PAPER 604 PRINCIPLES AND APPLICATION OF RS, GIS AND GPS

SYLLABUS

Part I: Theory (60 Marks)

Unit 1 : Remote Sensing

1. Basics concept of Remote Sensing
2. Components of Remote Sensing – Electromagnetic Radiation (EMR), Sensors and Sensor carrying platforms
3. Types of Remote Sensing: Aerial and Satellite Remote Sensing

Unit 2 : Geographical Information System (GIS)

1. Introduction to GIS: Definition and Components of GIS.
2. Functional units of GIS
3. Nature and types of Geographic data: Spatial and Non-spatial

Unit 3 : Global Positioning System (GPS)

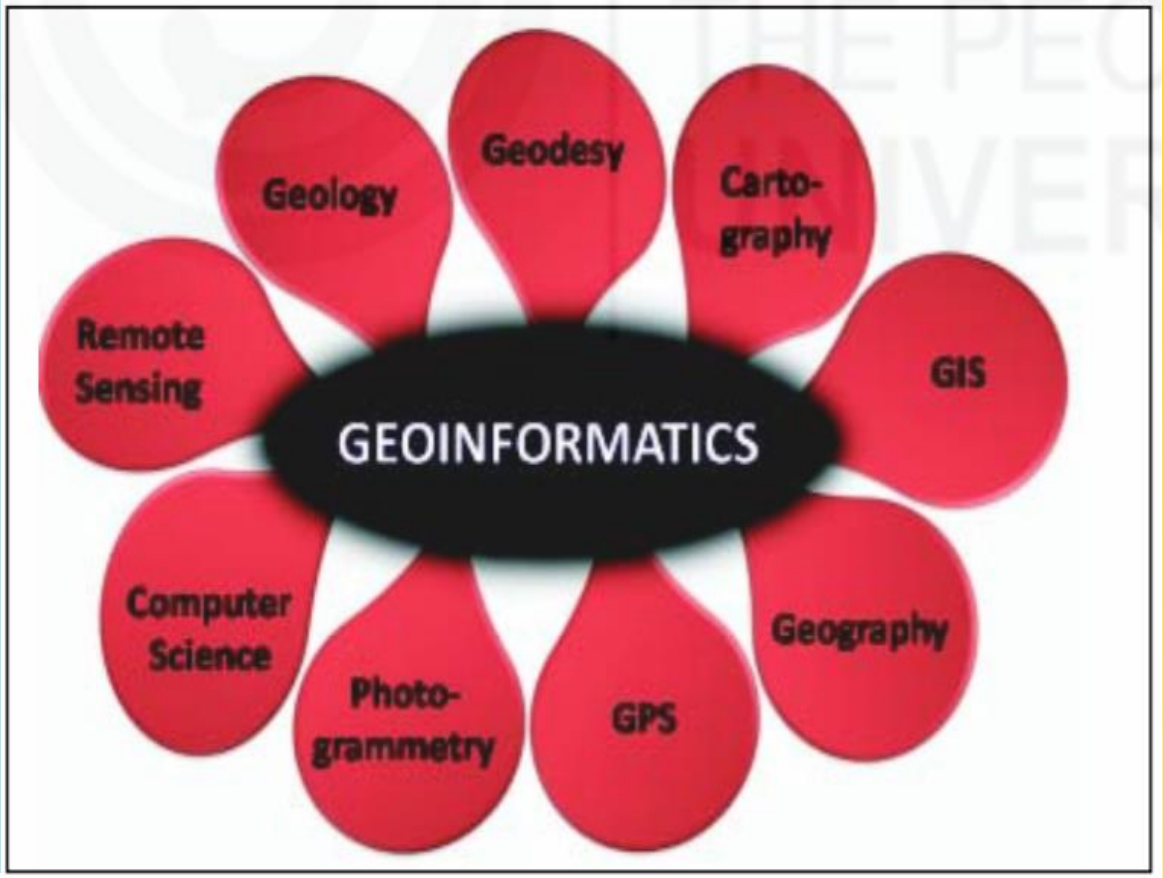
1. Concept of GPS
2. Functions and working principles of GPS

