of other gases, water vapour and dust.

QUESTION 2 *The Big Questions · p. 39*

How do the different layers of the atmosphere affect the planet Earth?

ANSWER

The atmosphere has a layered structure, defined by changes in temperature and density with altitude. Each layer affects the Earth in its own way.

a Effects of each layer

Layer	Extent	How it affects the Earth
Troposphere	About 12 km (average height)	The air we breathe, most water vapour and clouds; nearly all weather (rainfall, fog, hail) occurs here

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Layer	Extent	How it affects the Earth
Stratosphere	Up to 50 km	Free of clouds and weather disturbances, so ideal for aeroplanes; its ozone layer filters the Sun's harmful radiation, including ultraviolet
Mesosphere	Up to 80 km	Most meteorites entering from space burn up here
Thermosphere	80 to 700 km	Gas molecules absorb X-rays and short-wave UV; reflects radio waves back to Earth; contains the ionosphere; auroras occur here
Exosphere	Uppermost layer	Very thin air; light gases like helium and hydrogen float into space due to weak gravity

b Boundaries between layers

Transition zones separate the layers: the **tropopause** (between troposphere and stratosphere), the **stratopause** (between stratosphere and mesosphere) and the **mesopause** (top of the mesosphere), as shown in Fig. 3.3.

Therefore, the layers protect us from harmful radiation and meteors, give us air and weather, and help radio communication.

QUESTION 3 *The Big Questions · p. 39*

What is the mechanism of monsoon?

ANSWER

Monsoon is the seasonal reversal in the wind direction during a year. It is caused mainly by the unequal heating of land and sea, because air always moves from high-pressure to low-pressure areas.

a South-west (summer) monsoon

- It blows between June and September, from sea to land across the Indian Ocean, the Arabian Sea and the Bay of Bengal.
- In summer the landmass of India heats up faster than the surrounding oceans, creating a **low-pressure area** over the subcontinent, while the cooler Indian Ocean has **high pressure**.
- Winds move from high to low pressure, so moist winds blow from the ocean towards the land, bringing rainfall. It accounts for most of the country's rainfall throughout the year.

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b North-east (winter) monsoon

- It occurs from October to February. The Indian landmass cools faster than the oceans, creating **high pressure over land** and **low pressure over the seas**.
- Cold, dry winds blow from land to sea and generally bring no rain to most of India.
- When they pass over the Bay of Bengal they pick up moisture and cause rainfall on the eastern coast, especially in Tamil Nadu, Andhra Pradesh and parts of Karnataka.

c Advance and retreat of the monsoon

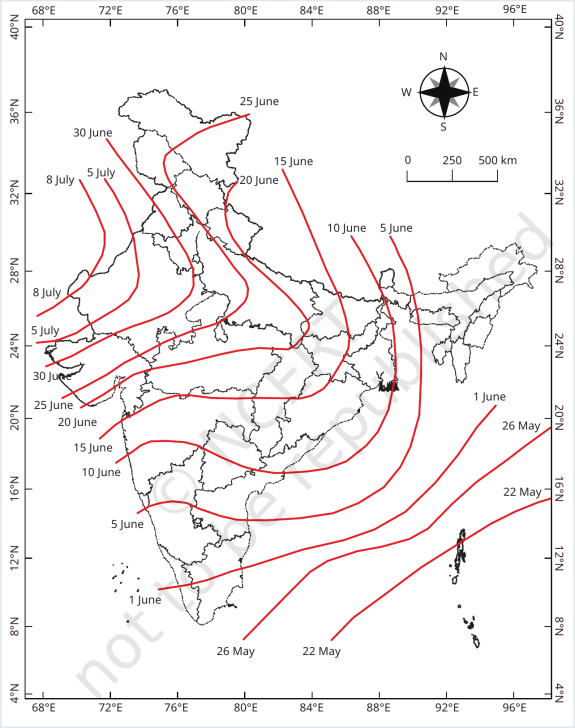


Fig. 3.10. Normal dates of advancing of south-west monsoon

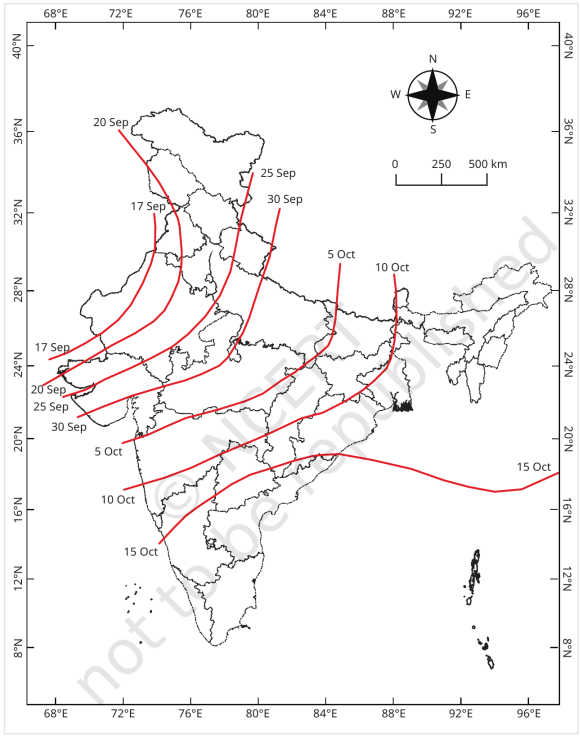


Fig. 3.11. Normal dates of retreating monsoon

Therefore, the monsoon is a seasonal reversal of winds caused by unequal heating of land and sea; the south-west monsoon brings most of India's rain.

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QUESTION 4 *The Big Questions · p. 39*

How can we reduce our carbon footprint?

