

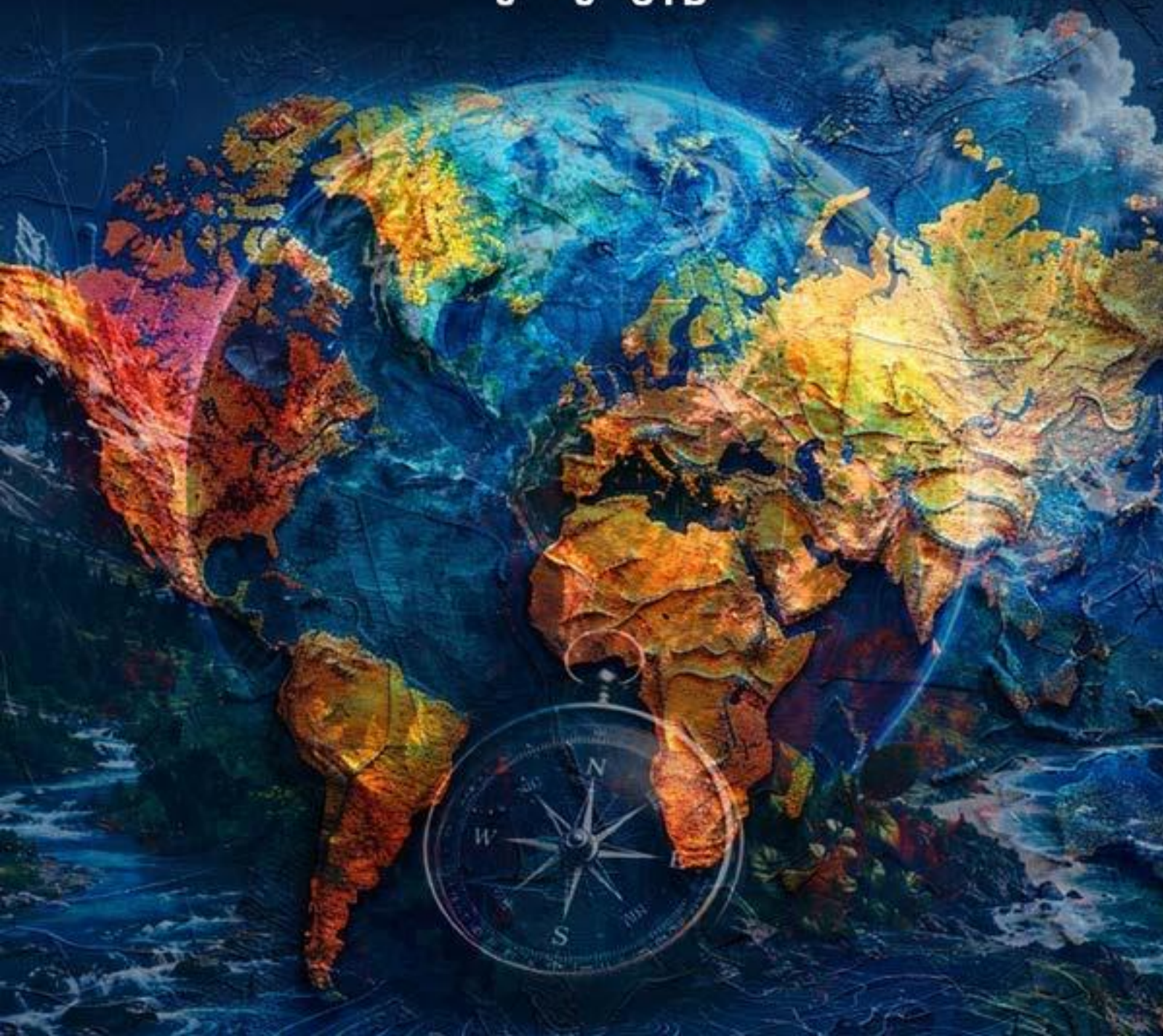


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GEOGRAPHY

NEW NCERT COMPILATION

6th - 9th STD



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NCERT has not yet released Volume 2 for Class 9 - the compilation will be updated immediately once it is published.

Locating Places on the Earth

CHAPTER

1

The globe of the Earth stands in space, made up of water, earth, fire and air and is spherical. ... It is surrounded by all creatures, terrestrial as well as aquatic.

— Āryabhaṭa (about 500 CE)



The Big Questions ?

1. What is a map and how do we use it? What are its main components?
2. What are coordinates? How can latitude and longitude be used to mark any location on the Earth?
3. How are local time and standard time related to longitude?



Imagine that you are visiting a city for the first time. How would you find the places you want to visit? You might ask a local person for help, or you might look at a map of the city. In previous grades, you learnt a little about maps, and in this chapter, we will study them in more detail.

Let us play a game. Examine the map of this small city (Fig. 1.1). Imagine that you just got off a train at the railway station, and you want to visit the bank marked on the map. Which way would you go? Are there other possible ways? Can you locate the public garden, the school and the museum? If you want to proceed from the bank to the market, which way will you go? This is where a map comes in handy!

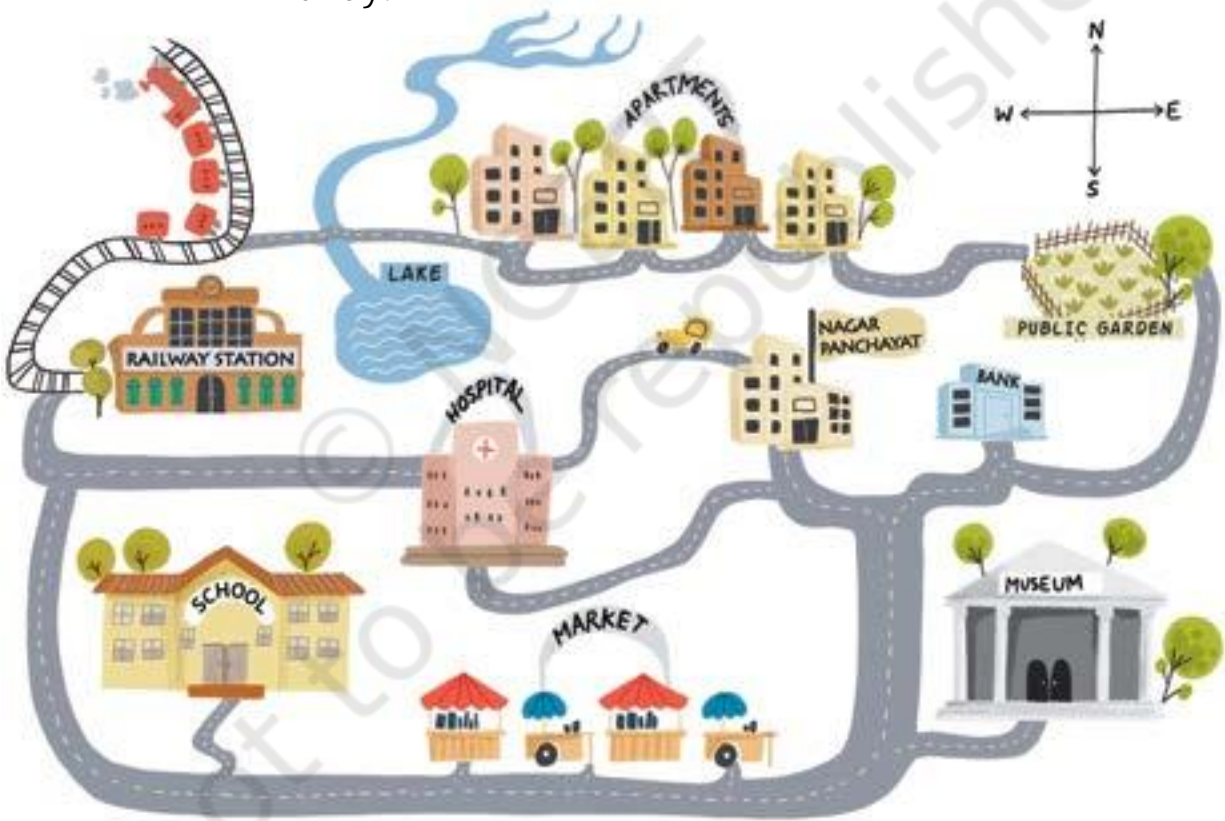


Fig. 1.1. A map of an imaginary small city.

A map is like a treasure guide; it shows you where things are and how to get to them. Notice the four arrows in the top right corner of the map; we will soon see how they point to some specific directions and make maps even more helpful.

LET'S EXPLORE

- On the map in Fig. 1.1 given on page 8 —
1. Mark the hospital.
 2. What is the meaning of the blue-coloured areas?
 3. Which is farther away from the railway station — the school, the Nagar Panchayat or the public garden?
- As a class activity, form groups of three or four students each. Let each group try to draw a map of your school and some of the streets or roads that lead to it, and a few neighbouring buildings. At the end, compare all the maps and discuss.



A Map and Its Components

From this simple example, we understand that a map is a representation, or a drawing, of some area — it may be a small area (a village, a town, etc.), a bigger area (say, your district or state), or a very large area like India or even the whole world. In a map, you look at the surface as if you are viewing it from the top.

An **atlas** is a book or collection of maps.

As you will discover, there are several kinds of maps —

- **physical maps**, which mainly show some natural features such as mountains, oceans and rivers (see an example in Fig. 5.2 in this textbook)
- **political maps**, which show details of countries or states, boundaries, cities, etc. (for instance, a map of India with all its States, Union Territories and their capitals)
- **thematic maps**, with a specific kind of information (examples include Fig. 6.3 and Fig. 8.1 in this textbook).

In addition, there are three important components of maps—**distance**, **direction** and **symbols**. You have already

experienced the first two while navigating the map in Fig. 1.1. Let us now define them more precisely.

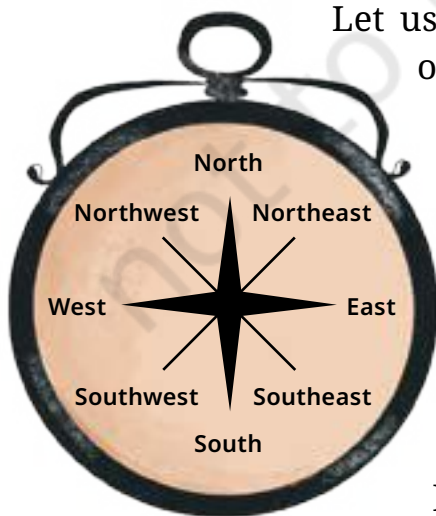
Have you ever wondered how a huge place can fit on a small piece of paper? It is all thanks to the map's **scale**. Let us go back to our map of a small city (Fig. 1.1). Each centimetre on the map represents a certain distance on the ground — let us suppose it is 500 metres; we say that the scale is 1 cm = 500 m. Now, turn to the map of India in Fig. 5.2 in Chapter 5 of this textbook. The scale is represented in the bottom left corner by a ruler with '500' written above its length and 'km' on the side. It simply means that this ruler, which measures 2.5 cm in the printed map, corresponds to 500 kilometres on the ground.

So, the actual **distance** between two points represented on the map depends on the scale that the map is using.

LET'S EXPLORE



- Draw a simple map of a school's playground. Let us assume it is a rectangle, 40 m in length and 30 m in width. Draw it precisely with your ruler on a scale of 1 cm = 10 m.
- Now measure the diagonal of the rectangle. How many centimetres do you get? Using the scale, calculate the real length of the playground's diagonal, in metres.



Let us return to the four arrows at the top right of the small city's map. They point to four **directions**, which are north, at the top, and, moving clockwise, east, south and west. These are called the **cardinal directions**, also **cardinal points**. Other than these, intermediate directions are also used — northeast (NE), southeast (SE), southwest (SW) and northwest (NW). Most maps simply have an arrow marked with the letter 'N', which points to the north direction.

LET'S EXPLORE

- Consider the map of the small city again. Identify the correct and incorrect statements in the list below:
 1. The market is north of the hospital.
 2. The museum is southeast of the bank.
 3. The railway station is northwest of the hospital.
 4. The lake is northwest of the apartment blocks.
- Taking your school as the starting point, do you know approximately in which cardinal direction your home is located? Discuss with your teacher and your parents.

Symbols are another important component of maps. Our map has small drawings of actual buildings and a few other elements, but there would not be enough space on the map of a large city or a country to draw them all. Instead, a symbol is used to represent these features — symbols for different kinds of buildings (for instance a railway station, a school, a post office), for roads and railway lines, and for natural elements such as a river, a pond or a forest. In that way, numerous details can be shown in the limited space available on a map.

To make maps more easily understood by a variety of users, map makers use specific symbols. Different countries use different sets of symbols. The Survey of India, a government body, has fixed a set of symbols for maps of India (or parts of India). A small selection of them is shown in Fig. 1.2 on page 12.

LET'S EXPLORE

Draw a rough map of your locality or your village, including your home, school and a few other important landmarks. Show the cardinal directions and use a few of the symbols shown in Fig. 1.2 on page 12 to mark some important features.

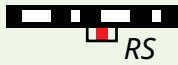
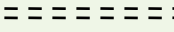
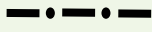
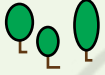
Railway Line: broad gauge, metre gauge, railway station			
Roads: metalled, unmetalled			
Boundary: international, state, district			
River, well, tank, canal, bridge			
Temple, church, mosque, chhatri			
Post Office, Post & Telegraph Office, Police Station			
Settlement, graveyard			
Trees, grass			

Fig. 1.2. A selection of symbols commonly used in maps.

Mapping the Earth

Mapping the Earth is a little more difficult because our planet is not a flat surface. It nearly has the shape of a sphere. (We say ‘nearly’ because it is not a perfect sphere, but is slightly flattened at the poles. However, in practice, we will consider it to be spherical.) Representing a sphere accurately on a flat sheet of paper is not possible. To understand why, peel an orange in such a way that you have just three or four large pieces of the skin; then try and flatten them on a table — you will see that you cannot do it without tearing them at the edges.

Now, consider a **globe**, which is a sphere on which a map is drawn. This may be a map of the Earth, the Moon, the planet Mars, the stars and constellations in the sky, etc. The physical object, like the one shown in the drawing on the next page, is a sphere that is generally made of metal, plastic or cardboard.

Here we will study the globe representing the Earth's geography. Because the globe and the Earth have the same spherical shape, a globe will better represent the geography of the Earth than a flat map.

Let us now explore some of its features.

a) Understanding coordinates

Imagine a big market in a city or town, with neat rows of shops, all the same size. You want to meet a friend at a stationery shop inside the market. But your friend does not know where the shop is. So you would give directions like, "Meet me at 6 pm at the 7th shop in the 5th row from the entrance." This will allow your friend to precisely determine your location.

Now, consider a chessboard. To record moves by advanced players, letters are placed alongside the main pieces (from 'a' to 'h', see the image) and numbers (from 1 to 8) in between the two sides. This simple system allows players to mark each square and record every move. Here, the white side has just opened the game by moving the queen's pawn two squares forward (a very common opening). So, the pawn is said to have moved from d2 to d4.



LET'S EXPLORE

Using the same terms, write down your move if you play black and respond with the same move.



1 - Locating Places on the Earth

The system used in these two examples may be called a system of **coordinates**. Thanks to their two coordinates, the stationery shop as well as the chess square on the chessboard can be precisely determined.

A similar system of coordinates is used in the world of maps to determine the location of any place on a map. Let us see how this system works.

b) Latitudes

Let us return to the globe. It is easy to identify the North Pole and the South Pole on it. Rotate the globe; while it rotates, the fixed points at the top and bottom are the two poles. Halfway between them is the Equator; note the circle marking it (see Fig. 1.3).

Imagine that you stand on the **Equator** and travel towards one of the poles; your distance from the Equator increases. **Latitude** measures this distance from the Equator. At any point of this travel, you can draw an imaginary line that runs east and west, parallel to the Equator. Such a line is called a **parallel of latitude** and it draws a circle around the Earth. Again, it is easy to note on the globe that the largest circle is the Equator, while the circles marked by the parallels of latitude grow smaller as we move northward or southward (Fig. 1.3).

Latitudes are expressed in **degrees**; by convention, the Equator is latitude 0° (zero degree), while the latitudes of the two poles are 90° North and 90° South respectively; this is noted 90°N and 90°S.

There is a connection between latitude and climate. Around the Equator, the climate is generally hot (it is also called 'torrid'). As you travel away from the Equator towards one of the two poles (in other words, as your latitude increases), the climate becomes more moderate (or 'temperate'). And closer to the North or South Pole, the climate grows colder (or 'frigid'). You will learn in Science why this is so, and

also why we experience different seasons in the course of a year.

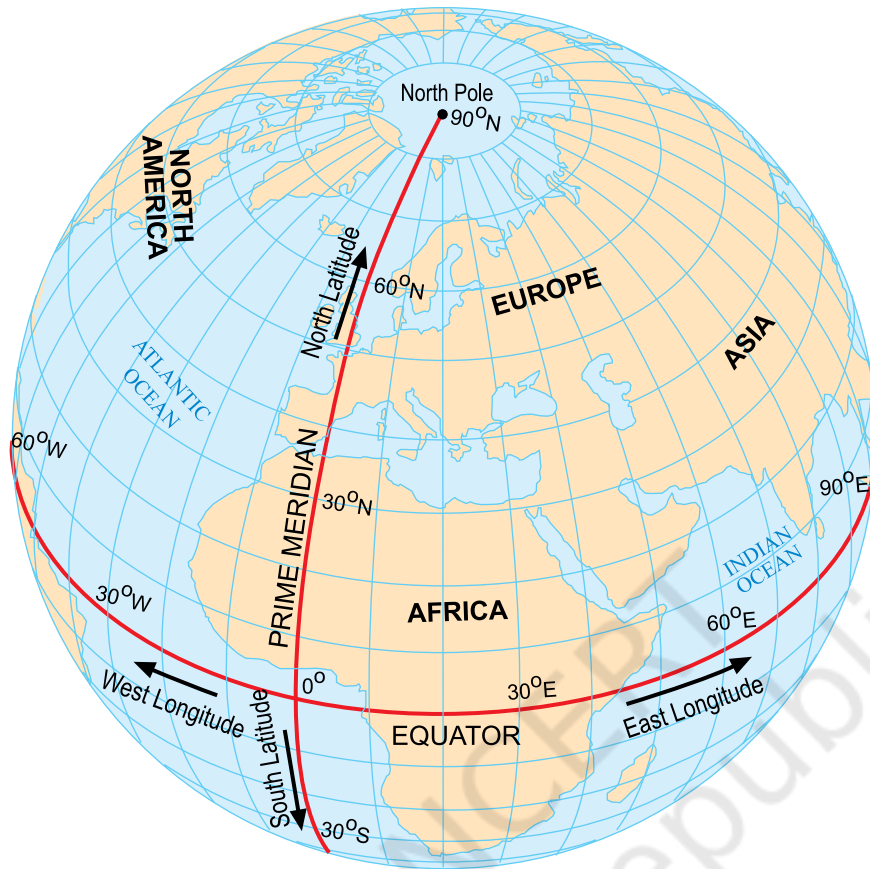


Fig. 1.3. This globe shows both parallels of latitude and meridians of longitudes

c) Longitudes

Imagine now that you travel from the North Pole to the South Pole by the shortest possible line. Observe the globe: you will see that instead of passing through Europe and Africa, you could just as well pass through Asia — the distance would be the same. These lines are called **meridians of longitude** (Fig. 1.3). They are all half-circles running from one pole to the other.

You will also learn in Science that the Earth spins on its axis. To put it simply, let's place a desk lamp a little away from our globe, focused on it, and imagine that this is

the Sun illuminating the Earth. Slowly rotating the globe eastward, we can note that for some places on the Earth it is morning, while for others it is mid-day, evening or night — when it's breakfast time in one country, it's lunchtime in another and in a third country people are fast asleep! That is why by measuring the longitude of a place, we will also be measuring the time at that place. Let us see how.

To measure longitudes, we need to define a reference point called the **Prime Meridian** (Fig. 1.3 on page 15). It is also called Greenwich Meridian because, in the year 1884, some nations decided that the meridian passing through Greenwich, an area of London in England, would become the international standard for the Prime Meridian. It is marked as 0° longitude.

Just as latitude is a measure of the distance from the Equator if you travel towards one of the poles, **longitude** is a measure of the distance from the Prime Meridian if you travel along the Equator. Longitude, too, is measured in degrees. Westward or eastward, it increases in value from 0° to 180°, with the letter 'W' or 'E' added. For instance, using round figures, New York's longitude is 74°W, while Delhi's is 77°E and Tokyo's is 140°E.



DON'T MISS OUT

As you can see on the globe of meridians of longitudes, 180°W and 180°E are the same longitude; so this longitude is noted 180°, omitting the letter W or E.

Latitude and longitude together are the two **coordinates** of a place. With them, you are now able to locate any place on Earth! You can now understand a statement such as “Delhi lies at 29°N latitude and 77°E longitude” (these values are rounded off, not exact).

Fig. 1.3 on page 15 shows the parallels of latitude and the meridians of longitude together on the globe as blue lines.

All these lines together constitute a **grid** for the globe; they are also called grid lines.

LET'S EXPLORE

If the globe or atlas in your class has well-marked latitudes and longitudes, try to note down approximate values for the latitude and longitude of (1) Mumbai, (2) Kolkata, (3) Singapore, (4) Paris.

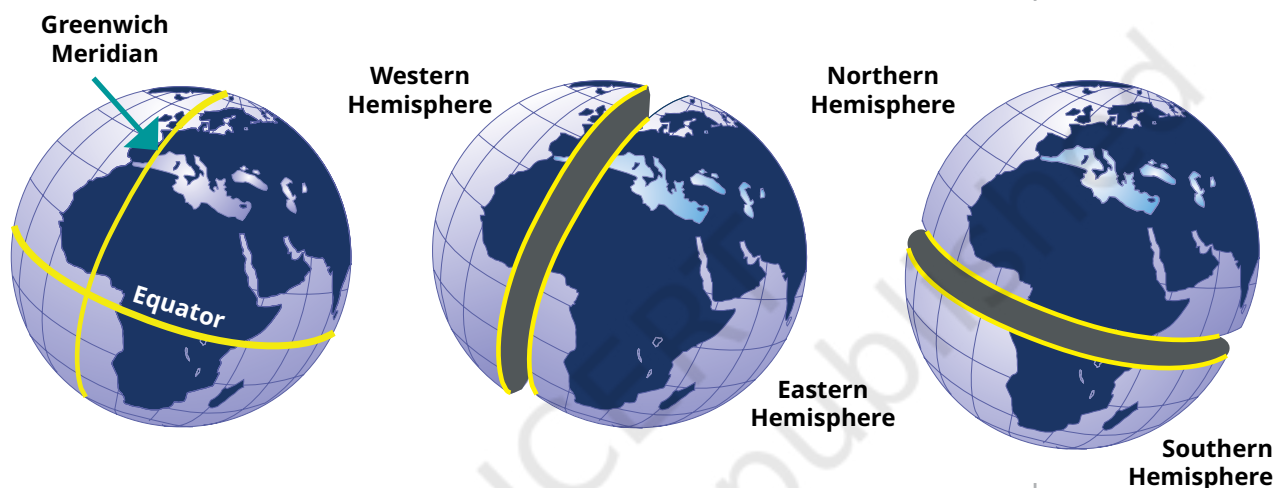


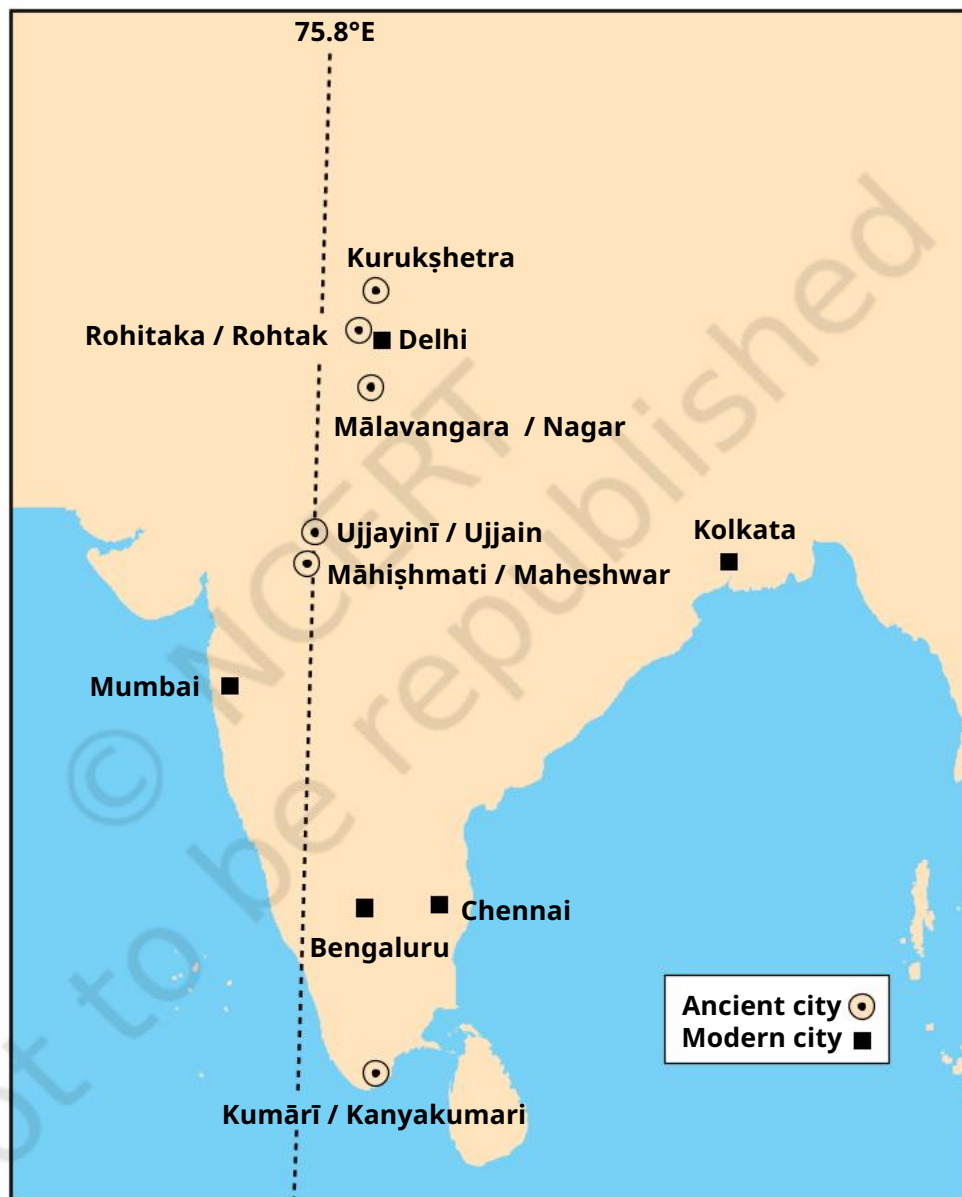
Fig. 1.4. This sketch shows how the Prime Meridian divides the Earth into the Western and Eastern Hemispheres, while the Equator divides it into the Northern and Southern Hemispheres.

DON'T MISS OUT

The Greenwich Meridian is not the first prime meridian. There were others in the past. In fact, many centuries before Europe, India had a prime meridian of its own! (Fig. 1.5) It was called *madhya rekhā* (or 'middle line') and passed through the city of Ujjayinī (today Ujjain), which was a reputed centre for astronomy over many centuries. Varāhamihira, a famous astronomer, lived and worked there some 1,500 years ago.

Indian astronomers were aware of concepts of latitude and longitude, including the need for a zero or prime meridian. The Ujjayinī meridian became a reference for calculations in all Indian astronomical texts.

The map shows a few ancient Indian cities close to the Ujjayinī meridian. Some are very close to it, while others are a little away. That is because measuring longitude required accurate timekeeping, which was not as precise then as it is today.



Not to scale

Fig. 1.5. The Ujjayinī prime meridian used in ancient Indian astronomy. Cities marked with a circle are mentioned in astronomical texts as being on this meridian (the modern name is given after the oblique bar).

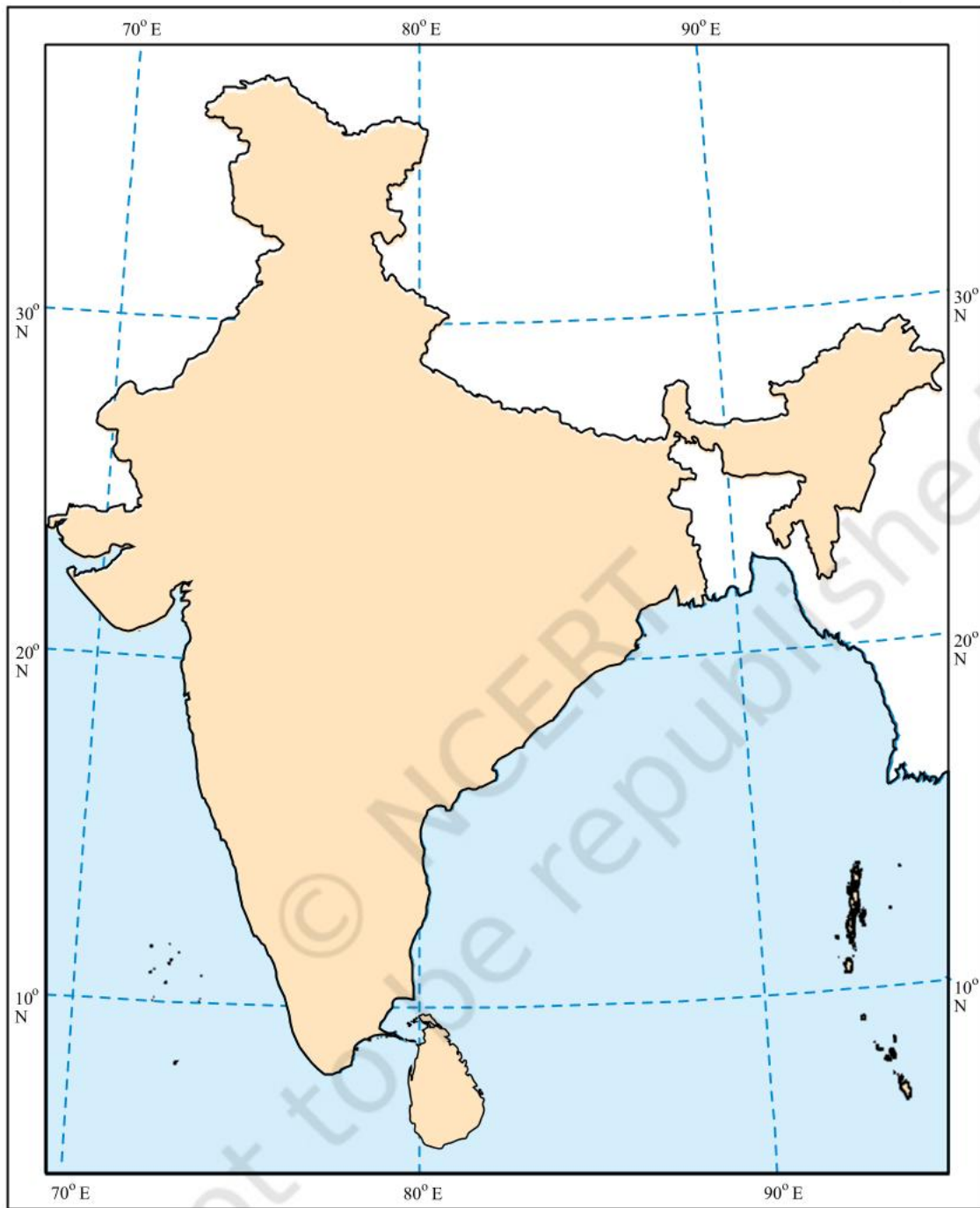


Fig. 1.6. This map, published by the Survey of India, shows the country's outline along with a few parallels of latitude and meridians of longitude. India's latitudes extend approximately from 8°N to 37°N, and longitudes approximately from 68°E to 97°E. (The two colours have been added.)

Understanding Time Zones

Let's make the globe rotate again from west to east — that is how our planet spins around its axis, making a full turn every 24 hours. A full turn is 360° , so this means 15° per hour ($15 \times 24 = 360$). Let us now mark the meridians of longitude every 15° . Moving eastward from the Prime Meridian, we get 0° , 15°E , 30°E , 45°E , and so on every 15° up to 180°E . It is the same as adding one hour of **local time** with each 15° meridian — if it is 12 pm or noon at Greenwich, it is 1 pm local time at 15°E , 2 pm at 30°E , and so on. But going westward, it is the other way round — 11 am local time at 15°W , 10 am at 30°W , etc.

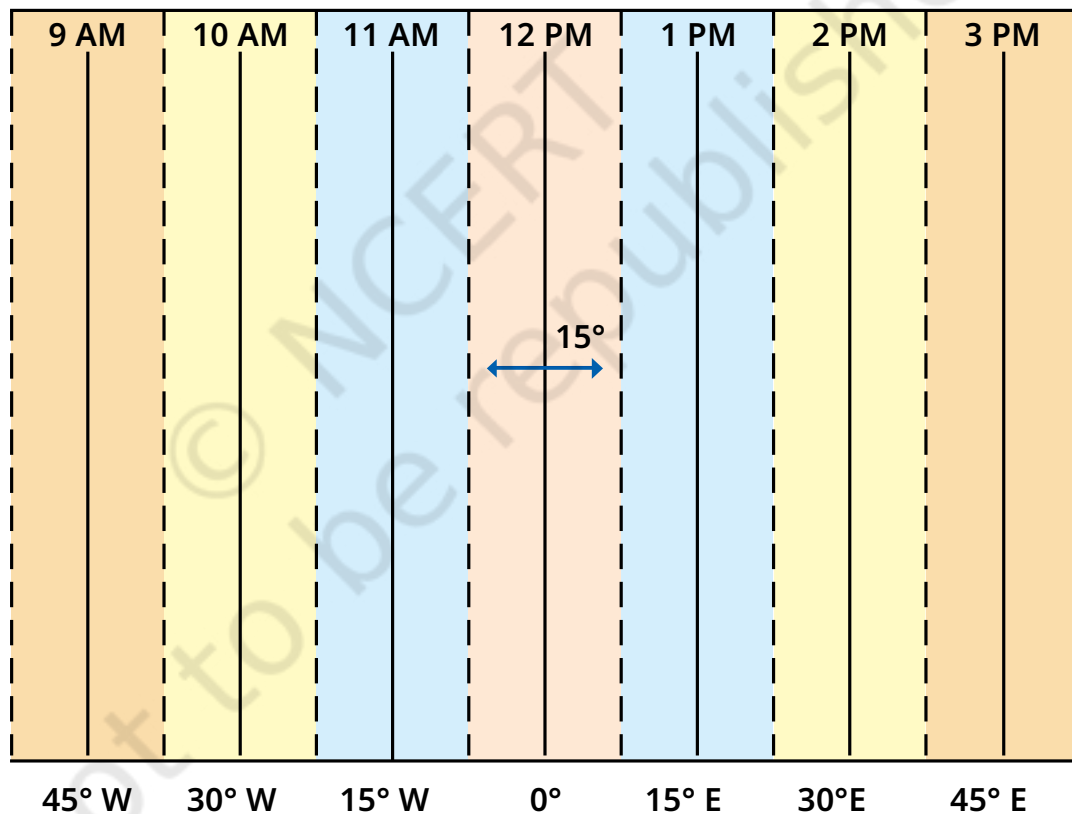


Fig. 1.7. This graph shows longitudes at the bottom and the local time at the top, with reference to the Prime Meridian at 0° . Each colour is a zone of 15° centred on a meridian.

LET'S EXPLORE

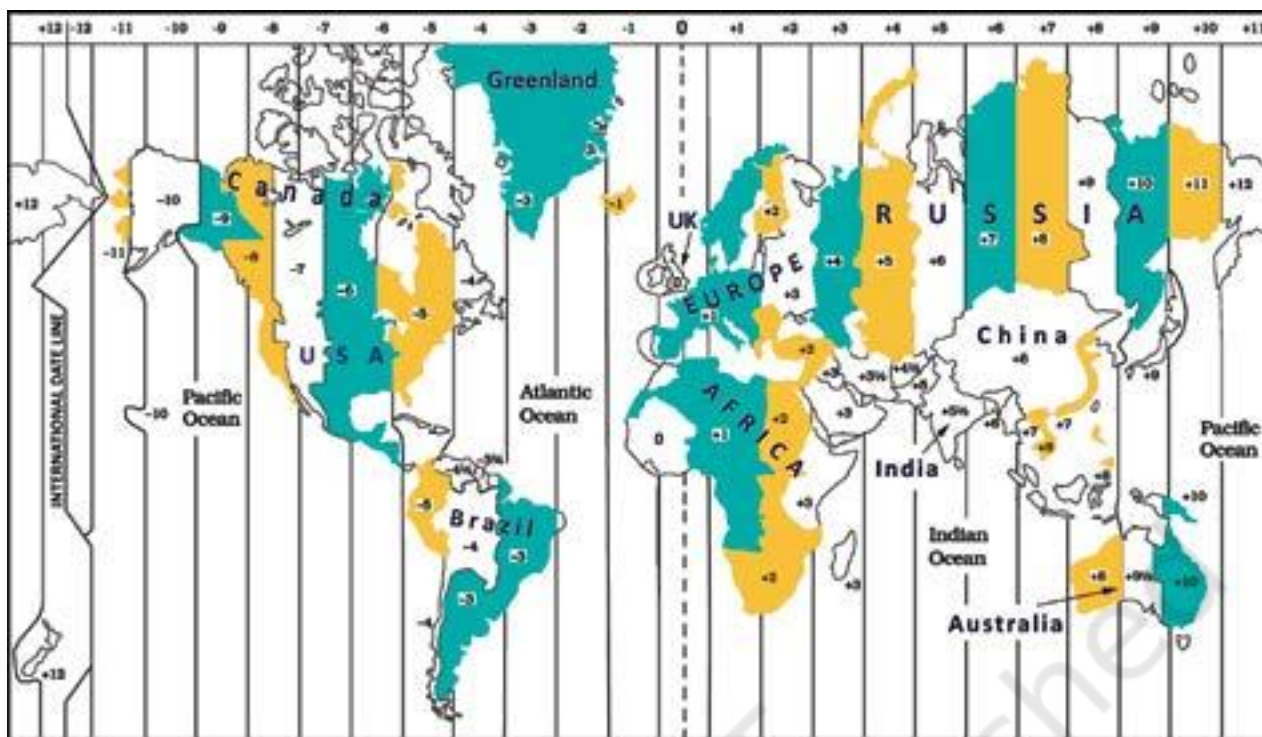
Two friends, one sitting in Porbandar (Gujarat) and the other in Tinsukia (Assam), are speaking on the phone late afternoon. The latter remarks that the sun has set in Assam and it's now dark. The former is surprised and says, "But it's still full daylight here!" Explain why. And, as a class activity, calculate the difference in local time between those two cities. (*Hint: for now, consider the difference in longitude between Porbandar and Tinsukia to be 30°; later, you can find out the precise value.*)

The same method can be used to calculate the local time of any place on the Earth. But it would not be convenient for a country to use many local times! That is why most countries adopt a **standard time** based on a meridian passing through them. Indian Standard Time (IST) is 5 hours 30 minutes (also noted 5.5 hours) ahead of the local time at Greenwich (called **Greenwich Mean Time** or GMT).

LET'S EXPLORE

Return to the two friends sitting in Gujarat and Assam. Use this example to explain the difference between local time and standard time.

All these standard times are organised in time zones, which broadly follow the zones of 15° in the graph (Fig. 1.7). But let us consider the world map below (Fig. 1.8). We can see that the lines dividing the time zones are not fully straight. This is because they have to respect each country's standard time and, therefore, tend to follow international borders. The numbers written inside some countries are the numbers of hours to be added to GMT to get their standard times if they have a positive sign, or subtracted from GMT if they have a negative sign.



Not to scale

Fig. 1.8. A world map of the time zones, showing the standard times (with respect to GMT) for a few countries. (Note that international borders are approximate, not exact.)



DON'T MISS OUT

From the above explanation, it may seem as if every country has one standard time. That is not always the case. Some countries, like Russia, Canada or the USA, are too large to have a single time zone. The USA has six time zones and Russia has 11 — which means that travelling across Russia from east to west, you will need to readjust your watch 10 times to align with the local time!

Similarly, the globe in Fig. 1.9, centred on India, shows standard times with respect to GMT for a few countries.

Finally, while the Prime Meridian was fixed at Greenwich, the opposite line — at approximately 180° longitude — is called the **International Date Line**.

As you can see on the map, the +12 and the -12 time zones touch each other at this line. If you cross it by ship or plane, you need to change the date in your watch. If you cross it



Fig. 1.9 A few time zones (with respect to GMT) in Africa and Eurasia.

travelling eastward, you subtract a day (say, from Monday to Sunday); if you cross it travelling westward, you add a day (from Sunday to Monday). We said that the International Date Line is ‘approximately’ at 180° longitude, as it deviates in places to avoid dividing some countries into two different days!

Before we move on ...

- Maps are a very useful tool to represent an area of the Earth, whether small or large. The main components of maps are distance, direction and symbols.
- Every place on the Earth has a location which can be precisely defined with the help of a grid of latitudes and longitudes — imaginary lines running from east to west (parallel to the Equator) and north to south (from pole to pole) respectively.



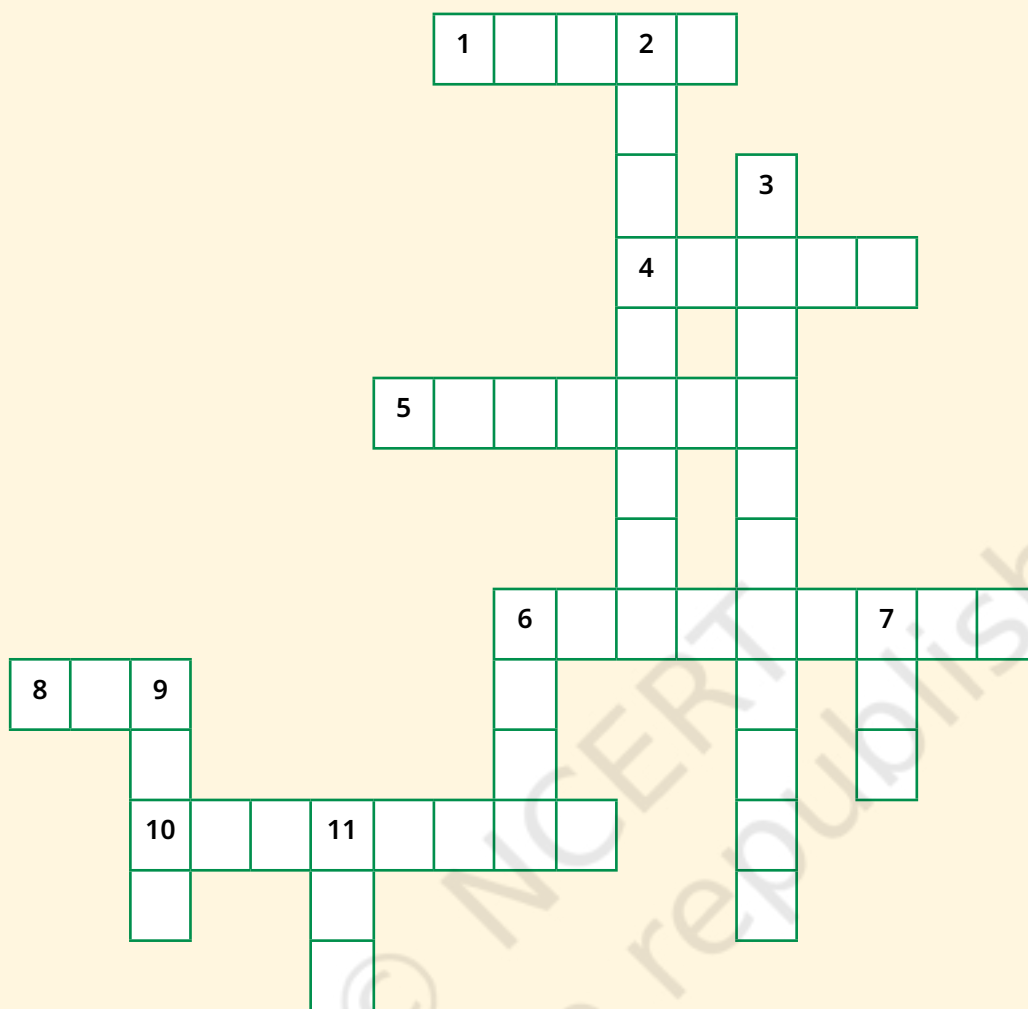
Estuary:
The place
where a
river meets
the sea.

- Longitude also marks the time and defines the time zones.
- The International Date Line is located approximately at 180 degrees longitude, opposite the Prime Meridian. Crossing the International Date Line changes the date by one day.

Questions, activities and projects

1. Returning to page 10 and to Fig. 5.2 in Chapter 5 of this textbook, taking the scale to be 2.5 cm = 500 km, calculate the real distance from the **estuary** of the Narmada River to the estuary of the Ganga river. (*Hint: round off your measurement on the map to an easy number.*)
2. Why is it 5:30 pm in India when it is 12 pm or noon in London?
3. Why do we need symbols and colours in the map?
4. Find out what you have in the eight directions from your home or school.
5. What is the difference between local time and standard time? Discuss it in groups, with each group writing an answer in 100 to 150 words. Compare the answers.
6. Delhi's and Bengaluru's latitudes are 29°N and 13°N; their longitudes are almost the same, 77°E. How much will be the difference in local time between the two cities?
7. Mark the following statements as true or false; explain your answers with a sentence or two.
 - All parallels of latitude have the same length.
 - The length of a meridian of longitude is half of that of the Equator.
 - The South Pole has a latitude of 90°S.
 - In Assam, the local time and the IST are identical.
 - Lines separating the time zones are identical with meridians of longitude.
 - The Equator is also a parallel of latitude.
8. Solve the crossword below.

Locating places on Earth



Across

1. Lets you squeeze a huge area into your map
4. A convenient sphere
5. The longest parallel of latitude
6. The place the Prime Meridian is attached to
8. So convenient to find your way
10. A measure of the distance from the Equator

Down

2. A measure of the distance from the Prime Meridian
3. These two together allow us to locate a place
6. What latitudes and longitudes together create
7. The time we all follow in India
9. On top of the world
11. An abbreviation for a line across which the day and date change

Noodles

*'Noodles' is our abbreviation for 'Notes and Doodles'!



Oceans and Continents

The ocean is everything. It covers seven-tenths of the terrestrial globe. Its breath is pure and healthy. It is an immense desert, where man is never lonely, for he feels life stirring all around. ... The ocean is the vast reservoir of Nature. The globe began with the ocean, so to speak, and who knows if it will not end with it. ...

— Jules Verne (1870)



Fig. 2.1 The Earth seen from space (photograph by the Lunar Reconnaissance Orbiter). The view is centred on the Indian Ocean, with Africa to the left, India and part of Asia at the top, Australia to the right, and Antarctica at the bottom.

The Big Questions ?

1. What are oceans and continents? What are their names and their distribution?
2. In what ways do oceans and continents impact life on Earth, including human life?



Let us return to our globe and rotate it gently. Or look at the picture of the Earth seen from the Moon. What is the most widespread colour you see? Blue, obviously, but what does it represent? You must have guessed the answer — it is ‘water’. This means that most of the Earth’s surface is actually covered with water — almost three-fourths of the surface, in fact. That is why, when seen from outer space, the Earth appears mostly blue. Indeed, early astronauts lovingly called the Earth the ‘blue planet’.

The largest water bodies we see on the globe are called ‘**oceans**’.

But in the picture of the Earth (Fig. 2.1), you can see at least one other colour, brown. This colour is that of land, which covers a little over one-fourth of the globe. A large body of land is called a ‘**landmass**’, and a large continuous expanse of land is called a ‘**continent**’.

Both oceans and continents play a vital role in shaping the climate of the Earth. They affect all aspects of life, including all plants and animals, and therefore, human life too. We see their impact throughout our history and culture, and in our daily lives.



DON'T MISS OUT



The emblem of the Indian Navy contains the motto *Sam noh Varunah* (pronounced ‘*Śham no Varuṇah*’), which means, “Be auspicious to us, O Varuna.” This is an invocation to Varuṇa, a Vedic deity associated with the oceans, the sky, and water in general.

The Distribution of Water and Land on the Earth

As it happens, oceans and continents are not distributed equally between the Northern and Southern Hemispheres.

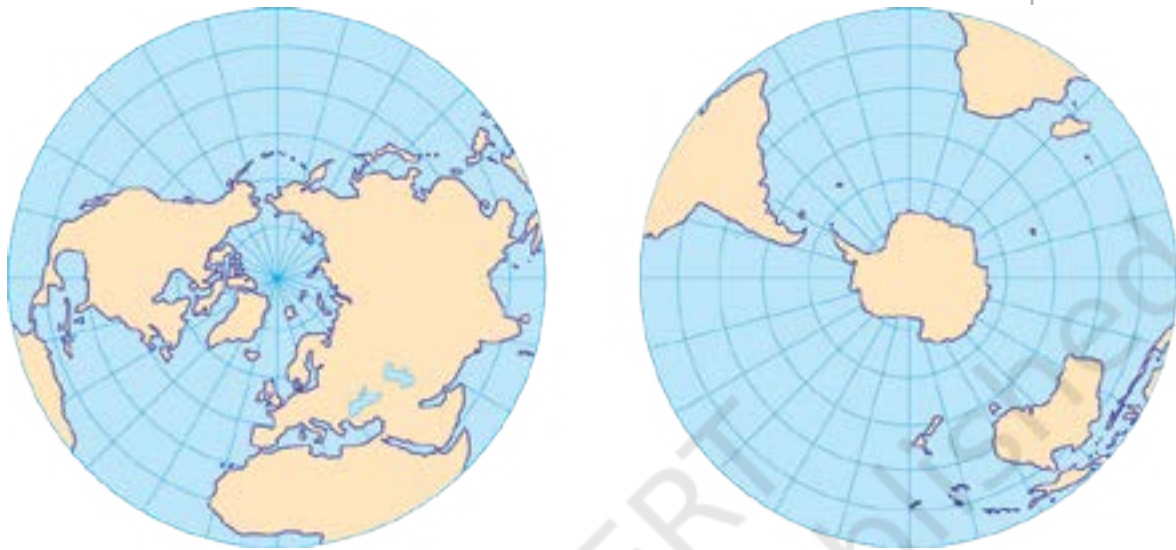


Fig. 2.2. Maps of the Earth as seen from above the North Pole (left) and above the South Pole (right).

Let us examine the two maps in Fig. 2.2. Here too, the blue areas consist of oceans, along with their smaller extensions, which have various names — ‘**sea**’, ‘**bay**’, ‘**gulf**’, etc.

LET’S EXPLORE

- What are the circular lines in each map called? And do you know what the lines radiating out of the two poles are called? (*Hint: you studied them in the previous chapter, but here they are presented differently.*)
- Which hemisphere holds more water?
- What do you think could be the approximate proportion of water to land in the Northern Hemisphere? And in the Southern Hemisphere? Discuss in groups.
- Are all the oceans connected with one another, or are there separations between them?

Definitions for these terms are in the Glossary at the end of this textbook.





Coral reef



A star fish on a sea anemone



Shark



Sperm whale, mother and baby



Dolphins



Shallow coral reef with colourful tropical fish



Algae



Emperor penguins



Bonaire sea turtle

The oceans together hold most of the water available on the planet. But this seawater is salty and unfit for consumption by most land animals, including humans. On the other hand, freshwater makes up a very small proportion of the planet's water resources; it is found in glaciers, rivers, lakes, in the atmosphere and also underground (the last is called 'groundwater').



THINK ABOUT IT

- ◇ If there is such abundance of water on the planet, why is there so much talk of 'water scarcity' or a 'water crisis'?
- ◇ What ways of saving water are you aware of? Which ones have you seen practised at home, at your school, and in your village, town or city?

Oceans

On the world map in Fig. 2.3 on page 32, we can observe five oceans — the Pacific Ocean, the Atlantic Ocean, the Indian Ocean, the Arctic Ocean and the Southern (or Antarctic) Ocean.

Although we have listed five oceans, it is clear from the map that they are not really separate. The lines that divide them on the map are no more than conventions — the natural world does not follow such boundaries. Seawater, for example, constantly flows across different oceans, sustaining a rich diversity of **marine** life. Many plant and animal species can be found across multiple oceans.

The marine **flora** includes tiny plants called algae and all kinds of seaweeds; the marine **fauna** consists of thousands of species of colourful fish, dolphins, whales, and countless mysterious deep-sea creatures. Each part of the ocean, from the sun-lit surface to the dark depths, has its own diverse life forms.

Marine:
Related to or found in the oceans and seas.

Flora:
The plant life of a particular region or period of time.

Fauna:
The animal life of a particular region or period of time.



Not to scale

Fig. 2.3. A world map showing the five oceans, their conventional boundaries, and the continents

LET'S EXPLORE



Locate the five oceans and, in the table below, mark the hemisphere or hemispheres they belong to.

	Northern Hemisphere	Southern Hemisphere
Pacific Ocean		
Atlantic Ocean		
Indian Ocean		
Southern Ocean		
Arctic Ocean		

It is visible on the map that the Pacific Ocean is the largest of all, followed by the Atlantic Ocean. The Indian Ocean is the third largest, while the Southern Ocean is the fourth. The smallest one is the Arctic Ocean.



DON'T MISS OUT

- ◇ As the map of oceans makes clear, the main limits of the Indian Ocean are Asia to the north, Africa to the west and Australia to the east, apart from the Southern Ocean in the south.
- ◇ On either side of India, we find two parts of the Indian Ocean — the Arabian Sea to the west and the Bay of Bengal to the east.

Fig. 2.4 (on the right). This map of India is the same as Fig. 1.6, but with the addition of the Arabian Sea and the Bay of Bengal. Also marked are India's two major groups of islands (see subsection on 'Islands' further below).

Oceans and disasters

Returning to the picture of the Earth at the start of this chapter, you may have noticed white shapes across the globe. Did you guess what they are? They are large masses of clouds. Such clouds bring rain to the continents; for instance, the monsoon rains we in India expect every summer originate in the ocean — without

such rains, our agriculture and all life will suffer. But oceans often also give rise to storms — violent events with extreme rainfall or very strong winds, such as cyclones, which can cause widespread damage to coastal regions of the world.

A tsunami is another natural disaster that originates in the ocean. It is a huge and powerful wave generally caused by a strong earthquake or a volcanic eruption at the bottom of the ocean. Tsunamis can travel thousands of kilometres and submerge coastal areas, causing widespread damage.



Not to scale

**DON'T MISS OUT**

- ◇ On 26 December 2004, India and another 13 countries around the Indian Ocean were struck by a powerful tsunami caused by an earthquake in Indonesia. More than two lakh people lost their lives. In India, the Andaman and Nicobar Islands (see Fig. 2.4) and the coasts of Tamil Nadu and Kerala were severely affected and suffered much damage and loss of life.
- ◇ Such tsunamis are rare but very destructive. Luckily, they can often be detected before they hit a coast. Many countries collaborate in such 'early warning systems'. There is, in particular, an Indian Ocean Tsunami Warning System, to which many countries, including India, contribute. This helps to take measures to protect lives and property.
- ◇ Events that lead to loss of life and property are handled under **disaster management**. India has its own 'National Disaster Management Authority' to deal with all kinds of disasters (we will see more examples in the next chapter).

Continents

Continents are visible on the map (Fig. 2.3). How many can you count? The answer is not so simple, as they can be counted in several ways. Depending on our choice, we may list any number of continents between four and seven! Here is why:

- North America and South America are generally considered to be two continents; but if seen as a single landmass, they can also be considered as one.
- Europe and Asia are generally considered as two continents, although the map makes it clear that they form a single landmass. For historical and cultural reasons, Europe's evolution has been very different

from Asia's, which is why they can be seen as two continents. Geologists, however, often regard them as a single continent called 'Eurasia'.

- Africa and Eurasia are generally regarded as two continents, but sometimes as one.

Let us summarise the different counts in a table:

Count of continents (in alphabetical order)	
Four continents	Africa-Eurasia, America, Antarctica, Australia
Five continents	Africa, America, Antarctica, Australia, Eurasia
Six continents	Africa, Antarctica, Australia, Eurasia, North America, South America
Seven continents	Africa, Antarctica, Asia, Australia, Europe, North America, South America (<i>this is reflected in Fig. 2.3 on page 32</i>)

In practice, the last list of seven continents is the one most widely adopted and used.

