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# MAPS: TYPES AND ELEMENTS; TOPOSHEETS

Sayali and her friend Jemmy were excited to go for the school educational trip to the nearby waterfall. The teacher announced about the picnic cum educational trip today itself and told the students to pack necessary items in the bag, wear a comfortable dress, keep a spare set of clothes, etc. and they will go for the trip in the coming week. Both the friends were wondering where this waterfall is. Therefore, they opened the local map of their place kept in their Geography lab and tried to locate the waterfall. After a while they were able to locate it lying in the outskirts of their town in the East direction. They were all the more excited to find out that while going there, they will pass by the famous rose garden in that area which also has beautiful and big fountains. So, on the day of their trip they knew where they were going and which route their bus would follow. During the journey they could see the beautiful fountains, showed them to friends and enjoyed the trip to the fullest.

Learners, with this story you must have understood the importance of maps. In this lesson, maps will be discussed in detail.

## OUTCOMES

After studying this lesson, learner:

- differentiates between general and thematic maps
- constructs linear scales
- recognises map symbols used in topographical sheets and
- interprets the physical and cultural features on toposheets.

## 1.1 WHAT IS A MAP

As you can make out from the story of two friends Sayali and Jemmy, maps are representations of some physical space. So, maps are simplified representations of whole or a part of the

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earth's surface on a plane surface. You have learnt in the previous classes that earth is in the shape of a geoid which is three dimensional. It is not possible to represent the whole of the earth or a part of it in the same three-dimensional form like a globe. Therefore, we represent if in two-dimensional forms such as, maps. You must be wondering, how a three-dimensional surface is converted into a two-dimensional surface! This is done with the help of projections. Projections help in providing exact position to a place on the map corresponding with the same on the earth. Similarly, is it possible to construct a map of a place exactly of the same size that exists on the earth? No, therefore a scale is chosen. Besides this, various features on the earth are represented in a simplified form using symbols, colours and shades. The representation of the earth's surface as a map is a generalised one and is also at a reduced scale. Let us try to do an activity and understand more about maps as a representation of the globe.

### LET'S DO IT

Take a rubber ball with few things drawn on it assuming it is a globe. Make a long cut in the ball vertically. Try opening the ball to make it a flat surface. What do you observe? It is almost impossible to do this. The round ball cannot be flattened into a flat surface.

Try answering the following questions to understand more about maps.

### INTEXT QUESTIONS 1.1

i. What is a map?

ii. What is the importance of maps?

Fill in the blanks.

iii. A globe is a _____dimensional representation of the earth whereas a map is a _____ dimensional representation.

iv. A map is the _____representation of the earth's surface and is drawn at a _____scale.

## 1.2 ESSENTIAL ELEMENTS OF A MAP

Have you ever thought, since when the maps are being drawn or were the early maps same as that of now? Since early times maps have been created involving various materials and processes. The art and science of making maps is known as Cartography. Earlier maps were made on clay tablets as drawn by the Mesopotamians (2,500 B.C.) and pieces of cloth. After the invention of paper, maps started being drawn on these using inks. One of the earliest maps of the world drawn by Ptolemy can be seen in Figure-1.


Fig. 1.1: Ptolemy's world map

Greek and Arab geographers were the ones who laid the foundation of modern cartography. In India also cartography started during Vedic times where representations of various places and their features were done as 'sidhantas' or laws. Today, maps are created by the Survey of India with the help of extensive surveys and computer applications.

It becomes important to know what are the essential elements or requirements of a map. Though various types of maps contain various components, there are few most important ones that need to be there in a map. They are:

## A. Scale

Scale is the most important component of a map. While we were discussing the definition of maps, we got to know that maps are drawn at a reduced scale. What is a scale then? A scale is the distance on the map representing the actual distance on the ground. It is the ratio of distance between two places shown in the map and the actual distance on the ground. If one has to show a smaller area on map then a large scale of 1:250 is taken. This means 1 cm distance on the map represents 250 km distance on the ground. Similarly, a scale of 1:50 will mean 1cm distance on map representing 50 km on ground. On the other hand, if a map of larger area is to be drawn a smaller scale is chosen for example, 1:250,000 which means 1 cm distance on map represents 2 lakh 50 thousand km distance on the ground. Similarly, a scale of 1:50,000 will mean 1cm distance on map representing 50 thousand km on ground.

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A scale is either written on the map as words (1cm to 2.5 km), in numerals as fraction such as, 1:250,000 and is known as Representative Fraction (RF) or represented graphically like a divided line on map.

If you open your atlas, you will see at the bottom or on the side of any map given there the scale of the map. It may be shown in different ways. Now we will study the different ways of representing scales on maps.

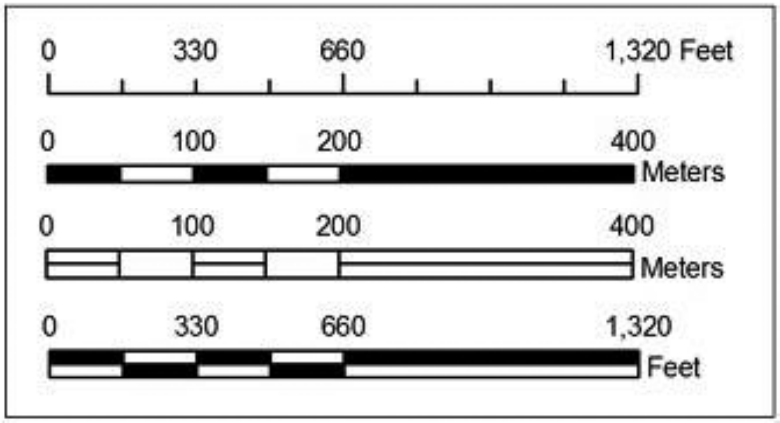


Fig.1.2: Map scales (graphical) and various forms in which they are represented

The scales are expressed on the maps in three different ways:

i. By a statement

ii. By a Representative Fraction, and

iii. By a Graphic scale/Linear Scale

Let us now see what each one of them stands for and what are their merits and demerits.

### i. By a statement

In this method, the scale is expressed in words. For example one centimetre to one kilometre. This statement means that a distance of one centimetre on the map represents a distance of one kilometre on the ground.

### Merits

1. This method is very easy and simple.
2. It is easy to understand.
3. It is easy to use.

4. Its conversion is easy into other forms of scales.

### Demerits

1. A scale represented by this method can be used only in those countries in which the units of measurement used in the statement are followed, for e.g. Kilometres or miles.
2. In this method the difficulty arises when one wants to convert one unit of distance into another unit of distance.
3. It becomes incorrect when the original map is enlarged or reduced.