ANSWER

A carbon footprint is the total amount of greenhouse gases released into the atmosphere by human activities such as energy use, transportation, or the production of goods and services.

a Actions given in the chapter

- Save energy and use renewable sources of energy.
- Protect forests and plant trees.
- Adopt sustainable, eco-friendly ways of living. Every small step counts and every human being plays a role.

b Everyday low-impact habits (from “My Carbon Footprint”)

Area	Low-impact habit
Transport	Walk or use a cycle (public transport or carpool is medium impact)
Electricity use	Always switch off lights, fans, etc. when not in use
Water use	Use water judiciously, e.g. just one bucket of water for bathing
Waste and plastics	Reuse, recycle and avoid single-use plastics

Therefore, we can reduce our carbon footprint by saving energy, using renewables, protecting forests and living eco-friendly lives.

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QUESTION 5 *Think About It · p. 39*

Can you imagine what would happen if there were no atmosphere? Discuss your thoughts with your friends and teachers.

ANSWER

Life on Earth would not be possible without the atmosphere. Every function the chapter gives for it would be lost.



Fig. 3.1

a What would happen without the atmosphere

What the atmosphere does	Without it
Provides a mixture of gases vital for survival	No oxygen to breathe and no nitrogen for plants; living beings could not survive
Shields us from harmful radiation, including ultraviolet	Harmful radiation from the Sun would reach the surface directly
Regulates temperature by trapping some of the Sun’s energy	Energy would escape into space; the Earth’s temperature would not be regulated
Holds water vapour, forms clouds and precipitation	No clouds, rain, fog or hail; no weather or climate
Burns up most meteorites in the mesosphere	Meteorites would strike the Earth’s surface

Therefore, without an atmosphere the Earth would have no air, no weather and no protection, so life could not exist.

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QUESTION 6 *Let's Recall · p. 40*

How is nitrogen useful for plants? Remember that you learnt this in the chapter 'The Invisible Living World: Beyond Our Naked Eyes', in your Grade 8 Science textbook.

ANSWER

Nitrogen is needed by plants for growth, but most plants cannot use the nitrogen gas of the air directly.

a How nitrogen helps plants

- Nitrogen-fixing bacteria (for example **Rhizobium** in the root nodules of pulse plants) convert nitrogen of the air into nitrogen compounds that plants can absorb from the soil.
- Plants use these compounds to make proteins and other substances needed for growth.
- Nitrogen is the most abundant gas in the atmosphere (78%), so it is a constant source for this process.

Therefore, atmospheric nitrogen, made usable by bacteria, helps plants grow.

QUESTION 7 *Think About It · p. 45*

You might have noticed that sometimes the wind is so strong that it is difficult to walk against it. Can you think of some other times when strong winds have caused problems for you?

ANSWER

Strong winds affect daily life. Table 3.1 says that at 39–49 km/hr (strong breeze) umbrellas are difficult to use, and that a storm is usually accompanied by widespread damage.

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a Examples of problems caused by strong winds

- Umbrellas become hard to hold or turn inside out; it is hard to walk or cycle against the wind.
- Dust is blown into the eyes; dry leaves and litter are scattered.
- Large branches break and trees are uprooted during a storm.
- Loose roofing sheets, hoardings and clothes drying outside are blown away; electric wires may be damaged, causing power cuts.

Add your own experiences, e.g. a dust storm or a stormy day in your area.

Therefore, strong winds can disturb travel, damage property and cause inconvenience.

QUESTION 8 *Let's Explore · p. 46*

Find out other categories of wind based on speed and their common effects, and share your findings in class.

ANSWER

Table 3.1 lists four categories (calm, light breeze, strong breeze, storm). The Beaufort wind scale gives the other categories below.

a Other categories of wind by speed

Wind	Speed (km/hr)	Common effects
Light air	1–5	Smoke drifts slowly and shows the wind direction
Gentle breeze	12–19	Leaves and small twigs in constant motion; light flags stretch out
Moderate breeze	20–28	Dust and loose paper are raised; small branches move
Fresh breeze	29–38	Small leafy trees begin to sway
Near gale	50–61	Whole trees in motion; difficult to walk against the wind
Gale	62–74	Twigs break off trees; walking is difficult
Strong gale	75–88	Slight damage to buildings (roof tiles blown off)
Storm	89–102	Trees uprooted; considerable damage to buildings
Hurricane	118 and above	Devastation

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Note: the “Storm” row of Table 3.1 (103–117 km/hr) is called “violent storm” on the Beaufort scale.

Therefore, winds are classed from calm to hurricane by their speed, and the damage they cause increases with speed.

QUESTION 9 *Let’s Analyse · p. 47*

Note down the weather report from a local newspaper for two weeks and observe the changes occurring in the weather.

ANSWER

This is an activity. Copy the daily weather report from a local newspaper for 14 days and study how the conditions change.

a **Record sheet (fill in from the newspaper)**

Day	Max temp (°C)	Min temp (°C)	Sky	Rainfall	Wind
Day 1					
Day 2					
Day 3					
Day 4					
Day 5					
Day 6					
Day 7					
Day 8					
Day 9					
Day 10					
Day 11					
Day 12					
Day 13					
Day 14					

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b What to observe

- Does the temperature change from day to day? Which day was hottest and which coolest?
- How many days were sunny, cloudy, windy or rainy?
- Weather conditions can change within a single day, while climate is the average weather of a place over thirty years or more.

Therefore, weather changes from day to day, while climate is the long-term average of weather.

QUESTION 10 *Think About It · p. 48*

Hindustani Classical music associates certain rāgas with specific seasons. Find out which rāgas are connected to each season with the help of your elders and teachers.

