An Introduction to

GEOGRAPHY

Class VIII

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Ministry of Education and Skills Development
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Advisors:

1. Kinga Dakpa, Director, Royal Education Council, Paro
2. Karma Tshering, Director General, DSE, Ministry of Education, Thimphu
3. Wangpo Tenzin, Curriculum Specialist, Royal Education Council, Paro

Research & Writing

1. Bak Bir Rai, Shari HSS, Paro
2. Chimi Tshering, Jakar HSS, Bumthang
3. Dawa Zangmo, Bitekha MSS, Paro
4. Dechen Choden, Gelephu HSS, Sarpang
5. Jampa Choden, Martshalla CS, Samdrup Jongkhar
6. Kelzang Tenzin, Shari HSS, Paro
7. Kuenga Wangmo, Subject coordinator, BCSEA
8. Laxman Chhetri, Khasadrapchu MSS, Thimphu
9. Kuenzang Gyeltshen, Samtse College of Education
10. Norbu Wangchuk, Royal Education Council
11. Pema Lhendrup, Sherubtse College, Kanglung
12. Pemba Tshering, Samtse HSS
13. Phuntsho Choden, Samdrup Jongkhar MSS
14. Rinzin Wangmo, Gonzim Ugyen Dorji CS, Haa
15. Rajan Kumar Kafley, EMD, MoE
16. Sangay Zangmo, Samtengang CS, Wangdue
17. Samdrup Dorji, National Land Commission, Thimphu
18. Sumitra Pokhrel, Phuntsholing HSS
19. Tshering Dorji, Motithang HSS, Thimphu
20. Ugyen Wangchuk, Jigme Sherubling CS, Khaling

Copy Editor

Norbu Wangchuk, Curriculum Specialist, Royal Education Council, Paro

Illustration, Cover Design & Layout

Surjay Lepcha

Foreword

The purpose of education is the wholesome development of learners to equip them with relevant knowledge, skills and values crucial for them to deal with realities in life. Learners ought to learn, how to think, understand, integrate and evaluate diverse situations they face in their lives. This pre-empts that education be visionary and future oriented.

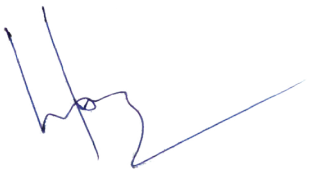
We live in an interconnected global world where Geographical perspectives including time and space, physical environment and people influence the world environment. Therefore, it is important for learners to understand and apply the different strands of geography education to help learners in making wise decisions. This is because human activities directly impact our environment.

Understanding of geography and practices of the basic theories of the subject should find link to higher level and transcend to career opportunities for learners. The diverse geography learning experiences and opportunities should stimulate love and care for our natural world to be educated and responsible citizens.

Thus, this book sets the foundation for the beginners to understand Geography based on astronomy, physical, human and economic dimensions of Geography education. In addition, it will help them to appreciate the importance of Geography in the conservation of the natural environment for sustainable socio economic development of the country. The textbook caters to the first time learners of Geography as a separate subject with clear and simple text with exciting learning activities, informative maps and pictures.

We are grateful to our writers and reviewers from the Royal University of Bhutan, the Ministry of Education, National Land Commission, Bhutan Council of School Examinations and Assessment and colleagues from the Royal Education Council for their valuable contributions. We hope that our teachers and learners enjoy teaching and learning the subject and contribute to the promotion of Geography education as a whole.

Tashi Delek!



Kinga Dakpa
Director

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CHAPTER

1

The Motions of the Earth

Learning Objectives

- Describe rotation and revolution
- Explain the key characteristics of the Earth's motion

Introduction

The two motions of the Earth are rotation and revolution. The Earth rotates on its axis and revolves on its orbit around the Sun. The motion of the Earth is understood better through the study of its characteristics.

1.1 Characteristics of Rotation

The Earth takes 24 hours to complete one rotation. The speed of rotation is maximum at the Equator (1670 kilometres/hour) and decreases towards the poles (1666 kilometres/hour). The varying speed results in flattening at the poles and bulging at the Equator. It also affects the general circulation of the atmosphere and deflection of any moving object.

1.2 Characteristics of Revolution

The Earth revolves around the Sun in an anti-clockwise direction. It completes one revolution in 365 ¼ days. During the revolution, the distance between the Earth and the Sun changes as the orbit is elliptical in shape. The position on the orbit when the Earth is farthest from the Sun is *Aphelion*. *Perihelion* is a position on

the orbit when the Earth is closest to the Sun. The Earth is 152 million kilometers away from the Sun at Aphelion and 147 million kilometers at Perihelion.

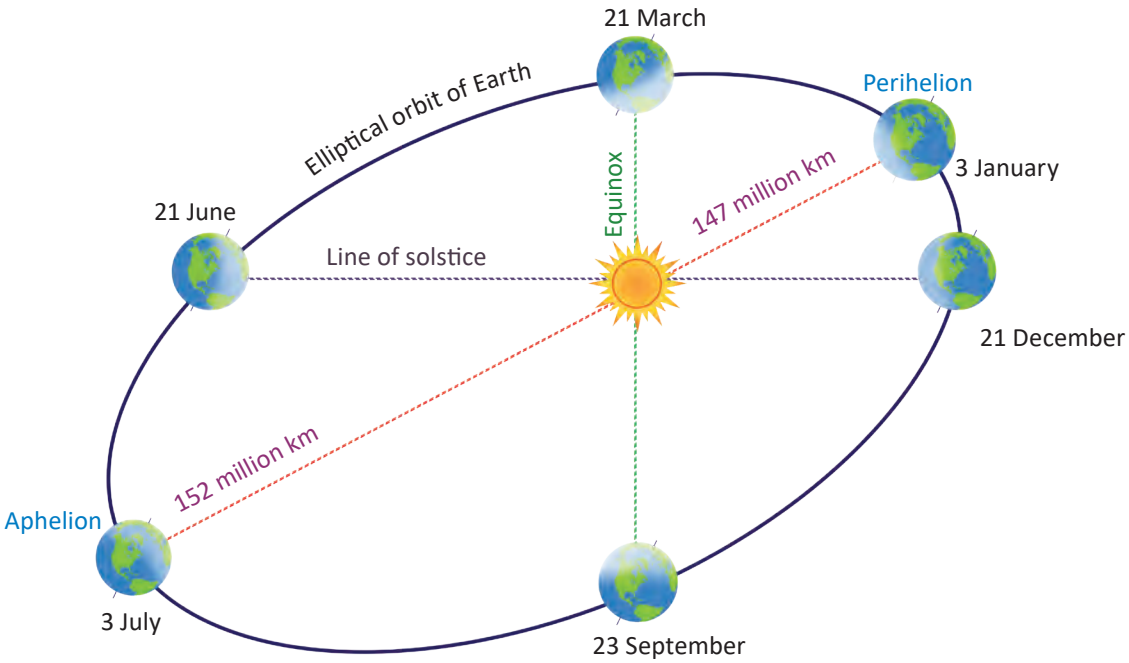

Figure 1.1 Aphelion and Perihelion

The revolution of the Earth with the inclined axis results in varying length of day and night. It also results in the occurrence of seasons. The Earth reaches at four different positions during its revolution. These positions are *Summer and Winter Solstice* and *Spring and Autumn Equinox*. The word solstice in Latin is '*Solstitium*' meaning 'Sun stands still'.

The seasons are opposite in the two hemispheres. In the Northern Hemisphere, Summer Solstice occurs on 21st June when the Sun rays are vertical over the Tropic of Cancer. On the same day, it is Winter Solstice in the Southern Hemisphere. The Winter Solstice occurs on 22nd December in the Northern Hemisphere when Sun rays are vertical over the Tropic of Capricorn. Similarly, it is Summer Solstice in the Southern Hemisphere.

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The word Equinox in Latin is '*Aequinoctium*' meaning 'equal nights' because the Sun is overhead at the Equator. Spring Equinox (Vernal Equinox) occurs on 21st March in the Northern Hemisphere when it is Autumn Equinox (Autumnal Equinox) in the Southern Hemisphere. On 23rd September when it is Autumn Equinox in Northern Hemisphere, the Southern Hemisphere will have Spring Equinox.

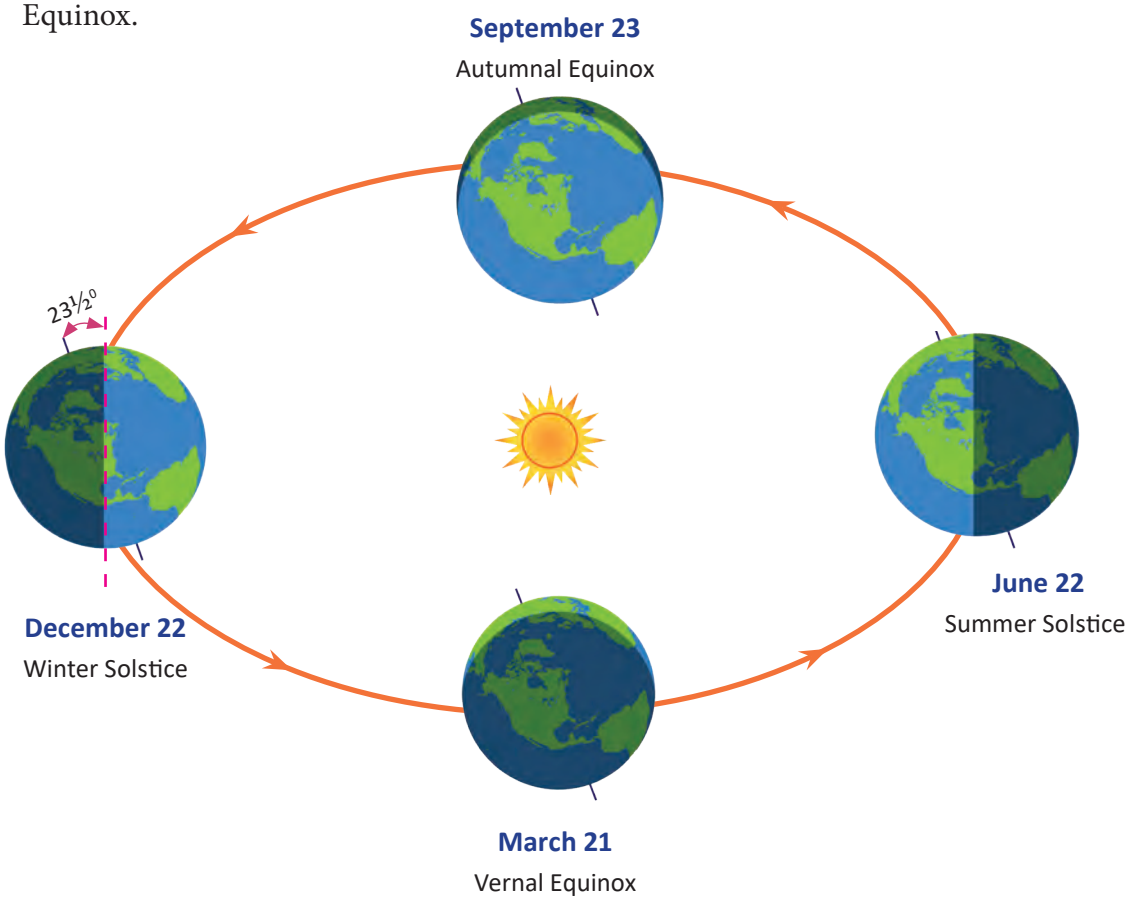

Figure 1.2 Solstice and Equinox

Know More

1. Midnight Sun is time of a year when sun never sets over Arctic region.
2. Circumference of the Earth is approximately 40,000 km.
3. Speed of revolution is 30 km per second.

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Learning Activity

Using the textbook, answer the questions.

1. The Earth rotates 1600 km per hour on an average but we do not feel it, why?
2. Explore the phenomena of Mid Night Sun and discuss.
3. Calculate the speed of rotation for following latitude given in the table.

   Formula:

   $$\text{Speed of rotation} = \frac{\text{Distance (circumference of the Earth)}}{\text{Time (time taken to complete one rotation)}}$$

Sl. No	Latitude	Circumference of Earth (km)	Speed of rotation (km/hr)
1	0^0	40,070	?
2	90^0	40,000	?

Test Yourself

1. What causes season?
   - A. Earth's rotation
   - B. Earth's revolution
   - C. Earth's tilt and rotation
   - D. Earth's tilt and revolution
2. There is continuous day light at the north pole during
   - A. Winter Solstice
   - B. Summer Solstice
   - C. Spring Equinox
   - D. Autumn Equinox
3. How does the speed of rotation affect the shape of the Earth?
4. What would happen if the Earth revolves in an opposite direction?
5. Blessed Rainy Day 'Thrue Baap' is celebrated in autumn season in Bhutan. In which season would Bhutanese people living in Australia celebrate?

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CHAPTER

2

Latitude and Longitude

Learning Objectives

- Describe the importance of latitudes and longitudes
- Identify latitudes and longitudes of places on a map
- Calculate time and longitudes

Introduction

The places around the world are located using coordinates of latitudes and longitudes. Heat zones are determined by latitudes and time by longitudes.

2.1 Latitude

Latitude is the angular distance of a place north or south of the equator. It is an imaginary line running east to west as circle parallel to the Equator. There are 180 lines of latitudes. The important latitudes are:

Table 2.1 Important latitudes

Degree	Latitude
0°	Equator
23 ½° North	Tropic of Cancer
23 ½° South	Tropic of Capricorn
66 ½° North	Arctic Circle

66 ½° South	Antarctic circle
90° North	North Pole
90° South	South Pole

Latitudes help in determining the heat zones of the world. The important latitudes demarcate the extent of these heat zones. The heat zones are Torrid, Temperate and Frigid.

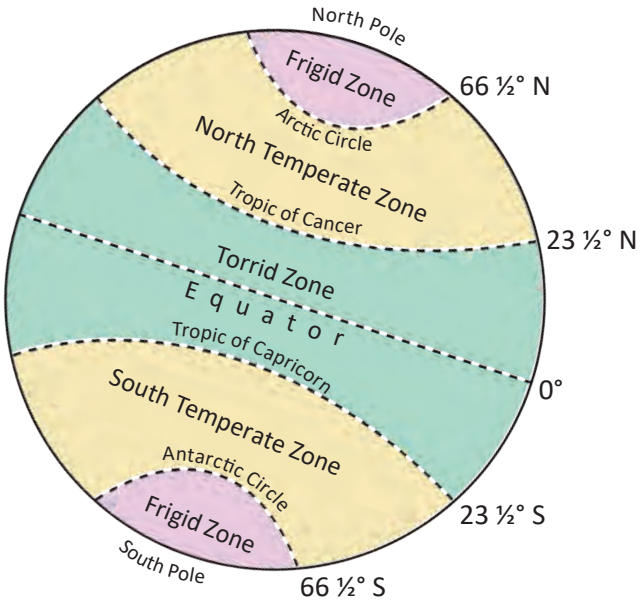

Figure 2.1 Heat Zones

Know More

Equator is the only Great circle dividing the Earth into two hemispheres.

Table 2.2 Heat Zones and Features

Zone	Latitudes	Location	Characteristics
Torrid Zone (Tropics)	23½°N-23½° S	Tropic of Cancer to Tropic of Capricorn	• Receives vertical sun rays throughout the year. • Hot and wet at the equator.
Temperate Zone	23½°-66½°N and 23½°- 66½°S	- Tropic of Cancer to Arctic circle in North - Tropic of Capricorn to Antarctic circle in south	• Precipitation varies with seasons. • There are four distinct seasons.
Frigid Zone	66½°-90° N/S	- Arctic circle to north pole - Antarctic circle to south pole	• Receives slanting sun rays throughout the year. • Precipitation is mostly in the form of snow. • Mostly cold.

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2.2 Longitude

Longitude is an imaginary line running from North Pole to South Pole. There are 360 lines of longitudes and all are great circles. *Great Circle* is a circle that divides the Earth into two equal halves. *Prime Meridian* (0°) and *International Dateline* (180°) are the two important lines of longitude.

International Dateline is a meridian that demarcates the change of one calendar day to a new day. Unlike other longitudes, it is not a straight line. It passes through the middle of Pacific Ocean but deviates to pass around some territories and islands to avoid confusion of two different dates in the same place.

2.3 Time Zone

A time zone is a region of the Earth that observes a uniform time. There is one hour time difference for every 15° longitudes. The world is divided into 24 time zones as the Earth completes one rotation in 24 hours.

Learning Activity *Refer Atlas and answer the questions.*

1. Identify the country with the maximum time zones in the world.
2. Which is the standard longitude to calculate time for Bhutan?

2.4 Calculating Time and Longitude

Time zones are identified with reference to Prime Meridian. The *Greenwich Mean Time* (GMT) is the time of Prime Meridian (0°). The time east of GMT is ahead while the time west of GMT is behind.

24 hours = 360^0 Longitude

1 hour = $360 \div 24 = 15^0$

60 minutes = 15^0 (or)

$60 \div 15$ = 4 minute

Therefore, 1^0 = 4 minutes

Know More

1. Greenwich was adopted in 1884 as Prime Meridian of longitude.
2. GMT is also referred as UTC (Universal Time Coordinate/Universal Coordinated Time)

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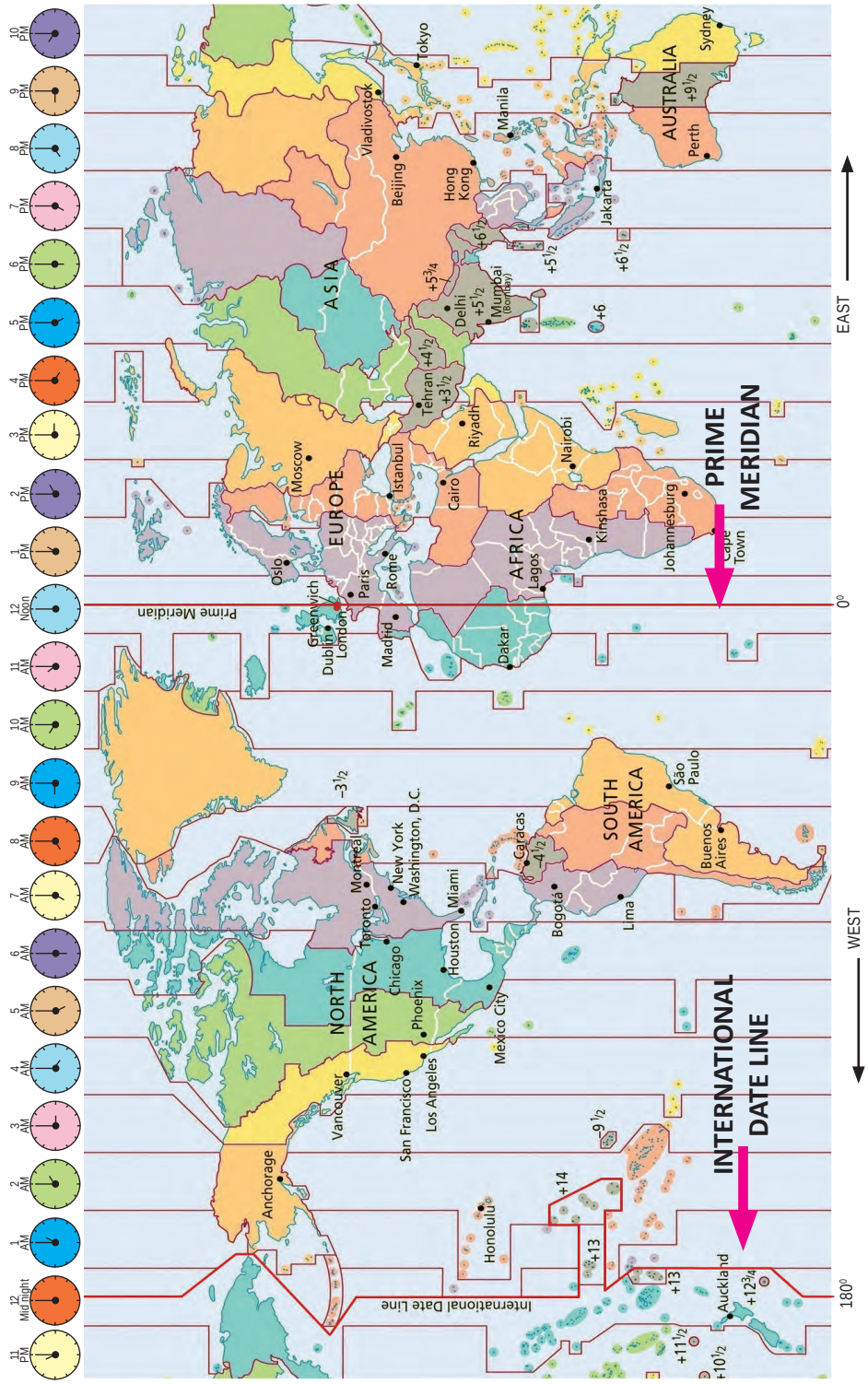

Figure 2.2 Map showing International Dateline

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Solved Example 2.1 *Finding time*

What will be the time at 30° W, when it is 9 AM in Bhutan (90^0 E)?

Solution:

Given:

Note: Longitudinal difference is added when the given longitudes are on opposite position (East and West).

No. of longitude between Bhutan (90°) and 30° West = 90 + 30 = 120°

$\Rightarrow 1^0 = 4$ minutes (fact)

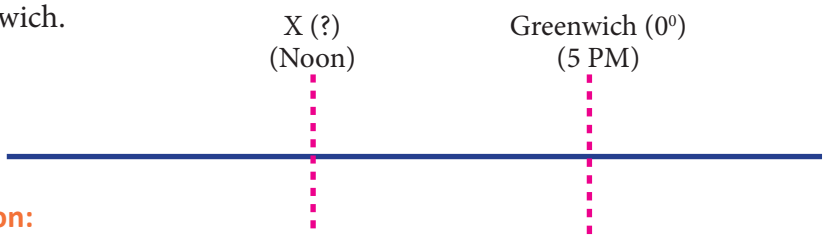
$\Rightarrow 120^0 = 120 \times 4 = 480$ minutes

$\Rightarrow 480$ minutes $= \frac{480}{60} = 8$ hours (*minutes should be always converted into hours*)

$\therefore$ The time at 30^0 West longitude is 9 hours - 8 hours = 1 hour or 1 AM

Solved Example 2.2 *Finding longitude*

Find the longitude of a place 'X' where the time is noon when it is 5 PM at Greenwich.



Solution:

Time difference between X and Greenwich = 12 noon - 5 PM = 5 hours

$\Rightarrow 5 \times 60 = 300$ minutes

$\Rightarrow 1^0 = 4$ minutes (fact)

$\Rightarrow \frac{300}{4} = 75^0$

$\therefore$ As the place X is behind the Greenwich, the longitude is 75^0 West of Greenwich.

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Learning Activity

Refer to the example, solve the questions.