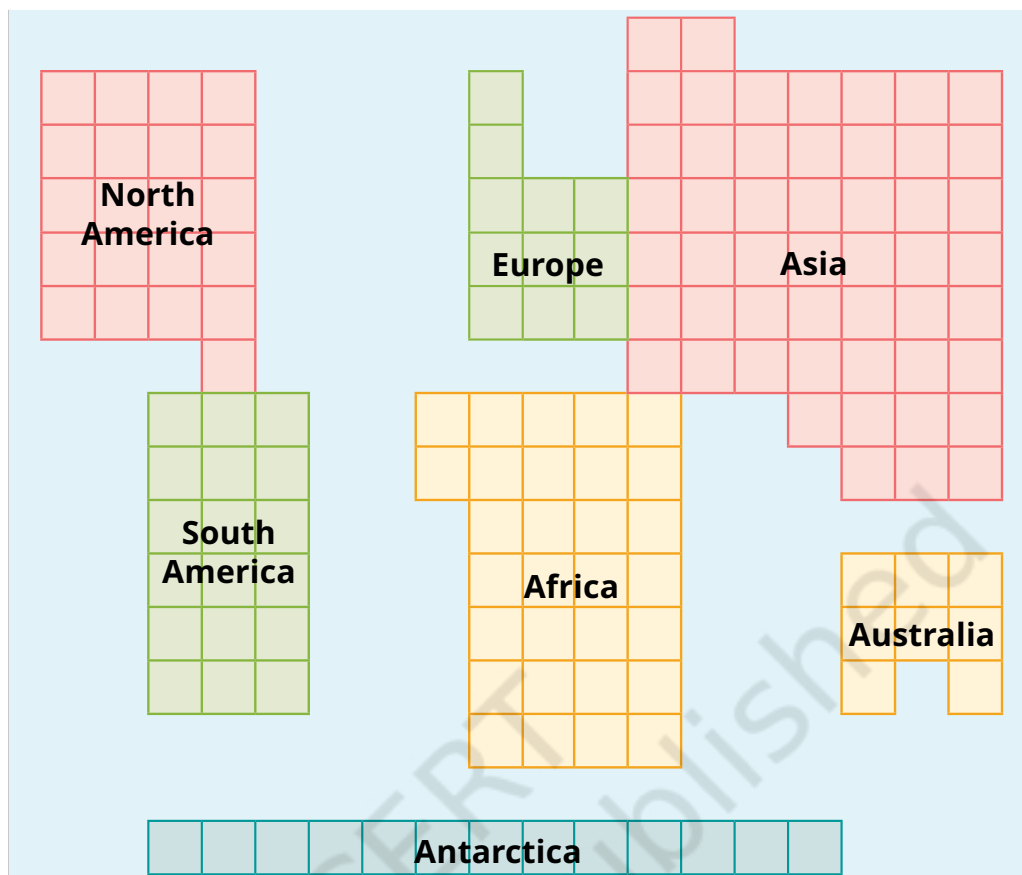


DON'T MISS OUT

You may have seen the five Olympic rings, one of the symbols of the Olympic Games. They symbolise the gathering of sportspeople from all over the world. The rings were chosen to represent five inhabited continents — Africa, America, Asia, Australia and Europe.



Now let us look at the diagram on page 36, which is based on the list of seven continents. It does not show their actual shapes, but their relative sizes.



LET'S EXPLORE

- Counting the numbers of squares, name the largest continent and the smallest.
- Which one is larger — North America or South America? Africa or North America? Antarctica or Australia?
- Re-colour the diagram by having a single colour for Europe and Asia and rename the result as 'Eurasia'. Compare its size with South America's.
- Write down the list of continents from the smallest to the largest.

Islands

If you have carefully observed the two maps earlier in this chapter (Fig. 2.2 and 2.3), you may have noticed that

the continents do not include all landmass. Some smaller pieces of land are left out; surrounded by water on all sides, they are called **islands**. (Continents are also surrounded by water, but because they are so large, they are not considered islands.)

There are lakhs of islands on the planet, of very different sizes.



DON'T MISS OUT

- ❖ Greenland is the largest island in the world (locate it on a globe or a map). You would have to add the areas of the 10 largest states of India to reach its size.
- ❖ India has more than 1,300 small islands! Those include two major groups — Andaman and Nicobar Islands in the Bay of Bengal and Lakshadweep Islands in the Arabian Sea (see Fig. 2.4).
- ❖ Since 1981, the Indian Antarctica Programme has been exploring Antarctica, a continent with a very cold climate and harsh environment (see the white expanse at the bottom of Fig. 2.1, which is mostly ice). In 1983, India established its first scientific base station there, called 'Dakshin Gangotri' (two more bases were established later). About 40 teams of Indian scientists have conducted research in this faraway region, especially on the evolution of climate and environment. The settlement where the scientists live has a library and even a post office!

Oceans and Life

Oceans and continents are vital parts of the environment and affect most aspects of our lives, even if we do not notice it. We have mentioned that oceans send rain to the continents; this is part of the Earth's water cycle, which you will further study in Science. Without oceans, for

instance, there would be no rainfall! The Earth would be a desert. Moreover, more than half of the world's oxygen is produced by the oceans' flora, which is why they are called 'the planet's lungs'. The oceans, therefore, play a crucial role in regulating the climate and sustaining life on Earth.

Oceans have deeply impacted humanity in many other ways. From early times, people have used oceans and seas to migrate to other regions, to trade in all kinds of goods, to conduct military campaigns, and as a source of food through fishing. Oceans have also nourished the cultures of coastal people all over the world. Almost all of them have tales and legends about the sea, sea gods and goddesses, sea monsters and treasures from the sea — the oceans' dangers but also their blessings.



DON'T MISS OUT

The United Nations has designated June 8 as World Oceans Day to “remind us all of the major role the ocean plays in everyday life. It serves as the lungs of our planet, a major source of food and medicine and a critical part of the biosphere.” Scientific studies have shown how the oceans are polluted by human activity — we throw several million tonnes of plastic waste into the oceans every year, choking marine life. There are several other forms of pollution. As a result, the marine environment is under threat. Overfishing (excessive fishing) is another cause for the decline of marine life. It is our collective responsibility to protect oceans for the future of the planet and of humanity.



Before we move on ...

- The Earth's surface has vast water bodies called 'oceans' and large landmasses called 'continents'. Oceans are interconnected. Continents may be counted in various ways; the most common count is seven.
- The Northern Hemisphere has more land than the Southern Hemisphere.

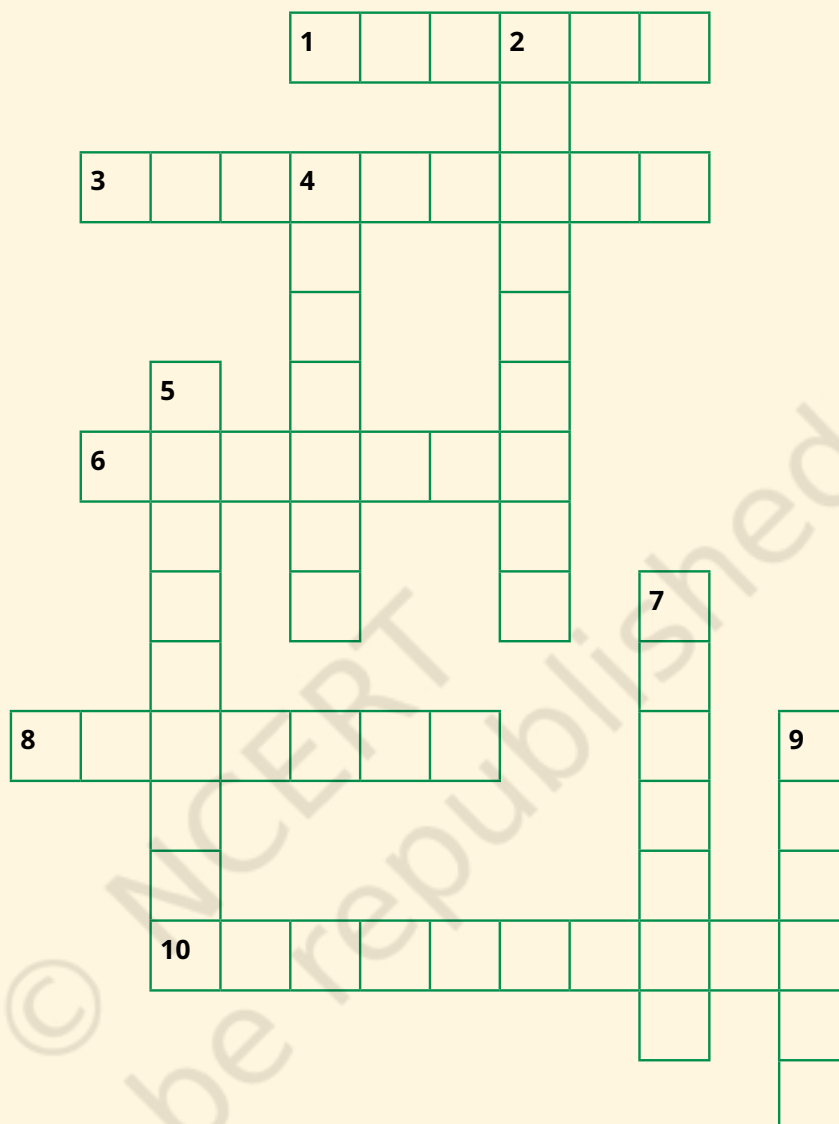
- Oceans support all kinds of marine life and play a critical role in the world climate. They are now seriously affected by human activity and need our collective protection.

Questions, activities and projects

1. Explain the following terms:
 - (a) Continent
 - (b) Ocean
 - (c) Island
2. Let us draw – Without looking at the maps in this chapter, draw the continents free hand on a sheet of paper and colour them. Then compare your drawing with the map of oceans and continents in the chapter.
3. Let us do – On the outline map of the world given below, label all the continents and oceans.



4. Solve this crossword

**Across**

1. Abundantly produced by the oceans
3. A large expanse of landmass
6. A large continent of which India is a part
8. A major source of pollution of the oceans
10. The coldest continent

Down

2. The largest island on Earth
4. A huge destructive wave from the ocean
5. The smallest continent
7. The largest body of water on the Earth
9. A landmass (but not a continent) surrounded by the sea or ocean

Landforms and Life

Free from the burden of human beings, may the Earth with many heights, slopes and great plains, bearing plants endowed with varied powers, spread out for us and show us her riches! ... The Earth is my mother and I am her child.

— Atharva Veda, Bhūmi Sūkta ('Hymn to the Earth')



The Big Questions ?

1. What are the major types of landforms and their significance to life and culture?
2. What are the challenges and opportunities of life associated with each landform?



Introduction

Humans, like most mammals, live on land. Land, as you may have noticed, has many forms and features; its appearance changes a lot from one region to another. Suppose that you are travelling by road from the region known as Chhota Nagpur in Jharkhand, reach Prayagraj in Uttar Pradesh, and go on to Almora in Uttarakhand. On the way, you will see very different landscapes. In fact, you will encounter three major landforms, which we will now explore.

LET'S EXPLORE

- As a class activity, form groups of four or five students and observe the school's surroundings. What kind of landscape do you see? Will the landscape change a few kilometres away? Or within some 50 kilometres? Compare with other groups.
- In the same groups, discuss a journey that any of you has made through a region of India. List the different landscapes seen on the way. Compare with other groups.

Altitude:
The height of an object above sea level.
Examples: the altitude of a mountain, the altitude of a bird or plane in flight, the altitude of a satellite.

A landform is a physical feature on the surface of our planet Earth. Landforms take shape over millions of years and have a significant connection with the environment and life. They can broadly be divided into three categories — **mountains, plateaus and plains** (Fig. 3.1).

These landforms have different climates and are home to a variety of flora and fauna. Humans have adapted to all landforms, but the number of people living on different kinds of landforms varies throughout the world.

Mountains

Mountains are landforms that are much higher than the surrounding landscape. They can be recognised by a broad base, steep slopes and a narrow summit. Depending on their height, some mountains are covered with snow. At lower **altitudes**, the snow melts every summer and turns



Fig. 3.1. This drawing illustrates three landforms — mountains in the background (two of them snow-capped), a plateau on the left and a plain in the foreground, with a river emerging from the mountains.

into water that feeds rivers. At high altitudes, the snow may never melt, leaving the mountain permanently snow-capped.

Other highlands with a lower height, less steep slopes and rounded tops are called **hills**.

Precipitation:

Water from the atmosphere reaching the ground in any form — rain, snow and hail are the most common forms of precipitation.



THINK ABOUT IT

What is snow? Unless you live in a Himalayan region (such as Kashmir, Ladakh, Himachal Pradesh, Uttarakhand, Sikkim, Arunachal Pradesh), you may never have seen snow! In the rest of India, most **precipitation** is in the form of rain and hail. But at higher altitudes, if it is cold enough, snow will fall, covering the landscape in a soft and beautiful white blanket. Snow and hailstones are nothing but precipitation of water in a solid state.



Mount Everest



Mount Aconcagua



Mount Kilimanjaro



Mont Blanc



Mount Kanchenjunga



Mount Anamudi

Fig. 3.2. Pictures of six mountains of the world

Most of the world's mountains are grouped in **mountain ranges**, such as the Himalayas in Asia, the Alps in Europe and the Andes in South America. Some of these ranges stretch for thousands of kilometres.



Fig. 3.3. A sketch showing the relative heights of six mountains of the world

Fig. 3.2 shows pictures of six mountains of the world. Fig. 3.3 brings them together to give a visual impression of their relative heights from top to bottom. Mount Everest (between Tibet (China) and Nepal) and Kanchenjunga (between Nepal and the Indian state of Sikkim) are the two highest peaks of the Himalayan range. Mount Aconcagua (in South America) is the highest peak of the Andes. Mount Kilimanjaro in eastern Africa is an isolated mountain that is not part of any range. Mont Blanc in Western Europe is the highest mountain of the Alps. Anamudi (in Kerala, also known as 'Anai Peak') is the highest mountain in south India.

Montane forest:

A type of forests that grows in mountainous regions.

Moss:

A small green plant without flowers or true roots, often spreading in a cushion-like cover.

Lichen:

A plant-like organism that generally clings to rocks, walls or tree.

Mountains with tall and sharp peaks, like the Himalayas, are relatively ‘young’, which means that they were formed recently in the Earth’s history — but that is still millions of years ago! Shorter and more rounded mountains and hills, like the Aravalli Range, are much older and have been rounded by erosion. Sometimes, as with the Himalayas, upliftment as well as erosion continue to this day. (You will learn more in Science about such processes and their causes; let us just say here that some mountains of the world, like the Himalayas, are still growing in height.)

Mountain environment

Mountain slopes are often covered with a type of forest called **montane forest**, where conifer trees such as pines, firs, spruce and deodar are common. These conifer trees grow tall and cone-shaped, with thin, pointed leaves. At higher altitudes, the trees give way to grasses, **mosses** and **lichen**.

Here are two verses from a long poem by Kālidāsa, who lived at least 1,500 years ago and is often considered to be the greatest poet of ancient India. The poem, *Kumārasambhava*, begins with an invocation to the Himalayas. (This is a simplified translation from the Sanskrit.)

In the north rises Himālaya, the Lord of mountains, like a living god, who measures the Earth and stretches from the western to the eastern oceans. ...

From it the wind comes down, carrying spray from descending Gangā, shaking the deodar trees, opening the peacocks’ tail feathers and cooling the mountain people after they hunt deer.

Discuss the verses and the following questions in class.

- What are the ‘western to the eastern oceans’? Can you locate them as well as the ‘Lord of mountains’ on Fig. 5.2?
- Why is Gangā mentioned? (*Hint: There could be several reasons.*)



Peregrine falcon



Himalayan tahr



Mountain hare



Golden eagle



Canadian lynx



Yak



Ibex



Grey fox



Leopard



Black bear

Fig. 3.4. A few mountain animals

Deep forests, flowing rivers, lakes, grasslands and caves in the mountains are home to diverse fauna, for instance, the golden eagle, the peregrine falcon, the Canadian lynx, the snow leopard, the ibex, the Himalayan tahr, the mountain hare, the yak, the grey fox and the black bear (Fig. 3.4).



DON'T MISS OUT

The Ganga is the largest river originating from the Himalayas. Nearly 2,500 km long, this river has numerous tributaries (that is, other rivers joining it). Some of them, like the Yamuna and the Ghagara, also originate in the Himalayas. Others, like the Son or Sone, originate from the Vindhya Range to the south of the Ganga plain.



Fig. 3.5. Terrace farming in north India

Terrain:
A piece or stretch of land, from the point of view of its physical features.

Life in the mountains

The mountain **terrain** is usually rugged or rough, and has steep slopes. This means that regular farming can only be practised in some **valleys**. Cultivation is practised on the

slopes by cutting steps into the slope (Fig. 3.5). This is called terrace farming. In many mountainous regions of the world, herding is the preferred occupation over agriculture.

Tourism is often an important source of income for the people living in the mountains. The crisp mountain air and scenic beauty attract many tourists. Some tourists also go to the mountains for sports such as skiing, hiking, mountaineering and paragliding. For many centuries, people have also travelled to these uplands for pilgrimages to holy sites. But an excessive inflow of visitors can also put the fragile mountain environment under pressure; it is often difficult to find the right balance.

Valley:

A lower area between hills or mountains, often with a river or stream flowing through it.

**DON'T MISS OUT**

- ❖ **Bachendri Pal** started climbing mountains from a young age and led many women's climbing expeditions. She was the first Indian woman to climb Mount Everest in 1984 and was awarded Padma Shri the same year (and Padma Bhushan in 2019).
- ❖ **Arunima Sinha** lost a leg in an accident when she was 22. With Bachendri Pal's encouragement and training, she managed to climb Mount Everest in 2013, and went on to climb the highest peak of every continent, including Mount Vinson in Antarctica! She was awarded Padma Shri in 2015.

LET'S EXPLORE

These images (Fig. 3.6 on page 50) depict a few challenges that people living in the mountains may face. Discuss them in groups in the class and write one paragraph on each. Also discuss why, despite many such challenges, people still choose to live in the mountains.



Flash flood:

A sudden local flood, often caused by a cloudburst.

Landslide:

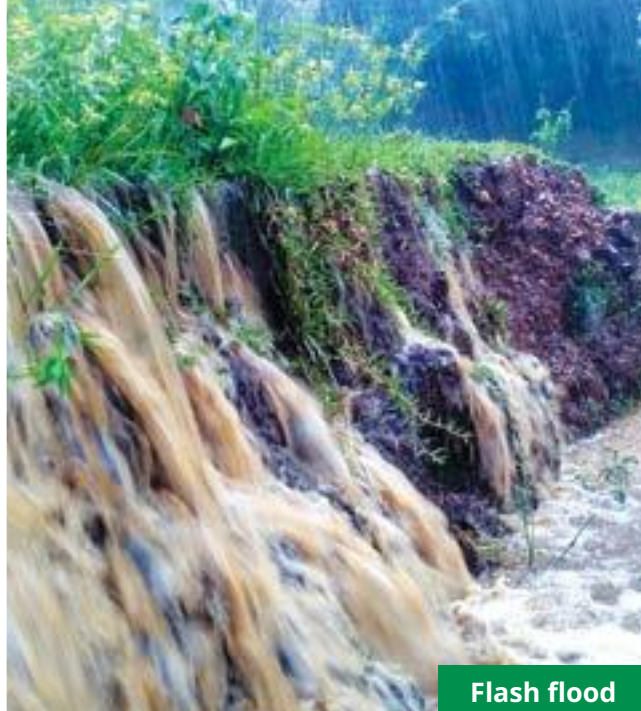
The sudden collapse of a mass of earth or rock from a mountainside.

Avalanche:

The sudden fall of snow, ice or rocks from a mountainside; often occurs when the snow starts melting.

Cloudburst:

A sudden violent rainstorm.



Flash flood



Landslide



Avalanche



Uncontrolled tourism



Cloudburst



Heavy snowfall



Cold weather

Fig. 3.6. Life in the mountains has definite positives, from pure air to the beautiful scenery. It also involves potential challenges, both natural and human-made, some of which are depicted in these pictures.



DON'T MISS OUT

Many traditional communities around the world consider mountains to be sacred places and worship them. Mount Everest, the highest mountain in the world at 8,848 m, has many names. Tibetans call it 'Chomolungma', which means 'Mother Goddess of the World' and worship the mountain as such. Nepalis call it 'Sagarmatha', meaning 'Goddess of the Sky'. Similarly, Mount Kailash in Tibet is held sacred by followers of Hinduism, Buddhism, Jainism and Bon (an ancient Tibetan religion). Such reverence for mountain summits is also found elsewhere in India, as well as in other parts of the world.

Plateaus

A plateau is a landform that rises up from the surrounding land and has a more or less flat surface; some of its sides are often steep slopes. Like mountains, plateaus can be young or old in terms of the Earth's history. Two examples of plateaus are the Tibetan Plateau, the largest and highest plateau in the world, and the Deccan Plateau. The height of plateaus can vary from a few hundred metres to several thousand metres.



DON'T MISS OUT

- ❖ The Tibetan Plateau has an average altitude of 4,500 m, which explains why it has been nicknamed the 'Roof of the World'! From east to west, it is nearly 2,500 km long — the distance from Chandigarh to Kanyakumari.
- ❖ The Deccan Plateau of central and south India is one of the oldest plateaus in the world, formed through volcanic activity millions of years ago.

Like mountains, plateaus are rich in mineral deposits; they have been called 'storehouses of minerals'. As a result, mining is a major activity on plateaus, where many of the world's largest mines are found. For example, the East

African Plateau is famous for gold and diamond mining. In India, huge reserves of iron, coal and manganese are found in the Chhota Nagpur Plateau.

The plateau environment is very diverse across the world. Many plateaus have a rocky soil, which makes them less fertile than plains (see next section) and therefore less favourable to farming. An exception is that of lava plateaus (that is, formed through volcanic activity), as they often have a rich black soil.

Plateaus are also home to many spectacular waterfalls. The Victoria Falls on the Zambezi River in southern Africa, the Hundru Falls on the Subarnarekha River in the Chhota Nagpur Plateau and the Jog Falls on the Sharavati River in the Western Ghats are a few such waterfalls. The Nohkalikai Falls (Fig. 3.7) drop down 340 metres from the Cherrapunji Plateau (in Meghalaya).



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Fig. 3.7. The Nohkalikai Falls emerging from the Cherrapunji Plateau

Plains

Plains are landforms that have an extensive flat or gently undulating surface. They do not have any large hills or deep valleys. They are generally not more than 300 metres above **sea level**.

Floodplains are one type of plains formed by rivers originating in mountain ranges, where they collect particles of rock, sand and silt called 'sediments'. These sediments are carried all the way to the plains, where the rivers deposit them, making the soil very fertile. As a result, these plains are ideal for growing crops of all kinds, and agriculture is a major economic occupation in this landform. Plains also support a variety of flora and fauna.

Sea level:
The average level of the surface of the oceans, also called 'mean sea level'.



Fig. 3.8. This world map shows a few major mountain ranges, plateaus and plains.

LET'S EXPLORE

Use the colour code in Fig. 3.8 to add a landform to each name. For instance, 'Tibetan plateau', 'Rocky range', 'Nile plain'. (You do not have to remember the names in this map.)



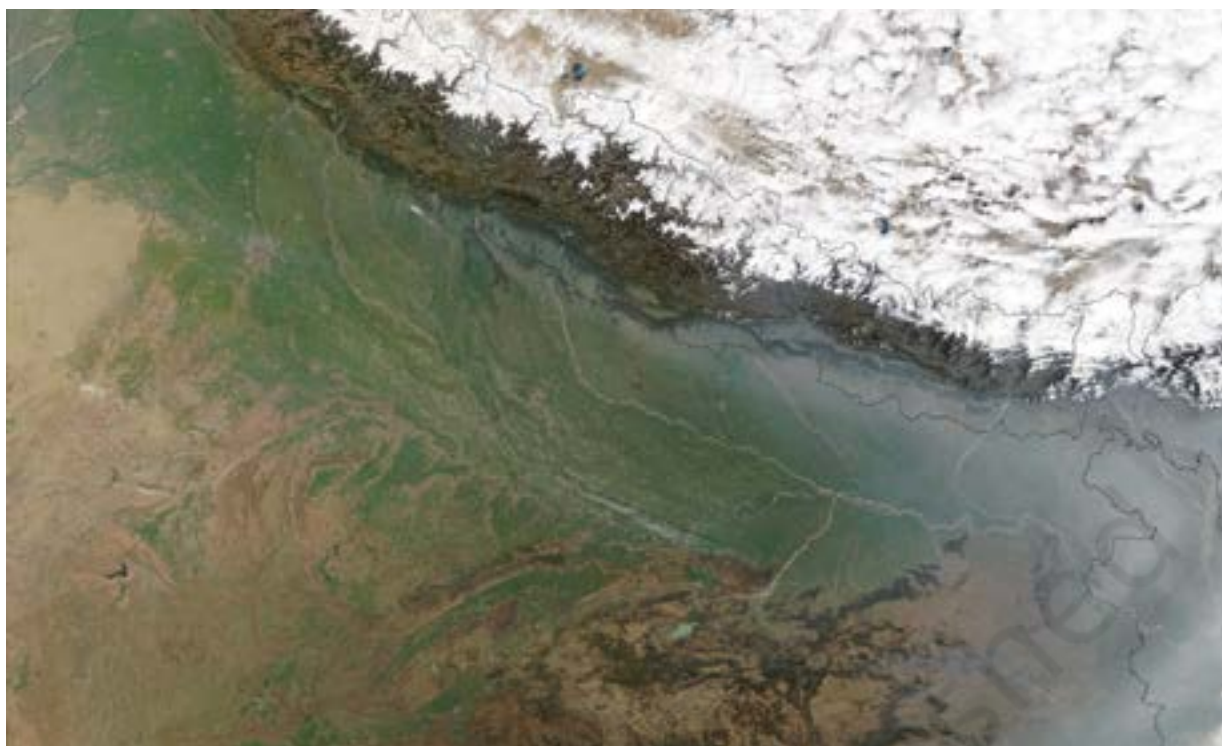


Fig. 3.9. A satellite view of the Ganga plain

LET'S EXPLORE



The picture in Fig. 3.9 has been taken from a satellite. It captures a portion of north India from a high altitude. Observe and discuss the image as a class activity.

- Which colour is the Ganga plain?
- What does the white expanse represent?
- What does the brown expanse at the bottom left of the image represent?

Life in the plains

Thousands of years ago, the first civilisations developed around rivers in fertile plains. In our times too, a large part of the world's population lives in plains.

About 40 crore people, more than one-fourth of the total Indian population, live in India's Ganga plain (often called the 'Gangetic plain'). As with many other plains of the

world, the major occupations of people in this region include river fishing and agriculture. Food crops such as rice, wheat, maize, barley and millets are grown. Fibre crops such as cotton, jute and hemp are also grown in the Ganga plain. Traditional agriculture has been mostly rainfed (that is, watered through rainfall). In recent decades, however, agriculture has turned to irrigation, with water brought to the fields through networks of canals or pumped from groundwater. While irrigation has increased agricultural production, it has also contributed to the depletion (or decrease) of groundwater. This presents a challenge for the future of agriculture in the region. Some of the other problems affecting the Ganga plains include high population and pollution.

Whether in mountain ranges or plains, rivers around the world have carried immense cultural value. In particular, many communities have considered a river's source and its **confluence** with one or two other rivers to be sacred. In India, numerous festivals, ceremonies and rituals are conducted at such locations.

Because plains have a gentle slope, river navigation is easy and supports a lot of economic activities. In earlier days, people also used rivers extensively to travel from one place to another. Even today (Fig. 3.10 on page 56), there are stretches along the Ganga where people prefer to use boats to move around!

LET'S EXPLORE

- Can you give examples of river sources or confluences from your region that are regarded sacred by any community?
- Visit a nearby river and observe all activities there, whether economic or cultural. Note them down and discuss with your classmates.

Confluence:
The meeting point of two or more rivers.



→ Name some popular tourist destinations in India and identify the category of landform they are associated with.



Fig. 3.10. River transportation on the Ganga

Resilience:
The capacity to meet challenges and difficulties, adapt to them or overcome them.

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India and the World: Land and the People

In this chapter, we explored the three main landforms. But its surface is very complex and experts often define a few more landforms. One such landform is the desert. Deserts are considered to be large and dry expanses with very little precipitation. Their flora and fauna are also unique. Some deserts are hot, like the Sahara Desert in Africa or the Thar Desert in the northwest of the Indian Subcontinent. Others are cold, like the Gobi Desert in Asia. (Some experts also describe the Antarctica continent as a desert.)

Despite harsh living conditions, humans have adapted to most of the deserts. In India, communities living in the Thar Desert, or migrating through it, hold rich cultural traditions, such as folk songs and legends, related to the desert.

The diverse ways in which humans have made all landforms their home is a testimony to our adaptability and **resilience**.

The five *tiṇais* of ancient Tamil Sangam poetry are five landscapes associated with certain specific deities, lifestyles, moods or emotions (such as love, longing, separation, quarrel, etc.). This table only lists the characteristics of the five landscapes and the main human occupations in each:

<i>Tiṇai</i>	Landscape	Main occupation
<i>Kuriṇṇi</i>	mountainous regions	hunting and gathering
<i>Mullai</i>	grassland and forests	cattle rearing
<i>Marudam</i>	fertile agricultural plains	farming
<i>Neydal</i>	coastal regions	fishing and seafaring
<i>Pālai</i>	arid, desert-like regions	journeying and fighting

These five *tiṇais* constitute a different classification of landforms than the one we have seen, but they reflect a keen awareness of the diverse regions and their characteristics. They also illustrate the deep connection between humanity and the natural environment. *(You do not need to remember the details of the tiṇais, but the concepts they reflect need to be understood.)*

Before we move on ...

- Landforms are classified into three main types — mountains, plateaus and plains. They have very different physical characteristics and environments.
- Throughout history, people's lives and activities have been much impacted by the type of landform they have lived in. These landforms are an integral part of culture across the world. Indian culture, in particular, has celebrated them in diverse ways.
- Each landform offers different challenges as well as opportunities.



Questions, activities and projects

1. In what type of landform is your town / village / city located? Which features mentioned in this chapter do you see around you?
2. Let us go back to our initial trip from Chhota Nagpur to Prayagraj and Almora. Describe the three landforms you came across on the way.
3. List a few famous pilgrimage spots in India along with the landforms in which they are found.
4. State whether true or false —
 - The Himalayas are young mountains with rounded tops.
 - Plateaus usually rise sharply at least on one side.
 - Mountains and hills belong to the same type of landform.
 - Mountains, plateaus and rivers in India have the same types of flora and fauna.
 - Ganga is a tributary to the Yamuna.
 - Deserts have unique flora and fauna.
 - Melting snow feeds rivers.
 - Sediments from rivers deposited in the plains makes the land fertile.
 - All deserts are hot.
5. Match words in pairs:

Mount Everest	Africa
rafting	roof of the world
camels	rice fields
plateau	desert
Ganga plains	river
waterway	Ganga
Mount Kilimanjaro	tributary
Yamuna	climbing

Geographical Diversity of India

CHAPTER

1

To us, by its very geography, the country [India] appears to be quite distinct from other countries, and that itself gives it a certain national character.

— Sri Aurobindo

Fig. 1.1. Jog Falls in Karnataka. Notice the plateau and the waterfalls. The power of the waterfall is converted into electricity (hydroelectricity; 'hydro' means water) through special turbines.



The Big Questions ?

1. What are some key geographical features of India?
2. How does India's geographical diversity affect our lives?



In 1984, Rakesh Sharma, the first Indian astronaut to go into space, spoke with the then Prime Minister of India, Indira Gandhi. When she asked him, “How does India look from space?”, he replied, “*Sāre jahān se achchha*”—better than the whole world. (This is the title of a well-known poem of the early 20th century.)

LET'S EXPLORE



Look at the map of India at the end of this book. What are you able to observe? Recall your lesson on different types of landforms—mountains, plains and plateaus. Which landforms can you identify on the map? What do the different colours on the map mean? (*Hint: The legend on the map shows the heights of each area.*)

As you go through this chapter, remember to refer periodically to the physical map.

India is the seventh-largest country in the world, and a part of Asia. Along with its neighbours—Pakistan, Bangladesh, Nepal, Bhutan, Sri Lanka, and Myanmar—it forms the region known as the Indian Subcontinent (subcontinent, since it is part of the continent of Asia). Often, for the purpose of discussion, we refer to five regions—the great mountain zone, the plains of the Ganga and the Indus, the desert region, the southern peninsula, and the islands. In this chapter, we will ‘fly’ over these zones, providing you with a bird’s-eye view of these features and offering glimpses of what things look like in close-up at some of these places. It would be difficult to go into all the details at this stage since, as you will soon see, India is large and diverse.

The Himalayan Mountain range stands as a natural barrier in the north, while the Thar Desert and the Arabian Sea mark its western limits. To the south, the Indian Ocean and to the east, the Bay of Bengal form a natural boundary. These geographical features create a separation between India and the rest of the continent and have played a crucial role in shaping India’s climate, culture, and history.

LET'S EXPLORE

- Do you recall your lesson on latitudes and longitudes? Look at the map. Can you read, approximately, the latitude and longitude where India lies?
- Identify the above features on India's physical map.

Let us now journey together from the Himalayas to the islands in the Indian Ocean, and onward to the east of India. The diverse colours on the map already give us a sense of the geographical diversity. Familiarise yourself with the legend on the map. The different colours indicate the altitudes.

The Himalayas

Look at the length of the Himalayan Range on the map. It is like a massive wall. From the legend, can you guess the altitude at different points of the Himalayas?



Fig. 1.2. These are satellite images of the Himalayan range. Note that the length of the range is about 2500 km.

**LET'S REMEMBER**

The Himalayas seem to touch the sky. In fact, many of its peaks are over 8000 metres in height and are together called the 'Eight Thousanders'. This mountain range stretches across six countries in Asia: India, Nepal, Bhutan, China, Pakistan, and Afghanistan. Can you name the highest mountain in the world?

In the summer, the snow on the mountains melts and feeds major rivers, such as the Ganga, Indus, and Brahmaputra. These rivers and their tributaries provide water for drinking, farming, and industrial use, connecting with the lives of hundreds of millions of people. Hence, the Himalayas are sometimes called the 'Water Tower of Asia'. The Himalayas are also important to many cultures and belief systems. The mountains themselves are considered sacred, and temples and monasteries have been built within them, attracting monks and spiritual seekers from around the world who come to pray and meditate.

**DON'T MISS OUT**

The Bhagirathi River, a major tributary of the Ganga, originates from Gaumukh ('Cow's Mouth'), in Uttarakhand. It is the edge



Fig. 1.3. Gaumukh

of the Gangotri Glacier. This glacier is one of the largest in the Indian Himalayas. It is considered sacred and attracts many pilgrims. Gaumukh is also a popular trekking destination. Next time you see the Ganga, remember—its journey began there!

How the Himalayas were formed ... an interesting story

A long, long time ago, India was part of a much bigger landmass called 'Gondwana', where its neighbour was Africa! At some point, it broke away and slowly started moving north. About 50 million years ago, it reached the landmass of Eurasia and collided with it. As India pushed against Eurasia, the land between them crumpled and rose up—just like how a carpet wrinkles when you push it. That's how the mighty Himalayan mountains were formed!

Amazingly, India is still pushing into Asia today, very slowly—about five centimetres each year, which is much slower than the rate at which your hair grows. This means the Himalayas are still growing taller, just a tiny bit each year—about five millimetres, but over a millennium, that adds up to five metres!



Fig. 1.4. India's journey
to Eurasia



Fig. 1.5. Folded layers of Himalayan rock



DON'T MISS OUT

The word 'Himalaya' is a combination of two Sanskrit words—*hima*, meaning 'snow', and *ālaya*, meaning 'abode' or 'dwelling'—thus, 'abode of snow'.

The Himalayas are broadly categorised into three main ranges:

- The **Himadri** (the Greater Himalayas) are the highest and most rugged part of the range, home to towering peaks like Mount Everest and Kanchenjunga. This region remains snow-covered throughout the year. Life here is tough, and there are not many human settlements.
- The **Himachal** (the Lower Himalayas) lie south of the Greater Himalayas and have a more moderate climate, allowing rich biodiversity and human habitation. Popular hill stations, such as Nainital (Uttarakhand), Darjeeling (West Bengal), Shimla (Himachal Pradesh), and Mussoorie (Uttarakhand), are located in this region.
- The **Shivalik** Hills (the Outer Himalayas) form the outermost and lowest range, consisting of rolling hills and dense forests. These foothills are rich in wildlife, serving as a transition zone between the Himalayas and the Gangetic Plains (also called the Northern Plains).

LET'S EXPLORE

Can you locate the names of the states in the different parts of the Himalayas? Take the help of both the physical and political maps for this exercise.

DON'T MISS OUT



Fig. 1.6. Kath-kuni House, Himachal Pradesh

The traditional house construction method in the western Himalayan region is known as 'kath-kuni' or 'dhajji-dewari' style of houses. A combination of locally available stone and wood is used, which not only keeps the house warm but also resists damage in the event of mild earthquakes.



DON'T MISS OUT

The Great Himalayan National Park in Himachal Pradesh has a wide diversity of flora and fauna. The park has been declared



Fig. 1.7. 1. Great Himalayan National Park Conservation Area. 2. Himalayan monal (male). 3. A monastery in Ladakh. 4. The Beas river in Himachal Pradesh. 5. Snow Leopard 6. A display of produce in a local market in the Himalayas. 7. Rhododendron — a type of sherbet is made out of this flower.

a World Heritage Site by UNESCO. The biodiversity of the park is being preserved by the government as well as the village communities that live inside the park.

The cold desert of India

The word 'desert' immediately evokes an image of a hot place. However, there are also cold deserts, and we have one in India. Ladakh is a cold desert where winter temperatures drop below -30°C . There is very little rainfall, and the landscape is rugged,



Fig. 1.8. Moonland, Ladakh

with rocky terrain, deep valleys, and lakes such as Pangong Tso (tso means lake).

The terrain here resembles that of the moon; hence, it is called 'moonland'. Geologists explain the formation of this terrain, as we saw earlier, by the fact that the mountains were 'folded' when the Indian landmass collided with Eurasia. This folded portion was part of an ocean, and so the rocks in this area



Fig. 1.9. Yaks are very important for the lives of people in the Himalayas. They are reared for their milk, meat, wool and dung, and are also used for transport.



Fig. 1.10. Pangong Tso, Ladakh. This lake has salty water, unlike most other lakes. The saltiness is a result of the minerals that dissolve from the surrounding mountain areas.

are made largely of sand and clay. Wind and rain have eroded the mountains into the shapes you see in the photograph.

Despite the harsh conditions, Ladakh is home to unique wildlife like snow leopards, ibex, and Tibetan antelopes. The Ladakhi people lead a simple life. The region is known for its ancient monasteries and colourful festivals such as Losar and the Hemis Festival.

The Gangetic Plains

As we move southwards from the Himalayas, we reach the vast and fertile Gangetic Plains. These plains have been an important part of the history and civilisation of India. These plains are nourished by mighty rivers originating from the Himalayas, providing a vital lifeline: water. The Ganga, Indus, and Brahmaputra river systems, along with their extensive network of tributaries, enrich the soil with minerals, making the region highly fertile and ideal for agriculture. The rivers bring with them minerals that enrich the soil, enabling abundant agriculture. The rivers are also a source for generating electricity. A large proportion of India's population lives in these plains.



Fig. 1.11. Modern agricultural practices in the plains



Fig. 1.12. Aerial view of Delhi with the river Yamuna on top right



Fig. 1.13. Multi-cropping in Uttar Pradesh



Fig. 1.14. Rural women working in a paddy field in West Bengal

The flat land of the Northern Plains has allowed for the development of an elaborate transportation network. Road and railway networks facilitate the movement of people and goods over long distances. As you will see in the Tapestry of the Past chapters, the Ganga, the Brahmaputra and other rivers have been used for millennia for travel and trade.



Fig. 1.15. Modes of transport in the Gangetic plains



DON'T MISS OUT

Most rivers are named after goddesses—Ganga, Yamuna, Kaveri, etc. The name of Brahmaputra, however, means ‘the son of Brahma’. This river gets bigger during summer instead of drying up! Can you guess why?

LET'S EXPLORE

Notice the concentration of lighting in the plains. What could be the reason for this concentration?



Fig. 1.16. Satellite image of the Gangetic plains



Fig. 1.17. The Northern plains grey langur sits on a wooden beam in Bandhavgarh National Park, Madhya Pradesh



Fig. 1.18. The majestic tiger that was on the verge of extinction. Project Tiger has supported the return of the tiger to its habitats.



Fig. 1.19. The Indian gharial; an adult is between 2.5 and 4.5 m long. This reptile is on the verge of extinction. There are laws that prohibit harming it or hunting it.



Fig. 1.20. A peacock and peahen — the Indian peacock is our national bird

The Great Indian Desert or Thar Desert

If we move westward on the map, you will notice a yellowish area. This area is the Thar Desert. What do you see? A vast stretch of golden dunes, rugged terrain, and a wide-open sky?



Fig. 1.21. A traveller among the sand dunes of the Thar Desert.

LET'S EXPLORE



What is the shape of a sand dune? While mountains are made of rock and their shape is fixed, why do you think sand dunes also have a similar shape, even though they are made of sand?



Fig. 1.22. Jaisalmer, the 'Golden City', located in the middle of the Thar desert in India. The Jaisalmer fort is a UNESCO World Heritage site.

Sand dunes are formed when the wind shifts and shapes the sand into hill-like formations. Sometimes these rise as high as 150 metres.

The Thar is a vast arid region. Most of it lies within India, spanning the states of Rajasthan, Gujarat, Punjab, and Haryana. The desert acts as a natural barrier due to the harsh conditions that deter human and animal movement — including very high daytime temperatures and cold nights, as well as a lack of access to water.

People living in the Thar have adapted their way of life to the place and what it offers; food habits, clothing and lifestyle are suited to these harsh conditions.



*Fig. 1.23.
Camel
vendor at
the Pushkar
Mela (at
the edge of
the Thar
Desert)*



DON'T MISS OUT



Fig. 1.24. (Left) Women fetching water from a source far away from home. (Right) Rainwater harvesting structure in a hamlet.

Water is scarce in the desert. Women often need to travel long distances every day to fetch water for their families. So, the traditional method for cleaning utensils is to scour them with sand until they are clean. A little water can be used for a light rinse. The water used for rinsing is reused for purposes like watering a plant. So, the next time you leave the tap running, remember the people of the Thar Desert. Rajasthan is also famous for its ingenious water conservation methods, including *taanka* or *kunds*. These are special water collection systems that store rainwater, often for drinking purposes.

The Aravalli Hills

LET'S EXPLORE

Let's go back to the map. Trace your path slowly from the Thar Desert towards the east. Do you see the Aravalli Hills?

The Aravallis are among the oldest mountains in the world, some 2.5 billion years old! The range has many peaks and ridges. Although its highest peak, Mount Abu, towers at over 1700 m, most of its hills are between 300 and 900 metres high. Isn't it fascinating that a drive of about 4 and a half hours can take us



Fig. 1.25. (Left) A part of the Aravallis; just beyond this range, the Thar Desert begins. (Right) A part of the Aravallis seen from space.

from Mount Abu in the Aravallis to Jodhpur in the Thar Desert, a drive into a completely different geography?

LET'S EXPLORE

Look at the political map in the textbook and identify the states that the range spans. Did you see Delhi, Rajasthan, Haryana and Gujarat?



The Aravallis play a vital role in shaping the geography and climate of northwestern India. One of its most important functions is acting as a natural barrier, preventing the Thar Desert from expanding further eastward. You will read more about this later.

The Aravallis, rich in minerals like marble, granite, zinc, and copper, have supported mining and construction activities for centuries. In fact, evidence from its ancient mines at Zawar has shown that over eight centuries ago, Indians were the first in the world to master the delicate process of extraction of zinc. Historic forts, such as Chittorgarh, Kumbhalgarh, and Ranthambore, are located here.



Fig. 1.26. Kumbhalgarh Fort surrounded by the Aravallis; this location in the hills proved to be an excellent deterrent to the enemy.

The Peninsular Plateau



LET'S REMEMBER

A plateau is a landform that rises up from the surrounding land and has a more or less flat surface; some of its sides are often steep slopes.

Peninsula:
A peninsula is a piece of land that is surrounded by water on three sides.

India has several plateaus; the most important one is the triangular peninsular area in the middle and south of the country.

It is also a very old land formation! Since this region is a **peninsula**, surrounded by water on all three sides by the Arabian Sea, the Bay of Bengal, and the Indian Ocean, it is called a peninsular plateau.

The plateau is bordered by two mountain ranges, the Western Ghats and Eastern Ghats. The Western Ghats are taller and run along the western coast like a wall, with many beautiful waterfalls flowing down their steep sides during the monsoon season.



DON'T MISS OUT

The Western Ghats have been declared a UNESCO World Heritage Site. They are home to many rivers and have a rich biodiversity. The northern portion of the Western Ghats are also known as the Sahyadri Hills.

The Eastern Ghats are lower and broken into smaller hills along the eastern coast. Between these mountain ranges lies the Deccan Plateau, a vast area of flat highlands.

Rivers like the Godavari, Krishna, and Kaveri flow across the plateau from west to east. These rivers are important for farming and provide water to millions of people.

LET'S EXPLORE

Look at the physical map of India given at the end of the book. Notice the direction of the flow of the rivers.



Fig. 1.27. Dense forests of Chhattisgarh, home to many tribal communities

This plateau is rich in minerals, forests, and fertile land, making it vital for India's economy. It tilts a little to the east, so a few of the rivers in this region flow towards the Bay of Bengal. East-flowing rivers like the Godavari, Krishna, and Mahanadi originate here, providing water for farming, industries, and hydroelectric power. There are west-flowing rivers (Narmada, Tapti) too, which drain into the Arabian Sea.

Dense forests on the plateau are home to tribal communities, including the Santhal, Gond, Baiga, Bhil, and Korku. These tribes have distinct languages, traditions, and ways of life closely connected to Nature.

LET'S EXPLORE

Tribal communities are largely spread over the states of Jharkhand, West Bengal, Odisha, Assam, Madhya Pradesh, Chhattisgarh, Maharashtra, Telangana, and Gujarat. Examine the physical and political maps at the end of this book to locate the states and connect them to their location on the physical map.

Plateaus are home to many beautiful waterfalls in India, as rivers flow over their uneven and rocky surfaces. These waterfalls not only attract tourists but also help in hydroelectric power generation and provide water for irrigation.





Fig. 1.28. Powerhouse Waterfalls at Periyakanal, near Munnar, Kerala



Fig. 1.29. Lion-tailed macaque in the Western Ghats



Fig. 1.30. King cobra of the Western Ghats



Fig. 1.31. This is an insectivorous plant, meaning it feeds on insects, found in the Western Ghats. It catches small insects in sticky traps and digests them!



Fig. 1.32. Coal mines in the plateau; an important resource, especially in the production of electricity. Coal is a fossil fuel, the use of which contributes to global warming.



Fig. 1.33. Mumbai, on the west coast, is India's financial centre

India's Amazing Coastlines

India's coastline is dotted with beautiful beaches, rocky cliffs, and lush green forests. Some beaches have golden sand while others have black rocks. Some islands have coral reefs while others are covered in thick jungles. India's coasts are full of surprises! The Indian coastline is over 7500 km long.

LET'S EXPLORE

- Look at the physical map of India in your school atlas or wall map and find the names of five rivers that flow into the Bay of Bengal. Find out India's coastal states and discuss the difference between the western and eastern coastal plains.
- Do you know what it is called when these rivers split into multiple streams near the coast? Discuss with your teacher in class to find out!

The West Coast of India

The West Coast of India stretches from Gujarat to Kerala, passing through Maharashtra, Goa, and Karnataka. Most rivers here originate in the Western Ghats, flow swiftly, and form estuaries. The coastline is shaped by alluvial deposits from short rivers and features coves, creeks, and estuaries, with the Narmada and Tapti estuaries being the largest.





Fig. 1.34. An aerial view of a part of the west coast. Note how close the hills of the Western Ghats are to the Arabian Sea.

The west coast has many important ports and cities. These have been the centres of economic activity for millennia.

The East Coast



Fig. 1.35. Satellite view of the East Coast of India.

The East Coast lies between the Eastern Ghats and the Bay of Bengal, stretching from the Ganga delta to Kanyakumari. It has wide plains and major river deltas, including Mahanadi, Godavari, Krishna, and Kaveri. Important water bodies like Chilika Lake and Pulicat Lake (a lagoon, which is a body of water separated from larger bodies of water by a natural barrier) are found here.

Deltas are landforms formed at the mouth of a river when it deposits sediments into a larger body of water, such as an ocean, a lake, or another river. Over time, these sediments build up, forming a triangular or fan-shaped area. The Godavari, Krishna, Kaveri and Mahanadi rivers create fertile deltas, making the land ideal for farming.

Indian Islands

The Indian Islands refer to the group of islands scattered across the Indian Ocean, the Arabian Sea, and the Bay of Bengal, which form part of India's territory. India has two major island

groups—Lakshadweep in the Arabian Sea and the Andaman and Nicobar Islands in the Bay of Bengal. These islands have unique wildlife, beautiful beaches, coral reefs, and volcanoes. Several ancient tribes made these islands their home tens of thousands of years ago.

Lakshadweep islands

Lakshadweep is an archipelago (a group of islands) located in the Arabian Sea, close to the Malabar coast of Kerala. It is made up of 36 islands made of coral. Not all islands are inhabited by people. India controls a vast marine area, allowing for fishing, resource exploration, and environmental protection.

Andaman and Nicobar islands

This archipelago comprises more than 500 large and small volcanic islands, divided into two distinct groups—the Andaman and the Nicobar Islands. Their location is very important.



Fig. 1.36. Coral reef in the Lakshadweep Islands



Fig. 1.37. Coral reef in the Andaman Islands



Fig. 1.38. A floating dock (a small port) of the Indian Navy near the Andaman Islands.



Fig. 1.39. An aerial view of the active volcano on Barren Island, the only one in India

They are like the outposts of India, keeping an eye on the ocean. It is home to a variety of flora and fauna. The Andaman Islands are also significant from a historical point of view — many of our freedom fighters were jailed there under the most severe conditions in a prison complex called ‘Cellular Jail’. It has been preserved to remind us of the tremendous sacrifices that our forefathers made so we could be free. We will discuss this some more in higher classes.



DON'T MISS OUT

Barren Island (Fig. 1.39 above) in the Andaman and Nicobar Islands is the only active volcano in India. It sometimes erupts, sending smoke and lava into the sky!

The Delta in West Bengal and the Sundarbans



Fig. 1.40. Mangroves of the delta in the Sundarbans of West Bengal

As we travel back from the islands towards the eastern side of the Himalayas via the Bay of Bengal, we come to the Sundarbans. This is located in the delta of the Ganga, Brahmaputra (you saw them earlier in the chapter) and their tributaries. This delta has a unique combination of the river, sea and land. About half of it is located in India, and the rest is in

Bangladesh. This is also a UNESCO Heritage site. The Sundarbans are home to many species, including the Royal Bengal Tiger.

Note: Do remember to look at the map and identify where the delta is.



Fig. 1.41. Left to right, top to bottom: Seven Sisters Waterfalls, Meghalaya, India; The Shad Suk Mynsiem festival is celebrated by the Khasi people as a form of gratitude towards nature; Living roots bridge near Nongriat village, Cherrapunjee, Meghalaya

The hills of the Northeast

Stay on the map as we move towards the hills of the Northeast, our final destination for now. Can you see Garo, Khasi, and Jantia marked on the map? These hills, part of the Meghalaya Plateau, are known for their lush greenery, heavy rainfall, and breathtaking waterfalls. This region experiences one of the highest rainfalls in the world, making it rich in forests, unique wildlife, and fertile land.



DON'T MISS OUT



Mawlynnong Village, situated in the East Khasi Hills of Meghalaya, is renowned as the 'cleanest village in Asia'. This picturesque village is famous for its well-maintained cleanliness, bamboo dustbins, and eco-friendly living practices. The village is also known for its living root bridges, which are created by weaving tree roots over the course of many years.

Fig. 1.42. Living root bridges showcase the craftsmanship of the tribes of the Northeast.



Before we move on ...

- India gives its name to the subcontinent it is a part of.
- It has many diverse geographical features, ranging from the snowy Himalayas to the heat of the Thar Desert. The plains are watered by a large number of rivers. There is also a peninsular plateau with the Arabian Sea on the west and the Bay of Bengal in the east.
- These diverse geographic features have created a variety of conditions with respect to soil, flora, fauna, life and economic opportunities, and honed a rich culture.
- These geographical features have played an important role in shaping our civilisation.

Questions and activities

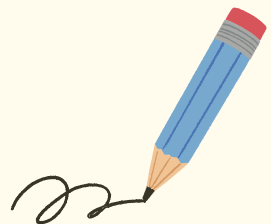
1. What, in your opinion, are two important geographical features of India? Why do you think they are important?

2. What do you think India might have looked like if the Himalayas did not exist? Write a short note or sketch a drawing to express your imagination.
3. India has been called a 'mini-continent'. Based on what you've read, why do you think this is so?
4. Follow one of India's big rivers from where it starts to where it meets the ocean. What are the different ways in which people might utilise this river along its journey? Discuss in groups in your class.
5. Why is the southern part of India referred to as a peninsular plateau?
6. Which UNESCO Heritage Site mentioned in this chapter did you find more interesting? Write a short paragraph to describe what about it is interesting.
7. Look at the two maps of India, physical as well as political, given at the end of this book. Identify the place you are at now. Which physical feature of India would you use to describe its location?
8. Food preservation techniques differ from place to place across India. They are adapted to local conditions. Do a class project. Gather different methods of preserving food. Hint: Drying vegetables when they are in season for use during the off-season.
9. Despite having such different regions (mountains, deserts, plains, coasts), India remains one country. How do you think our geography has helped unite people?

Noodles

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*'Noodles' is our abbreviation for 'Notes and Doodles'!



Understanding the Weather

CHAPTER

2



A change in the weather is sufficient to create the world and oneself anew.

Marcel Proust, French novelist



Fig. 2.1



The **Big**
Questions ?

1. How can we measure and monitor the weather around us?
2. How do weather predictions help us prepare for events like heavy rain, storms, drought and heat waves?



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Weather and its Elements

You wake up one winter morning and shiver. You reach for thick clothes to keep yourself warm. In the summer, you choose clothes that keep you cool and comfortable. You are responding to your body's signals; your body is sensing the weather.

What is weather?

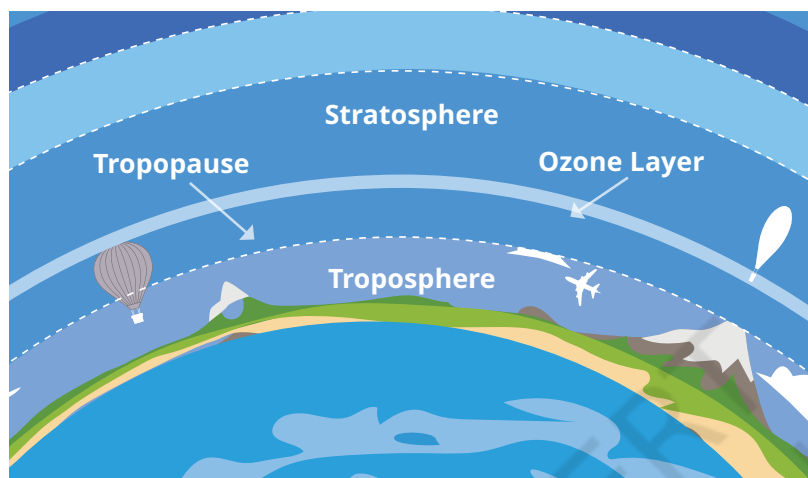


Fig. 2.2

Weather is a state of the Earth's atmosphere at a particular time and place. But what is an atmosphere? In simple terms, it is the layer of gases that surround some planets—in the case of our Earth, we call these gases 'air'. The Earth's atmosphere may be compared to a cake

with several layers. The layer closest to the surface of the Earth is called the 'troposphere', and that is where all land-based plants and animals (including humans!) live and breathe. It is also where almost all weather phenomena, which we will explore in this chapter, take place. The troposphere extends to a height of 6 to 18 kilometres from the ground; it is less thick at the poles (where the cold air contracts) and thicker in the tropical zone (where the warmer air expands). You will study more about the other layers in your Science classes.

We use many words to describe the weather—hot, cold, rainy, cloudy, humid, snowy, windy, and so on. They describe the different ways in which we experience the elements of weather.

LET'S EXPLORE

What are some of the words in your local language that you use to describe the weather? Hot, cold, warm, chilly, crisp, pleasant, and so on, are commonly used terms in English.



The elements of weather are:

- **Temperature:** How hot or cold the atmosphere is.
- **Precipitation:** Any form of water, such as rain, snow, **sleet** or **hail**, that falls from the sky.
- **Atmospheric Pressure:** The weight of the air above us, felt on the Earth's surface.
- **Wind:** The movement of air, including its speed and direction.
- **Humidity:** The amount of **water vapour** in the air.



THINK ABOUT IT

Let us imagine that Krishnan from Chennai is speaking with Amir in Kashmir. Krishnan tells Amir that it has become chilly in Chennai after it rained the previous night. Amir asks him how cold it is. How will Krishnan explain to Amir how cold it is? After all, what is cold for Krishnan may be quite pleasant for Amir!

As you can see, it would be difficult for Krishnan to convey his sense of chilliness to Amir unless there is a commonly agreed way to measure the temperature. It is the same with other elements of the weather. In this chapter, we will learn how we measure the weather using common standards.

LET'S EXPLORE

What do you think could be some other reasons to measure the weather more precisely? (Hint: Think how knowing the weather a few hours or a few days in advance would help you plan some activities.)

From early times, humans have closely observed Nature and learnt to read her signals to **forecast** the weather. Observing birds flying low, ants carrying eggs, squirrels gathering nuts, frogs croaking loudly, or even the opening and closing of pine cones, provided valuable information about coming rain or storms. This knowledge has been passed down from generation to generation. Even today, in many parts of India, people use traditional ways to predict the weather, especially the arrival of the monsoon.

Sleet:

Frozen or partly frozen rain.

Hail:

Small, hard balls of ice that fall from the sky like rain.

Water vapour:

Water vapour is water in gaseous instead of liquid form.



Forecast:

To predict or find out in advance (in our case, the weather).

Observing Nature's clues



Fig. 2.3.1. Ants shifting their eggs to higher ground is a natural behaviour that indicates an expected change in the weather, especially heavy rain.

Fig. 2.3.2. A frog croaking in a forest of the Western Ghats, in expectation of rain.



Meteorology:

Meteorology is the systematic study of weather and its evolution. This study is the basis for weather forecasting.



Fig. 2.3.3. The opening and closing of pine cones are natural mechanisms driven by environmental humidity. Pine cones close in humid conditions to protect their seeds, and open in dry conditions to release them, ensuring they spread in favourable weather.

LET'S EXPLORE



Talk to elders in your neighbourhood and ask them how they predict the weather. What signs do they observe? Document any sayings in your regional language that refer to weather prediction.

In the last few centuries, scientists have worked out methods to measure and monitor the elements of the weather with great precision. Based on those inputs, **meteorologists** try to predict how the weather will behave in a particular region after a few hours or a few days, or even a few weeks. How do they do it? Do they just look up at the sky and guess? No, they've got some cool gadgets, a few of which we will now look at.

