UNIT 7

Mapping Skills

Learning objectives

- To introduce maps
- To read maps using its components
- To learn the methods of surveying and other techniques of acquiring map data like aerial photography and satellite remote sensing
- To gain knowledge of the latest techniques of mapping, namely GIS and GNSS

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Introduction

With maps on hand, one can see the world in one sweep. A map is worth a thousand words. Mapping skills are the basics to understand a map and to interpret the area depicted. Maps are introduced with its components such as scale, signs and symbols. Surveying is the process of recording the measurement of a land area. Its outcomes are the data sources of maps. This lesson deals with the latest techniques of mapping - remote sensing, GPS, GIS, global navigation system and web maps of the 21st century.

7.1 Map as a Tool

A map is the basic tool of a geographer. It illustrates the earth's surface clearly and effectively through a combination of drawings, words and symbols. Thus, maps form an integral part of teaching geography. A map is a location guide.

DO YOU KNOW?

A cartographer is one who measures, analyzes and interprets geographical information to create maps and charts for political, cultural and educational purposes.

7.1.1 Maps and Cartography

Maps are drawings of an area as seen from above. A map is defined as the miniature image of the 3 dimensional earth's surface on a paper/cloth or any flat surface. Maps can show a whole or part of the world. Maps are drawn to a scale and direction. Maps have legends to explain the meaning of symbols and colours used on it. The art of map - making is called **Cartography**.

7.1.2 Components of a map

A map should include the following components namely, the title, scale, direction, grid system, projection, legend, conventional signs and symbols.

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(A) Title

It indicates the purpose or theme of the map. Example: India – Physical, World – Political, Tamil Nadu – Transport.

(B) Scale

Scale makes it possible to reduce the size of the whole earth to show it on a piece of paper. A scale is a ratio between the actual

distance on the map to the actual distance on the ground. Scales can be represented in three methods. They are the **Statement, Representative Fraction (R.F) and Linear or Graphical scale methods.**

Statement scale

The statement scale describes the relationship of map distance to ground distance in words, such as one centimetre to ten kilometres. It is expressed as 1cm = 10 km.

The Representative Fraction (R.F)

It describes the proportion or ratio of the map distance to ground distance. It is usually abbreviated as R.F. It is stated as 1/100000 (or) 1:100000. This means that one unit on the map represents 100,000 of the same unit on the ground. This unit may be an inch or a centimetre or any other linear measurement unit. Thus,

Representative Fraction

$$(R.F.) = \frac{\text{Distance on the map}}{\text{Distance on the ground}}$$

For example: To find the RF when the scale is 1 cm to 1km. Here, 1 cm =1 km

According to the formula, R.F= $\frac{1\,cm}{1\,km}$

Convert the km to cm. Therefore, 1km =100000 cm. So, RF. is 1:100000.

Find the R.F. when the scale is 1 centimetre to 2 kilometre.

Linear (or) Graphical scale

In a map, a linear scale is represented by a straight line divided into equal parts (Primary and secondary) to show what these markings represent on the actual ground. This scale helps in the direct measurement of distance on the map.

Linear scale model

1/50,000 (fractional scale)
1:50,000 (ratio)
1 unit on the map represents 50,000 units in the real world.

(C) Direction

Maps are drawn normally with north orientation. North direction in a map is always towards the North Pole of the earth. If you position yourself looking at the North Pole, on your right will be the east; your left will be the west; at your back will be south. These four main directions are called the cardinal directions. Direction is usually indicated on a map by a North-South line, with the North direction represented by an arrow head.

Activity

Imagine you are standing in India facing north, find in which direction are the following located using the map given below

Saudi Arabia _____
Myanmar _____
China _____
Indian ocean _____
Kazakhstan _____
Sumatra _____
Afghanistan _____

Mnemonic device or memory technique to recall cardinal directions is the sentence "Never Eat Soggy Wheaties." (North, East, South and West)