1. What is the time at place X located at 20° E longitude when it is 2 PM at place Y at 110° E?
2. When it is 10 PM at 15° E, what will be the time at 15° W?

Test Yourself

1. In which heat zone does Bhutan lie? Give reasons.
2. How will you adjust the time when you cross into different time zones?
3. You are studying in a school which is located at 45° West longitude. How many hours are you behind from your family in Bhutan?
4. When the time is 2 AM at GMT, it is already 5 AM at place X. Calculate the longitude of place X.
5. If the time at 60° West is 6.30 PM, what will be the longitude of a town whose time is 4.30 PM?
6. Find the latitude and longitude of the following cities given in the table by referring the Atlas.

Sl No.	Cities	Latitude	Longitude
1	Thimphu		
2	Dhaka		
3	London		
4	Tokyo		

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CHAPTER

3

Map Reading and Interpretation

Learning Objectives

- Discuss types of map scale
- Interpret and illustrate relief features from contour map

Introduction

Map reading is an art of understanding and interpreting information represented on the map. Map reading skills are essential for learning and exploring geography.

Map is a graphical representation of Earth or a portion of the Earth drawn to the scale on a plane surface. Map title, scale, direction, signs and symbols are key components of a map. Natural and human-made features are represented by various colours, signs and symbols.

3.1 Types of Scale

Scale is a ratio of the distance on the map to the corresponding distance on the ground. The scale on the map is represented in three different ways.

i) Statement Scale

Statement scale is expressed in words or in a written form. For example, one centimetre on the map represents four kilometres on the ground. (1 cm = 4 km)

ii) Representative Fraction

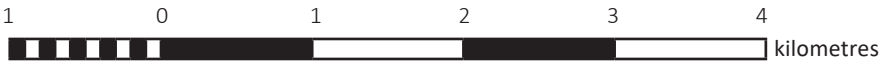
Representative fraction (R.F.) is a scale expressed as a fraction or ratio. For example, 1/50000 or 1: 50000.

iii) Linear Scale

Linear scale is a straight line divided into equal parts. This is also called as graphical scale.

Know More

1. The art of map making is called cartography.
2. The earliest maps were found in Mesopotamia imprinted on the clay tablets and cave walls.



Scale 1: 500,000

(1 centimetre on the map represents 5 kilometres on the ground)

Figure 3.1 Linear Scale

3.2 Conversion of Scales

The scale conversion gives us understanding of ground measurement.

Conversion of Scale

$$\text{Scale} = \frac{\text{Map distance}}{\text{Ground distance}}$$

1 km = 1000 m

1 m = 100 cm

1 km = 100,000 cm

Statement scale to RF

1. Convert 1 cm = 5 km into Representative Fraction.

   Statement Scale: 1 cm = 5 km

   RF = ?

   $$RF = \frac{MD}{GD} = \frac{1\text{ cm}}{5\text{ km}}$$

   1 km = 100,000 cm

   $$RF = \frac{1\text{ cm}}{5 \times 100{,}000\text{ cm}} = \frac{1}{500{,}000}$$

   Therefore, RF is 1:500,000

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Representative Fraction to Statement scale

2. Convert R.F. 1:50,000 into statement scale (cm to km).

R.F. 1:50,000

Statement Scale = ?

$$\text{Statement Scale} = \frac{MD}{GD} = \frac{1}{50,000}$$

1 km = 100,000 cm

$$\text{Statement Scale} = \frac{1}{50,000 \div 100,000} = \frac{50,000}{100,000} = \frac{1}{2}\text{ km}$$

Therefore, Statement Scale is 1 cm = $\frac{1}{2}$ km or 1 cm = 0.5 km

Learning Activity *Using the given formula, solve the questions.*

1. The R.F. of map is 1:100000. Convert it into statement scale (cm to km)
2. Calculate R.F. when the statement scale is 1 cm = 4 km.

3.3 Grid Reference

The network of vertical and horizontal lines used for locating features on a map is called *Grid System*. Vertical lines numbered eastward to measure distance are referred to as *Eastings*, while Horizontal lines numbered northward are called *Northings*. The location of a place is determined using four figure and six figure grid references.

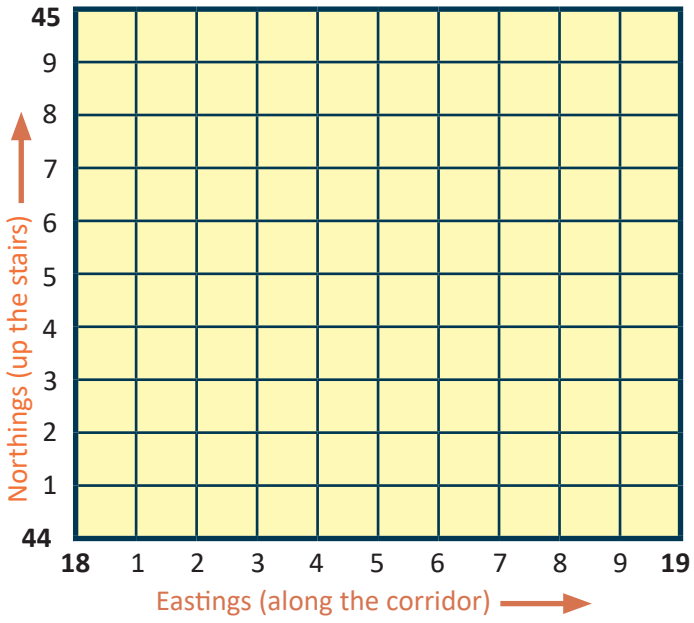

Figure 3.2 Grid Reference

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i) Four Figure Grid Reference

A four figure grid reference indicates a location of feature on a particular grid. While reading four figure grid reference, use easting followed by northing. For example, the four figure grid reference for the feature in Figure 3.3 is **3381**.

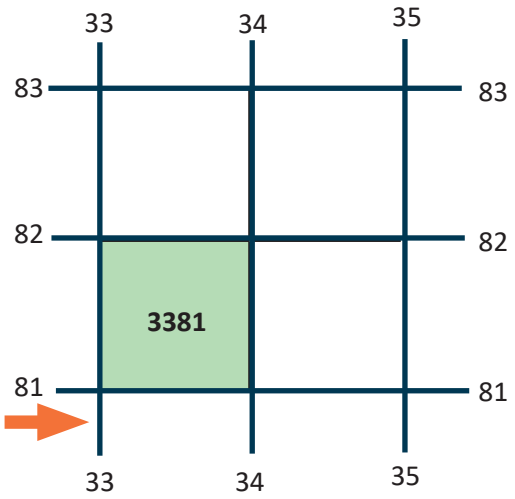

Figure 3.3 Four Figure Grid Reference

ii) Six Figure Grid Reference

Six Figure Grid reference is used to find exact location of a feature within a grid. In six figure grid reference, each grid is divided into ten equal parts. While reading six figure grid references, use easting along with its sub division followed by northing and its sub division. For example, the six figure grid reference for the feature given in Figure 3.4 is **62** 5 **33** 3.

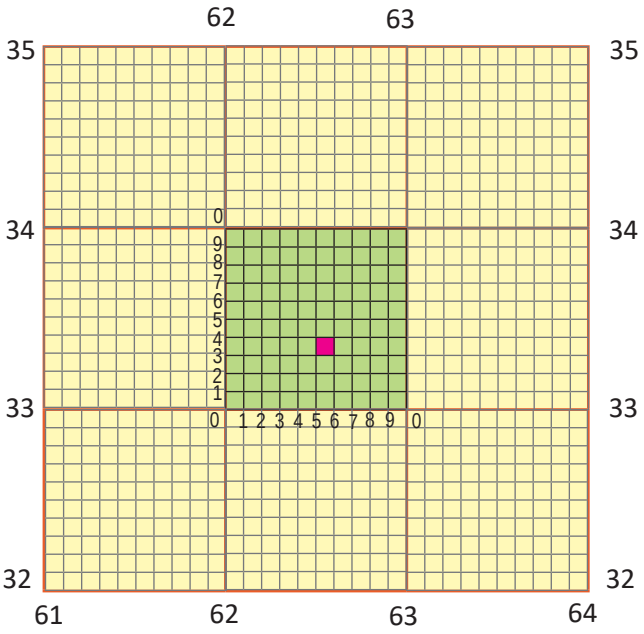

Figure 3.4 Six Figure Grid Reference

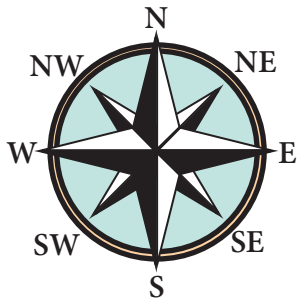

Figure 3.5 Compass Direction

Know More

Compass Direction

It shows the four cardinal direction and its sub-directions.

It helps in finding directions of places.

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Learning Activity *With the help of a given toposheet*

Find the four figure and six figure grid reference of *Kichhu Lhakhang* from the sample topographical map in Figure 3.11.

3.4 Contour, Relief Feature and Profile

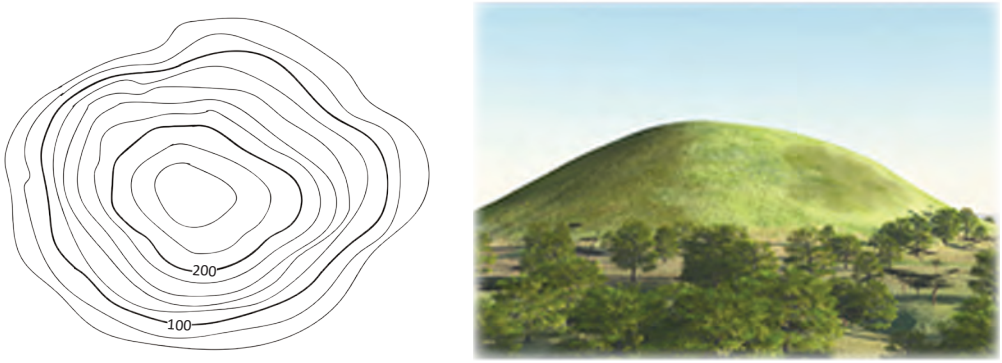
A contour is an imaginary line connecting places of equal height above the sea level. The contour map has the following characteristics:

- Contour lines are numbered as per the height.
- Contour lines do not merge or cross one another except in case of cliff.
- Difference in height between the successive contour lines is the contour interval.

i) Relief Features

A. Widely spaced contour indicates flat surface

B. Circular contour indicates a round hill



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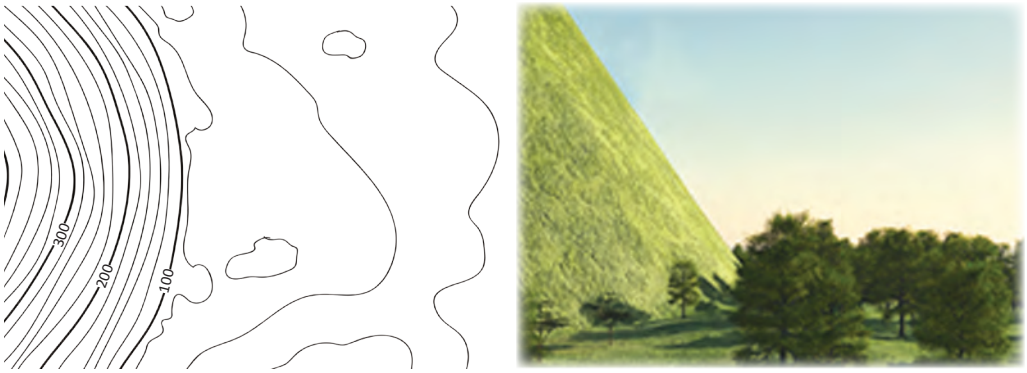
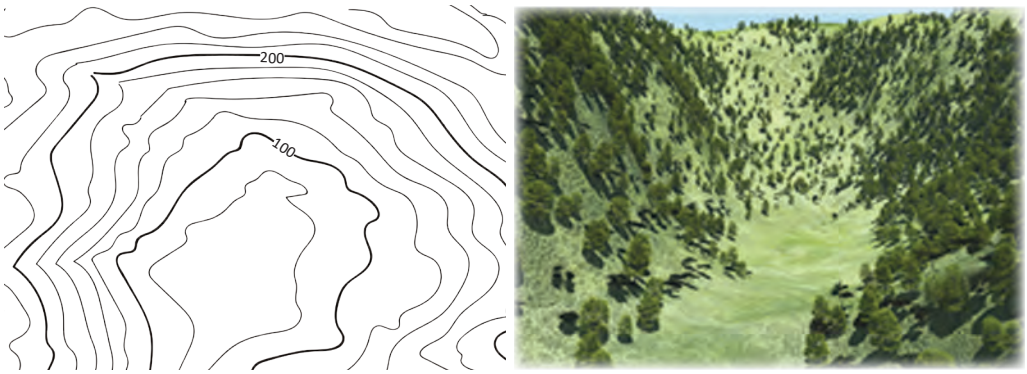
C. Closely spaced contour indicates steep slope.



D. Inner bending contour indicates a valley.



E. Irregular contours indicate uneven surface landform.

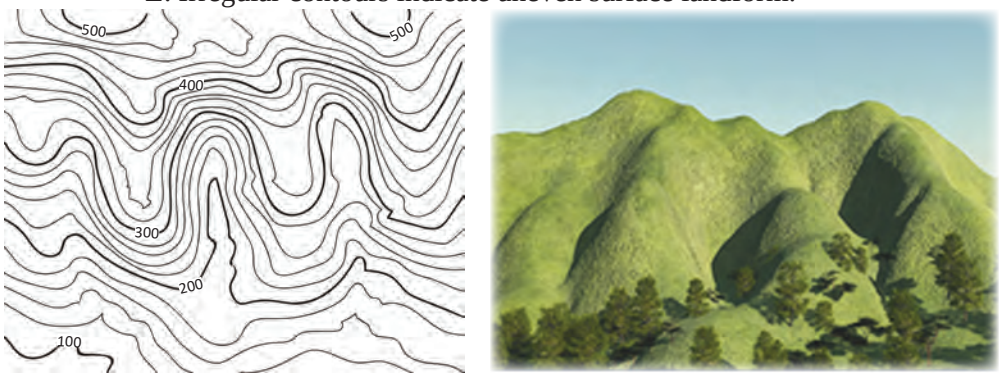


Figure 3.6 Relief features

ii). Cross Section Profile

Cross section Profile is a diagram showing change in height along a line drawn between two points on a map. It is drawn to represent land form depicted by contours. Cross-Section is drawn across physical features like valley, mountain range and a hill. The procedures for drawing are:

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Step 1. Take a thin strip of paper and place it on the cross-section line.

Step 2. Mark and record the height where the contour intersects with the strip.

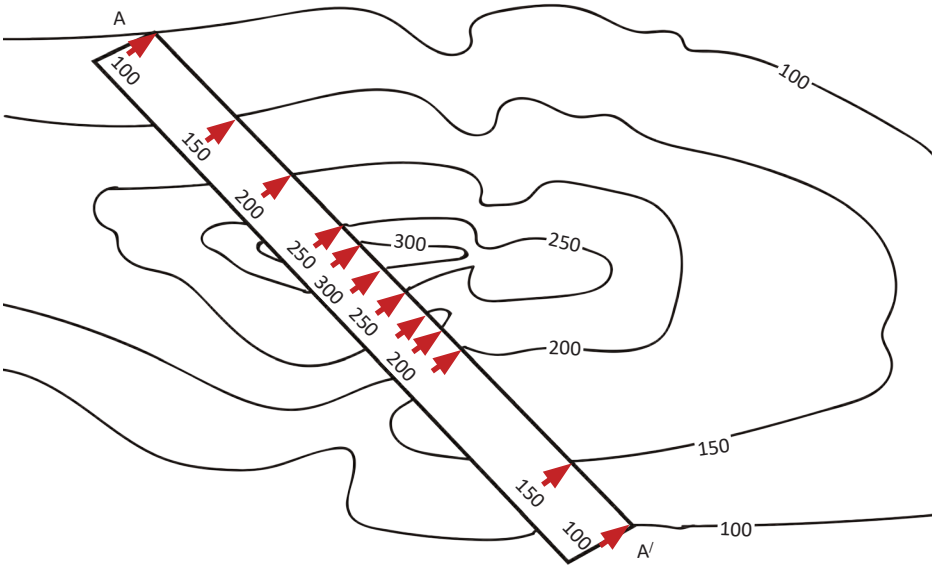

Figure 3.7 (a)

Step 3. Take the strip of paper and put it on a blank paper.

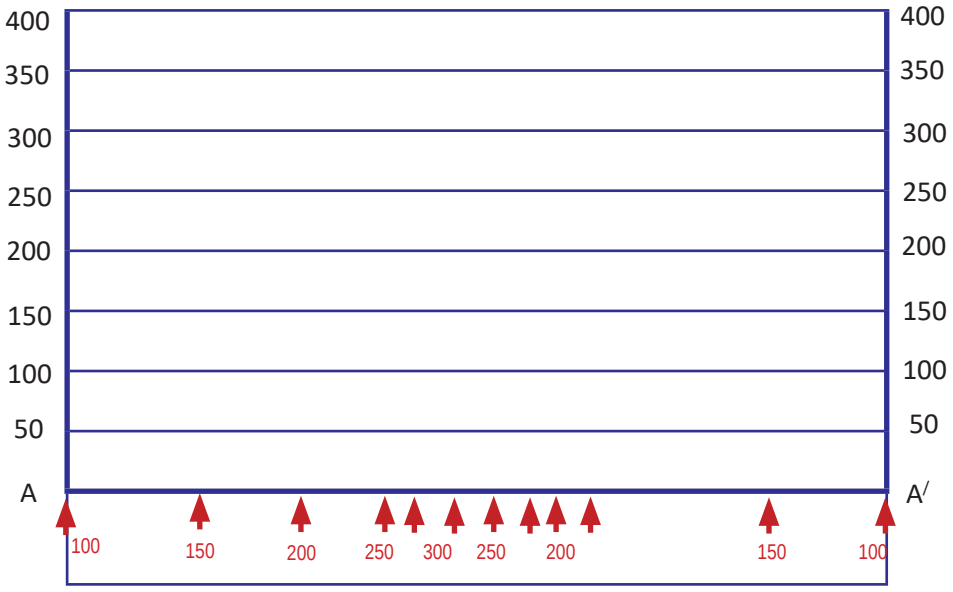

Figure 3.7(b)

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Step 4. Draw two vertical lines representing the boundaries of cross-section.

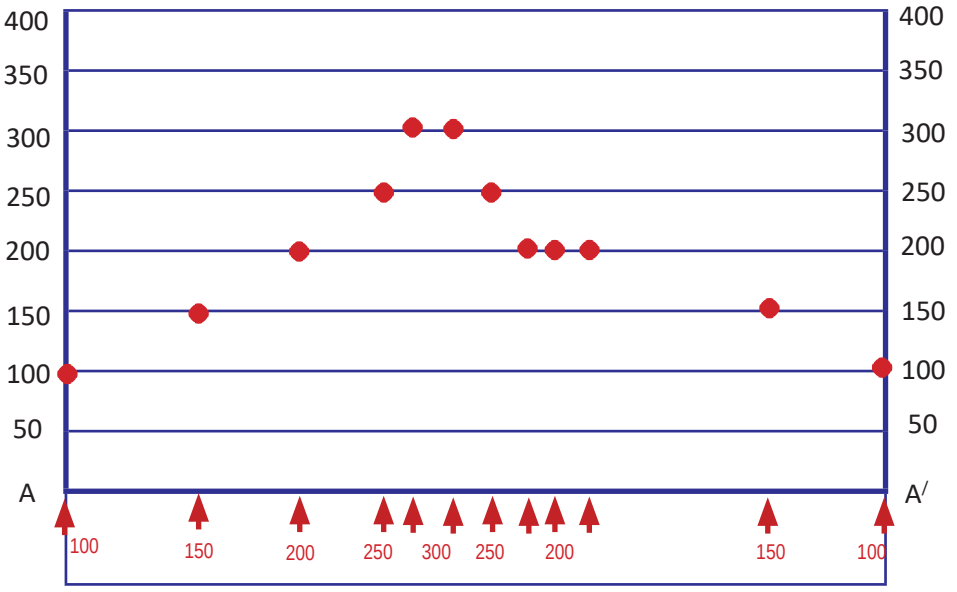

Figure 3.7 (c)

Step 5. Draw dots corresponding to the heights along the strip of paper.

Step 6. Draw a smooth line connecting the dots.