Weather Instruments

a) Temperature

LET'S REMEMBER



In your Grade 6 Science textbook, *Curiosity*, you read about different types of thermometers used for measuring the temperature—the clinical thermometer and the laboratory thermometer. You also learnt about temperature scales. One of them is the Celsius scale; another is the Fahrenheit scale. If, for instance, we have a cool temperature of 15 degrees Celsius (noted as 15°C), it is the same as 59 degrees Fahrenheit (noted as 59°F).



Fig. 2.4.1. Snow melts quickly when it's warm.



Fig. 2.4.2. Cloudy weather—it's getting cold.



Fig. 2.4.3. In winter, coconut oil turns solid.



Fig. 2.4.4. Curd takes longer to set in cold weather.

Ambient:
Of the
immediate
surroundings.

Statistics:
The technique
of gathering
and analysing
information
or data in
order to be
able to detect
patterns,
understand
events or make
predictions.

There are several types of thermometers. Some simply measure the **ambient** temperature; others record the maximum and minimum temperatures during a day. Thermometers often use a coloured liquid which expands when the temperature increases. However, more and more, digital thermometers are preferred as they are more precise and can record more data.

Indeed, temperature recordings can be used to collect some useful **statistics**, including:

- **Range of temperature** or the maximum temperature minus the minimum temperature during a particular period of time (usually 24 hours).
- **Mean daily temperature** or the maximum temperature plus the minimum temperature of the day divided by two.

DON'T MISS OUT



- The India Meteorological Department was set up in 1875. Its motto is *ādityāt jāyate vṛiṣhti*, which means, “From the sun arises rain.” The phrase comes from the ancient text *Manusmṛiti*, and the complete sentence reads, “From the sun arises rain, from rain comes food, and from food, living beings originate.”
- Can you think of a reason why rain arises from the sun?



Fig. 2.5

LET'S EXPLORE



- Here's a chart of the temperatures of a city in Madhya Pradesh. What is the maximum temperature recorded in the week shown here? What is the minimum? Calculate the range.

Date	Maximum Temperature (in °C)	Minimum Temperature (in °C)
28.02.2025	29	16
01.03.2025	30	15
02.03.2025	31	17
03.03.2025	32	18
04.03.2025	30	17
05.03.2025	28	14
06.03.2025	29	15

→ Remember the conversation between Krishnan and Amir? If Krishnan said it was 20°C in Chennai and he was feeling a little cold, he and Amir would have a measure they could understand. What do you think Amir's reaction to Krishnan's statement might be?

b) Precipitation

If the news says that a particular place received 30 mm of rainfall in a day, what does it mean? How is rainfall measured?

The amount of rainfall is measured with the help of an instrument called a **rain gauge** (Fig. 2.6). When it rains, the water falls into a funnel and is collected in a cylinder. A scale is attached to the cylinder to measure the depth of rainwater collected. For example, when the height of the water collected is 5 mm, we say that the area received 5 mm of rainfall.

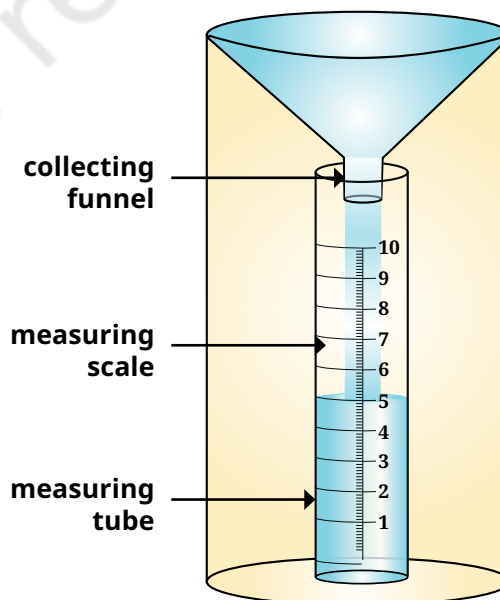


Fig. 2.6. Rain gauge



LET'S EXPLORE

Make a rain gauge as shown in the diagram above. Place the rain gauge in an open area, away from objects that might obstruct rain. Ensure that the rain gauge is on a flat surface and will not tilt or topple with the wind. Using the measuring scale, record the amount of rainwater collected at the same time every day, for a month. (If there is snow, allow it to melt before taking the measurement.) Calculate the average rainfall for every week in that month and comment on the variation from week to week.

c) Atmospheric pressure

Our bodies are quite aware of temperature and rainfall. But you may also have experienced that the weather sometimes feels 'heavy', as before a thunderstorm. This is related to atmospheric pressure, which is the pressure exerted by the weight of the air above and around us.

The atmospheric pressure is higher near the sea coast and lower as we go higher up into the mountains. When you climb a mountain, the air gets thinner than in the plain below. As a result, the air pressure is lower, and there is less oxygen available for

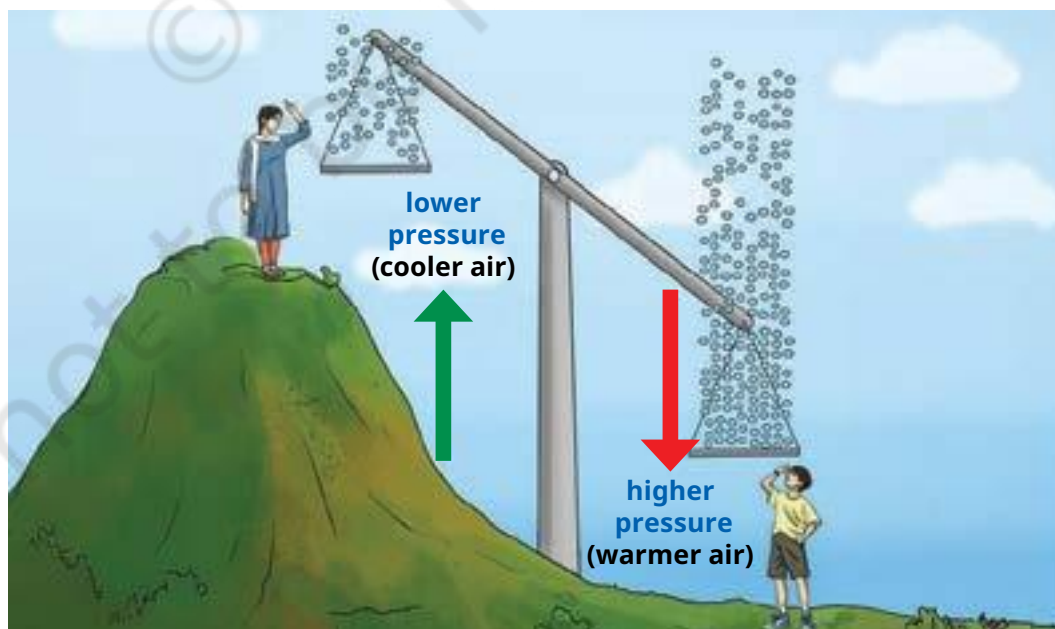


Fig. 2.7

your lungs to take in. With less oxygen getting into your blood, your body has to work harder to keep you moving! That's why people sometimes feel breathless, dizzy or tired at high altitudes. This does not mean that the atmospheric pressure is always high in the plains below or on the coast. In fact, it sometimes drops dramatically, resulting in what meteorologists call a 'depression' or 'low-pressure system', which can sometimes develop into a storm or even a cyclone.



THINK ABOUT IT

Why do you think it would be important to measure atmospheric pressure? Who are the people most likely to use such measurements?

The instrument used to measure atmospheric pressure is called a **barometer**. As with thermometers, there are several types of barometers. The unit they display is generally the **millibar** (abbreviated as mb). The normal atmospheric pressure at the sea coast is around 1013 mb; a pressure below 1000 mb indicates a depression.



THINK ABOUT IT

People who journey to places at a high altitude are advised to make pauses on the way to allow the body to **acclimatise**. Our army personnel serve in high-altitude places like Khardung la in Ladakh, which is over 5600 metres above sea level. It is hard to imagine how they live and work in places where the oxygen level is so low—the atmospheric pressure there is generally about 650 millibars!

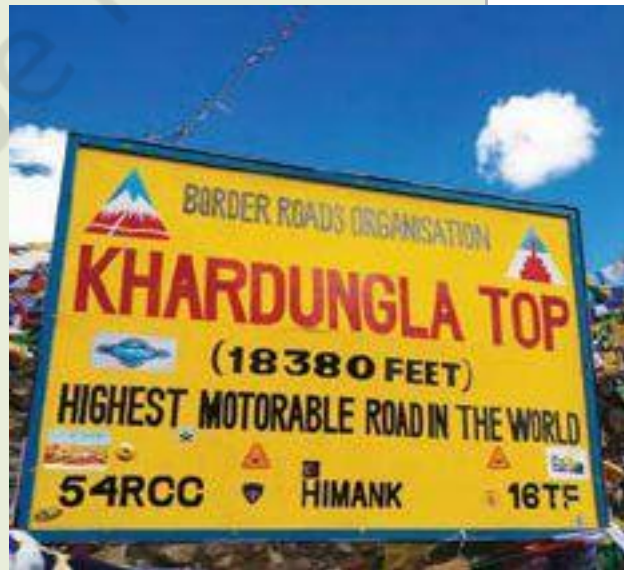


Fig. 2.8

Acclimatise:
Adjust to a
new climate
or new
condition

d) Wind

Wind is the movement of air from areas of high pressure to areas of low pressure. Speed and direction are two important factors when we describe the wind.



THINK ABOUT IT

Have you seen seeds like these flying in the wind? What would happen to the seeds if there was no wind?



Fig. 2.9

The wind is an important element of the weather. Its direction and speed help in weather forecasting. Besides, air pilots and sailors need to be aware of wind data, as the wind has a great influence on flying or sailing. Farmers also use the wind direction to predict where rain might come from. Also, a greater wind speed will cause the soil to dry faster.

So, how do we measure this direction and speed? A wind vane (or weather vane) has a rotating arm with a pointer at one end and a tail at the other. When the wind blows, the tail is pushed, and the pointer turns in the direction of the wind. It responds even to a light breeze.



Fig. 2.10. Left: Wind vane on the tarmac. Right: Anemometer

This wind vane on the tarmac is called a ‘wind sock’. It gives pilots an indication of the direction of the wind during take-off and landing. Similar socks are used in industries that release ash or gases.

The simplest instrument to measure the wind direction and speed is the **anemometer**. It has three or four metal cups that rotate on a vertical shaft when the wind blows—the stronger the wind, the faster the rotation. A meter attached at the bottom counts how many times the anemometer spins in a certain period of time and calculates the wind speed in kilometres per hour (km/h).

e) Humidity

Humidity is the last element of the weather on our list. It refers to the amount of water vapour present in the air. It also depends on factors like temperature, wind, pressure and location.

LET'S EXPLORE

Where do you think humidity is likely to be more, Kochi or Jaipur? You might guess that Kochi has higher humidity than Jaipur because it is located near the sea. But how will we know for sure? If we had to compare the humidity level between Kochi and Mangaluru, how would we do it? Discuss with your classmates.



We can answer these questions more precisely by learning how to measure humidity.

Before we move forward, we need to remember our Science lesson from Grade 6 about the states of water. This will help us to understand how humidity is measured.



LET'S REMEMBER

- When water evaporates, it causes a cooling effect.
- If the amount of water in the air is already high (more humidity), water evaporates slowly. That is typically the case on a rainy day.

Humidity of the air is measured as **relative humidity**: air that would contain absolutely no water vapour (which is impossible in natural conditions) is rated at 0%, while air saturated with water vapour will have a humidity of 100%. In practice, dry weather has a relative humidity range between 20% and 40%, while humid weather usually falls between 60% and 80% relative humidity.



THINK ABOUT IT

If the humidity in Delhi is at 52% while in Kochi it is 84%, in which of the two places are wet clothes likely to dry faster? And where are you likely to sweat more, assuming the temperature is the same in both places?

But how do we measure such numbers? This is done through an instrument called a **hygrometer**. Again, there are several types of hygrometers, depending on the principle they are based on. The measurement of humidity is of great importance in many industrial processes, such as food processing. Museums also monitor humidity as they need to maintain a dry environment to preserve their exhibit.

Weather Stations

As you can see, we need several instruments to measure the weather at a particular place and time. A weather station brings all these instruments together, making it easy to measure and track the weather. Readings of all the measurements are taken at regular intervals, which helps in mapping and forecasting the weather.



Fig. 2.11

An automated weather station

An **Automated Weather Station (AWS)** is a self-operating system that uses various sensors to measure and record weather data, such as temperature, humidity, wind speed and direction, precipitation, and atmospheric pressure. Such stations are widely used in fields like agriculture, aviation, navigation, environmental monitoring, and so on, providing accurate and timely weather information without the need for human intervention.

DON'T MISS OUT



In 2023, the National Disaster Management Authority set up an AWS at a glacial lake of Sikkim at an altitude of more than 4800 metres above sea level. The AWS provides early information about upcoming weather conditions.



Fig. 2.12. AWS at a glacial lake of Sikkim

Predicting the Weather

Meteorologists collect data using these instruments over long periods of time. They study the data and use scientific

methods to try and predict the weather. Such predictions are very important nowadays, as climate change makes extreme weather, such as droughts, floods, cyclones, etc., more frequent.

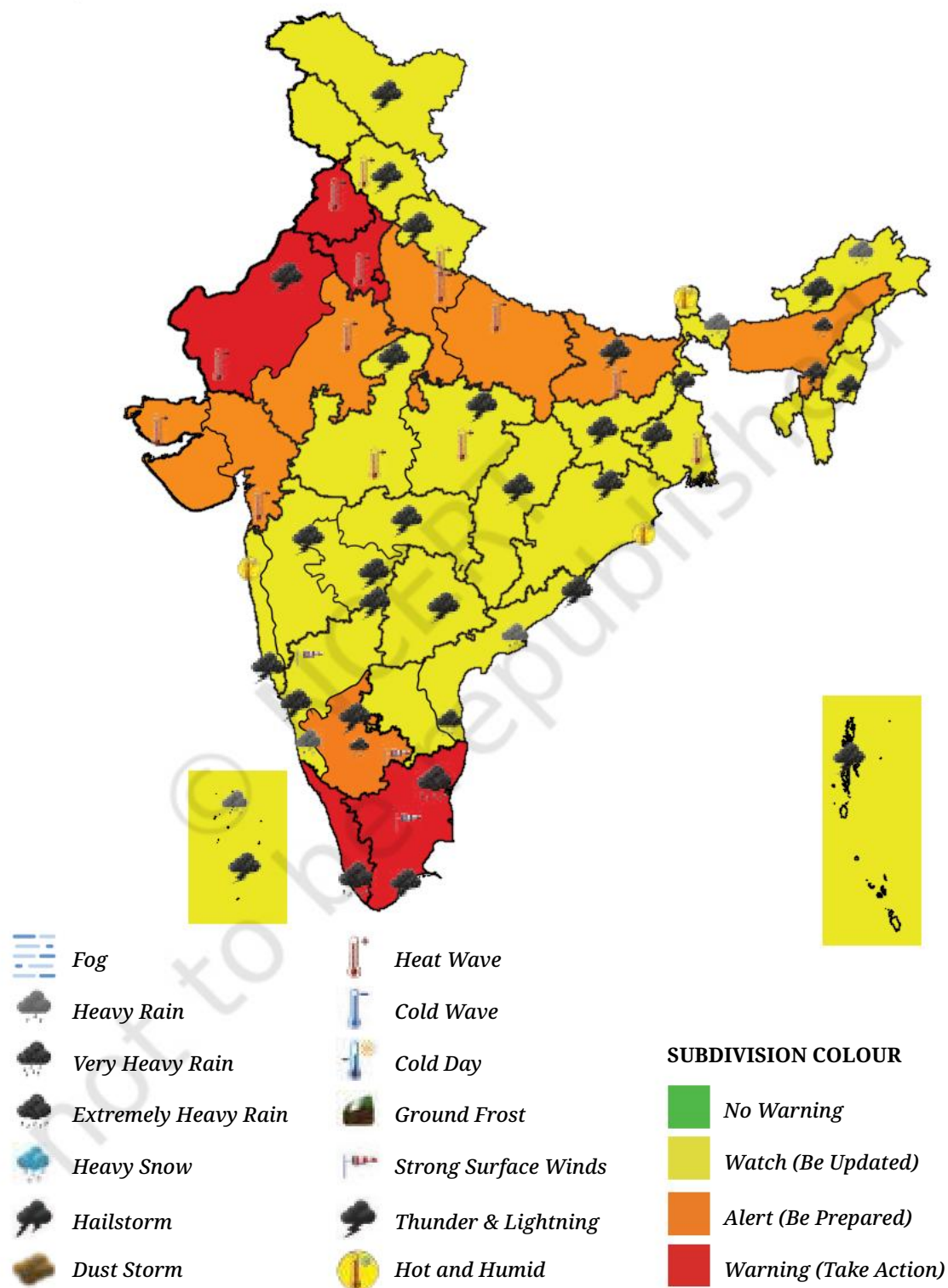


Fig. 2.13. India: weather warning for India on 19 May 2024

Accurate predictions help us to be ready for such events. They also enable local governments to mobilise resources and prepare for any disasters. For example, if stormy weather is expected at sea, fishermen are warned about venturing out in their boats, or an entire coastal area might have to be evacuated if a cyclone is expected.

LET'S EXPLORE

Discuss, in pairs, different situations in which weather predictions are helpful. Make a list, and after you have completed it, share it and discuss it with the pair sitting next to you. How many different categories of situations have you been able to identify?

Look carefully at the map of India above. This map was issued by the India Meteorological Department on 19 May 2024. Study the icons and connect them to the conditions shown on the map.

LET'S EXPLORE

- What do you observe happening on that day? What are the various weather conditions that the IMD is alerting people to?
- Which states have warning signs?
- Which parts of India are likely to be free from severe weather?
- Which states are likely to face heat wave conditions?
- What are the causes for warning in Tripura and Lakshadweep?

Before we move on ...

- Temperature, humidity, precipitation, wind and atmospheric pressure together define the weather at a particular place.
- The condition of these elements is measured using special instruments. Data collected from these help us to monitor and predict the weather.



- In different times or situations, one of the elements is dominant — for example, rainfall in July, the temperature in May and December, atmospheric pressure when a cyclone is moving, and wind when a loo (strong, hot and dusty winds that blow in north India in summers) is blowing, or forest fires are spreading.
- Weather is closely linked to climate. We will discuss this in the next chapter.

Questions and activities

1. Match the instrument with the weather element it measures.

Instrument used		Element of the Weather	
(1)	Hygrometer	(a)	Precipitation
(2)	Anemometer	(b)	Atmospheric pressure
(3)	Barometer	(c)	Wind direction and speed
(4)	Thermometer	(d)	Humidity
(5)	Rain gauge	(e)	Temperature

2. Jyotsna is deciding what clothes to pack for her school trip to Mumbai in June. She looks at the weather forecast, which predicts 29°C and 84% humidity. What would be your advice to her?
3. Imagine that a small group of students is setting up a rain gauge.

Here are some options for the site.

1. The school vegetable garden.
2. The terrace of the school building.
3. Open ground with elevated platform.
4. Compound wall of school.
5. Verandah of the school laboratory.

Discuss in your group and finalise the site. Write down the reasons for your decision.

- Below is a chart taken from IMD, Jammu and Kashmir. Looking at the data available, write a short script to report the weather conditions in different parts of Jammu and Kashmir on the date shown. (Hint: Cover the temperature range, maximum and minimum temperatures, humidity, precipitation, etc.)

DAILY WEATHER PARAMETERS
Jammu & Kashmir (EVENING)
DATE: 01-02-2024

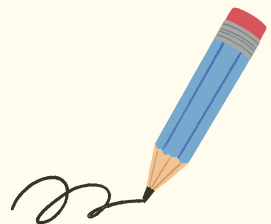
Station	max temperature of date			min temperature of date			from 0830 to 1730 hrs (mm/cm)		24 hrs R/F ending 0830 of date (mm/cm)		relative humidity	
	ACT	NOR	DEP	ACT	NOR	DEP					0830	1730
	(°C)	(°C)	(°C)	(°C)	(°C)	(°C)	R/F (mm)	S/N (cm)	R/F	S/N	(%)	(%)
SRINAGAR	6.5	8.9	-2.4	0.2	-0.7	0.9	TR	0.0	13.4	2.4	89	89
QAZIGUND	3.2	8.5	-5.3	-0.4	-2.1	1.7	11.8	10.0	36.2	22.0	97	90
PAHALGAM	1.1	5.6	-4.5	-4.1	-6.1	2.0	6.0	8.0	19.4	23.0	96	96
KUPWARA	5.1	8.5	-3.4	-0.7	-2.3	1.6	0.5	0.0	21.9	10.0	97	94
KUKERNAG	2.6	6.6	-4.0	-1.4	-2.4	1.0	12.0	8.0	35.2	30.0	96	97
GULMARG	-2.6	1.4	-4.0	-7.6	-7.6	0.0	8.2	6.35	35.2	35.0	76	100
MUZAFARABAD	8.5	-	-	5.6	-	-	-	-	25.8	-	93	-

Note: ACT means actual; NOR means normal; DEP is departure from normal; R/F is rainfall; S/N is snowfall; TR means trace amount.

Noodles

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*'Noodles' is our abbreviation for 'Notes and Doodles'!



Climates of India

kāle varṣhatu parjanyaḥ prīṭhivī sasyaśhālīnī

deśhoyam kṣhobharahitah brāhmaṇāsantu nirbhayāḥ

May the rains be timely, may the Earth be lush with vegetation

May this country be free from turmoil, may good people be fearless!

– Subhāśhita



Fig. 3.1

The **Big**
Questions ?

1. What makes India's climate so diverse?
2. What are the monsoons?
How are they formed?
3. What is the effect of climate on economy, culture and society?
4. How can understanding the climate help us to prepare for natural disasters?
5. What is climate change? What are its consequences?



Weather, Seasons and the Climate

‘Climate’ is a word people use in everyday conversations. But, quite often, what they really mean is ‘weather’, and not ‘climate’. What’s the difference? ‘Weather’ is what we experience every hour or day: it might be raining, or there could be bright sunshine, a lot of wind, etc. The weather keeps changing. Climate, on the other hand, is the pattern of weather an area or a region experiences over a long period of time—several decades at least. This pattern varies from region to region.

Before we come to the various types of climates, let us briefly stop to introduce seasons. Seasons occur as the Earth revolves around the Sun. Each season lasts for a few months and recurs every year. As we know, there are several seasons in the year—spring, summer, monsoon, autumn and winter—that occur in a cycle. Are seasons related to the weather or to the climate? The answer is: to both.

The weather changes with the season, that is, it can be dry and hot in the summer months, or humid and rainy during the monsoon. Further, the pattern of seasons in a region is closely connected with the climate. There are four main seasons across most regions of the world—spring, summer, autumn and winter. However, India receives rainfall during a specific period of the year—the ‘rainy season’ or monsoon—along with the other four.



Fig. 3.2

Traditionally, in many parts of India, the year is divided into six seasons or *ṛitus*—*vasanta* (spring), *grīṣhma* (summer), *varṣhā* (rainy season), *śharad* (autumn), *hemanta* (pre-winter), *śhiṣhir* (winter). Specific rituals and festivals are associated with these six *ṛitus*, such as Vasanta Pañchamī or Śharad Pūrṇima.

If we observe the world around us, we will notice that human, plant and animal life are in rhythm with the *ritus* or seasons. The crops we grow, the food we eat, the clothes we wear, and so on, change with the season. Depending on the region, some trees and shrubs bloom with the onset of *vasanta* or spring, in some places they shed their leaves or change their colour as *śharad* or autumn approaches and some animals develop thick fur in the cold winter months.

LET'S EXPLORE

- Which are your favourite seasons? Write a short essay explaining your reasons.
- Discuss in groups of three or four and find out whether there are specific events connected to the seasons in your region. Collect information about them—songs, feasts with specific types of food, practices in different seasons, etc. Document these and share your discoveries with your class.
- Do you know which trees in your area change colours before the onset of winter? Are there trees that shed their leaves around this time? Why do you think this happens? Find out and document the local names of these trees.

Usually, the climate remains stable over long periods of time. However, scientists have been recording changes in the climates of the world in the recent decades. Studies show that many of these changes have been caused by human actions.

Let us recapitulate:

- Weather is what we experience from day to day—windy, rainy, hot, dry, etc.
- Seasons recur every year and the weather of a place is different in every season.
- Climate is the long-term pattern in a particular region. There are many types of climates in the world. We will now survey the main types found in India.



Types of Climates in India

We have often seen how India is a land of diversity. This is equally true of its climate:

- In the north, the Himalayan mountains have an alpine climate with cold, snowy winters and cool summers (the word ‘alpine’ comes from the Alps, a mountain range of Europe). That’s probably where you will see the thickest clothing in India!
- Lower in the Himalayas, and in many hilly areas of India, the climate is often said to be temperate, as the winters are moderately cold and the summers not too hot. That is where we find many ‘hill stations’, much frequented by people seeking relief from the heat in the plains below.



Fig. 3.3

- In the northern plains, the climate is subtropical, with very hot summers and cold winters. This is where most of India’s wheat is grown.
- In the west, the Thar Desert has an arid climate featuring extremely hot days, cool nights, and very little rainfall. People there have had to develop unique ways to collect and save water.

- The western coastal strip receives heavy rainfall during monsoon months, creating a tropical wet climate, which is favourable to the growing of rice and spices.
- The central Deccan Plateau has a semi-arid climate with hot summers, mild winters and moderate rainfall during the rainy season.
- Eastern India and the southern peninsula experience a tropical climate with a mild winter and distinct wet and dry periods controlled by monsoon winds (more on them soon).

Note: You will understand later the meaning of the terms ‘tropical’ and ‘subtropical’, which are related to two special parallels of latitude called the ‘tropics’.

Factors Determining the Climate

What creates those different climates? There are many factors at work. Some are general ones — on the scale of the planet — while others are regional or even local. Let's examine a few.

a) Latitude

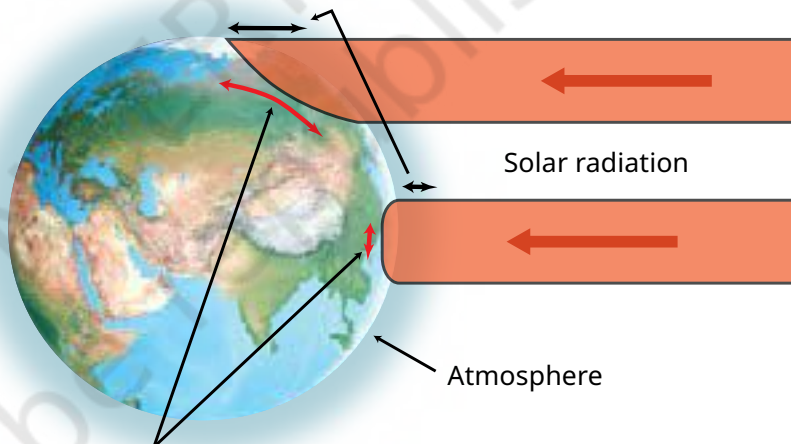
LET'S REMEMBER



We studied about latitudes in Grade 6. Do you remember that latitudes measure the distance from the Equator, increasing as we move away from it (either northward or southward)? While the climate around the Equator is extremely hot, as the latitude increases it becomes temperate and then cold or frigid. Why is this so?

Places near the Equator, that is, at low latitudes, are warmer, while those near the poles (high latitudes) are colder. This happens due to the angle at which the sun's rays hit a particular area. At the Equator, the rays are nearly perpendicular, and so all their energy is focused on a smaller area of the Earth's surface. In the

polar regions, the rays are inclined or oblique, and the energy is distributed over a larger surface. Moreover, they have to pass through more of the Earth's atmosphere, as the diagram shows, which further dissipates their energy. As a result, the polar regions receive less heat than the equatorial zone. We can see this in India too: Kanniyakumari and the Nicobar Islands being close to the Equator are warm or hot almost throughout the year, whereas places in the north, such as Srinagar, are much cooler.



At the equator exposure to the sun's rays is concentrated, but near the poles it is dispersed over a wide area

Fig. 3.4

b) Altitude

We mentioned hill stations above, which are popular tourist centres because of their cooler climate. India has many including Munnar, Theni, Udhagamandalam (Ooty), Madikeri, Mahabaleshwar, Mount Abu, Shimla, Nainital, Darjeeling, Tawang, Shillong, etc. We know they are located at a higher altitude than the plains below, but how does that explain their cooler temperature? You will later learn the full answer in your Science classes.

To keep things simple for now, the temperature decreases as the altitude increases because:



Fig. 3.5

1. The atmospheric pressure, and therefore the air density, decreases as the altitude increases (as we saw in the chapter 'Understanding the Weather'), and as the air gets less dense, it gets cooler.
2. The sun heats the surface of the Earth, and so the farther away from the surface, the less hot the air will be. The Himalayas are so high that many peaks maintain a temperature below water's freezing point, keeping them covered in snow.

LET'S EXPLORE

Udhagamandalam (Ooty) and Coimbatore are almost at the same latitude. The range of summer temperatures in Ooty is 10–25° while that in Coimbatore is 25–38°. Why do you think there is such a difference in temperature between these two places?

c) Proximity to the sea

Temperatures in coastal areas do not vary much; the summers are not too hot and the winters are not too cold. That is because the sea acts as a moderator for the temperature. This diagram sums up the phenomenon, and your Science textbook explains this further while discussing the heating and cooling of land and water in coastal regions. The result is that those

regions tend to be more temperate. As you move inland from the coast, the temperatures get more extreme—summer temperatures will be higher and winter temperatures lower. For instance, Mumbai and Nagpur are located at a similar latitude, but Mumbai, being near the sea, has cooler summers (around 32°C) and milder winters (around 18°C), while Nagpur, away from the coast, experiences up to 44°C in summer and about 10°C in winter. As you can see, Mumbai's range of temperature (i.e. the difference between the maximum and the minimum) is about 14°C while the range at Nagpur reaches 34°C.

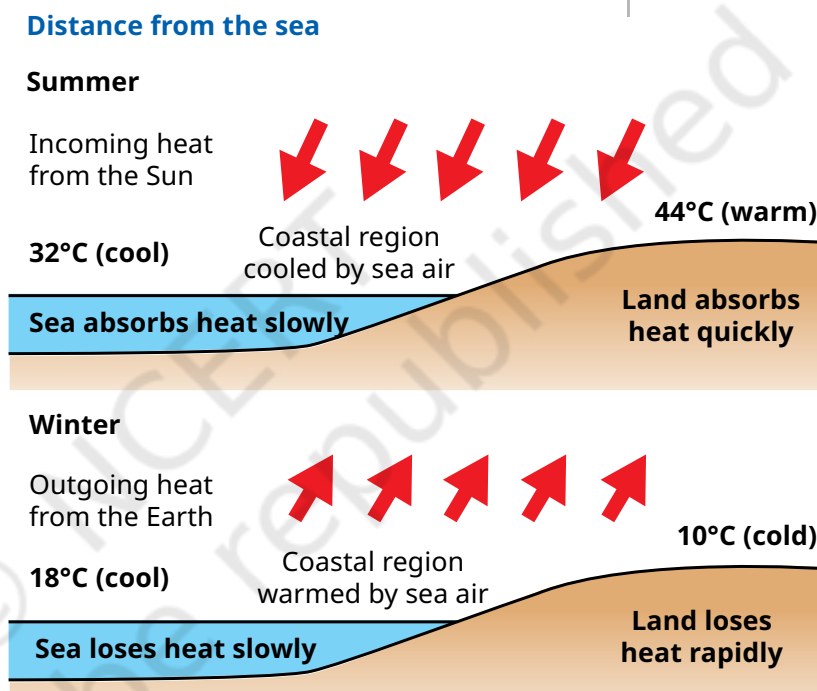


Fig. 3.6

d) Winds

Wind can move masses of warmer or cooler air. States like Punjab, Haryana, Rajasthan and Madhya Pradesh often receive winds blowing from the west. Having travelled over the deserts of Arabia to Afghanistan, they bring dry and hot air that causes severe heat waves in summer. In winter cold winds from across the Himalayas creep into the Himalayan foothills, resulting in cold waves.

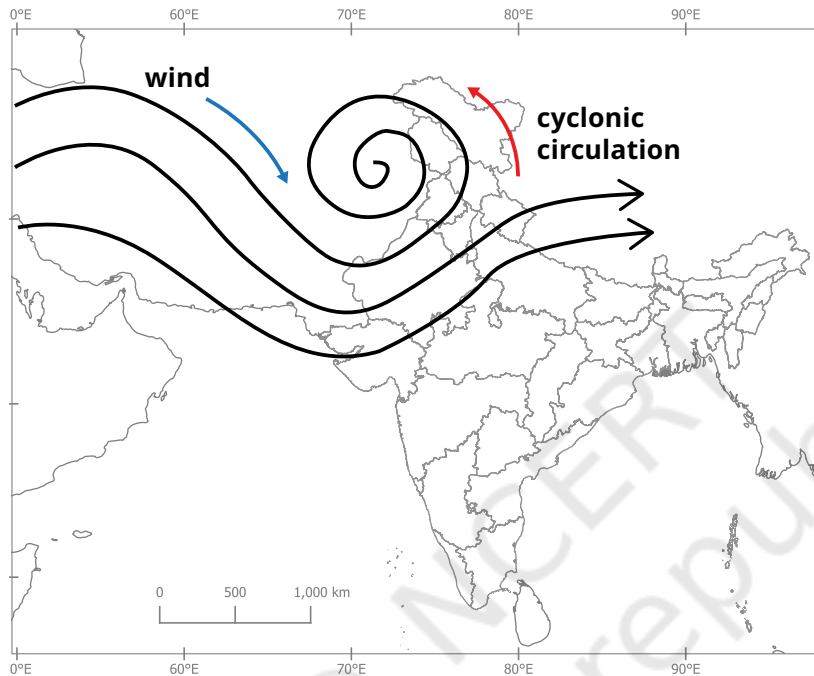


Fig. 3.7

Winds affect not only temperature, but also humidity, and in turn, precipitation. We saw dry winds coming from distant deserts; in contrast, winds coming from the sea bring moisture over the land, which may result in rainfall. We will soon see the case of the monsoon winds.

LET'S REMEMBER



In your Grade 6 Science textbook '*Curiosity*' you studied the water cycle! "The water from the ocean and the Earth's surface evaporates into the atmosphere as vapour and returns as rain, hail or snow...."

Topography:

The totality of the physical surface features of an area. This may include mountains, hills, valleys, slopes, coasts, etc.

e) Topography

Finally, the **topography** of a region also plays an important role in determining its climate. For instance, the Himalayas and the Karakoram ranges protect, to some extent, the Indian

subcontinent from the winds of the cold deserts of Central Asia. The nearly flat topography of the Thar desert, on the other hand, has nothing to protect it from hot and dry winds. In the next section, we will see the role of the Western Ghats in India's southwest monsoon.

Putting it all together...

The climate of any region is determined collectively by all the above factors. Describing the climate involves a description of the patterns of temperature, precipitation (rain or snowfall, occurrence of fog or mist) and wind conditions in a region over three decades or more.

A microclimate is a climate localised in a small area, which differs from the climate in the surrounding region. It has a

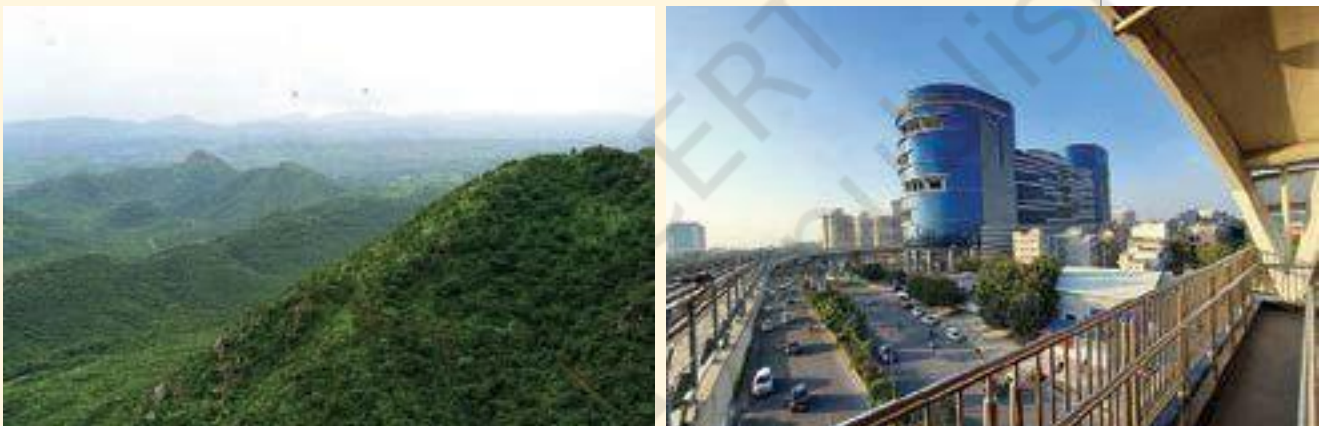


Fig. 3.8. Aravallis and urban heat islands

unique pattern of temperature, humidity, precipitation, etc., in a small geographical area.

For instance, enclosed valleys and some forests have microclimates of their own. So do 'urban heat islands', that is, some cities that have a large number of buildings and other concrete structures and very little vegetation; all this traps the heat and they are often much warmer than the surrounding region.

Microclimates can influence the local flora and fauna, the crops grown, and impact human health and well-being.

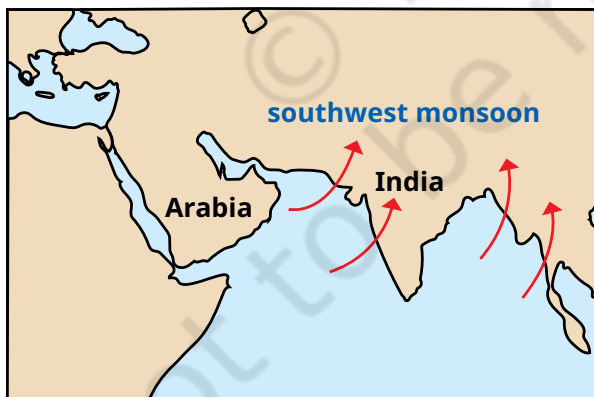
The Monsoons

The monsoon season is central to life in India. During the monsoon months, the rivers fill up, the soil is soaked with water, crops grow and life thrives. Strictly speaking, the word 'monsoon', which comes from the Arabic word *mausim*, meaning 'season', refers to seasonal winds over a large area of the Indian Ocean and surrounding regions, including Australia, Africa and South Asia.

There is a yearly pattern to the monsoons. Their mechanism is complex, but based on the simple fact that land heats up or cools down faster than the ocean. Monsoons bring out the fundamental relationship between temperature, pressure and wind movement.

To put it simply, as summer begins, the Asian landmass heats up, creating a powerful low-pressure system over it. Since air always flows from high pressure to low pressure, winds are drawn from the cooler, high-pressure ocean towards the hot land. These ocean winds carry moisture that condenses over the warmer land and falls in the form of heavy monsoon rains. (That is why 'monsoon' commonly refers to the seasonal rains rather than the winds.)

A. Summer



B. Winter

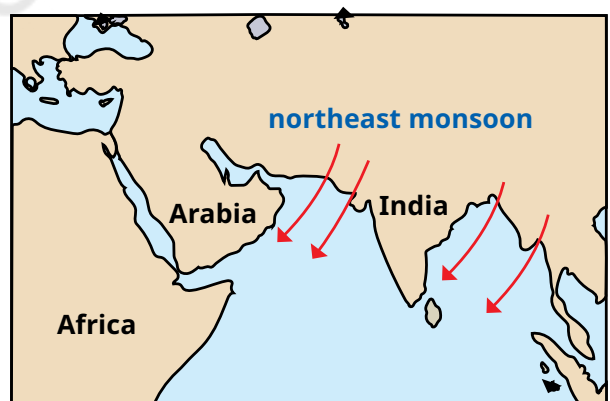


Fig. 3.9

The pattern reverses in winter, when the landmass cools down more rapidly than the ocean. Now the land has a high-pressure system while the ocean remains warmer with relatively lower pressure. This causes the winds to blow in the opposite direction—from the land towards the ocean—bringing dry conditions to much of Asia.

Coming to India, the monsoon rains typically advance from the southern tip of India in early June, moving northward over several weeks until they cover the entire subcontinent by mid-July. It is not a smooth progression, though the Western Ghats (remember our brief survey of topography) act as a natural barrier; their western slopes receive much rainfall, while the Deccan plateau to the east receive less, and often with interruptions. This is commonly called the summer or southwest monsoon ('southwest' reflecting the direction the winds come from).

As winter approaches, the winds reverse and blow from the land to the ocean, as we just saw. These are dry winds that bring cold weather to south India, but a part of them, passing over the Bay of Bengal, collect some moisture and bring rainfall to parts of east and south India. This is called the winter or northeast monsoon.



DON'T MISS OUT

- Mawsynram, located in Meghalaya, receives the highest average annual rainfall in the world, about 11,000 mm (which is the same as 11 metres!).



Fig. 3.10.

- The monsoons have inspired many *ragās* in both Carnatic and Hindustani classical music. *Meghamalhār* and *amruthavarshini* are names of a couple of them.

**LET'S EXPLORE**

Since the ability to predict the monsoon rainfall has been an important aspect of life in India, our ancestors observed Nature around them carefully. They developed local traditional knowledge through their experience. This traditional knowledge is an important heritage we must preserve. For example, fishermen on the Konkan coast predict the onset of the monsoon when fishes that normally stay under water are seen at the surface; in parts of southern India monsoon is said to arrive within 50 days after the Golden Shower tree (*Cassia fistula*) blossoms. Some communities also believe that when crows build their nests high on tree-tops, it indicates less rainfall, whereas if the nests are lower, rainfall is likely to be heavy. Make a list of such local knowledge about rain, fog, snow or hail in your area.

Climate and our Lives

Our lives are deeply connected with the climate and dependent on it. The impact of climate is visible in local cultures for instance, and India has many festivals associated with seasons and agricultural activities.

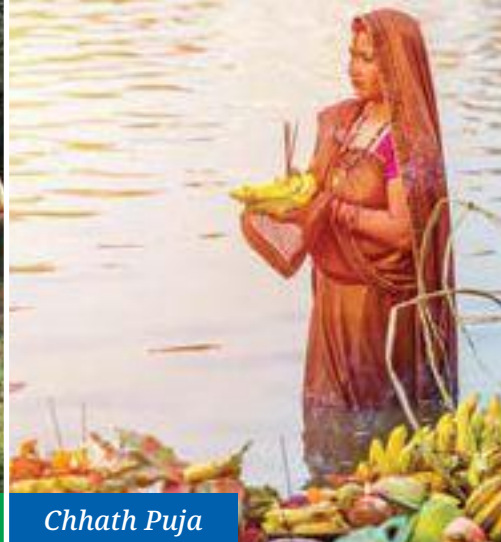
**LET'S EXPLORE**

Reach out to your grandparents or elders in your neighbourhood. Ask them about the traditional festivals and dances they remember from their childhood and youth, especially those related to agriculture and rain. What rituals did they participate in? Then organise a cultural fest with your friends. You can showcase some of the dances, songs and activities your elders shared with you. Whether it is a dance, harvest ritual, or a simple story about a prayer to rain gods, try to bring these traditions to life for your classmates.

The climate also has a direct impact on the economy. For instance, you may have heard the phrase 'monsoon failure', which refers



Bihu



Chhath Puja



Makar Sankranti



Baisakhi



Pongal



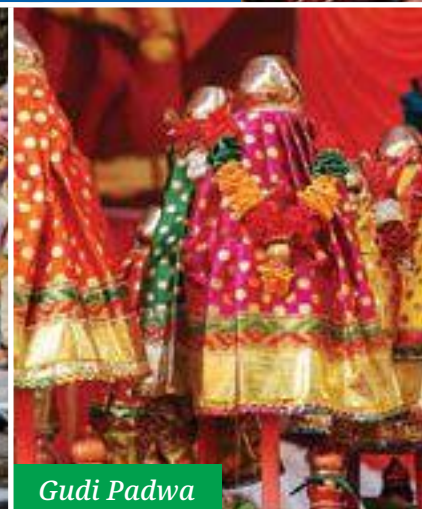
Achean Winter Festival



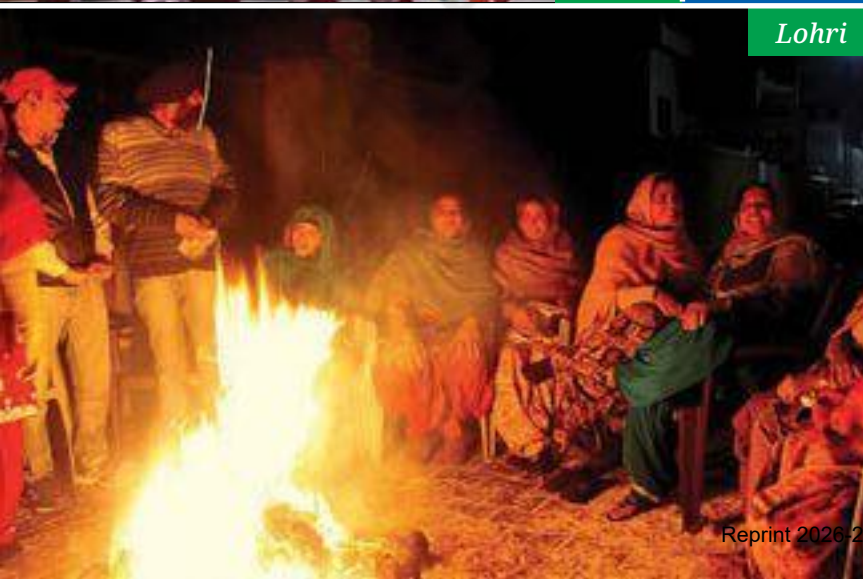
Hemis



Losong festival



Gudi Padwa



Lohri



Onam

Fig. 3.11

to poor rainfall during the monsoon season; in such a case, the agriculture suffers, people (women, generally) have to walk long distances in search of water, and agricultural labourers are likely to migrate to the cities; food (grains, vegetables and fruits, to begin with) becomes costlier, fuelling inflation. Industrial activity also often depends on a predictable weather and the availability of water. The world over, we can easily detect such connections between the climate and socioeconomic conditions. Those conditions get especially strained when climate disasters strike.

Climates and Disasters

India's diverse weather patterns can bring about extreme conditions such as cyclones, floods, landslides and other such climate-related disasters. These events affect people's lives, disrupt agriculture, damage infrastructure and disturb local economies.

a) Cyclones

Every year, the Indian coastline, especially the eastern coast, witness several cyclones. In past years, some of them have been highly destructive, resulting in the loss of human and animal life, damaging property and infrastructure, uprooting trees and causing soil erosion. The India Meteorological Department (IMD) keeps track of coming cyclones and provides information on their formation, evolution, place of landing, etc.

DON'T MISS OUT



Fig. 3.12

The National Disaster Response Force (NDRF) is specially trained to respond to natural as well as human-made disasters. NDRF battalions are located at 12 different locations in India. The NDRF has played a key role in rescue and evacuation during disasters like cyclones, landslides and floods.

How are cyclones formed? We saw that in some special situations, the atmospheric pressure near the sea becomes lower than the surrounding areas, creating a low-pressure system. This is an invitation to the air from surrounding areas to come into the low-pressure area, and the air from the sea moves in, bringing with it moisture and rain. When the low-pressure system is intense and the wind speeds are high, this may result in a cyclone.

As winds collect moisture, they form clouds and rotate inwards towards the centre of the depression. This centre, which is cloudless, is called ‘the eye of the cyclone’.



THINK ABOUT IT

What are clouds? White lumps in the sky, you might say. But what are they made of? The answer is simple—water. But not just any water; clouds are masses of water droplets, ice crystals, or a mixture of both, that are suspended in the atmosphere.

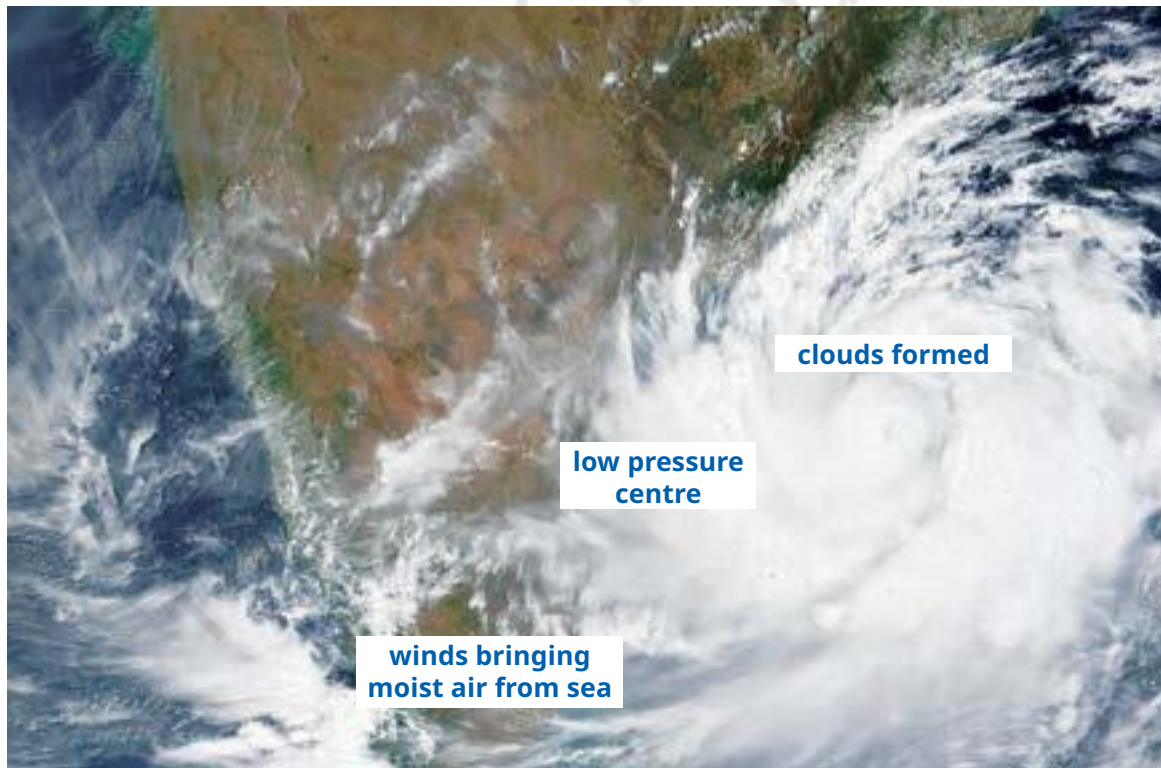


Fig. 3.13. Cyclone Fani



Fig. 3.14. Eye of the storm

b) Floods

A flood occurs when water overflows into normally dry land. This could be due to heavy rainfall generating huge run-off water that the land cannot absorb, or due to excessive accumulation of water in bodies like rivers and lakes, until the water overflows or their banks are breached. Floods occur frequently during the monsoons. States such as Uttar Pradesh, Bihar, Kerala, Andhra Pradesh and Assam are particularly vulnerable to floods.



LET'S EXPLORE

Have you seen or read about floods? Look at the physical map of India. Discuss in pairs why you think floods occur in the areas mentioned above.

In the Himalayan regions, on the other hand, floods occur when glacial lakes overflow. Glacial lakes form a barrier of rocks and ice to hold their water, which often comes from melting glaciers. If the glaciers melt too fast (as is increasingly the case) or if there is too much rainfall, the build-up of pressure can cause the water



Cyclone



Landslide



Forest Fire



Flood

Fig. 3.15

to break through the barrier — this is called a glacial burst and it often has devastating consequences for people and property.



DON'T MISS OUT

In 2013, Uttarakhand experienced a sudden glacial burst caused by continuous heavy rain over several days. Many landslides followed. Areas around one of India's important sacred sites, the Kedarnath temple, were completely destroyed. Several villages were washed away in the floods, along with many roads and bridges. Altogether about 6,000 people, many of them pilgrims, lost their lives.

Many cities experience flooding when there is heavy rainfall. This may be due to an overburdened drainage system or poorly planned construction encroaching on the waterways and blocking the flow of water. Besides, urban surfaces of concrete or asphalt do not allow water to be absorbed by the earth.

c) Landslides

A landslide is the sudden collapse of rock, soil, or debris, often triggered by heavy rain, earthquakes or volcanic activity. Landslides are common in hilly and mountainous regions such as Himachal Pradesh, Uttarakhand, Sikkim and Arunachal Pradesh, as well as the Western Ghats and hilly regions. These events often occur during the monsoon.

In those regions, the chances of landslides have increased due to human activities such as the cutting down of forests, building infrastructure without following approved methods and the construction of too many buildings that block the natural flow of water.

d) Forest fires

Forest fires are uncontrolled fires that spread rapidly across vegetation, often fuelled by dry climatic conditions, droughts or high winds. Human carelessness is another frequent cause. Forest fires are common in states with large forested or grassland areas such as Uttarakhand, Himachal Pradesh, Madhya Pradesh and Chhattisgarh, as well as mountain ranges such as the Western Ghats. Apart from destroying large areas of forest, fires harm wildlife, degrade the ecosystem, spoil the air quality and displace local communities. The consequences are therefore both environmental and economic.

LET'S EXPLORE



- Observe Fig. 3.15. Describe the effects they may have on people, plants, animals and economic life.
- In groups of four or five, identify in each of the above disasters the part of natural causes and the part of human causes. Compare your conclusions.
- Discuss in the same groups series of preventive measures that could help avoid the above disasters.

Climate Change

Climate change refers to significant, long-term changes in the climate. This may be on the scale of the planet or on a regional scale, and it involves shifts in temperature, precipitation and weather events. In past millennia (we can go back millions of years, in fact), natural processes drove climate change. Since the 19th century, however, climate change has been largely driven by human activities, particularly the burning of **fossil fuels**, deforestation, environmentally harmful industrial practices, and production and patterns of excessive or wasteful consumption.



Fig. 3.16

Fossil fuels: Sources of energy that were formed from the remains of plants and animals that died millions of years ago and were buried deep under layers of soil and rock or under the sea, where heat and pressure slowly turned them into coal, petroleum oil and natural gas.

Resilience:

The capacity to withstand or recover quickly from difficulties.

Mitigation:

The adoption of steps to help slow down global warming and reduce the causes of climate change.

Sustainable:

Something which can be maintained over a long period of time.

Why does the burning of fossil fuels affect the climate? In the Earth's natural carbon cycle, carbon dioxide (CO₂) and other gases are released gradually into the atmosphere and trap heat from the Sun. This natural 'greenhouse effect' warms Earth enough to support life. However, human activities like industry, transportation, and agriculture have released enormous amounts of these 'greenhouse gases' in just a few centuries. This sudden increase traps extra heat, causing rapid global warming and disrupting the climate patterns that plants, animals, and human societies have adapted to over thousands of years.

In India, rising temperatures are perceptible in many regions. Early in 2025, for instance, the country's average temperature was 1 to 3°C above normal, as a result of which the winter was much shorter and milder than usual. This affects not only agricultural production but also many small-scale industries. This is only one example showing how a warmer planet will present us with increasing challenges.

Understanding the relationship between the causes of climate change and disasters can help us to prepare better for these challenges. It also supports the need for more environment-friendly practices and building **resilience** and adaptation in communities. Governments worldwide, including India's, attempt to promote measures of climate **mitigation**, such as cutting down on greenhouse gas emissions, planting trees, boosting renewable energy and improving energy efficiency, promoting **sustainable** lifestyles, etc. But these often clash with a desire for economic growth and increased consumption.



Before we move on ...

- India's diverse climate is shaped by its geography, including mountains, deserts, and plateaus.
- Weather is short-term, seasons recur on a yearly basis, and climate reflects long-term patterns over decades.
- Factors such as latitude, altitude, proximity to the sea, wind and topography determine the climate.
- Monsoons are vital for agriculture, influencing crop cycles and livelihoods.

- Climate is connected with cultural traditions, festivals, agriculture and economic activity.
- Understanding the climate helps prepare for natural disasters like floods and cyclones.
- Climate change leads to extremes of weather or temperature and can have severe consequences on the natural and human worlds.

Questions and activities

1. Match the climatic factors with their effects:

Column A	Column B
(1) Latitude	(a) Brings wet air to India during summer
(2) Altitude	(b) Creates different climates in the north and south
(3) Proximity to the ocean	(c) Keeps higher places cooler
(4) Monsoon winds	(d) Moderates the temperature

2. Answer the following questions:

- a) What is the difference between weather and climate?
- b) Why do places near the ocean have milder temperatures than places far away from it?
- c) What role do monsoon winds play in affecting India's climate?
- d) Why is Chennai warm or hot throughout the year, while Leh is cold?

3. Look at a map of India given at the end of this book. Identify the climate for these cities—Leh, Chennai, Delhi, Panaji and Jaipur.

- Is the place near the sea, in the mountains, or in the desert?
- How do these factors affect the climate there?

4. Draw the monsoon cycle in summers and winters on a map of India.
 - Label where the winds blow in summer and winter
 - Show the direction of winds during the monsoon
5. Make a colourful poster showing festivals in India linked to farming and weather (e.g., Baisakhi, Onam). Add pictures or drawings of these festivals.
6. Imagine you are a farmer in India. Write a short diary entry about how you would prepare for the rainy season.
7. Identify a natural disaster (e.g., cyclone, flood, landslide, or forest fire) and write a short essay that includes the causes and impacts. Suggest actions that individuals, communities and the government can take to reduce the impact.

The Story of Indian Farming

CHAPTER

1

A farmer who looks after the welfare of his cattle, visits his farms daily, has the knowledge of the seasons, is careful about seeds, and is industrious, is rewarded with harvests of all kinds and never perishes.