### ii By a Representative Fraction or R.F.

This method of expressing a scale is commonly called a Representative Fraction or R.F. In this method, the distance on the map and the corresponding distance on the actual ground are given in the same unit of measurement. The numerator and the denominator of the fraction are given in the same unit of measurement. The numerator of the fraction represents the distance on the map and the denominator represents the actual distance on the ground. Therefore, representative fraction is written as:

Distance between two points on the map (map distance)

R.F. =

Distance between the corresponding points on the actual ground

### Points to Remember

1. The numerator of the fraction is always one, while the denominator keeps on changing, as:

   1/1000,000 or 1: 1000,000

   1/63,360 or 1: 63,360

   1/2500 or 1: 2,500

2. The numerator and the denominator of the fraction represent the same unit of measurement. The unit may be used in centimetres or inches or any other unit.

   1/1000,000 may mean one centimetre = 1000,000 centimetres or one inch = 1000,000 inches.

   1/2,500 may mean 1 centimetre = 2500 centimetres or 1 inch = 2500 inches.

   1/63,360 may mean 1 inch = 63,360 inches or 1 centimetre = 63,360 cm.

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3. The numerator always represents the distance on the map and the denominator always represents the ground distance for example 1/1,000,000 means that a distance of one centimetre on the map represents a distance of 1,000,000 centimetres on the ground.

### Merits

1. The most significant advantage of this method is that a map drawn on this type of scale can be understood universally.
2. Due to the above advantage, countries of the world using different units of measurement find no difficulty in using this method of scale.
3. It remains correct even if a map is enlarged or reduced.

### Demerits

1. Representative fraction is a difficult method of representing the scale.
2. A common person cannot easily understand the scale represented by this method because the conversion of the smaller unit of measurement into the larger unit of measurement involves multiplication and division.

- In Statement of scale, the scale is expressed in words, such as, one centimetre to four kilometres.
- In Representative Fraction, the distance on the map and the distance on the ground are shown in the same unit of measurement.
- The numerator of this fraction represents the distance on the map and the denominator represents the actual distance on the ground.

### iii Linear Scale

A linear scale is represented by a straight line which is divided into a number of equal parts. The main divisions are called primary divisions and the subdivisions are called secondary divisions. The scale is divided in such a manner that the distances on the map can be easily measured in terms of actual distance on the ground.

### Merits

1. In this method, the distance on the map can be directly and easily read in terms of the distance on the ground.
2. The scale has the advantage of remaining true even after enlargement or reduction of a map.

## Demerits

1. This scale can be understood only by those people who are familiar with the units of measurement used in the scale.
2. It is difficult to draw this scale.

## B. Projection

As we know that maps are the simplified representations of the whole of the earth's surface or a part of it, in a two-dimensional surface projections are used in this transformation. A map projection is the system of transformation of the spherical surface to plane surface. This is done with the help of grids of lines representing latitudes and longitudes. As maps are flat, some of the simplest projections are made into geometric shapes that can be flattened without stretching their surfaces. These are called developable surfaces. Some common examples of developable surfaces are cones, cylinders, and planes. A map projection systematically projects locations from the surface of a spheroid to representative positions on a flat surface using mathematical algorithms. Let us have a brief idea of how projections are drawn using various developable surfaces.

The first step in the construction of a map using projection or projecting from one surface to another is creating one or more points of contact. Each contact is called a point (or line) of tangency. A planar projection is tangential to the globe at one point. Tangential cones and cylinders touch the globe along a line. If the projection surface intersects the globe instead of merely touching its surface, the resulting projection is a secant rather than a tangent case. Whether the contact is tangent or secant, the contact points or lines are significant because they define locations of zero distortion. Lines of true scale include the central meridian and standard parallels and are sometimes called standard lines. Though care is taken to represent the globe exactly onto a plane surface, distortions take place depending upon the location of point of contact. These distortions take place either in terms of shape or size or area. In general, distortion increases with the distance from the point of contact. Many common map projections are classified according to the projection surface used: conic, cylindrical, or planar.


(a) Conic tangent

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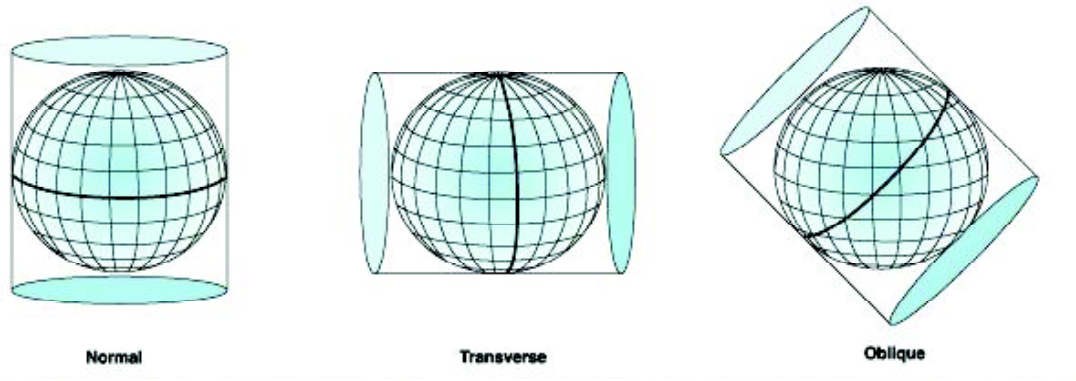
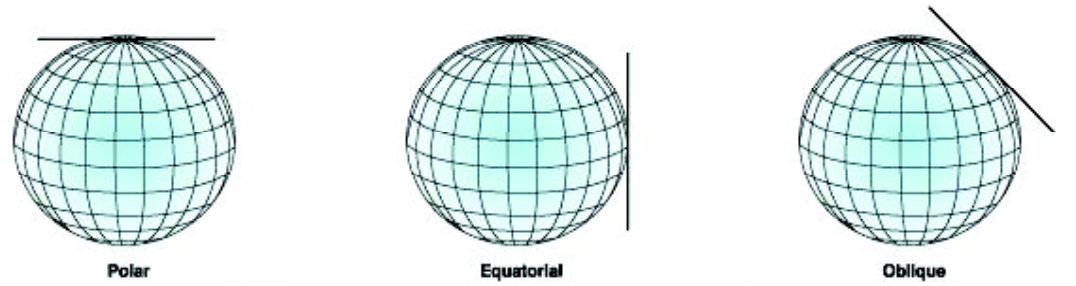



(b) Cylindrical Aspect




(c) Plantar Aspect

Fig. 1.3 Various types of developable surfaces

So, depending upon the plane surface on which the earth is being projected and the area (tropical, subtropical, polar, etc.) which is being studied there are several types of projections. An example of projection is given in Figure.