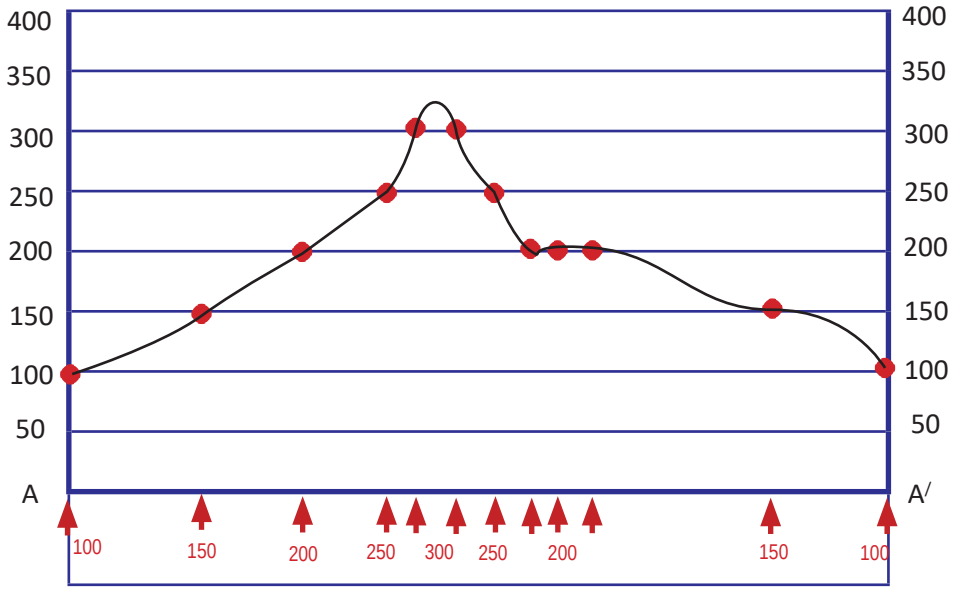

Figure 3.7 (d)

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Learning Activity *Draw a cross-section profile of contours.*

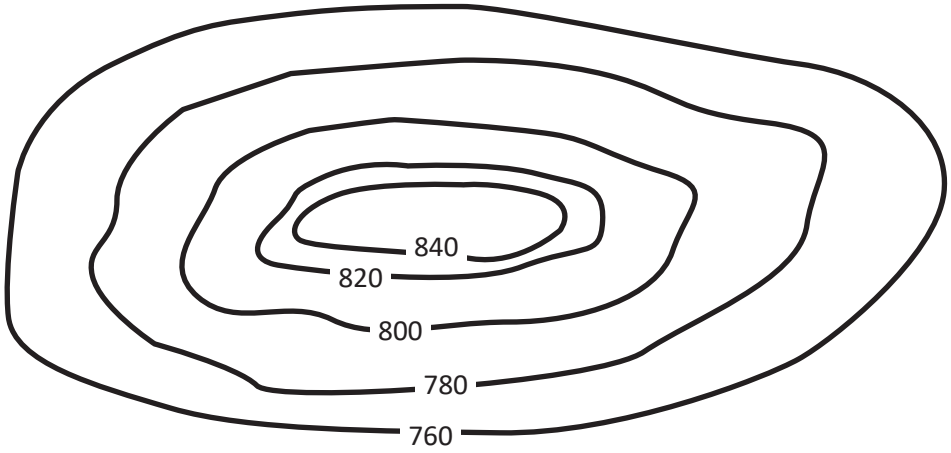

Figure 3.8

3.5 Signs and Symbols

Signs and Symbols are used to represent physical and human-made features on a map. Signs and symbols used for representing physical features are:

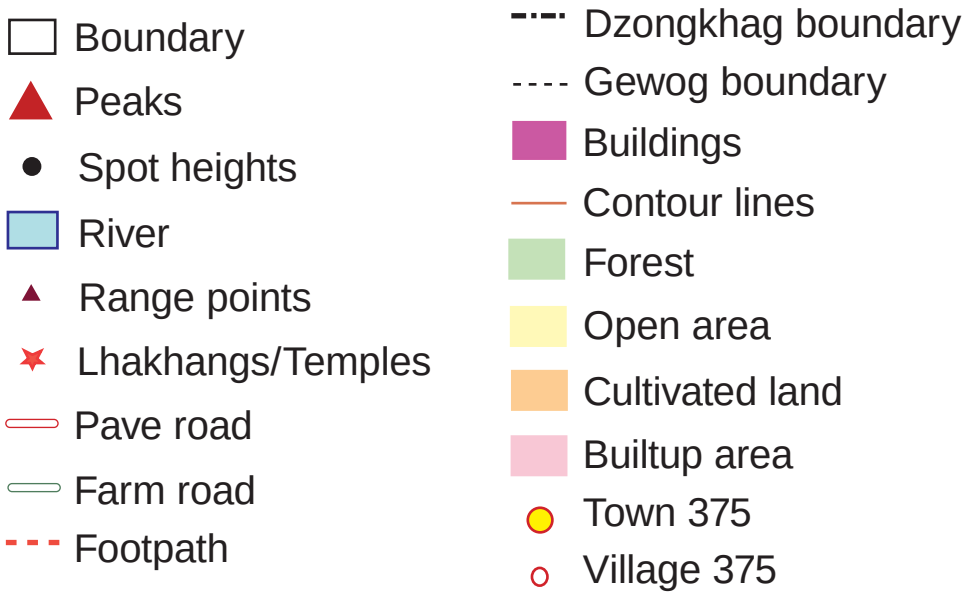

Figure 3.9 Signs and symbols

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Test Yourself

1. Convert the scales.
   a) R.F. 1:100,000 to statement Scale (cm to km)
   b) Statement Scale 1cm=5 km to R.F.
2. Draw the symbols for the following features referring to Figure 3.9.

Features	Symbols
1. Open area	
2. Cultivable land	
3. Footpath	

3. Using the sample topographical map given in Figure 3.11:
   a) Find the four figure grid reference of the places in the table.

Features	Four Figure Grid Reference
1. Chhubjakha	
2. Khamkhug	

   b) Find the compass direction of Shari from Bongde.
   c) Find the six figure grid reference of Tabchhugang.

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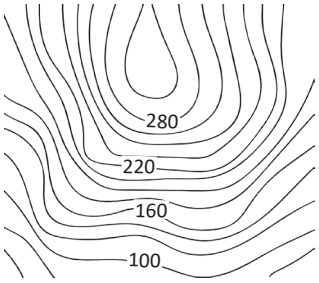
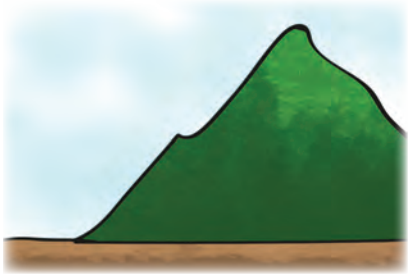
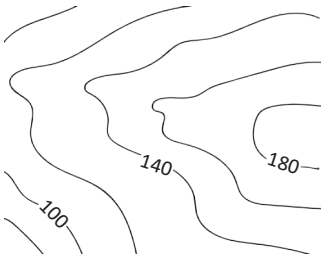
Extra Information for Reference

a. Landform: Steep slope **Description:** Contour lines closer together

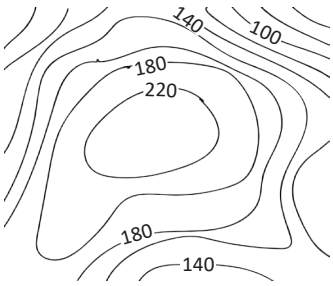




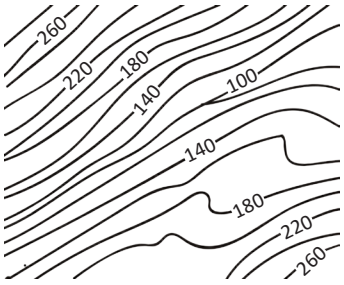
b. Landform: Gentle slope **Description:** Contour lines far apart



c. Landform: Hill **Description**: Rounded area projected above surrounding land



d. Landform: Hill **Description:** V-Shaped caused by water erosion



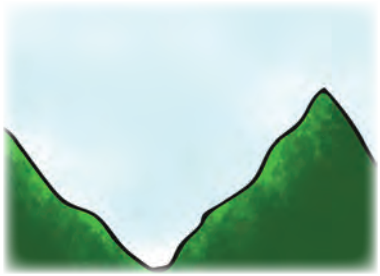


Figure 3.10 Landforms

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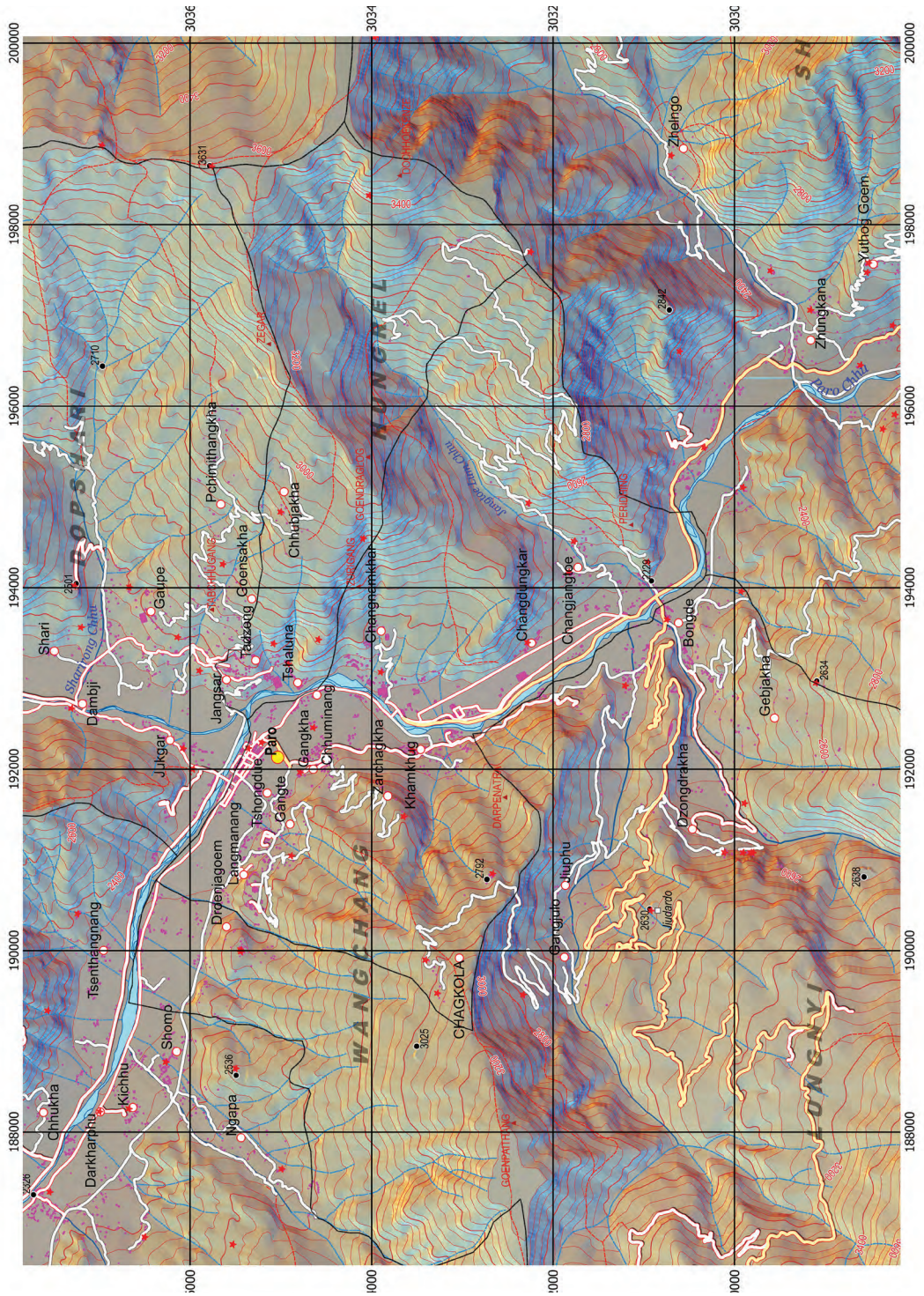

Figure 3.11 Sample topographical map

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CHAPTER

4

River

Learning Objectives

- Discuss stages of river
- Describe the lanforms at different stages

Introduction

A river begins from mountains or hills and flows down to low land. In a cold region, a river may originate from melting snow or a glacier. In warmer places, water drains from slope to form a channels during rainfall. These channels join together to form stream and river.

The impact of river on the physical landscape is understood through the study of different stages. These stages are divided into upper, middle and lower based on the flow of water.

4.1 The works of river

The three main works of river comprises of erosion, transportation and deposition.

i) Erosion

It is the removal of materials from the Earth's surface. The erosional work of a river depends on channel gradient, volume of water, river load and velocity.

ii) Transportation

River transport the eroded materials from higher gradient to lower gradient. The transportation capacity is determined by size and amount of load, volume and velocity of a river.

iii) Deposition

Deposition of loads take place as the river enters the low lying areas. It is due to decrease in gradient and velocity of river.

Learning Activity *Refer figure 4.1 and answer the questions.*

1. Prepare a diagram in MS paint or draw a sketch showing velocity, volume and load of river which determine erosion, transportation and deposition of a river. Display and discuss your work.

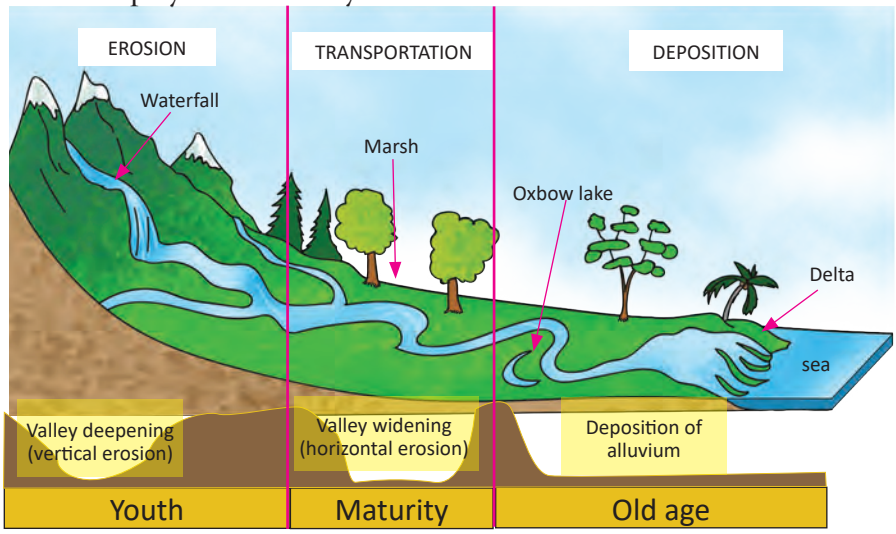

Figure 4.1

2. Identify a stream nearby and observe which activity of a stream is more prominent and why?

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4.2 Stages of River

i) Upper Course or Youthful Stage

Rivers are usually small and flow down with lots of energy due to steep gradient. The features formed in this stage are formed by erosional work. The main work of a river in this stage is vertical erosion or downward cutting. Some of the land features formed are V-shaped valleys, gorges, interlocking spurs and waterfalls.

Figure 4.2 Gorge

Figure 4.3 V- Shaped Valley

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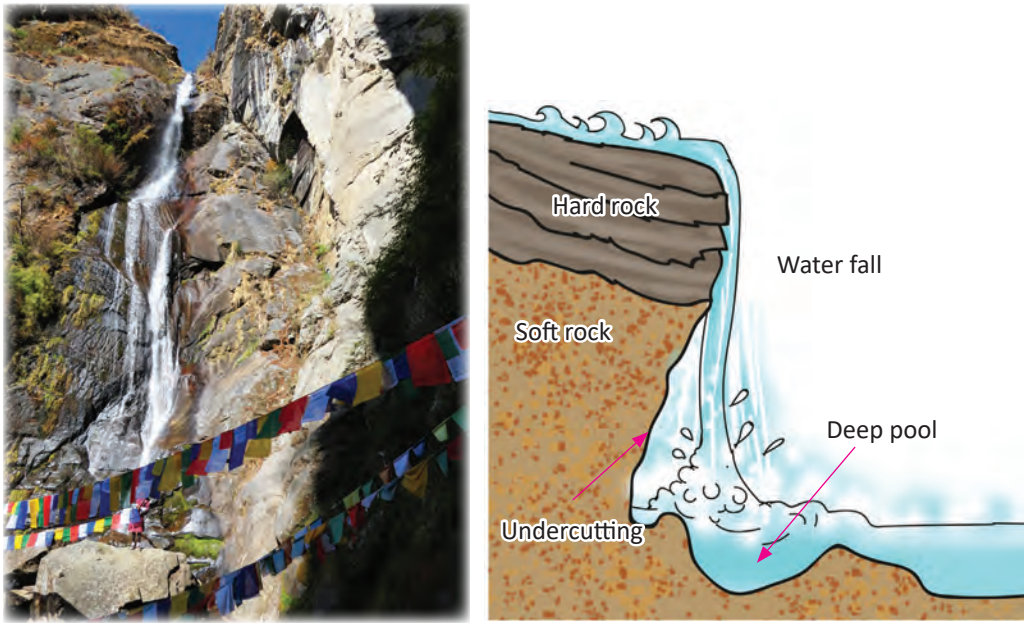

Figure 4.4 Waterfall

Figure 4.5 Interlocking Spur

ii) Middle or Mature stage

In this stage, the river flows through gentle slope. The volume of river increases with increase in number of tributaries. The speed of the river decreases due to decrease in slope. River erodes side wards and it is called lateral erosion. Transportation is the main work while some deposition also takes place. The main land features formed in this stage are alluvial fans, broad valleys and meanders.

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Figure 4.6 Alluvial fan

Figure 4.7 Broad Valleys

iii) Lower or Old stage

In this stage the speed of the river decreases mainly due to low gradient. The volume of water also increases. The main work in this stage is deposition. Some of the features are meanders, oxbow lakes, flood plains and natural levees.

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Figure 4.8 Meander

Figure 4.9 Oxbow lake

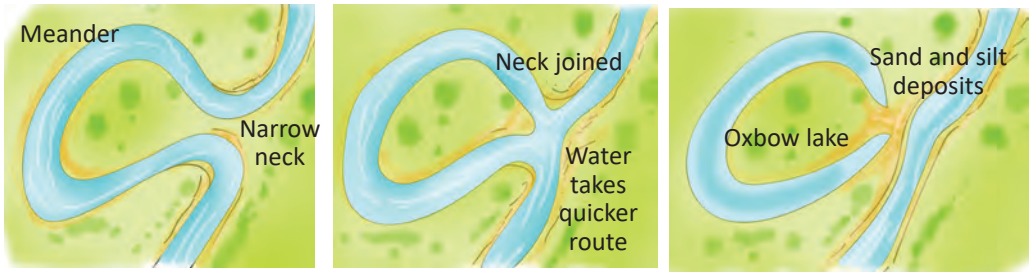

Figure 4.10 Oxbow lake formation

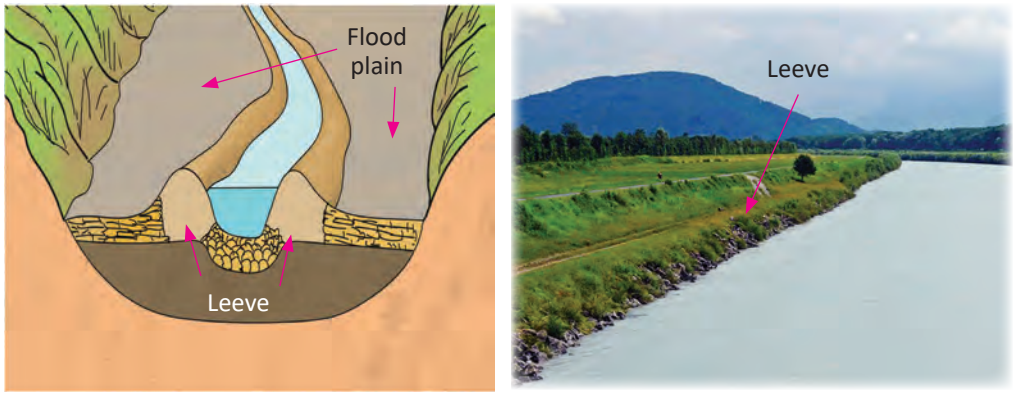

Figure 4.11 Levee

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Learning Activity

Draw a cross-section profile of contours by referring Figure 4.12.

1. Which stage of river is common in Bhutan? Give reasons to support your answer.
2. Study the diagram and complete the activity.

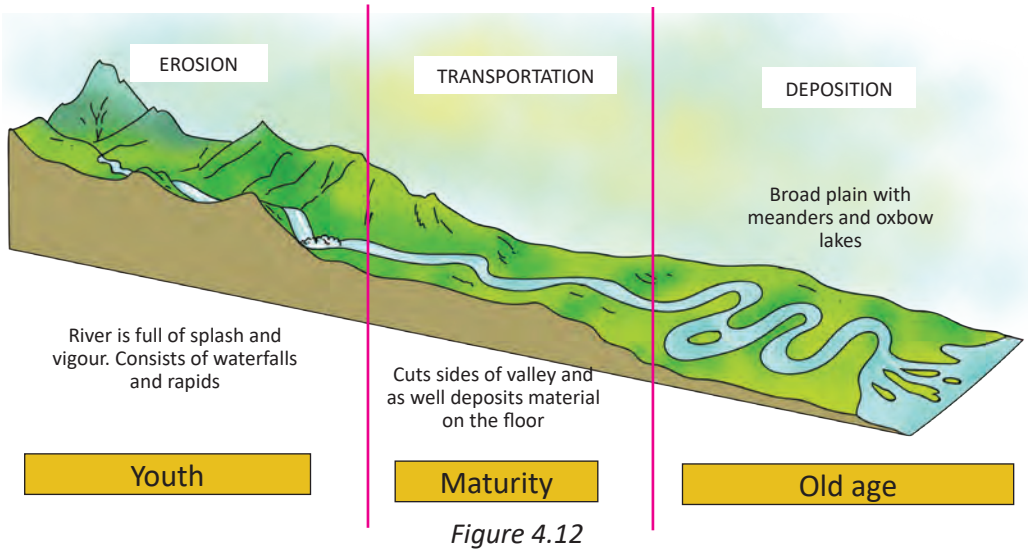

Figure 4.12

	Youthful stage	Maturity stage	Old stage
Volume of water			
Gradient			
Velocity			
Landforms			
Work of the river			

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Test Yourself

1. Describe the characteristics of rivers at a youthful, mature and old stages.
2. Explain the work of a river at mature stage.
3. Why is river in the lower course also known as old stage?
4. Find the landforms from the word puzzle.

A	L	L	U	V	I	A	L	F	A	N
D	P	E	A	S	D	F	G	H	N	K
R	K	G	V	O	G	D	X	I	C	G
H	W	A	T	E	R	F	A	L	L	D
M	E	F	V	H	E	L	X	L	D	B
L	W	A	Z	X	P	X	F	U	I	H
B	R	O	A	D	V	A	L	L	E	Y
S	A	T	O	Q	E	F	A	G	V	B
Z	X	O	U	I	F	D	R	Z	X	C
C	L	P	J	V	M	O	A	S	D	F
F	V	G	J	Q	G	Q	W	E	R	T

5. Frequent flooding of river is common in the lower foothills of Bhutan. Do you agree? Justify.

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CHAPTER

5

Earthquake and Volcano

Learning Objectives

- Discuss earthquake and volcano
- Describe the effects of earthquake and volcano
- Explain the stages of volcano

Introduction

The landforms on the Earth surface are continuously changing under the influence of internal and external forces. The forces generated in the interior of the Earth are known as internal forces. The internal forces cause vertical and horizontal movements of the Earth's crust. These movements are responsible for formation of relief features. The internal forces also cause earthquake and volcano.

5.1 Earthquake

An earthquake is a tremor or vibration caused by sudden movement of a part of the Earth's crust. The tremor originates at a point called **focus** which lie on the line of weakness in the crust. It produces vibration or tremors called **seismic waves**. These waves spread in all directions like a series of concentric waves. This cause the part of land surface to rattle and tremble. The strength of vibration depends upon the intensity of earthquake and the distance from its **epicenter**, point on the Earth's surface vertically above the focus.

The intensity of earthquake is measured by an instrument called **Seismograph** or **Seismometer** at the epicentre. Earthquake is measured by an instrument called Seismograph or Seismometer on Richter scale.