(D) Grid System

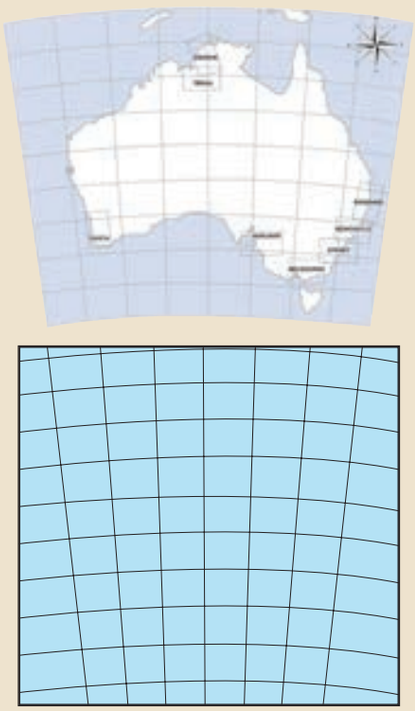
The location of a place can be simply defined by its latitude and longitude. In normal practice, latitude is stated first and then comes the longitude. The latitude and longitude of a place can be expressed in units of **degree, minutes and seconds**.

DO YOU KNOW?

The mainland of India extends from 8°4'N to 37°6'N latitude and from 68°7' E to 97°25' E longitude. Here, (°) is degree and (') is minutes.

Activity

Use grids to enlarge Australia.

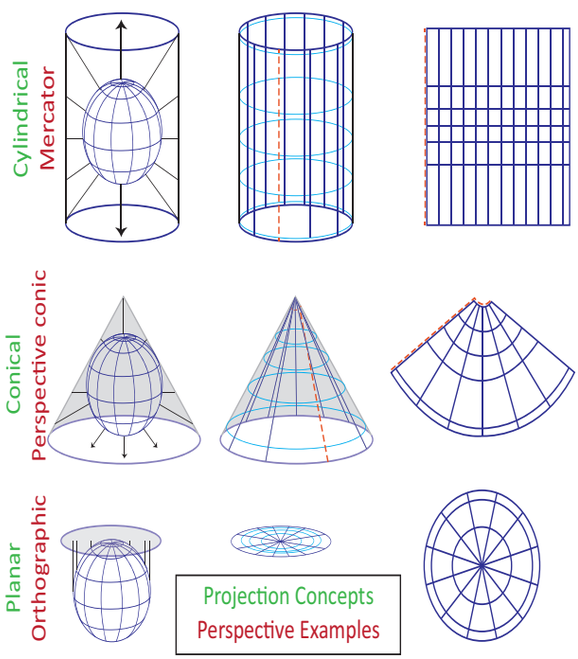


(E) Projection

A map projection is a way of showing the spherical shaped earth on a flat piece of paper. Where does the word 'projection' come from? Imagine a clear globe with latitude and longitude lines and the outlines of the landmasses on it. Suppose there was a light bulb inside the globe. If you wrapped a piece of paper around the globe and turned on the light bulb, the outlines of the grid and landmasses would be projected onto the paper. Map projection is defined as the transformation of spherical network of latitudes and longitudes on a plane surface. Projections are drawn to maintain the **shape, area and directions**.

The three methods in widest use are as follows:

- Projection on the surface of a cylinder
- Projection on to the surface of a cone
- Projection directly onto a flat plane, called planar or zenithal or azimuthal projection



(F) Legend

The legend of a map helps to understand the map details which are placed at the left or right corner at the bottom of the map.

(G) Conventional signs and symbols

Conventional signs and symbols are standard symbols used on a map and explained in the legend to convey a definite meaning. The topographic map contains a variety of information about physical and cultural features.

These are shown by using signs and symbols in various colours so that the clarity of the map is maintained.

There are three types of map symbols

1. **Point Symbols** - buildings, dipping tanks, trigonometrical beacons
2. **Line Symbols** - railways, roads, power lines, telephone lines
3. **Area Symbols** - Cultivated lands, ponds, orchards and vineyards

The actual shape of the Earth is termed Geoid, which is an oblate spheroid.

The "azimuthal" polar projection is depicted on the United Nations flag.

North America was prominent on the initial 1945 UN flag (which had the longitude line 90 degrees west pointing upwards). The following year, the map on the flag was reoriented to be more neutral by having the International Date Line (180 degrees east, lying in the middle of the Pacific Ocean) pointing upwards. The map ends at 60 degrees South latitude, meaning Antarctica does not appear.