Unit 1 : Remote Sensing

Geoinformatics

Due to increase in human population there is an unprecedented pressure on the existing natural resources such as:

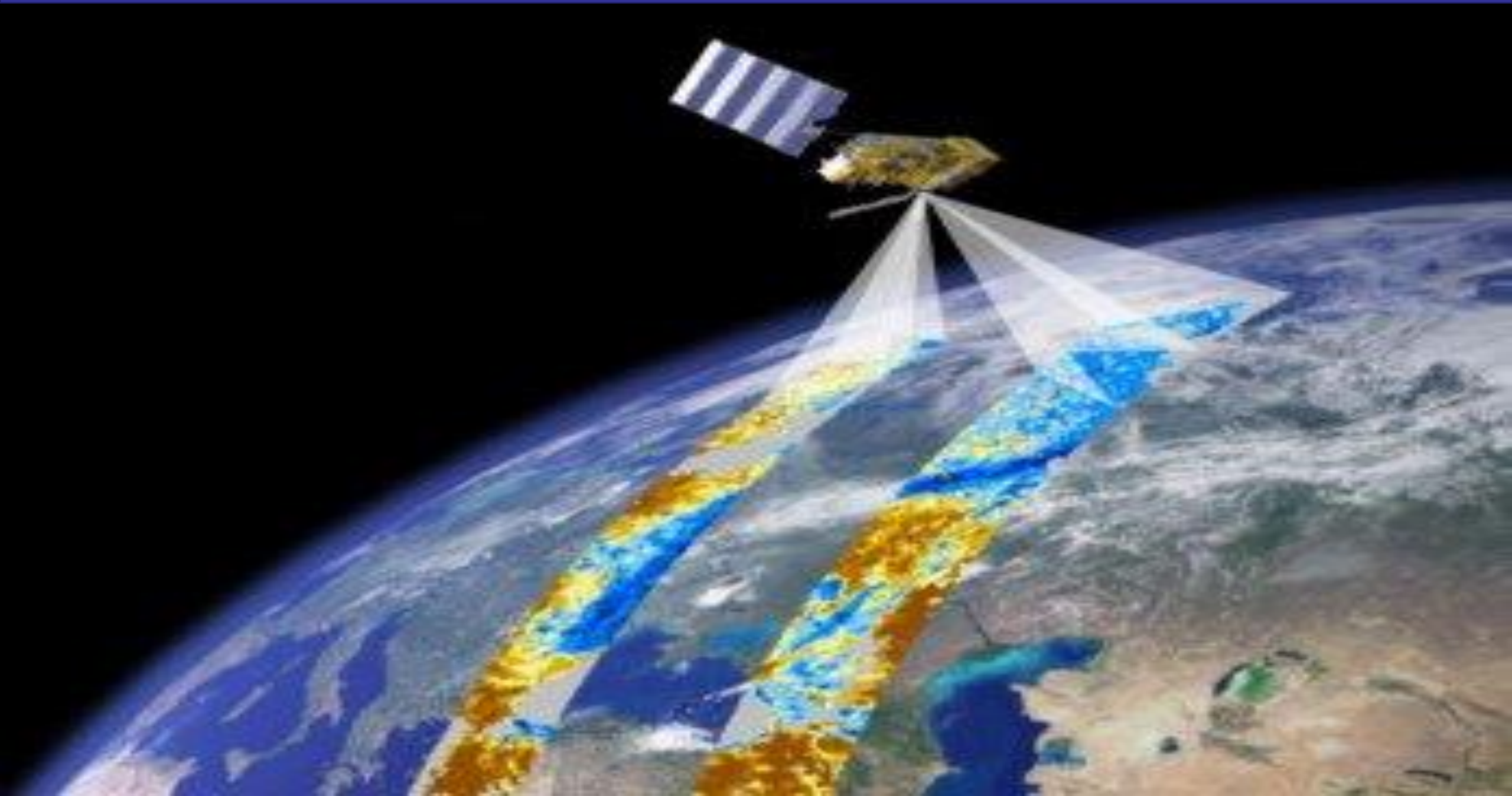
- demand on the infrastructure development,
- urban planning,
- healthy neighbourhood,
- safe transportation of human populace and material, management of natural resources,
- disaster preparedness of the community,
- conservation of biodiversity and elevating the status of endangered animals to safe level, etc.