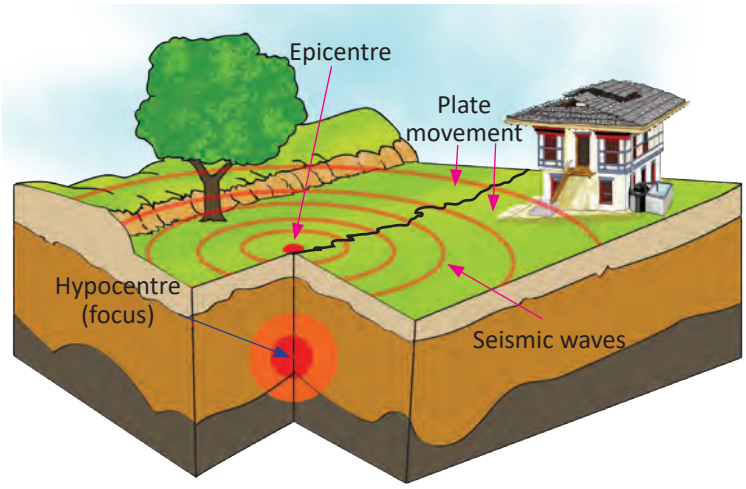

Figure 5.1 Features of Earthquake

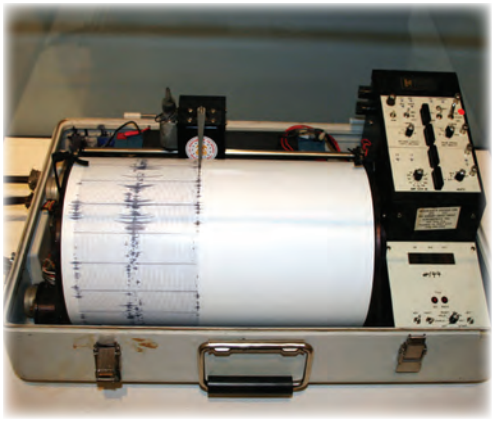

Figure 5.2 Seismograph

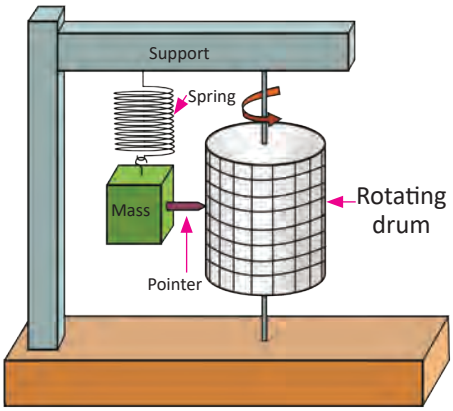

Figure 5.3 Seismometer

5.2 Causes of Earthquake

Earthquake is a result of many factors such as faulting and folding, volcanic activity, gaseous expansion and contraction inside the Earth. Human activities like deep underground mining and blasting of rocks by dynamite and nuclear explosion also cause earthquake.

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5.3 Effects of Earthquake

Earthquake can be mild or severe depending upon the magnitude. Severe earthquake causes damage to lives and properties like buildings, bridges, roads and other structures. Earthquake also causes disasters like landslides, floods, tsunamis and fire.

Figure 5.4 Effects of earthquake

5.4 Earthquake in Bhutan

Bhutan is located in the young fold Himalayan Mountains. It lies in one of the active seismic zones in the world and experiences numerous earthquakes. Bhutan

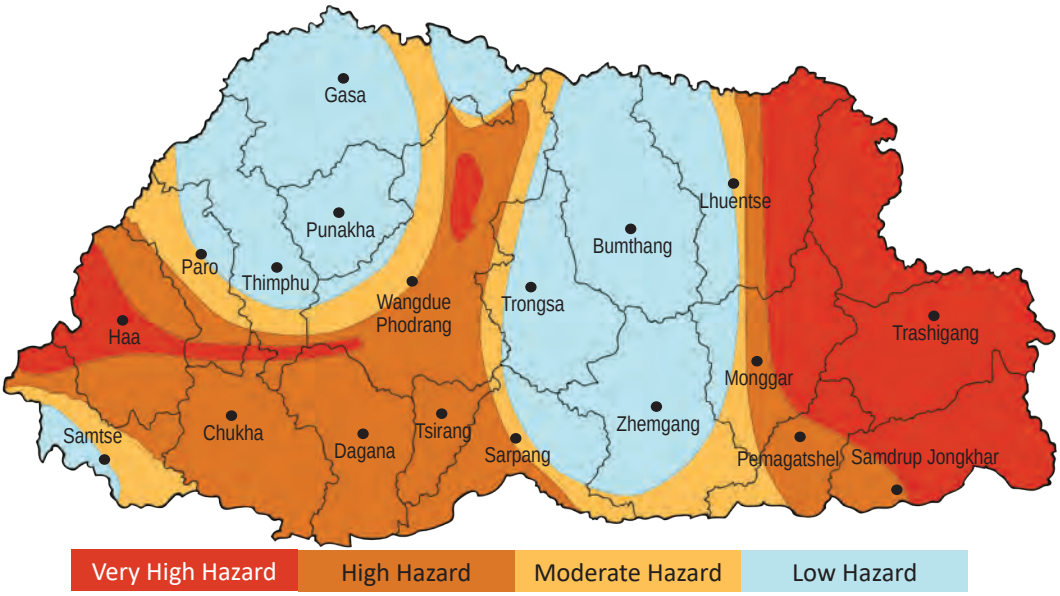

Figure 5.5 Seismic Zone of Bhutan

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Figure 5.6 Effects of Earthquake in Bhutan

experienced a severe earthquake of 6.75 magnitude on 21st January 1941.

Earthquake of 2009 (6.1 magnitude) and 2011 (6.9 magnitude) were some other examples of severe earthquake that caused destruction in Bhutan in recent years. Bhutan is categorised into different seismic zones. Thimphu, Paro, Punakha, Bumthang and Trongsa valleys fall in low and moderate hazard areas. Haa, Chukha, Trashigang, Mongar, Lhuentse, Trashiyangtse valleys and the southern dzongkhags are in high and very high risk areas.

Learning Activity *Arrange the following in order of occurrence.*

1. Tremors felt on surface.
2. Seismic waves generated.
3. Buildings collapse.
4. Dislocation in the Earth's crust.
5. Waves reaches to epicentre.

Discuss and present it to the class

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5.5 Volcano

Volcano is a vent through which magma and hot gases come out from the interior of the Earth. The movement of heated materials from the interior of the Earth towards the surface is known as **volcanism** or **volcanicity**.

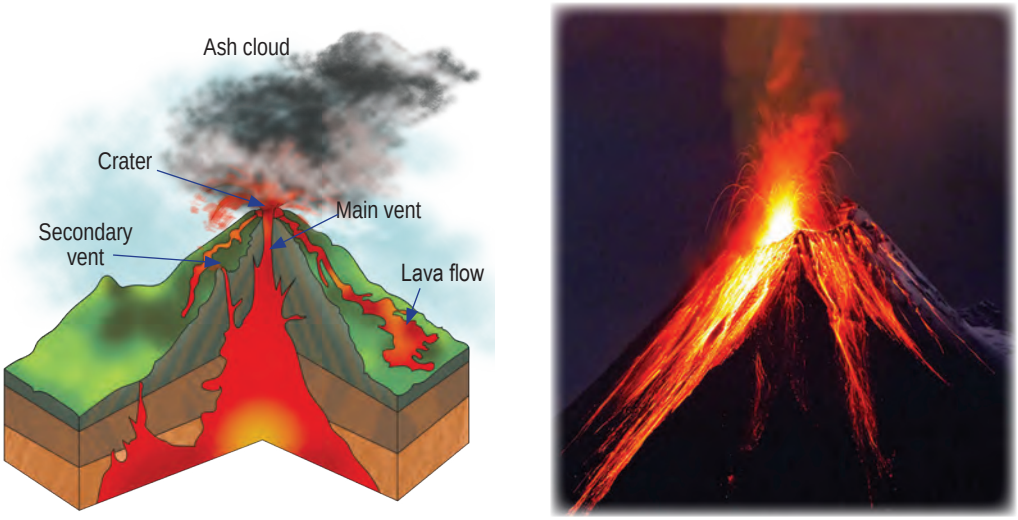

Figure 5.7 Features of Volcano

Learning Activity *Using internet or library resources.*

1. Explain the terms vent, cone and crater.
2. Discuss the advantages and disadvantages of volcanic eruption.

5.6 Stages of volcano

There are different stages of volcanoes based on periodicity of eruption. The stages are:

i) Active volcano

This type of volcano erupts frequently and emits gases and flames. There are around 1500 potentially active volcanoes in the world. Stromboli in Mediterranean is an example of active volcano.

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ii) Dormant volcano

Volcanoes that had erupted in the past and are now inactive but may become active any time. Vesuvius in Italy is an example.

iii) Extinct volcano

Extinct volcanoes are those volcanoes which are no longer active. Mountain Kilimanjaro in Tanzania is an example.

5.7 Causes of volcanic eruption

Movement of plates inside the Earth's crust creates cracks and fractures along the lines of faults and folds that forms weak points. The heat and pressure inside the Earth's interior forces magma through these weak points. Severe earthquake may also cause volcanic eruptions.

5.8. Effects of volcanic eruption

Volcanic eruptions are constructive as well as destructive in nature. It helps to understand the interior of the Earth. Many minerals from the interior of the Earth are brought up to the surface by volcanic eruptions. It helps in releasing the pressure build up in the interior of the Earth. Igneous rocks, parent of all other rocks are formed by volcanism. Lava is a source of fertile soil. Hot springs are generally found in volcanic regions.

Volcanic eruptions are also destructive to lives and properties. Hot lava flow destroys human settlement, agricultural land and vegetation and causes fires. It destroys marine life when it occurs under the sea. Many poisonous gases released during volcanic eruption causes environmental pollution.

Know More

1. Seismologist- person who study about the earthquakes and its related activity
2. Volcanology- the study of volcano and its related activity

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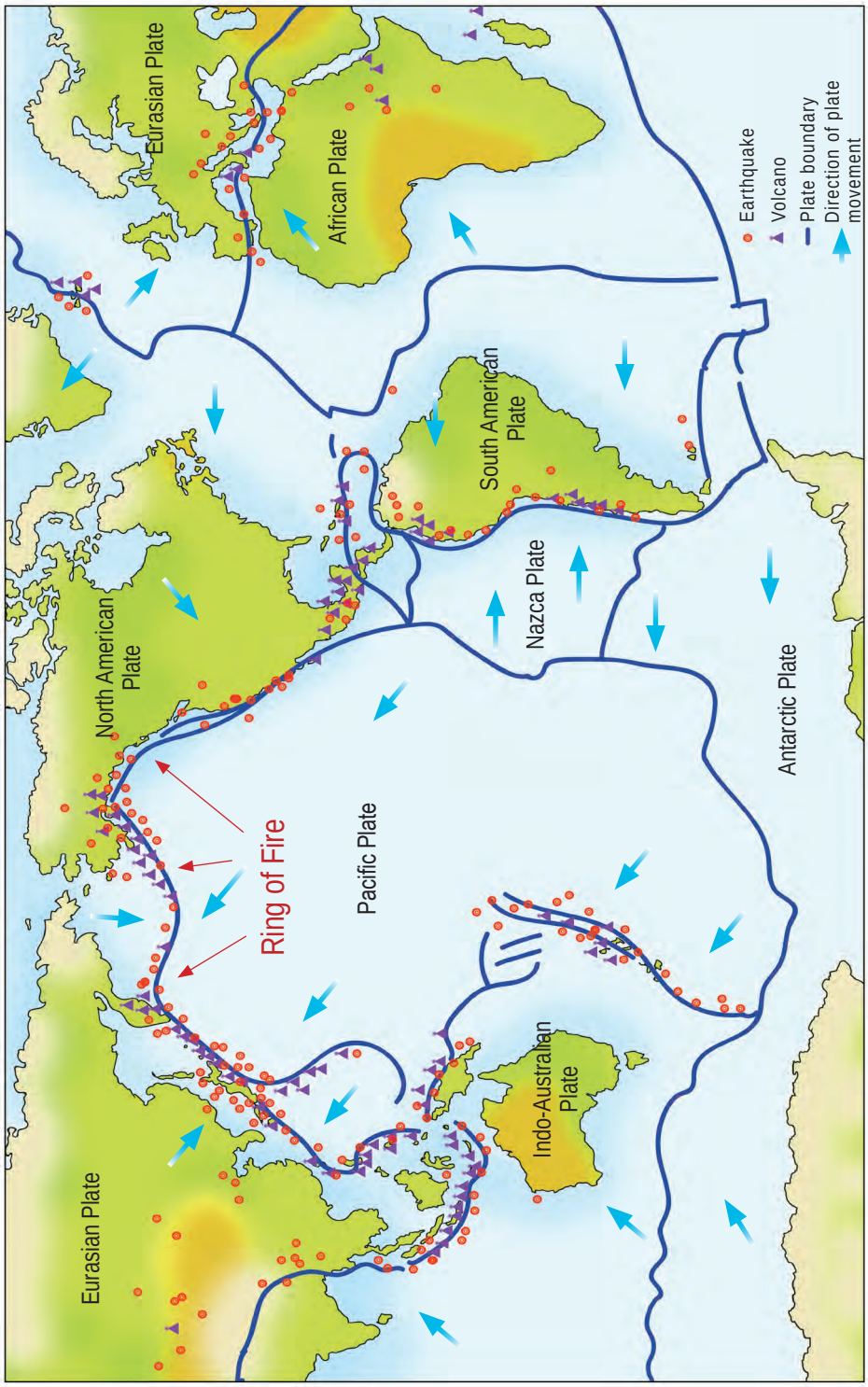

Figure 5.8 World map showing earthquakes and volcanoes

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Test Yourself

1. Explain the causes and effects of earthquake.
2. Frequent earthquakes occur in Bhutan. Discuss the reasons for its occurrence.
3. Discuss the following terms using internet or library resource.
   a) Epicenter
   b) Focus
   c) Seismic wave

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CHAPTER

6

The Atmosphere

Learning Objectives

- Describe the composition of the atmosphere
- Explain the significance of atmosphere

Introduction

The Earth is a unique planet as it supports life. It is the atmospheric condition that has made life possible on Earth. The density of atmosphere is less than land and water. It has the weight and exerts pressure. The atmosphere is mobile, elastic and can be compressed or expanded. It is composed of different elements.

6.1 Composition

The atmosphere is a mixture of different types of gases, water vapour and dust particles. The composition of the atmosphere changes according to structure, time and place.

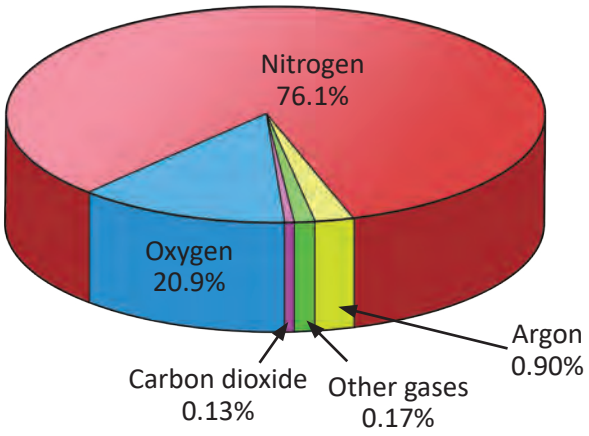

Figure 6.1 Composition of Atmosphere

i) Gases

The atmosphere is composed of different types of gases. Nitrogen and Oxygen are major gases and accounts for 99% of gases found in the atmosphere. Some other gases found in the atmosphere are carbon dioxide, hydrogen, ozone and inert gases.

Table 6.1 Composition of Atmosphere

Sl. No	Gas	Amount in %	Significance
1	Nitrogen	78.1%	controls the fire by neutralizing oxygen
2	Oxygen	20.9%	essential for respiration
3	Carbon dioxide	0.03%	used during photosynthesis
4	Hydrogen	0.01%	forms water when combined with oxygen
5	Inert gases	1.25%	lighting and food preservation
6	Ozone	0.000004%	filters ultraviolet rays

ii) Water vapour

Gaseous form of water present in the atmosphere is called water vapour and it condenses to form clouds and fog. Water vapour also helps to moderate the temperature of the Earth.

iii) Dust Particles

Dust particles are found in the form of sand, soot, and ashes. It helps to condense water vapour into droplets of water and causes precipitation. It also reflects sun rays and moderates the temperature.

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6.2 Significance of atmosphere

The presence of the atmosphere on the Earth makes life possible. It filters sun's dangerous rays from reaching the Earth. Atmosphere is also a medium for the movement of water without which the water would simply boil away into the space or remain frozen below the surface of the Earth. It maintains the temperature making a living comfortable. Different weather phenomena on the Earth are also caused by the presence of atmosphere which supports different forms of life.

Learning Activity *Answer the questions.*

1. Explore the significance of water vapour in the atmosphere and represent in a diagrammatic form.

2. Discuss human activities that contribute to the increase in carbon dioxide in the atmosphere.

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Test Yourself

1. The atmosphere is made up of a mixture of gases. Which of the following is a greenhouse gas?
   a) Oxygen
   b) Carbon dioxide
   c) Hydrogen
   d) Neon
2. Discuss advantages and disadvantages of dust particles in the air.
3. Describe the condition of life that would prevail on the Earth if there is no water vapour in the atmosphere.
4. Nitrogen and oxygen are equally important for all the living beings on the Earth. Do you agree? Justify your answer.

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CHAPTER

7

Weather and Climate

Learning Objectives

- Discuss the elements of climate
- Explain the factors affecting climate

Introduction

Climate is an average weather conditions of a region. It is the main factor that determines the natural environment. Rainfall, temperature, pressure and wind are important elements of weather and climate.

7.1 Elements of climate

i) Temperature

Temperature is the degree or intensity of heat. The sun is the primary source of heat for the Earth. Temperature is one of the elements that determines the type of weather and climate of a place. A place experiences warm or hot weather with rise in temperature, and cool or cold with fall in temperature.

ii) Pressure

The force exerted by atmosphere is known as atmospheric pressure. Pressure changes with altitude. Pressure increases with decrease in altitude, while it decreases with increase in altitude. The difference in air pressure leads to movement of air. High pressure is related to dry, stable and clear sky, whereas low pressure to unstable weather, rain and storm.

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iii) Wind

Wind is the horizontal movement of air. It blows from high pressure area to low pressure. It is caused by difference in air pressure. The speed of wind depends on difference in air pressure.

Wind blowing from warm places increases the temperature, while wind blowing from cold places lowers the temperature. Places that experience dry wind have dry climate, whereas places that experience moist wind have wet or humid type of climate. Wind blowing from the sea is moist and those blowing from the land is dry.

iv) Rainfall

Rainfall is the amount of rain that falls in a place during a particular period. Rainfall decreases with increase in altitude and distance from sea. It maintains atmospheric temperature. Rainfall is the most important form of precipitation.

Climate of a place is categorized into wet or dry based on the rainfall. The place that receives heavy rainfall experiences wet climate and place with less rain experiences dry or desert like climate.

Learning Activity *True or false statements.*

State whether the statements are true or false and correct the false statement.

Statement	True or False	Corrected statement
The type and intensity of weather is controlled by changes in temperature.		
Wind is moving air and is caused by difference in pressure in the atmosphere.		
Wind blows from low pressure to high pressure.		
Atmospheric pressure increases with increase in altitude.		
Rainfall maintains atmospheric temperature.		

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7.2 Factors affecting climate

The climate of any place is influenced by the interaction of factors such as:

i) Latitude

Climate of a place is generally determined by its latitude. The amount of heat received by the Earth's surface depends on the angle of sun rays. At the equator, sun's rays are vertical and the length of the day is longer and therefore it is hot. The climate becomes colder as one moves away from the equator towards the poles.

Bhutan is located to the north of Tropic of Cancer between 26° 7' N to 28° 4' N latitude. It does not receive vertical rays of the sun. Therefore, it experiences moderate climate.

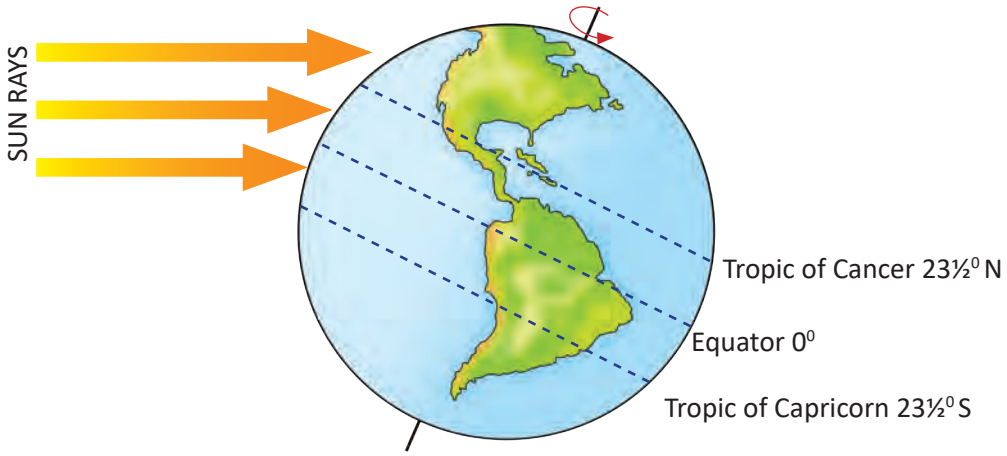

Figure 7.1 Angle of sun's ray

ii) Altitude

Altitude is height of a place above the mean sea level. The temperature of a place decreases with the increase in altitude, while it increases with decrease in altitude. Temperature decreases with increase in altitude at the rate of 1⁰C for every 165 meters of ascent. This is known as normal lapse rate. Places located at lower altitude like Samtse, Sarpang and Samdrup Jongkhar experience warmer climate whereas places at higher altitude like Gasa, Haa and Bumthang experience cold climate.

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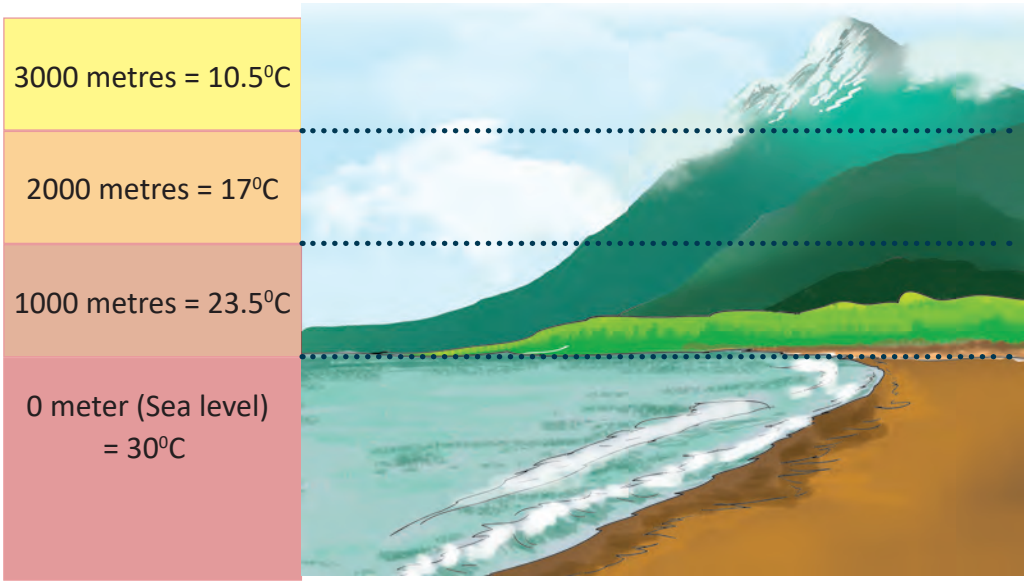

Figure 7.2 Altitude showing decrease of temperature

iii) Seasonal winds

Wind that changes directions with change in season is seasonal wind. Bhutan experiences two seasonal winds.