Kṛiṣhi Parāśhara



Fig. 1.1. (1) Ploughing a field with a ploughshare pulled by oxen. (2) A farmer uses a tractor to plough the land. (3) Women transplanting rice seedlings. (4) Transplanting seedlings using a transplanter. (5) Separating wheat from the stalk using a threshing machine. (6) Transporting vegetables on the Dal Lake, Kashmir.

The Big Questions ?

1. What are the main characteristics of Indian agriculture?
2. How are farming, climate, soil, and water interrelated?
3. How can traditional practices and contemporary ones complement each other?



India's Agricultural Landscape

Farming or agriculture is one of the oldest occupations of humankind. It encompasses the preparation of soil, cultivation of plants, rearing of livestock, and, in many cases, the growing of trees as part of a comprehensive farming system. In some areas, farmers also practice pisciculture (fish rearing) or rear cocoons to extract silk thread. Very broadly, the term 'agriculture' encompasses farming, animal husbandry (raising livestock), forestry, and horticulture.



DON'T MISS OUT

The word agriculture comes from Latin. *Agri* means field and *culture* means to cultivate. The Government of India classifies economic activities related to agriculture as 'agriculture and allied activities'. Broadly, this includes agriculture, livestock-related activities, beekeeping (apiculture), fisheries, rearing of silkworms and preparing silk yarn, and fibre production, such as cotton and hemp.

A little over 18 per cent of the country's total value of goods and services produced in a year (gross domestic product) comes from agriculture and allied activities (2022-2023). Approximately 46 per cent of India's working population is engaged in agriculture and allied activities for their livelihood (2022-2023). A large proportion of families in India are closely connected to the land in one way or another, and in many cases, have been cultivating it for generations. Farming activities are, of course, essential for nurturing and sustaining the human population.



THINK ABOUT IT

Threshing:
Removing the edible grain from the straw or husk, manually or using a machine

When you read or hear the word 'farmer', what do you visualise? Many people imagine a man. However, in rural areas of India, more than 75 per cent of people working in the agriculture sector are women (2025). They perform most of the farming operations, from sowing to harvesting and **threshing**.

India's agricultural landscape is a vibrant blend of traditional and modern farming practices, with diverse crops and deep-rooted cultural traditions. From the golden wheat fields of Punjab, the saffron valley of Kashmir, the lush tea gardens of the Northeast or the Nilgiris to the emerald paddy fields of Kerala, agriculture has long been a fundamental part of the nation's identity.

LET'S EXPLORE

Create a list of the foods you typically eat. Identify the grains, pulses, oils, vegetables, and fruits in them. Now locate where you live on a physical map of India. (You may refer to the political map of India at the end of the book if you wish.) Which of the food items do you think grow in and around where you live? What do you think are the reasons that they are cultivated in your region? Which of them comes from other places? Why do you think they are not grown in your area?

You may have reasoned that growing crops is dependent on several factors — the soil, the climate, the availability of water, the terrain, and so on. The story of farming is, therefore, linked to these factors. We will look at some of these factors in this chapter. But before that, we need to go back a little in time...

Echoes from the Past

The story of Indian farming goes back to prehistory. Archaeological investigations have shown the presence of rice grains in the Ganga Plain as early as the 7th or 8th millennium BCE. Some experts have, however, pointed out that this need not mean that rice cultivation was already systematic; that may have taken a few more millennia to be mastered. At Mehrgarh (in Baluchistan, a site antecedent of the Sindhu-Sarasvatī civilisation), the cultivation of barley and millets is also dated to the 7th millennium BCE. Later, barley and wheat were the staple crops of the Harappans; several Harappan sites also point to the presence of rice in the 3rd millennium BCE, at least in some regions, apart from millets and several vegetables.



Over time, farmers learned to cultivate oilseeds (such as sesame, safflower, linseed, mustard, and castor), legumes (green gram, black gram, and fenugreek), fibre crops (cotton, hemp, jute), more vegetables, and fruits (grapes, dates, jujube, jackfruit, mango, mulberry, and black plum).



DON'T MISS OUT

The Vedas also mention *yava* (barley), *godhūma* (wheat) and *vr̥thi* (rice) as well as other crops such as sesame, black gram, and various types of pulses and legumes.

Intercropping:
the practice
of growing
two or more
different crops
simultaneously



Fig. 1.2. (Top) **Intercropping** at the Harappan site of Kalibangan (Rajasthan) around 2800 BCE, as evidenced by perpendicular furrows. (Bottom) The same practice continuing in the 1960s, around 4800 years later!



Fig. 1.3. An example of intercropping:
growing sugarcane along with pumpkin

This period also saw the domestication of animals. Cattle, asses, sheep, goats, dogs, pigs, fowl, and other animals were domesticated from the pre-urban phase of the Sindhu-Sarasvatī civilisation (c. 3500 BCE).

In the historical period, ancient Indian texts provide a wealth of information on agriculture. Kautilya's *Arthashastra*, the Sangam literature of the early Tamils, *Amarakoṣha*, *Kṛṣhiparāśhara*, Varāhamihira's *Bṛihatsamhitā*, and Surapāla's *Vṛikṣhāyurveda*, among others, contain writings on agriculture, horticulture, and plant biodiversity. Some texts also refer to the rearing and care of animals.

Surapāla's *Vṛikṣhāyurveda* provides recommendations on seed preparation, soil cultivation methods, planting techniques, and more. "Seeds sprinkled with milk, rubbed with cow dung, dried and profusely smeared with *maksika* (honey) and *bidanga* (false black pepper) definitely sprout." On watering of trees — "Newly planted trees in arid land should be watered every morning and evening for a period of fifteen days until the soil is fully soaked." Further recommendations include irrigation methods for other types of soils. The *Bṛihatsamhitā* describes a method of **grafting** still in use today.

From the types of plants, animals, soils, and climates to the methods of irrigation, we find a wealth of information about the knowledge and practices of our ancestors regarding agriculture in these texts.

Grafting:

A technique that joins one plant with another to grow as a single plant enabling the combining of desirable traits like resistance to pests or sweetness of the fruit.

Climate, Seasons, and Crops: What Grows Where and When?

India's varied geography and climate influence the variety of crops grown in different regions and at various times of the year. This section examines India's climatic diversity, the primary cropping seasons, and the pivotal role of monsoons in the country's agriculture.

In the words of Xuanzang, a Chinese pilgrim travelling in India in the 7th century (you will meet him later in this book), "The climate and the quality of the soil being different according to situation, the produce of the land is various in its character. The flowers and plants, the fruits and trees are different kinds, and have distinct names."

This was a sharp observation of India's climatic diversity. In Part 1 of this textbook, we introduced seven different types of climates in India.

LET'S REMEMBER



The types of climates in India are:

- Alpine – the Himalayas
- Temperate – the lower Himalayas
- Subtropical – the northern plains
- Arid – the Thar Desert
- Tropical wet – western coastal strip
- Semi-arid – central Deccan Plateau
- Tropical – eastern India and the southern peninsula

Each of these areas receives different quantities of sunshine and rainfall, experiences variations in the temperatures across the seasons, and is affected differently by the monsoons.

India is divided into 15 agroclimatic zones. In simple terms, climate factors, different types of soil and terrain, and types of vegetation are combined to create these categories. This categorisation helps the government and other agencies identify

and plan appropriate actions to improve agricultural production — what, when, and how to grow different crops. A few examples of agroclimatic zones are the Upper Gangetic Plain Region, Southern Plateau and Hills Region, and Western Dry Region.

The monsoon and agriculture

The Indian monsoon system is a key factor in the country's agricultural diversity. It brings rainfall, which is vital for many crops. India experiences the southwest monsoon and the northeast monsoon. (Refer to the chapter 'Climates of India' in Part 1 of this textbook.) The southwest monsoon brings rain from June to September. It is crucial for the seasonal growth of kharif crops in northern and central India. The northeast monsoon prevails from October to December. This brings rainfall to the east and south of India. Coastal regions, including the Malabar (Kerala) and Coromandel (Tamil Nadu) plains, receive rainfall from both the southwest and northeast monsoons.

The rain from these two monsoon periods enables farmers in the south to grow crops during the period in between; this is a dry season for farmers in north India who depend on other sources of water like groundwater, water from rivers, canals and ponds, and moisture retained in the soil, to ensure irrigation for their crops. States like Tamil Nadu, West Bengal and Andhra Pradesh grow rice throughout the year on account of availability of water from the monsoon as well as irrigation.



Fig. 1.4. An irrigated crop of peanuts in south India

LET'S EXPLORE

Imagine that your state received less than normal monsoon rains for two consecutive years. Which items are likely to disappear from your meals, or are likely to become difficult to access?



The rhythm of seasons and crops: kharif, rabi, and zaid

Indian agriculture is mainly divided into three cropping seasons: kharif, rabi, and zaid.

Farmers have been following this rhythm for centuries. A wide variety of agricultural products becomes available throughout the year. This rhythm is one of the factors that ensures food supply for the people. The terms kharif, rabi, and zaid are of Arabic origin and have been in use since the Mughal times.

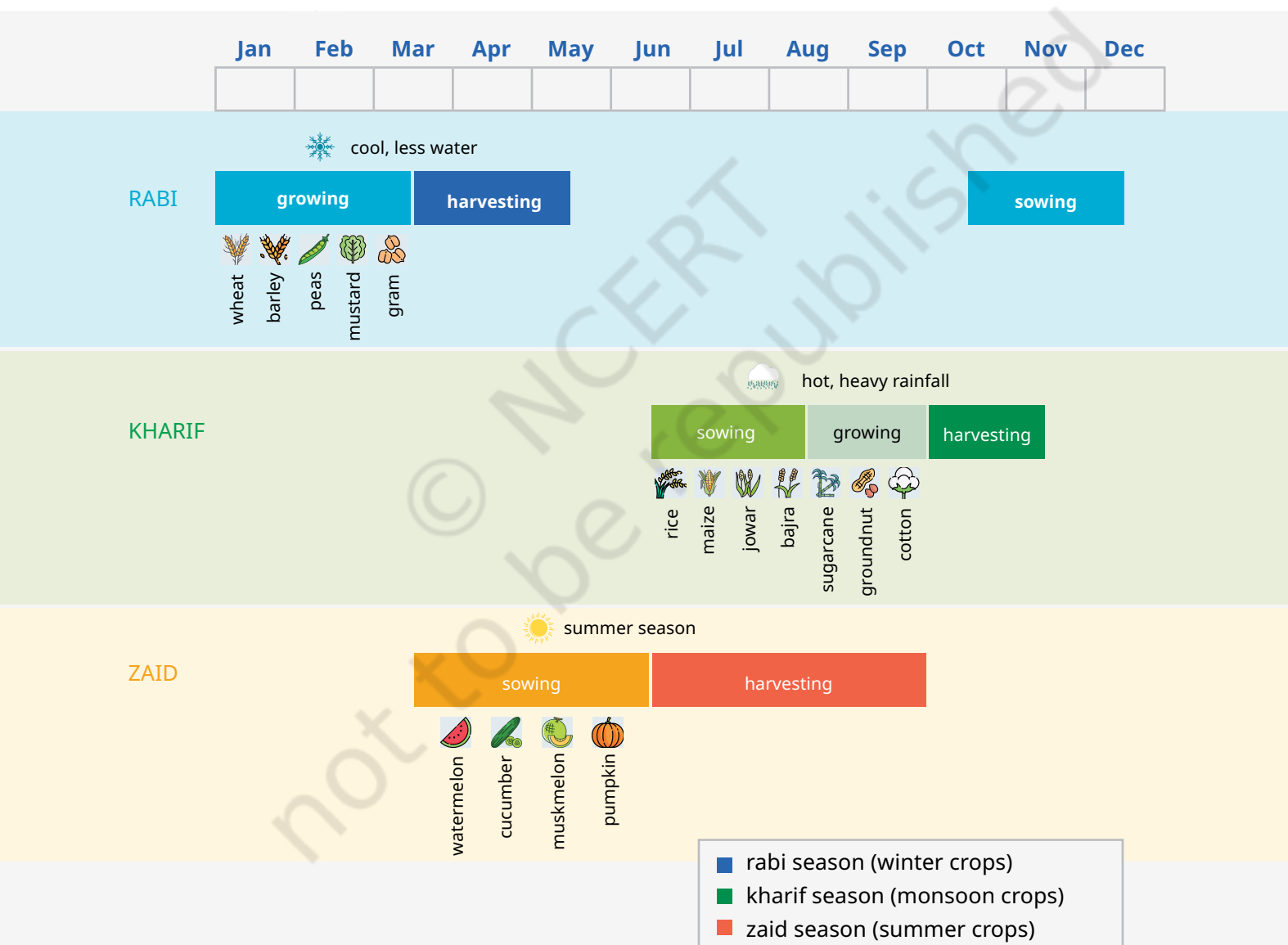


Fig. 1.5. Kharif, rabi, and zaid crops and seasons in most parts of India



DON'T MISS OUT

Before the Arabic terms for the three types of crops became more widely used, they were called *kedāra* (wet crops), *haimana* (winter crops), and *graiṣhmika* (summer crops).

Each of these crop seasons presents its own unique challenges as well. For example, the kharif crops are dependent on the timely arrival of the monsoons. Excessive rainfall also leads to the destruction of crops, causing significant distress to farmers and their families in particular.

LET'S EXPLORE

Prepare a list of the crops that are cultivated in your state or union territory in a year and classify them into kharif, rabi, and zaid.



Fig. 1.6. Rabi crops of mustard (in the foreground) and wheat (in the background)



Fig. 1.7. Pearl millet, a kharif crop



DON'T MISS OUT

The *Arthaśhāstra* contains sections on agriculture, including the preparation of land and seeds, as well as payment to farmers and other relevant topics. “A good rainy season is one when one-third of the annual rainfall occurs at the beginning (*Śhrāvaṇa* — July-August) and at the end of the season (*Kārtika* — October-November), and two-thirds in the middle (*Praṣṭhapada* — August-September and *Āśhvayuja* — September-October).” Why do you think this statement was made? (Hint: Did it have anything to do with the crop cycle?)

Humus:

Humus is the dark organic matter in soil that is formed by the decomposition of plant and animal matter.

It is rich in nutrients and retains moisture in the soil.

Humus is the Latin word for 'earth' or 'soil'.

Soil, the Foundation of Cultivation

Soil is the thin, upper layer of the Earth's crust that supports plant life. It is formed over millions of years through the breakdown of rocks and the decay of organic matter. It's the most essential resource for farmers, as it provides the necessary nutrients, water, and support for crops to grow. This section examines the various soils found in the Indian subcontinent and their associations with specific crops.

How is soil formed?

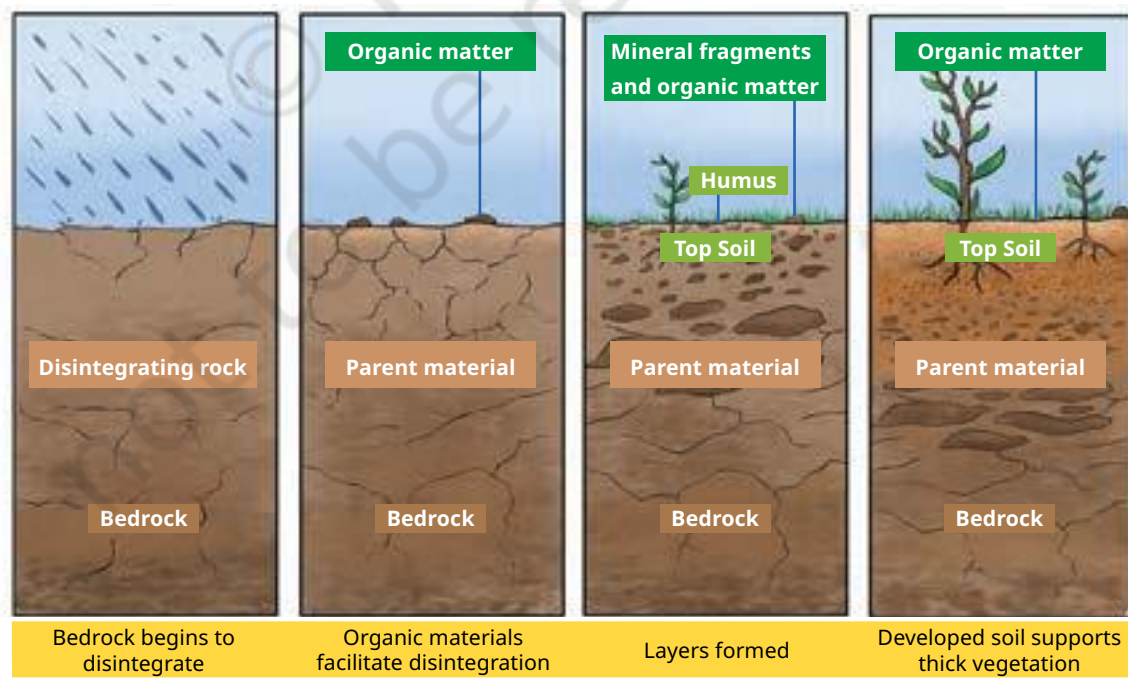


Fig. 1.8. A simplified diagram of soil formation, a process that ranges from a century to several millennia

Soils of India

India has a diverse range of soil types, each with its distinct properties. Ancient texts, such as the *Amarakoṣha*, describe twelve types of agricultural land based on soil fertility. Today, we classify the soils of India into six major types: alluvial soil, black soil, red soil, laterite soil, desert soil, and mountain / alpine soil.

LET'S EXPLORE

- Try to name at least two states in each of the zones mentioned above.
- Which type of soil is predominantly found in your state or union territory?
- Soils tell us stories about places — what might have happened over thousands of years during which the soils were being formed. Take a few samples of soil from your neighbourhood. Look carefully at them. (Examine the soil using a magnifying glass or microscope if you have access to either.) What do the samples consist of? What might be the origins of the soil? Are there signs of human activity that you notice? What might happen to the soil over time on account of this?

Soil-crop linkages

In addition to the agroclimatic conditions that we briefly saw above, crops are also strongly influenced by the type of soil where they grow.

LET'S EXPLORE

- Take up a small group project. Identify the types of vegetables, fruits, and trees that grow in the different soil types.
- Create a family food flowchart that connects your favourite dishes to the different crops they are prepared from and the corresponding soil types in which they are cultivated.

Weathering:

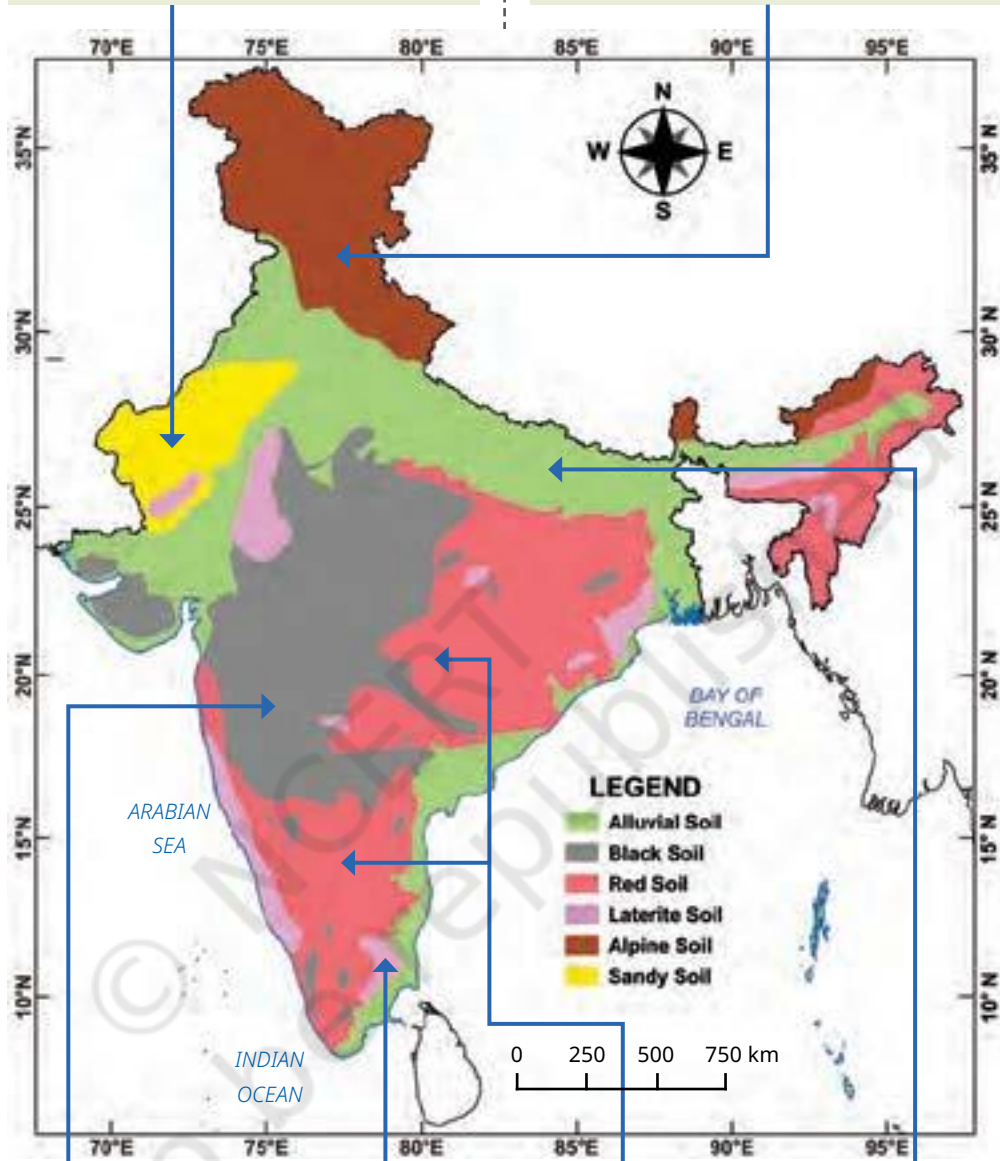
Refers to the process by which rocks and minerals are broken down into soil particles through physical, chemical, or biological means.

Silt:

A fine-grained, dust-like sediment composed of rock and mineral particles that are larger than clay but smaller than sand. As a result, they are easily transported by rivers from the mountains to the plains.

Sandy soil: made up mostly of small grains of sand; when a little bit of water, air and organic matter mix, it becomes sandy soil

Alpine soil: formed by the freezing and melting of ice which leads to **weathering** of rock; the soil is thin, rough and rocky



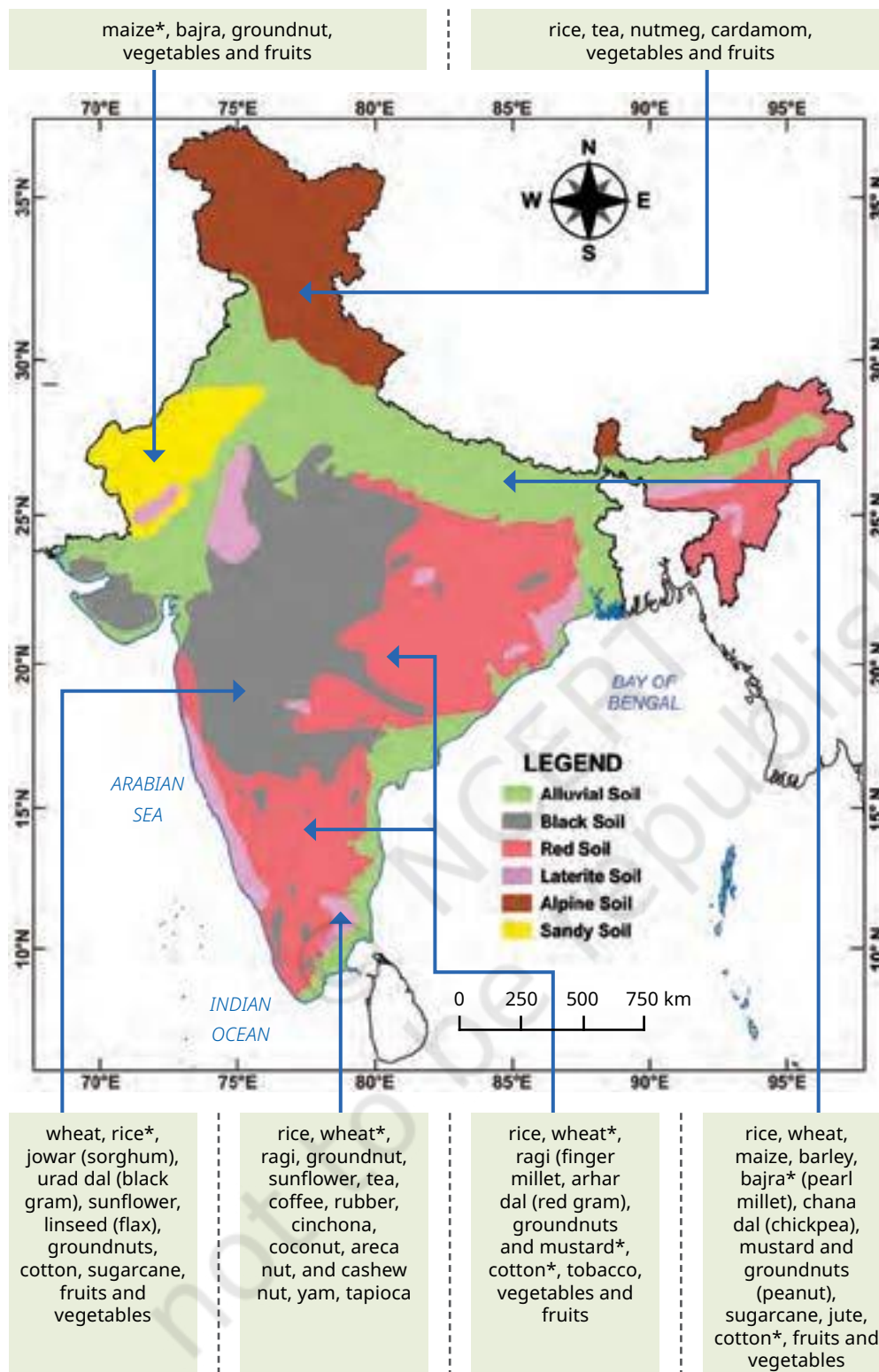
Black soil or cotton soil: formed by the weathering of volcanic rocks; holds a lot of moisture and is very fertile

Laterite soil or brick earth: formed by the weathering of rock by rain; becomes hard in hot weather. Most minerals get washed away leaving largely iron and aluminium, react with air and water and give reddish colour; not fertile

Red soil: formed by weathering of lava (that has cooled slowly) or of old rocks; they are red because they have a chemical called iron; when iron reacts with air and water it becomes reddish in colour; not very fertile

Alluvial soil: **Silt** deposits (mud, sand and other fine particles) brought by rivers from the mountains and plateaus; rich in nutrients

Fig. 1.9. A simplified map of the major soil types of India and their formation. Most regions will have local variations.



Bedrock:
Bedrock refers to the original rock from which new rocks and soils are derived through weathering, erosion, and other processes.

**These crops are not here on the ideal soil for their cultivation, but can be grown with efficient irrigation.*

Fig. 1.10. Some examples of crops grown in the different soil-type areas
(You need not remember all these details)

Soil conservation:
It refers to the practice of managing soil to prevent its degradation and preserve its productivity.

Nurturing the soil

Healthy soil is crucial for a good harvest. Soil is a complex ecosystem with organisms like bacteria, fungi, earthworms, and insects. It has minerals, organic matter (humus), water, and air. The organisms break down the organic material and improve the health of the soil enabling it to sustain healthy plants. To maintain its health and fertility, farmers use various **soil conservation** techniques.

- **Traditional methods:** Our ancestors employed numerous ingenious techniques to protect the soil. **Crop rotation** is one such method, where different types of crops are grown in the same field in different seasons to prevent the soil from losing specific nutrients. Equally important was **multiple cropping** where multiple crops were grown in the same field. This reduced the risk of pests and also ensured at least one crop. The crops were chosen in such a way that there would be periodic harvests from the same field. Another practice is **contour ploughing**, which involves ploughing along the natural curves of a hill slope to avoid soil erosion from rainwater. Farmers also used **organic fertilisers**, such as cow dung, to replenish the soil's nutrients.



DON'T MISS OUT

Did you know that *panchagavya* is a fermented mixture of five cow products: dung, urine, milk, curd, and ghee? Recent studies have shown that it acts as a biofertiliser, enhancing crop growth and productivity while increasing their resistance to diseases.

- **Contemporary approaches:** Today, modern techniques such as terracing are used in hilly areas to create flat steps for farming, which slows down water runoff and reduces soil erosion. Afforestation, or planting trees, is another method that helps to prevent soil erosion. Some traditional methods like mulching, ploughing back crop residue, are still practised by farmers today. Very precise application of fertilisers enables their efficient use and also maintains soil health.



Fig. 1.11. Banana trees on the bunds of these paddy fields serve as windbreakers, hold the soil in place, and also provide another crop to the farmers.



*Fig. 1.12. A drone being used to assess soil moisture in a **greenhouse**.*

Greenhouse:
A transparent covered structure made of glass or plastic that captures sunlight and heat for the growth of plants in a controlled environment.

Water: Rain-Fed vs. Irrigated Agriculture

Water is a fundamental resource for agriculture. Without it, crops cannot grow. The availability of water is a significant factor that determines how farming is done in different parts of India. This section examines two primary types of irrigation practices: rain-fed and irrigated.

a. Rain-fed agriculture

Rain-fed agriculture refers to farming practices that rely entirely on rainfall. This type of farming is common in areas that receive sufficient rain during the monsoon season. However, farmers

who are dependent on rainfall face numerous challenges, including droughts and unpredictable monsoons. To cope with these challenges, they have developed various adaptations, such as choosing drought-resistant crops or utilising traditional water-harvesting techniques.

b. Irrigated agriculture

Irrigated agriculture uses artificial methods to supply water to crops. This type of irrigation is crucial for enhancing farm productivity and reducing reliance on monsoon rains.

The history of irrigation in India is very long. Right from the time of the Indus civilisation, various water structures have been built in India. Throughout the country, a rich vocabulary



Fig. 1.13. The Munsar Lake at Viramgam (Gujarat), like many lakes in Indian cities, is an artificial one; it was constructed by Minaldevi, a queen of the Chaulukya dynasty in the 11th century CE. Its banks are dotted with small shrines and a few bigger temples, as a reminder that water bodies have been regarded as sacred.

of water structures developed, such as *kull*, *kund*, *ahar*, *pokhar*, *khadin*, *arakere*, *koḷam*, *surangam*, *taḍāgam*, and *eri*, to name a few.

Some **traditional irrigation systems** include *phad* systems, and bamboo drip irrigation. Farmers also create small ponds that collect rainwater and provide moisture to the soil for a longer period of time.



Fig. 1.14. Bamboo irrigation system used in northeast India

- **Phad systems** are community-based irrigation systems, particularly found in the state of Maharashtra. These systems use small canals to divert river water to fields.
- **Bamboo drip irrigation** is practised in parts of northeastern India. Here, farmers traditionally use bamboo pipes to channel water from springs to their fields.

LET'S REMEMBER



In Part 1 of this textbook, you became familiar with *Kallanai*, the grand anicut, built by Karikāla across the Kaveri River about 1,800 years ago. It is a massive and effective water-diverting structure that irrigates thousands of hectares of land.

Over time, irrigation has evolved from simple systems to more advanced ones. Modern irrigation techniques include drip and sprinkler irrigation.

- **Drip irrigation**, also known as trickle irrigation, delivers water slowly and directly to the plant's roots through a network of tubes and emitters.



THINK ABOUT IT

Imagine a network of small pipes with tiny holes placed near the base of your plants. These pipes are connected to a water source, and when the water is turned on, it drips slowly and steadily from the holes, watering only the roots. This targeted delivery ensures that water is used efficiently, minimising waste.



Fig. 1.15. Drip irrigation to reach water efficiently to plants

- **Sprinkler irrigation** sprays water into the air, which falls over the crops like artificial rain.



Fig. 1.16. Sprinklers in a wheat field

These modern methods help in using water more efficiently. This is very necessary as in many parts of India, groundwater reserves are fast decreasing. The evolution of irrigation has had a significant impact on India's agricultural landscape, enabling farming even in areas with low rainfall. It has helped to increase crop yields and ensure a more stable food supply for the country.

Seeds

One key component of farming is seeds. Seeds have been passed down in families from generation to generation, preserved at the community level, and shared. In some areas women also carry them as part of the gifts they bring to their marital home. High-yielding seeds were carefully selected and preserved for use during the next planting season.

The *Arthashastra* provides instructions for preparing seeds of various varieties for planting. For example, cotton seeds are to be smeared with cow dung. Cereals, beans, and pulses are to be soaked in dew for a certain number of days and then sun-dried before being planted. Sugarcane was to be smeared at the cut with a mixture of honey, ghee, lard, and covered with cow dung.

The Indian Council for Agricultural Research (ICAR) has developed methods for the use of a paste called *beejamrit* made of cow dung and urine, combined with other materials, to coat seeds before planting. This protects seeds from being spoilt and also reduces germination time.



DON'T MISS OUT

The Indian seed drill is an ingenious invention of ancient Indian farmers. These seed drills combined soil preparation, seed planting, and the closing of the furrow in one operation. This reduced the labour involved in what would have been a three-step operation.

Today, an increasing number of farmers purchase seeds from various companies. These seeds are developed using scientific processes that provide higher yields and are pest-resistant. However, often the seeds that the plant later produces are not suitable for planting in the next season. This has drawn criticism because it creates a dependency of farmers on these seed companies.

Agricultural Practices: Traditional Wisdom and Modern Innovations

Over the centuries, Indian farmers have developed numerous farming methods. Some of these are based on ancient knowledge and traditions, while others are modern techniques that use contemporary technology. Many farmers use a combination of methods.

Traditional farming systems

Traditional agriculture considers the plant and the soil (including the whole soil ecosystem) as a complete system. The soil is considered to be the primary source of nutrients, along with other sources of plant nutrients supplied in the form of farmyard manure. The bacteria, fungi, etc. in the soil help to convert the nutrients in the soil into forms that are easily taken up by the plants. The plants, in turn, support the growth of these organisms by supplying energy to them through their roots.



Fig. 1.17. Terrace farming in Uttarakhand

Traditional farming typically involves small-scale, resource-reliant methods that are closely tied to the environment. Terrace farming is an example. This is a method used on hilly slopes. Farmers cut steps or terraces into the hillside to create flat land for agriculture, which helps to prevent soil erosion and conserve water.

ICAR has documented almost 5000 traditional practices and tested over a hundred of them. It has been found that over 85 per cent of these practices were

validated by modern science and could be applied to reduce the use of chemicals and enhancing soil health.



DON'T MISS OUT

Traditional farming systems are usually aligned with natural cycles, such as the *ritu chakra* (cycle of seasons), and often rely on family involvement and domestic animals. Examples include *kulāgar* and *gokṛīshi*.

❖ ***Kulāgar***: This term comes from the Konkani words '*kula*' meaning 'family' and '*āgar*' meaning 'storehouse'. It is a traditional homestead farming system where families cultivate a variety of crops, including food crops, cash

crops, fruits, vegetables, spices, and medicinal plants, around their homes by designing a structured irrigated system. This practice is common in the Konkan Plains (Goa) of India.

- ❖ **Gokṛishi:** This is a holistic method in which cows provide manure, which is used as organic fertiliser, and bullocks are used to plough the fields.

Contemporary agriculture

Contemporary agriculture is characterised by modern farming methods that use technology, machinery, and new farming techniques. A significant turning point was the **Green Revolution** in the 1960s and 1970s. This movement introduced:

- high-yielding varieties (HYV) of seeds,
- increased irrigation,
- chemical fertilisers and pesticides, and
- mechanised equipment, among others.

This revolution led to a significant increase in food grain production, particularly of wheat and rice, and India achieved self-sufficiency in food. Modern farms started using tractors, harvesters, and other machinery to make work faster and easier. Since then, agriculture has emerged as the ‘backbone of the Indian economy’.



Fig. 1.19. Stamp released to mark the revolution in wheat production in India. Note the bar graph in the stamp.



Fig. 1.18. M.S. Swaminathan, architect of the Green Revolution, recipient of Bharat Ratna

Over the last few decades, the limits of the approach and methods of the Green Revolution have become visible — the long-term impoverishment of the soil, depletion of groundwater, contamination of the soil and water by pesticides and fertilisers, damage to human and animal health (including

multiplication of cancer cases in rural areas, as many scientific studies have established), among others. More and more agricultural scientists the world over question the sustainability of this type of agriculture.

Sustainable pathways

In recent years, there has been a growing interest in combining the productivity of modern methods with the wisdom of traditional practices to create sustainable agriculture. This approach is inspired by Indian Knowledge Systems (IKS) and focuses on environment-friendly, long-lasting farming practices. One example is the resurgence of organic farming, which avoids the use of chemical fertilisers and pesticides. Instead, it relies on natural fertilisers, such as compost, seed cake (residue after oil has been extracted from seeds) and manure from animal sources. Another example is the use of neem-based pesticides, which are natural and much less harmful to the environment than chemical ones.



DON'T MISS OUT

Sikkim is the world's first 100 per cent organic state. It adopted an organic farming model for sustainable agriculture by banning in 2014 chemical fertilisers and pesticides, and focusing on natural farming practices. (We visited Sikkim in Part 1 of this textbook.)



LET'S EXPLORE

Identify modern agricultural solutions inspired by traditional practices (for example., neem-based practices).

When comparing traditional and modern methods, a trade-off is evident. Modern techniques, such as those from the Green Revolution, are highly productive and can produce a substantial amount of food quickly. However, as we saw above, the Green

Revolution has not been without long term harmful effects. The use of chemicals pollutes water sources (they dissolve and enter water), and disrupts the ecosystem by harming important creatures like bees which are so necessary for pollination. Traditional methods, on the other hand, are often more resilient and sustainable because they work in harmony with Nature; however, they may yield lower results. The challenge today is to find a balance between the two — using modern innovations to meet our food needs while also adopting the sustainable practices of our ancestors.



DON'T MISS OUT

The Food and Agriculture Organisation (FAO) has recognised three globally significant agricultural heritage systems in India. The farming of saffron in Kashmir, the traditional agricultural systems of Odisha that integrate forest management, and the below-sea-level agricultural methods in Kerala, which includes crop plantation and fishing.



Fig. 1.20. (1) A field of crocus flowers that yields saffron, Kashmir. (2) Integrated forest and land-based agricultural system, Odisha. (3) Integrated paddy farming in saline water, fishing, and rearing livestock, Kerala.



DON'T MISS OUT

If you thought that soil is absolutely essential for growing plants, think again. Hydroponics is a method by which plants are grown in nutrient-rich water solutions; essential minerals are given directly to the roots. It is used in controlled environments, making it an option for urban farming and areas with poor soil quality.



Fig. 1.21. Vegetables being grown using hydroponics

The Role of the Government

In many states, the government has a support system to help farmers access seeds, fertilisers and pesticides, information on the weather forecast, research and training on new farming practices, and so on.

The government also provides electricity for irrigation at lower prices, to reduce input costs. Farmers can access financial assistance through schemes for crop insurance like the Pradhan Mantri Fasal Bima Yojana. Finally, the government purchases important crops from farmers to ensure that they have no difficulty marketing their produce and get fair prices.



Fig. 1.22. An example of a government insurance scheme for farmers

The promotion of cold storages, and better access to information and markets through the use of digital technology, enable farmers to get better prices for their produce. (Refer to the chapter 'Understanding Markets' in Part 1 of this textbook.)

LET'S EXPLORE

Listen to the special programmes for farmers on the radio or watch a programme on television for a few days. Write down carefully the information that is shared through these mediums. Make a short report on the categories of information you gathered as well as questions that came to your mind during this activity.

Challenges

Indian farmers face several challenges. One of them has been the decreasing size of **landholding** as land gets divided among family members over generations. The average landholding is approximately three-fourths of a **hectare**; this is about the size of an average football field.

Farmers with small landholdings are not able to earn much income. It is also difficult for farmers to use tractors and other machines on their farms — the machines are designed for larger farms and are expensive to buy or rent, although of late machines have been designed and invented for small farms too.

Traditionally, families in farming have different sources of income beyond the crops they grow. They rear cows, goats, poultry, practise apiculture or fishing, and so on. Where possible, they collect forest produce. Many grow trees on the bunds for fruit and timber. Diversity builds resilience. However, today this is proving to be inadequate to provide a decent quality of life to farmers.

Farmers also face one of the biggest challenges of our time, climate change. With increasing unpredictability of weather patterns (for instance, untimely rains), and more frequent extreme events (such as severe droughts or heavy rainfall),



Landholding:
An area of land that a person owns

Hectare:
1 hectare
= 10,000 square metres. (The old unit of an acre, about 4047 square metres, is still widely in use in India.)

farmers face a higher risk of crop destruction, leading at times to heavy losses. This trend is likely to get worse as our planet gets rapidly warmer.

THINK ABOUT IT

With its rich alluvial soil, for millennia the Ganga basin has been a source of food and water to millions of people — over 500 million today. Yet, for some years, the Ganga river has been under stress and is increasingly unable to replenish itself; parts of it are no longer navigable in summer as the water level is too low even for river boats.

The causes are multiple: global warming is causing Himalayan glaciers to melt at an unprecedented rate; much water is diverted to irrigation; agriculture and industry pump out huge amounts of groundwater; and hundreds of dams interfere with the river's natural flow. Solutions exist, but if this condition of Ganga persists, agriculture in its basin may become less and less sustainable, threatening the livelihood of millions and India's food production.

Such challenges and a few more have often led farmers to take loans in times of hardship, only to find that paying those loans back was difficult and catching them in a debt trap. As a result, many farmers — as many as 2,300 every day, according to some estimates — have been compelled to abandon agriculture. With new approaches such as those described in this chapter, there is hope that agriculture will eventually flourish in every part of India.



Before we move on ...

- Indian agriculture blends traditional and modern methods, involving crops, livestock, forestry, and more.
- Agriculture in India is connected with its diverse climates and the monsoons, with three cropping seasons: kharif, rabi, and zaid.
- Six major soil types influence which crops are grown. Soil health is key to flourishing and sustainable farming.

- Seeds are passed down traditionally or bought as high-yield varieties from companies. This sometimes creates dependence on companies for seeds.
- Sustainable farming combines modern technology with eco-friendly practices, such as efficient irrigation.
- Farmers face challenges like small landholdings, climate change, non-affordability of modern equipment, and market challenges.
- The government helps through access to information, research and training, as well as different types of financial support.

Questions and activities

1. Why do farmers in Kerala grow rice while farmers in Punjab grow mostly wheat? What would happen if they swapped?
2. Match the following:

Column A	Column B
(a) Kharif crops	(i) Crops during the winter
(b) Rabi crops	(ii) Crops grown during the monsoon
(c) Alluvial soil	(iii) Thin, rough, and rocky soil found in mountainous regions
(d) Terrace farming	(iv) Crops grown in summer
(e) Alpine soil	(v) Soil rich in nutrients deposited by rivers
(f) Zaid crops	(vi) Method of farming on hillsides

3. Why do certain crops thrive in specific regions?

4. How has modern technology helped farmers?
5. Why is sustainable agriculture important? Write a short note on this.
6. Name some challenges that farmers face today. What might be their impact for people?
7. Have a debate in class on the topic “Traditional irrigation methods are better than modern ones.”
8. Write a short essay describing what farming might be like when you are 60 years old. You could also draw / paint a picture to illustrate what you envision.
9. Form small groups and discuss the issues affecting the Ganga basin. Prepare a presentation proposing your solutions and their rationale (your reasons). Share and discuss in class. Your teacher will guide you in this exercise.
10. Looking at the crops listed in the section ‘Echoes from the Past’, which ones do you find in use in your home? What conclusion can you draw from your observations?

India and Her Neighbours

CHAPTER 2

Our destinies are inextricably tied together. What affects one nation affects the rest of us.

— Nelson Mandela (1995)

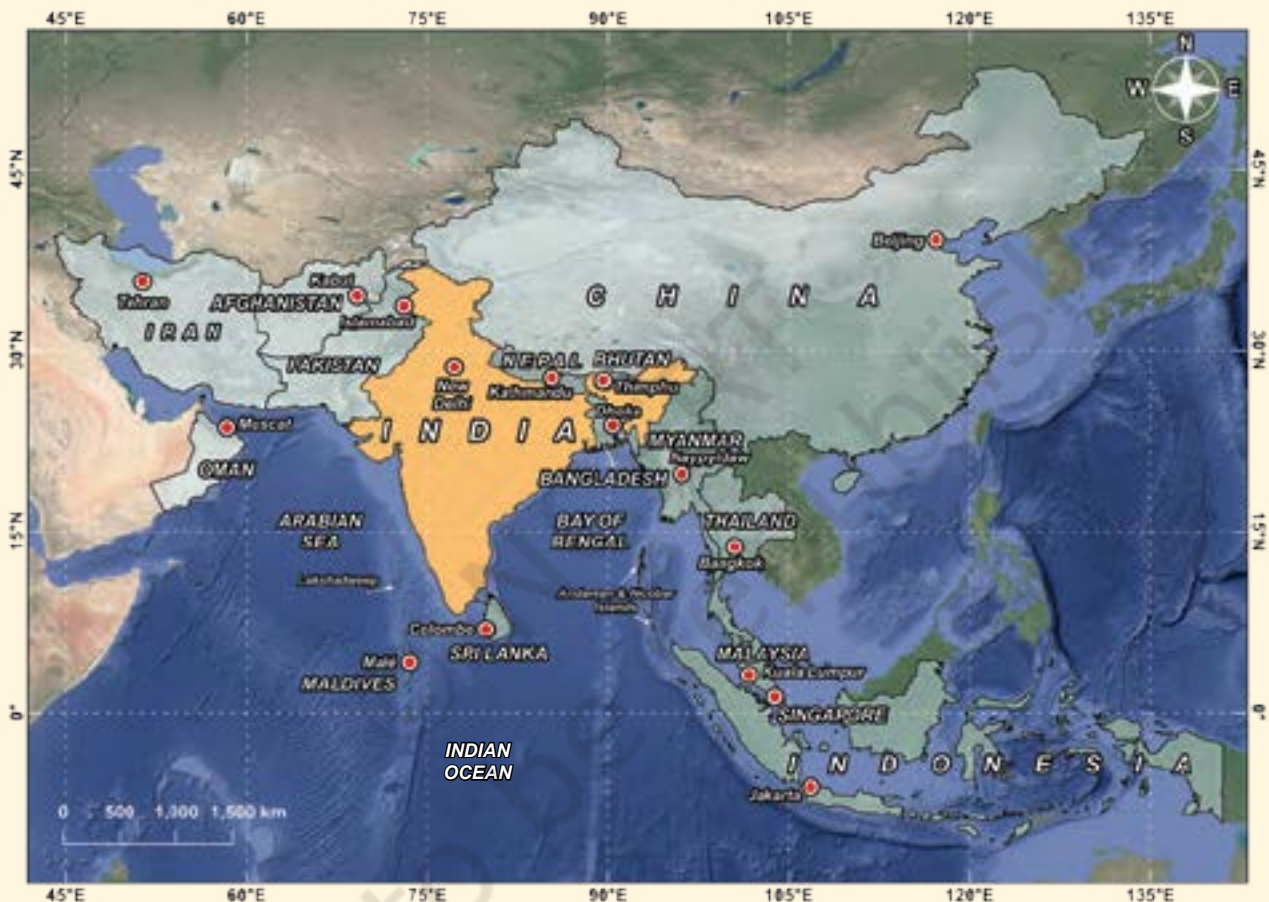


Fig. 2.1. India and some of her neighbours

The Big Questions ?

1. What defines a 'neighbour'? Is it just shared land borders?
2. How do geography and history influence the nature of India's relationships with her neighbours?
3. In what ways are India and her neighbours interconnected today?



Framing the Neighbourhood

When we think of a neighbour, we often imagine a country that shares a land boundary with us. That is the traditional view of neighbourhood. In that sense, Pakistan and Afghanistan in the northwest, China's region of Tibet, Nepal, and Bhutan in the north, and Bangladesh and Myanmar in the east are indeed our neighbours. India's total land boundary stretches over 15,100 km and passes through diverse landscapes, including deserts, plains, forests, mountains, marshes, and river valleys.

India, however, has always been a maritime nation, surrounded by the sea on three sides. This makes Sri Lanka and the Maldives our immediate neighbours across the waters. But if we look at India from a high-altitude satellite, we can also see that nations like Iran, Oman, Thailand, Malaysia, Singapore, and Indonesia are part of our maritime neighbourhood. In this chapter, we use this understanding of a wider neighbourhood to situate India's central and strategic place in South Asia (Fig. 2.1).



DON'T MISS OUT

Who is a **maritime neighbour**?

A maritime neighbour is a country connected to another by a shared sea or ocean, even without a direct land border. (*Revisit the chapter 'Oceans and Continents' in your Grade 6 textbook.*) The ocean acts as a vital link, facilitating centuries of trade, cultural exchange, and historical ties. In this chapter, we will visit only the maritime neighbours nearest to India.



LET'S EXPLORE

Identify the three large water bodies that surround India in the map on the facing page (Fig.2.2).

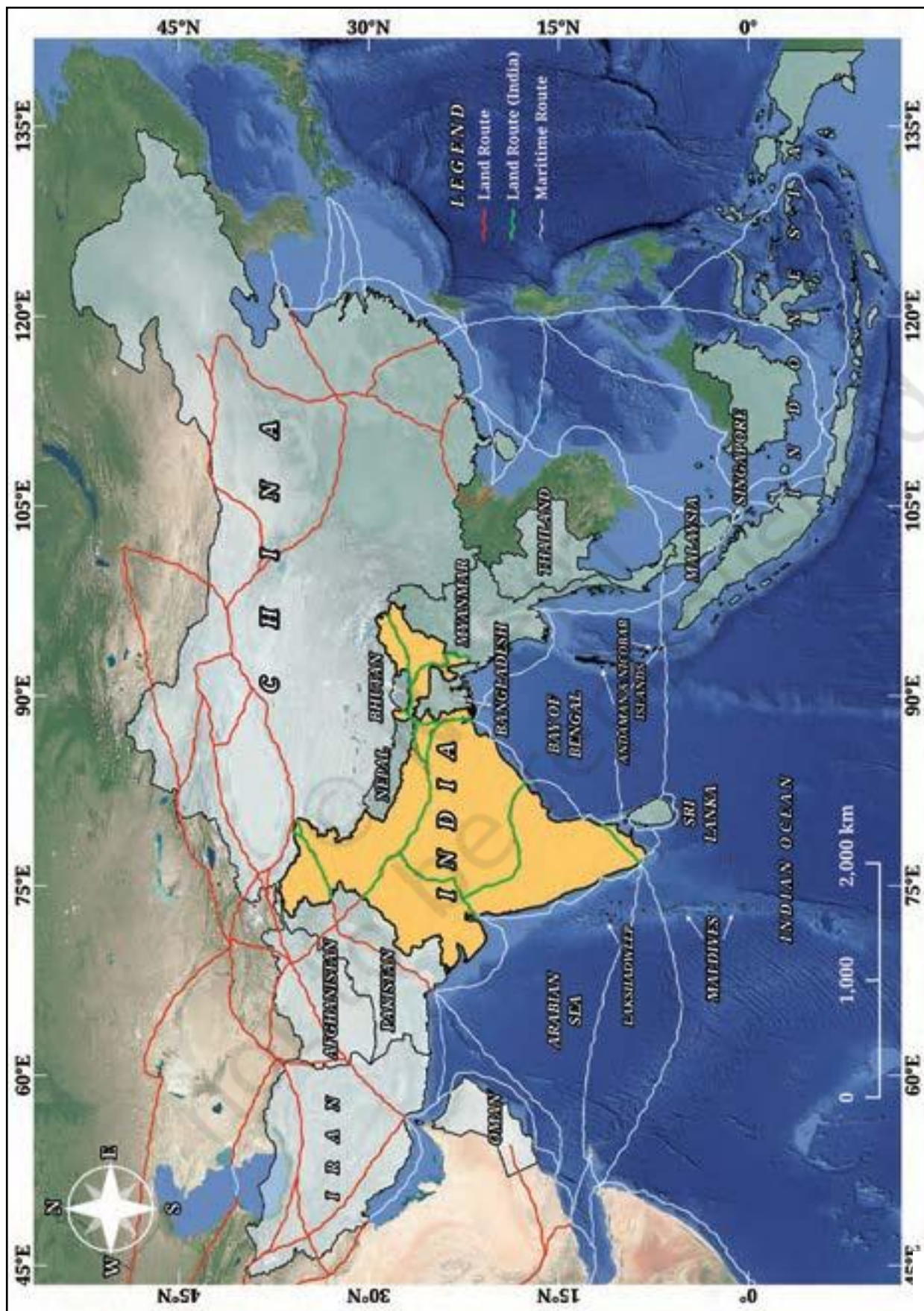


Fig. 2.2. A simplified map of the major land and sea routes that have connected India with many regions and countries of Eurasia and Africa over the centuries. (The routes shown here are approximate and fluctuated in time.)

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DON'T MISS OUT

The Indian Ocean is the third-largest ocean in the world and is a busy route where half of the world's container ships, one third of the bulk cargo, and two-thirds of the world's oil are transported. This ocean connects many countries, which are home to around 2.7 billion people.

With a long coastline of approximately 11,100 km, India holds a unique maritime position. Her peninsular shape extends deep into the Indian Ocean — a location that provides India with access to important sea routes, making her a vital link between Southeast Asia, West Asia, and Africa. This has allowed India to play a key role in trade and regional cooperation. India's ports serve as gateways for imports and exports, and her central position helps in providing timely humanitarian aid and disaster relief in the region.

Such involvement is called **regionalism** and helps create peace, stability, and shared progress. It teaches us that being good neighbours is not just about borders, but also about working together for the benefit of everyone in the region. See the map in Fig. 2.2 to get a sense of the dense networks of land and sea routes connecting India with many regions in this part of the world.

India and Her Land-based Neighbours

India and her largest neighbour

Since 1950, India and **China**, two of Asia's largest and most influential nations, have shared a long and strategic relationship shaped by history, geography, culture, trade, and politics. Separated by the Himalayas, their border stretches (from east to west) across the states of Arunachal Pradesh, Sikkim, Uttarakhand, Himachal Pradesh, and the Union Territory of Ladakh.

Culturally, Buddhism is a powerful link between the two countries. Originating in India, it reached China around the 1st century CE via trade and pilgrimage routes. A few centuries later, Chinese monks like Faxian and Xuanzang travelled to Indian centres of

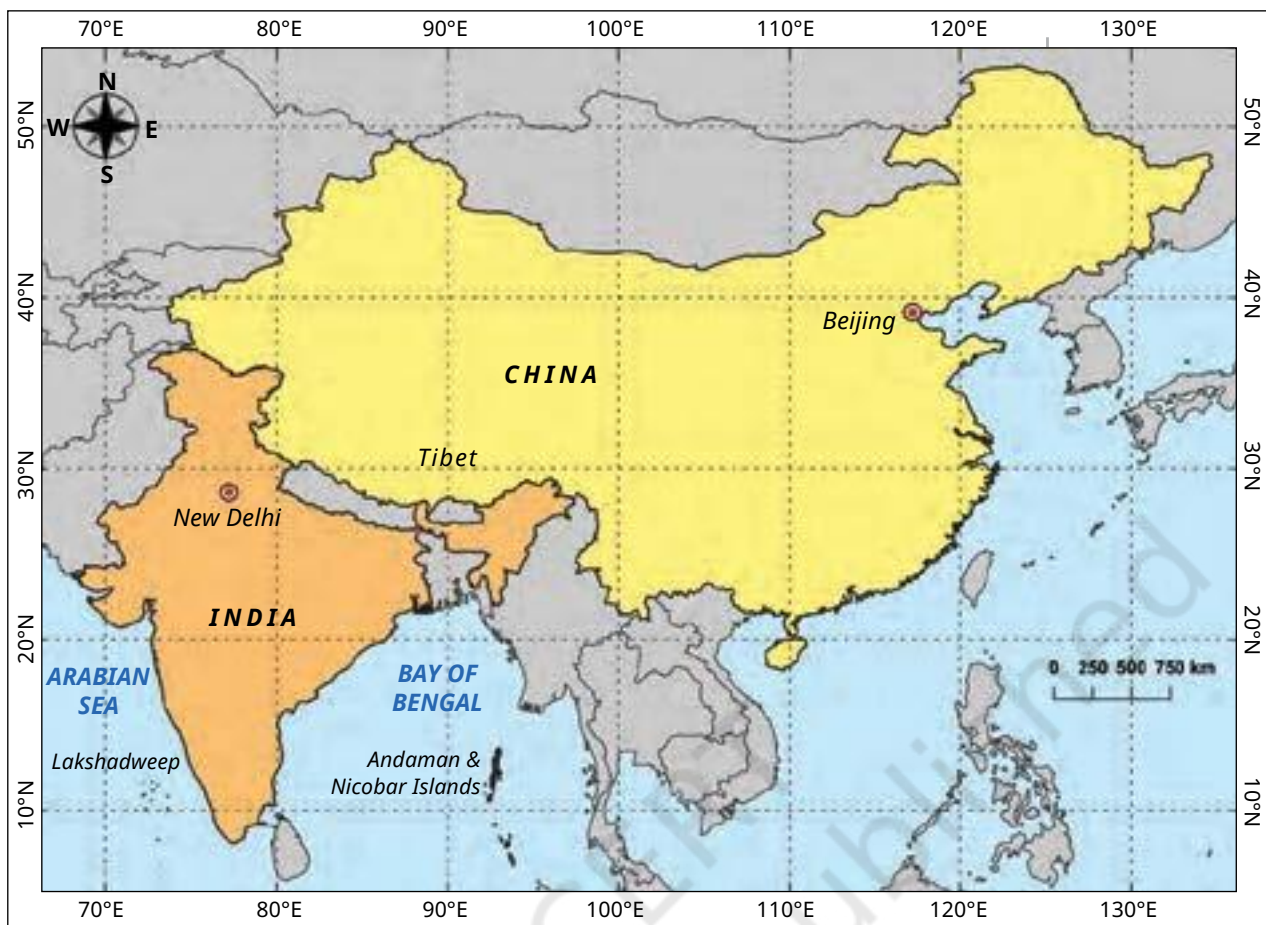


Fig. 2.3. India and China. (Note that China is approximately three times larger than India in area.)

learning, while Indian monks such as Bodhidharma, Dharmakṣhema and Kumārajīva carried Buddhist teachings to China, creating deep spiritual and intellectual ties.