The following colour codes are used with map symbols

1. **Brown:** land or earth features - contour lines, eroded areas, prominent rock outcrops, sand areas and dunes, secondary or gravel roads
2. **Light Blue:** water features - canals, coastlines, dams, lakes, marshes, swamps and levees, ponds, rivers and water towers.
3. **Dark Blue:** national waterways
4. **Green:** vegetation features - cultivated fields, golf courses, nature and game reserve boundaries, orchards and vineyards, recreation grounds, woodland
5. **Black:** construction features - roads, tracks, railways, buildings, bridges, cemeteries, communication towers, dam walls, excavations and mine dumps, telelphone lines, power lines, windpumps, boundaries
6. **Red:** construction features - national, arterial and main roads, lighthouses and marine lights
7. **Pink:** international boundaries

Conventional Signs and Symbols

	Fort		Metalled Road
	Church		Cart track
	Pagoda		Pack-track
	Graveyard		Foot-path with bridge
	Chhatri		Aerodrome
	Mosque		Light-house
	Temple		Electric power Line
PO	Post Office		Perennial Stream
PS	Police Station		Dry Stream
RH	Rest House		Canal
CH	Circuit House		Dry River
IB	Inspection Bunglow		Dam with masonry work
RS	Railway station		Dam with earth work
	Broad Gauge Railway		Permenant Hut
	Level Crossing		Temporary Hut
	Metalled Road		Tower Antiquities

7.1.3. Survey

Surveying is done to measure the angle, direction, area, height and distance of an object or place on the surface of the earth using instruments. Surveying techniques are used to obtain the field data and to prepare maps. A knowledge of surveying helps one in map-making, particularly in the preparation of physical maps.

Geographers mainly use **Chain, Prismatic compass, Plane table, Dumpy level, Abney level, Clinometre, Theodolite, Total Station** and **GNSS** to measure the distance, angle, altitude and position of the area of survey.

Modern survey tools used by geographers for map making.

Early History of Surveying: In Egypt, surveyors were called 'rope stretchers' because they used ropes to measure distances.

The Egyptian 'Rope Stretchers'

7.2 Remote Sensing as a Source of Map Data

Remote Sensing refers to the observation and measurement of earthly objects without touching them.

'**Remote**' means far away and '**Sensing**' means observing or collecting information. Remote sensing means acquiring information of things/places from a distance, using a variety of tools and methods.

We operate three remote sensing organs in our body.

a) Eyes -sense of sight

b) Nose - sense of smell

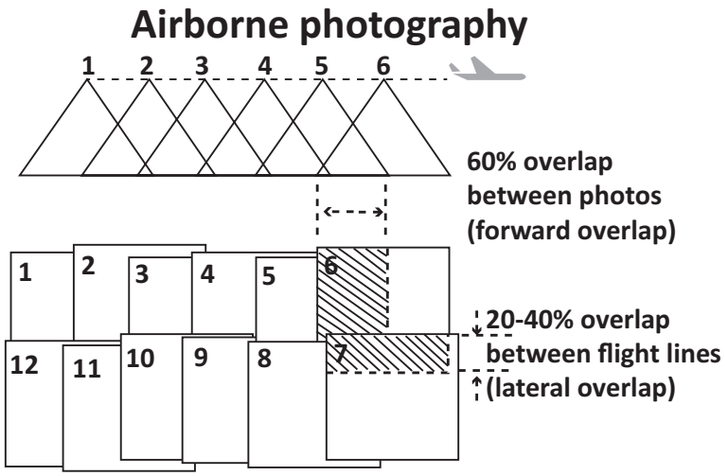
c) Ear – Sense of hearing

Remote sensing has a long history, dating back from the use of cameras carried by balloons and pigeons in the 18th and 19th centuries. During the 20th century, airborne photographs and satellite remote sensing developed swiftly.

7.2.1. Aerial photography

Aerial photography refers to the technique of obtaining information about places or objects or phenomena with the help of photographs taken using cameras mounted on **low flying birds, balloons, helicopters, aeroplanes and drones.** The aerial photographs are captured continuously with a time gap of 10-30 seconds at a fixed height. Each photo will have a slight overlap of the area in the preceding photo. By making a mosaic of all the photos excluding the overlapping areas, a stereoscopic (3D) image of the study area can be produced.

Felix Nadar was a French photographer, journalist, novelist and balloonist. In 1858, he became the first person to take aerial photographs. He took his first photograph in 1853 and pioneered the use of artificial lighting in photography, working in the catacombs of Paris. Around 1863, Nadar built a huge (6000 m^3) balloon named Le Géant ('The Giant').