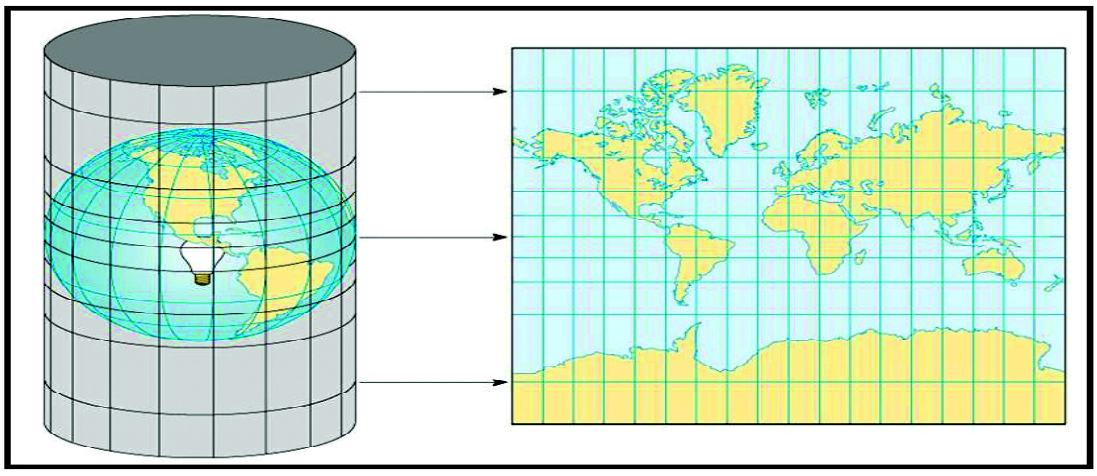


Fig. 1.4 Map projection (Cylindrical projection)

Generalisation- Every place on the earth's surface has some or the other uniqueness. We have understood that maps are drawn at a reduced scale meaning, large areas on the earth are reduced in size to be represented on a map. This leads to ignoring a few uniqueness and

details of places. This means generalisation is done keeping in mind the definite purpose for which a map is created. In this process, relevant information (or data) is selected depending on the theme which is to be studied.

**C. Conventional symbols-** There are large number of features present on the earth's surface. Representing them on a map requires use of various symbols, colours and shades. These symbols are called conventional symbols. Table-1 gives a list of a few conventional symbols used in a map. Conventional symbols are an important entity of a map as they help in understanding various features existing on the earth's surface.

Road, metalled: according to importance: milestone.....

Road, unmetalled: according to importance: bridge.....

Cart-Track, Pack-track and pass..Foot-path with bridge.....

Bridges with piers without. Causeway, Ford of Ferry.....

Sreams:withrack in bed: undefined, Canal.....

Dams: masonry or Rockfilled earthwork. Weir/Anicut.....

River banks. shelving: steep. 10 to 19ft: over19ft.....

River dry with water channel with island & rocks. Tidel river....

Submerged rocks. Shoal. Swamp, Reeds.....

Wells: lined, unlined Spring, Tanks:perenniel dry.....

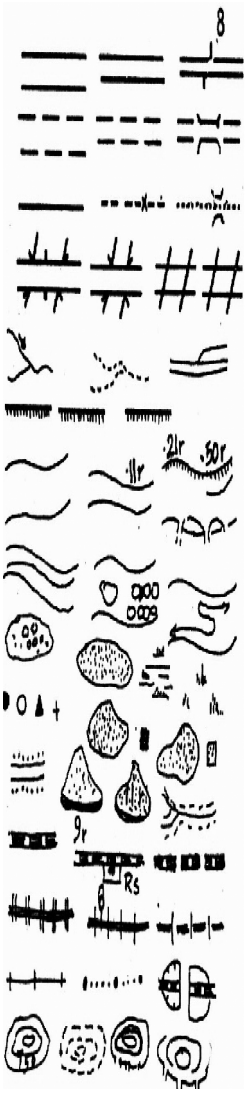
Embankments: road or rail, tank, Broken ground.....

Railway. Broad gauge: Double/Single with station: under constrn

Railways. other gauges: Double/Single with milestone: under constrn

Light Railway or tramway. Telegraph line. Cutting with Tunnel.....

Contours, Formlines, Rocky slopes Cliffs.....



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Sand features;(1) flat (2)sand-hills(permanent)(3) dunes, (shifting).....

Towns or villages: inhabited: desrted Fort.....

Huts, permanent, temporary. Tower, Antiquities.....

Temple. Chhatri, Church. Mosque, Idgah, Tomb. Graves.....

Light house, Lightship, Bouys: lighted, unlighted, anchorage....

Mine, Vine on trellis. Grass, Scrub.....

Palms, palmyra.other Plantain. Conifer. Bamboo Other trees.....

Boundary pillers surveyed. unlocated. villaget trijunction.....

Heights. triangulation: station: spot heights.....

Bench mark: .....

Post office, Telegraph office Combined PT office. Police Station.....

Bunglows:dak or travellers: inspection. Rest house.....

Circuit House. Camping ground. Forest: reserved: protected.....

Space names: administrative :locality or tribal.....

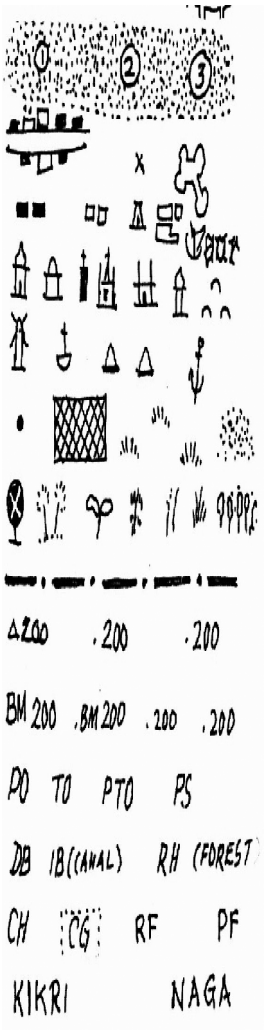


Fig. 1.5 Conventional Signs and Symbols

## D. Map design

Map design includes, title of the map, latitudinal and longitudinal extent, representation of direction, size and type of text used in a map and the overall aesthetics used in the map. These features help in a better representation and understanding of the themes to be shown in the map.

Direction on the earth's surface is determined with the help of a compass. During ancient times, directions were determined with the help of stars and other celestial bodies. Then the use of hand-held magnetic compass with needles in it representing direction started. With the advancement of technology electronic devices with Global Positioning System (GPS) are used.