DON'T MISS OUT

In the 13th century, Hindu merchants built temples in the Chinese port city of Quanzhou, an important trading centre. At the Kaiyuan temple, pillars depict carvings of Viṣṇu, Śhiva, and stories from the Rāmāyaṇa and the Purāṇas.



Fig. 2.4. 'Gajendra mokṣham' or the story of Viṣṇu rescuing the elephant from a crocodile, carved on a pillar at the Kaiyuan temple

India's trade relationship with China continues till date. In 2024-2025, India's chief exports to China were iron ore, chemicals, and cotton yarn; the imports include electronic items (including mobile phones, computer hardware, etc.), and a variety of industrial equipment. Several Indian companies have set up operations in China and vice versa. However, the balance of trade is currently much in China's favour, since her exports to India are worth about eight times more than India's exports to China.

Recent years have also seen phases of heightened tensions, mostly related to their shared borders, and a few serious conflicts, some of which you will encounter in higher classes. On the other hand, efforts are being made to resolve disputes through trade, dialogue and border resolution mechanisms.

India and Pakistan

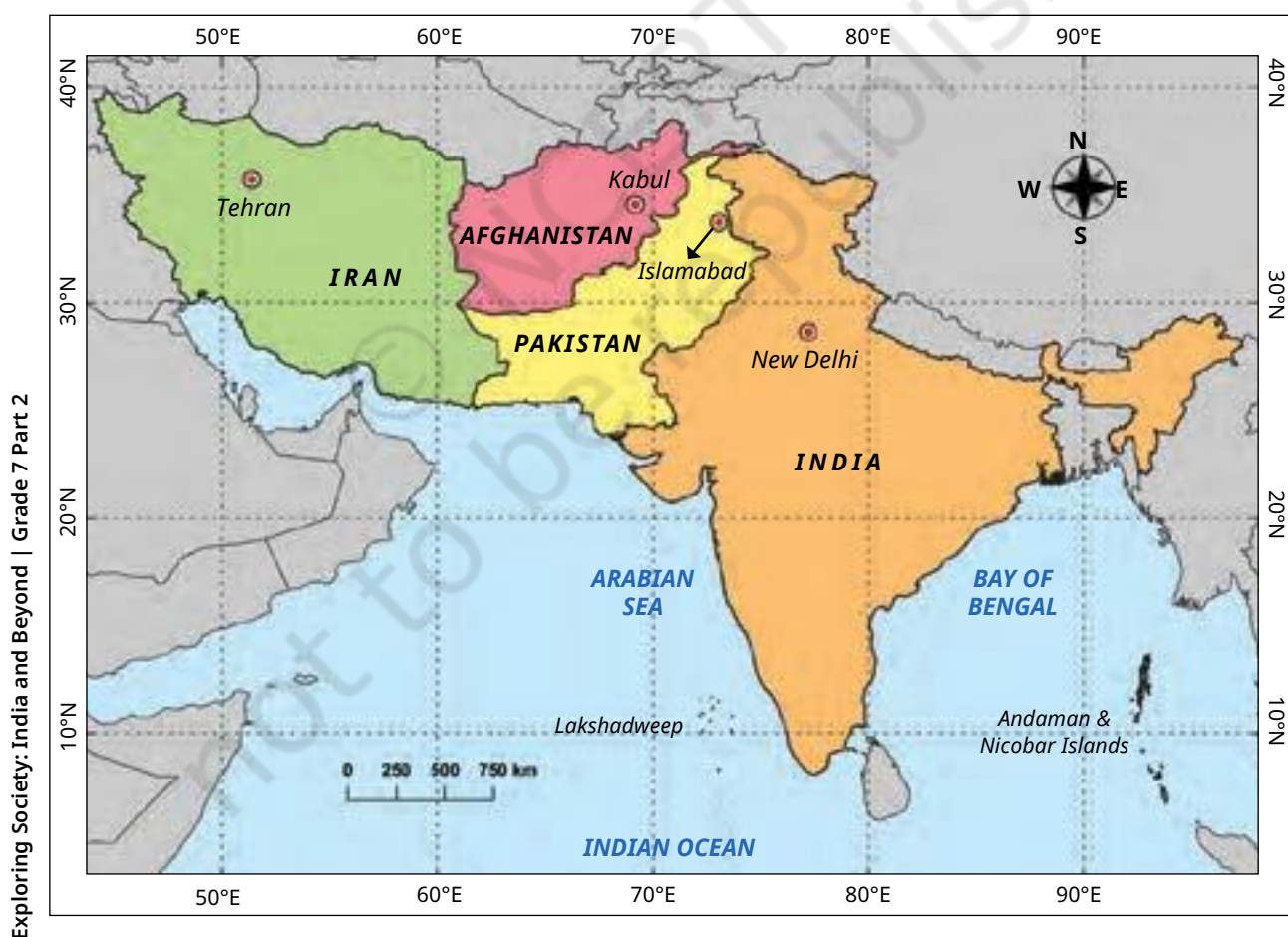


Fig. 2.5. India, Pakistan, Afghanistan, and Iran

Before the 1947 Partition — a legacy of the colonial era that continues to shape the present — **Pakistan** was a part of India. Let us note for now that Pakistan was founded on a religious basis, unlike India; this will be explored further in Grade 8. Suffice to say that these nations share one of the most complex relationships in South Asia. Since the Partition, several military conflicts and wars, including wars in 1948, 1965 and 1971, and full-scale conflicts like the Kargil War in 1999, have defined an ongoing tension. In particular, frequent terrorist attacks launched against India with the support of the Pakistan army have prevented normal relations between the two countries.

The border between the two nations stretches across the Indian states of Gujarat, Rajasthan, Punjab, and the union territories of Jammu and Kashmir and Ladakh (Fig. 2.5). It is not just a geographical line, but also a symbol of shared heritage as well as a tragically divided history.

This tumultuous journey has also been marked by attempts at peace, such as periods of trade and the opening of pilgrimage routes for Hindu or Sikh pilgrims — religious and cultural landmarks of a shared past that lives on. The Katas Raj temple complex in Pakistan's Punjab is one such example, linked to the Mahābhārata and containing a sacred pond. Other examples include several ancient Hindu, Buddhist, and Sikh shrines, such as the Hinglaj Mata Mandir in Balochistan. Besides, languages, cuisines, music, and festivals continue to bridge the border.



DON'T MISS OUT

The Kartarpur Corridor is a visa-free border crossing between India and Pakistan, created to allow Indian pilgrims to visit the Gurdwara Darbar Sahib in Kartarpur, Pakistan (Fig. 2.6). Pilgrims using the corridor do not need a visa, only a permit, which makes it easier for thousands of people to visit the gurdwara. This gurdwara holds great religious significance as it is the final resting place of Guru Nānak Dev, the founder of Sikhism, who spent the last 18 years of his life there.

For decades, Indian devotees could only view this holy site from a distance, using binoculars set up near the border at Dera Baba Nanak in Punjab. The idea for a corridor was first proposed in the 1990s but only became a reality in 2019, when the corridor was officially opened to mark Guru Nānak's 550th birth anniversary.

Can the Kartarpur Corridor be a model for the possible progress of peace and dialogue?



Fig. 2.6. A view of the Kartarpur Sahib Gurdwara

A newborn neighbour

India and Bangladesh have an enduring relationship shaped by a common history, culture and language. 'History' because, as we will see in higher grades, **Bangladesh** (which was 'East Pakistan' earlier) was born in 1971 as the outcome of a war between India and Pakistan; and 'language' because Bangla is a language common to Bangladesh and India's state of West Bengal.

The land border between the two countries (Fig. 2.7) is even longer than India's border with China; it runs along the Indian states of West Bengal, Assam, Meghalaya, Tripura, and Mizoram. India and Bangladesh also share several transboundary river systems originating from the Ganga and the Brahmaputra. The rivers play a major role in agriculture, fisheries, transportation, and the livelihoods of millions of people in both countries.

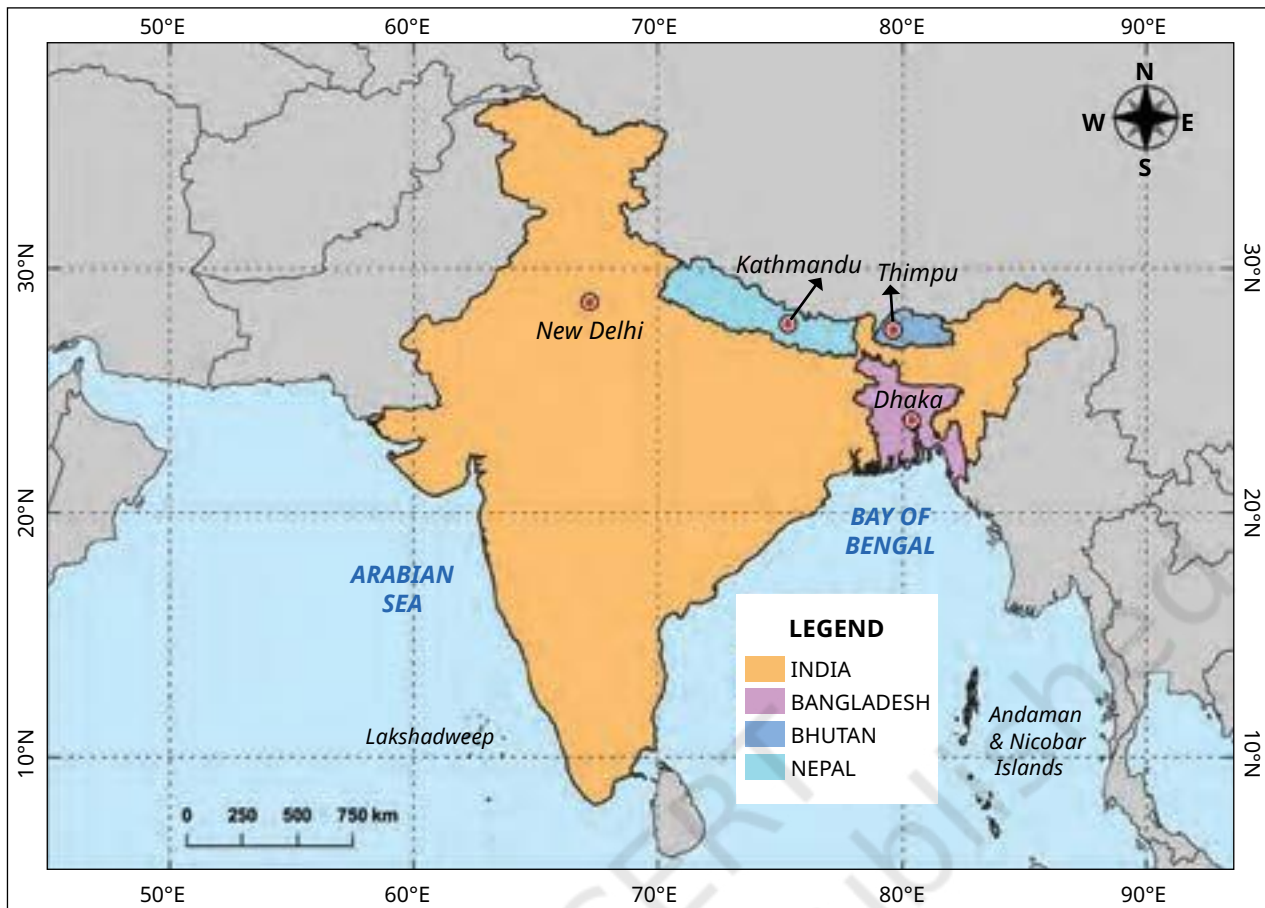


Fig. 2.7. India, Bangladesh, Nepal, and Bhutan

India and Bangladesh have built on their historical ties through strong diplomatic, economic, strategic and cultural cooperation, making their relationship one of the most important in South Asia.

The two countries also share a coastline, and therefore a maritime environment. The Sundarban National Park (Fig. 2.8) is a UNESCO World Heritage Site, with its protection and management coordinated by the two neighbours. A home to the Bengal tiger and many other species, it is important in terms of biodiversity, as well as climate



Fig. 2.8. A view of the largest mangrove forest of the world, in the Sundarban National Park. About two-thirds of the forest lies in Bangladesh and the rest in India.

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resilience since it serves as a barrier to cyclones. However, because of global warming and climate change, experts predict that Bangladesh will have to face the impact of rising sea levels and increasingly intense cyclones in coming years. Many people are likely to lose their homes or see their livelihoods affected.

In the lap of the Himalayas

Nestled in the lap of the Himalayas, **Nepal** shares a long and open border with India, stretching across the Indian states of Uttarakhand, Uttar Pradesh, Bihar, West Bengal, and Sikkim (Fig. 2.7). This geographical proximity has allowed for centuries of interaction and cooperation between the two nations and the relationship is marked by shared heritage, spiritual linkages, cross-border movement, and political partnerships.

Culturally, the ties between India and Nepal are profound. Pilgrims from both countries regularly visit sacred sites across the border. The Paśhupatinātha temple in Kathmandu (Fig. 2.9),



Fig. 2.9. The Paśhupatinātha Temple, Kathmandu, where Śhiva is worshipped as the protector of animals

a major Hindu pilgrimage destination, draws thousands of Indian visitors every year. Festivals such as Daśhain (Daśhaharā), Tihar (Dīpāvalī), and Holi are observed with equal enthusiasm in both countries. These shared spiritual traditions strengthen the people-to-people bonds and reflect a rich tapestry of mutual cultural appreciation.

On the political front, India and Nepal have maintained close diplomatic relations, largely shaped by the 1950 Treaty of Peace and Friendship. This treaty provides for open borders, free movement of people and goods, and cooperation in areas such as defence and foreign policy. Cross-border migration and trade form another vital component of the India-Nepal relationship. The open border policy allows citizens to cross freely without passports or visas, enabling people from both sides to access education, healthcare, employment, and maintain family connections. Daily life in many border towns reflects this close interdependence, with vibrant markets and thriving trade.

India is Nepal's largest trading partner, supplying essential goods such as petroleum, medicines, food items, and manufactured products. In return, Nepal exports agricultural produce, handicrafts, and garments. These exchanges not only contribute to economic development but also reinforce the social and economic integration of the border communities. The India-Nepal relationship stands as a unique example of neighbourhood cooperation shaped by a shared history, faith, geography, and a commitment to regional harmony.



DON'T MISS OUT

What is an 'open border'? It is when people from two countries can travel across the border without a visa or passport. This enables families living on both sides to stay connected, and people to move easily for work, education, trade, or religious visits. However, India and Nepal work together to ensure the open border remains safe and is not misused; it is a symbol of trust and friendship between the two countries.

The 'Land of the Thunder Dragon'

Bhutan, called 'Drukyul' or 'Land of the Thunder Dragon' by its inhabitants, is a small, landlocked Himalayan kingdom nestled between India and China. Bhutan's border with India touches the states of Sikkim, West Bengal, Assam, and Arunachal Pradesh (see Fig. 2.7). Over centuries, Bhutan has developed strong economic and cultural links with India.



DON'T MISS OUT



Several important rivers originate in Bhutan and flow into India; they are not only vital for agriculture but also serve as the foundation for hydroelectric power generation, which is one of the most significant areas of bilateral cooperation. Some major power plants contribute to Bhutan's economic growth and also supply renewable energy to India.

Fig. 2.10. The emblem of Bhutan. Notice the dragons that symbolise the 'Land of the Thunder Dragon'. What other elements look familiar?



Fig. 2.11. The Tala Hydroelectric Project, built with support from India, being dedicated to the peoples of Bhutan and India by the two countries' respective prime ministers in 2008.

Cultural and religious ties further strengthen the bond between the two nations. Rooted in the shared heritage of Buddhism, Bhutan and India maintain deep spiritual connections. Bhutanese pilgrims frequently visit sacred Buddhist sites in India, such as Bodh Gaya, Rajgir, Nalanda, Udayagiri, and Sikkim. The influence of Indian Buddhist masters such as Guru Padmasambhava (Guru

Rinpoche), who introduced the Vajrayāna school of Buddhism to Bhutan in the 8th century CE, remains central to Bhutan's religious identity. Indeed the dragon found on Bhutan's emblem (Fig. 2.10) and flag is said to symbolise the 'the thunderous voice of the Buddha's teachings'.

The relationship between India and Bhutan is marked by mutual respect, strategic cooperation, and cultural affinity. Their partnership exemplifies how shared geography, spiritual heritage, and economic collaboration can foster long-lasting and peaceful regional ties.



DON'T MISS OUT

Three main schools of Buddhism grew in ancient India and migrated to many of her neighbours:

- **Theravāda**, or the 'School of the Elders', took shape around the 3rd century BCE. It is considered closest to the Buddha's original teachings and today has followers mainly in Sri Lanka and in Southeast Asia, especially Thailand and Myanmar.
- **Mahāyāna** or the 'Great Vehicle' came into being around the 1st century BCE, incorporating new ideas and practices, such as a belief that the Buddha had a divine nature and could guide people in many forms. This school travelled to several countries, including China, Japan and Korea, where several sub-schools (including Zen Buddhism) emerged on the way.
- **Vajrayāna**, or the 'Diamond Vehicle', also generally known as 'Tantric Buddhism', arose around the 6th century CE as an extension of Mahāyāna. It emphasised special techniques and secret teachings such as the use of mantras, mandalas (sacred diagrams), and visualisations of the Buddha and the bodhisattvas. Tibetan Buddhism derived from this school around the 7th century CE.

Even today, these three schools of Buddhism are still followed in some parts of India, especially in the Himalayan states.



Fig. 2.12. 'Tiger's nest', a Buddhist monastery perched high on the mountainside overhanging the Paro valley, Bhutan



DON'T MISS OUT

Bhutan developed the concept of Gross National Happiness Index as a more holistic measure of their nation's progress compared with prevailing concepts like Gross Domestic Product. This includes ideas of sustainability, good governance and the promotion of culture, among others. The country assesses its progress periodically based on this index.

India's gateway to Southeast Asia

India and **Myanmar** (earlier known as 'Burma') share a long-standing relationship grounded in historical, ethnic, and cultural connections, despite periods of political turmoil. As the birthplace of Buddhism, India holds special spiritual significance for the people of Myanmar, many of whom visit India during pilgrimages. The two countries are connected by a land border as well as a maritime boundary in the Bay of Bengal (Fig. 2.20). India's northeastern states of Arunachal Pradesh, Nagaland, Manipur, and Mizoram share borders with Myanmar, facilitating cross-border interaction and cooperation. These ties form the basis for sustained cultural exchanges and regional connectivity initiatives between the two nations.



Fig. 2.13. Myanmar on the left and India (Mizoram) on the right bank of Tio River. The river forms part of the international boundary between the two countries (picture taken in 2008).

Myanmar is also India's gateway to Southeast Asia. The Land Border Crossing Agreement of 2018 between India and Myanmar eased cross-border movement for people living in border areas, boosted trade, enhanced connectivity, and deepened people-to-people ties, especially between India's northeast and Myanmar. Over the past couple of years, however, some restrictions have been placed on the free movement across the land border on account of conflicts in these areas.



DON'T MISS OUT



Fig. 2.14. The Ananda temple, Bagan

A few years ago, India helped restore the Ananda temple in Bagan, among others, that had been damaged by earthquakes. India also gifted a 16-foot replica of the Sarnath statue of the Buddha to the Shwedagon Pagoda in Yangon, Myanmar.



Fig. 2.15. National Highway 1, Afghanistan, from Zaranj to Delaram; it connects to the Asian Highway Network 1 (AH 1). Parts of NH 44 in India are also part of AH 1.

A land-locked neighbour

Afghanistan, a multiethnic landlocked country in south-central Asia, once shared a direct land border with India. However, the creation of Pakistan in 1947 has complicated access between the two countries (Fig. 2.5). Despite these geopolitical challenges, India and Afghanistan have, by and large, maintained close and friendly ties rooted in shared history and culture, besides significant strategic interests.

Their connection dates back to ancient times, when the historic Uttarāpatha trade route linked the Ganga plains to Central Asia via Afghanistan, fostering centuries of exchange in goods, religion, and ideas. Stretching from Gandhāra (modern Kandahar) through major Indian cities like Takṣhaśhīlā, Varanasi, and Pāṭaliputra, this cultural superhighway enabled the flow of Buddhism, Hinduism, art, and philosophy.

Before the spread of Islam in the 7th century CE, Afghanistan was a thriving centre of Buddhist and Hindu culture. Kingdoms like Kapiśha and Zābul mirrored Indian systems of governance. The gigantic Buddhas of Bamiyan, carved into Afghan cliffs, stood as powerful symbols of Mahāyāna Buddhism's reach from India, reflecting the deep civilisational ties between the two regions; sadly, they were destroyed in 2001.

In recent decades, India and Afghanistan have continued to share strong people-to-people ties. India has supported education, healthcare, and infrastructure development in Afghanistan, including the construction of the Afghan Parliament building and the Zaranj-Delaram highway. These initiatives, despite ups and downs, reflect a wish to build on the long-shared history of friendship and mutual respect.

India's Maritime Neighbours

From a few centuries BCE, Indian traders were sailing to Southeast Asian countries in search of gold and other valuable resources. They frequently visited the islands of Java, Sumatra, and Malaya, so much so that these places came to be known as 'Suvarṇabhūmi' (the 'golden land') or 'Suvarṇadvīpa' (the 'golden island'). But let us start closer to home.



DON'T MISS OUT

Many nations in India's neighbourhood came together in 1985 to form an association called SAARC — the South Asian Association for Regional Cooperation — in order to promote mutual interests, sociocultural and economic progress.

Afghanistan, Bangladesh, Bhutan, India, the Maldives, Nepal, Pakistan, and Sri Lanka are members. SAARC aims to share resources around development in science, education, health, and other areas. However, political tensions among some members have often disrupted its functioning.

Several more such regional groups of nations centred on the Indian Ocean exist for other specific purposes.

India's nearest maritime neighbour

Sri Lanka is an island nation located to the southeast of India, with the two countries divided by a narrow stretch of sea known as the Palk Strait. At its nearest point, the distance between the two countries is only about 32 km, making them close maritime neighbours with a long history of cultural contact, trade, and

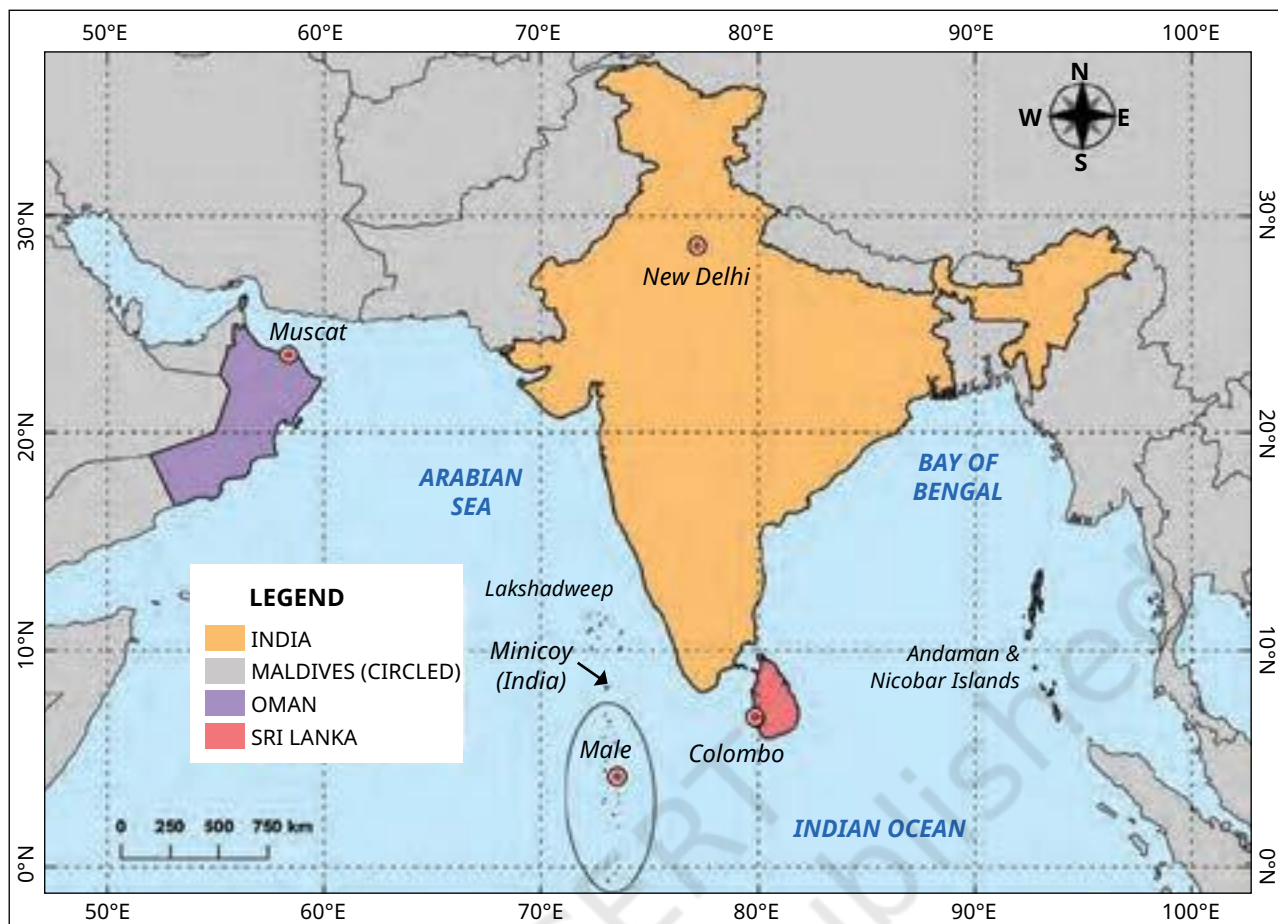


Fig. 2.16. India, Sri Lanka, the Maldives (circled) and Oman

cooperation. Buddhism was introduced to Sri Lanka in the 3rd century BCE by Mahendra and Sanghamitrā, the son and the daughter of Emperor Aśhoka. Hinduism also travelled there, notably through its two Epics. Even now, both countries continue to celebrate this shared spiritual and cultural heritage.

However, the relationship has not always been smooth. One difficult time was during Sri Lanka's civil war from the mid-1980s to around 2010. The war was mainly between the Sinhalese majority (whose language is Sinhala) and the Tamil minority, which has close cultural ties to India. Because of the fighting, many Tamil families had to leave Sri Lanka and move to south India, especially Tamil Nadu.

India and Sri Lanka share a multidimensional partnership that combines cultural closeness, historical ties, economic cooperation, and strategic collaboration. The relationship continues to grow through people-to-people exchanges, regional groupings and shared goals for peace and development in South Asia.



Fig. 2.17. Traditional fishermen at sunset in Sri Lanka, standing on stilts



Fig. 2.18. Brightly coloured traditional wooden masks of Sri Lanka; this tradition may have connections with similar mask-making traditions in India, particularly from south India.

A nation of islets

India and **the Maldives** share a close relationship based on geography, history, and culture. The Maldives, which consists of over 1,100 islets (or small islands), is only about 130 km from Minicoy (an Indian island part of the Union Territory of Lakshadweep), making it an important neighbour, especially for trade and security in the Indian Ocean (Figs. 2.16 and 2.20).

The two countries share centuries-old cultural ties shaped by maritime trade. Buddhism travelled to the Maldives early on, as established by archaeological finds of ancient Buddhist temples and inscriptions. Influences from Tamil Nadu and Kerala brought language, cuisine, and arts to the islands. Maldivian dishes like coconut curries and *roshi* reflect South Indian flavours, while the Boduberu dance echoes Tamil folk rhythms. Dhivehi (the official language of the Maldives, also called Maldivian) vocabulary and boat-building techniques also show South Indian roots.

India was one of the first countries to recognise the Maldives after it became independent in 1965. Over the years, the two nations have built strong ties in many areas, including defence, trade, and disaster relief. India's quick help during the 2004 tsunami, the 2014 water crisis in Malé (the Maldives' capital), and the COVID-19 pandemic further strengthened this bond. These actions highlighted India's ability to respond quickly in times of crisis and further reinforced her role as the region's trusted first responder.



DON'T MISS OUT

Dhivehi, the language of the Maldives, is a vibrant blend shaped by centuries of contact with Indian cultures. It borrows words from Sanskrit, Prakrit, Tamil, Malayalam, and Hindi. *Raajje* (king) and *mas* (fish) echo Sanskrit words *rājā* and *matsya*, while *dhoni* (boat) and *kukulhu* (chicken) share roots with Tamil and Malayalam. Modern Hindi words like *filmu* have entered everyday use, thanks to Bollywood. Dhivehi reflects the Maldives' rich history as a maritime hub shaped by Indian linguistic and cultural influences.

As an island nation, the Maldives is highly vulnerable to the effects of climate change, including a rise in sea level which could reach 1 metre by the end of the century, partly submerging many of its islands.

This nation is a member of the International Solar Alliance, an Indian initiative (we will revisit this in Grade 8), which shares research technology on solar energy. This joint effort towards



Fig. 2.19. (Left) A satellite view of the main islands of the Maldives (notice the faint outlines), with India's southern tip visible in the top right corner. (Right) To draw attention to the danger of rising sea levels owing to global warming, the Maldives' president and cabinet of ministers held in 2009 a meeting underwater, at a depth of 4 m below the surface.

sustainability is another example of the long-term relationship between the two countries.

From Dvārakā to Dvāravatī and Ayodhyā to Ayutthayā

India and **Thailand** are closely linked through maritime routes and regional geography. Sharing a maritime boundary (Fig. 2.20), the two countries have been connected since ancient times through trade and cultural exchange. As early as the 3rd century BCE, Indian traders and scholars sailed to what is now Thailand, exchanging goods such as spices and textiles, while also bringing religious and cultural ideas that would deeply influence the region.

Indeed, the impact of Indian culture is reflected in the names of later Thai kingdoms. The Dvāravatī culture, which flourished from the 6th to the 11th centuries CE, derived its name from a Sanskrit word for 'that which has gates', directly referencing Dvārakā, Kṛiṣṇa's city described in the Mahābhārata. Much later, the Ayutthayā Kingdom, founded in 1351, was named after the

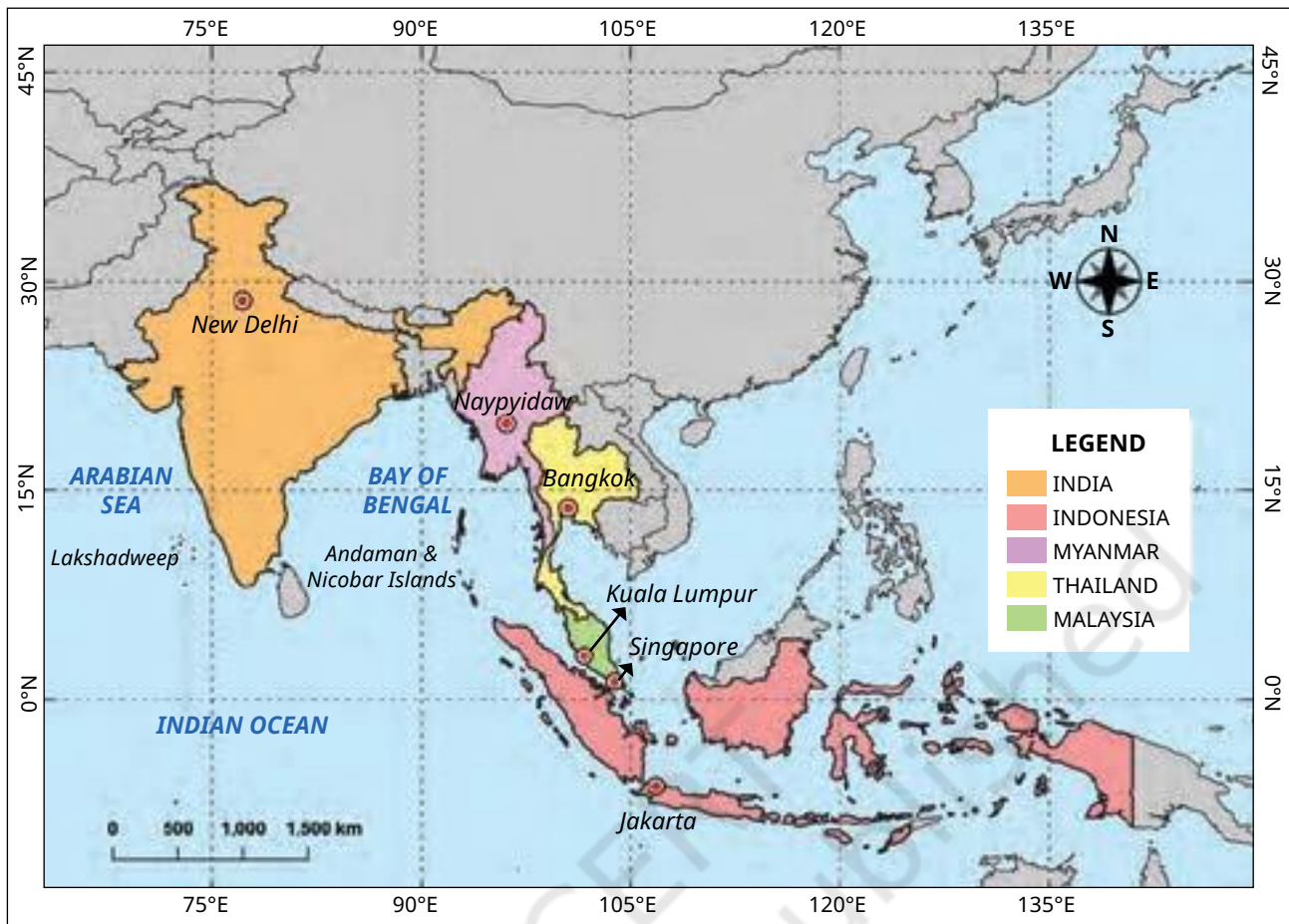


Fig. 2.20. India, Myanmar, Thailand, Malaysia, Singapore, Indonesia

ancient Indian city of Ayodhyā, the birthplace of Rāma according to the Rāmāyaṇa. This choice of place names reflecting Indian traditions illustrates the profound impact of Indian civilisation on Thailand's history and culture.



DON'T MISS OUT

Monarchs of the current Chakri dynasty have all been named after Rāma; the current king, for instance, is Rama X (that is, the tenth King Rama in this dynasty).

Cultural ties were further strengthened by the shared heritage of Buddhism and Hinduism. Indian monks, scholars and texts played a central role in shaping the religious and philosophical foundations of Thai society. Theravāda Buddhism is widely practised there, while Hindu deities and stories from Indian epics

are also integrated into Thai royal ceremonies, dance forms and literature.

LET'S EXPLORE



Fig. 2.21. A massive sculpture at Bangkok airport

The scene in Fig. 2.21 depicts the well-known Hindu myth of *samudra manthana* or the churning of the ocean. The devas (gods, on the right here) and the asuras (demons, on the left) decided to join forces to churn the cosmic ocean in search of *amrita* or the nectar of immortality, with the serpent Vāsuki as the churning rope and Viṣṇu (above) presiding over the operation — he will eventually deceive the asuras to make sure that the *amrita* goes to the devas alone. Note also the airport's official name of 'Suvarnabhumi Airport' — does it remind you of something?

The India–Myanmar–Thailand Trilateral Highway is a modern effort to revive and strengthen these age-old connections. Stretching from India's state of Manipur through Myanmar and into Thailand, this highway improves overland connectivity, enhances regional trade, and supports greater cooperation among the countries involved.

Through both ancient and modern ties, India and Thailand demonstrate how geography, history, and shared values can bring nations closer together across land and sea.

The Malay Peninsula

Relations between India and **Malaysia** are rooted in historical, cultural, and economic linkages dating back over two millennia, when the Malay Peninsula was connected to India through sea routes across the Bay of Bengal (Fig. 2.20). Hindu and Buddhist cultural influences began early on, with (as in Thailand) names such as ‘Srivijaya Kingdom’; around the 4th century CE, the region adopted a script based on India’s Brāhmī script. Such influences remain visible in Malaysian society through art and literature in particular even though by the 15th century Islam became the predominant religion. In the 19th and 20th centuries, a large number of Indian workers, mainly from south India, migrated to Malaysia to work as labour on the rubber plantations. The Malaysian Indian community remains prominent today with 9 per cent of the population being of Indian origin.

India is one of Malaysia’s largest trading partners, with collaborations in palm oil, energy, infrastructure, and information technology. The two nations are also strategic partners, working closely on regional security and maritime stability. Many Indian organisations working in areas of manufacturing, information technology, research, tourism, and education have set up collaborations with local companies, furthering economic ties.



Fig. 2.22. The Petronas Towers at Kuala Lumpur, Malaysia’s capital, are the world’s tallest twin skyscrapers.

The 'Lion City'

The name of **Singapore** derives from 'Singapuram' or 'lion city', which was the name of an ancient kingdom just off the southern tip of present-day Malaysia. Just like Thailand and Malaysia, it had close cultural and commercial ties with India, with Buddhist monks as well as traders visiting the region a few centuries BCE. After many fluctuations, Singapore became a British colony, then a part of Malaysia, and eventually a separate nation in 1965.

LET'S EXPLORE

Seeing that Tamil is one of Singapore's official languages, what does this suggest to you about the relationship between south India and Singapore?



Fig. 2.23. A signage in Singapore's four official languages — English, Mandarin, Tamil and Malay.

Singapore has served as a benchmark for urban planning and maintenance. The citizens play an important role in keeping the streets litter-free. It helps that anyone found throwing garbage on the street, disrespecting traffic rules or indulging in **jaywalking** will be fined heavily! With a focus on wellbeing, the city has many people-friendly and sustainability-oriented features such as parks, walkways, terrace gardens, and so on.

Singapore's contacts with India remain vibrant in several areas. In recent years, the island nation has become one of the largest foreign investors in India, especially in infrastructure and technology sectors, and many Indian companies have set up offices in Singapore. Singapore receives large numbers of Indian tourists and is one of the preferred destinations of Indian students for higher studies.

India's presence also remains visible in cultural areas, from art to cuisine to religion (Buddhism being currently the most widely

Jaywalking:

Pedestrians walking or crossing roads without taking care to follow traffic rules

practised religion). Ethnically, about 9 per cent of Singaporean residents are of Indian origin, many of whom live in an area of Singapore called 'Little India'.



Fig. 2.24. Little India, an area of Singapore city

The Indonesian archipelago

India and **Indonesia**, separated by the Bay of Bengal and the Andaman Sea, are close maritime neighbours with a long history of cultural, religious and commercial exchange. Indonesia is not a single landmass: it is actually an archipelago, that is, an extensive group of islands (Fig. 2.20) — in this case, several large islands and over 17,000 smaller ones! The two neighbouring

nations have a legacy of trade and sociocultural interaction that dates back to early maritime trade between Indian kingdoms and the large islands of Java and Sumatra over 2,000 years ago. Collaborations between India's ancient university of Nālandā and the ancient Indonesian Muara Jambi temple complex further strengthened the bond. Later, Islam travelled to Indonesia from the shores of India.



Fig. 2.25. The Indonesian currency, the rupiah, carries the national symbol, Garuda, the vāhana (vehicle) of Viṣṇu



Fig. 2.26. The mandala-shaped Borobudur Stūpa, the world's largest Buddhist monument

The shared history and culture, and vision for the future, have played a significant role in expanding bilateral relations. In present times, India and Indonesia work closely in regional groups to promote peace, trade, and sustainable development in the Indo-Pacific region. Strategic cooperation has also grown stronger, especially in areas like maritime security, defence, and disaster relief. Both countries have large coastlines and shared concerns about piracy, climate change, and the protection of sea lanes, which makes their partnership especially important.

Together, India and Indonesia show how two ancient civilisations can build a strong, forward-looking partnership rooted in shared values and mutual respect.



DON'T MISS OUT

A *stūpa* is a Buddhist shrine, often built in the shape of a dome, that keeps sacred relics, either of the Buddha himself, of senior monks or of other revered figures. (Remember, for example, the Sanchi Stūpa and the Bharhut Stūpa in Part 1 of this textbook.) The Borobudur Stūpa (Fig. 2.26), built in stone in the 8th and 9th centuries CE, is unique not only for its huge dimensions (tourists would look like tiny dots on the picture) and pyramidal shape in five enormous platforms, but also because it harbours over 500 statues of the Buddha and many smaller *stūpas*. Moreover, its highly geometric design replicates a mandala; mandalas are traditional Hindu, Buddhist, and Jaina geometric symbols used in various rituals and generally symbolising the entire cosmos.



Fig. 2.27. Indonesian actors performing a scene from the Rāmāyaṇa



DON'T MISS OUT

Indonesian islands lie in a region that experiences frequent earthquakes and volcanic eruptions, which makes Indonesia one of the most earthquake-prone countries in the world.

On 26 December 2004, a powerful earthquake under the Indian Ocean near Indonesia triggered a massive tsunami. Giant waves swept across the ocean, striking the coasts of many countries and causing serious damage: in India alone, some 15,000 people lost their lives, especially in Tamil Nadu, Kerala, and the Andaman and Nicobar Islands. Across the whole region, more than 200,000 people were killed.

This disaster exposed the urgent need for better early warning systems. India thus joined hands with Indonesia, Sri Lanka, Thailand and other Indian Ocean countries to set up a network of sensors, satellites, and communication links. The Indian Tsunami Early Warning Centre in Hyderabad helps alert not only India but also neighbouring countries, potentially saving many lives when earthquakes strike the ocean floor.

An Ancient Neighbour

Let us travel westward again. India and **Iran** have shared close ties since the Bronze Age; trade and cultural exchanges took place early between India and the rugged Iranian plateau



Fig. 2.28. The Shahid Beheshti Port at Chabahar, Iran

through land routes passing through present-day Pakistan and Afghanistan (Fig. 2.5). Gradually, such routes became part of the Silk Route, with people, goods, and ideas moving back and forth, connecting the two lands in the fields of language, literature, art, architecture, food etc. Sea routes were also used, since Iran's ports were within easy reach of India's west coast.

The Avesta, the ancient sacred text of Zoroastrianism (see 'India, a Home to Many' in this textbook), has parallels with India's R̥gveda. Indian texts such as the Mahābhārata mention Persians under the name *Pārasika*, and the later Persian language (which belongs to the same language family as Sanskrit) was used as court language in India by the Mughals and other rulers. Of course, the Parsis of India have been a living link with the ancient Persian culture.

In modern times, India and Iran have cooperated in many areas such as trade, energy, and transport. India is helping to develop Iran's Chabahar Port (Figs. 2.28 and 2.29), which gives India better access to Afghanistan and Central Asia. Despite international challenges, both countries continue to engage with each other as important neighbours in Asia.

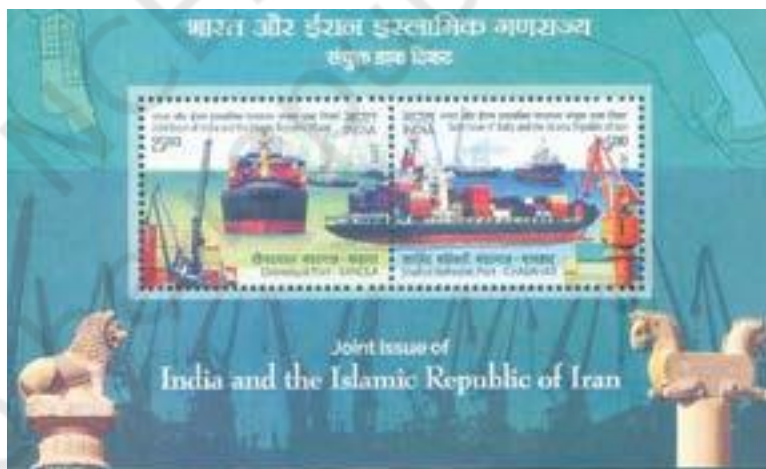


Fig. 2.29. Joint stamps issued to mark the strategic partnership between India and Iran for the development of ports

The 'Land of Copper'

Located on the southeastern coast of the Arabian Peninsula at the intersection of the Persian Gulf and Arabian Sea (Fig. 2.16), **Oman** shares maritime boundaries with India and holds significant strategic importance. As a key partner in India's engagement with the Gulf region, Oman plays an important role in regional forums.

The relationship between India and Oman is rooted in shared geography, history and cultural ties, with people-to-people contact dating back over 5,000 years, during the time of the Indus or Harappan (or Indus-Sarasvatī) civilisation.

As Oman is rich in copper, it is thought that Harappan traders brought back **ingots** of the metal to the coppersmiths of the Indus-Sarasvatī cities (Fig. 2.30).



Fig. 2.30. A copper ingot from Oman, dated to the 3rd millennium BCE

Ingot: A lump or block of metal put into a shape convenient for transport and reworking.



DON'T MISS OUT



Fig. 2.31. The Motishwar Mandir, a Śhiva temple in Muscat, Oman

Over 10% of the population of Oman is of Indian origin. Merchant communities from north-western parts of India settled there over the past few centuries; there is an indigenous population of Indians living in Oman. The Hindu community was allowed to build a Śhiva temple in the early 20th century (Fig. 2.31).



Fig. 2.32. An India-Oman joint military exercise, 2024

Moreover, Oman is India's closest defence partner in the Gulf, being the first in the region where India holds joint military exercises with all three armed forces (Fig. 2.32). The two countries work together on Indian Ocean maritime security.

Before we move on ...

- India and her neighbours share centuries of cultural, spiritual, religious and commercial exchanges. India's schools of thought and belief, arts, literature and architecture left a visible cultural imprint across countries of Southeast Asia.
- Ancient trade routes like the Uttarāpatha, Dakṣiṇāpatha, the Silk Route, and spice routes connected India with Central Asia, Southeast Asia, and the Arabian Peninsula, resulting in trade and cultural exchanges with all those regions.
- India spread her traditions peacefully through trade, pilgrimage, and culture.
- Today, regional connectivity projects aim to revive these historical links. Besides, Indian films, music, and television often contribute to sustained bonds, in addition to shared strategic and trade interests.



Questions and activities

1. Explain who a maritime neighbour is with two examples with respect to India.
2. How has Buddhism created links with India's neighbours? Give examples to explain your answer.
3. What does 'open border' policy mean? How does the India–Nepal 'open border' policy affect the lives of people living along the border?
4. The chapter says, "Being neighbours is not just about geography." Explain this statement with an example.
5. What are the different ways in which India has helped smaller countries in her neighbourhood? Explain with examples.
6. How do shared challenges become opportunities for cooperation? Were there examples in this chapter to illustrate this?
7. If borders were drawn only by culture and connections, how would the map look different?
8. On blank maps:
 - Label India's neighbours.
 - Draw arrows showing cultural flows (e.g., food, festivals, languages) between India and her neighbours.
 - Imagine and redraw new "borders of friendship" that connect neighbours through rivers, trade routes, or cultural zones.
 - Collect pictures of the flags of the countries listed in this chapter and write your observations.

Natural Resources and Their Use

CHAPTER

1

Concerned social scientists are clear on what we need to do: we must move toward a regenerative economy, an economy that operates in harmony with nature, repurposing used resources, minimizing waste, and replenishing depleted resources. We must return to the innate wisdom of nature herself, the ultimate regenerator and recycler of all resources.

— Christiana Figueres and
Tom Rivett-Carnac in ‘The Future We Choose’

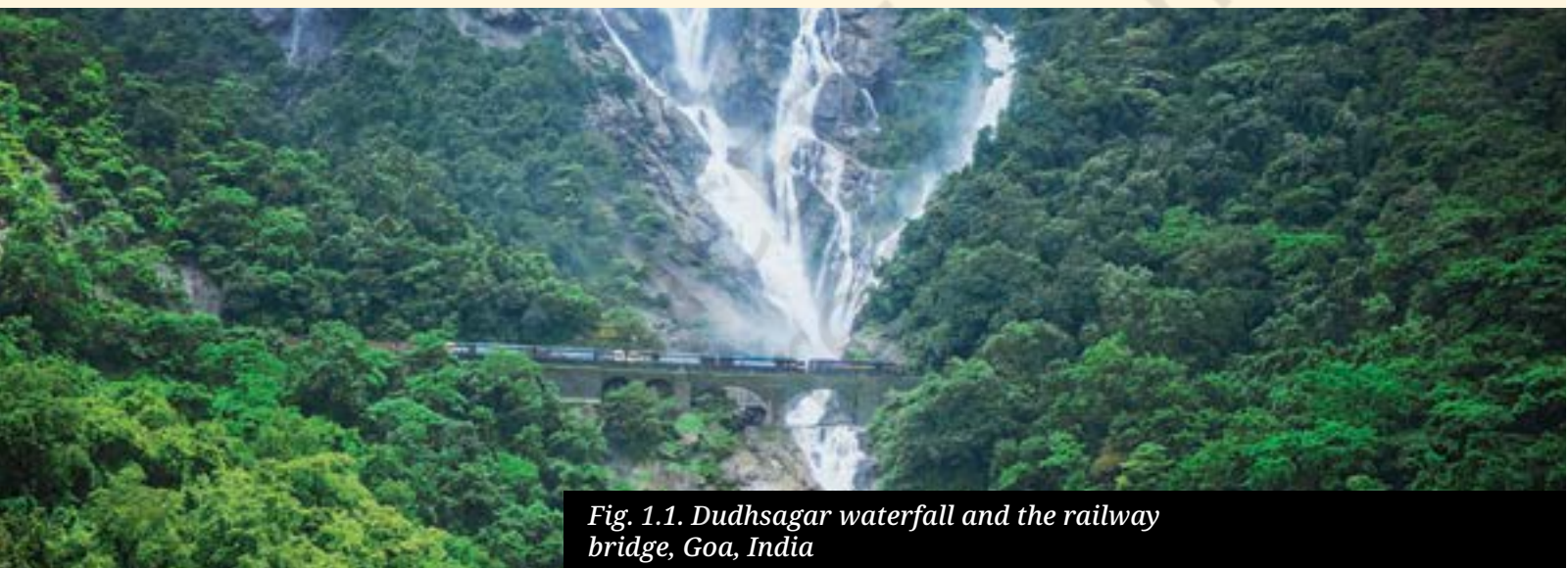


Fig. 1.1. Dudhsagar waterfall and the railway bridge, Goa, India

The Big
Questions ?

1. How do we categorise natural resources?
2. What is the connection between the distribution of natural resources and different aspects of life?
3. What are the implications of unsustainable use / over exploitation of natural resources?





Fig. 1.2. A microhydel plant in Himachal Pradesh—the power of flowing water converted into electricity



Fig. 1.3. An offshore oil rig extracts petroleum from below the seabed

WHEN DOES NATURE BECOME A RESOURCE?

One of the meanings of the word ‘Nature’ is the totality of life and non-life forms that are part of our environment but have not been created by humans. When humans use these for their sustenance, or create new things from them for consumption, these elements of Nature become ‘resources’. For example, trees are part of the environment; they exist independently of humans. When we cut them and convert their wood into furniture, we see the trees as a resource.

Often these entities are not easily accessible. For example, there may be petroleum in places deep under the ocean that we do not have the technology to access, or the extraction cost may be too high; or it may be culturally unacceptable like cutting trees in sacred groves. So, for an entity to be called a resource, it should be technologically accessible, and its exploitation should be economically feasible and culturally acceptable. (Usually, the word ‘exploitation’ has a negative connotation; in the context we use it here, it means ‘extraction, utilisation and consumption of Natural resources’.)

The Earth has treasures, many of which have formed over millions of years, and which humans have taken and learnt to use. These include the most obvious ones like water, air and soil, and also the not-so-obvious ones like coal, petroleum, precious stones, metal ores, timber, etc.



Fig. 1.4. Gentle ploughing causes minimal disturbance to the underground ecosystem and retains soil moisture.



Fig. 1.5. Honey from a beehive



DON'T MISS OUT

- In many indigenous traditions of the world, Nature is considered sacred. You have read about this. In such traditions, Nature is a nurturer and nourisher.
- Do you know of practices that reflect this?



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THINK ABOUT IT

Take a pause. Look at yourself and the things around you. What is the origin of each of them? At some point they all lead to Nature; even the plastic button on your shirt.

In short, we apply the term 'natural resources' to materials and substances that occur in Nature and are valuable to humans.

CATEGORIES OF NATURAL RESOURCES

In Science, we learn the usefulness of categorisation and naming — we use some shared characteristics (or criteria) when we categorise ideas or things; we name the categories so that we can refer to them with just one word or a short phrase. When these names and meanings are shared across groups of people, it helps

us discuss a set of ideas or things without needing to describe them every time. We can communicate more effectively, too. In earlier classes, you learnt about living and non-living things. As soon as we use these words, you know what they mean. This is a simple example of categories.

We do the same with natural resources.



THINK ABOUT IT

What might be the different criteria we can use to categorise natural resources?

One of the ways we could categorise natural resources is based on the uses we put them to — essential for our life, source for materials and sources for energy.

Resources essential for life

Life could not exist on Earth without the air we breathe, the water we drink and the food we eat. We take these from the atmosphere, the rivers and ponds, and through the cultivation of soil or other living things. We cannot make the air we breathe, the water we drink, or the soil which gives us food.

Resources for materials

Human beings create physical objects out of Nature's gifts. We make them for our utility or to create things of beauty that enrich our lives and those of others — a piece of wood can be transformed into a chair and also carved into a statuette. India's geographical diversity provides us with a wide variety of natural resources, from wood to marble, and coal to gold.

Resources for energy

Energy is a cornerstone of modern living — electricity for our buildings, transportation, and all types of production processes. This energy can come from diverse natural sources: coal, water, petroleum, natural gas, sunlight, wind, etc.



Fig. 1.7. River water, a renewable resource as long as glaciers and forests exist



Fig. 1.8. We can take timber from the forest, in limited quantities, for a long time if we allow it to regenerate.

Renewable and non-renewable resources

A second way of categorising natural resources could be based on whether they are renewable or not.

A general principle of Nature is that it functions in a restorative and regenerative way. Restoration is the process of returning something to its original healthy state if it has been degraded or damaged. Nature heals, renews and maintains herself over time. A cut on your skin will normally heal; a forest recovers after a wildfire. Regeneration goes beyond restoration. It is about Nature's ability to create new life and the conditions for thriving.

We plant trees in areas that may have lost them on account of human interventions like clearing forests for housing. Planting the types of trees that were originally growing there restores the ecosystem — the trees provide food and shelter for birds, squirrels and other creatures, enabling life to return.

Nature works in cycles where there is no waste. Take a forest. Let's say a tree falls in the forest. It decomposes with the bacteria, fungi and insects feeding on it. The tree becomes part of the soil enriching it. New trees and plants grow from seeds ... eventually some will fall and the cycle starts again.

These are examples of Nature's principle of restoration and regeneration in practice.

Renewable resources

Renewable resources exhibit these characteristics over time. Most of India has abundant sunshine. In the natural course, rivers are



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the sun-god, in gratitude.

Arghyam:
offering,
generally
of water, as
a mark of
respect or
gratitude

fed regularly by rain and melting glaciers, forests renew themselves, soil replenishes itself through natural processes, and so on.

Solar energy, wind energy, energy from flowing water, timber from forests are renewable resources as long as we are able to manage them in a sustainable manner.

However, for them to remain renewable there is a condition — the natural rhythm of restoration and regeneration must not be disturbed. If we harvest timber faster than the forest can grow trees, we will

eventually deplete the forest. Scientists have shown that through irresponsible human actions, many of Nature's cycles have been disturbed. A combination of several factors interacting — fossil fuel-driven industrialisation and the cutting down of forests for agriculture and other purposes are two of them — has led to rising temperatures that we are experiencing; on account of this, the glaciers in some places in the Himalayas are melting at a rate faster than precipitation can replace them. This has implications on water security for the populations living in the plains dependent on the 'water tower'.



DON'T MISS OUT

- Traditionally, communities had a system of regulating (or refraining from) fishing during the spawning season to enable the maintenance of the fish population. However, the commercialisation of fishing resulted in over-fishing. In the case of a type of fish called tuna, for example, the rapid and extensive decline in their population led to some agreements on control of fishing. Nevertheless, this important type of fish that keeps the ocean ecosystem in balance by consuming smaller fish, shrimps, etc., is on a decline.
- Do you know of other traditional practices that help the ecosystem to stay in balance?

We need industries to produce the goods we consume. The process also creates wastes that are frequently discharged into rivers and other water bodies. Often, these wastes cannot decay to become the food of some lifeform. Instead, it leads to a disturbance in Nature's cycle of restoration and regeneration, leading to a situation where the river becomes poisonous and cannot support life.



Fig. 1.10. Waste from industries is often disposed without proper treatment

LET'S EXPLORE

Identify human actions in your surroundings that result in Nature losing her ability to restore and regenerate. What types of interventions can be undertaken to restore Nature's cycle?



DON'T MISS OUT

- Ecosystem functions and ecosystem services: Nature has some inherent ways of working. For example, trees naturally produce oxygen. When these natural processes benefit humans, we call them 'ecosystem services'. We can think of it like this: a forest naturally filters water, prevents soil erosion, and provides habitat for animals — these are ecosystem functions. When we benefit from clean water, protected farmland, and pollinated crops because of that forest, we are receiving ecosystem services from Nature.
- A mature tree produces about 275 litres of oxygen per day (this varies a little depending on the type of tree). A human being needs about 350 litres of oxygen every day (this can change based on the type of activity that an individual engages in, their height and weight, and so on).

**LET'S EXPLORE**

Take up a small research study to assess the types of renewable resources in your region; you may discuss with your teacher the geographical area of your study and sources to access information that you may need. What has been the change in their status over time? Make a small report that identifies the reasons for the change and what may be done.