Components of Remote Sensing

- Energy source
- Transmission path
- Target
- Sensor

Aerial photography using drone in the techno world

7.2.2 Satellite Remote Sensing

Satellite remote sensing is the science of collecting data about an object or area from artificial satellites orbiting the Earth. The term 'satellite imagery' refers to digitally transmitted images of the satellites.

7.2.3 Global Navigation Satellite System (GNSS)

Have you ever booked a cab using a smart phone app? Did you see the map showing the route of your travel and movement of your vehicle on mobile phones? How is it possible to calculate the time duration of your travel?

Satellite remote sensing	Aerial Photography
	
■ High cost of satellite systems. Takes at least 10 years to plan, construct, test and launch. ■ Satellites collect large amount of data of the entire area in a short span. ■ It allows global coverage and does not require permission. ■ Satellites circle the Earth; they can repeat and revisit easily. ■ Weather does not affect the functioning of satellites. ■ All information is digital; it can be easily integrated with software for image improvement.	■ Surveying can be planned and executed in a shorter time economically. ■ Takes more time to capture an area. Aircraft needs to fly back and forth. ■ It covers a small area and needs permission from authorities. ■ Revisits or repeatability involves extra cost. ■ Adversely affected by bad weather ■ It is an analogue record, so no further improvement is possible after obtaining photographs.

In the 21st century, GNSS has become a part of our lives to promote the safety and convenience of transport. **Global Navigation Satellite System (GNSS)** is a satellite system connected with a small electronic receiver or tracker to locate, monitor and track a user's vehicle wherever in the world. It can also set up instant alerts when a driver of a vehicle speeds or deviates from a particular area. GNSS applications are used in tracking or mapping vehicles, ships and aircraft. A group of satellites (Space Segment) working with a network of ground stations (Control Segment) provide location data. The receiver (User Segment) converts satellite signals into location, speed and time data.

Examples of GNSS

- Europe-Galileo
- USA-NAVSTAR Global Positioning System (GPS)
- Russia-Global'naya Navigatsionnaya Sputnikovaya Sistema (GLONASS)
- China- BeiDou Navigation Satellite System
- India's-IRNSS (NAVIC) system

a. Global Positioning System (GPS)

Without the Global Positioning System (**GPS**) on our vehicles and mobile phones, we would feel lost. GPS is the U.S. implementation of the world's first and currently the most used Global Navigation Satellite System (GNSS) created by the U. S. Department Of Defense (**DOD**). It became fully operational in 1995. **NAVSTAR** (Navigation Satellite Timing and Ranging) is a network of 24 U.S. satellites in six different orbits in space flying 20,350 km above the surface of the Earth; each one circles the planet twice a day to provide continuous, worldwide coverage. GPS receivers now come in all shapes and sizes, Most are the size of a cellular phone. Some are handheld, others are installed in ships, planes, trucks and cars.

Advantages of GPS

- GPS technology has tremendous applications in everything from mobile phones, watches, bulldozers, shipping containers and ATMs.
- The main purpose of GPS is to help in providing accurate transport data (distance, route and direction). It helps in military searches and rescue in wars. It can work as a reliable tourist guide.
- GPS helps during accident and rescue efforts, speeding the delivery of emergency services and disaster relief.
- Weather forecasting, earthquake monitoring and environmental protection can be done effectively by using GPS.

b. Geographic Information System (GIS)

Geographic Information System is a computer-based tool for managing a large amount of data collected for a given geographic region through remote sensing, GPS and other sources. The Geographic Information System is a combination of computer hardware, software, geographic data and the personnel.

G - Geographic - A particular area
I - Information - facts in order
S - System - arrangement

GIS was first recognised in the late 1950s by Waldo Tobler and Roger Tomlinson (Canada). Prime examples of importing GIS for public welfare are Google Maps, Yahoo Maps and Google Earth.

The key ingredient is location. We must have a coordinate, an address or a distance from a known point that helps us to link the information to a location on a map. Each type of data of an area is stored as a separate 'layer' of the map. In GIS, layers may be used some times and removed according to need. Examples are hospitals, schools, water bodies, parks and ATMs. The computers can create maps showing any combination of data.