Magnetic compass

GPS-based compass

## LET'S DO IT

With the help of pen and paper, try to draw a rough map of your house and then of your locality. Try comparing both of them and see what all details have you included in both these maps.

Try solving the questions to find out more about map making.

## INTEXT QUESTIONS 1.2

i. What is known as the art and science of map making?

ii. Essential pre-requisites or essential features of a map are:

   a. Scale

   b. Projection

   c. Generalisation

   d. Conventional symbols

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e. Map design

f. All the above

iii. The distance on the map representing the actual distance on the ground is known as the _____ of a map.

iv. A _____ is the system of transformation of the spherical surface to plane surface.

v. What are conventional symbols?

## 1.3 TYPES OF MAPS

Maps are drawn to serve a certain purpose therefore various features are used to draw maps based on the covered themes. Based on these features maps are classified into various types.

### A. On the basis of scale

We have read in the previous section that a map is drawn using a scale. Depending on the type of scale, maps can be categorised as large scale maps and small scale maps.

- **Large scale maps-** As mentioned earlier, large scale maps show smaller areas showing greater details. Some of the examples of such maps are: cadastral maps and topographic maps. Cadastral maps are drawn to show the landed property of people. These consist of field boundaries of agricultural land and location of individual houses. As these represent the ownership of lands, they are prepared by the government agencies and are used for keeping a record and for revenue purposes. These are drawn at a very large scale of 1:4,000.

  Topographical maps are drawn to show topographic and other details of the area and are based on extensive surveys. In India, such maps are prepared by the Survey of India and the scale used for these maps are, 1:250,000 to 1:25,000. The topographic details shown in the maps include relief, drainage, agricultural land, forest, settlement, etc. An example is given in Fig. 1.6.

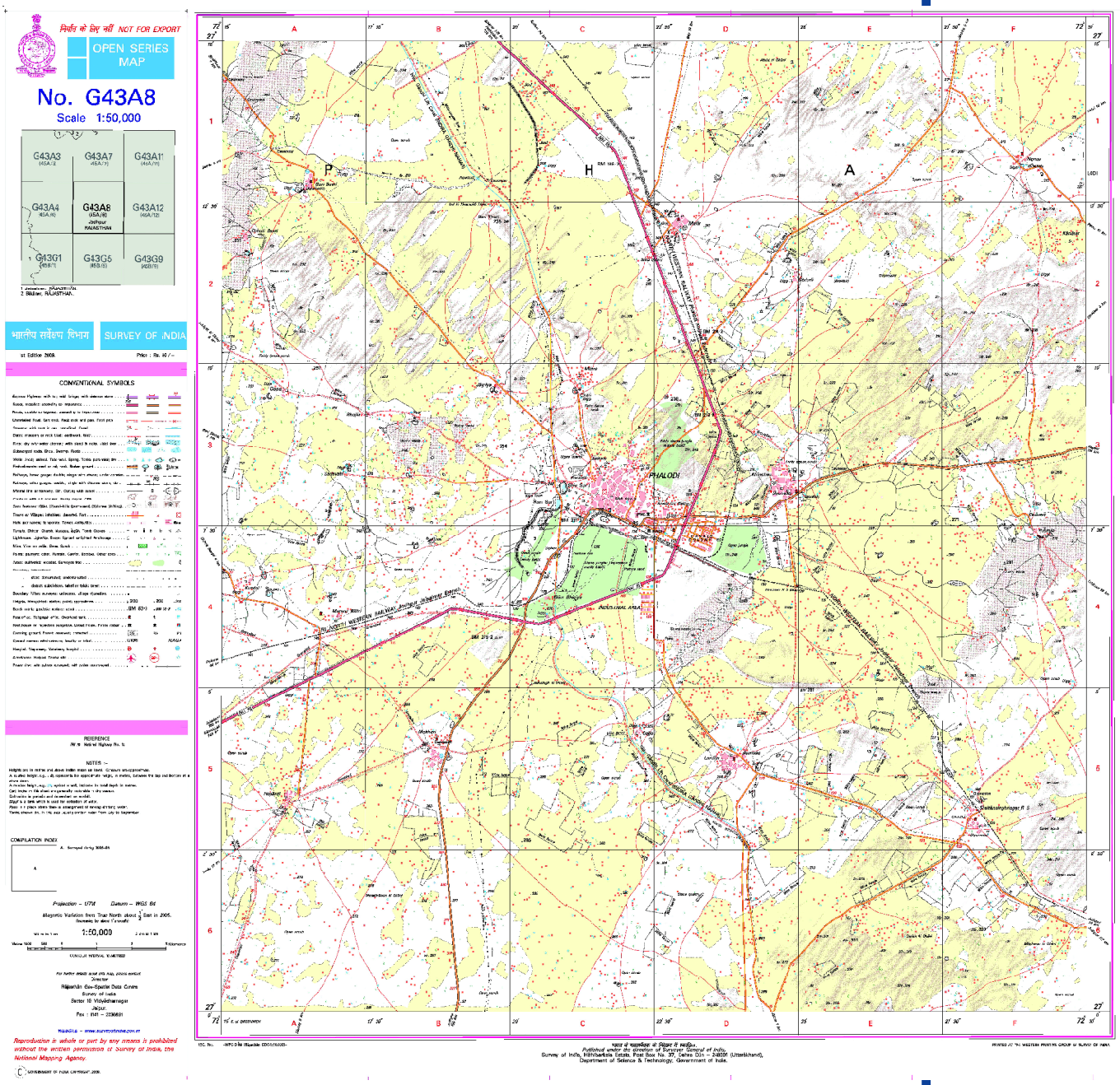


Fig. 1.6: Topographical map of a part of Jodhpur, Rajasthan, India

(Survey of India Topo G43A8 (45A/8) https://surveyofindia.gov.in/pages/educational-map-series)

- Small scale maps- Small scale maps represent larger areas showing lesser details. Wall maps and atlas maps are examples of these maps.