Non-renewable resources

Non-renewable resources are created over long periods. They cannot be replenished at the rate we use them. For example, fossil fuels (coal and petroleum), and minerals and metals like iron, copper and gold, are non-renewable resources. India has significant quantities of coal reserves. We mine coal to meet our growing need for energy, but it has been estimated that the coal reserves in India may last another 50 years; the demand for electricity has been increasing as the population expands and development work accelerates. Till more sustainable options become available widely, we need to use the coal we have judiciously.

**LET'S EXPLORE**

What are the non-renewable resources that you use daily, directly or indirectly? What are the possible renewable substitutes? What are some of the steps we can take to transition to renewables?

**DISTRIBUTION OF NATURAL RESOURCES
AND ITS IMPLICATIONS**

Natural resources are not evenly distributed across our planet or even within countries. This uneven distribution shapes human settlements, trade patterns, international relations, and conflicts too. Many wars have been fought, and continue to be fought, to gain control over natural resources.

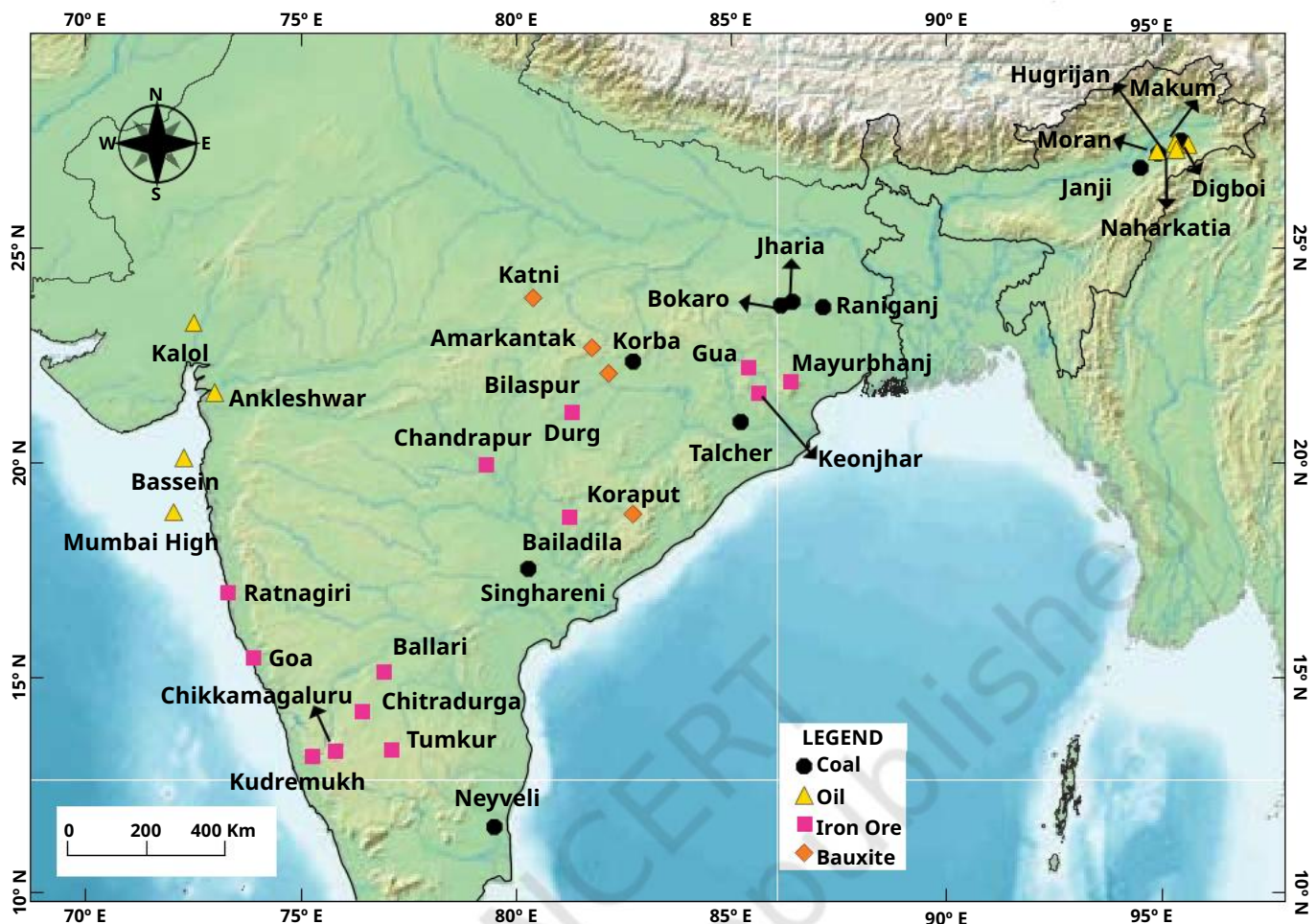


Fig. 1.11. Distribution of important minerals

LET'S EXPLORE

Observe the map in Fig.1.11. Notice the uneven distribution of important minerals. What types of resources are available in your region? How are they distributed?



Industries located near natural resources create employment opportunities for the local people. Townships grow around them and expand economic opportunities for others, too. More modern facilities that improve the quality of life become accessible. However, these benefits are often accompanied by costs, in the short term as well as in the long term. We have examples from across the world of people living in resource-rich areas who have been displaced from their homes to facilitate such



Fig. 1.12. Shared waters of the Brahmaputra river

developments. In some cases their sacred places are under threat, leading to conflicts.

National and international trade depend on the geographical location of natural resources. Combined with human knowledge and skills, these can create unique products like the Wootz steel. As we know, trade fuelled the development of large empires in India.



LET'S EXPLORE

- Select any two natural resources. Gather information about their availability across different parts of India. Mark them on a map. What do you observe about their distribution? What are the types of economic activities connected with them?
- Discuss the implications of extracting the natural resources in those parts for current and future generations. Suggest ways in which we can use Nature's gifts in responsible ways.

Nature does not pay attention to political boundaries. This leads to tensions regarding the sharing of natural resources across states as well as countries. One example is the sharing of Kaveri River water among Karnataka, Tamil Nadu, Kerala and Puducherry; negotiations and deft management were required to maintain peace and fair sharing. Of course, reaching such agreements between neighbouring countries is not easy.

LET'S EXPLORE

Find out about such a conflict in the international context. Discuss your findings in the class.





Fig. 1.13. Mettur dam in Tamil Nadu built on the Kaveri river

THE ‘PARADOX OF PLenty’

Having abundant natural resources does not guarantee economic prosperity. Some regions rich in natural resources can experience slower economic growth and development — a phenomenon economists call the ‘natural resource curse’ or the **‘paradox of plenty’**. Put very simply, this means that often having plenty of natural resources does not automatically mean that a country is rich. Frequently, economies are unable to develop industries that convert the resources into products of higher value; the chapter ‘Factors of Production’ in the latter part of this book will give you an understanding of this.

India has generally avoided this curse by investing in the development of such industries to meet our growing needs.

LET’S EXPLORE

What do you think are the different inputs required to enable the use of the natural resources available in different geographical areas?

However, the challenge of balancing resource extraction with sustainability remains. Understanding and managing natural resources is a valuable starting point, but human knowledge, good governance, and strategic planning determine whether they become lasting benefits or temporary windfalls.



Biodiversity loss :
The decline
in the
variety of
life on Earth

RESPONSIBLE AND WISE USE OF NATURAL RESOURCES: STEWARDSHIP

Sustaining life on Earth requires that we respect Nature and use natural resources in a way that enables the restoration and regeneration of renewable resources, and the responsible and judicious use of non-renewable ones.

Scientists studying these aspects have warned that the irresponsible treatment of natural resources has led to pollution, **biodiversity loss** and climate change, which has been taking place at an increased pace in recent years.

Restoration and regeneration of renewable resources

Here are two examples of how we are pushing the use of natural resources beyond their capacity to regenerate.

Many farmers in our country extract groundwater for irrigation purposes. In most states, the extraction rate is greater than the rate at which the water table is replenished. Over time, this deficit builds up, leading to higher cost of extraction of groundwater and eventually to its unavailability. It has been predicted that many of our growing cities will run out of groundwater soon. Initiatives to raise groundwater levels have been launched to remedy this. Traditional practices of water harvesting, rejuvenation of ponds and tanks, cutting down on wasteful consumption of water, processing and reusing water are some of the strategies attempted.

Similarly, the improper use of chemical fertilisers and pesticides has led to soil degradation. Traditional farming practices considered soil to be part of Mother Earth. Practices like the use of cow dung and other natural fertilisers, mulching, multi-cropping, and so on, enabled holistic soil management. We must learn from these practices and apply



Fig. 1.14. Crop failure on account of injudicious use of chemical fertilisers

them in our current situation to prevent further degradation. We need to replenish and rejuvenate our soil.

Overexploitation of groundwater: a caselet from Punjab

A crisis has unfolded in the fertile plains of Punjab where groundwater resources have been severely depleted. Punjab was home to the Green Revolution that fed a large proportion of our population, and contributed to India becoming self-sufficient in food. Today the same state faces issues of sustainability — Nature has been exploited beyond regeneration, at least in the short term. However, this concern is not particular to Punjab; it affects many other states.

In the 1960s, farmers shifted to high-yielding varieties of wheat and paddy. These required more water than the traditional seeds, and farmers began to extract groundwater to meet this need. In addition, the supply of free power led to the over-pumping of groundwater (a situation still prevalent in much of India today). Modern farming techniques also required the use of chemical pesticides and fertilisers.

The combined effect of these factors is that the groundwater level in a large part of Punjab (see Fig. 1.17) has become inaccessible till depths of about 30 metres; and the chemicals from the pesticides and fertilisers have dissolved in the groundwater causing health hazards.



Fig. 1.15. Extraction of groundwater



Fig. 1.16. Wet paddy fields

Almost 80% of the area of Punjab has been classified as 'over-exploited'; in other words, we have drawn water at a rate much greater than at which restoration and rejuvenation of groundwater is possible.

We can see that food security was ensured for the short term, but the long-term consequences will take time and effort to heal.

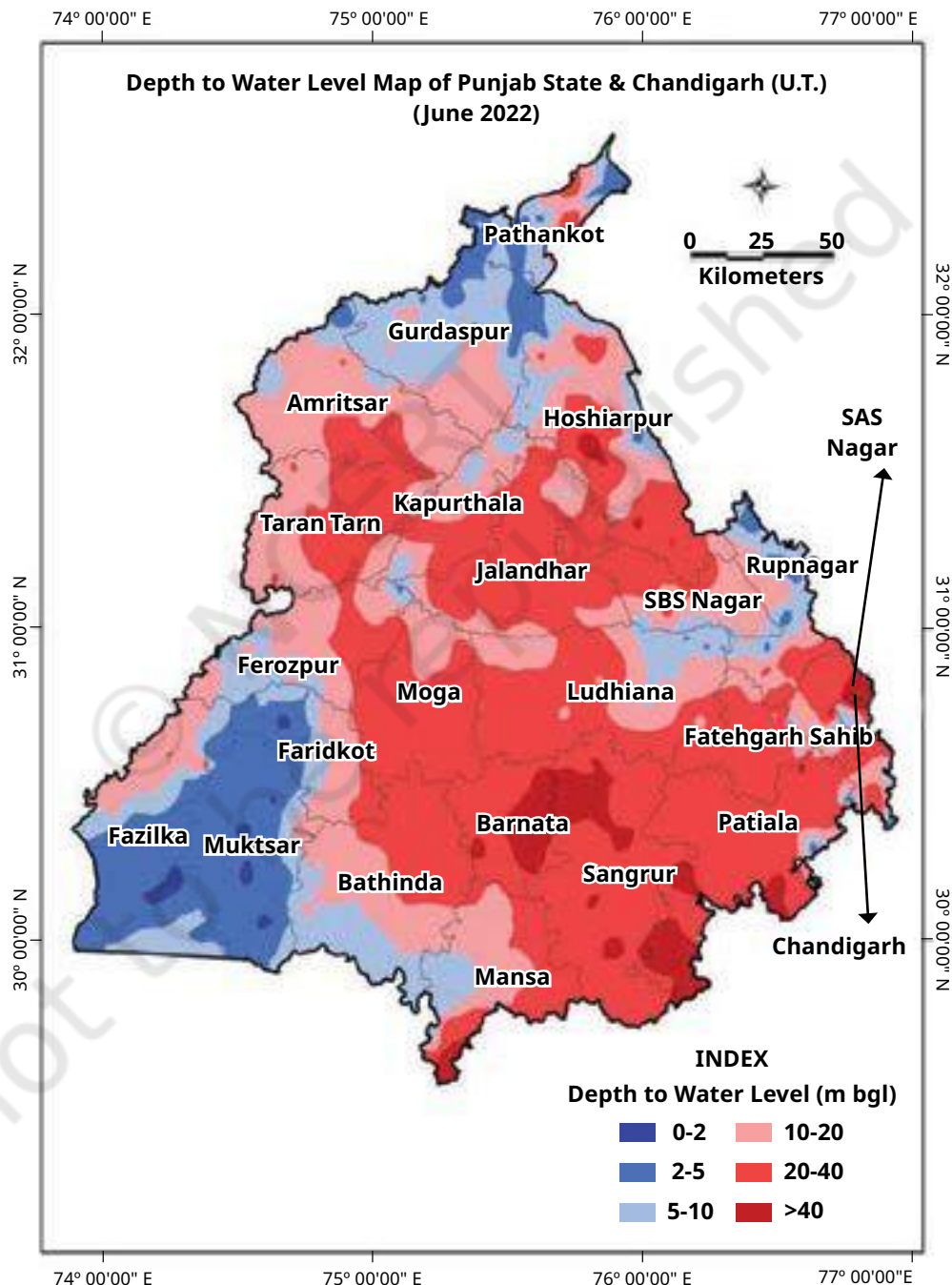


Fig 1.17. Depth to water level map of Punjab and Chandigarh, June 2022
(m bgl = metres below ground level)



Fig. 1.18. Jaisalmer fort, Rajasthan. A mud structure built in the 12th century and refurbished later using sandstone.

The case of cement

We cannot imagine life without cement. Our houses, schools and hospitals and other buildings, bridges, roads and airports, all require cement. The production of cement has been listed as one of the most polluting industries. The process of production releases fine dust that enters our lungs and those of animals damaging them, settles on leaves of plants decreasing their yields, and causes soil and water pollution too. The Central Pollution Control Board has created guidelines for cement factories to ensure that the pollution is minimised or eliminated.

In addition, there is a move towards creating alternative materials that reduce pollution. These include the use of traditional materials like stone and mud, new plant-based materials and recycled materials from waste plastic.



Fig. 1.19. A community building in Auroville constructed by Auroville Earth Institute (which holds the UNESCO Chair for Earthen Architecture). This modern building is made of mud using special techniques.

Traditional materials and methods are being combined with modern technological advances to create new materials that are sustainable — the process of production is less polluting, provides local employment, and is designed keeping in mind the climate of the place.

s dñ' - fl' - Ś is an ancient Indian botanical science that focuses on the study and care of plants and trees. The term comes from Sanskrit, with *dñ' Ś* meaning tree and *ayurveda* meaning the science of life or health. This traditional knowledge system dates back several millennia and was formalised in texts such as Surapala's *s dñ' - fl' - Ś* around the 10th century CE.

It has elaborate recommendations on the specific plants to be grown on different soil types, and provides intricate methods for seed collection, preservation, and pre-planting treatments. Irrigation techniques are elaborately described, with recommendations varying according to plant species, growth stage, and seasonal conditions. It specifies pest management strategies through natural repellents and plants that should be grown together. This form of sustainable agriculture promotes practices like crop rotation and mixed cropping to maintain soil health. *s dñ' - fl' - Ś* also offers advice on proper methods of ploughing soil so as to retain soil moisture as well as facilitate the growth of living organisms in the soil like fungi, bacteria and earthworms.



Fig. 1.20. Organic farming in Sikkim

A caselet from Sikkim

Pema's family farm in Sikkim faced declining yields and mounting debts from expensive chemical inputs. When the state government announced a policy to promote organic farming throughout the state, Pema's family decided to try. It was not an easy transition — initially the yields dropped as the soil was recovering from years of chemical use.

The family switched to compost, prepared natural pest repellents using neem and garlic, and started growing multiple crops across the year. After about five years, Pema's farm was thriving. She was able to sell her cardamom, ginger, and traditional vegetables at premium prices. In 2016, Sikkim became a 100 per cent organic state with all of its farmland certified organic. The effects were transformational — local biodiversity flourished, with beneficial insects and birds returning; tourism increased as visitors came to see the organic farming model, and farmers' incomes grew by 20 per cent on average. Today, Sikkim serves as a global model, demonstrating that an entire region can successfully transition to sustainable agricultural practices while improving both ecological and economic outcomes.

Responsible and judicious use of resources

In the case of non-renewables we need to ensure that we use the resources so that they can last long enough for humanity to find more sustainable alternatives. For example, we need to make the switch to renewable sources of energy for as many purposes as we can.



Fig. 1.21. Satellite image of one of the largest solar parks in the world located in Rajasthan. It can generate enough electricity to power about 15% of the current needs of Rajasthan.



Fig. 1.22. Solar farm near Raichur, Karnataka

The International Solar Alliance — India's leadership in renewable energy

India and France launched the International Alliance for Solar Energy (IASE) in 2015 — a coalition of sunshine-rich countries committed to harnessing solar power. The alliance focuses on countries blessed with abundant sunlight throughout the year. India has helped channel billions of dollars into solar projects across developing nations, sharing technical expertise and creating affordable financing options. The Bhadla Solar Park is a symbol of India's solar ambitions, demonstrating how a country can transition from traditional energy sources to renewable alternatives. For Indians, this alliance represents both environmental responsibility and economic opportunity.

Even as we deal with these issues we must be mindful that the distribution and access to resources, including basic ones like water and clean air, is often unfair to some sections of society. In cities, many areas do not receive adequate and regular supply of drinking water. Air pollution caused by industries and excessive use of fossil fuels, affects those who are unable to protect themselves from these hazards.

We must remember our relationship with Nature and act as stewards of natural resources toward restoration, regeneration, and sustainability. The *Bhagavad Gītā* refers to *lokasangraha*,

the idea that everyone must transcend personal desires and act for the wellbeing of all. Has the time come for us to consider this seriously?

Before we move on ...

- 'Natural resources' are materials and substances that occur in Nature and are valuable to humans.
- There are different ways of categorising resources; renewable and non-renewable are useful categories.
- The 'resource curse' can be overcome through investments in the development of technology and skills.
- We need to become vigilant about the rate at which we use renewables so as not to overexploit them; judicious and wise use of non-renewables will enable stretching their use for a longer period of time.



Questions and activities

1. What can make what is today a renewable resource non-renewable tomorrow? Describe some actions that can prevent this from happening.
2. Name five ecosystem functions that serve humans.
3. What are renewable resources? How are they different from non-renewable ones? What can people do to ensure that renewable resources continue to be available for our use and that of future generations? Give two examples.
4. Identify cultural practices in your home and neighbourhood that point to mindfulness in the use of natural resources.
5. What are some considerations to keep in mind in the production of goods for our current use?

A NOTE ON HISTORY'S DARKER PERIODS

History sometimes seems to be full of wars and destruction; it is true that it rarely focuses on periods when the society is, on the whole, harmonious and peaceful. But while every country may have had such peaceful eras and some benevolent rulers, history seems peopled by incompetent, corrupt or cruel rulers. We find them especially in what we may call the darker chapters or periods of history, when war, abuse, fanaticism, bloodshed, etc., suddenly dominate the landscape and inflict suffering and misery on the whole society or country.

The world over, historians have faced this dilemma: how much attention should we draw to such darker periods? Should we omit them entirely? Should we mention them in passing, with most atrocious details left out? Or should we face them and analyse them so as to understand what made such developments possible and, hopefully, help avoid their recurrence in future? The third option is, in our opinion, the best, if it can be done with enough detachment and sensitivity; it is important to know our past, pleasant or unpleasant, since the past continues to live with us and shapes the present.

What do we mean by 'detachment and sensitivity'? Simply that it is important to study those darker developments dispassionately, without blaming anyone living today for them. For instance, you will learn later that World War II (1939–1945) resulted in millions of deaths worldwide; Germany then followed a cruel ideology (known as 'Nazism') which believed in the extermination of 'inferior races' and resulted in the inhuman treatment of some ethnic groups and a brutal rule of occupied nations. Yet it would be clearly unacceptable to blame today's Germans for what happened over eight decades ago. Rather, what matters is to understand what made the Nazi ideology possible, so that similar ideologies today or tomorrow may be defeated.

The same principle applies to the 'Tapestry of the Past' chapters in this textbook, which include passages on warfare and instances of cruelty or brutality. While those happenings cannot be erased or denied, it would be wrong to hold anyone today responsible for them. Understanding the historical origin of cruel violence, abusive misrule or misplaced ambitions of power is the best way to heal the past and build a future where, hopefully, they will have no place.

World Geography: Some Glimpses

CHAPTER

1

The modern age has brought the geography of the earth near to us, but made it difficult for us to come into touch with man.

— Rabindranath Tagore



Fig. 1.1. An image of the Earth 'stitched together' by scientists at NASA using minute data collected over several years.

The Big Questions ?

1. What are the unique physical features of the continents?
2. Why do we need to understand world geography?
3. How do human actions trigger environmental issues?



The Earth has long been revered as a mother by indigenous communities and personified in India as a living deity, often known as *X' -'* or *sŚffl -'*. Human lives are deeply connected to its many features; for instance, the distant Southern Indian Ocean influences the monsoon in the Gangetic Plains. From vast oceans to towering mountains and harsh deserts, humanity has long sought to understand the planet's wonders. Let's take a quick tour of our 'blue planet', our home, to give you a glimpse of a few of them.



LET'S EXPLORE

- What do you think each of the different colours in the map in Fig. 1.1 represents?
- Since this chapter is about world geography, we are concerned with physical maps. Physical maps have their own language that use colours —

Blue: water bodies (oceans, seas, lakes, rivers);

Green: plains; **Yellow/Brown:** plateaus;

Dark brown: high mountains; **Light yellow:** deserts;

White: ice and glaciers

Cartographer:

Person who draws or produces maps

Oblate spheroid:

A nearly spherical shape that bulges at the equator and is slightly flattened at the poles due to its rotation

THE COMPLEXITY OF MAPPING THE EARTH

The Earth is an **oblate spheroid**. When we draw a map, we try to show the Earth on a flat surface. Take an orange; imagine that it represents the Earth. Now peel it and lay the peel flat without tearing it. As you will discover, it is quite impossible to do so. This is why all maps have some distortion. The process of showing the Earth on a flat surface is called a map projection. **Cartographers** have made several attempts at creating accurate representative projections of the Earth. They use different methods to draw the world. Some maps show the right shapes of countries but wrong sizes, while others show the right sizes but distorted shapes.

Every map is a compromise. To understand the world fairly, we must **look at multiple projections**, not just one. Given below are two projections.



Fig. 1.2. (1) The Mercator Projection — Preserves shape and direction, making it useful for navigation. However, it greatly distorts size near the poles (e.g., Greenland looks as big as Africa).

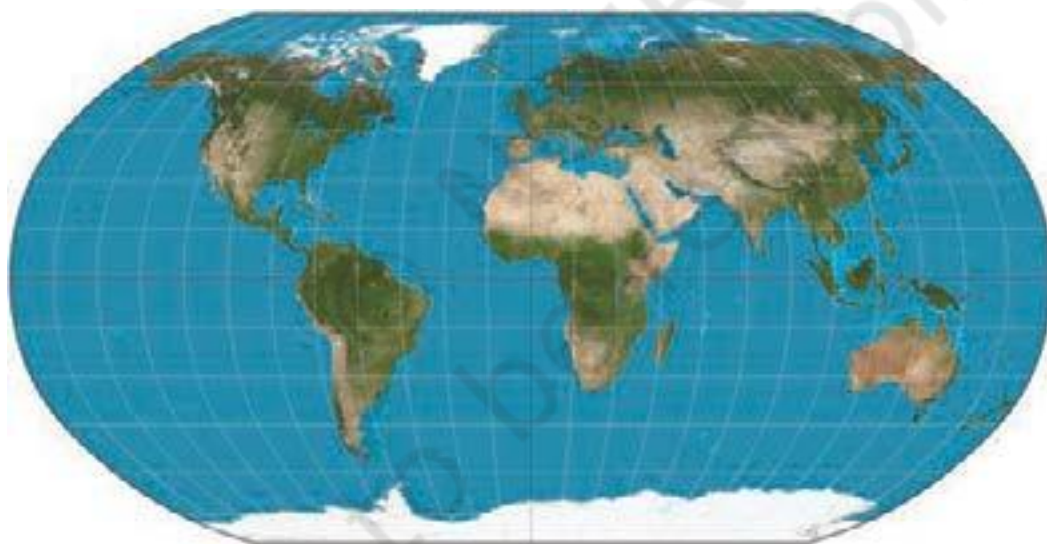


Fig. 1.2. (2) Robinson Projection — A compromise map that balances size and shape distortions, giving a more visually pleasing 'realistic' world map.



DON'T MISS OUT

Look at the size of Greenland compared to India in both the maps. In the Mercator Projection Greenland looks larger than India whereas in fact it is smaller.



Fig. 1.3. Fluorescent plankton (very small organisms that float on water) on a beach



Fig. 1.4. The blue whale, the largest mammal in the world, can be over 30 metres in length and weigh almost 150,000 kg.

Plankton:
Microscopic organisms that have chlorophyll and use sunlight and carbon-dioxide to make food.

As we saw, world map projections on a flat surface are tricky. They only provide a visual representation that allows us to gauge size, shape, location, and distance across the whole world. However, professionals use maps that use the latitude and longitude coordinates (we saw these in Grade 6) which are more precise.

THE BLUE OF THE BLUE PLANET, THE OCEANS

The **ocean** is a vast body of saltwater covering about 71 per cent of the Earth's surface. This is why the Earth looks blue from space and early astronauts called it the 'blue planet'. The oceans hold 97 per cent of the Earth's water. They support life, from tiny **plankton** to giant blue whales, and help regulate the climate by absorbing heat, slowly releasing it, and adding moisture to the air forming clouds and rainfall. As you may already know, the ocean floor is not flat! It has mountains, valleys, and plains like the land.



THINK ABOUT IT

Oceans give us almost half the oxygen we breathe. Tiny marine organisms, such as plankton, make this possible. What do you think would happen to all living beings if pollution harmed these planktons, and they could no longer produce enough oxygen?

The oceans



LET'S REMEMBER

In Grade 6, we got a glimpse of the oceans — the Indian, the Pacific, the Arctic, the Atlantic, and the Southern.

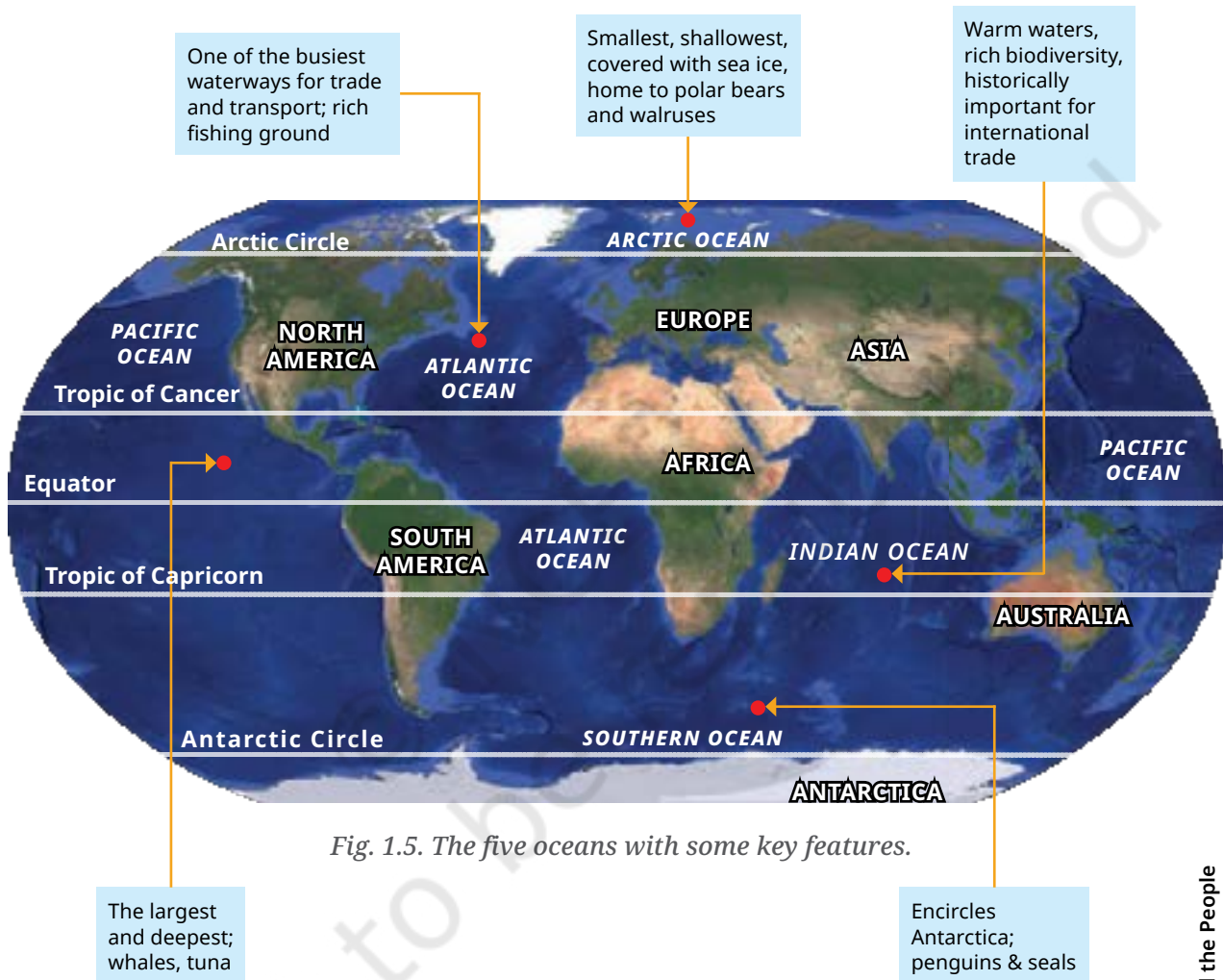


Fig. 1.5. The five oceans with some key features.

Ocean currents

Oceans are constantly moving! Ocean currents are like giant rivers flowing through the ocean. They can be:

- **Warm currents** bringing warm water from the equator toward the poles, or
- **Cold currents** bringing cold water from the poles toward the equator.



Fig. 1.6. A simplified diagram of the Gulf Stream showing its main course.

These currents affect the climate of coastal areas. For example, the Gulf Stream flows north from near the Equator (where the water is warm) through the Atlantic Ocean towards Western Europe. This warm water makes places like the United Kingdom warmer than other places at the same latitude.



Fig. 1.7. A type of snail photographed on the seabed of the Mariana Trench. It feeds on bacteria that synthesise chemicals for their own food.

Ocean trenches

The seafloor has very deep, V-shaped areas called trenches. The Mariana Trench is the deepest of these. Near-freezing temperatures, high pressure, and complete darkness make it one of the harshest environments on Earth. The trench is over 2,000 metres deeper than the height of Mount Everest. Its deepest section, the Challenger Deep, reaches over 11,000 metres below sea level.

Scientists studying these trenches have found unique life forms. Since there is no light, plants cannot use photosynthesis to make food. Instead, they use energy from chemicals in the water to produce food. Life finds a way to survive and thrive even in such harsh conditions.

The Great Barrier Reef

A **reef** is a ridge found at or near the surface of the ocean, formed either naturally or artificially. Natural reefs can be made of rock or built by tiny sea animals called corals. Reefs are among the

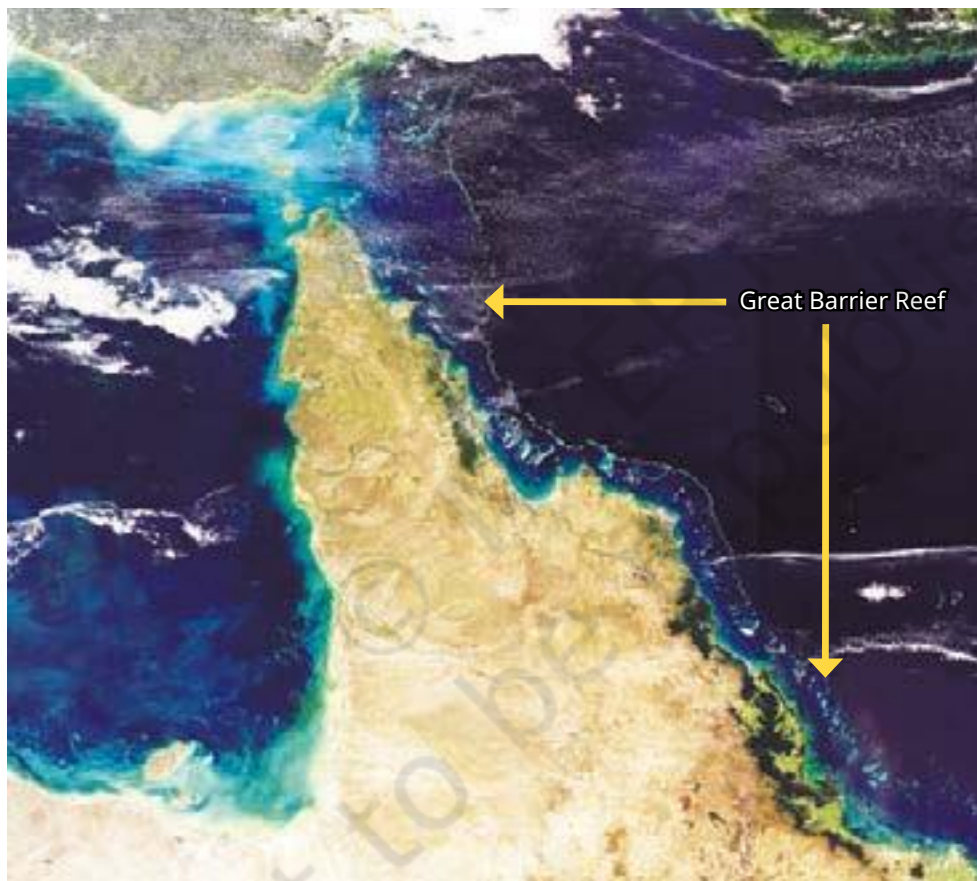


Fig. 1.8. The Great Barrier Reef seen from space.

most diverse ecosystems on Earth, often called the ‘rainforests of the sea’, as they provide food and shelter for about one-quarter of all ocean species, including fish, crabs, turtles, and sponges. However, they face serious threats from human activities such as overfishing, pollution, and climate change, making their conservation crucial.



Fig. 1.9. (1) Live corals in the Great Barrier Reef, home to a variety of sea life. (2) The bleaching and death of coral leads to the loss of habitat of a whole host of sea animals. The bleaching occurs due to changes in the chemical composition of ocean waters, largely caused by human actions.

The Great Barrier Reef (Fig. 1.8), off Australia's northeastern coast, stretches over a length of 2,000 km and covers about 350,000 square kilometres. It is a complex, interconnected habitat housing hundreds of species of coral, thousands of species of fish and other sea animals. Recognised as a UNESCO World Heritage Site, the reef is one of the planet's most remarkable features.

Smaller water bodies and waterways

It helps differentiate among the various types of formations in the sea through a system of classification and naming — seas, straits, bays, gulfs and canals — as shown in the table below.

Type	Description	Example
Sea	Large, partly enclosed saltwater area connected to an ocean	Arabian Sea
Gulf	Large inlet of the sea deeply cutting into land	Persian Gulf
Bay	Smaller, broad inlet of the sea	Bay of Bengal
Strait	Narrow channel joining two seas or oceans	Strait of Malacca
Canal	Man-made channel connecting water bodies	Suez Canal

These formations play an important role in supporting trade and transport. The Persian Gulf, for instance, has been important for

trade between India and Europe for millennia. The bays provide safe havens for ports and dockyards shielding them from the strong winds of the open oceans.



DON'T MISS OUT

The Bay of Bengal is the world's largest bay and has been important in trade, influences climate, and is home to a variety of flora and fauna.



Fig. 1.10. The Suez Canal is the shortest maritime route from India to Europe.

The **Suez Canal** is a human-made passage (opened in 1869) connecting the Red Sea with the Mediterranean, creating a waterway from the Indian Ocean to Europe.

THE CONTINENTS: VARIETY ON LAND

Landforms of the world include mountains, plateaus, and plains. We have encountered them across various chapters throughout the Middle Stage, mainly in the context of India. Here we expand the scope to look briefly at these landforms across the world — where they are located, what some of their features are, and in what ways they are connected to life.



LET'S REMEMBER

- In Grade 6 we looked at the three main landforms — mountains, plateaus and plains.
- Mountains are landforms that are much higher than the surrounding landscape. They can be recognised by a broad base, steep slopes and a narrow summit.
- A plateau is a landform that rises from the surrounding land and has a more or less flat surface; some of its sides are often steep slopes.
- Plains are landforms that have an extensive flat or gently undulating surface. They do not have any large hills or deep valleys.
- Deserts are considered to be large and dry expanses with very little precipitation. Their flora and fauna are also unique. Some deserts are hot, such as the Sahara Desert in Africa and the Thar Desert in the northwest of the Indian Subcontinent. Others are cold, like the Gobi Desert in Asia.
- A large continuous expanse of land is called a 'continent'. The most common count is of seven continents — Africa, Antarctica, Asia, Australia, Europe, North America, and South America.

We will tour the continents, spotlighting one or two landforms in each. We start from near home, Asia. Since we have taken a tour of the major landforms of India in Part 1 of this textbook, our focus will be on other parts of the world.

Asia



Fig. 1.11. Physical map of Asia with some features marked

LET'S EXPLORE

Study the map in Fig.1.11. What are the different physical features represented here? (Hint: You may refer to LET'S EXPLORE on page 2 of this chapter.)

Roof of the world — the Tibetan Plateau

As we fly across the Himalayas, we encounter the Tibetan Plateau. Studying plateaus offers us insights into the Earth's geology, and their importance for both nature and human life.



India and the World: Land and the People
1 – World Geography: Some Glimpses

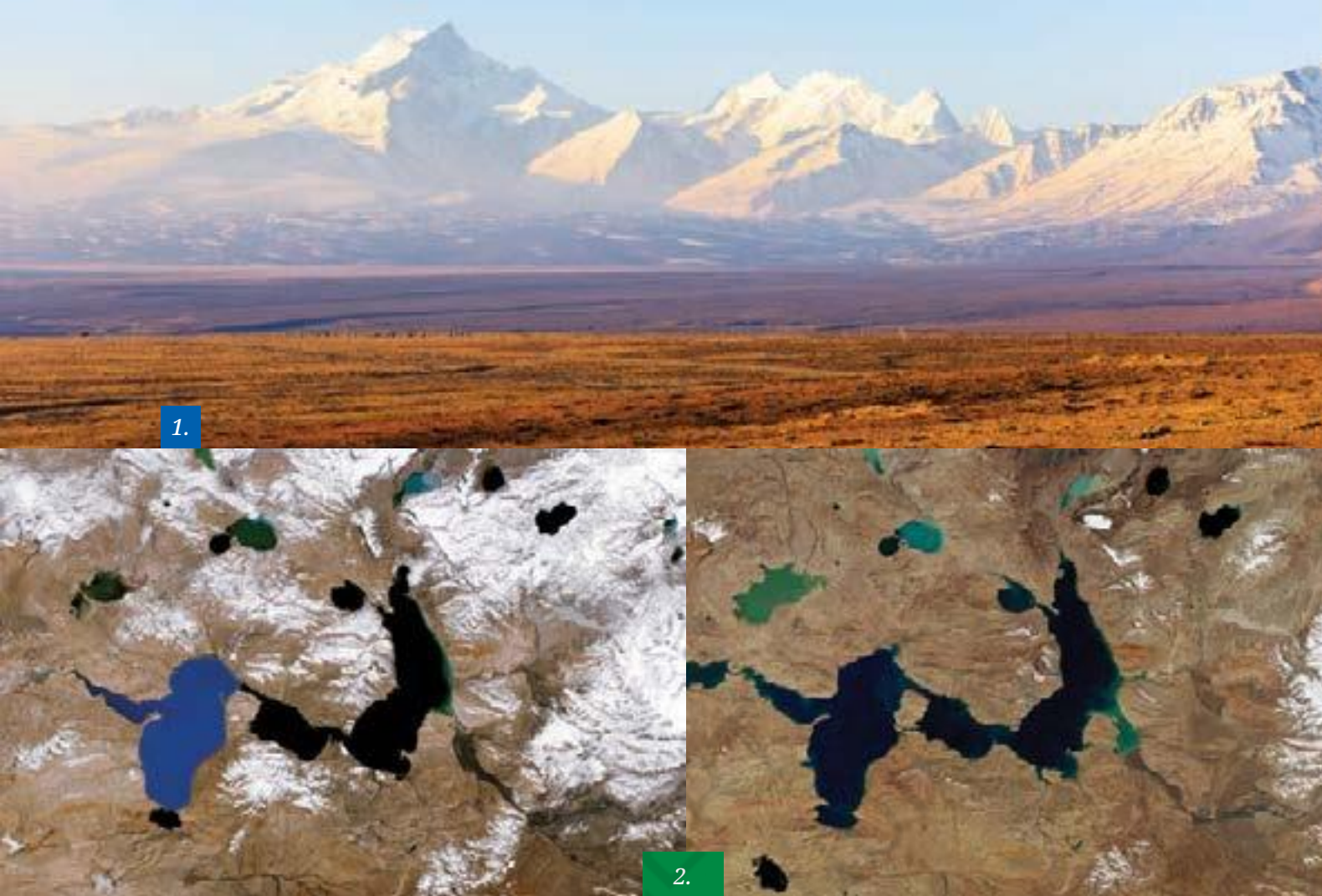


Fig. 1.12. (1) The Tibetan Plateau, an expanse of flat land with the steep Himalayan mountains towards the south; (2) Part of the Tibetan Plateau. These satellite pictures are from 1987 and 2021 respectively. What differences do you notice?

Tectonic:
Geological
forces
related
to the
movement
of the
Earth's crust

The Tibetan Plateau is the highest and largest plateau on Earth. Located north of the Himalayan Range, it is the result of collisions between the Indo-Australian and Eurasian **tectonic** plates, which also led to the formation of the Himalayan mountain range. The plateau stretches about 2,500 km from east to west and 1,000 km from north to south, with an average height of over 4,500 metres above sea level. The region plays an important role in influencing the climate of Asia, and is the source of many major rivers, including the Indus, Brahmaputra, and Yangtze.

Scientists call the Tibetan Plateau and its mountains the 'Third Pole'; it contains the largest reserves of freshwater outside the polar regions. With climate change, snow-melt has led to the expansion of existing lakes and the creation of new ones.

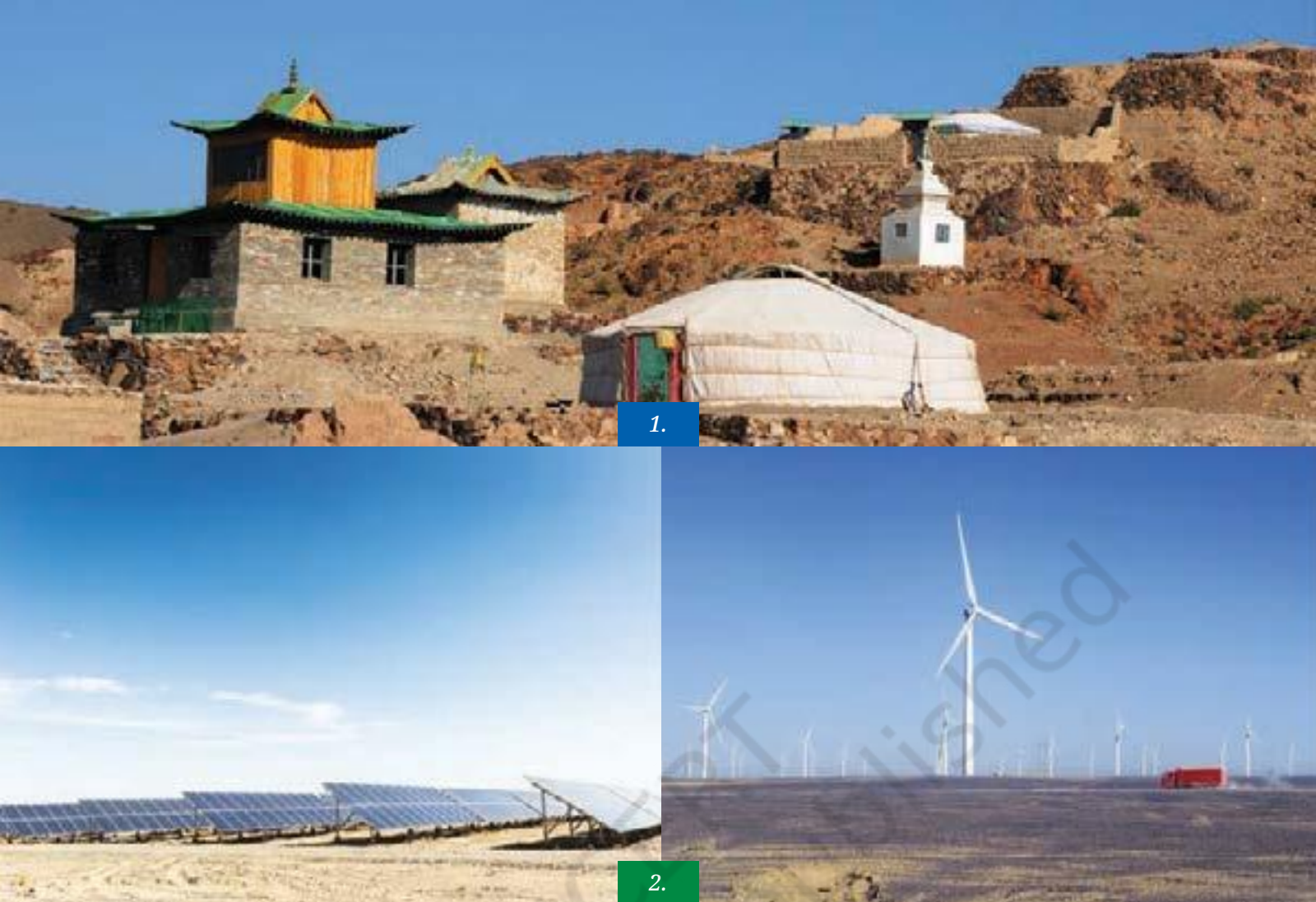


*Fig. 1.13. (1) A Buddhist monastery at the edge of the Gobi Desert. Notice the lack of vegetation in the surrounding area. (2) Harnessing energy from Nature in the Gobi Desert
Left: Solar panels; Right: Windmills*

Gobi Desert in the ‘Land of the Eternal Blue Sky’

Deserts are large, extremely dry areas of land with low precipitation (less than 25 cm per year). Deserts are found on every continent and cover about one-fifth of the Earth’s land area. According to the National Geographic Society, around one billion people (one-eighth of the world’s population) live in deserts.

As we move to the northeast, we arrive at the Gobi Desert in Mongolia (part of the desert is in north China). Mongolia is called the ‘Land of the Eternal Blue Sky’ because it has about 8 to 9 months of sunny weather, but winter temperatures can drop to minus 30°C. The climate is harsh and vegetation sparse; herds migrate seasonally to access pastures supported by underground water supplies.



Fig. 1.14. (1) The landscape of the Steppes. (2) The steppe tortoise is about 13–25 cm in size. It lives in burrows almost 2 metres deep, and hibernates for 2–5 months depending on weather conditions. Two of them were among the first inhabitants of the Earth to travel to the moon in 1968. (3) This is a yurt, the hut of a nomad of the steppes. (4) The inside of a yurt.

Steppe:

A large area of flat unforested grassland, that has a temperate climate with hot summers and cold winters, and moderate rainfall that is often seasonal.

The Eurasian Steppes

We are now ready for better weather — we go north we arrive at the **Steppes**.

The Steppes are spread for over 8,000 km west to east (see Fig. 1.11) This grassland is a global **carbon sink**; it absorbs carbon from the air and stores it underground; this helps to reduce greenhouse effects over time. The steppes and their water bodies nearby serve as resting spots for migratory birds like the Siberian crane.



1. 2.

Fig. 1.15. (1) Snow-capped Ural mountains; (2) A collection of rocks from the Urals that yield semiprecious stones like crystal, topaz, quartz, agate, beryl, amethyst and gypsum.

The Urals

We now travel a little westward to the Ural Mountains (see Fig. 1.11).

Mountains are formed by tectonic forces, volcanic activity, and erosion. They play an important role in determining climates, serve as ‘**water towers**’, biodiversity hotspots and, in many cases, serve as natural boundaries between countries.

LET'S EXPLORE

Assess and describe the Himalayas from the perspective of these different roles.

Since we have gathered information about the Himalayas in the past, in this chapter we will explore a few mountain ranges in other parts of the world.

The Ural Mountains are an ancient range stretching about 2,500 km from the Arctic Ocean in the north to the border of Kazakhstan in the south. (See Fig. 1.11.) They form a natural boundary between Europe and Asia. The range is notable for its rugged slopes, caves, valleys, and forests.

Water towers: Mountains are called water towers because they are at a height, and provide freshwater through melting snow and glaciers.



India and the World: Land and the People
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Fig. 1.16. An aerial view of the Siberian taiga, an area near the Arctic with forests of coniferous trees.



Fig. 1.17. Winter night in the polar tundra



Fig. 1.18. The tundra in the Ural Mountains in summer

Tundra: A tundra is a treeless, cold plain where the soil stays frozen most of the time. This frozen soil, called permafrost, acts like a giant freezer, trapping greenhouse gases like carbon dioxide and methane. As global warming causes the planet to heat up, the permafrost melts, releasing these stored gases and speeding up climate change.

Swamp: Land that is always wet and partly covered with water

The Urals are rich in mineral resources, including iron ore, copper, zinc, platinum, gold, and coal, as well as oil and natural gas.

These mountains support diverse ecosystems, with coniferous taiga forests dominating the western and eastern parts, while deciduous forests (Fig. 1.18) prevail in the south, providing habitats for animals such as brown bears, wolves, lynx, elk, reindeer, and sable. The varied landscapes, from the northern **tundra** and **swamps** to the fertile southern farmland, make the Urals significant for their ecological diversity, natural beauty, and economic importance.

Europe

The European Plain

We now fly west across the Urals to Europe, where we come to the vast European Plain (Fig. 1.19).

Plains are vast flatlands formed by sediment deposition and are known for their fertile soils that support farming, trade, and dense populations. Valleys are carved by rivers and provide fertile soil, water, and transport routes that have nurtured some of the world's earliest civilisations. Together, plains and river valleys sustain agriculture, and foster biodiversity.

The **European Plain**, or the Great European Plain, is one of the largest flat lands in the world. It covers parts of several countries. The plain is characterised by low-lying terrain, gentle rolling hills, and several wide river valleys.



Fig. 1.19. Physical map of Europe

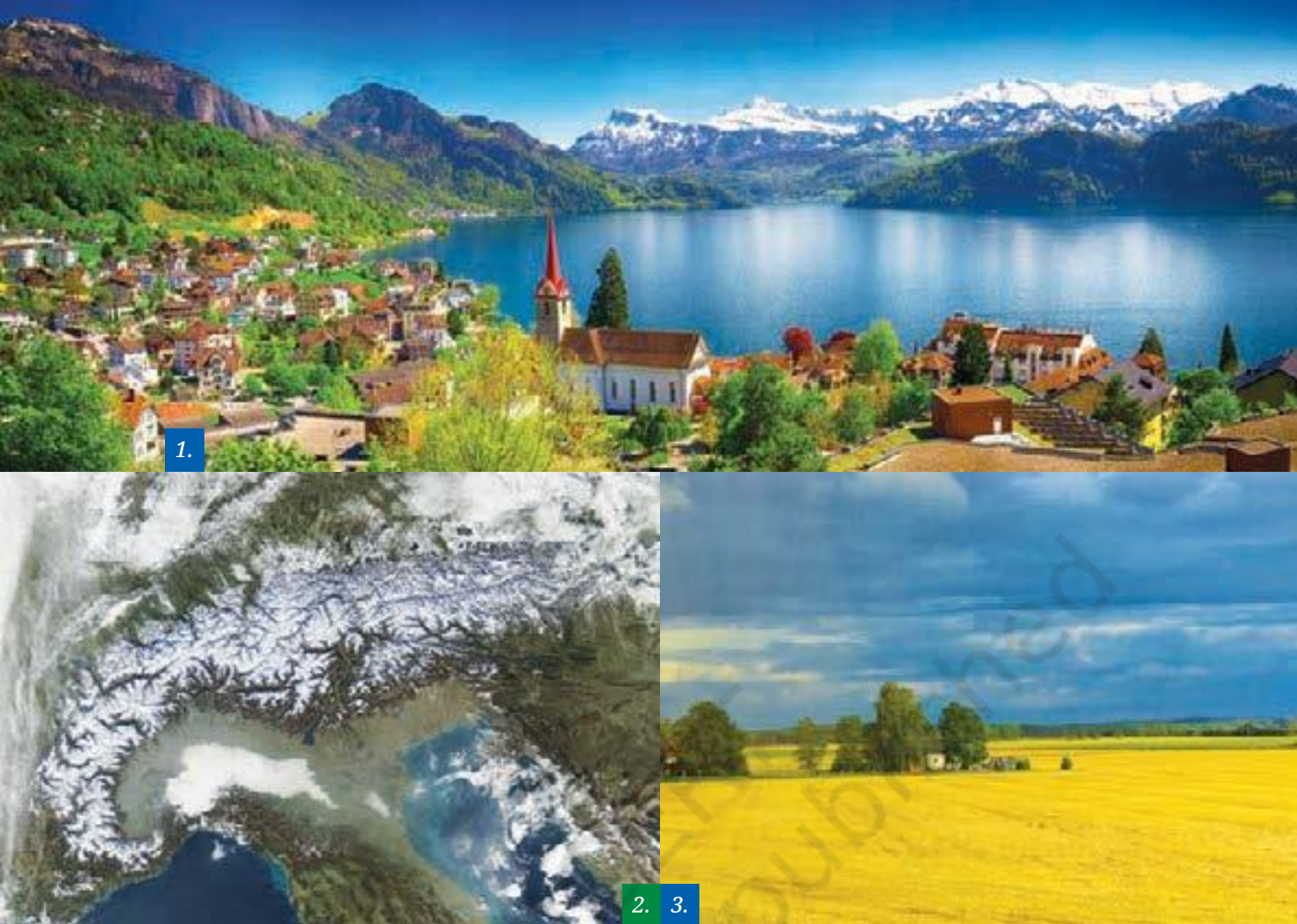


Fig. 1.20. (1) A village in Switzerland located next to Lake Lucerne, with a view of the Alps; (2) The 1,200 km long, crescent-shaped Alps photographed from space. (3) Wheat fields in Europe; the largest proportion of the world's wheat production is from Europe.



LET'S EXPLORE

Observe the area covered by the European Plain. Now turn to the political map of the world at the end of this textbook. List the countries that are part of the European Plain (*you need not memorise them*).

The fertile soils here make it one of the most productive agricultural regions in the world. Wheat, barley, rye, and potatoes are widely cultivated. The rivers of the region have played an important role in trade and transport. The region has deposits of coal, oil and natural gas, resources that have been important for economic growth. The relatively flat land and favourable

climate have also supported the growth of major cities like Moscow, Berlin, Paris, Amsterdam, and Warsaw, among others.

The European Plain has been the ground for major battles with many rulers jostling to take control of it. Today, it remains vital for Europe's economy especially for agriculture and transportation.

As we continue southwest we sight a crescent-shaped mountain range, the Alps. The Alps are renowned for their picturesque landscapes with skiing and hiking in all the countries they span. They form a natural barrier in south-central Europe and contain famous peaks such as Mont Blanc.

The Alps have oak and beech forests at lower altitudes, spruce and pine at higher elevations, and alpine flowers such as the edelweiss in the high mountains. Wildlife includes ibex, chamois, marmots, golden eagles, lynxes, wolves, and brown bears. The Alps provide water to major European rivers like the Rhine and tributaries of the Danube (see Fig. 1.19), which supply drinking water, irrigation, and hydroelectric power to lowland Europe. The region is also rich in minerals such as iron, copper, lead, rock salt, graphite, gypsum, and magnesite, and is known for its forests and fertile land.



Fig. 1.21. Edelweiss, flower of the Alps. It is the national flower of Austria and belongs to the family of sunflowers.

Africa

After this whirlwind tour of the key landforms of Europe, we fly south to the African Continent. As on every other part of the Earth, Africa too has varied landforms. The first large one we traverse is the **Sahara Desert**, the largest hot desert in the world. (See Fig. 1.22.) Temperatures range widely across the desert, from 30°C to 46°C, with rainfall below 25 cm, and hardly any vegetation.