ANSWER

This is an activity to be done with elders and teachers. The six traditional seasons (Table 3.2 of the chapter) are given below with rāgas to note.

a Seasons and associated rāgas

Season (Ṛtu)	Months (Gregorian)	Rāgas to note
Vasanta	March–April	Basant, Bahar
Grīṣhma	May–June	Deepak (traditionally linked with summer)
Varṣhā	July–August	Megh, Miyan kī Malhār (the Malhār family)
Śharad	September–October	Find out and write here
Hemanta	November–December	Find out and write here
Śhiśhira	January–February	Find out and write here

Note: associations of rāgas with seasons differ between traditions, so confirm the remaining rows with your music teacher.

Therefore, Indian classical music reflects the traditional seasons of the year.

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QUESTION 11 *Let's Explore · p. 52*

Describe in your own words how monsoon affects the lives of the people around you.

ANSWER

The monsoon greatly influences the economy, lifestyle and livelihoods of people in India. A model answer is given below.

a How the monsoon affects life

Area of life	Effect
Agriculture	Most of India's agriculture depends on monsoon rainfall; farmers rely on rain for sowing and growing crops
Food and water	A good monsoon ensures sufficient food production and water in rivers, reservoirs and wells
Daily life	Affects transport, festivals and employment, especially in rural areas
Floods	Excessive rainfall can cause floods
Droughts	A weak monsoon can lead to droughts

Add what you notice around you: crops grown in your area, waterlogging in streets, umbrellas and raincoats, clothes taking longer to dry.

Therefore, the monsoon shapes farming, water supply and everyday life across India.

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QUESTION 12 *Let's Explore · p. 53*

My Carbon Footprint. Step 1: My Daily Habits – tick the options that best describe you (A. Transport, B. Electricity Use, C. Water Use, D. Waste and Plastics). Step 2: Score Yourself – low impact = 1 point, medium = 2, high = 3, very high = 4; add up your total score. Step 3: My Climate Action Pledge – think about two simple changes you can make to reduce your score, and write them down.

ANSWER

This is a self-assessment activity. Tick one option in each of A–D, add the points, then write two pledges. A worked example is given.

a Steps 1 and 2: choices and points

Habit	Option	Impact	Points
A. Transport	I usually walk/use a cycle	Low	1
	I use public transport/carpool	Medium	2
	I travel by private cars even for short distances	High	3
	I take flights more than twice a year	Very high	4
B. Electricity	I always switch off electrical appliances when not in use	Low	1
	I sometimes forget to switch off appliances	Medium	2
	I leave appliances on frequently	High	3
C. Water	I use water judiciously (e.g. one bucket for bathing)	Low	1
	I sometimes waste water	Medium	2
	I rarely think about saving water	High	3
D. Waste and plastics	I reuse, recycle and avoid single-use plastics	Low	1
	I sometimes use disposable plastics	Medium	2
	I often throw away plastic and do not recycle	High	3

b Step 2: total score

Add the points of the one option you ticked in each area. The lowest possible total is 4 (all low impact) and the highest is 13 (4 + 3 + 3 + 3). A lower score means a smaller carbon footprint.

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c Worked example

A student who walks to school (1), sometimes forgets to switch off appliances (2), sometimes wastes water (2) and sometimes uses disposable plastics (2) scores 1 + 2 + 2 + 2 = **7 points**.

d Step 3: My Climate Action Pledge (model)

- I will switch off lights and fans whenever I leave a room (Electricity: 2 → 1).
- I will carry a cloth bag and a reusable bottle instead of using single-use plastics (Waste: 2 → 1).

New score = 1 + 1 + 2 + 1 = **5 points**, which is 2 points lower than before.

Therefore, two simple changes in daily habits can lower our carbon footprint score.

QUESTION 13 *Classroom Discussion · p. 56*

To what extent did natural factors cause these floods compared to human activities?

ANSWER

Both kinds of factors caused the 2025 Punjab floods. Natural factors triggered the flooding; human-made factors made the damage far worse.



Fig. 3.12. Floods in Punjab

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a Natural and human-made causes

Natural causes	Human-made causes
Very heavy monsoon rains, intensified by western disturbances	Weak and old river embankments (dhūsī bāndh) could not stop the rising water
Rain also fell in Himachal Pradesh and Jammu & Kashmir	Houses and farms built too close to rivers, reducing the natural space for floodwater
Satluj, Beas, Ravi and Ghaggar were already flowing high	Silt and mud collected in rivers and dams, reducing their capacity
Water from the hills and local rainfall made rivers overflow	Flood warnings came late or were not clearly communicated

Therefore, extreme rain was the trigger, but human factors greatly increased the damage; the chapter treats both as causes.

QUESTION 14 *Classroom Discussion · p. 56*

Do you think better planning could have reduced the damage? How?

ANSWER

Yes. The chapter stresses the urgent need for improved flood management and preparedness. Better planning could have reduced the damage.

a How better planning could help

Problem seen in 2025	Better planning
Weak, old embankments	Repair and strengthen embankments before the monsoon
Silt in rivers and dams	Remove silt regularly so that rivers and dams can hold and carry more water
Houses and farms near rivers	Keep space near rivers free for floodwater; avoid building too close
Late or unclear warnings	Give timely, clear flood warnings so people can move to safety
Large numbers displaced	Keep relief camps, food, water and medicines ready in advance

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Therefore, strong embankments, silt removal, safe land use and early warnings can reduce flood damage.

QUESTION 15 *Classroom Discussion · p. 56*

What are the guidelines for the management of floods according to the National Disaster Management Authority (NDMA)?