## B. On the basis of function:

As we know that a map is drawn to represent a theme based on a purpose. Depending

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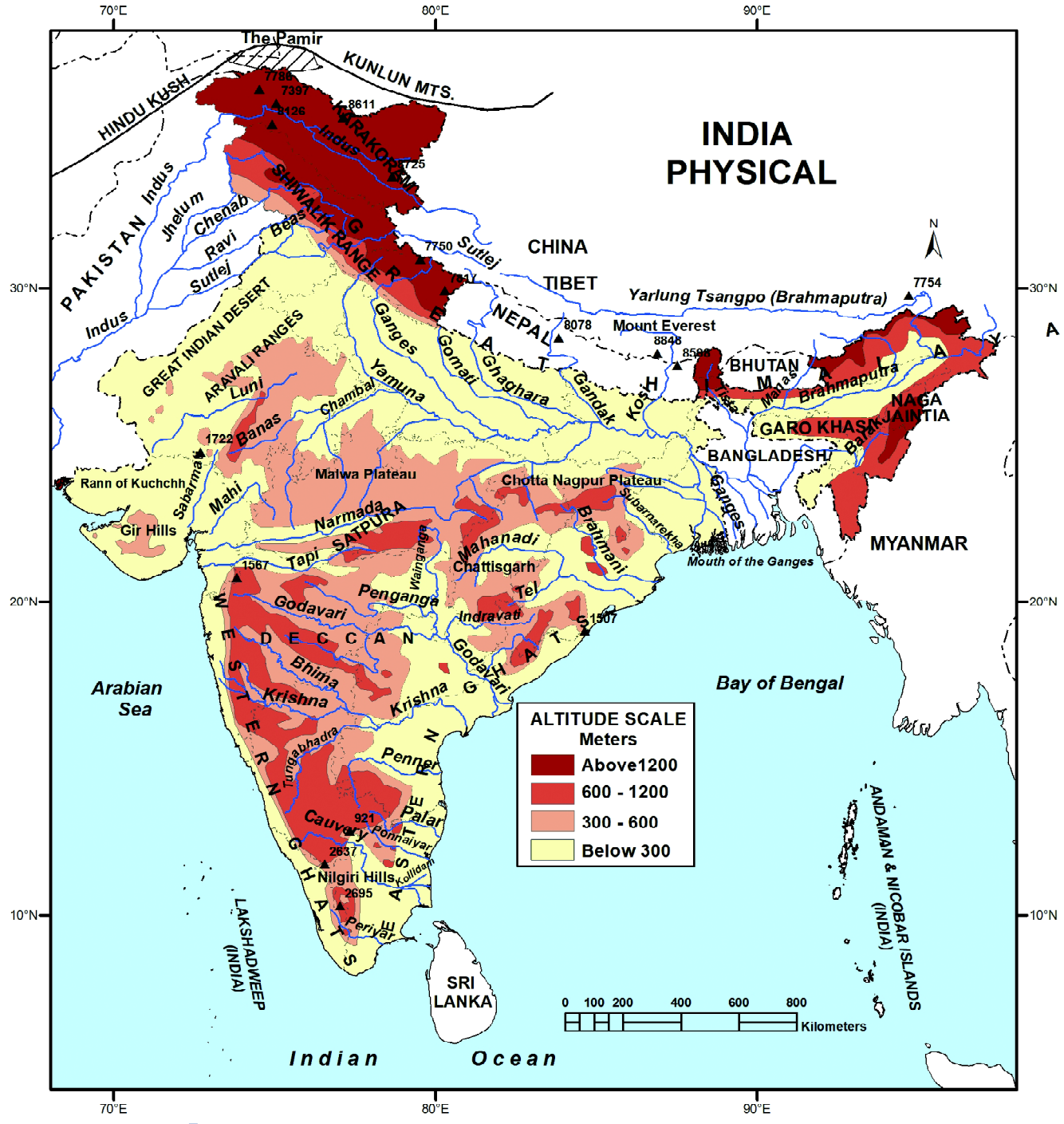
upon the function that a map is to perform, maps can be classified into physical and cultural maps.

- **Physical maps-** Physical maps show the physical features. These include relief, geology, drainage, soil, various elements of weather, climate and vegetation, etc. Depending upon the features they represent maps are known as relief maps, geological maps, climatic maps and soil maps, etc. Figure-8 shows a few examples of physical maps.




(a)