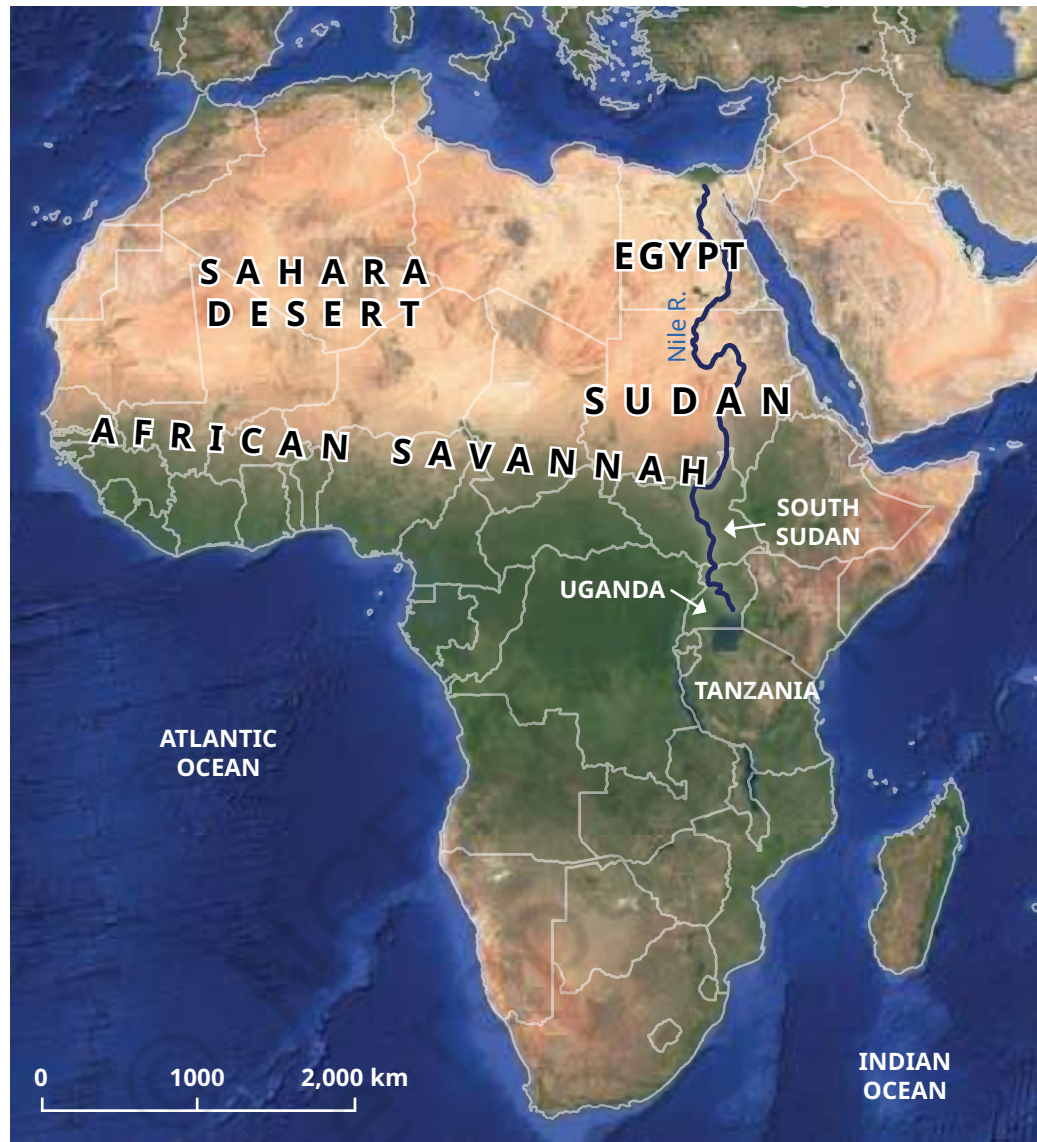


Fig. 1.22. The African continent highlighting the African Savannah, the Sahara Desert, and the River Nile.

The savannah is a tropical grassland ecosystem that has wide open spaces, scattered trees, and seasonal rainfall. It lies mainly between tropical rainforests and deserts, the most famous one being in Africa. The savannah supports a rich diversity of wildlife, including elephants, lions, zebras, and giraffes, which depend on its grasses and waterholes. Its climate features a distinct wet and dry season, influencing plant growth and animal migration patterns. However, human activities such as farming, deforestation, and climate change are threatening the balance of these vital ecosystems.



Fig. 1.23. (1) An oasis in the Sahara, an area with water and vegetation in the otherwise dry desert. (2) Underground dwelling in the Sahara. This design keeps the house cool in summer and warm in winter.



Fig. 1.24. (1) Traditional clothing and headgear of nomads in the Sahara, designed to keep the body cool. (2) Date palm trees in an oasis. Dates are rich in carbohydrates, vitamins and minerals. (3) Cacti in the desert store water in their leaves. (4) The large ears of the Saharan fennec fox help dissipate heat and listen to the sounds of underground prey. The flora and fauna have adapted and built resilience to extreme heat, sometimes upward of 50°C.

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The Sahara has been home to nomadic tribes that herd livestock — sheep, goats and camels — and engage in trade for their livelihood. Ancient trade routes passed through here, carrying gold, salt, and ideas to the Mediterranean world.

The African continent has the longest river in the world, the Nile, almost 6,650 km long. The Nile and its basin have been the cradle of the ancient Egyptian civilisation. For thousands of years, the river has provided irrigation, transforming dry lands into fertile agricultural areas that support crops such as wheat, barley, flax, fruits, and vegetables. The river also provides drinking water, fishing, and hydroelectric power, and it has served as an important transportation route for centuries.



LET'S EXPLORE

On the map (Fig. 1.22) locate the course of the River Nile. Where does it originate from and in which direction does it flow? Turn to the political map at the end of the book, and identify some of the areas that the river flows through.

South America

We now fly across the Atlantic Ocean to South America. On the west coast of South America are the Andes Mountains — the largest mountain range in the continent (Fig. 1.25). They are home to Mount Aconcagua, the highest peak in the Western Hemisphere and Bolivia's Uyuni Salt Flats, the largest **salt flat** on Earth.

The Andes are a vital source of freshwater for millions of people, feeding major rivers including the Amazon, world's largest river by volume. Rich in biodiversity, the mountains are also home to thousands of species of mammals, birds, amphibians, reptiles, and fish, many of which are unique to the region. However, only about one-fourth of the original flora and fauna remains, making the Andes a critical **conservation hotspot**.

In addition, the Andes are among the most resource-rich regions in the world, holding vast reserves of copper, zinc, silver, and lithium.

Salt flat:
Areas of flat land covered with a layer of salt.

Conservation hotspot:
An area where efforts are made to save the native flora and fauna lost generally due to human activities.



Fig. 1.25.
South America



Fig. 1.26. (1) The Andean condor is a national symbol of several South American countries. It has an average wing span of 3.2 metres, and is a significant part of the mythology representing the sun deity; (2) Salt flats in South America.



Fig. 1.27. The Amazon River flows through the Amazon Rainforest in South America.



DON'T MISS OUT

Rainforest:

An area of tall, mostly evergreen trees that receives a high amount of rainfall.

- The **Amazon River** is the longest in South America and flows from the Andes Mountains in Peru and flows east towards the Atlantic Ocean. The river basin with all its tributaries supports the Amazon **Rainforest**.
- Almost 400 indigenous communities reside in the forest and play an important role in conserving the forest. Today, the Amazon is threatened by deforestation and climate change.
- Dust travels all the way from the Sahara to the Amazon rainforest, carrying with it phosphorous needed by the plants in the rainforest.



LET'S EXPLORE

- The Amazon Rainforest has been called the 'Lungs of the Earth'. Why do you think this might be so?
- The countries in this region need land for development but risk losing the Amazon Rainforest. Discuss in groups: What are the short and long-term effects of deforestation, and how can we protect the Amazon for the planet?



Fig. 1.28. (1) Moon Valley in the Atacama Desert. The moon-like formation has occurred due to movements in the Earth's crust. (2) A sculpted human hand rises from the Atacama Desert, seemingly reaching for the sky, created by a famous Chilean artist. (3) Rainbow Valley, a part of the Atacama Desert. The colours are from different minerals in the soil.

From the Amazon Forests we travel to the **Atacama Desert** in Chile (see Fig. 1.25), one of the driest places on Earth, stretching about 1,000 km. The temperature varies from 40°C during the day to 5°C at night.



LET'S EXPLORE

The Atacama Desert is famous for stargazing, offering some of the clearest night skies, and its rocky, Mars-like landscape has even been used by NASA to test rovers. However, it has also become one of the world's fastest-growing dumps for discarded clothes, caused by the rise of cheap **fast fashion**. The UN has called this waste problem 'an environmental and social emergency'.

Fast fashion: Replication of trendy clothing fast and at low costs, generally by producing in countries where labour is paid low wages. The clothing is very quickly discarded when the fashion trends change.

India and the World: Land and the People
1 – World Geography: Some Glimpses

North America

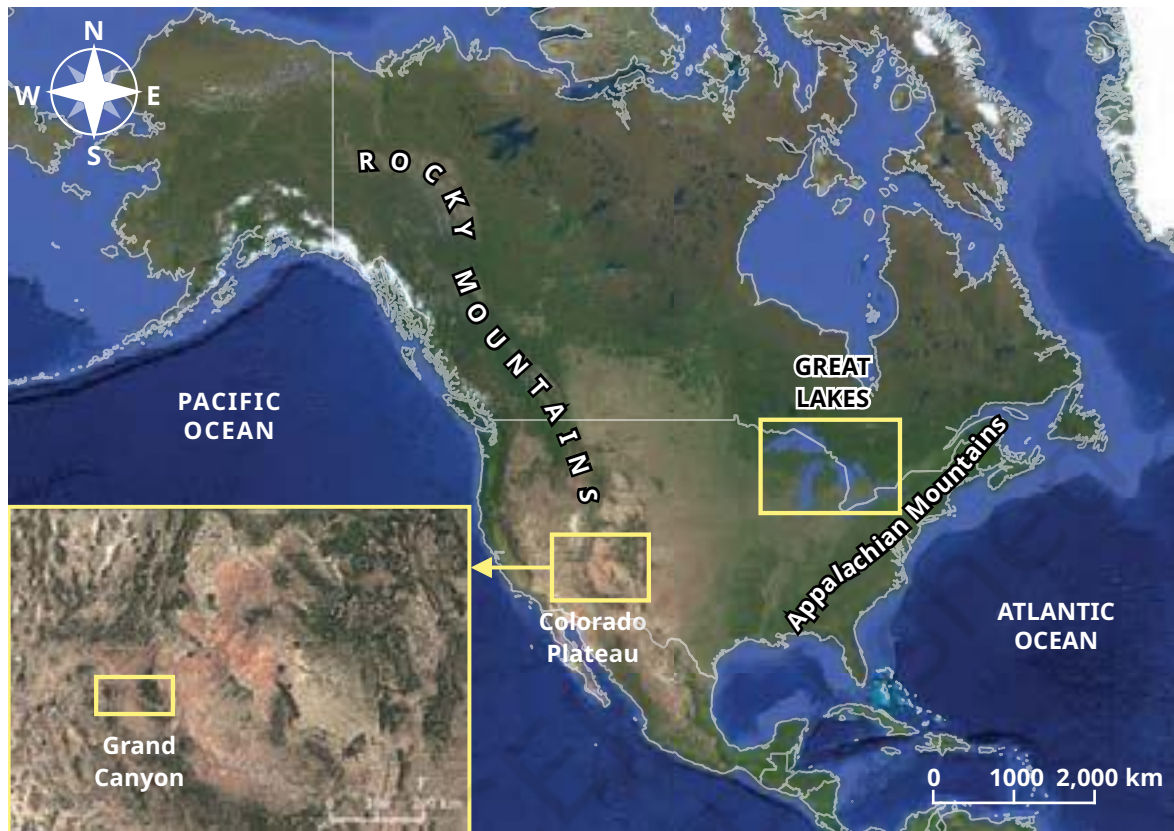


Fig. 1.29. North America

We now travel north to North America.

The Colorado Plateau

The Colorado Plateau is a large highland region in the southwestern United States that stretches across several states. Covering over 3,30,000 square km it is renowned for its landscapes, including the Grand Canyon. The plateau is composed mostly of layers of sedimentary rock that were slowly uplifted by tectonic forces and shaped by erosion over millions of years. This process has created dramatic red rock formations and deep canyons (see Fig. 1.29).

The Colorado Plateau is rich in natural resources, such as coal, oil, natural gas, uranium, copper, and other minerals. Its unique geology, mineral wealth, and diverse plant life, including both coniferous and deciduous trees, makes the region important for tourism and natural resource use. The Grand Canyon has had about 5 million visitors annually over the past several years.



Fig. 1.30. The Colorado Plateau with the Colorado River flowing. Note the plateau, at a height above the river.

The Rocky Mountains (see Fig. 1.29), or the ‘Rockies,’ stretch over 4,800 km. They are rich in natural resources such as copper, gold, and silver. Mining, hydropower generation, tourism and agriculture contribute to the GDP. The Rockies were home to large indigenous communities, Native Americans as they are called, till about 300 years ago. These communities depended on the region’s rivers, forests, and wildlife for sustenance and regarded the mountains as sacred. Today, many of them live on reservations that have been established for them.



Fig. 1.31. ‘Old Faithful’, a geyser erupts at Yellowstone National Park in the Rockies. Geysers are jets of boiling water and steam, caused in this case by volcanic activity deep beneath the Earth’s surface.



Fig. 1.32. The Appalachian Mountains



DON'T MISS OUT

The Yellowstone National Park, located in the Rockies, is an example of ecosystem restoration. The Park was experiencing an ecological imbalance due to overgrazing by elk, a type of deer. In 1995, wolves were introduced here. This predator hunted the elk, reducing their population and enabling the return of the flora, hence leading to the restoration of ecological balance.



Fig. 1.33. A Native American of the Cherokee community in traditional dress. The Cherokee are one of the communities indigenous to the Appalachian Mountains.

The Appalachian Mountains (see Fig. 1.29) are among the oldest mountain ranges in the world. The fertile valleys, abundant game, and natural travel routes enabled indigenous communities to thrive. Like in other traditions, the mountains hold spiritual significance for the people here. The mountains have been vital for economic development providing coal, timber, and natural gas industries. Tourism and renewable energy are also growing sectors.

The Great Lakes (see Fig. 1.29) are a chain of five massive fresh-water lakes. They have been vital to North American commerce and industry for centuries through their shipping routes. Several cities in the region depend on the lakes for drinking water. The lakes are a vast habitat for diverse wildlife, though they also face environmental challenges such as chemical contamination of the sediments in the lake, and water contamination due to agricultural run-off and industrial processes.

We have travelled all over the world, exploring a few significant geographical features, and how they connect with our lives in various ways. The continent we now visit is Australia, our last stop.

The Australian Continent

As you may be able to figure out from Fig. 1.34, a large part of Australia is desert, or arid, and has been termed the Great Australian Desert. It comprises several desert areas, among which is the Great Victoria Desert.

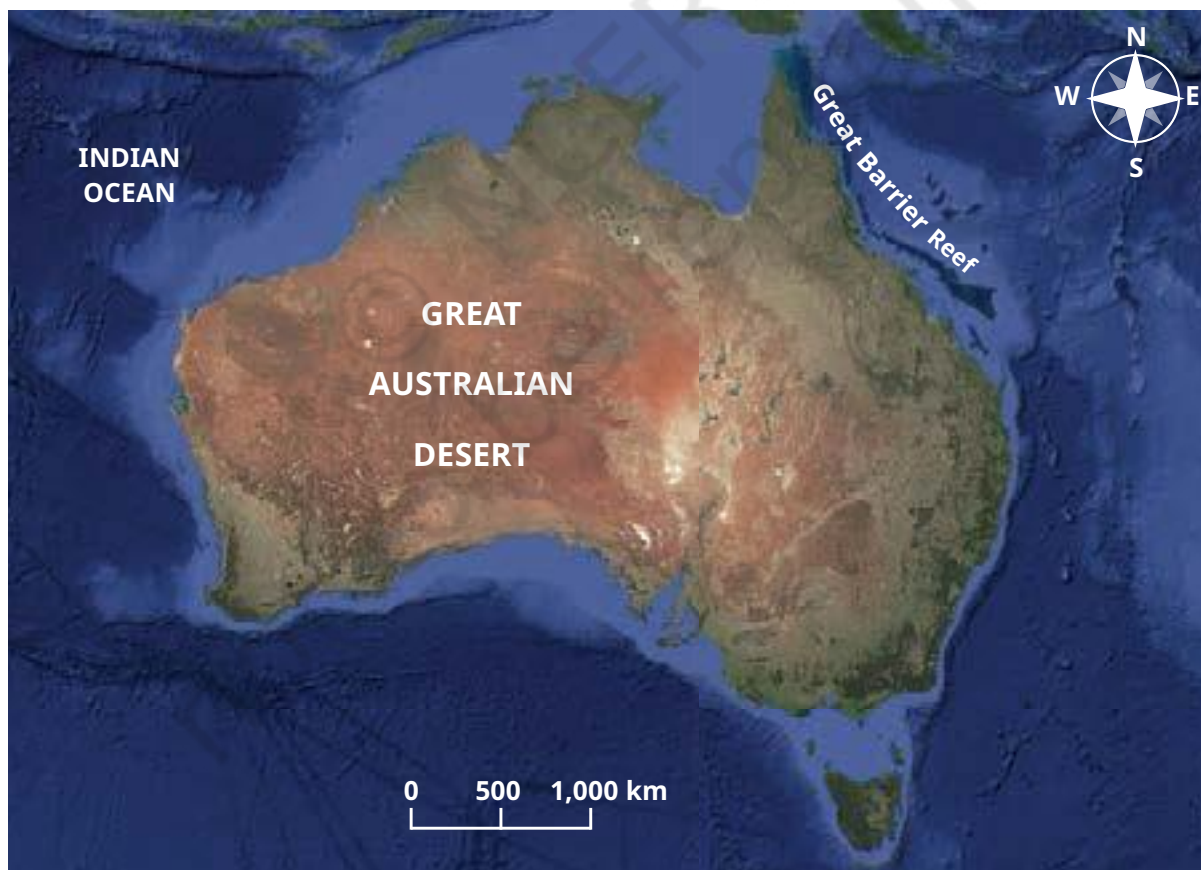


Fig. 1.34. Physical map of Australia. Based on the colours you see, what conclusions can you draw about the landforms?



Fig. 1.35. (1) A remote road in the Great Australian Desert. (2) Camel in the wild — camels were transported from places like India and Afghanistan to help exploration and colonisation during the 19th century.

The deserts are home to many animals, like reptiles, skinks, wallabies, bilbies, and feral camels. Predators include dingoes, large lizards, cats, foxes, and snakes. Some rare animals, such as the sandhill dunnart, marsupial mole, and mallee fowl, are struggling to survive.

The Spinifex are an indigenous population of Australia who have lived in the desert for over 25,000 years. Their way of life and culture are being preserved by younger generations and attract tourists. Tourists also come to see the unique geography and wildlife.



DON'T MISS OUT

The word 'desert' conjures up images of a very hot and dry place. However, there are cold deserts too. The largest desert on Earth is Antarctica, which covers over 14 million square kilometres, more than four times the area of India. It is also the coldest desert on Earth, even colder than the Arctic, the planet's other polar desert.

Through our whirlwind world tour we have visited most of the key geographical features of the Earth.

Before we move on ...



- The Earth's surface includes varied landforms and water bodies such as mountains, plateaus, plains, deserts, grasslands, rivers, and oceans, all shaped by natural processes like tectonic movements, erosion, and deposition.
- These features influence climate, ecosystems, and human activities such as settlement, agriculture, and trade.
- Human actions like deforestation, overuse of resources, and pollution disturb this balance, causing issues like desertification, biodiversity loss, and climate change.
- Studying world geography helps us understand these features and the need to manage them wisely for sustainable development.

Questions and activities

1. Why do all map projections have some amount of distortion?
2. What makes the Tibetan Plateau unique?
3. Why are coral reefs called the 'rainforests of the sea'?
4. How do the oceans help to regulate the Earth's climate?
5. What is the main reason for the Great Barrier Reef facing threats today?
6. Why is the Amazon Rainforest often called the 'Lungs of the Earth'?
7. Choose two different types of geographical features you have explored in this chapter. Write short paragraphs on how they influence the flora and fauna or human lives in that area. Do they also have an implication for the whole globe?

8. Discuss how oceans influence climate and trade. Use examples from the Indian and Pacific Oceans.
9. Choose one environmental issue (deforestation, reef bleaching, or desertification) and explain its causes, impacts, and possible solutions.
10. Imagine you are a geographer asked to advise a government about protecting one major landscape in your country. Which one would you choose, and why?
11. Imagine that someone is funding a group of you for a road trip across two continents. There are differences of opinion on which two they should be. Make a pitch for the ones you would like everyone to go to. Use a blank map, trace your route and locate the places on it, and try to convince the others to your point of view. You could use a variety of creative ways.

LOOKING BACK AND FORWARD...

Remember that in the chapter 'The Colonial Era in India' (Part 1 of this textbook), we saw how the Great Rebellion of 1857 was not an isolated flashpoint, but rather the culmination of a long history of resistance and uprisings against the British. Before we embark on the second leg of India's long journey to independence, let us look back at two more important movements that took place in eastern India and serve as examples illustrating how deep-seated grievances over land revenue and the loss of sovereignty fuelled the desire for fairness and an end to colonial tyranny.

The Paika Sangram: Odisha's Early Uprising Against Colonial Rule

The Paika Sangram was one of the earliest uprisings against colonial rule. It took place at Khorda, in present-day Odisha and its roots lay in decades of British betrayal and exploitation. After assisting the East India Company in 1803, the Raja of Khorda found his territories annexed by the Company and his religious authority over the Jagannath Temple stripped away. Resistance led by the royal preceptor, Jayee Rajguru, resulted in his execution in 1806, further fuelling local anger.

A further source of distress was the Company's revenue policy. The British began collecting tax even from revenue-free lands earlier granted to local officers and soldiers in return for service. The Paikas—Odisha's traditional peasant militia—lost their hereditary, rent-free lands because of these high tax demands imposed by the British. This economic distress was compounded by rise in salt prices and by forced payments in a new currency, as the East India Company abolished the traditional system of cowrie currency. All this not only affected peasants but also tribal communities, as they suffered dispossession and hardship.



Buxi (or Bakshi) Jagabandhu, the hereditary military commander of Khorda, emerged as the chief leader of resistance and mobilised the disaffected Paikas and tribal groups. Under his command, the rebels seized control of Puri and reinstated the Raja's authority. The temple priests even declared the end of British rule, using Lord Jagannath of Puri as a symbol of Odia sovereignty to unite the masses.

The rebellion spread across large parts of Odisha and involved thousands of fighters. Though the British imposed martial law and eventually contained the main uprising by May 1817, imprisoning and executing some of the rebels, Buxi Jagabandhu pursued a guerrilla campaign, taking advantage of forests and hills to launch surprise attacks, disrupt communications, and challenge British authority. Even after his surrender in 1825, the spirit of defiance persisted through further revolts that continued into the 1830s. Today, the Paika Sangram is remembered as a broad-based and influential 'people's movement' which equally involved peasants, tribal communities, religious institutions, and local elites.

The Sambalpur Uprising: A Saga of Resilience

Sambalpur, in present-day western Odisha, witnessed one of the longest regional resistances to British rule in eastern India, lasting from 1827 to 1862. It was sparked by colonial interference in royal succession, and the eventual British annexation of the state. The conflict began when the British refused to recognise Surendra Sai as the rightful ruler and annexed the state, imposing heavy land revenue that united local landlords and peasants against colonial injustice and economic exploitation.

The resistance reached its peak during the Great Rebellion of 1857, when Surendra Sai, released from prison, led a valiant resistance with several members of his family, including his younger brothers Udanta Sai and Chhabila Sai, along with other local supporters, in defence of their land, regional autonomy, and right to self-rule. They used guerrilla tactics, taking advantage of the region's dense forests and hills, converting hilltops into forts and using the terrain to repeatedly launch surprise attacks on the British forces. The battle of Kudopali in December 1857 was a historic landmark in this struggle, in which fifty-seven fighters, led by Chhabila Sai, sacrificed their lives.

Despite inflicting heavy casualties and executing numerous fighters, the British could not defeat the movement militarily. They ultimately resorted to deception to arrest Surendra Sai, who died in prison after 37 years of captivity. The Sambalpur Uprising stands as a powerful example of courage, guerrilla warfare, mass martyrdom, and prolonged suffering in India's struggle against colonial rule.



Chapter 2

Shaping of the Earth's Surface



The Big Questions

1. *What shapes the Earth's surface?*
2. *What is plate tectonics? What are the effects of plate movement?*
3. *How are landforms formed and how are they classified?*
4. *How are humans and other living beings connected to these landforms?*
5. *How do disasters associated with different landforms impact human lives?*



The Earth's surface is not consistent; it is constantly being transformed by powerful forces acting from within and on the surface of the planet. One of the most important ideas that explains these changes is the theory of plate tectonics, which describes how large pieces of the Earth's crust move slowly over the molten mantle. The movement of these plates gives rise to various **landforms**, such as mountains, volcanoes, plains, and valleys. Understanding plate tectonics and landforms helps us explain natural phenomena like earthquakes, volcanic eruptions, and the formation of continents and oceans, and allows us to better appreciate the dynamic nature of the Earth.

Plate Tectonics

Plate tectonics is an important theory, given by W.J. Morgan, in earth science, that explains the movement of the Earth's crust. According to this theory, the outermost layer of the Earth is not one single piece but is broken into several large and small pieces called **tectonic plates**. These plates move slowly over the semi-molten layer beneath them and are responsible for major physical features and natural phenomena, such as mountains, earthquakes, and volcanoes.

Landforms:

A landform is a natural feature on the Earth's surface formed by processes, such as weathering, erosion, deposition, and the movement of the Earth's crust. Examples of landforms include mountains, valleys, plateaus, plains, deserts, and coastal features.

The Earth is made up of three main layers: **crust**, **mantle**, and **core**. The crust is the outermost layer on which we live. Below the crust lies the mantle, which is very thick and hot. The core is the innermost layer and is extremely hot and heavy. The crust along with the upper part of the mantle forms the **lithosphere**. This lithosphere is broken into different tectonic plates. Beneath the lithosphere lies the **asthenosphere**, which is semi-molten and allows the plates to move.

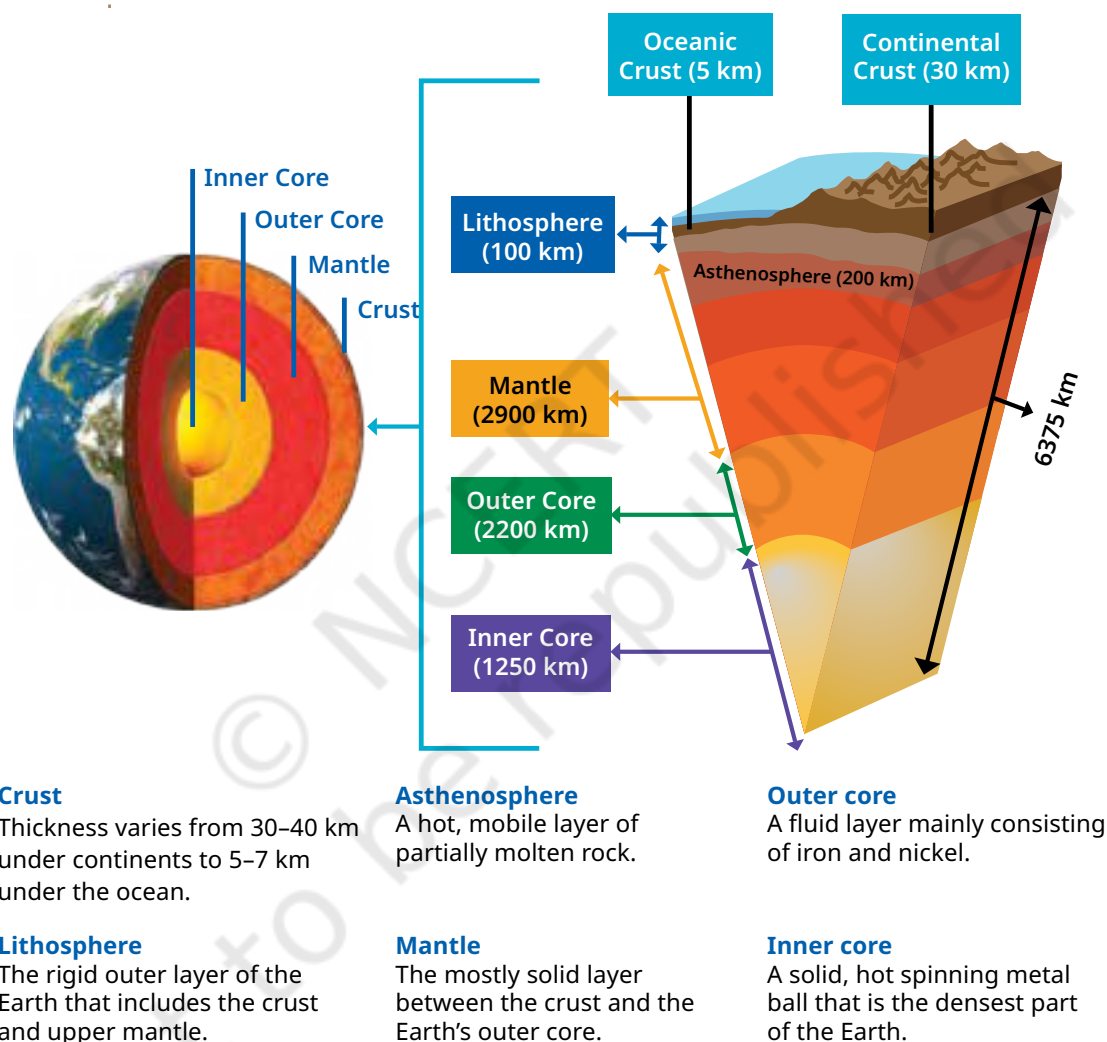


Fig. 2.1. The Earth's interior (Given values are approximate)

Tectonic plates are massive slabs of solid rock that move very slowly, usually a few centimetres per year. There are three main types of tectonic plates—**continental plates**, which carry continents; **oceanic plates**, which carry ocean floors; and **mixed plates**, which carry both continents and oceans. Some of the major tectonic plates

of the world include the Pacific Plate, Eurasian Plate, African Plate, North American Plate, South American Plate, Indo-Australian Plate, and Antarctic Plate.

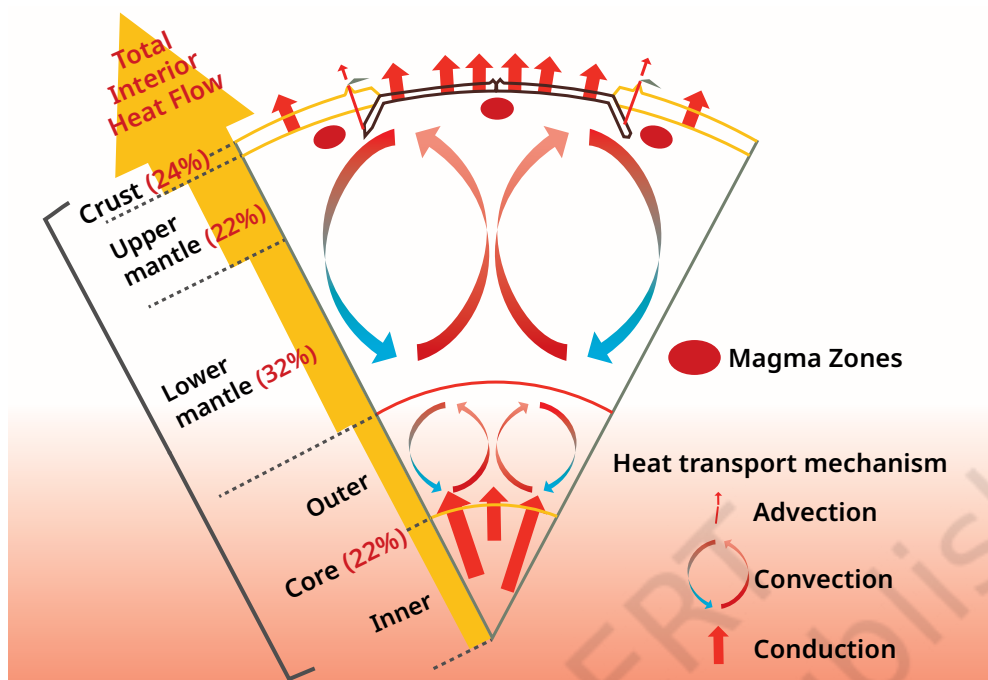
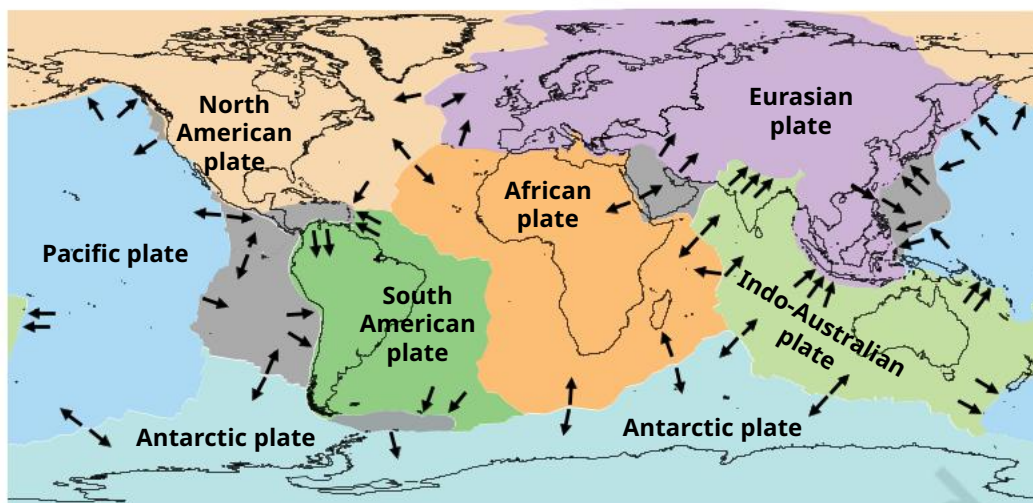


Fig. 2.2. Movement of material below the crust

The movement of tectonic plates is caused by **convection currents** in the mantle. Heat from the Earth's core causes molten material in the mantle to rise, while cooler material sinks. This continuous movement creates convection currents that push and pull the tectonic plates, causing them to move in different directions.

The edges where tectonic plates meet are called **plate boundaries**. There are three main types of plate boundaries. The first is the **convergent boundary**, where two plates move towards each other. When continental plates collide, they form fold mountains, such as the Himalaya. When an oceanic plate collides with a continental plate, the oceanic plate sinks beneath the continental plate, leading to volcanic activity and earthquakes. The second type is the **divergent boundary**, where plates move away from each other. In this case, magma rises from below and forms new crust, creating features, such as mid-ocean ridges. The Mid-Atlantic Ridge is a good example. The third type is the **transform boundary**, where plates slide past each other without creating or destroying crust. This type of movement mainly causes earthquakes, such as along the San Andreas Fault in the United States.



Major Plates: ■ North American plate ■ African plate ■ Eurasian plate ■ South American plate
■ Indo-Australian plate ■ Pacific plate ■ Antarctic plate ■ Minor Plates

Fig. 2.3. World map showing major plates and their direction of movement

LET'S MAP

Pick any two plates from the map above and complete the table given below.

Name of the plate	Continents	Ocean

Plate tectonics plays a major role in shaping the Earth's surface. The movement of plates leads to the formation of mountains, valleys, ocean basins, volcanoes, and earthquakes. It also explains the distribution of continents and oceans across the Earth. Most earthquakes and volcanoes occur along plate boundaries, especially around the Pacific Ocean, an area known as the **Ring of Fire**.

LET'S EXPLORE

Examine the plate map (Fig. 2.3) with the earthquake and volcano map (Fig. 2.4). What correlation do you observe?

In conclusion, the theory of plate tectonics helps us understand how the Earth's surface is constantly changing. It explains the origin of many landforms and natural disasters. This theory is very important for identification of earthquake and volcano-prone regions and managing disasters arising from them.

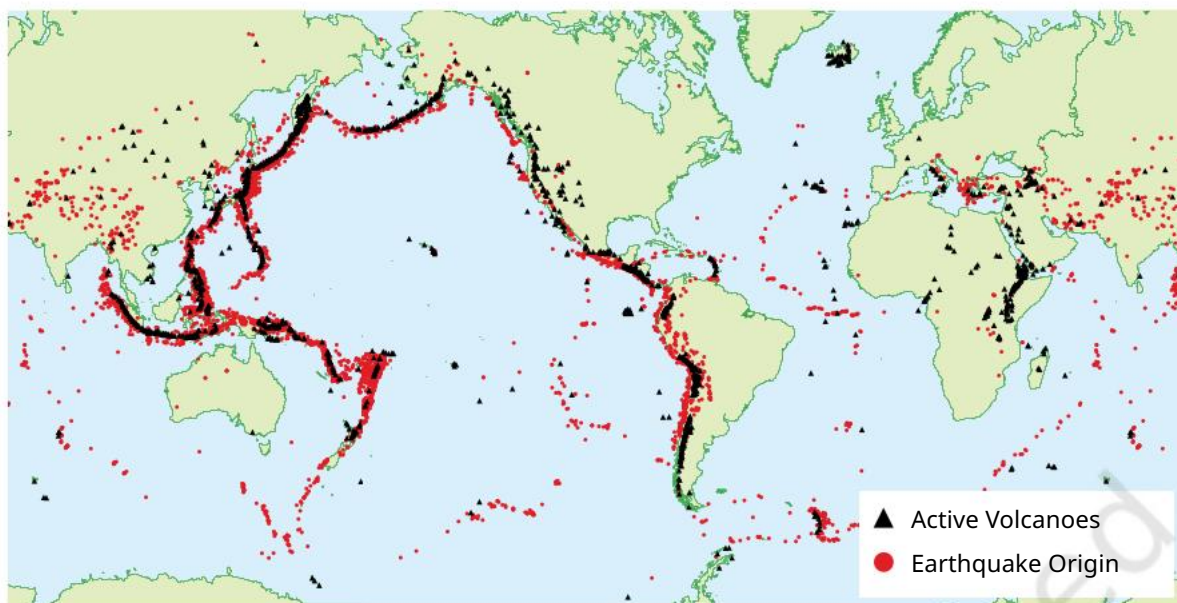


Fig. 2.4. Map showing the distribution of earthquakes and volcanoes

LET'S EXPLORE

Observe the map showing the distribution of earthquakes and volcanoes (Fig. 2.4). Can you identify which continents and countries are located around the Ring of Fire with the help of an atlas or a globe?



LET'S EXPLORE

Does India have a risk of earthquakes?

India has experienced some major earthquakes in the past, resulting in thousands of deaths. A large earthquake in a densely populated country like India can cause severe damage to life and environment. Can you find out which region is more vulnerable to earthquakes? Why do you think human lives are at risk?



Fig. 2.5. The extensive damage caused by the major earthquake in Gujarat in 2001

2 – Shaping of the Earth's Surface



DON'T MISS OUT

In early times too, earthquakes were known as '*bhūkampa*', meaning the shaking of the Earth. In the *Bṛihatsamhitā*, Varāhamihira dedicated a section to earthquakes, noting how changes in wind, rain, clouds, animal behaviour, and planetary alignments could signal them. He attributed earthquakes to four elemental forces—*Vāyu* (wind), *Agni* (fire), *Indra* (heaven/thunder), and *Varuṇa* (water), each linked to specific constellations and regions. This reflects an early attempt to blend observations with cosmological reasoning and physical phenomenon in India.

LET'S EXPLORE

Look carefully at this photograph and answer the following questions:

- What do you think caused this situation?
- What could that grey powder be?
- What does it tell us about the Earth's internal forces?



Fig. 2.6. Photograph showing the deposition by volcanic eruption

DON'T MISS OUT

The mud volcano at Baratang Island is a rare natural wonder in India and a unique attraction of the Andaman and Nicobar Islands. Unlike fiery volcanoes, here you will find mud bubbling out due to natural underground gases and pressure.



Fig. 2.7. India's only mud volcano in Baratang in the Andaman and Nicobar Islands



Process of Weathering and Erosion

Weathering and erosion play a vital role in the development of landforms by continuously breaking down and reshaping the Earth's surface. Over long periods of time, weathering and erosion work together to wear down mountains, carve valleys, form plains, and create features, such as caves, cliffs, and river deltas, gradually giving shape to the diverse landscapes we see on Earth today.

Weathering

Weathering is the process through which rocks on the Earth's surface break down into smaller pieces due to various processes. It does not involve movement of the broken material, only the breaking down. There are three main types of weathering: **physical weathering**, in which rocks break into smaller pieces due to temperature changes, frost, or wind; **chemical weathering**, in which minerals in rocks

2 – Shaping of the Earth's Surface



Physical heating and cooling, water, wind, and ice expansion



Chemical substances in the air and in rain



Biological plants and animals

Fig. 2.8. Types of weathering

change because of reactions with water, air, or acids, leading to new substances; and **biological weathering**, which is caused by plants, animals, or micro-organisms, for example, when plant roots grow into cracks of rocks and split them apart. Weathering plays an important role in shaping the Earth's surface and forming soil.

Erosion

Erosion is the process by which soil, rocks, and other surface materials are worn away and carried from one place to another by natural agents like water, wind, ice, or waves. Unlike weathering that only breaks down rocks, erosion involves movement of the broken material. There are several types of erosion — **water erosion**, caused by rivers, rain, or ocean waves; **wind erosion**, common in dry and sandy areas; **glacial erosion**, where moving ice scrapes and carries rocks; and **coastal erosion**, where sea waves wear away the



Fig. 2.9. Erosion caused by (a) water and (b) wind

land along the shore. Erosion shapes landforms and can both create and destroy features on the Earth's surface.

Erosion affects many human occupations by changing the land and soil on which people depend. For farmers, erosion removes the fertile topsoil needed for crop growth, leading to lower yields. For those living near rivers and coasts, erosion can wash away land, houses, and roads, causing damage and loss of property. In construction and mining, erosion destabilises land, posing safety risks. Even industries like tourism and fishing suffer, since beaches, rivers, and fertile lands may be destroyed. This shows that erosion not only shapes the Earth's surface but also directly affects human labour and livelihoods.

LET'S EXPLORE

Observe the photographs (Fig. 2.9) and also note the types of erosion. How are farmers affected by erosion due to water and wind?

DON'T MISS OUT

The Sindhu-Sarasvatī civilisation employed sophisticated techniques, including **contouring**, **bunding**, **terracing**, dams, and canals for water management. Multiple Sanskrit texts document these practices, including the Vedas, *Kṛṣhiparāśhara*, Kauṭilya's *Arthaśhāstra*, and specialised treatises like *Vṛikṣhāyurveda*. The *Arthaśhāstra* contains detailed guidelines on land assessment and categorisation based on fertility and productivity.

The Zabo system in Nagaland represents an integrated farming approach using earthen bunds on hillslopes for soil and water conservation. Check dams were constructed across small streams to reduce water velocity, prevent soil erosion, and allow sediment deposition. These structures were designed to slow down water flow and enhance groundwater recharge.

Contouring:

A continuous contour trench (CCT) is a water conservation technique in which trenches are dug along the contour lines of a hillside to slow down, hold, and infiltrate rainwater, preventing soil erosion and recharging groundwater.

Bunding:

Earthen embankments built along contour lines to slow surface run-off, reduce soil erosion, increase water infiltration and soil moisture.

Terracing:

Terracing is a soil conservation practice that creates a series of level or gently sloping steps on a hillside to prevent soil erosion.



Agents of Gradation

Agents of gradation are natural forces that wear down, transport, and deposit materials on the Earth's surface, helping to level or smooth it over time. The main agents of gradation are **running water**, **glaciers**, **wind**, **waves**, and **groundwater**. Running water

2 – Shaping of the Earth's Surface

erodes rocks and soils to form valleys and plains. Glaciers scrape and carry huge amounts of material, carving U-shaped valleys. Wind shapes deserts by eroding and depositing sand. Sea waves erode coastlines to form cliffs, beaches, and bays. Groundwater dissolves rocks, such as limestone, creating caves, and sinkholes. Together, these agents are continuously modifying landforms, lowering high areas, and filling up low areas.

DON'T MISS OUT

Landforms have played a major role in shaping the history of human civilisations. Rivers and fertile plains like those of the Ganga, Nile, Brahmaputra, and Indus, gave rise to agricultural societies and early cities. Mountains acted both as barriers and protectors—the Himalayas shielded India from invasions but also allowed cultural exchanges through passes like the Khyber pass. Deserts, such as the Thar limited the development of large settlements but encouraged trade routes, such as the Silk Route. Coasts and harbours supported trade, travel, and cultural contacts with distant lands, helping kingdoms like those in south India flourish. Even today, history shows that wars, settlements, trade, and cultural growth were all deeply influenced by the land's physical features.



Running Water

Rivers shape the land through the processes of erosion, transportation, and deposition, creating a variety of landforms along their course. At the upper course, rivers often form **V-shaped valleys**, **waterfalls**, and **rapids** due to steep gradients and strong erosive forces. In the middle course, the river starts to **meander**, forming **oxbow lakes**, and **floodplains** as it loses energy and begins depositing sediments. In the lower course, the river slows further and deposits large amounts of sediment, forming **deltas**, **levees**, and **alluvial fans**. These landforms are not only important for understanding river dynamics but also play a vital role in agriculture, settlement, and ecosystems.

Waterfall

A **waterfall** is a landform where a river flows over a steep cliff or vertical drop, creating a dramatic fall. Waterfalls form in the upper course of rivers, where hard rocks resist erosion, while softer rocks below are worn away, creating a sudden drop. They are not only

beautiful natural features, but also attract tourists, making them important for local tourism and economy. Waterfalls are sometimes used for **hydroelectric power generation**, as the force with which the water falls, can be harnessed to produce electricity. In addition, they provide opportunities for recreation, such as trekking and photography, and often hold cultural or religious significance in certain regions.

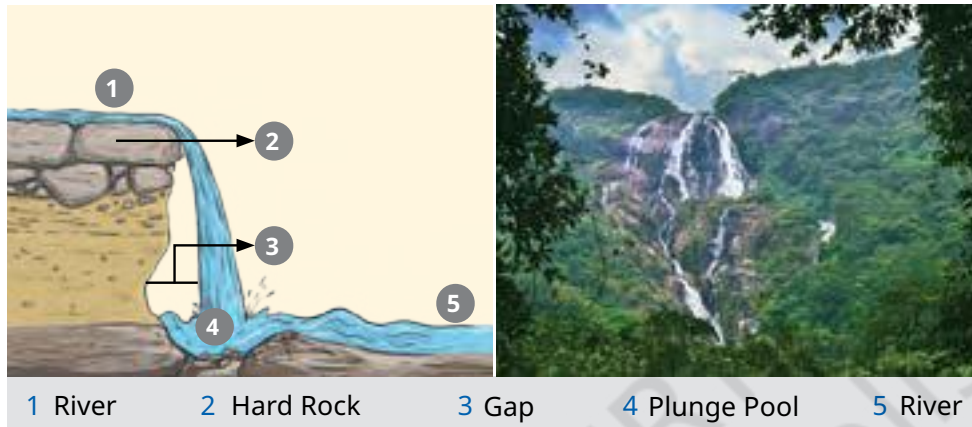


Fig. 2.10. Waterfall

Meander

A **meander** is a winding curve or bend in the middle or lower course of a river formed due to the lateral erosion and deposition



Fig. 2.11. Meander

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Earth's Surface

of sediments. As the river flows, it erodes the outer banks of bends and deposits sediment on the inner banks, gradually creating large loops. Meanders are important for humans because the fertile soil deposited along their banks supports agriculture, making these areas ideal for farming. They also influence settlement patterns, as villages and towns often develop on the gentle slopes near meanders. In addition, meandering rivers can be used for navigation, irrigation, and, in some cases, tourism, as their scenic curves create attractive landscapes. The Grand Anicut, also known as Kallanai in Tamil Nadu, is an example of the use of rivers for irrigation.

Deltas

A **delta** is a landform formed at the mouth of a river, where it flows into a sea, ocean, or lake, and deposits the sediments it has carried from upstream. Over time, these deposits accumulate to form a fan-shaped or triangular area of land. Deltas are highly fertile due to their rich alluvial soil, making them ideal for agriculture and supporting crops, such as rice and jute. They are also important for fishing, as the mix of fresh and saltwater creates diverse aquatic life. Many deltas support dense human settlements and are centres of trade and transportation because rivers provide navigable routes. However, they can also be prone to flooding, which affects human life and activities.



Fig. 2.12. Delta

LET'S EXPLORE

Have you heard about the Sundarbans delta? Try and explore its uniqueness and find out why it is popular with tourists.



Fig. 2.13. Sundarbans delta



Waves and Currents

Waves and currents are constantly moving over the oceanic surface. They work in coastal areas and reshape the land along the coastal zone. The action of waves and currents creates a range of landforms along the coastline, such as **beaches, sand bars, sea cliffs, sea caves, arches, and stacks**. You will learn more about waves and currents in Part 2 of this textbook.

A **beach** is a landform made up of sand, pebbles, or rocks along the shoreline of a sea, ocean, or lake, created by the deposition of sediments by waves. Beaches are constantly shaped by wave action, tides, and currents, which move and deposit materials along the coast. For humans, beaches are popular tourist destinations for relaxation, swimming, and recreation, which boosts the local economy. Beaches also provide fishing areas, and some coastal communities rely on them for collecting sand and shells. Additionally, beaches act as natural barriers against strong waves and coastal erosion, helping safeguard human settlements near the coast.

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Earth's Surface



Fig. 2.14. Beach

Coastal erosion occurs when waves, tides, and currents wear away the land along the coast, creating unique landforms. Some common **landforms of coastal erosion** include **cliffs** (steep rock faces formed as waves undercut the base of the coast), **wave-cut platforms** (flat areas left behind as cliffs retreat), **caves** (formed when waves erode weak parts of the rock), **arches** (created when caves on opposite sides of a headland meet), and **stacks** (isolated pillars of rock left standing after the arches collapse). These landforms not only shape the coastal landscape but also influence human activities, as some areas are important for tourism, while others may need coastal protection to safeguard settlements.

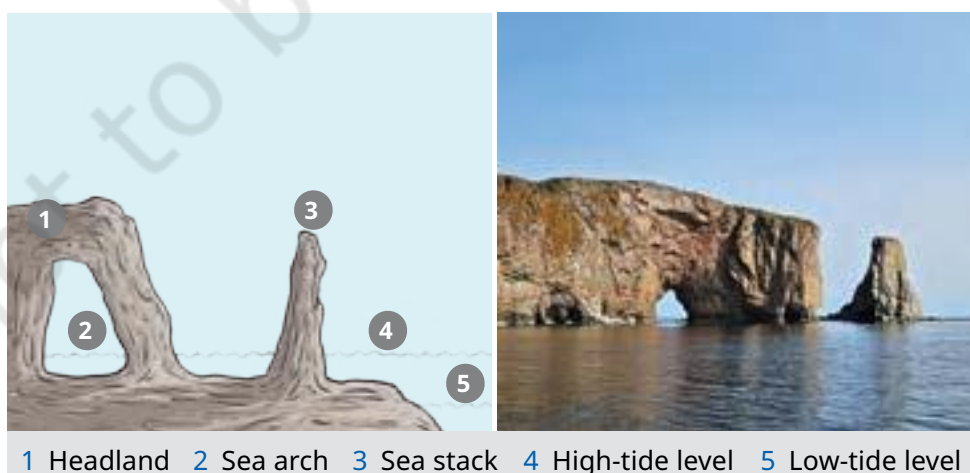


Fig. 2.15. Sea arch and sea stack

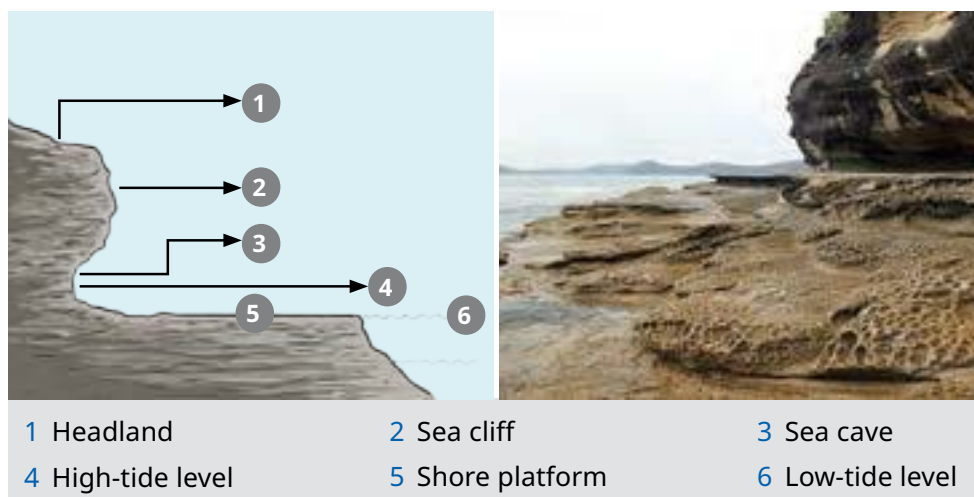


Fig. 2.16. Sea cliff and shore platform

Glaciers

Glacial erosion occurs when glaciers slowly move over the land, carving and shaping the landscape. Common **landforms made from glacial erosion** include—**U-shaped valleys** (formed as glaciers widen and deepen river valleys), **cirques** (bowl-shaped depressions at the head of a glacier), **aretes** (sharp ridges between valleys), **hanging valleys** (which occur where smaller glaciers meet larger ones), and **fjords** (deep, narrow inlets created when the sea floods glacial valleys). These landforms are important for humans in several ways. U-shaped valleys and cirques often provide tourist attractions for trekking, skiing, and mountaineering. Fjords are used for harbours and fishing, while in some valleys the fertile glacial soil supports

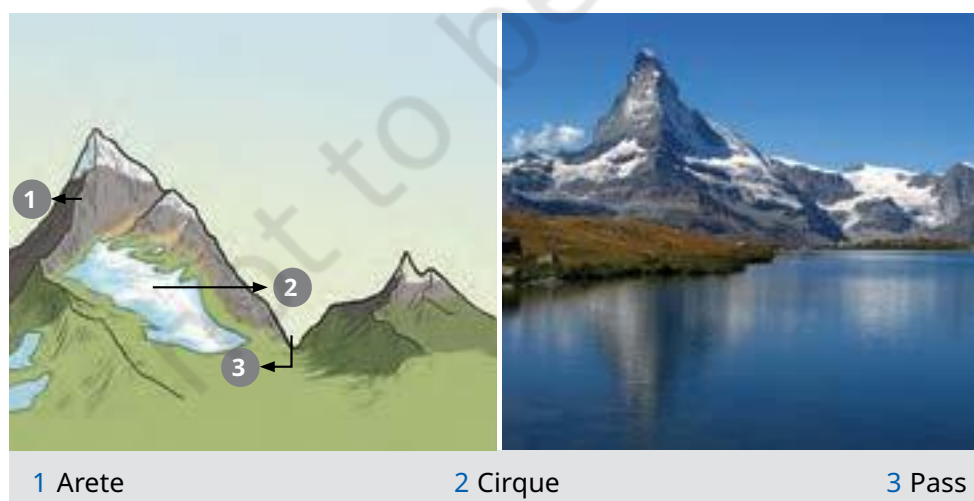


Fig. 2.17. Glacial landforms

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Earth's Surface

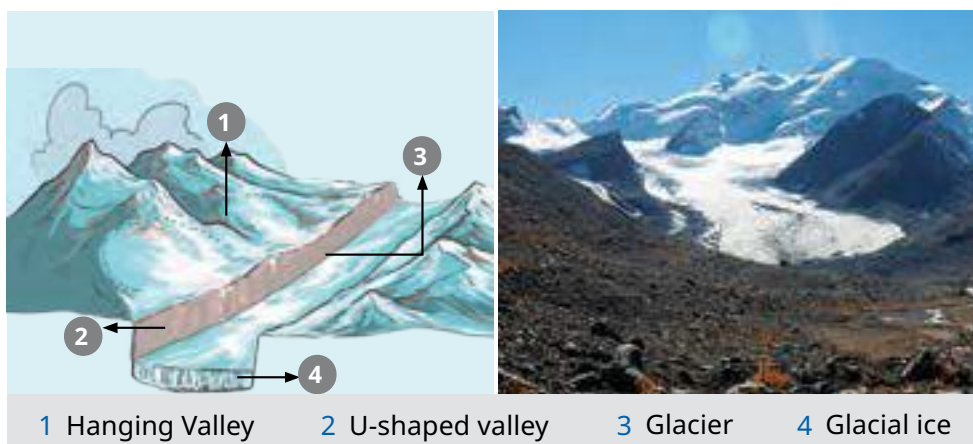


Fig. 2.18. U-shaped valley

agriculture. Additionally, glaciers are crucial sources of fresh water, feeding rivers that sustain human populations downstream.

Moraines are landforms created by the deposition of rocks, soil, and debris (called **till**) carried along and left behind by glaciers. They are formed when a glacier melts and deposits the material it has eroded from land. There are different types of moraines — **lateral moraines** (which form along the sides of glaciers), **terminal moraines** (found at the end of glaciers, marking their furthest advance), and **medial moraines** (formed when two glaciers meet and their lateral moraines join in the middle). Moraines are important for humans because they often create fertile soil for agriculture and can form natural dams and lakes used for water supply, irrigation, and sometimes hydroelectric power.

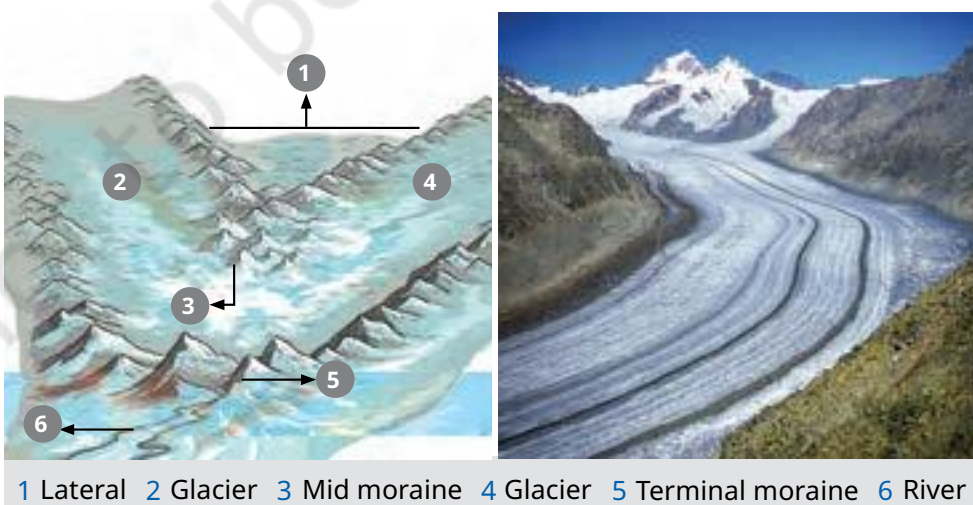


Fig. 2.19. Moraines

THINK ABOUT IT

A devastating flood struck the Chamoli district in Uttarakhand in February 2021 in which many people and livestock lost their lives. There was severe damage to buildings, roads, bridges, and hydel projects, and connectivity to villages was adversely affected. Can you find out the reasons that led to the sudden and unexpected flood?