'Geoinformatics', uses the modern scientific and technological advancements for better utilisation of space to have for sustainable human growth.

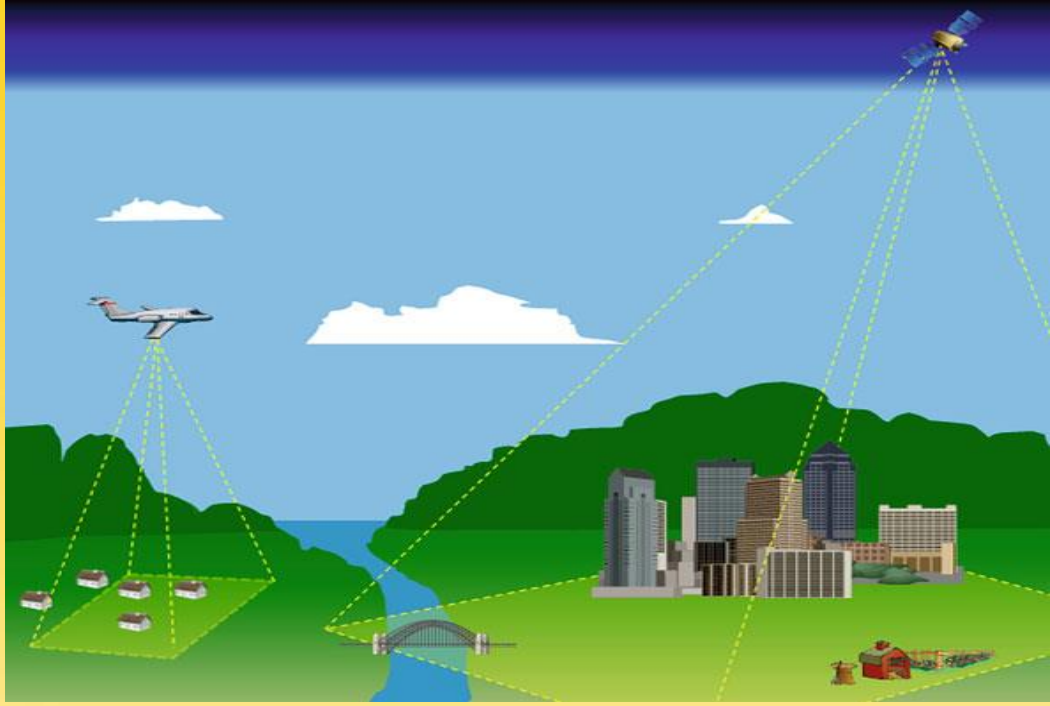
Geoinformatics can be defined as the science and technology that deals with the geoinformation, its acquisition, creation, storage, processing, presentation and dissemination.