ANSWER

The NDMA is India's national body for disaster management. Its flood guidelines (Management of Floods) combine the following types of measures.

a Main points of flood management

Type of measure	What it includes
Structural	Embankments and other flood-control works, reservoirs, and improved drainage
Non-structural	Flood forecasting and early warning; zoning of flood-prone land to control construction; flood-proofing of buildings
Preparedness and response	Community awareness and training, evacuation plans, relief camps, medical care and sanitation after floods

b Basic safety steps for people

- Keep an emergency kit (torch, radio, first-aid, drinking water, dry food, important papers) ready.
- Listen to official warnings and move to higher ground or a relief camp when told to.
- Do not walk or drive through floodwater; stay away from electric poles and wires.
- Drink only safe (boiled or treated) water after a flood.

For the complete text, read the NDMA flood guidelines on ndma.gov.in.

Therefore, the NDMA approach combines flood-control works with warnings, land-use control and community preparedness.

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QUESTION 16 *Classroom Discussion · p. 56*

What role can students/youth play in helping with disaster preparedness?

ANSWER

Students and youth can help at every stage: before, during and after a disaster.



Fig. 3.13. Relief operations during the floods

a What students can do

- **Learn:** know the causes of floods, the warning signals and the nearest relief camp or safe place.
- **Prepare:** help families make an emergency kit and take part in mock drills and first-aid training.
- **Spread awareness:** share correct warnings in the neighbourhood, and avoid spreading rumours.
- **Protect the environment:** do not dump waste into drains and rivers; plant trees.
- **Help in relief:** with adults and organisations, collect and sort food, clothes and medicines, and help the elderly and children.

Therefore, informed and prepared youth can reduce losses and speed up relief during disasters.

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3.2

CLASS 9 SOCIAL SCIENCE · CHAPTER 3

Questions and Activities

Solutions · 8 questions

Directions (Questions 1–8): These are the Questions and activities at the end of the chapter (page 57). Answer each in your own words using the points given. Question 7 has parts 7.1 to 7.5, each answered separately.

QUESTION 1

What is atmosphere? Explain its composition with the help of a pie diagram.

ANSWER

The atmosphere is a blanket of air surrounding the Earth. It is pulled down around the Earth by gravity and is a mixture of gases in various proportions, vital for the survival of all living beings.

a **Composition shown by a pie diagram**

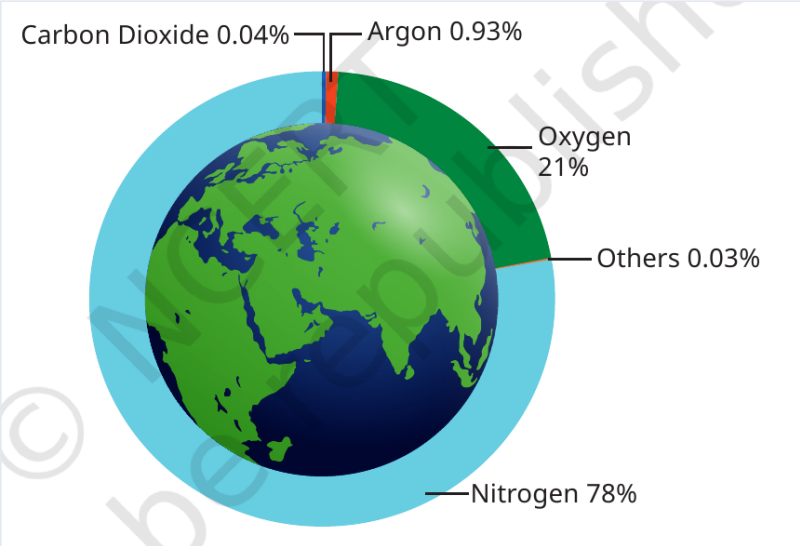


Fig. 3.2. Composition of the atmosphere

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b Explanation

- **Nitrogen 78%** and **oxygen 21%** together make up 99% of the atmosphere and are essential to life.
- **Argon 0.93%**, **carbon dioxide 0.04%** and **others 0.03%** (helium, neon, krypton, xenon, ozone, hydrogen) are found in lesser quantities. Check: 78 + 21 + 0.93 + 0.04 + 0.03 = 100.
- Water vapour (0.1 to 0.4 per cent, varying) and dust particles are also present. The atmosphere shields us from harmful radiation and regulates the Earth's temperature.

Therefore, the atmosphere is a mixture of gases, mainly nitrogen and oxygen, that sustains life.

QUESTION 2

Draw a labelled diagram of the structure of atmosphere.

ANSWER

The atmosphere has five major layers, defined by changes in temperature and density with altitude. The labelled diagram (Fig. 3.3) is given below.

a Layers in brief

Layer	Height	Key features
Troposphere	Up to about 12 km	Weather, air we breathe, most water vapour and clouds
Stratosphere	12 to 50 km	Free of clouds; ozone layer; aeroplanes fly here
Mesosphere	50 to 80 km	Most meteorites burn up
Thermosphere	80 to 700 km	Temperature rises rapidly; ionosphere; auroras
Exosphere	Above the thermosphere	Very thin air; helium and hydrogen escape to space

Temperature decreases with altitude only in the troposphere and mesosphere. The tropopause, stratopause and mesopause mark the boundaries.