Know More

1. The word monsoon has been derived from the Arabic word "Mausim" which means season.
2. Atmospheric pressure on Earth is 1.03 kg per square cm.
3. Precipitation occurs in the form of rain, hailstone, snow and sleet.

a) Summer monsoon wind

The moist wind which blows from South West (SW) to North East (NE) direction during summer is known as summer monsoon. During summer, land mass of Asia gets heated intensely and low pressure develops over the land. On the other hand, the Indian Ocean remains relatively cold during this period developing high pressure. The moisture laden winds blow from the Indian Ocean into Asia bringing a lot of rain. Thus, Bhutan receives rainfall and experiences wet climate during summer.

b) Winter monsoon wind.

The dry wind which blows from north east to south west is known as winter monsoon wind. During winter, the land mass of Asia cools down rapidly developing high pressure over it. The Indian Ocean on the other hand remains comparatively warm with a low pressure over it. As a result, the winds blow from the land to sea. That is why Bhutan remains dry and cold during winter.

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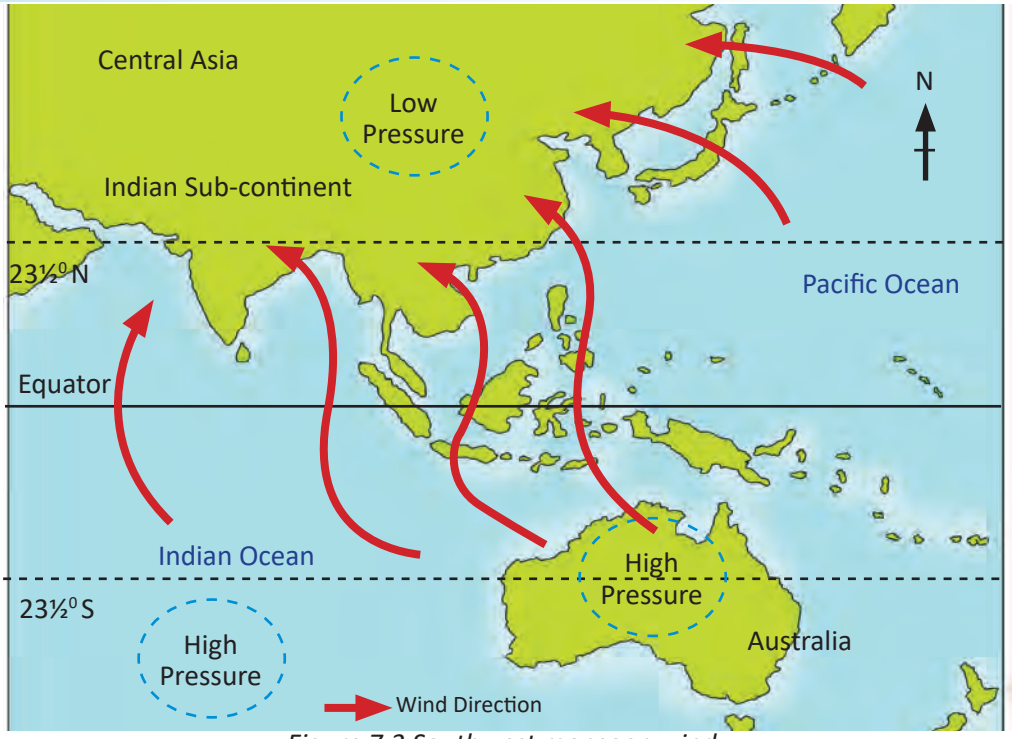

Figure 7.3 Southwest monsoon wind

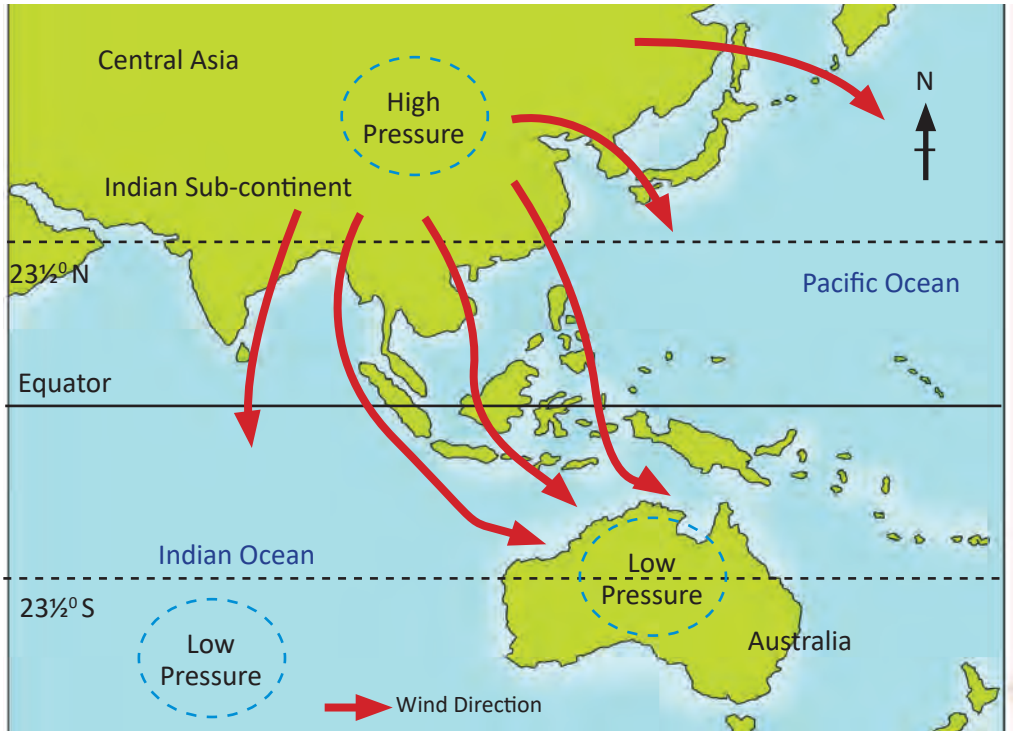

Figure 7.4 Northwest monsoon wind

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c) Direction of Mountain ranges

The Himalayan Mountain range lies west to east and the slopes of the mountain face either north or south. The north facing slopes, receive less heat from the sun. As a result, in some places snow and ice do not melt and remain cold. South facing slopes receive more heat and remain warm. The Himalayan Mountain range protects Bhutan from cold dry winds blowing from the Tibetan Plateau during winter.

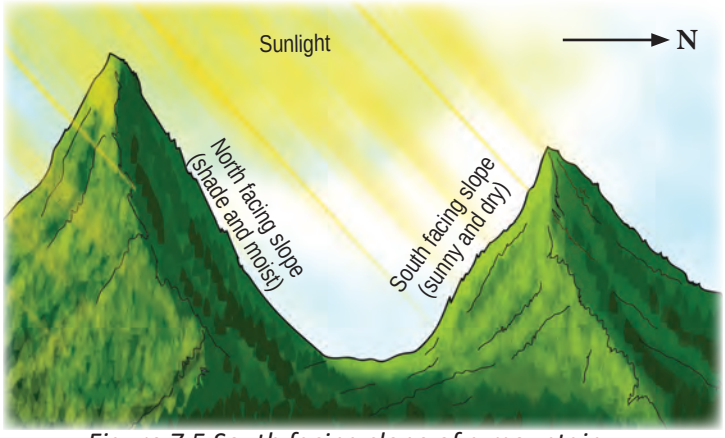

Figure 7.5 South facing slope of a mountain

Learning Activity *Complete the activity.*

Which climatic factors affect the climate of your local area? Prepare a power point presentation or design a poster and share it to the class.

Test Yourself

1. Explain the effects of wind on temperature of a place.
2. Atmospheric pressure on the surface is 1.03 kg per square cm but we do not feel it. Why?
3. Monsoon plays an important role. What would happen if there is no monsoon?
4. Explain the factors affecting the climate of Bhutan.
5. What type of climate would prevail in Bhutan, if there were no Himalayas?

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CHAPTER

8

Soil

Learning Objectives

- Describe basic soil properties
- Explain the soil forming factors
- Classify soil types

Introduction

Soil is an important gift of nature that supports life on Earth. It is a mixture of weathered rock particles, decaying organic matter, living organisms, mineral salts, air and water. It is found in the upper most part of the Earth's crust.

8.1 Soil profile

Soil profile is a vertical cross section of soil showing different layers. A well-developed soil profile has three main layers. Each layer is differentiated from other by its colour and the size of particles.

i) Top soil

The upper layer of soil profile is called a top soil. It consists of fine particles and humus. The decayed remains of plants and animals is known as humus. Top soil provides best environment for the growth of plants and other lives. This layer is also known as A-horizon.

ii) Sub soil

Sub soil lies below the top soil. It is a mixture of small particles of sand, silt and clay. This layer has low percentage of organic matter and humus. This layer is also known as B-horizon.

iii) Weathered rocks

The layer below the sub soil is weathered rocks. It does not contain any humus. It serves as parent material for the soil. This layer is also known as C-horizon.

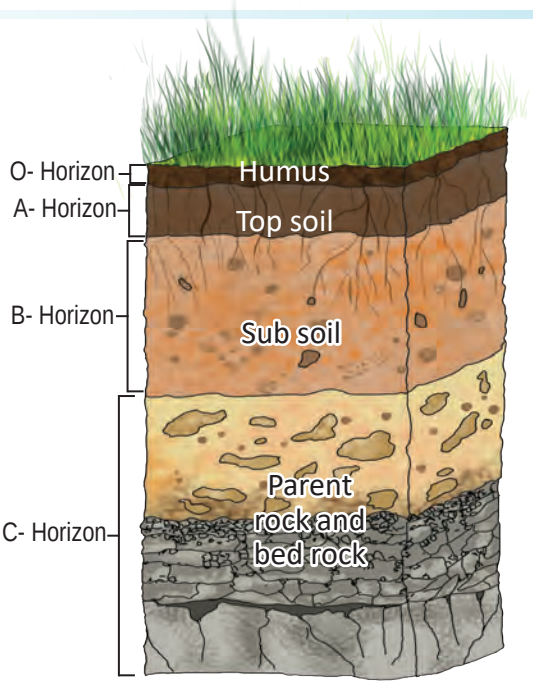

Figure 8.1 Soil Profile

8.2 Properties of soil

Soils contain mineral particles, organic matter, water and air. The combination of these determines the soil properties like colour, texture, structure and chemical composition.

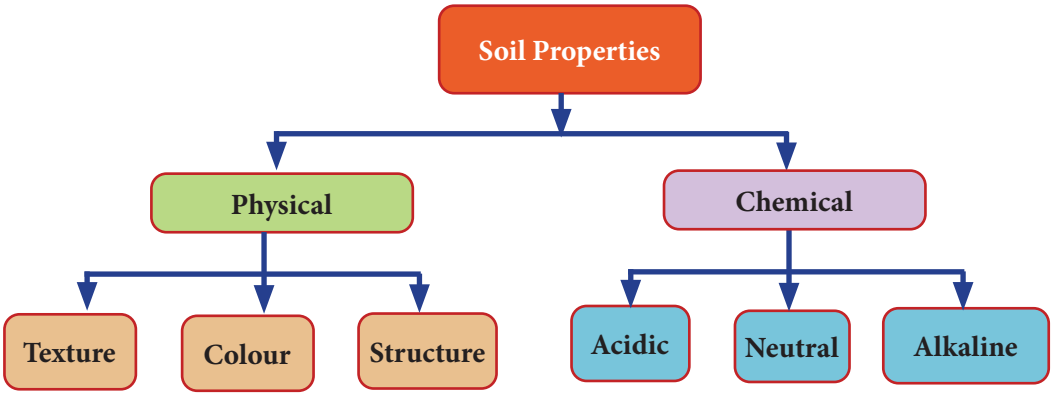

Figure 8.2 Properties of Soil

i) Physical properties

The physical properties of soil are dominant factors affecting the use of soil. Physical properties of soil include:

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a) Texture

It refers to size of particles that make soil. Size of the soil varies from fine silt to the coarse grain. Depending on texture, soil can be classified into clay, clay loam, loam and silt.

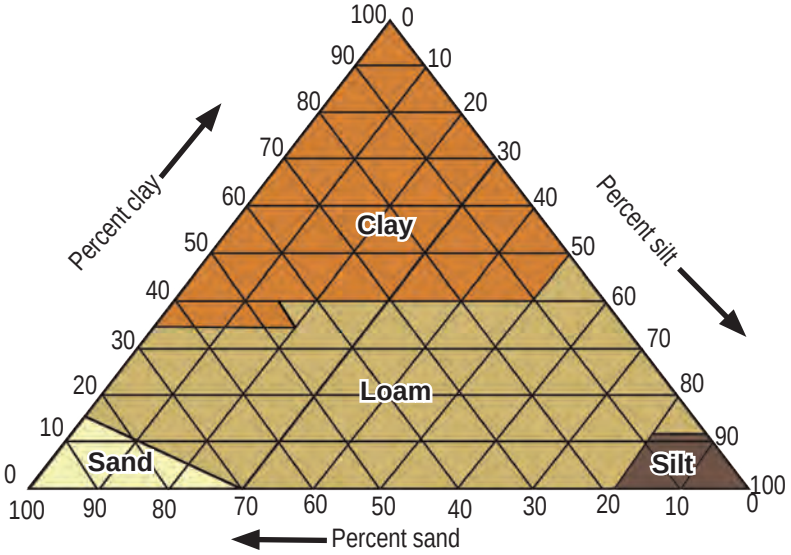

Figure 8.3 Soil Texture

b) Structure

Structure of soil refers to arrangement of particles called grains within the mass. It influences the movement of water and air inside the soil.

c) Colour

The colour of the soil depends on the mineral and organic content. The soil is reddish if it contains iron while it is black if it contains humus.

Figure 8.4 Soil Colour

ii) Chemical properties

Chemical properties of the soil are determined by measuring acidity and alkalinity. It is measured in pH scale. Acidity is determined by the concentration of hydrogen ions. Soil with more hydrogen ions is considered **acidic**, whereas soil with more base (calcium, magnesium, potassium and sodium) is considered **alkaline**. Soil which is neither acidic nor alkaline is considered **neutral**.

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Know More

1. Base is a chemical that dissolves in water and combines with an acid to create salt or chemical substances.
2. pH stands for potential of hydrogen.
3. A pH value below 7 is acidic while above 7 is alkaline.
4. Neutral soil has a pH value of 7 which is best for plant growth.

8.3 Factors affecting soil formation

Soil is formed from the interaction of five main factors. These factors are:

i) Parent material

The underlying bed rock is the parent material of soil. The type of bed rock determines type of soil. A sandy bed rock will form coarse sandy soil, while a shale bed rock will result in fine textured soil.

ii) Time

Formation of a soil is a continuous process that takes many years. The development of a soil in an area depends on the length of time. Fine soils take longer time to develop while coarse soil takes shorter time to develop.

iii) Climate

Temperature and precipitation are two important elements that influence soil formation. Soil formation is fast and is well developed in hot and wet region. In cold and dry region, soil formation is slow and is not well developed.

iv) Topography

The formation of soil on a steep slope is thin and less fertile due to high runoff and erosion. Deep and fertile soil is formed in low land due to more deposits, less runoff and erosion.

v) Living Organisms

The remains of dead plants and animals form humus that helps in the formation of fertile soil. The roots of the plant help in soil formation by breaking down the rocks. Burrowing animals help in loosening and mixing of soil.

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8.4 Types of Soil

Soils are classified into different types based on texture. These are:

i) Sandy soil

Sandy soil is coarse and loose. It does not support growth of plants because it does not hold water and nutrients. It is usually formed from the breaking of bedrock such as limestone, granite and quartz.

ii) Silt

Silt is light and moisture retentive soil with a high fertility. It is composed of silt, sand and clay with more silt particles. Silt particles are smaller than sand and larger than clay.

iii) Clay

It is very fine particles of soil. There is very little space between the fine grains for air or water to pass through. Soil becomes sticky when it is wet and cracks when it is dry. As a result, most plants do not grow well in clay soil.

iv) Loamy soil

Loamy soil is a mixture of sand, clay and silt. It absorbs and retains moisture; hence it is good for cultivation. Based on the percentage of silt, sand, and clay content, it is further classified into silt loam, sandy loam, and clay loam.

(a) Sandy soil

(b) Silt

(c) Clay

(d) Loamy soil

Figure 8.5 Types of soil

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Learning Activity

Observe the soil in your locality.

1. Identify the types of soil found and discuss the characteristics.
2. Make a soil profile model in an empty glass jar or plastic bottle using following materials:
   a) Humus
   b) Pebbles
   c) Sand
   d) Clay
   e) Stones
   f) Mud

Know More

1. Bed rock is a hard unweathered rock
2. Burrowing animals are those animals that burrow or dig hole in the ground like rabbits and rats.

Test Yourself

1. Which type of soil is best for cultivation and why?
2. Why is soil in the low lying areas generally fertile than the soil in the mountain slopes?
3. Bhutan being a mountainous country experiences landslides and erosion frequently that degrades the soil. Suggest ways to conserve it.
4. Imagine yourself as a farmer owning land which is infertile. How would you convert it into a fertile farmland?
5. Plants do not grow well in clay soil. Justify.
6. Which of the soil forming factors have more influence in soil formation? Give reasons.

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CHAPTER

9

Natural Vegetation

Learning Objectives

- Describe the types of vegetation
- Explain the sub-types of vegetation

Introduction

The World is divided into different natural regions based on geographical location and climate. The regions are distinguished by diversity of plants and animals which forms natural vegetation. These regions have unique characteristics like temperature and rainfall that helps in sustaining different habitats.

9.1 Types of Natural Vegetation

There are four major types of natural vegetation. These are Forest, Grassland, Desert and Tundra.

i) Forest vegetation

Forest refers to a large area covered with trees and undergrowth like shrubs and bushes. It is classified based on distance from equator, altitude and climate. Forest vegetation is found in most parts of the world extending from rain forest in the Equator to coniferous forest near Arctic region. Tropical Rain forest, Temperate Deciduous and Coniferous are major types of forest vegetation.

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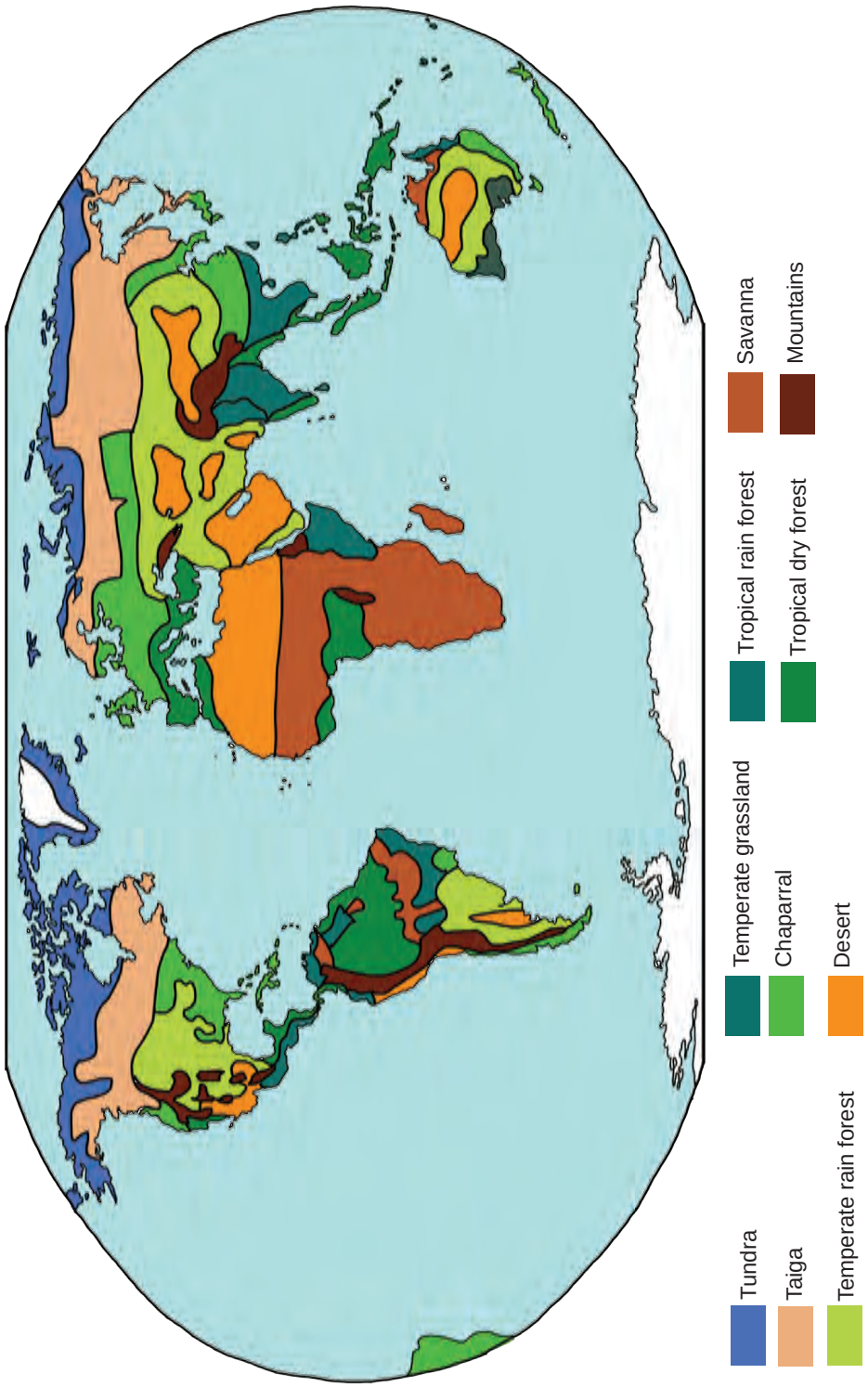

Figure 9.1 World Natural Vegetation

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a) Tropical rainforest

It is found in the equatorial region. This region is hot and wet with average temperature of 25^0C throughout the year. The trees are evergreen, hardwood and forms canopy with thick undergrowth.

Figure 9.2 Tropical rainforest

b) Temperate deciduous forests

This forest is characterized by moderate climatic condition. Such type of forest are found in eastern North America, north-eastern Asia and western and eastern Europe. Forest in this region is a mixture of deciduous and coniferous evergreen trees.