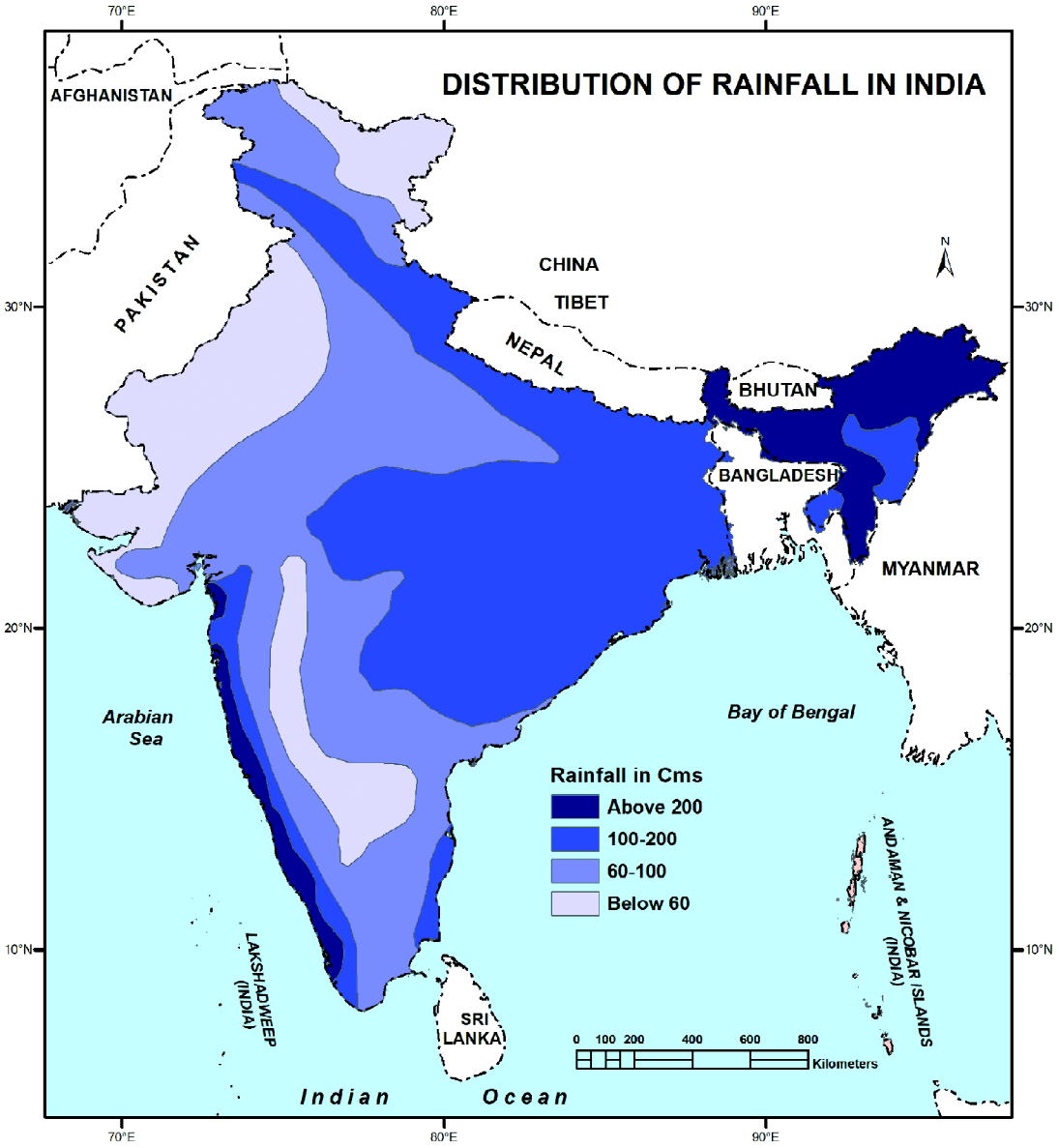



Fig. 1.7: (a) Relief map (b) Weather map

- **Cultural maps-** Cultural maps show cultural features or human-made features existing on the earth's surface. These include maps showing administrative divisions, population distribution, population density, age and sex of population, location of settlement, transportation lines and flow of goods and services from one place to another, etc. Based on the features, cultural maps show they are known as political maps (showing administrative divisions), population maps, economic maps (showing agricultural production, types of crops, minerals, location of industries, etc.), transportation maps, etc.

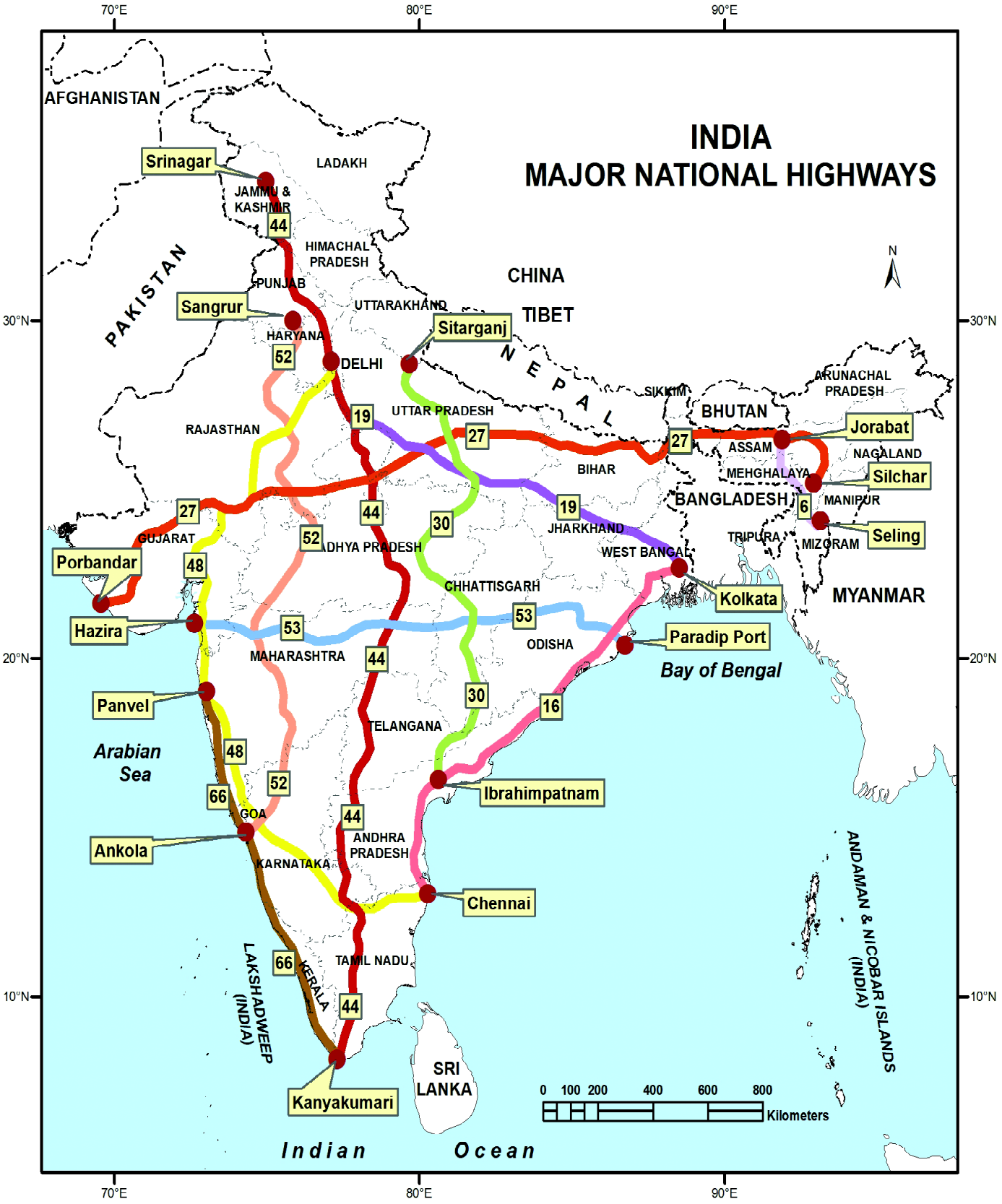



Fig. 1.8: Road map

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Let us try out an activity related to what we have learnt about types of maps.

**LET'S DO IT**

Take your school atlas. Observe the maps given there. Try to find out various types of maps mentioned in this section. You can categorise them as physical and cultural maps depending upon the functions they serve or the features they represent.

The questions ahead will help you in understanding what you have learnt in a better manner.

## INTEXT QUESTIONS 1.3

Mark the options as True or False.

i. Maps can be categorised depending upon the scale into:

   a. Very small scale map and Small scale map

   b. Large scale map and Very large scale map

   c. Small scale map and Large scale map

   d. All the above

ii. _____ is the organisation in India that prepares and publishes topographical maps. Fill in the blank.

iii. Depending upon the type of scale, maps can be categorised into how many types? Name them.

iv. Physical maps show physical features. True or False?

v. Transportation lines are shown with the help of cultural maps. True or False?

## 1.4 TOPOSHEET

Have you ever heard of a toposheet? Do you know what is it? A toposheet is a commonly used name of a topographical map or sheet. As we have learnt earlier in this lesson that toposheets are large scale maps they show greater details of a smaller area. Physical features as well as cultural features, both are shown in it. A topographic map is typically published as a map series, made up of two or more map sheets that combine to form the whole map. The preparation of toposheets started with topographic surveys that were prepared by the military to assist in planning for battle and for defensive emplacements. For this purpose, elevation information was of vital importance. As they evolved, topographic map series became a national resource in modern nations in planning infrastructure and resource exploitation.