Fig. 2.20



Wind

Wind erosion occurs when strong winds pick up and carry away loose particles of sand and soil, gradually shaping the landscape. This process creates several distinctive **landforms**, such as **yardangs** (which are streamlined rock ridges carved by wind), **ventifacts** (which are rocks polished and shaped by sandblasting), **deflation**

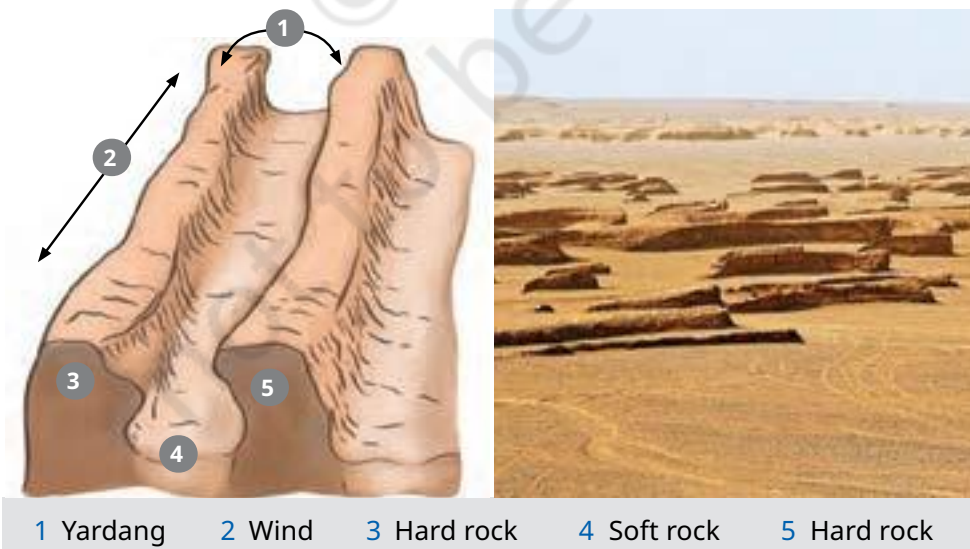
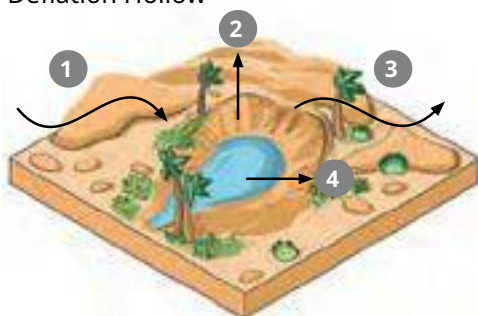


Fig. 2.21. Yardang

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Deflation Hollow



1 Wind

2 Oasis

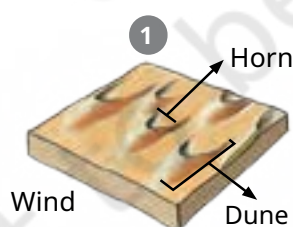
3 Blown sand

4 Water table

Fig. 2.22. Oasis

hollows or **blowouts** (shallow depressions formed where loose material is removed), and **desert pavements** (flat surfaces left behind after finer particles are blown away). These landforms are important for humans as they influence **settlement patterns** and agriculture in arid regions, and ventifacts and yardangs attract **tourists and geologists** interested in unique desert landscapes.

Dunes are hills or ridges of sand formed by the wind in desert areas or along sandy coasts. There are several types of dunes, including **barchan dunes** (which are crescent-shaped and form in areas with limited sand and a single wind direction), **longitudinal dunes** (which are long ridges formed parallel to the prevailing wind), **star dunes** (which have multiple arms and form where winds come from different directions), and **parabolic dunes** (U-shaped dunes often



1 Barchan Dunes

2 Transverse Dunes

3 Star Dunes

Fig. 2.23. Dunes

stabilised by vegetation). For humans, dunes act as natural barriers against desertification and wind erosion, and provide areas for tourism and adventure sports. In some coastal regions, they protect settlements from strong sea winds and waves. In addition, sand from dunes is sometimes used for construction purposes.

Underground Water

Underground water, especially in areas of limestone or soluble rocks, creates unique landforms called Karst topography through **chemical weathering** and **erosion**. Common landforms of underground water include **caves** (hollow spaces formed as acidic water dissolves rock), **stalactites** (icicle-shaped formations hanging from the ceiling of caves), **stalagmites** (formations rising from the floor of caves), **sinkholes** or **dolines** (depressions formed when the

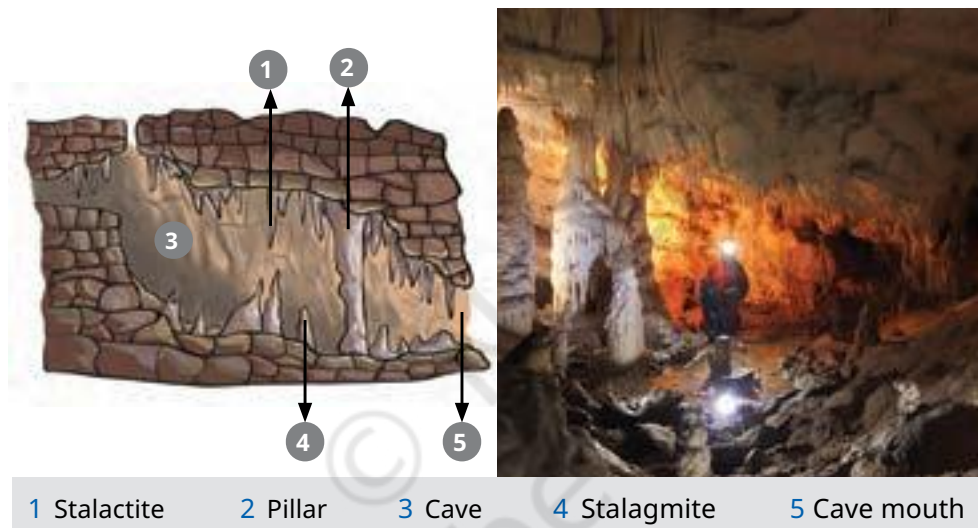


Fig. 2.24. Cave

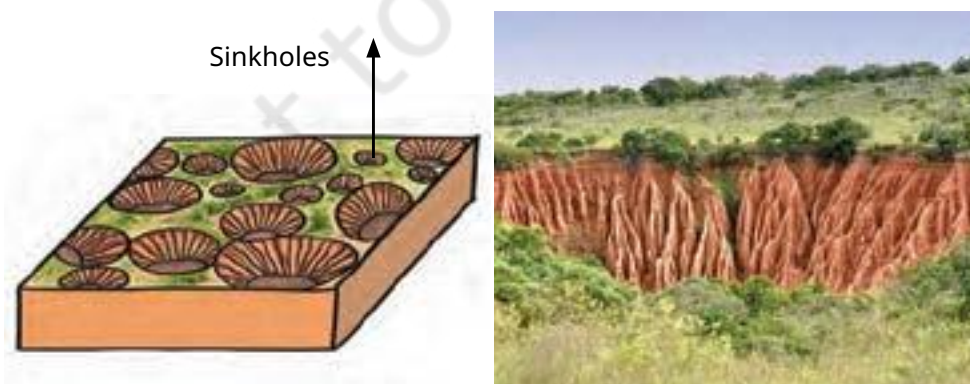


Fig. 2.25. Sinkholes

2 – Shaping of the
Earth's Surface



Fig. 2.26. Underground river

ground collapses into an underground cavity), and **underground rivers** (which flow through cave systems). These landforms are important for humans because caves and underground rivers provide sources of fresh water, tourism opportunities, and, in some cases, cultural, or religious significance. Stalagmites and stalactites also attract geologists and adventurers, making them valuable for both study and recreation.



LET'S EXPLORE

Observe the landforms around your school or residence and try to identify which agent may have created them.

Landforms and Disasters

There are several disasters associated with different landforms that commonly occur around us. Four such disasters are presented below:

LET'S EXPLORE

Complete the exercises given at the end of each type of disaster with the help of newspapers, atlases, and books. Make a list of disaster-prone areas from India and the world and enlist mitigation measures quoting recent examples.

Landslides

Landslides are caused by a combination of natural and human factors that make slopes unstable. Heavy and continuous rainfall is one of the main natural causes, as water seeps into the soil and rocks, increasing their weight and reducing friction. Earthquakes and volcanic eruptions can also trigger landslides by shaking the ground and weakening slopes. Steep slopes and the presence of loose or weathered rocks further increase the risk. Human activities, such as deforestation, mining, road construction, and unplanned construction on hillsides disturb the natural balance of slopes. Poor drainage systems and improper land use also contribute to landslides by allowing excess water to accumulate, leading to sudden slope failure.



Fig. 2.27. A landslide

Prone areas:

Mitigation measures:

Recent examples:

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Earth's Surface

Avalanches

Avalanches are caused by the sudden instability of snow on steep mountain slopes. Heavy snowfall within a short period adds extra weight to the snowpack, making it unstable, especially when it rests on weak or loosely bonded layers of snow. A sudden rise in temperature can cause partial melting, reducing the friction that holds the snow together. Strong winds may also pile up snow unevenly, creating fragile layers. Natural disturbances, such as earthquakes and vibrations, as well as human activities like skiing, trekking, or construction in mountainous areas, can trigger avalanches by disturbing the balance of the snow-covered slopes.



Fig. 2.28. An avalanche

Prone areas:

Mitigation measures:

Recent examples:

GLOFs

Glacial Lake Outburst Floods (GLOFs) are caused by the sudden release of large volumes of water from glacial lakes due to natural and climatic factors. Rapid melting of glaciers because of rising temperatures increases the size and water level of glacial lakes, putting pressure on their natural dams made of ice or loose moraines. Heavy rainfall or intense snowfall can add excess water to these lakes. Earthquakes, avalanches, or landslides may strike the lake or weaken the dam, leading to its sudden collapse. As a result, the stored water is released abruptly, causing destructive floods in downstream areas.



Fig. 2.29. A GLOF

Prone areas:

Mitigation measures:

Recent examples:

2 – Shaping of the
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Dust Storms

Dust storms are caused by strong winds lifting large amounts of loose, dry soil and sand into the air. Prolonged drought and low rainfall dry out the soil, making it easier for wind to pick up the fine particles. Dust storms are common in desert and semi-arid regions where the soil is loose and dry. Sparse vegetation cover, often due to deforestation, overgrazing, or poor farming practices, also leaves the land exposed. Climate change and extreme weather conditions can further increase the frequency and intensity of dust storms.



Fig. 2.30. A dust storm

Prone areas:

Mitigation measures:

Recent examples:

The Earth's surface is constantly changing due to powerful forces working both inside and outside the planet. Internal forces, such as earthquakes, volcanic eruptions, folding, and faulting create mountains, valleys, and ocean basins, while external forces like weathering, erosion, and deposition slowly wear them down and reshape them. Together, these natural processes give rise to the diverse landforms we see today, from the highest peaks to the deepest ocean floors. Human life, too, is deeply connected to these landforms, as it influences our climate, resources, settlements, and cultures. Understanding the shape of the Earth's surface helps us appreciate nature's power and prepare wisely for natural disasters, ensuring a safer and more sustainable relationship with our planet.

Before we move on...

- The Earth is made up of layers, namely, the crust, mantle, and core.
- Interior forces of the Earth (earthquakes, volcanoes, folding, and faulting) are responsible for the movement of the crust.
- External forces like weathering and erosion carve smaller landforms over the Earth's surface which affect human life in multiple ways.
- The surface of the Earth is carved by agents of gradation like running water, waves and tides, glaciers, wind, and underground water.
- Disasters like landslides, avalanches, glacial lake outflows, and sandstorms are associated with specific landforms.



Questions and activities

1. What are the sources of energy that are required to cause movements associated with the internal forces of the Earth?
2. Relate various physiographic divisions you have studied in the earlier grades with various endogenic forces responsible for their origin.
3. Why and where do earthquakes occur frequently? Is it possible to predict earthquakes?
4. "Plate movements are responsible for the distribution of earthquakes and volcanoes." Explain.
5. Draw and label a diagram of a meander and a delta.



2 – Shaping of the Earth's Surface

6. How are deforestation and erosion associated with each other? Explain.
7. Develop a plan to protect the land in your local area from erosion.
8. Which disasters do you think you might experience in your region? Discuss a mitigation plan in your classroom.
9. Prepare a model of landforms created by underground water.
10. What precautionary measures will you take if you are staying in an earthquake-prone region?
11. Prepare a map showing landform-associated disasters that happened in the current calendar year.
12. Create a poster showing landforms that are considered to be sacred or important in your region, and add the folk stories associated with them.
13. Document a case of a disaster that hit your region in the past, highlighting its effects on various human activities.
14. Translate the given poster on landslide into your native language and display it in your home.
15. Divide the class into three groups. Each group will work on one project (water, wind, and glacier). The project should highlight the causes, impact on human life and the environment, and mitigation measures.



Chapter 3

Atmosphere and Climate



The Big Questions

1. What is the composition of the atmosphere?
2. How do the different layers of the atmosphere affect the planet Earth?
3. What is the mechanism of monsoon?
4. How can we reduce our carbon footprint?



What do you see when you look up in the sky? You might see the floating clouds, the sunshine, and feel a breeze as well. All of these are a result of a blanket of air surrounding the Earth, called the atmosphere. 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 on the Earth. The atmosphere shields us from the harmful radiation coming from the Sun, including ultraviolet radiation. It regulates the Earth's temperature by trapping some of the Sun's energy and prevents it from escaping back into space. The atmosphere is a key component of the Earth's weather and climate systems, influencing factors such as temperature, humidity, and air pressure.

Gravity:

Gravity is a fundamental physical force of attraction between objects that have mass or energy such as the Sun and the Earth. The force of attraction that the Earth's mass exerts on the objects that are on or close to its surface is referred to as Earth's gravity.

THINK ABOUT IT



Fig. 3.1

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

Composition and Structure of the Atmosphere

Composition of the Atmosphere

The Earth's atmosphere is composed of a mixture of various gases. Nitrogen and oxygen are the two primary and most abundant gases that are essential to life on the Earth. Carbon dioxide, argon, helium, neon, krypton, xenon, ozone, and hydrogen are some other gases present in the atmosphere, but are found in lesser quantities. Besides these, the atmosphere also consists of water vapour and tiny dust particles. The amount of water vapour in the atmosphere varies, but it generally ranges from 0.1 per cent to 0.4 per cent. It plays a significant role in cloud formation and precipitation. The composition of the atmosphere also varies with altitude.

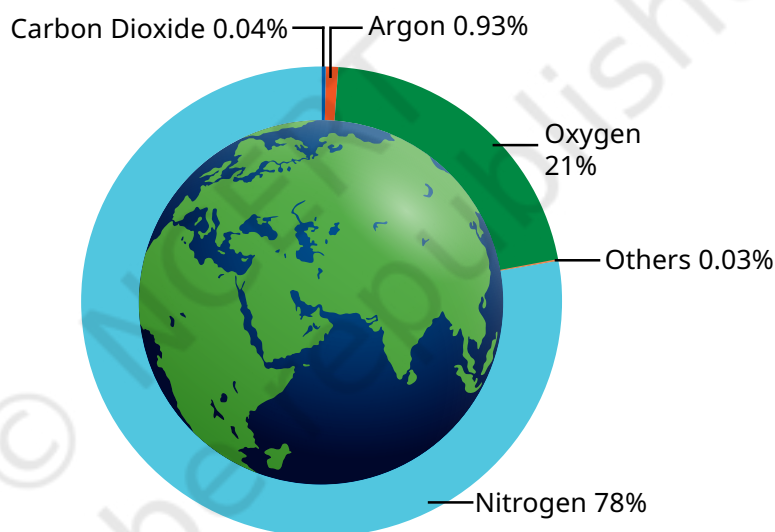


Fig. 3.2. Composition of the atmosphere

LET'S RECALL



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.

Structure of the Atmosphere

The atmosphere has a layered structure. These layers are defined on the basis of changes in temperature and density with increasing altitude. The density of air is highest near the Earth's surface and

decreases with **altitude**. The major layers extending from the Earth's surface to outer space are illustrated below.

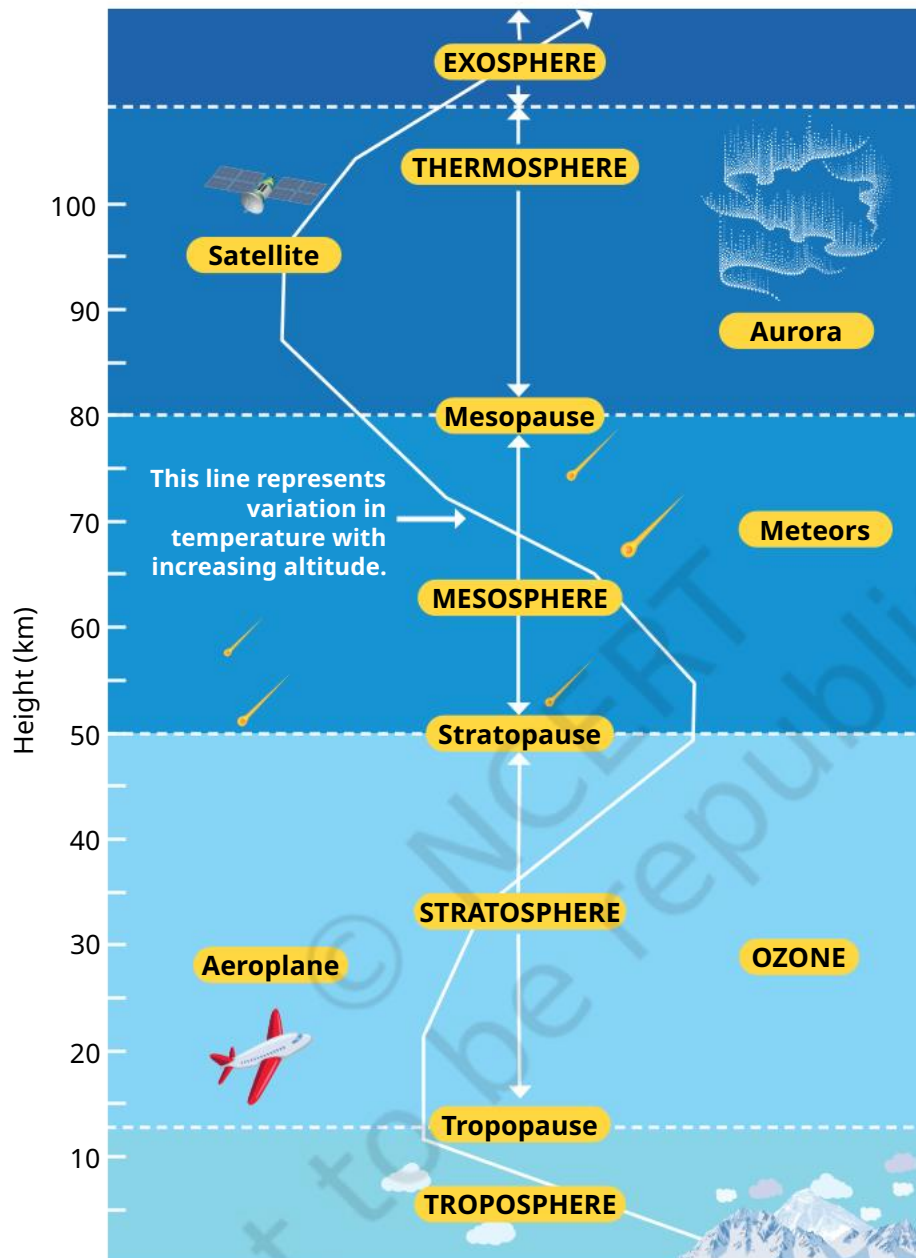


Fig. 3.3. Layers of the atmosphere

- ◆ **Troposphere:** The troposphere is the most important layer of the atmosphere, with an average height of about 12 kilometres. In this layer, temperature decreases with increasing altitude. The air we breathe exists here, along with most of the water vapour and clouds. Nearly all the weather phenomena, such as rainfall, fog, and hail, occur in this layer. The troposphere is separated from the stratosphere by a transition zone known as the tropopause.

Altitude:
The height of a location above mean sea level is called altitude, usually measured in metres or feet. The mean sea level is considered zero.

- ◆ **Stratosphere:** Above the troposphere lies the stratosphere, extending up to 50 kilometres. This layer is ideal for flying aeroplanes because it is free of clouds and other weather disturbances. A notable feature of the stratosphere is that it contains a layer of ozone gas, which shields us by filtering the Sun's harmful radiation, including ultraviolet radiation. The stratopause marks the boundary between the stratosphere and the mesosphere.
- ◆ **Mesosphere:** Above the stratosphere lies the third layer of the atmosphere, the mesosphere. It extends up to a height of 80 kilometres. In this layer, temperature decreases with increasing altitude. Most meteorites entering from space burn up in the mesosphere.



DON'T MISS OUT

Temperature decreases with altitude only in the troposphere and mesosphere.

- ◆ **Thermosphere:** In the thermosphere, temperature rises very rapidly with increasing altitude, as the gas molecules in this layer absorb the X-rays and short-wave ultraviolet radiation of the Sun. The thermosphere extends from 80 to 700 km. It also helps with radio transmission by reflecting radio waves transmitted from the Earth back towards it. Ionosphere is a part of the thermosphere. Additionally, the northern and southern lights (**auroras**) also occur in the thermosphere.



Fig. 3.4: Aurora

The word 'aurora' originates from Latin, meaning 'dawn' or 'morning light.' It is named after the Roman goddess Aurora, the goddess of dawn, and refers to the colourful display of light seen in the sky near the poles. The 'solar wind' (charged particles emitted by the Sun), upon reaching the Earth's atmosphere, is directed towards the magnetic poles. As these particles interact with different atmospheric gases, each gas glows with a particular colour. This phenomenon is known as the Aurora Borealis in the Northern Hemisphere and the Aurora Australis in the Southern Hemisphere.

- ◆ **Exosphere:** The uppermost layer of the atmosphere is known as the exosphere, characterised by very thin air. Light gases like helium and hydrogen float into space from this layer due to weak gravity. All of these layers play a vital role in the Earth's atmospheric processes and also affect its weather and climate.

DON'T MISS OUT

The air above us exerts a significant force on our bodies, and yet we do not feel it. This is because air presses on us from all sides, and our bodies exert a counter-pressure in response.

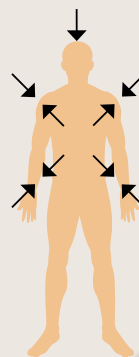


Fig. 3.5. The pressure inside our bodies is also equal to the atmospheric pressure and cancels the pressure from outside.



Weather and Climate

'Is it going to rain today?' 'Will it be bright and sunny today?' How often do you find yourself wondering about these questions when you want to go out and play?

The term **weather** refers to the hour-to-hour and day-to-day conditions of the atmosphere. Hot or humid weather may make one irritable, while pleasant or breezy weather may make one cheerful, or even plan for an outing. Weather can vary significantly from day-to-day. The average weather conditions of a place over a longer period of time refer to the **climate** of the place. Climate refers to the sum total of weather conditions and variations over a large area for an extended period of time, usually thirty years or more.

Elements of Weather and Climate

Various elements influence weather and climate. The major elements of atmosphere that impact human life on the Earth are temperature, precipitation, humidity, wind, and atmospheric pressure. These elements can change under varying conditions.

- ◆ **Temperature:** The temperature of the atmosphere varies not only between day and night but also across seasons, just as summers tend to be hotter than winters. An important factor affecting temperature distribution is **insolation**. The amount of

Insolation:
The incoming solar energy from the Sun that is intercepted by the Earth.

3 – Atmosphere and Climate

insolation decreases from the equator towards the poles. Hence, the temperature decreases from the equator towards the poles.

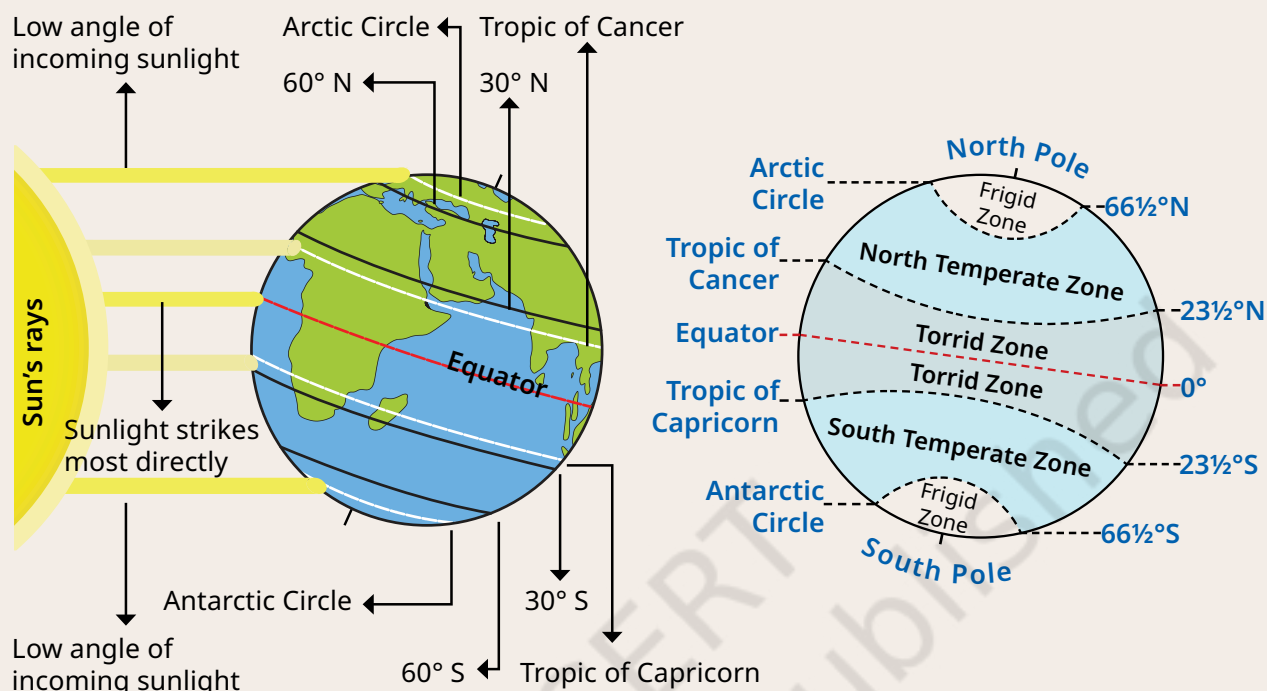


Fig. 3.6. Temperature zones of the Earth

- ◆ **Humidity:** When water evaporates from land and different water bodies, it becomes water vapour. When the levels of water vapour in the air are high, it leads to humidity. Therefore, humidity refers to the presence of water vapour in the air, creating moisture. As the air gets warmer, its capacity to hold water vapour increases, leading to higher humidity levels. On such a day, clothes take longer to dry, and sweat evaporates more slowly, leaving us feeling very uncomfortable.
- ◆ **Precipitation:** It occurs when a part of the atmosphere becomes saturated with water vapour, which condenses and 'precipitates', or falls on the Earth due to gravity. This includes drizzle, rain, snow, sleet, and hail. The main factors that affect precipitation include prevailing winds, mountains, and seasons. When precipitation falls on the Earth in liquid form, it is called rain. Rain is the most common form of precipitation and lowers the temperature of a place. A long absence of rainfall results in a dry climate. Most of the groundwater is collected from rainwater.

- ◆ **Atmospheric pressure:** The pressure exerted by the weight of air on the the Earth's surface is called air pressure. As we go higher in the atmosphere, pressure falls rapidly. It is highest at sea level and decreases with altitude. Horizontally, the distribution of air pressure is influenced by the air's temperature at a given place. In areas with high temperatures, air heats up and rises. This creates a low-pressure area. Low pressure is associated with cloudy skies and wet weather. In areas with lower temperatures, air is cold. It is therefore heavy and sinks, creating a high-pressure area. High pressure is associated with clear and sunny skies. Air always moves from high-pressure areas to low-pressure areas. You can refer to Chapter 8 of the Grade 8 Science textbook *Curiosity* to learn more about this.

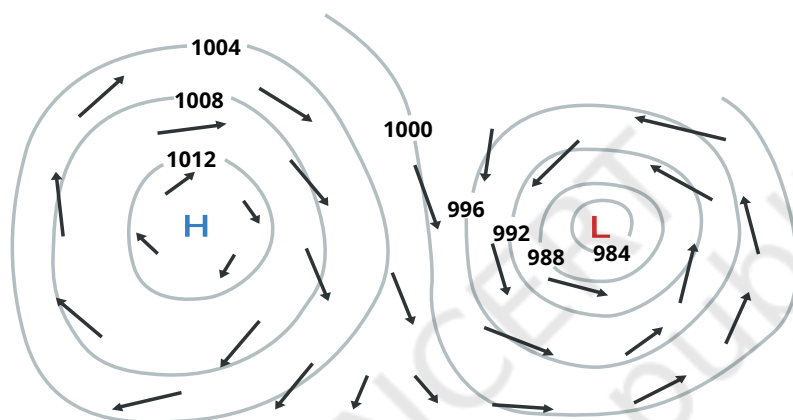


Fig. 3.7. Wind is caused by air flowing from high-pressure to low-pressure areas. Its direction is influenced by the Earth's rotation.

- ◆ **Wind:** The movement of air from a high-pressure area to a low-pressure area is called wind. It can be gentle or strong. You can observe the flow of wind as it blows dry leaves down the pavement, gently blows away dust particles, or uproots trees during a storm.

THINK ABOUT IT

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?



DON'T MISS OUT

Winds are named after the direction they blow from, for example, the wind blowing from the west is called westerly.



Table 3.1. Wind speeds and their common effects

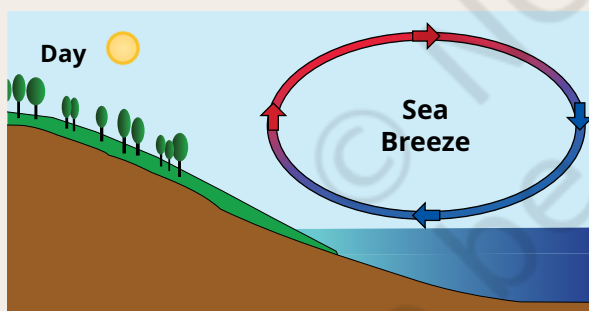
Wind	Speed (km/hr)	Common Effects
Calm	0–1	Calm, smoke rises vertically.
Light breeze	6–11	Wind can be felt on the face. Leaves rustle. An ordinary vane moves by winds.
Strong breeze	39–49	Large branches sway in the wind. Umbrellas are difficult to use.
Storm	103–117	It is very rarely experienced. Usually accompanied by widespread damage.

LET'S EXPLORE

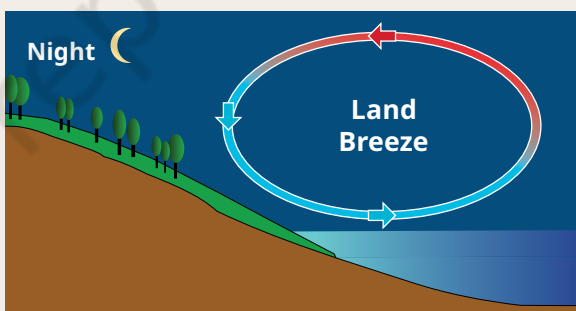


Find out other categories of wind based on speed and their common effects, and share your findings in class.

Local winds such as the land breeze and the sea breeze, also affect the weather and climate of a place. They are essential in creating moderate climatic conditions in the coastal region.



Land is warmer than the water



Water is warmer than the land

Fig. 3.8. Land and sea breeze

Sea breeze

It is a local wind that blows from sea to land during the day, especially in the afternoon, when the land becomes relatively warmer than the sea. This results in the formation of a low-pressure region over land, and so the wind starts blowing from the sea.

Land breeze

It is a local wind that blows from land to sea during the night, resulting from differential surface cooling between the land and the sea. Land cools faster than sea at night. Since the difference in temperatures and air pressure between the sea and the land is low, the wind speed is low.

You may have observed that weather conditions often fluctuate, sometimes even within a single day. However, based on generalised monthly atmospheric conditions, or a common pattern over a few weeks or months—such as the days being cool or hot, windy or calm, cloudy or bright, and wet or dry—the year is divided into seasons.

LET'S ANALYSE

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



Seasons in India

The climate of India can be broadly classified as tropical monsoon. The Indian Meteorological Department (IMD) has recognised four distinct seasons in India:

- ❖ **Winter:** The winter season generally lasts from December to early April. The coldest months of the year are December and January, when the average temperature in the north-west is around 10–15°C. Temperatures increase towards the equator, reaching around 20–25°C in mainland India's south-east.
- ❖ **Summer or pre-monsoon:** The summer or pre-monsoon season spans from April to June, or up to July in north-western India. In western and southern regions, the hottest month is April; in northern regions, it is May. The average temperature across most of inland India ranges from 32–40°C.
- ❖ **Monsoon or rainy (Advancing monsoon):** The monsoon season generally spans from June to September. This season is dominated by the humid south-west summer monsoon, which slowly sweeps across the country in late May or early June. Monsoon rain begins to recede from north India at the beginning of October, and South India typically receives more rainfall during this time.
- ❖ **Post-monsoon (Retreating monsoon):** The post-monsoon season lasts from October to December. In north-western India, October and November are usually cloudless.

The Himalayan states, being more temperate, experience two additional seasons, autumn and spring.



DON'T MISS OUT

Traditionally, India experiences six seasons, each about two months long—spring, summer, monsoon, early autumn, late autumn, and winter. These seasons are based on the astronomical division of the 12 months into six parts. The traditional Indian calendar also reflects these seasons through its arrangement of months.

Table 3.2. Traditional Indian seasons. These seasons and their duration may vary across different parts of the country.

Seasons (R̥tu)	Months (According to the Indian Calendar)	Months (According to the Gregorian Calendar)
Vasanta	Chaitra–Vaiśhākha	March–April
Gr̥ishma	Jyeshṭha–Āṣhāḍha	May–June
Varṣhā	Śhrāvaṇa–Bhādrapada	July–August
Śharad	Āśhvina–Kārtika	September–October
Hemanta	Mārgaśhīrṣha–Pauṣha	November–December
Śhishira	Māgha–Phālguna	January–February



THINK ABOUT IT

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.



DON'T MISS OUT

Kauṭilya's *Arthaśhāstra* contains records of scientific measurements of rainfall and their practical application in managing the country's revenue and relief efforts.

Monsoon

The climate of India is strongly influenced by **monsoon** winds. The sailors who came to India during ancient times were among the first to notice the phenomenon of monsoon. They benefited from the reversal of the wind system as they travelled by sailing ships at the mercy of the winds. The Arabs, who had also come to India as traders, named this seasonal reversal of the wind system ‘monsoon’, derived from the Arabic word *mausim*, which literally means season.

DON'T MISS OUT

Since crop production often depended on seasonal monsoon rains, Indians worked out methods to predict rainfall. *Kṛṣhiparāśhara* and the *Bṛihatsamhitā* describe such methods in every season. *Kṛṣhiparāśhara*'s main technique was based on the positions of the Moon and the Sun in the sky. Varāhamihira in his *Bṛihatsamhitā* considered **lunar mansions (*nakṣhatras*)** in predicting seasonal rainfall. Even today, a large number of farming practices in India are based on these ancient methods.

Monsoon winds are seasonal winds. They can be categorised into the south-west and the north-east monsoon. The south-west monsoon, also known as the summer monsoon, is characterised by winds blowing from sea to land across the Indian Ocean, the Arabian Sea, and the Bay of Bengal between June and September. It is mainly caused by the unequal heating of land and the sea. During summer, the landmass of India heats up faster than the surrounding oceans. This creates a low-pressure area over the Indian subcontinent, while the Indian Ocean remains relatively cooler and has high pressure. Winds move from high-pressure areas to low-pressure areas, so moist winds blow from the ocean towards the land, bringing rainfall. It accounts for most of the rainfall in the country throughout the year.

The winter monsoon, also known as the north-east monsoon, occurs in India from October to February. During this season, the Indian landmass cools faster than the surrounding oceans, creating a high-pressure area over the land and low pressure over the seas.



Fig. 3.9. Arrival of monsoon in the Mountains

Monsoon:

It refers to the seasonal reversal in the wind direction during a year.

Lunar Mansions (*nakṣhatras*):

Nakṣhatras are a way of dividing the sky into 27 equal parts along the path the Moon travels. Each part is linked to a star or group of stars, but really it is just a fixed section of the sky. The Moon takes about 27 days to go around the Earth relative to the stars, so it moves through one *nakṣhatra* each day. That's why they are called “lunar mansions”—it's like the Moon stays in a different “house” in the sky every night.

3 – Atmosphere and Climate

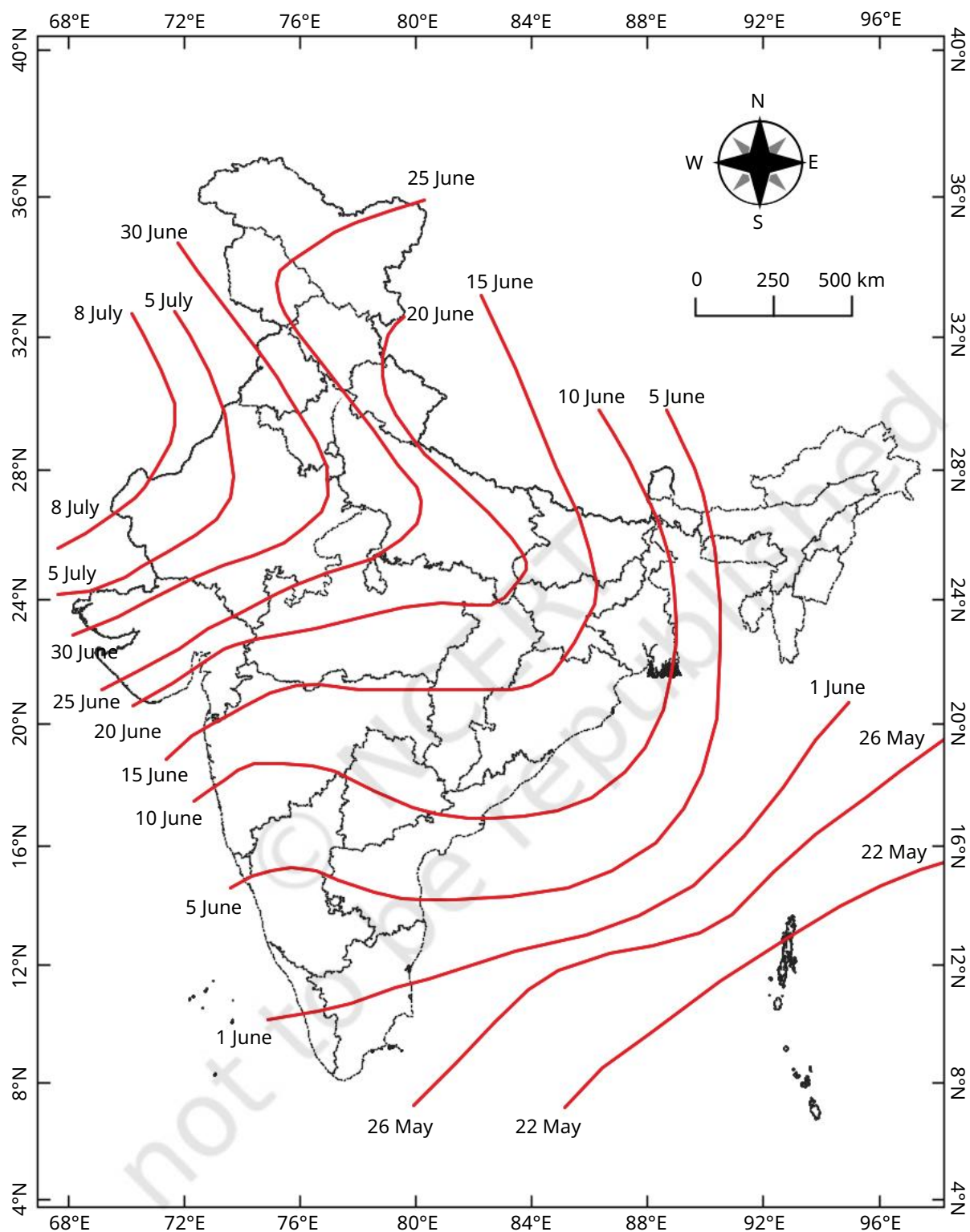


Fig. 3.10. Normal dates of advancing of south-west monsoon

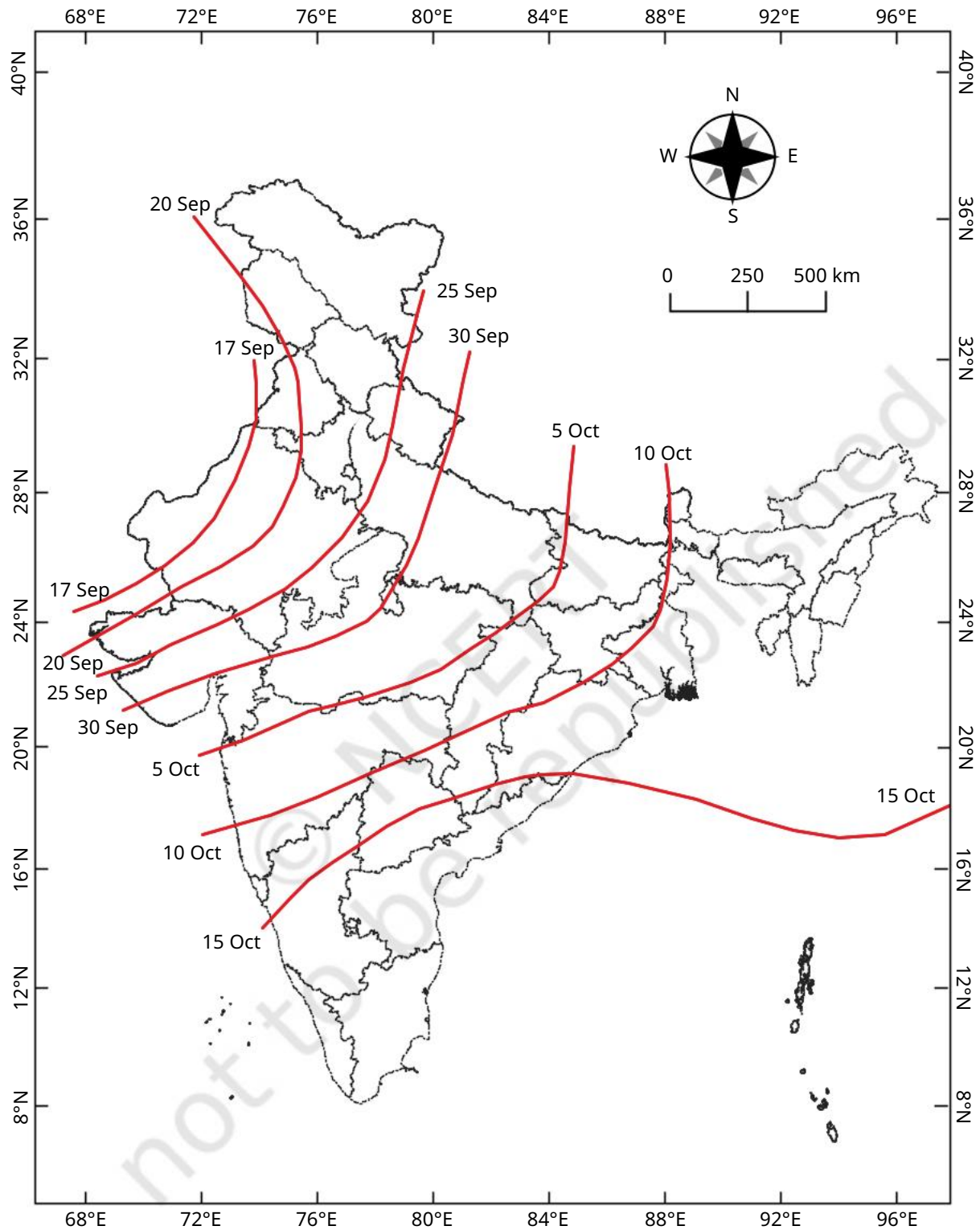


Fig. 3.11. Normal dates of retreating monsoon

As a result, cold and dry winds blow from land to sea. These winds generally do not bring rainfall to most parts of India. However, when the north-east monsoon winds pass over the Bay of Bengal, they pick up moisture and cause rainfall in the eastern coast of India, especially in Tamil Nadu, Andhra Pradesh, and parts of Karnataka. Thus, the winter monsoon is important for the rainfall of the south-eastern regions of India.

Monsoon plays a vital role in the lives of people in India. Most of India's agriculture depends on monsoon rainfall, as farmers rely on rain for sowing and growing crops. A good monsoon ensures sufficient food production and water supply in rivers, reservoirs, and wells. Monsoon also affects daily life, transport, festivals, and employment, especially in rural areas. However, excessive rainfall can cause floods, while weak monsoons can lead to droughts. Thus, monsoon greatly influences the economy, lifestyle, and livelihoods of people in India.

DON'T MISS OUT



Kālidāsa, in *Meghadūtam* written around the 5th century CE, mentions the date of the onset of the monsoon over central India and also traces the path of monsoon clouds.

LET'S EXPLORE



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

DON'T MISS OUT

Under the National Monsoon Mission (NMM), Ministry of Earth Sciences (Government of India) has developed state-of-the-art weather and climate prediction models. The overall objective of the NMM is to enhance monsoon predictions for India over all time frames.

'Mission Mausam' is designed to position India as a global leader in weather and climate sciences. The mission aims to make the nation 'Weather Ready' and 'Climate Smart', meeting the global standards. It aims to improve weather and climate services, ensuring timely and precise observation, modelling, and forecasting information for multiple sectors, including agriculture, disaster management, and rural development.



Climate Change

One of the most urgent challenges that the Earth is facing today is climate change. It refers to long-term changes in weather patterns, such as temperature, rainfall, and wind, caused mainly by human activities, including the burning of fossil fuels, deforestation, and industrial pollution that releases gases like carbon dioxide into the atmosphere. These actions increase greenhouse gases such as carbon dioxide, methane, nitrous oxide, water vapour in the atmosphere, trapping heat and raising global temperatures. As a result, we are witnessing more frequent floods, droughts, melting of glaciers, rising sea levels, and loss of biodiversity. Climate change not only threatens ecosystems but also impacts human health, agriculture, and livelihoods. You may recall that you have read about 'climate change' in your grade 8 Science textbook. What actions can be taken to reduce such changes? It also has great impact on almost all sections of the population including women and children. Tackling this issue requires collective efforts—reducing **carbon footprints**, using renewable energy, protecting forests, and adopting sustainable lifestyles. Every small step counts, and every human being plays a vital role in shaping a healthier and greener future.

LET'S EXPLORE

My **Carbon Footprint**

Step 1: My Daily Habits

Tick the options that best describe you.

A. **Transport**

- I usually walk/use a cycle. (Low impact)
- I use public transport/carpool. (Medium impact)
- I travel by private cars even for short distances. (High impact).
- I take flights more than twice a year. (Very high impact)

B. **Electricity Use**

- I always switch off electrical appliances (lights, fans, etc.) when not in use. (Low impact)
- I sometimes forget to switch off electrical appliances (lights, fans, etc.). (Medium impact)
- I leave electrical appliances (lights, fans, etc.) on frequently. (High impact)

C. **Water Use**

- I use water judiciously, for example, just one bucket of water for bathing. (Low impact)



Carbon footprint:

The total amount of greenhouse gases released into the atmosphere as a result of human activities, such as energy use, transportation, or the production of goods and services.

3 – Atmosphere and Climate

- I sometimes waste water (leaving the tap running/ more buckets of water for a bath/long showers). (Medium impact)
- I rarely think about saving water. (High impact)

D. Waste and Plastics

- I reuse, recycle, and avoid single-use plastics. (Low impact)
- I sometimes use disposable plastics (bottles/bags/ straws). (Medium impact)
- I often throw away plastic and do not recycle. (High impact)

Step 2: Score Yourself

- **Low impact choices = 1 point**
- **Medium impact choices = 2 points**
- **High impact choices = 3 points**
- **Very high impact choices = 4 points**

Now add up your total score: _____ points

Step 3: My Climate Action Pledge

Think about **two simple changes** you can make to reduce your score, and write them down below.

1. _____
2. _____



Punjab Floods 2025: A Case Study



Fig. 3.12. Floods in Punjab

In 2025, Punjab experienced severe floods due to heavy monsoon rains and the consecutive swelling of the rivers Satluj, Beas, and Ravi. The floods damaged large parts of the state, including villages, agricultural fields, houses, and important infrastructure such as roads and bridges. While the water started to recede in some

places and relief operations were carried out, the overall impact was devastating. The state suffered heavy economic losses, social disruption, and environmental damage, underscoring the urgent need for improved flood management and preparedness.

Causes

The floods in Punjab resulted from both natural and human-made factors.

- **Natural Causes:** In 2025, Punjab faced very heavy monsoon rains, which were intensified by the western disturbances that brought even more moisture and rain. It rained not only in Punjab but also in Himachal Pradesh and Jammu & Kashmir. The major rivers of Punjab—the Satluj, the Beas, the Ravi, and the Ghaggar—were already flowing high before the heavy rains began. When additional rain fell, water from the hills and local rainfall caused rivers to overflow, leading to severe flooding in many parts of Punjab.
- **Human-made Causes:** The floods were further aggravated by weak and old river embankments, or *dhūsi bāndh*, which could not stop the rising water during heavy monsoon rains. People had also built houses and farms too close to the rivers, reducing the natural space where floodwater could spread safely. Over time, silt and mud had collected in rivers and dams, reducing their capacity to hold and carry water. In some areas, flood warnings came late or were not clearly communicated, leaving people unprepared. All these factors together increased the damage caused by the floods.



Fig. 3.13. Relief operations during the floods



Effects of the Floods in Punjab

- Many people lost their lives in the floods.
- Thousands of people had to leave their homes and move to relief camps for safety.
- Large areas of farmland were covered with water, and crops like paddy were severely damaged.
- Poultry and dairy farms were damaged and destroyed. Many animals, including cows, buffaloes, and chickens, got sick or died.
- Roads, bridges, border fences, and some public buildings were also damaged.
- Murky standing water caused health problems, including the spread of waterborne diseases and sanitation concerns.

Classroom Discussion

- To what extent did natural factors cause these floods compared to human activities?
- Do you think better planning could have reduced the damage? How?
- What are the guidelines for the management of floods according to the National Disaster Management Authority (NDMA)?
- What role can students/youth play in helping with disaster preparedness?

Before we move on...

- The Earth's atmosphere is made up of different gases, mainly nitrogen and oxygen, along with small amounts of other gases like water vapour and dust, support life and help in forming clouds and causing rainfall.
- The atmosphere is made up of different layers, namely the Troposphere, Stratosphere, Mesosphere, Thermosphere, and Exosphere, which are divided based on changes in temperature and air density as we go higher above the Earth's surface.
- Weather refers to the daily atmospheric conditions, while climate is the average weather of a place over a long period of time.
- India has a tropical monsoon climate, and the Indian Meteorological Department (IMD) divides the year into four main seasons, namely—Winter, Summer, Monsoon, and Post-monsoon.

- Climate change is the long-term change in weather caused mainly by human activities like burning fuels and cutting trees, which leads to global warming and extreme weather conditions.
- We can reduce our carbon footprint by saving energy, using renewable sources, planting trees, and living in more eco-friendly ways.

Questions and activities

1. What is atmosphere? Explain its composition with the help of a pie diagram.
2. Draw a labelled diagram of the structure of atmosphere.
3. Which are the four main seasons of India?
4. Why do you not feel the pressure of the atmosphere?
5. In which layer of the atmosphere do aeroplanes fly and why?
6. Distinguish between the following:
 - a. The troposphere and stratosphere
 - b. The south-west monsoon and north-east monsoon
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.
 - 7.1. Now look at Table 3.3 again. Re-arrange the 10 stations according to their distance from the equator.
 - 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
 - 7.3. Now find out:
 - a. Why does Shillong experience more rainfall than Kolkata?
 - b. Why does Delhi receive more rainfall than Jodhpur?



Table 3.3. Average monthly temperatures and rainfall for 10 representative stations (temperature and rainfall data are representational)

Stations	Latitude	Altitude (Metres)	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Annual Rainfall
Temperature (°C) Bengaluru	12°58'N	909	20.5	22.7	25.2	27.1	26.7	24.2	23.0	23.0	23.1	22.9	18.9	20.2	
Rainfall (cm)			0.7	0.9	1.1	4.5	10.7	7.1	11.1	13.7	16.4	15.3	6.1	1.3	88.9
Temperature (°C) Mumbai	19°N	11	24.4	24.4	26.7	28.3	30.0	28.9	27.2	27.2	27.2	27.8	27.2	25.0	
Rainfall (cm)			0.2	0.2	–	–	1.8	50.6	61.0	36.9	26.9	4.8	1.0	–	183.4
Temperature (°C) Kolkata	22°34'N	6	19.6	22.0	27.1	30.1	30.4	29.9	28.9	28.7	28.9	27.6	23.4	19.7	
Rainfall (cm)			1.2	2.8	3.4	5.1	13.4	29.0	33.1	33.4	25.3	12.7	2.7	0.4	162.5
Temperature (°C) Delhi	29°N	219	14.4	16.7	23.3	30.0	33.3	33.3	30.0	29.4	28.9	25.6	19.4	15.6	
Rainfall (cm)			2.5	1.5	1.3	1.0	1.8	7.4	19.3	17.8	11.9	1.3	0.2	1.0	67.0
Temperature (°C) Jodhpur	26°18'N	224	16.8	19.2	26.6	29.8	33.3	33.9	31.3	29.0	20.1	27.0	20.1	14.9	
Rainfall			0.5	0.6	0.3	0.3	1.0	3.1	10.8	13.1	5.7	0.8	0.2	0.2	36.6
Temperature (°C) Chennai	13°4'N	7	24.5	25.7	27.7	30.4	33.0	32.5	31.0	30.2	29.8	28.0	25.9	24.7	
Rainfall (cm)			4.6	1.3	1.3	1.8	3.8	4.5	8.7	11.3	11.9	30.6	35.0	13.9	128.6
Temperature (°C) Nagpur	21°9'N	312	21.5	23.9	28.3	32.7	35.5	32.0	27.7	27.3	27.9	26.7	23.1	20.7	
Rainfall (cm)			1.1	2.3	1.7	1.6	2.1	22.2	37.6	28.6	18.5	5.5	2.0	1.0	124.2
Temperature (°C) Shillong	24°34'N	1461	9.8	11.3	15.9	18.5	19.2	20.5	21.1	20.9	20.0	17.2	13.3	10.4	
Rainfall (cm)			1.4	2.9	5.6	14.6	29.5	47.6	35.9	34.3	30.2	18.8	3.8	0.6	225.3
Temperature (°C) Thiruvananthapuram	8°29'N	61	26.7	27.3	28.3	28.7	28.6	26.6	26.2	26.2	26.5	26.7	26.6	26.5	
Rainfall (cm)			2.3	2.1	3.7	10.6	20.8	35.6	22.3	14.6	13.8	27.3	20.6	7.5	181.2
Temperature (°C) Leh	34°N	3506	–8.5	–7.2	–0.6	6.1	10.0	14.4	17.2	16.1	12.2	6.1	0.0	–5.6	
Rainfall (cm)			1.0	0.8	0.8	0.5	0.5	0.5	1.3	1.3	0.8	0.5	–	0.5	8.5

7.4. Now think why

- Thiruvananthapuram has an equable climate?
- Chennai has more rainfall only after the fury of the monsoon is over in most parts of the country?
- Leh has moderate precipitation almost throughout the year?

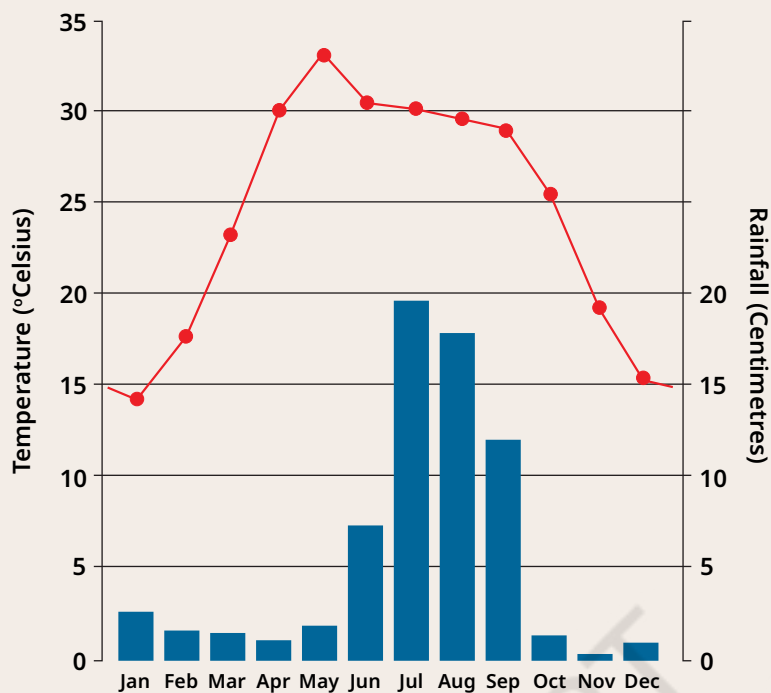


Fig. 3.14. Temperature and Rainfall of Delhi

- 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?
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.

Notes

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