Figure 9.3 Temperate deciduous forest

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c) Coniferous forest

Coniferous forest is found in North America, Europe and Asia in the northern hemisphere and in New Zealand and Chile in southern hemisphere. The average summer temperature is 10^0C with 300 to 900 millimetre of rain in a year.

Figure 9.4 Coniferous forest

ii) Grassland vegetation

Grassland is a large open area where dominant vegetation is grass. Climate plays vital roles in determining types of grasslands. It is found in mid-latitudes mostly

Figure 9.5 Tropical grassland

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in the interior part of the continents. Tropical and Temperate are two types of grasslands.

a) Tropical grassland

Tropical grassland has tall and thorny grasses with scattered deciduous trees. It covers half of Africa and South America. Average temperature ranges from 20^0C to 30^0C in a year.

b) Temperate grassland

Temperate grass land has short, soft, juicy and nutritious grass. It is located in north of Tropic of Cancer and south of Tropic of Capricorn. It is a vast stretch of treeless plain. Commercial farming and ranching is practiced here. Bison is dominant grazing animal and prairie dog is a dominant rodent.

Table 9.1 Different names of Grasslands

Grassland	Region
Savannah	Central Africa
Ilanos/Campos	South America
Prairies	North America
Steppes	Russia
Downs	Australia
Veld	South Africa
Pampas	South America

Figure 9.6 Temperate grassland

iii) Desert vegetation

Desert is a large dry area covered with sandy and rocky soil. It has very high temperature during day and very low during night. It receives little or no rainfall. Vegetation is characterized by thorny plants with thick stems, long roots and wax coated leaves.

a) Tropical Desert

Tropical Desert lies between 20^0 to 30^0 North and South latitude. Most of these deserts lie on the western side of continents. It is the driest and hottest place on Earth. Sahara desert is an example of Tropical desert.

Figure 9.7 Tropical desert

b) Temperate Desert

Temperate desert is located in the interior of continent. It is distinguished by extreme seasonal change. It receives low rainfall and mostly in winter. Temperature ranges from 0^0C in winter to 25^0C in summer. Gobi (desert in Mongolia) is an example of Temperate Desert.

Figure 9.8 Temperate desert

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Learning Activity *Using Atlas, answer the questions.*

1. Locate and shade the deserts of the on an outline map of the world.
2. Why the natural vegetation of the world is undergoing various changes?

iv) Tundra vegetation

Tundra vegetation consists of shrubs, grasses, mosses and lichen. Tall trees are absent due to cold temperature and short growing seasons. It is extremely cold in winter with temperatures below -34^0 C. The summer last only for about two months. There are two types of tundra vegetation.

Know More

1. Sahara desert is the largest hot desert.
2. Antarctica is the coldest desert.
3. Venus flytrap is an insect eating plant of Tropical Rain Forest
4. Grassland consist ¼ of total land area of the world.

a) Alpine tundra

Alpine tundra is mostly found in rocky mountain tops throughout the world above tree line. Some of the places are Rocky Mountain, Alps, Himalayas and Tibetan plateau. Weather conditions in this region are cold, snowy and windy.

Figure 9.9 Alpine Tundra

Figure 9.10 Arctic Tundra

b) Arctic tundra

Arctic tundra is characterized by barren land and remains covered under snow most of the time. Caribou and polar bear are common animals found in this region. Russia, Alaska and Canada consist of huge area of Arctic tundra.

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Test Yourself

1. Imagine you are given an offer to travel around the world. Which natural vegetation zone would you choose to explore. Why?

2. Describe the characteristics of Tropical Rain forest referring to Figure 9.11.

3. 'Human activities are increasing with economic development'. How is this affecting the natural vegetation around the world?

Figure 9.11

4. How is Temperate Grassland different from Tropical Grassland?

5. Match the following

Column A	Column B
Forest	
Desert	
Grassland	
Tundra	
	

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CHAPTER

10

Population Change

Learning Objectives

- Explain the causes of change in population
- Discuss the importance of addressing population change

Introduction

Population refers to the total number of men, women and children living in a particular place for a particular period of time. The composition and structure of a population provide information such as number of people in different age groups, sex ratio and socio-economic characteristics of population.

Population is unevenly distributed and also changes over time. Birth rate, death rate and migration determine the change in population. A population of a place or a country may increase or decrease. Population planning addresses the various impacts of population change.

10.1 Population Composition

Population composition describes sex ratio, age group and economic characteristics. Sex ratio is the number of males per 100 females. The factors influencing sex ratio are mortality and migration.

The population of Bhutan as per the Population and Housing Census of Bhutan (PHCB) 2017 was 735,553 persons. The sex ratio of the resident population was 110 males per 100 females.

10.2 Population Structure

The population structure is the number of males and females in different age groups. The population structure is understood by studying population pyramid. Population in the age group of 15-59 years are considered as productive working population, while population below 15 years and above 60 years are considered as dependents.

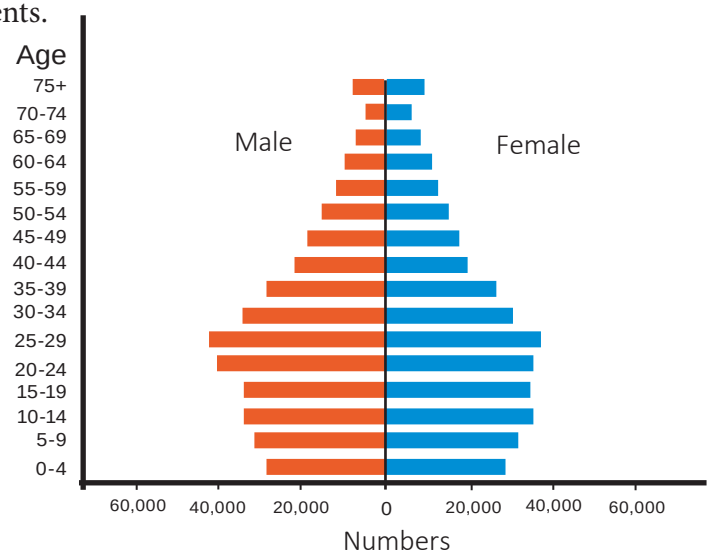

Figure 10.1 Age Sex Structure of Bhutan (PHCB,2017)

10.3 Population Change

The change in a number of people in a particular area during a specific period of time is called Population Change. Birth and death rates are the important factors of population change. It is also caused by migration of people. The change will result in increase or decrease in population. Population change is measured in absolute numbers and also in percentage.

10.4 Factors of Population Change

i) Birth rate

Birth rate refers to number of live births per 1000 population in a year. Increase in birth rate leads to increase in population while decrease in birth rate results in decrease in population, other factors remaining same. Some factors that determine birth rate are health, education and marriage.

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ii) Death Rate

Death rate is the number of deaths per 1000 population in a year. The population increases when death rate is lower than birth rate and decreases when death rate is higher than birth rate.

The death rate in the world has decreased due to improved health and educational facilities, increase in income, improved living standard and better nutrition. This has led to increase in the world population.

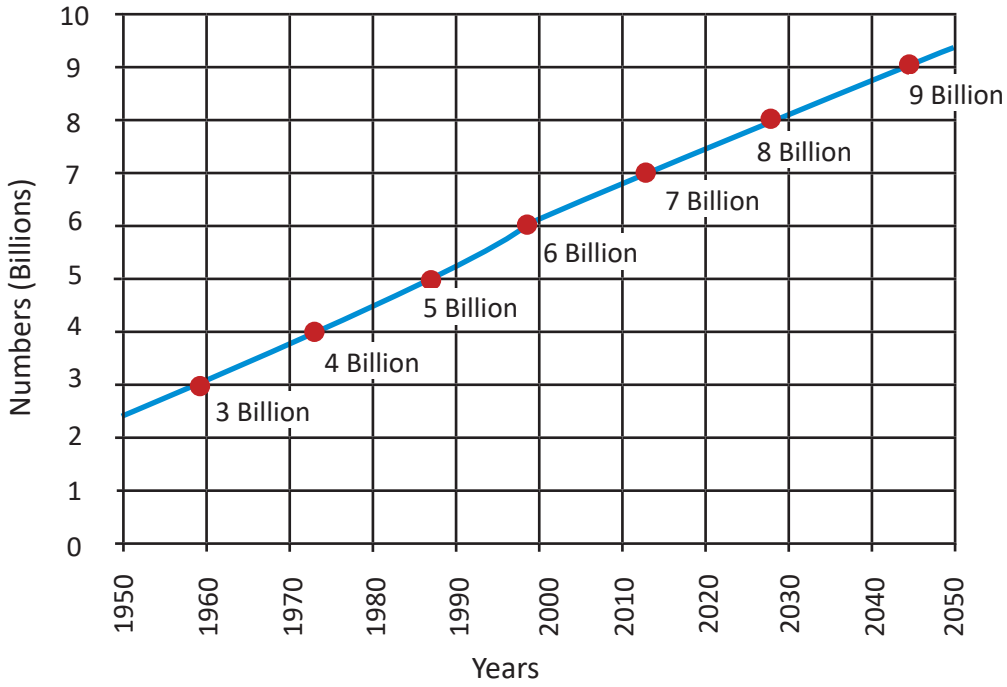

Figure 10.2 World Population 1950-2050 (Source: U.S. Census Bureau)

iii) Migration

Migration is the movement of people from one place to another. Migration takes place with an intention to settle temporarily or permanently in a new location. People migrate mainly in search of better opportunities. The population of a place changes due to out-migration and in-migration. Out-migration is movement of people out of a place, whereas in-migration is the movement of people into a place.

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The population of a destination increases due to in-migration and decreases in the place of origin as a result of out-migration. Population increases when there are more in-migrants and higher birth rate. More out-migrants and higher death rates leads to decrease in population.

Population Change = (*Birth Rate* + *In-migration*) - (*Death Rate* + *Out-migration*)

Learning Activity *Study the diagram and answer the questions.*

Discuss the consequences of the migration in places A and B and present it to the class using PowerPoint presentation/chart.

Figure 10.3 Migration

1. What happens to place A?
2. What will happen to place B?

10.5 Impacts of Population Change

Population changes overtime and the need of people is also increasing. This results in high consumption of natural resources which are limited in nature. The increasing consumption leads to depletion of resources and adversely affect the environment. This effect on the environment is making resources scarce and causing hazards and disasters.

An increase in number of people exerts pressure on natural resources. The forests are cleared for the economic activities and agriculture. The non-renewable resources are consumed in large quantity. Waste disposal has become a problem with increasing generation of waste.

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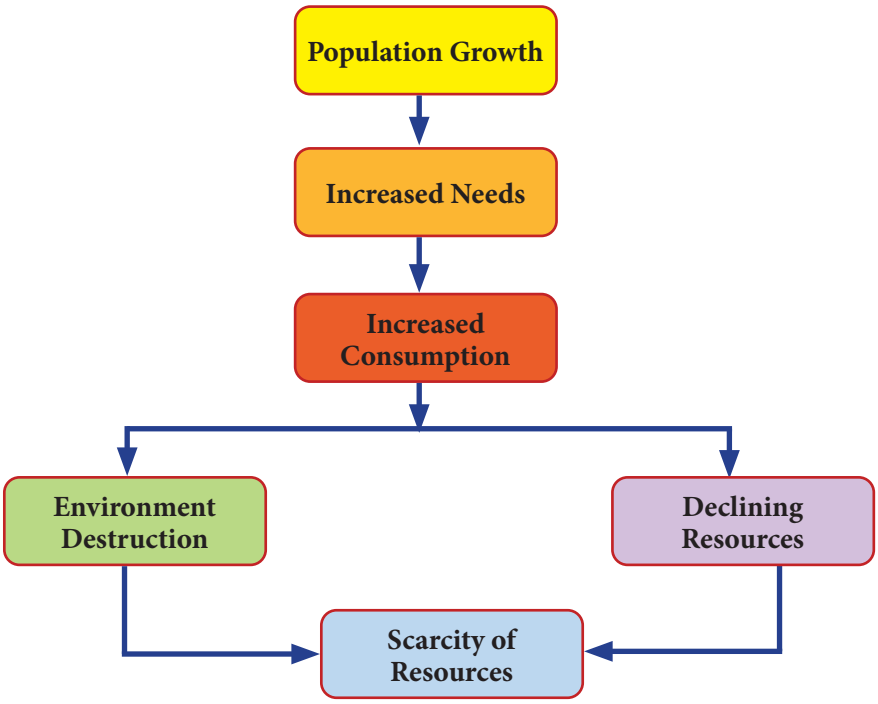

Figure 10.4 Impacts of Population growth

Learning Activity *Answer the questions.*

In 2018, it is reported that the population in Japan was shrinking and that there are more adult diapers than baby diapers in Japanese super markets.

Using internet, investigate the situation and make a report in Microsoft word. Consider the following question in your report.

1. What is the cause of the situation?
2. Do you think the above situation will have impact in population change? Explain.
3. What measures can be taken to address the situation?
4. How do you relate this situation to Bhutanese population and what must be done to avoid similar problem in Bhutan?

The best report will be presented to the whole class in MS power point

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10.6 Population Planning

Population planning is the practice of managing the rate of growth of human population. Population planning includes providing family planning services, educational and medical facilities. It maintains better health and education, living standard and wellbeing of the people.

The increase in population exerts pressure on resources. It is important to balance the population with the available resources. Therefore, population planning is

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Test Yourself

necessary to maintain this balance.

1. Fill in the blanks.
   a) Population change is affected by death rate, _____ and _____.
   b) The population of a country increases when_____ higher than _____.
   c) The increasing population is seen as a problem as it causes more pressure on _____.
   d) The change of population in a country can be understood and explained by looking at the _____of population.
   e) A population _____ shows the total population divided into various age groups.

Figure 10.5

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2. What conclusion can you draw from Figure 10.5 in relation to population and resources?

3. With the help of population pyramid, complete the activity.

Category of population	Age range
Young dependent population	a.....
Economically active population	b.....
Elderly dependent population	c.....

4. A large number of youth prefer to work in urban areas and this increases the number of out-migrants from rural areas. What are some of its impacts?

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CHAPTER

11

Settlement

Learning Objectives

- Classify patterns of settlement
- Illustrate patterns of settlement with examples

Introduction

Settlement is a place where people live. It is characterised by a dwelling consisting of a single or a group of houses. In a settlement, people live a systematic life usually sharing a common occupation, language, religion and culture.

Settlements are broadly classified as rural and urban. Rural settlements are generally found in villages or remote areas of a country, while the towns and cities are considered as urban settlements. Rural settlement is further distinguished based on the pattern like clustered, dispersed, linear, terraced, circular and amorphous patterns.

11.1 Classification of Settlements

Settlements are classified as rural and urban based on occupation and functions.

i) Rural settlement

People living in rural areas are engaged in primary activities like agriculture, livestock rearing, fishing, and mining. Agriculture is the most dominant

activity. People in rural settlements are engaged in gathering forest products and logging activities. Rural settlements also function as administrative centres. A majority of Bhutan's population live in rural settlements.

Figure 11.1(a) Rural Settlement

Figure 11.1(b) Urban Settlement

ii) Urban Settlement

Urban settlement is characterised by network of roads within clusters of buildings. It is generally large and densely populated. Urban settlement is distinguished from rural settlement based on occupation. In urban settlement most of the people are engaged in activities like manufacturing, commerce, trade, transport and banking. Urban settlements have better facilities compared to rural settlements

Learning Activity *Answer the questions.*

Discuss the differences between rural and urban settlement. Show the differences with the help of sketches.

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11.2 Patterns of Rural Settlements

Rural settlements are generally a small group of houses. Some patterns of rural settlement are:

i) Clustered Pattern

In clustered pattern of settlement, houses are close to each other. Generally, in this pattern of settlement the houses are surrounded by agricultural land. The factors responsible for causing this pattern of settlement are availability of facilities like school and health care, fertile soil and security. Limited land for construction of houses in other areas and extreme weather condition in high altitude regions may result in this pattern of settlement.

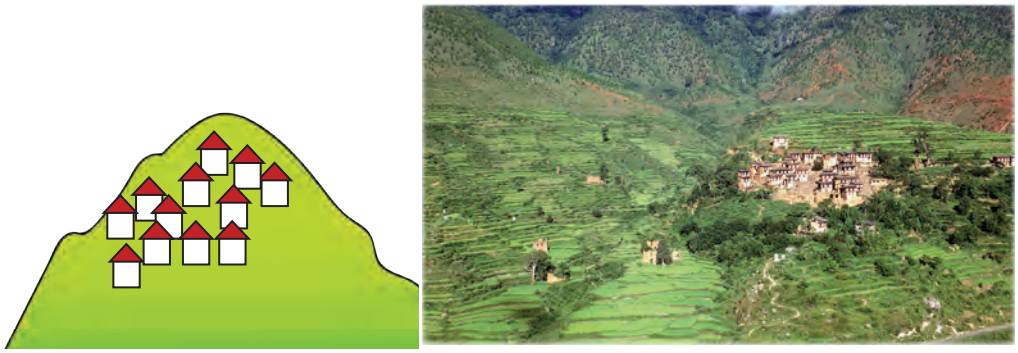

Figure 11.2 Clustered settlement

ii) Dispersed Pattern

Dispersed patterns of settlements are characterised by houses located far away from one another. Large area of cultivated land is usually found in between the houses. This pattern of settlement is mainly determined by relief of an area.

Figure 11.3 Dispersed settlement

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iii) Linear Pattern

Road is one of the factors that causes the formation of linear pattern of settlement. In this pattern, houses are built in a line usually on both sides of the road. Most of the houses function as shops or hotels to serve the travellers and inhabitants of the area. This pattern of settlement also develops along the river valleys.

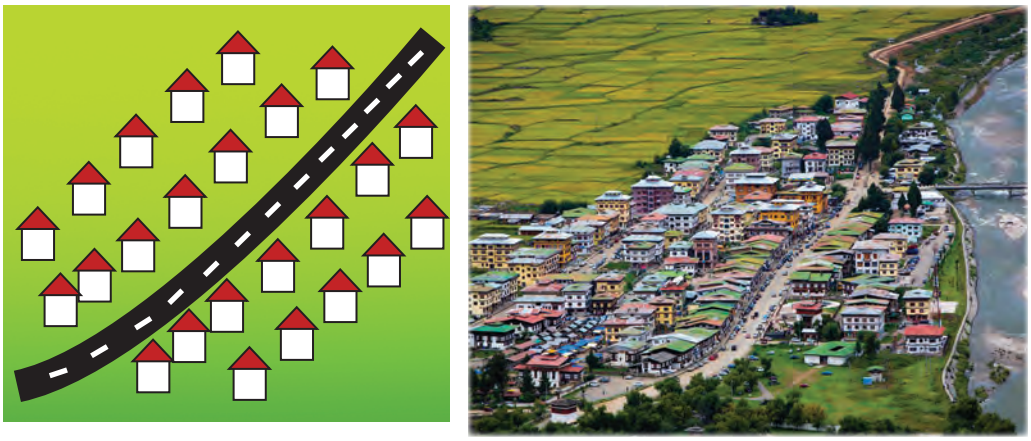

Figure 11.4 Linear settlement

iv) Terraced Pattern

This pattern of settlement generally develops on the hills and slopes of the mountains. Houses are spread across the strips of land which are built like steps on the slopes or hills. People here practice terrace farming.

Figure 11.5 Terraced settlement

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v) Circular Pattern

Circular pattern of settlement develops around important cultural or geographical features. These features are fortress, temple, lakes and institutions.

Figure 11.6 Circular settlement

Learning Activity *Read the features of a settlement in the table.*

Identify and write the name of the settlement pattern in the right column.

Features	Settlement Pattern
Houses built around a pond.	
Houses are close to one another.	
Settlements are located on the slopes or hills.	
Houses are scattered over a large region.	
Houses are spread over the strips of land.	

1. Which settlement pattern would you prefer to live in and why?
2. What are some advantages and disadvantages of living in a clustered settlement?

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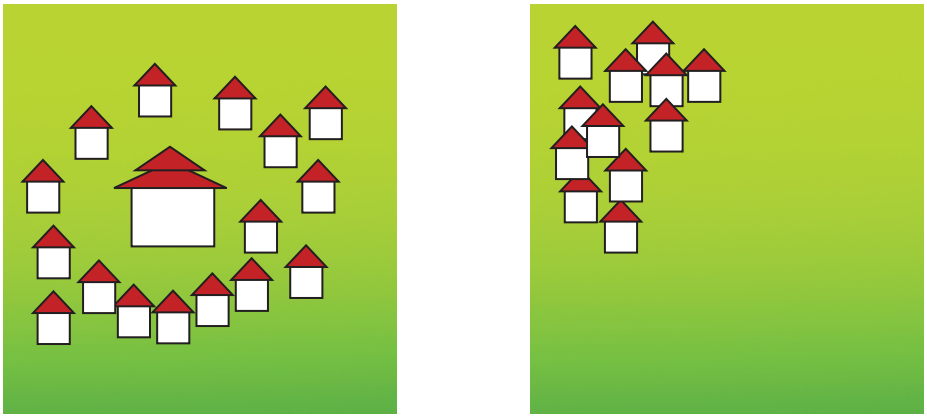
Test Yourself

1. Discuss reasons that attract rural people to urban areas.
2. Describe the pattern of settlements in Figure 11.7.



A B

Figure 11.7 Settlements

3. What are the factors that influence rural settlements in Bhutan?
4. If you happen to settle along the road, how would this affect you?
5. 'People living in the high altitude prefer to raise cattle than cultivate crops'. Give reasons to support your answer.

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CHAPTER

12

The Environment

Learning Objectives

- Describe the interrelationship that exist among the various components of the environment
- Discuss the importance of environmental conservation

Introduction

Natural environment encompasses all living and non-living things. People are dependent on natural environment for survival. The increasing interaction between people and environment has led to environmental degradation.

Bhutan has rich biodiversity that provides social and economic benefits that contributes to quality of life. Therefore, conservation and management of the natural environment is important for the long-term socio-economic development of the country.