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b Labelled diagram

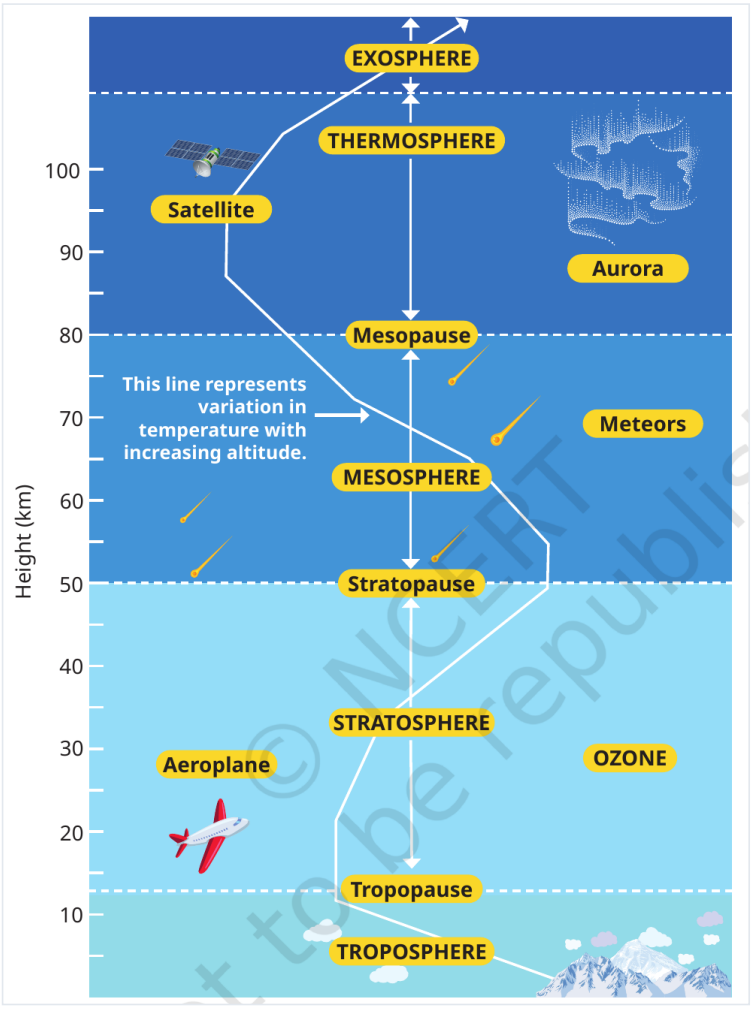


Fig. 3.3. Layers of the atmosphere

Therefore, the atmosphere has five layers: troposphere, stratosphere, mesosphere, thermosphere and exosphere.

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QUESTION 3

Which are the four main seasons of India?

ANSWER

The climate of India is broadly tropical monsoon. The Indian Meteorological Department (IMD) recognises four distinct seasons.

a The four seasons

Season	Period	Main features
Winter	December to early April	Coldest months are December and January; average temperature about 10–15°C in the north-west, rising to 20–25°C in the south-east of mainland India
Summer or pre-monsoon	April to June (up to July in north-western India)	Hottest month is April in western and southern regions and May in the north; average temperature across most of inland India 32–40°C
Monsoon or rainy (advancing monsoon)	June to September	Dominated by the humid south-west summer monsoon, which sweeps across the country
Post-monsoon (retreating monsoon)	October to December	Monsoon retreats; in north-western India October and November are usually cloudless

The Himalayan states, being more temperate, experience two additional seasons: autumn and spring. Traditionally India has six seasons of about two months each (Vasanta, Grīṣhma, Varṣhā, Śharad, Hemanta, Śhiśhira).

Therefore, the four main seasons of India are winter, summer, monsoon and post-monsoon.

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QUESTION 4

Why do you not feel the pressure of the atmosphere?

ANSWER

The air above us exerts a significant force on our bodies, and yet we do not feel it.

a Reasons

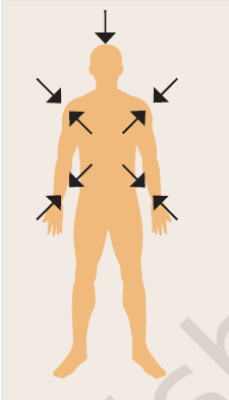


Fig. 3.5. The pressure inside our bodies is also equal to the atmospheric pressure and cancels the pressure from outside.

- Atmospheric pressure is the pressure exerted by the weight of air on the Earth’s surface.
- Air presses on us from all sides, not only from above.
- Our bodies exert a counter-pressure: the pressure inside our bodies is equal to the atmospheric pressure, so it cancels the pressure from outside.

Therefore, we do not feel atmospheric pressure because the pressure inside our bodies balances it.

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QUESTION 5

In which layer of the atmosphere do aeroplanes fly and why?

ANSWER

Aeroplanes fly in the stratosphere, the layer above the troposphere that extends up to 50 kilometres.

a Why the stratosphere?

- It is free of clouds and other weather disturbances, so flying is smooth.
- Nearly all weather phenomena, such as rainfall, fog and hail, occur in the troposphere below.
- Fig. 3.3 shows the aeroplane within the stratosphere.

Therefore, aeroplanes fly in the stratosphere because it is free of clouds and weather disturbances.

QUESTION 6

Distinguish between the following:
a. The troposphere and stratosphere
b. The south-west monsoon and north-east monsoon

ANSWER

The two parts are answered in tables.

a The troposphere and stratosphere

Point	Troposphere	Stratosphere
Position	Layer nearest the Earth’s surface	Lies above the troposphere
Height	Average about 12 km	Extends up to 50 km
Temperature	Decreases with increasing altitude	Does not decrease with altitude; it rises (Fig. 3.3)
Contents	Air we breathe; most water vapour and clouds	Layer of ozone gas

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Point	Troposphere	Stratosphere
Weather	Nearly all weather phenomena (rainfall, fog, hail)	Free of clouds and weather disturbances
Importance	Most important layer for life	Ozone filters harmful radiation; ideal for aeroplanes
Boundary	Tropopause separates it from the stratosphere	Stratopause marks its boundary with the mesosphere

b The south-west monsoon and north-east monsoon

Point	South-west monsoon	North-east monsoon
Also called	Summer monsoon	Winter monsoon
Period	June to September	October to February
Wind direction	Sea to land	Land to sea
Cause	Land heats faster than sea: low pressure over land, high over the ocean	Land cools faster than sea: high pressure over land, low over the seas
Nature of winds	Humid, moisture-laden	Cold and dry
Rainfall	Most of the country’s rainfall	Generally none for most of India; rain on the east coast (Tamil Nadu, Andhra Pradesh, parts of Karnataka) after picking up moisture over the Bay of Bengal

Therefore, the layers differ in height, temperature and weather, and the two monsoons differ in season, wind direction and rainfall.