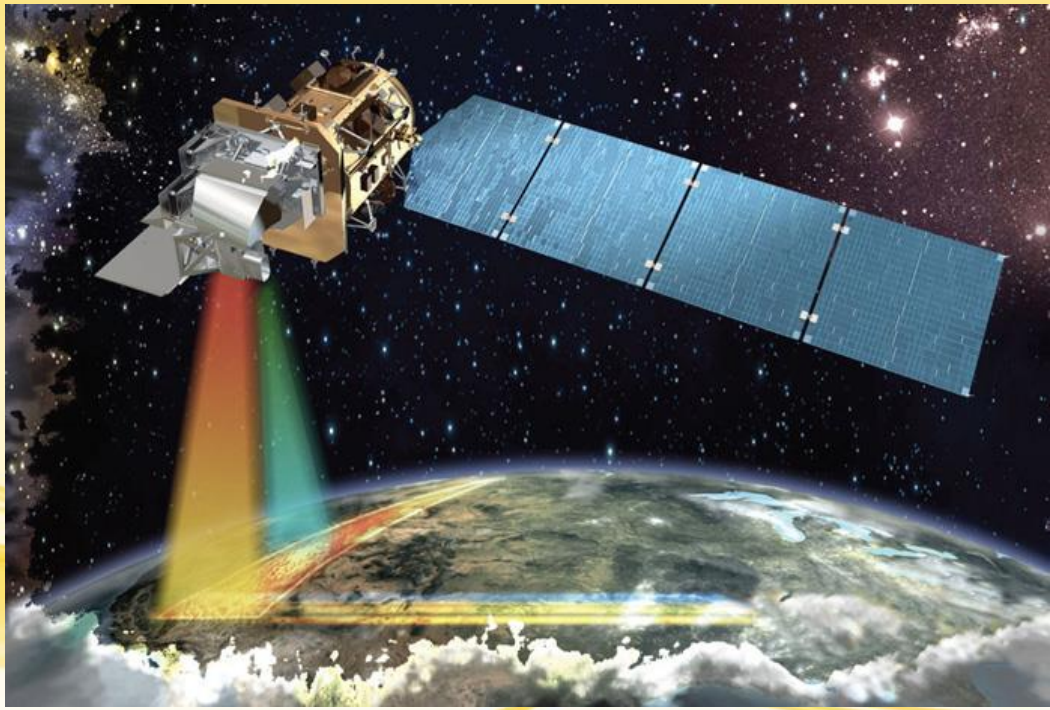
Remote Sensing: Meaning and Definition



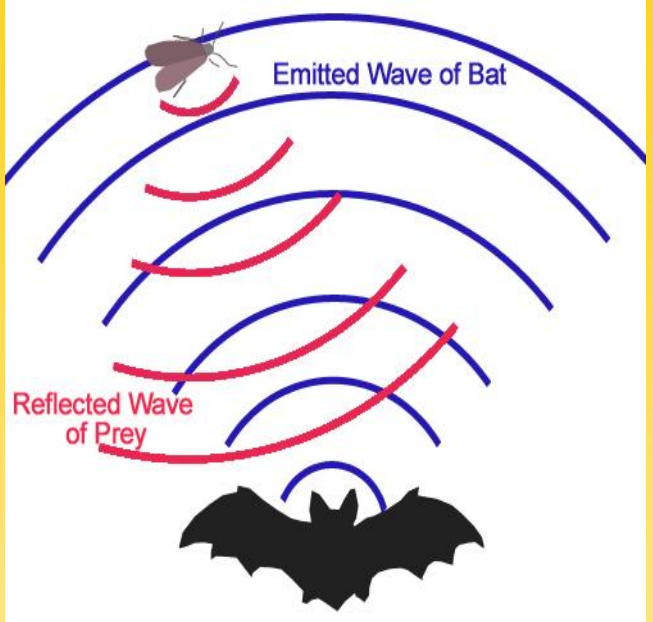
Introduction

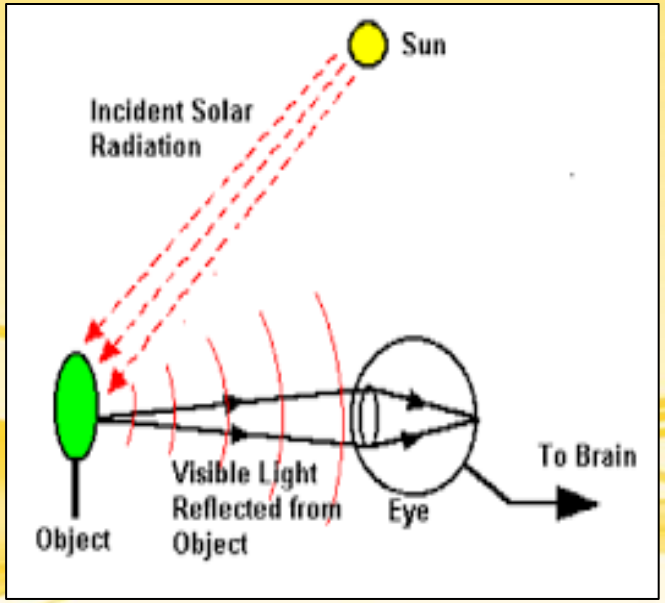
“The collection of data about the spatial distribution of the significant features of the earth's surface has long been an important part of the activities of organized societies. From the earliest civilizations to modern times, spatial data have been collected by navigators, geographers and surveyors, and rendered into pictorial form by map makers or cartographers. Originally, maps were used to describe faroff places, as an aid for navigation and military strategies (Hodgkiss 1961). During the eighteenth century, many governments realised the advantages of systematic mapping of their lands, and commissioned national government institutions to prepare topographical maps. These institutions are still continuing the mapping work. Many of the developing countries are making all attempts to obtain the status of a developed country. These attempts are based on certain strategies relating to areas like natural resources management and development, information technology, tourism development, infrastructure development, rural development, environmental management, facility management, and e-governance. In order to make an effective study of these thrust and emerging fields, new and innovative technologies have been developed.”- Reddy, 2008