7.3 Bhuvan

Bhuvan (Sanskrit for Earth) is a **free internet based computer application** launched by the **Indian Space Research Organization** (ISRO)

on August 12th 2009. It enables visualization of Indian Remote Sensing (IRS) images taken over a year ago, by ISRO's seven satellites, including CartoSat-1 and CartoSat-2. Using Bhuvan connected to Internet, one can explore places of interest, scenes of events in the news or parts around the world they may never visit in person, by either entering the names of places or co-ordinates (latitudes and longitudes). Bhuvan has tremendous uses for scientists, academicians, policy makers and the general public.

Recap

- Surveying is the process of recording the measurements of a land area.
- Anaximander was the first ancient Greek to draw a map of the known world.
- Maps can show the whole or a part of the world.
- The art and science of map making is called Cartography.
- A map should include certain components namely, the title, scale, direction, grid reference, projection, legend, conventional signs and symbols.
- Grids are sets of lines for defining a location on a map.
- Remote sensing means acquiring information of things / places from a distance.
- Global Navigation Satellite System (GNSS) helps to locate, monitor and track a user's vehicle anywhere in the world.
- GIS is a combination of computer hardware, software, geographic data and the personnel.

EXERCISE

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I. Choose the correct answer

1. _____ indicates the purpose or theme of the map.
   a) Title
   b) Scale
   c) Direction
   d) Legend
2. Standard symbols that are used in maps to convey a definite meaning are called _____.
   a) conventional signs and symbols
   b) coordinates
   c) grid references
   d) directions
3. GPS consists of a constellation of _____ satellites.
   a) 7
   b) 24
   c) 32
   d) 64

II. Match the following

1. The art and science of mapping – a) USA
2. Actual shape of the earth – b) Geoid
3. NAVSTAR – e) Cartography

III. Consider the given statements and choose the right option given below

1. **Assertion (A):** The points at which the vertical and horizontal lines of the grid intersect are called coordinates.

   Reason (R): The lines that run horizontally and vertically are called Northings and Eastings respectively.

   (a) Both (A) and (R) are true ; (R) explains (A)

   (b) Both (A) and (R) are true ; (R) does not explain (A)

   (c) (A) is correct ; (R) is false

   (d) (A) is false ; (R) is true

2. **Assertion (A)** The legend of a map does not help us to understand the information in a map.

   Reason (R) It is usually placed at the left or right corner at the bottom of the map.

   (a) (A) is false ; (R) is true

   (b) Both (A) and (R) are true ; (R) does not explain (A)

   (c) (A) is correct ; (R) is false

   (d) Both (A) and (R) are true ; (R) explains (A)

IV. Answer in brief

1. What is a map?
2. What are the components of a map?
3. The distance between two cities A and B is 5 km. It is represented by a line of 5 cm on the map. Calculate the distance and give the answer in RF.
4. Mention a few surveying instruments.
5. Define remote sensing.
6. What are the components of remote sensing?

V. Give Reasons

1. Satellite imageries stimulate map making.
2. Map is the basic tool of a geographer.
3. Grid references are essential to find the exact location of places on a map.

VI. Distinguish Between The Following

1. Globe and Map
2. Aerial photographs and satellite imageries
3. GIS and GPS

VII. Answer in Paragraph

1. What do you mean by the term 'scale of the map'? Explain its classification.
2. Write a note on directions with relevant diagram.
3. Explain the major uses of GPS? Explain about any one.

VIII. MAP EXCERCISE:

1. With the help of an atlas, mark the following on the outline map of Tamil Nadu.
   a) The latitude and longitude of Chennai.
   b) Mark the city located at 10^{0} N, 78^{0} E.
   c) Locate the city approximately on 11^{0}N and 76^{0}E.
   d) Find the latitude and longitude of Kanyakumari and mark it.

IX. HOTS

1. Can you imagine a world without satellites?
2. Imagine you are a cartographer. Draw the map of your area.

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INTERNET RESOURCES

www.usgs.gov.in

www.nasa.gov.in

www.surveyofindia.gov.in

https://bhuvan.nrsc.gov.in

https://www.isro.gov.in

ICT CORNER

MAPPING SKILL

Through this activity, you will know about the distance between any two landmarks in the maps.

Procedure

Step 1: Use the URL or scan the QR code to open the activity page.

Step 2: Click 'Polyline' button. Draw a poly line between any two favourable places.

Step 3: After finishing, the Poly line shows the measurement of distance as miles and kilometres.

Step 4: Click '+' and '-'button to zoom in and zoom out.

URL:

https://mapmaker.nationalgeographic.org/ (or) scan the QR Code

*Pictures are indicatives only.