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QUESTION 7

Do it yourself: Table 3.3 shows the average monthly temperatures and rainfall amounts for 10 representative stations. Study these figures on your own and convert them into 'temperature and rainfall' graphs. The visual representations will help you grasp their similarities and differences at a glance. One such graph (Fig. 3.14) is already prepared for you. See if you can arrive at some broad generalisations about our diverse climatic conditions.

ANSWER

Table 3.3 gives monthly temperature and rainfall for 10 stations. Fig. 3.14 (Delhi) is drawn in the chapter; the other nine stations are drawn below from the table in the same style.

a How the graphs are drawn

- Months are on the x-axis. The left axis is temperature (°C), drawn as a line with dots; the right axis is rainfall (cm), drawn as bars, as in Fig. 3.14.
- All graphs use the same scales (temperature −10 to 40 °C, rainfall 0 to 70 cm) so they can be compared at a glance.
- Values are plotted as printed in Table 3.3; a dash means nil or negligible rainfall and is plotted as 0. Jodhpur's September temperature is printed as 20.1 °C, lower than the months around it; it is plotted as given.

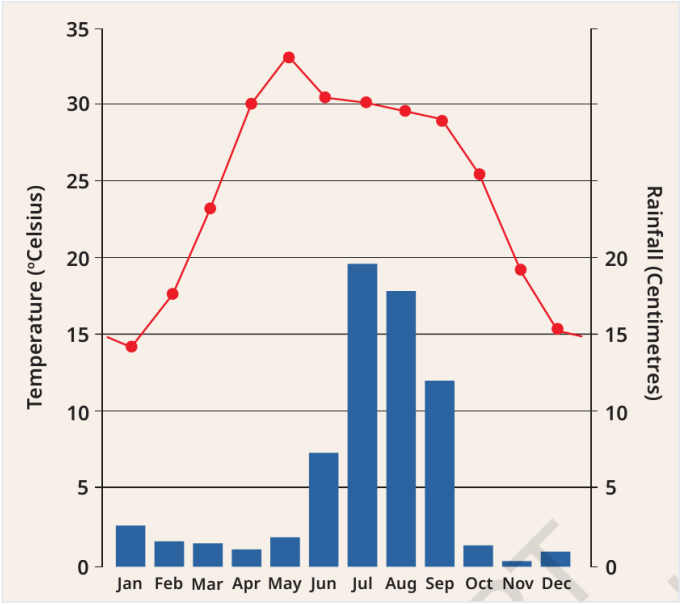
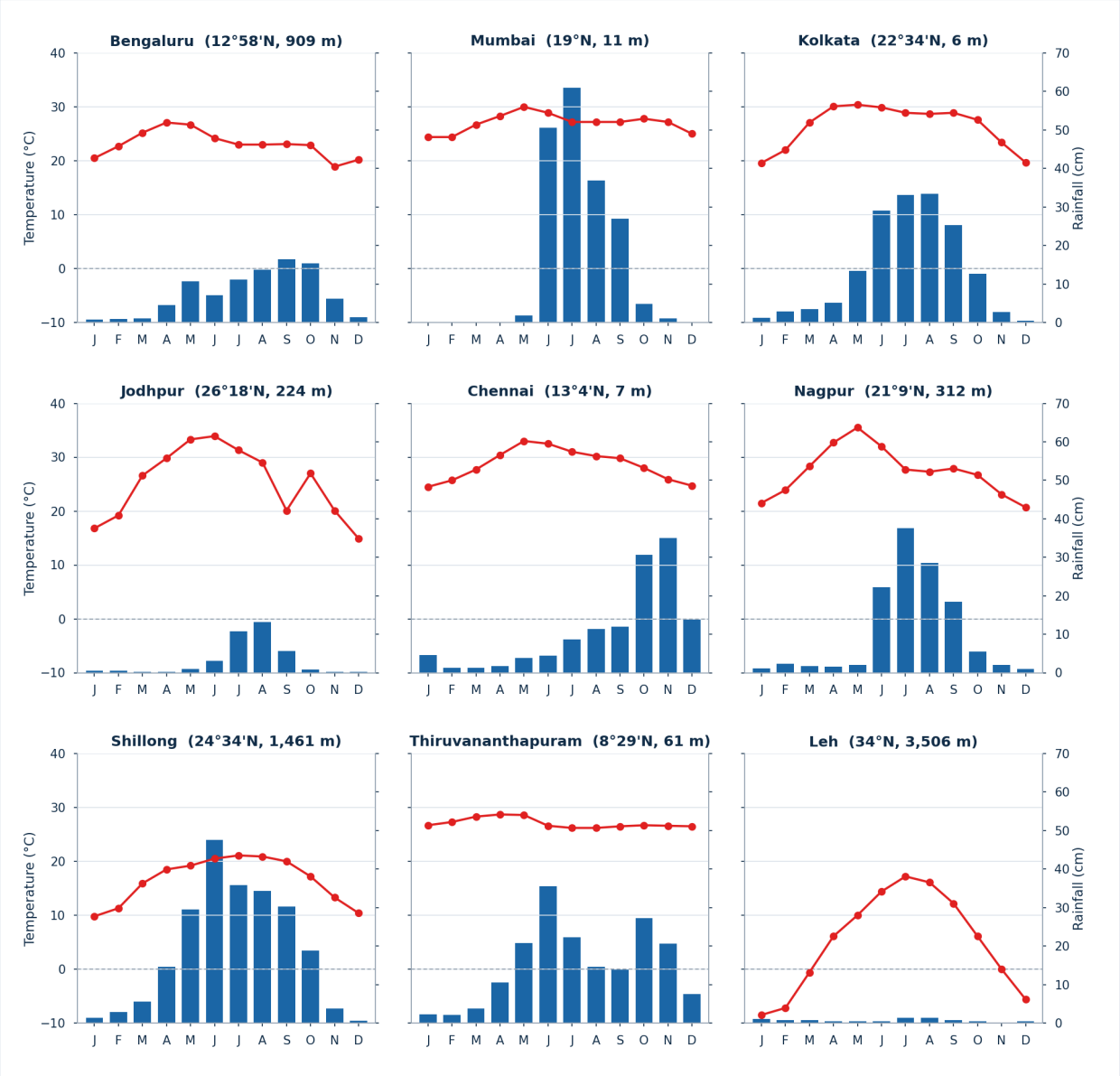