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Topographic maps have multiple uses in the present day. This includes any type of geographic planning or large-scale architecture, earth sciences and many other geographic disciplines, mining and other earth-based endeavours and recreational uses such as hiking or, in particular, orienteering, which uses highly detailed maps in its standard requirements. Today, topographic maps are prepared using photogrammetric interpretation of aerial photography, LIDAR and other Remote sensing techniques. Older topographic maps were prepared using traditional surveying instruments.

Let us now try to understand a toposheet. Figure1.9 gives an example of a conventional toposheet whereas Figure-1.10 shows a recent one published by the Survey of India. Let us try to compare both the sheets in detail. Figure-10 gives a labelled toposheet showing the headings and features they show. The details of state (s) represented in the toposheet is given alongwith the districts being covered. The index of sheet with no. is given at one end, latitudinal and longitudinal details, legend with conventional symbols used in the toposheet and other details are mentioned on a toposheet. The newer series as given in Figure-1.10 shows similar features with most of the details given about the toposheet in the left hand side instead of at the top or bottom. The centre of each toposheet shows the details of that place represented by the conventional symbols. For example, red patches show settlement, yellow patches show agricultural land, green patches show forest area, blue lines depict rivers and other water bodies, 2 black parallel lines with vertical lines in between at regular intervals represent railway lines, brown undulated lines and circles are the contours, etc.