12.1 Components of Environment

An environment consists of living (biotic) and non-living (abiotic) components. The interaction between biotic and abiotic components support life on Earth.

i) Abiotic Components

The non-living elements of an ecosystem are called abiotic components. It includes:

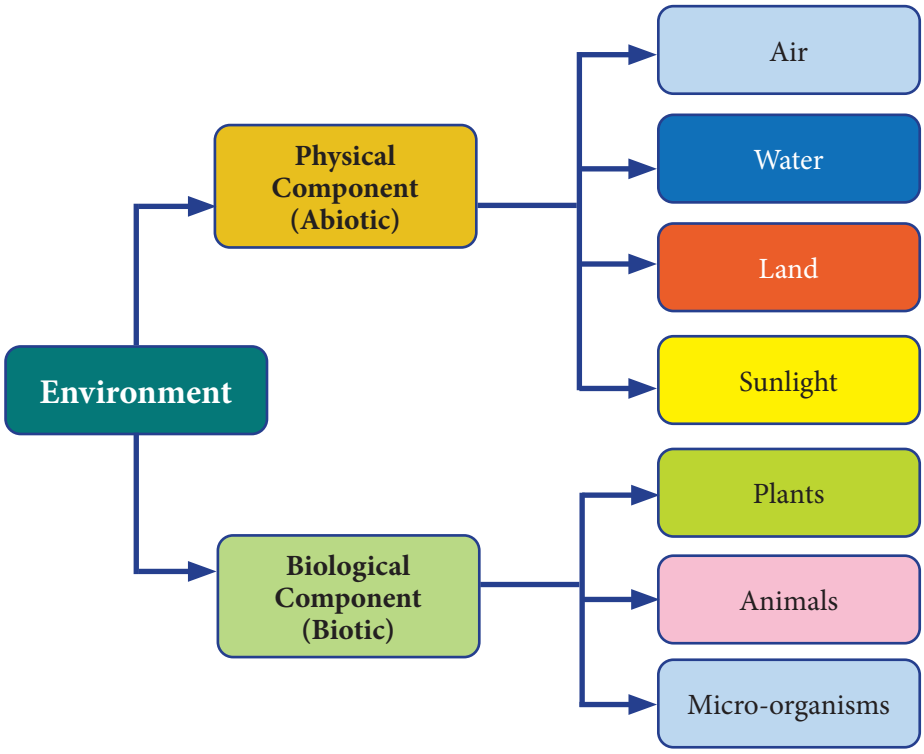

Figure 12.1 Components of Environment

a) Air

Air is used by organisms to carry out life process. Oxygen is used by animals for respiration, and carbon dioxide is used by plants for photosynthesis.

b) Water

Water is an essential component for plants and animals. Plants need water to grow. Plants growing on land obtain water through their roots. Animals need water for survival.

c) Soil

Soil is the major source of nutrients and moisture in the ecosystem. Nutrients are recycled in the soil by the plants and animals in their life cycles of growth, death and decomposition.

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d) Sunlight

Sunlight is the main source of energy in the ecosystem. It is used by the plants to produce food. Solar energy is also used by animals.

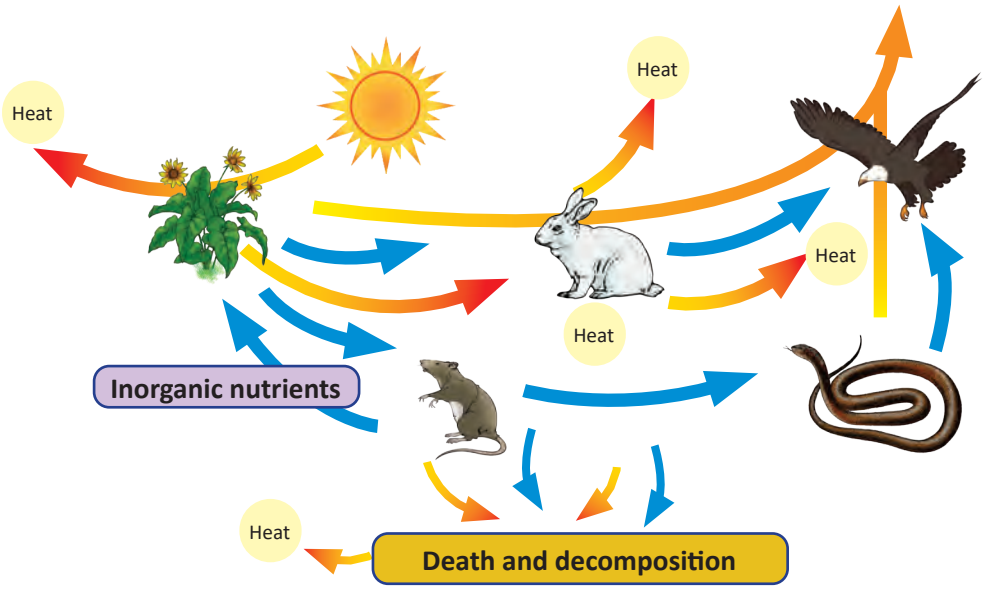

Figure 12.2 Energy flow in the ecosystem

ii) Biotic Components

Biotic components of an ecosystem comprise of plants, animals and micro-organisms (bacteria and fungi). The components carry out different functions.

a) Producer

Producers are green plants that produce their own food through photosynthesis. Part of the food produced is consumed by the plant themselves and the remaining food is stored in the plants and becomes food for other biotic components.

b) Consumer

Consumers are primarily animals including people. They are not able to produce their own food as they do not have chlorophyll. Consumers depend on producers for food. **Herbivores** consume plants while **carnivores** consume

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herbivores. Besides, herbivores and carnivores there are other consumers called **omnivores**. They depend on both plants and animals.

c) Decomposer

Decomposers such as bacteria and fungi change wastes and dead organisms into nutrients. These nutrients are used by plants and animals.

12.2 Energy flow in the ecosystem

Energy flow refers to the flow of energy in the ecosystem through food chain. The sun is the source of energy. Plants absorb the solar energy and transfer to other organisms. The energy decreases when it is transferred from producers to different levels of consumers in an ecosystem.

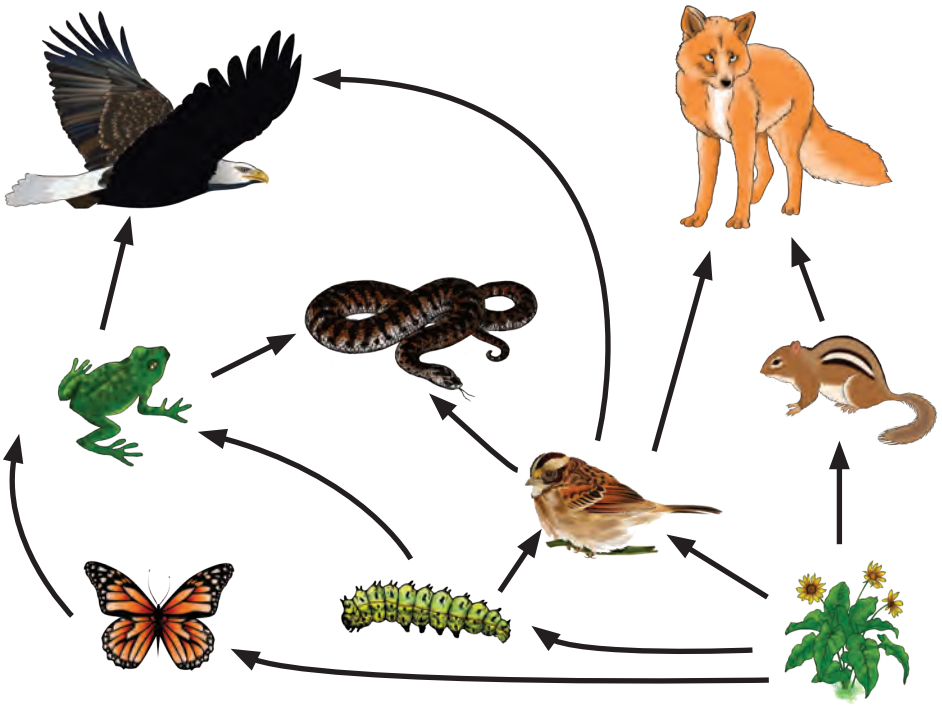

Figure 12.3 Food web

The flow of energy through a variety of organisms in a complex web of pathway is called food web. This means that organisms have more than one alternative food for survival.

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Learning Activity

Complete this exercise with appripriate words or terms.

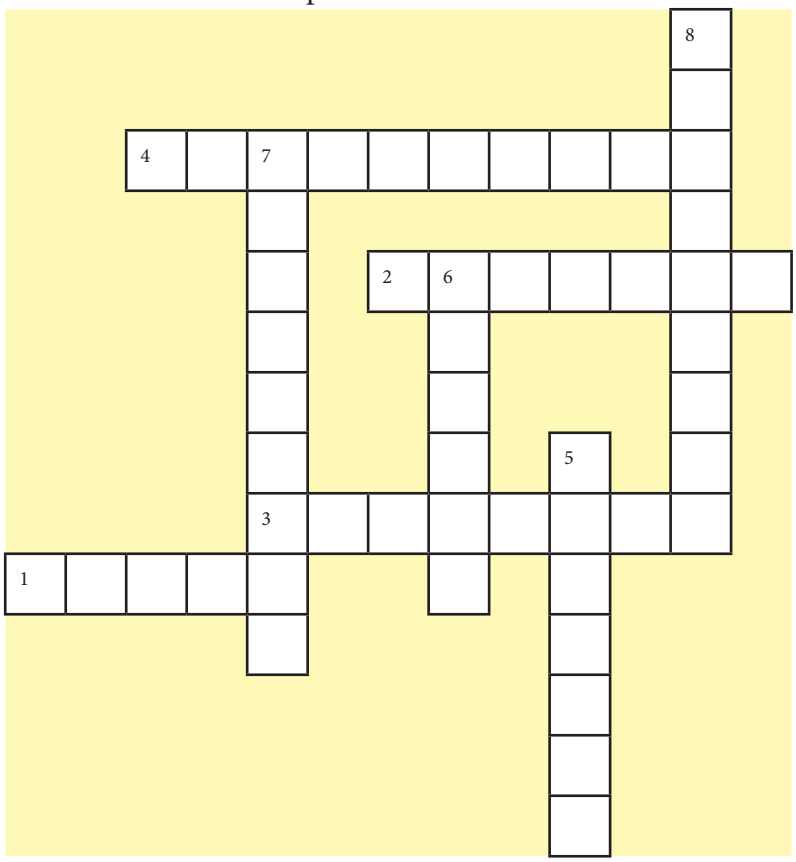
Complete the crossword puzzle.

Across

1. The energy received from the sun.
2. Non-living component of environment.
3. An animal that feeds on plants and animals.
4. Dead organisms are changed into nutrients and are used by plants.

Down

5. Organisms have more than one alternative source of food.
6. The living component of the environment.
7. An animal that consumes other animals.
8. An animal that consume plants.



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12.3 Interactions between People and the Natural Environment

People are important part of biotic component of an ecosystem. They are the largest consumer of resources because they depend on the natural environment for food, shelter, clothing and other needs.

The interaction between people and environment has changed over time. This changing interaction is understood through four stages:

a) Period of hunting and gathering
b) Period of animal domestication and pastoralism
c) Period of agriculture
d) Period of science, technology and industrialization

12.4 Impacts of human activities

Human activities affect the natural environment in several ways. Some human activities directly affect the natural environment while others affect indirectly. Some of the common impacts on the natural environment are:

i) Water pollution

Human activities pollute water by releasing huge quantity of pollutants from cities and industries. The chemical fertilisers and pesticides used in agriculture also pollute water bodies. Polluted water creates problems like shortage of consumable water, diseases and extinction of some aquatic species.

Water pollution is also a problem in Bhutan. Wang Chhu in Thimphu is under serious threat from pollution due to huge amount of wastes and improper disposal.

ii) Human wildlife conflict

The natural environment is shrinking due to destruction by increasing population. This results into conflict between people and wildlife. People lose their crops, livestock, property and sometimes their lives due to human encroachment into wildlife habitat. Human wildlife conflict is a problem in Bhutan.

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Learning Activity *Study the figure and answer the questions.*

A B

1. Describe the situation in the picture in figure A.
2. Why do you think situation in figure B is occurring?
3. Suggest measures to minimise such situations.

iii) Global warming

The increase in temperature on the Earth is known as global warming. The main cause of global warming is the increasing quantity of carbon dioxide and methane in atmosphere. Human activities like agriculture, burning of fossil fuels, deforestation and urbanisation produce carbon dioxide and methane. These gases form a layer around the Earth which traps outgoing heat and increases the temperature of the Earth. It accelerates the melting of ice sheets and glaciers and rises sea level. This also changes precipitation and weather pattern.

In Bhutan, global warming has resulted in melting of glaciers which causes flood disasters. Retreating glaciers also pose threat to the sustainability of river systems.

Learning Activity *Read the extract and answer the questions.*

Between 19% and 29% of global greenhouse gas emissions come from food production, with beef and lamb the biggest contributors. So changing diets towards fruit and vegetable intake is a good way for reducing climate change.

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"If you ask people to guess the difference between items such as beef and vegetable soup on the environment they assume there is not much difference, but beef soup creates more than 10 times the amount of greenhouse gases than vegetable soup," says Dr. Camilleri.

1. How do you think the consumption of beef and lamb contribute to global warming?
2. Why do you think Bhutan is not a major contributor of greenhouse gases?

12.5 Conservation of Environment

Environment is very important for the survival of life forms including human. It is a source of natural resources. The exploitation of resources by people cause environmental problems. These problems are addressed by practicing conservation measures like:

i) Use of alternative source of energy

The alternative source of energy is environment friendly because it does not pollute the environment. It is cheap and renewable.

ii) Planting trees

Planting trees help to control soil erosion and maintain water resources. It also helps to protect habitats for wildlife.

iii) Water Conservation

Practices like closing taps when they are not in use helps to conserve water. Reuse of water for watering the kitchen gardens is also an important practice of conserving water.

Rain water harvesting is also an important practice to minimize the usage of water from the water-bodies.

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iv) Energy conservation

This practice includes switching off the lights and unplugging electrical appliances when not in use. The use of biogas also helps to reduce pressure on non-renewable resources like fossil fuels.

v) Recycling of wastes

Recycling involves re-manufacturing of already used materials. Wastes like plastics, papers, bottles and scraps have resulted to tones of garbage. However, these wastes are recycled to reduce dependence on non-renewable resources.

vi) Practice crop rotation

Cultivation of same crop in the same area for a long time reduces soil fertility. The practice of crop rotation will restore and maintain soil fertility. This helps to conserve soil resource.

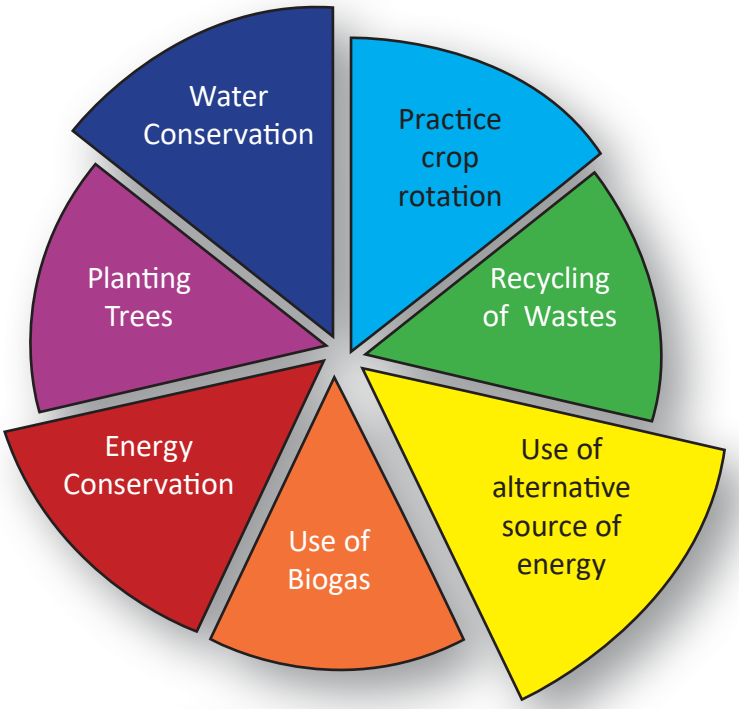

Figure 12.4 Conservation Practices

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Test Yourself

1. Study Figure 12.5 and answer the questions.

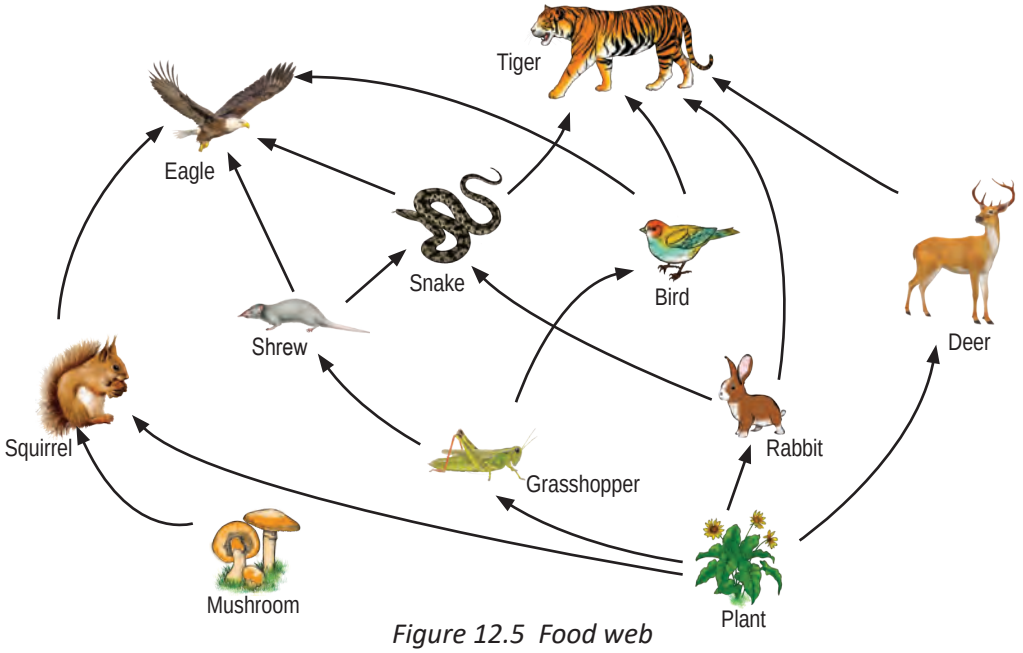

Figure 12.5 Food web

a) Choose the correct food chain.

A. Plant → Rabbit → Snake → Eagle

B. Grasshopper → Shrew → Rabbit → Eagle

C. Plant → Rabbit → Deer → Tiger

D. Fungi → Plant → Rabbit → Snake

b) What are the alternative food for tiger other than deer?

2. Urban areas cause more negative impact on the natural environment than rural areas. Do you agree with the above statement? Justify your answer with reasons.

3. Suggest ways to conserve environment in your school and at home.

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CHAPTER

13

Natural Resources

Learning Objectives

- Classify the natural resources into renewable and non-renewable
- Describe the importance of natural resources

Introduction

Natural resources are the materials that people derive from nature. These resources include soil, air, water, sunshine, forests, fossil fuels and minerals. They are used for housing, clothing, heating, cooling, transporting and to meet other human needs and wants.

Resources were considered infinite and were exploited to the fullest. However, people have come to realize that these resources are finite and limited. In order to meet the present and future need, natural resources management has become necessary.

13.1 Classification of Natural Resources

Resources are classified into two types on the basis of renewability: Renewable Resources and Non-Renewable Resources.

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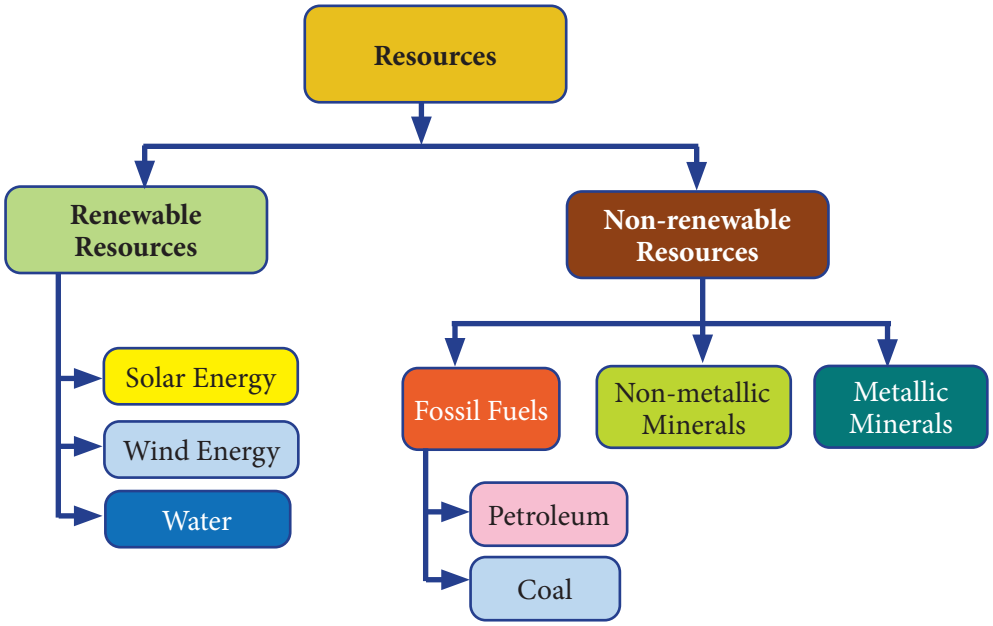

Figure 13.1 Classification of natural resources

i) Renewable resource

Renewable resources are those that are used again and again. Commonly used resources are:

a) Sun

Sun is the ultimate source of energy. Solar energy is used by plants to produce food and people for heating and drying. Solar energy is harnessed using technology like photovoltaic system to produce electricity.

Figure 13.2 Solar panels

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Learning Activity *Study the picture and answer the questions.*

The picture below shows few gadgets powered by solar energy.

Do you think Bhutanese people should adopt such technologies to promote conservation ethics? Share your views.

Solar powered street light

Solar powered lawn mower

Solar powered calculator

Figure 13.3

b) Wind

A strong and consistent wind is essential for generating electricity. The electricity generated is mainly used for lighting and pumping water for irrigation. Wind is one of the clean sources of energy.

In Bhutan, wind turbines are installed at Rubesa in Wangdue Phodrang to generate electricity.

Figure 13.4 Wind turbine at Rubesa, Wangdue Phodrang

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c) Water

There is tremendous energy in the flowing water. People use this energy to generate hydroelectricity. It is also used for transportation, irrigation, industries and domestic purposes.

Figure 13.5 Hydroelectric dam

ii) Non-renewable Resources

Non-renewable resources are those resources that cannot be reused. These resources are limited in nature and take millions of years to form. Minerals and fossil fuels are non-renewable resources. Some of the minerals are iron ore, gold, silver, copper, aluminium, gypsum, marble and limestone. Coal and petroleum are fossil fuels.

Figure 13.6 Non-renewable resources

Learning Activity *Complete the task.*

Discuss the differences between renewable and non-renewable resources. Display your findings on a chart paper and share with the class.

1. Which resource would you prefer and why?
2. What is the main source of energy that you use in your house?

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13.2 Conservation of Natural Resources

The growing population, rapid industrialization and urbanization increases the need for natural resources. Therefore, proper steps need to be taken to ensure that we continue enjoying these resources and the ecological balance is maintained. Conservation measures include:

i) Forest conservation

Forest conservation is the practice of planning and maintaining forested areas for sustainability of future generations. Common methods of forest conservation are afforestation, reforestation and protection of wildlife.