Fig. 3.14. Temperature and Rainfall of Delhi (from the chapter)

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Temperature (line, °C) and rainfall (bars, cm) of the other nine stations, drawn from Table 3.3

b Broad generalisations

- **Rainfall season:** at nine of the ten stations the wettest month is between June and September (the south-west monsoon). Chennai, wettest in November, is the exception.
- **Rainfall amount:** varies widely, from 8.5 cm (Leh) and 36.6 cm (Jodhpur) to 225.3 cm (Shillong) in a year.
- **Hottest months:** April to June at eight stations; the line falls once monsoon rains arrive. Shillong and Leh are warmest in July.
- **Range of temperature:** small on the coast and near the equator (Thiruvananthapuram 2.5 °C, Mumbai 5.6 °C), large in the north and interior (Delhi 18.9 °C, Jodhpur 19.0 °C, Leh 25.7 °C).
- **Altitude:** Shillong (1,461 m) and Leh (3,506 m) are much cooler than low-lying stations.

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Therefore, the graphs show a common monsoon rhythm of rainfall, but amount of rain and range of temperature differ widely.

QUESTION 7.1

Now look at Table 3.3 again. Re-arrange the 10 stations according to their distance from the equator.

ANSWER

Distance from the equator is measured by latitude: the smaller the latitude (°N), the nearer the station is to the equator.

a **Stations from nearest to farthest**

Order	Station	Latitude
1	Thiruvananthapuram	8°29′N
2	Bengaluru	12°58′N
3	Chennai	13°4′N
4	Mumbai	19°N
5	Nagpur	21°9′N
6	Kolkata	22°34′N
7	Shillong	24°34′N
8	Jodhpur	26°18′N
9	Delhi	29°N
10	Leh	34°N

Therefore, Thiruvananthapuram (8°29′N) is nearest to the equator and Leh (34°N) is farthest.

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QUESTION 7.2

Find out:
a. Two stations with the most extreme climate.
b. Two stations influenced by retreating monsoons.
c. The two hottest stations in the months of (i) February (ii) June.

ANSWER

Each part is answered from the data of Table 3.3 (temperatures in °C).

a Two stations with the most extreme climate

A climate is extreme when the yearly range of temperature is large and the rainfall is very low or very high.

Station	Highest (month)	Lowest (month)	Range	Annual rain
Leh	17.2 (Jul)	-8.5 (Jan)	25.7	8.5
Jodhpur	33.9 (Jun)	14.9 (Dec)	19.0	36.6
Delhi	33.3 (May/Jun)	14.4 (Jan)	18.9	67.0
Nagpur	35.5 (May)	20.7 (Dec)	14.8	124.2
Shillong	21.1 (Jul)	9.8 (Jan)	11.3	225.3
Kolkata	30.4 (May)	19.6 (Jan)	10.8	162.5
Chennai	33.0 (May)	24.5 (Jan)	8.5	128.6
Bengaluru	27.1 (Apr)	18.9 (Nov)	8.2	88.9
Mumbai	30.0 (May)	24.4 (Jan/Feb)	5.6	183.4
Thiruvananthapuram	28.7 (Apr)	26.2 (Jul/Aug)	2.5	181.2

Leh (range 25.7 °C, only 8.5 cm rain) and **Jodhpur** (range 19.0 °C, 36.6 cm rain) have the most extreme climates. Delhi (18.9 °C) is almost as extreme as Jodhpur.

b Two stations influenced by retreating monsoon

The retreating (north-east) monsoon brings rain in October–December.

Station	Oct (cm)	Nov (cm)	Dec (cm)	Oct–Dec (cm)	Share of year
Chennai	30.6	35.0	13.9	79.5	62%
Thiruvananthapuram	27.3	20.6	7.5	55.4	31%
Bengaluru	15.3	6.1	1.3	22.7	26%

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Chennai (62% of its rain) and **Thiruvananthapuram** (31%) are the two most influenced; both get a second rainfall peak in October–November.

c The two hottest stations

- **(i) February:** Thiruvananthapuram (27.3 °C) and Chennai (25.7 °C). The next is Mumbai (24.4 °C).
- **(ii) June:** Jodhpur (33.9 °C) and Delhi (33.3 °C). The next is Chennai (32.5 °C).

Therefore: Leh and Jodhpur are most extreme; Chennai and Thiruvananthapuram feel the retreating monsoon; the hottest are as shown above.

QUESTION 7.3

Now find out:
a. Why does Shillong experience more rainfall than Kolkata?
b. Why does Delhi receive more rainfall than Jodhpur?