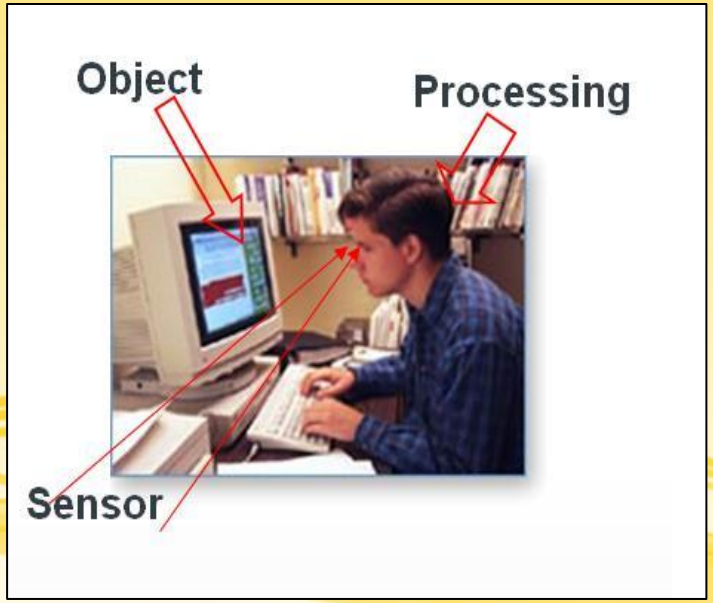


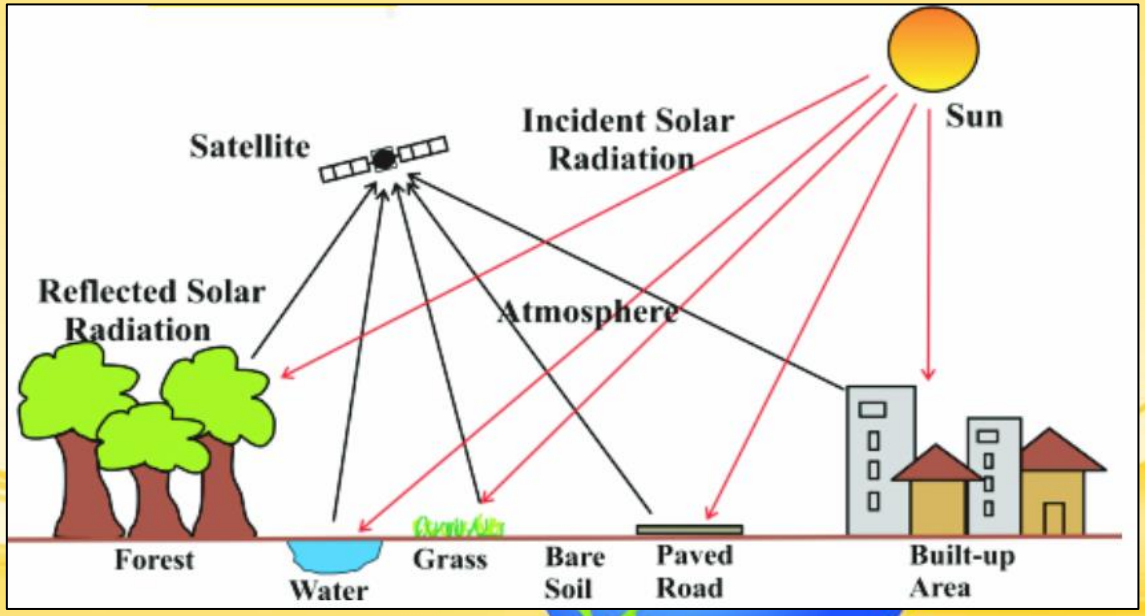


- ***Remote sensing*** is the collection of data about an object from a distance.
- The technique of remote sensing is used to monitor or measure phenomena found in the Earth's lithosphere, biosphere, hydrosphere, and atmosphere.
- Humans and many other types of animals accomplish this task with aid of eyes or by the sense of smell or hearing.
- Remote sensing is usually done with the help of mechanical device known as remote sensor such as cameras, scanners, radiometers, etc.