Afforestation is the planting of trees in barren land while reforestation is planting of trees to replace those that are used by people. Some measures to protect forest and wildlife are establishment of protected areas and biological corridors.

ii) Water conservation:

Water conservation includes policies, strategies and activities to sustainably manage water resources. Water conservation includes reducing pollution and improving water management practices.

Some strategies of water conservation are watershed management and rain water harvesting. Bhutan is rich in water resources as it is located in the Himalayas. This resource is widely used in agriculture and generation of hydroelectricity which is the backbone of the country's economy.

iii) Soil conservation

Conservation of soil is important as it is essential for the continuity of life on Earth. **Soil conservation** is prevention of soil loss from erosion and maintaining soil fertility.

Some methods of soil conservation are afforestation, control overgrazing, and changing agricultural practices.

Bhutan is located in the Himalayan region where farmlands are prone to soil erosion. As a result, food production is affected. Therefore, it is important to conserve soil to sustain agriculture for self-reliance.

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Learning Activity

Complete this activity.

1. Maintain a record of renewable and non-renewable resources that you use in a week. After a week, calculate the amount or duration of resources that you used and compare with your friends. Find out who is the most environment friendly person from your class.
2. Reflect on your record and using MS Word, write some ways you would follow henceforth to minimise use of resources to conserve environment. Email it as an attachment to one of your friends for feedback.

Sample table to record resource use

MONDAY			
Activity	**Resource used**	**Renewable / Non-renewable**	**Approximate Amount/ Duration**
Washing face	Water	Renewable	2 litres
Cooking food	Liquid Petroleum Gas	Non-renewable	1 hour

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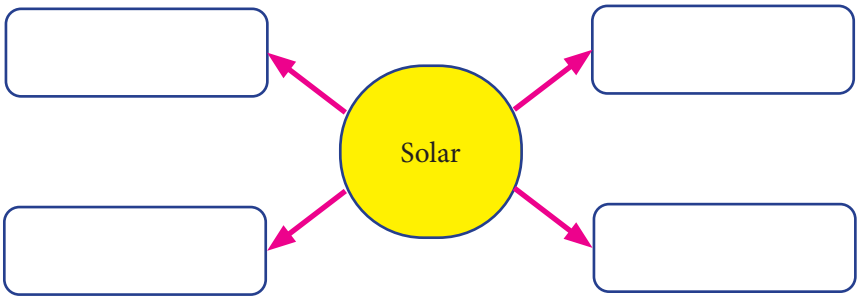
Test Yourself

1. Fill in the boxes with advantages and disadvantages of solar energy.



2. Wangpo and Wangmo are two friends. In their daily lives both have different opinion on the use of resources. Considering the necessity of resource conservation, give your suggestion.

   Wangpo says – Firewood should be used as a fuel to cook food.

   Wangmo says – Hydroelectricity should be used to cook food.

   Who is right and why?

3. The table shows different sources of energy and their uses. Put a tick mark against the appropriate use(s).

Uses	Energy		
	Wind energy	Firewood	Petroleum
Generation of electricity			
Fuel for cooking			
Fuel for vehicles			

4. Mention three ways of conserving electricity at home.

5. Why are iron and copper considered as non-renewable resources? Give reasons.

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6. Extensive planting of trees to increase forest cover is called
   A. Afforestation
   B. Re-forestation
   C. Replanting
   D. Social forestry

7. Which of the following activity will help in soil conservation?
   A. Overgrazing
   B. Farming in slope areas
   C. Reforestation
   D. Mining

8. Which of the following is a renewable resource?
   A. Petroleum
   B. Coal
   C. Minerals
   D. Water

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CHAPTER

14

Hazard and Disaster

Learning Objectives

- Distinguish between hazard and disaster
- Differentiate natural hazard from human induced hazard
- Discuss causes and effects of disasters
- Suggest measures to mitigate disasters

Introduction

Disaster is a sudden event that causes destruction. Every year lives and properties are lost due to natural and human induced disasters. The increasing occurrence of hazard and disaster has led people to enhance preparedness plans to reduce impact.

Disaster management has become necessary, despite numerous challenges and constraints. Therefore, countries are investing resources for prevention and risk reduction.

14.1 Hazard and Disaster

Hazard and disaster are closely interlinked and sometimes used synonymously. Yet they are quite distinct from each other. Hazard becomes a disaster only when it causes harm.

Know More

In Bhutan the National Disaster Risk Management Framework was adopted in 2006 to guide the development of Disaster Management Act of Bhutan 2013

i) Hazards

Hazard is a threat in the natural and human environment that has potential to affect lives and properties. It is a phenomenon that creates risk to people and properties. Natural and human induced are two types of hazards. Earthquakes, volcanic eruptions, droughts, floods, landslides and avalanches are some examples of natural hazards. War, fire, accident and nuclear explosion are some examples of human induced hazards.

Figure 14.1 Hazard

ii) Disasters

Disaster is an event that cause serious disturbance to the functioning of a society. It is a sudden event that affects life and properties. Most of the damages in a disaster whether life or property are suffered shortly after the event.

Disasters in the past were viewed as a result of natural forces and humans as helpless victim. However, people have realized that human activities also cause disasters. Forest fire, collapse of buildings, industrial accidents are some examples of human induced disasters.

14.2 Causes and Effects of Disaster

Bhutan is vulnerable to many hazards because of its location and terrain. It has been frequently experiencing disasters like earthquake, flash flood, windstorm, and fire.

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i) Earthquake

A severe earthquake leads to destruction and causes disaster. The impact of earthquake depends on preparedness, quality of structures, magnitude of an earthquake and location of a place.

Fig 14.2 Damage by earthquake

The poorly constructed structures with low quality building materials are vulnerable to destructions during earthquake. Earthquake measuring beyond six magnitudes on Richter scale bring destruction to lives and properties. Places located along the fault lines and hilly terrains are prone to disaster. Preparedness is a key to disaster risk reduction.

Earthquake results in various destructions like loss of lives and properties, destructions to forest lands, landslides, floods, avalanches and tsunami in coastal areas.

ii) Fire

Fire usually destroys forest resources, human settlements and lives. Sometimes fire is caused by natural factor like lightning. Most fire disasters are caused by human negligence, accidents and deliberate actions. Fire at Haa, Chamkhar and Wamrong towns are examples of fire disasters.

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Figure 14.3(a) Forest fire

Figure 14.3(b) Building on fire

iii) Windstorm

Windstorm is high speed wind accompanied by lightning and thunder. In Bhutan, thunderstorms are more common during monsoon and often associated to landslides and floods. The intensity of destruction depends on location of place and human negligence.

During windstorm, the roofs of houses are blown off and damages crops. It also intensifies the spread of forest fires.

Figure 14.4(a) House damaged by windstrom

Figure 14.4(b) Crops damaged by windstrom

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iv) Flash flood

Flash flood occurs when there is continuous heavy rainfall. It also occurs when landslide blocks course of running water and siltation of river bed. The other causes of floods are outburst of lakes, dams and reservoirs.

Flood leads to loss of cultivable land, livestock, destruction to settlement and health hazard due to waterborne diseases.

Figure 14.5 Flood

v) Landslide

Landslide is caused by heavy rainfall, rapid flow of rivers and streams, use of explosive for construction, forest degradation, forest fire, earthquake and loose soil. Landslides are common on steep slopes and in places that receive long periods of intense rainfall. Bhutan is prone to landslide every summer because of location and topography. Landslide leads to property damage, injury and death.

Figure 14.6 Landslides

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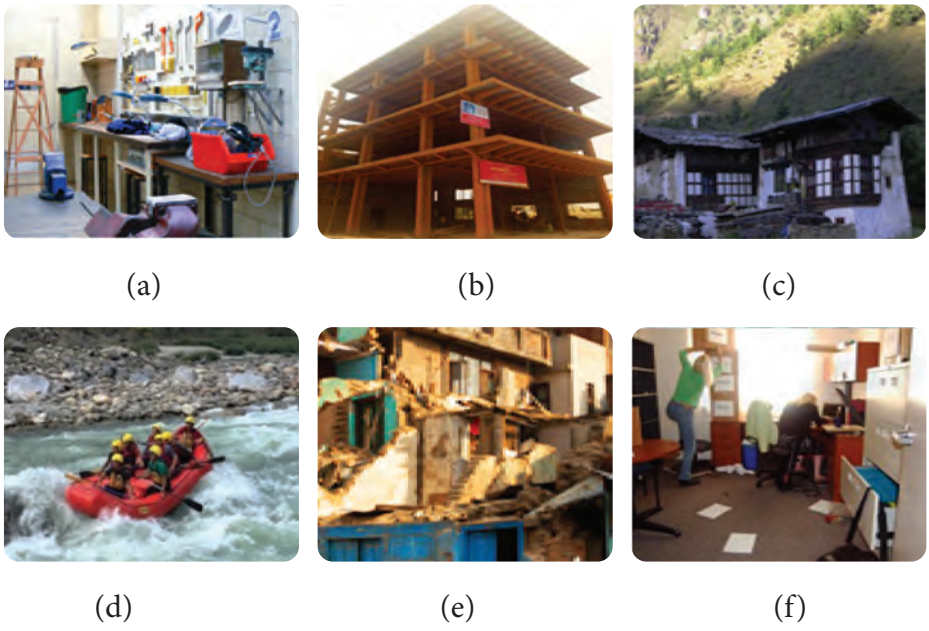
Learning Activity

Study the figure and answer the questions.

1. Identify potential hazards from the pictures. Give reasons.



(a) (b) (c)

(d) (e) (f)

Figure 14.7 Hazards

2. Differentiate hazards and disasters from the pictures. Give reasons.

Know More

1. In The National Earthquake Information Center (NEIC) records an average of 20000 earthquakes every year around the world.
2. Bhutan lies in the most active seismic zone IV and V as per Indian Seismic Code.
3. Bhutan experienced major earthquakes in 2009 and 2011.

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14.3 Disaster Management

Disaster management refers to planning, organizing and managing resources for reducing the impact of disaster. Disaster management team coordinates humanitarian aspects of emergencies like mitigation, preparedness, response and recovery. However, it is important that every individual takes responsibility to manage disaster.

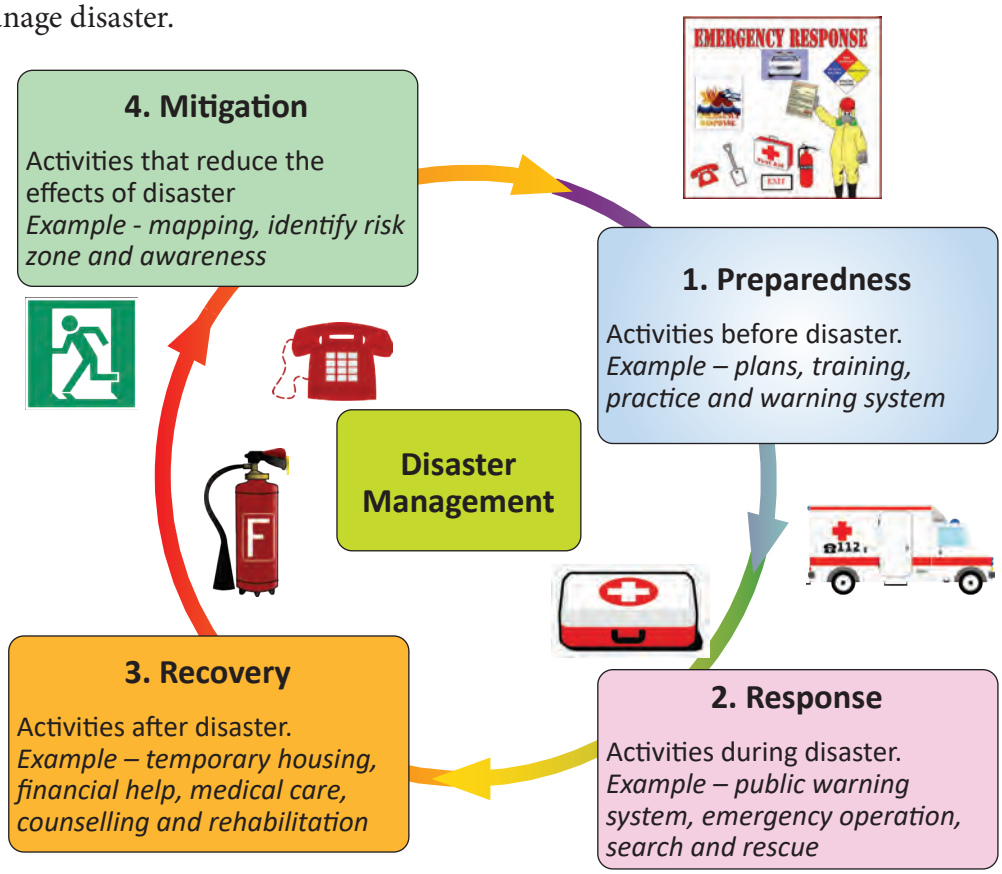

Figure 14.8 Disaster Management Cycle

i) Preparedness

Preparedness is a measure taken to prepare for and reduce the effects of disaster. It is an ability of oneself to respond to possible disaster and prevent it. It is found that casualties are more due to lack of awareness and preparedness during disaster. For example: mock drill for an earthquake.

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ii) Response

Response is an immediate reaction during and after disaster to minimize the impact of disaster. Response plans are important component for the safety of workplace during emergencies. Effective communication helps connecting affected people, families and community during and after disaster. For example: emergency medical services search and rescue and providing temporary sheds.

Figure 14.10 Preparedness

Figure 14.11 Response

iii) Recovery

Recovery means bringing back to normal. It includes restoration and reconstruction in the affected areas. For example, financial aid and emotional supports are basic recovery measures.

Disaster management plan and its efficient implementation becomes essential responsibility of every individual. Disaster risk education and public awareness play a crucial role in disaster prevention and reduction

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iv) Mitigation

Figure 14.12 Recovery

Mitigation is an effort to reduce the loss of life and properties and the impact of disaster. It deals with risk reduction, mitigation and preparedness and creates general awareness, education on disaster risk and hazards. It is taking action before the next disaster. Effective mitigation can break the cycle of disaster damage and recovery. For example: construction of river embankments.

Figure 14.9 Mitigation

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Test Yourself

1. Referring to Kuensel report given below, answer the following questions.

KUENSEL Jul 20, 2016

Sarpang Town Flooded

Karma Wangdi, Sarpang

More than 40 shopkeepers of Sarpang had to move to higher ground after Sarpang River broke its banks and flooded the town. After two days of continuous downpour, the river started edging towards the town this morning, almost washing away a two-storied house, located five metres away from the town towards the river.

The shopkeepers, with the help of dzongkhag officials, forest, and police personnel, could move their belongings to multipurpose hall, FCB, and vegetable shed located a half a kilometre away from town.

No casualties have been reported.

The embankment wall had also been damaged. The affected are putting up with their relatives and friends.

Sarpang town was hit twice by flash flood in the past.

In Gelephu, the swollen streams along the Gelegphu-Zhemgang highway are obstructing traffic.

According to the Department of Hydro-met Services, the southern belt of the country is expected to experience heavy rainfall in the next 48 hours. Rest of the country is expected to receive moderate rain.

Source: Kuensel

a) How did the river become a cause of disaster?
b) Suggest some measures to manage this disaster.
c) Is your locality at risk from such disaster? Why?

2. What will you do if earthquake occurs when you are outside? Write at least five important steps showing self-help measures.

3. 'Prevention is better than cure'. How is this statement relevant in disaster management?

4. Complete the table with relevant information.

Events	Causes	Effects	Preventive measures
Earthquake			
Flashflood			
Windstorm			
Fire			
Landslides			

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Assessments

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Weighting and period allocation

Sl. No.	Strand	Strand wise weighting	Chapters	Weighting (%)	Time (min) Period Allocation	Remarks
1.	Time and Space	25	1. Motions of the Earth	5	240 m (6)	7.5
			2. Latitude and Longitude	8	384 m (9.6)	
			3. Map Reading and Interpretation	12	576 m (14.4)	
2.	Physical Environment	40	4. River- major features	7	336 m (8.4)	12.0
			5. Earthquake and Volcano	7	336 m (8.4)	
			6. The Atmosphere	5	240 m (6)	
			7. Weather and Climate	8	384 m (9.6)	
			8. Soil	7	336 m (8.4)	
			9. Natural Vegetation	6	360 m (9)	
3.	People and Environment	35	10. Population	8	320 m (8)	10.5
			11. Settlement	6	320 m (8)	
			12. The Environment	8	360 m (9)	
			13. Natural Resources	7	360 m (9)	
			14. Hazard and Disaster	6	320 m (8)	
		100		100%	4800 minutes or (120 periods)	30 weeks or 150 days

Assessment Matrix- Broad assessment based on Knowledge, Skills and Values and Attitudes (KSA)

Assessment type	Formative assessment			Continuous Summative Assessment			Summative Assessment	
Domains	**Knowledge**	**Skills (process)**	**Values & Attitude**	**Knowledge**	**Skills**	**Values & Attitude**	**KSA Term I**	**KSA Term II**
Techniques	Self and Peer assessment, Quiz, Debate, homework, classwork, class interaction	Map work, case study, sketching, drawing, making models, using instruments	Field work, group work, self and peer assessment, interaction, case analysis, resolving social and environmental issues, moral dilemma	Homework, Class work, project work and test	Project work, map work, test, models, field work, case study, sketching, drawing, making	Field work, group work, test, interaction, case analysis, resolving social and environmental issues, moral dilemma	Exams	Exams
Assessment tools	Question & answer, checklist, rating scale, rubrics	Question & answer, checklist, rating scale, rubrics	Question & answer, checklist, rating scale, rubrics	Question & answer, checklist, rating scale, rubrics	Question & answer, checklist, rating scale, rubrics	Question & answer, checklist, rating scale, rubrics	CBT-MCQs, completion, matching, true/false, short answer, essays	CBT-MCQs, completion, matching, true or false, short answer, essays
Frequency	Maintain either checklist/ rating scale/ rubrics for each chapter	Maintain either checklist/ rating scale/ rubrics for each chapter	Maintain either checklist/ rating scale/ rubrics for each chapter	Minimum two homework and two classwork to be graded for each term	One Project (different types)	Maintain either checklist/ rating scale/ rubrics for relevant content	Once a term	Once a term
Weighting				**Term I** HW, CW and Test- 7	**Term II** HW, CW, Test and PW- 7	**6**	**30**	**50**

Criteria for project and field work

Name	Criteria					Total (20)
	Content (4)	Presentation (4)	Language (4)	Process (4)	Originality and creativity (4)	

Rubrics for project and field work

Criteria	Marking range				Scores
	4	3	2	1	
Content	Information presented is relevant, accurate and in logical order.	Information presented is substantially relevant, accurate and in logical order.	Information presented is to some extent relevant, accurate and in logical order.	Information presented is not relevant, accurate and in logical order.	
Presentation	Exceptionally clear and precise expression of ideas, transfer of ideas into product with appropriate illustrations.	Clear and precise expression of ideas, transfer of ideas into product with appropriate illustrations.	Little expression of ideas, transfer of ideas into product with appropriate illustrations.	No clear and precise expression of ideas, transfer of ideas into product with appropriate illustrations.	
Process	Proper planning with regular consultations.	Partial planning with some consultations.	Little planning with little consultations.	No proper planning and consultations.	
Language	Language without grammatical error	Language with few grammatical error	Language with few grammatical error	Language with full of error	
Originality and creativity	Display of original and creative ideas.	Partial display of original and creative ideas.	Little display of original and creative ideas.	No display of original and creative ideas.	
				Total score	

Teachers may use the above rubric for assessing project and field work.

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Sample rating scale for Affective domain

Name	Criteria										Teacher's comments
	Participation in learning activities	Respect for others views	Curiosity for exploration	Responsibility	Empathy for others	Punctuality	Honesty	Intellectual drive	Concern for environment	Collaboration	

Note: The above parameters to be rated as: A-Outstanding, B- Very Good, C- Good, D- Fair and E- Need improvement.

This rating scale is to be used at least once a term to assess the development of values and attitudes.

Rubric for Homework

Criteria	Marking range				Score
	4	3	2	1	
Completion	100% complete	75% complete	50% complete	25% complete	
Accuracy	100% correct	75% correct	50% correct	25% correct	
Presentation	Work is crystal clear and legible	Work is clear and legible	Poor clarity and less legible	Not clear and illegible	
Originality & Creativity	Display of original and creative ideas.	Partial display of original and creative ideas.	Little display of original and creative ideas.	No display of original and creative ideas.	
Timely submission	Work submitted on time	Work submitted one day late	Work submitted two days late	Work submitted three days late	
				Total score	

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Criteria for Home work

Name	Criteria					Total Marks 20
	Completion (4)	Accuracy (4)	Presentation (4)	Creativity and originality (4)	Timely submission (4)	

Criteria for Class work:

Name	Criteria					Total Marks 20
	Participation (4)	Follow instructions (4)	Completion (4)	Quality of work (4)	Behaviour (4)	

Rubric for Class Work

Criteria	Marking Range				Score
	4	3	2	1	
Participation	Participates voluntarily all the time	Participates voluntarily most of the time	Participates voluntarily sometimes	Participates only when asked	
Follow instructions	Follow instructions accurately all the time	Follow instructions accurately most of the time	Follow instructions sometimes	Follow instructions rarely	
Timely Completion	Completes task always on time	Completes most of the task on time	Completes some of the task on time	Rarely completes task on time	
Quality of work	Demonstrate full knowledge with full explanation and elaboration	Demonstrate knowledge but fails to elaborate	Does not fully understand but answers basic questions	Does not understand and answer rarely	
Behaviour	Always demonstrate positive attitude and behaviour	Demonstrate positive attitude and behaviour most of the time	Demonstrate positive attitude and behaviour sometimes	Rarely demonstrate positive attitude and behaviour	

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Sample rating scale for self and peer assessment

Sl. no	Items	Rating Scale			Remarks
		Very Good	Good	Fair	
1	Participation- Actively participates in all class activities				
2	Time management and responsibility- Accepts fair share of work and completes timely				
3	Adaptability- Displays a wide range of skills in tasks, readily accepts suggestions				
4	Problem solving- Solves problem when faced with challenges				
5	Communication skills- Listens and communicates effectively				
6	General team skills- Exhibits positive attitude, encourages and motivates team				
7	Creativity and originality- Initiates new ideas and develops materials				

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Question pattern for term examinations as per the strands

1. ***Limited choice: (30 Marks-compulsory questions)***

   i. MCQ :15 Marks

   ii. Alternative response :5 Marks

   iii. Matching :5 Marks

   iv. Completion :5 Marks

2. ***Open ended : (60 Marks)***

   i. Map Interpretation : 10 Marks (compulsory)

   ii. Short answer type : 20 Marks (compulsory)

   iii. Essay type : 30 Marks- attempt three sets out of five sets of questions.

3. ***Map work (Continents, Countries and natural and human features of Bhutan and the World) :10 Marks***

Total Marks :100 Marks

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