ANSWER

The main factors affecting precipitation are prevailing winds, mountains and seasons (chapter text on precipitation).

a Shillong and Kolkata

- Shillong receives 225.3 cm a year and Kolkata 162.5 cm, which is 62.8 cm less.
- Shillong is a hill station on the Meghalaya plateau (1,461 m) in the path of moist monsoon winds from the Bay of Bengal. The hills force the winds to rise, cool and condense, giving heavy rain.
- Its rain starts early and lasts long: 14.6 cm in April, 29.5 cm in May, 47.6 cm in June and 18.8 cm even in October.
- Kolkata is a low plain station (6 m) with no hills to lift the air, so it receives less.

b Delhi and Jodhpur

- Delhi receives 67.0 cm a year and Jodhpur only 36.6 cm.
- Jodhpur lies in the dry west of Rajasthan, where the monsoon brings little moisture. Fig. 3.10 and Fig. 3.11 show the monsoon arriving later and withdrawing earlier in the north-west than at Delhi, so Jodhpur's rainy season is shorter.

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- In the table Delhi gets more in July (19.3 cm against 10.8 cm) and August (17.8 cm against 13.1 cm), and also more winter rain in January–February (4.0 cm against 1.1 cm).

Therefore, mountains in the path of moist winds explain Shillong's heavy rain, and Jodhpur's dry location and short rainy season explain its lower rainfall.

QUESTION 7.4

Now think why
a. Thiruvananthapuram has an equable climate?
b. Chennai has more rainfall only after the fury of the monsoon is over in most parts of the country?
c. Leh has moderate precipitation almost throughout the year?

ANSWER

Each answer is supported by the data of Table 3.3.

a Thiruvananthapuram has an equable climate

- "Equable" means without extremes. Its temperature stays between 26.2 °C and 28.7 °C all year, a range of only 2.5 °C, and rain falls in every month (at least 2.1 cm).
- It lies at 8°29′N, near the equator, where insolation is high in all months, so there is little seasonal change in temperature.
- It is a coastal, low station (61 m), so the sea keeps temperatures moderate. It also gets both monsoons: 35.6 cm in June and 27.3 cm in October.

b Chennai has more rainfall after the monsoon is over

Period	Rainfall (cm)	Share of year
January–May	12.8	10%
June–September (south-west monsoon)	36.4	28%
October–December (retreating monsoon)	79.5	62%

- Chennai is on the east coast. When the north-east monsoon winds pass over the Bay of Bengal they pick up moisture and cause rain on the east coast, especially in Tamil Nadu.
- So its heaviest rain comes in October (30.6 cm) and November (35.0 cm), after the south-west monsoon has retreated from most of the country (Fig. 3.11).

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c Leh has moderate precipitation almost throughout the year

- Leh gets small amounts in every month (0.5–1.3 cm, except a nil in November), totalling 8.5 cm, with no monsoon peak.
- It lies at 34°N and 3,506 m. Cold air holds little water vapour (warmer air holds more), so there is little moisture to fall as precipitation.
- In the cold months (December to March, below freezing) the precipitation falls as snow.

Therefore, latitude, nearness to the sea, wind systems and altitude explain these three climates.

QUESTION 7.5

Despite these differences across regions, can you observe any substantial evidence to conclude that the monsoons provide a very strong framework, lending overall climatic unity to the whole country?

ANSWER

Yes. The data of Table 3.3 show that the monsoon gives a common rhythm to the climate of the whole country.

a Evidence from Table 3.3

Station	Wettest month (cm)	Jun–Sep rain (cm)	Share of year
Mumbai	Jul (61.0)	175.4	96%
Jodhpur	Aug (13.1)	32.7	89%
Nagpur	Jul (37.6)	106.9	86%
Delhi	Jul (19.3)	56.4	84%
Kolkata	Aug (33.4)	120.8	74%
Shillong	Jun (47.6)	148.0	66%
Bengaluru	Sep (16.4)	48.3	54%
Thiruvananthapuram	Jun (35.6)	86.3	48%
Leh	Jul–Aug (1.3)	3.9	46%
Chennai	Nov (35.0)	36.4	28%

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b What the evidence shows

- The wettest month is in June–September at nine of the ten stations.
- Six stations get most of their rain then: Mumbai 96%, Jodhpur 89%, Nagpur 86%, Delhi 84%, Kolkata 74%, Shillong 66%.
- Chennai’s rain also comes from the monsoon system, as the retreating north-east monsoon.
- Temperatures fall as rains set in, e.g. Delhi 33.3 °C in June to 29.4 °C in August.
- Fig. 3.10 shows the monsoon covering the whole country between 22 May and 8 July.

Differences remain in the amount of rain (8.5 cm to 225.3 cm) and in its timing, but all regions share the monsoon cycle.

Therefore, the monsoon provides a strong framework that gives overall climatic unity to India.

QUESTION 8

Collect pictures of houses and clothing of people from different regions of India. Examine whether they reflect any relationship with the climatic conditions or the relief of those regions.

ANSWER

This is an activity. Collect pictures, paste them, and note the climate or relief of each region. A model table is given.

a Climate, relief, houses and clothing

Region	Climate or relief	Houses	Clothing
Ladakh	Cold, very little rain, high mountains	Thick stone or mud walls and flat roofs	Heavy woollen clothes
Himalayan hills	Cold, snow and heavy rain, steep slopes	Sloping roofs so snow and rain slide off	Woollen clothes and jackets
Rajasthan	Hot and dry	Thick walls and small windows to keep out heat	Loose cotton clothes, head covering
Assam and north-east	Heavy rain, humid, floods	Bamboo and wood houses on stilts with sloping roofs	Light cotton and handloom clothes
Kerala coast	Hot, humid, heavy rain	Sloping tiled roofs with wide eaves	Light cotton clothes

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Region	Climate or relief	Houses	Clothing
Northern plains	Hot summers, cold winters	Brick houses with flat roofs	Cotton in summer, woollens in winter

Paste each picture, name the region, and write which feature of climate or relief the house or dress reflects.

Therefore, houses and clothing reflect the climate and relief of a region.

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