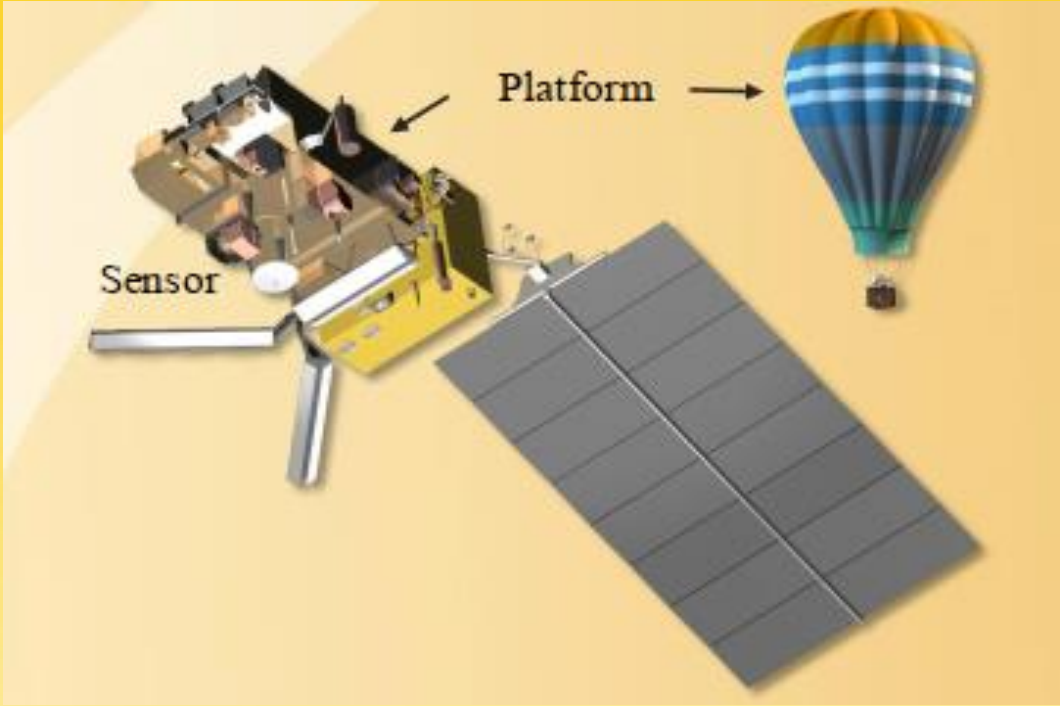


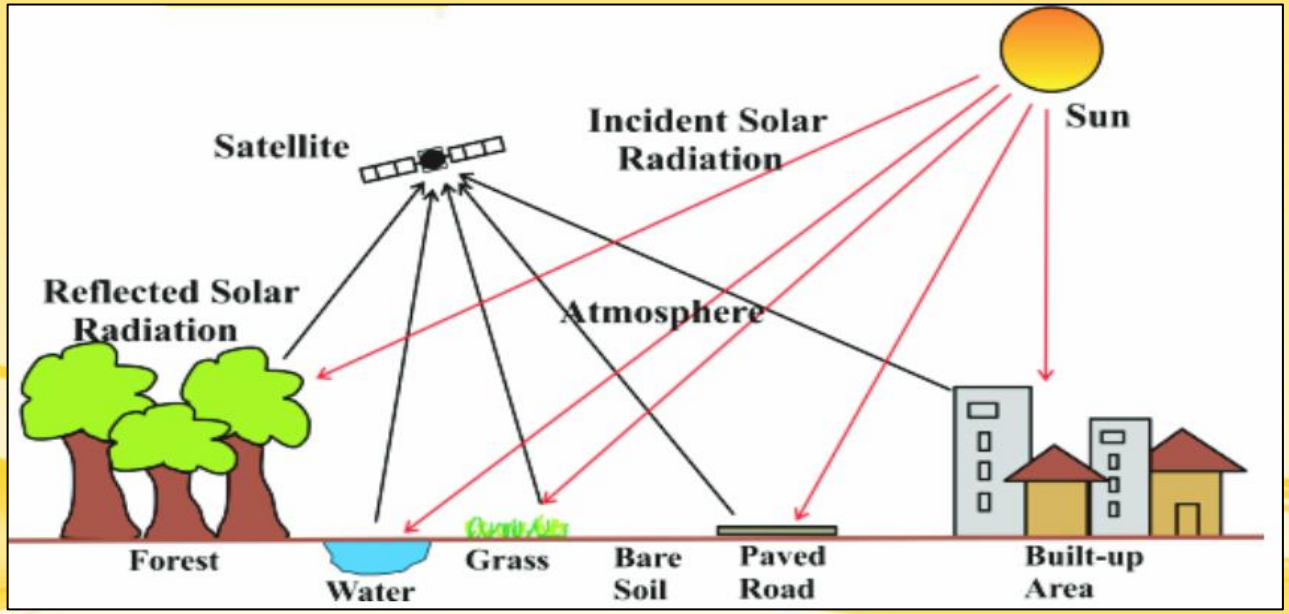


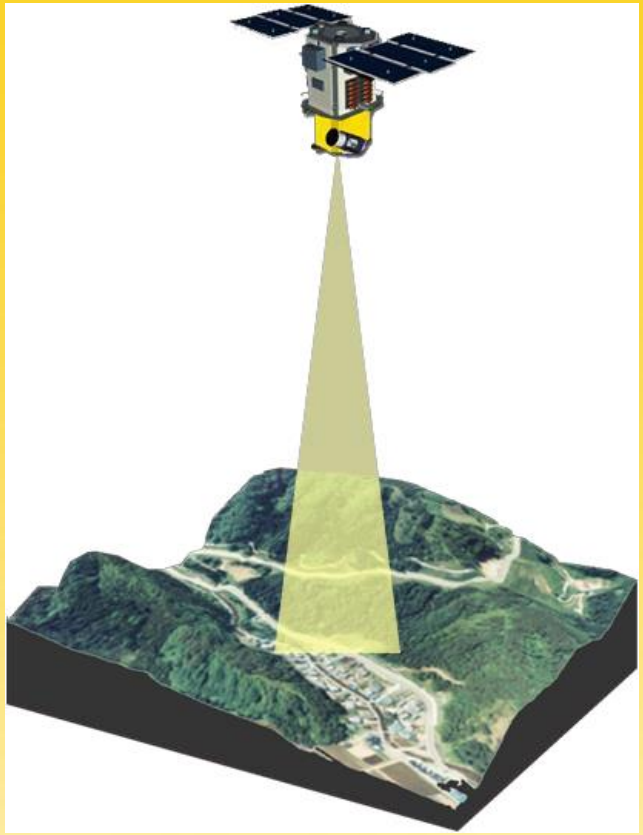




- This device has the ability to receive and record information about an object without having any physical contact with them.
- These sensors are positioned away from the object of interest by using helicopters, planes, space shuttle and satellites.
- Most remote sensing devices record information about an object by measuring an object's transmission of electromagnetic energy from reflecting and radiating surfaces.