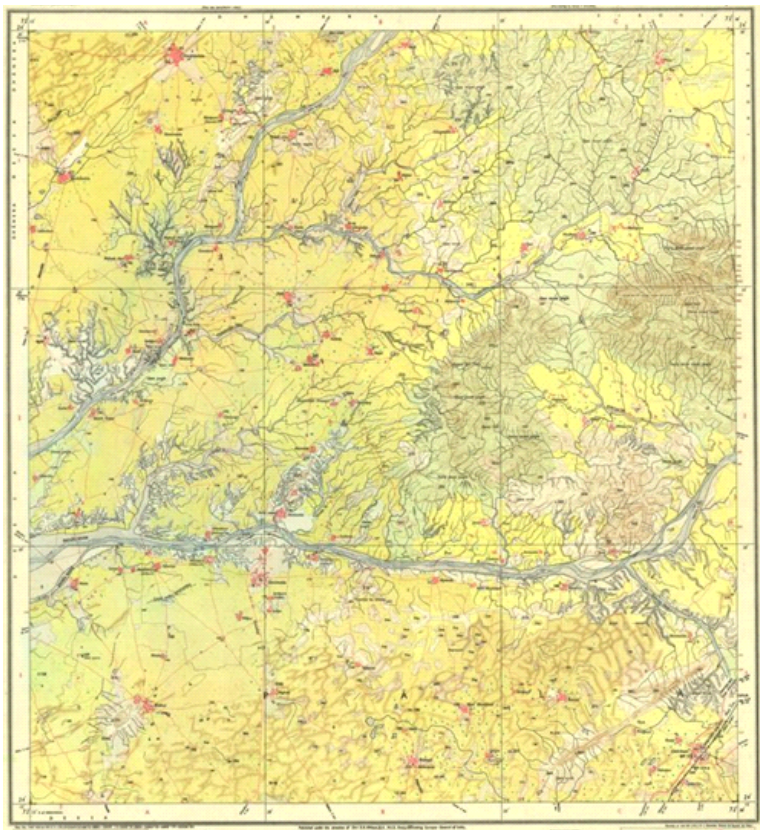

Fig. 1.9 Labelled Toposheet

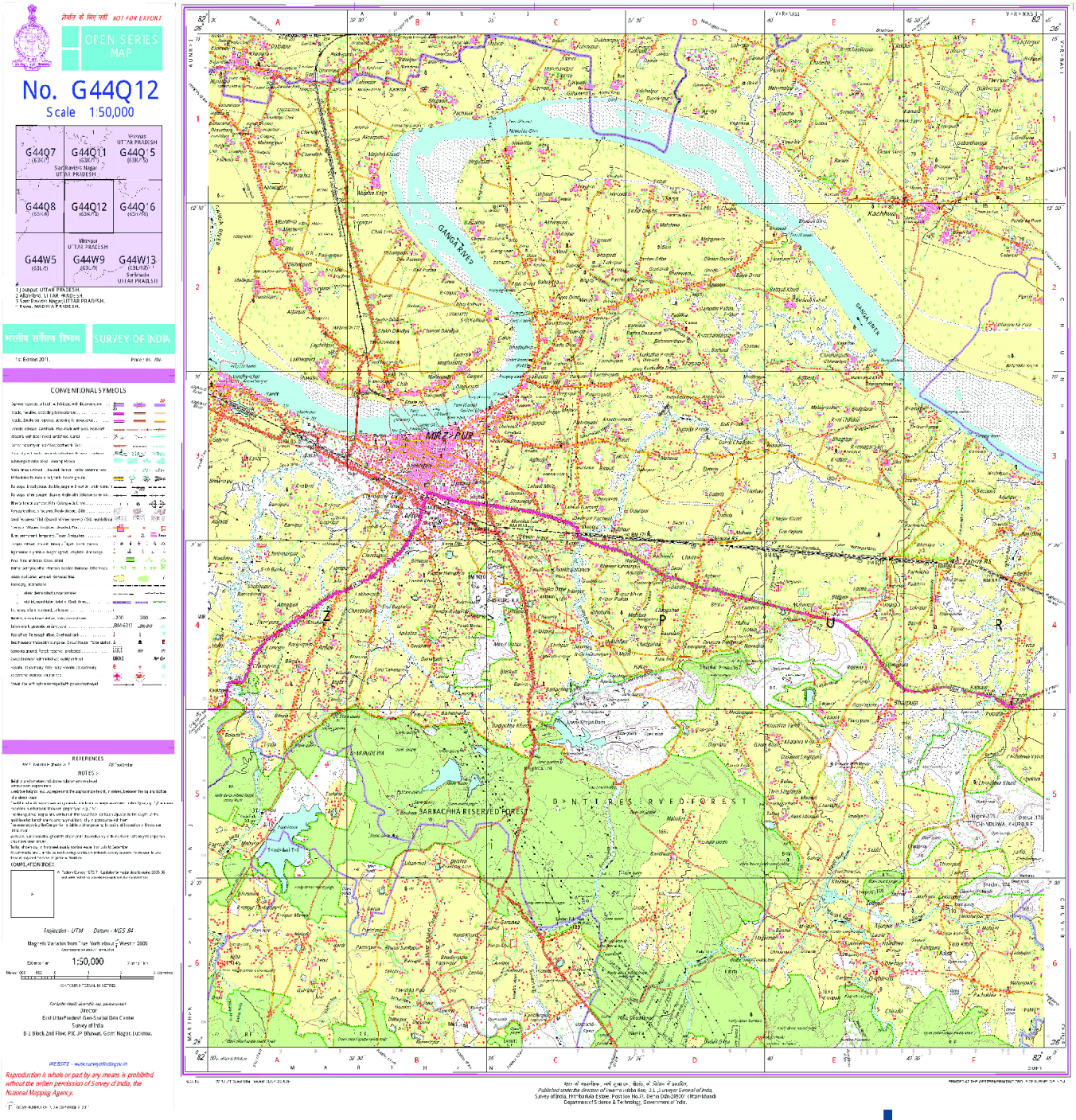


Fig. 1.10 Toposheet- Open Educational Series

Let us try to read a toposheet in brief. The toposheet (Figure-1.10) belongs to Uttar Pradesh covering parts of Mirzapur district. The index no. of the sheet is G44Q12 which is drawn on the scale of 1:50,000 and is drawn using UTM projection. The area represented in the toposheet is located in the northern part of the district. The latitudinal extent of the area is 25 degrees 0 minutes-25 degrees 15 minutes N and the longitudinal extent is from 82 degrees 30 minutes-82 degrees 45 minutes E. The toposheet was published by the Survey of India and it is the 1st edition of this series which came out in 2019.

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In general, the area represented in the toposheet is a plain area as there are few contour lines which do not exceed 200 metres of height and they are placed at larger distances. Though few rocky slopes can be seen in the southern part that are covered with vegetation (green colour). River Ganga passes through the northern part of the area forming meanders and floodplains on both the sides. The plains are used for settlement and agricultural purposes. The southern side of the river has more settlements as the district headquarter of Mirzapur is located here which has a dense compact settlement represented with red coloured dots. A railway line passes through the area from East to West dividing the whole area into two parts. NH135 comes and joins NH35 and is met with several other secondary roads. Settlements of linear type are seen all along these roads. Settlements are surrounded by agricultural land shown in yellow colour and are dotted with various religious features like, temples and mosques, etc. and cultural features like, railway station and post office, etc.

After knowing about maps, elements of a map, types of maps, toposheet and scale let us solve a few questions.

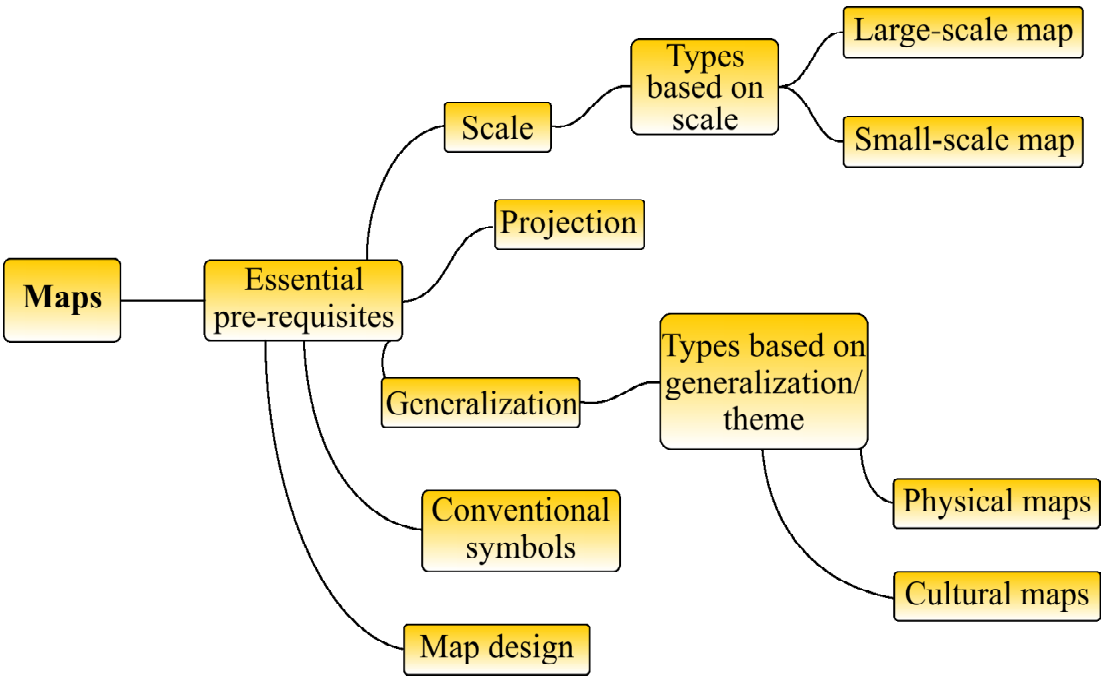
## TERMINAL QUESTIONS

1. Name the scale represented by a straight line.
2. What are the demerits of Linear Scale?
3. What are topographical sheets?
4. Match the correct pair:

| | | |
|---|---|---|
| a. | 1:50 | Cultural Map |
| b. | RF | Physical Map |
| c. | Soil Map | Small Scale |
| d. | Population Distribution Map | Large Scale |
| e. | 1:5,000 | Representative Fraction |

5. What are developable surfaces?

## WHAT YOU HAVE LEARNT




### Exercise For Practical Record Book

1. A car running at a speed of 45 Kilometres per hour to reach Ghaziabad from Delhi in 20 minutes. If the distance between Delhi and Ghaziabad is shown on a map by a distance of 2.5 cm, draw a graphic scale for this map and calculate the R.F. also.

2. Construct a graphic scale on a R.F. of 1:40,000 so that one can read kilometres and metres directly on it.

## ANSWERS TO INTEXT QUESTIONS

**1.1**

i. Maps are simplified representations of whole or a part of the earth's surface on a plane surface.

ii. It is not possible to represent the whole of the earth or a part of it in the same three-dimensional form like a globe. Therefore, we represent if in two-dimensional forms such as, maps.

iii. Three, two

iv. Two, different

*Notes*

**1.2**

i. Cartography

ii. All the above

iii. Scale

iv. Projection

v. The features present on the earth's surface are represented on a map using various symbols, colours and shades. These are known as conventional symbols.

**1.3**

i. C

ii. Survey of India

iii. Two: Large-scale and small-scale

iv. True

v. True