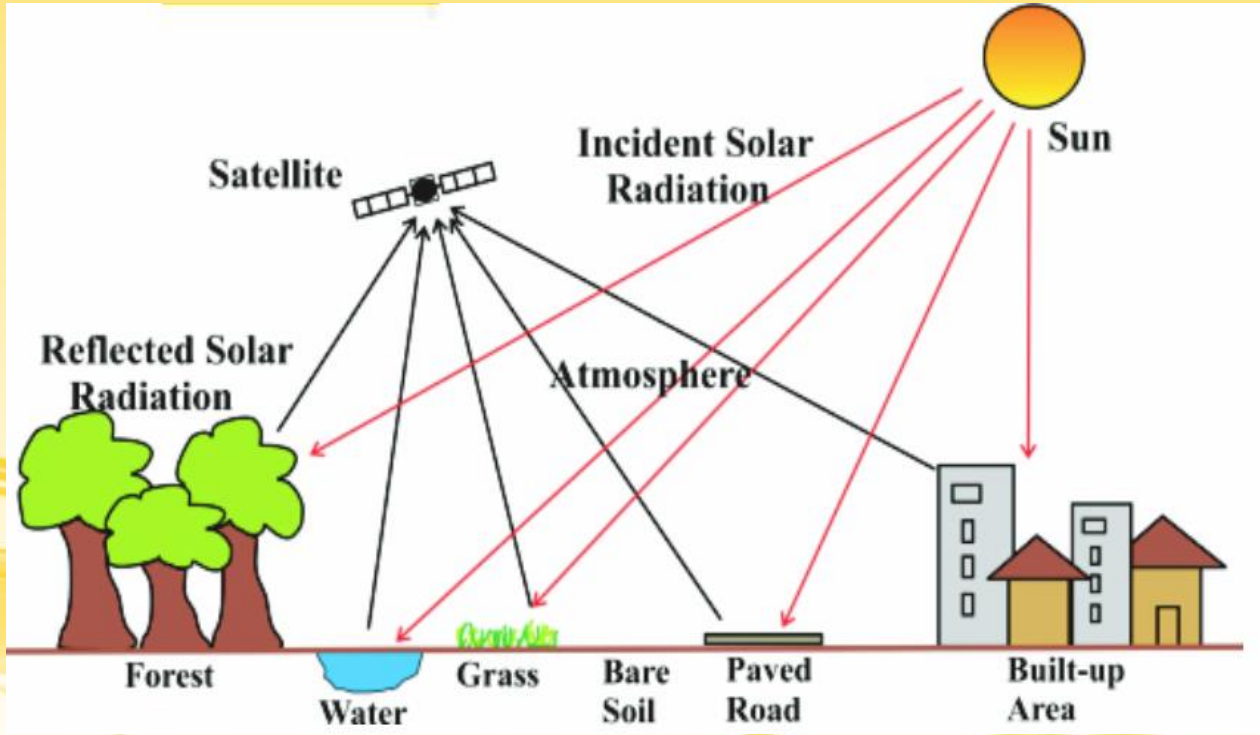






- The simplest form of remote sensing uses photographic cameras to record information from visible or near infrared wavelengths of the electromagnetic spectrum.
- When the energy (in the form of electromagnetic radiation) reaches the Earth's atmosphere, it undergoes the process of reflection, absorption and transmission. Earth's surface consists of different natural and man-made features which reflect, absorb, store and emit Earth's radiation at different wavelengths in different percentages, depending upon their physical and chemical properties.
- Remote sensing sensors record different amount of radiation that is reflected or emitted from different earth surface features and reproduce it in form of an image.

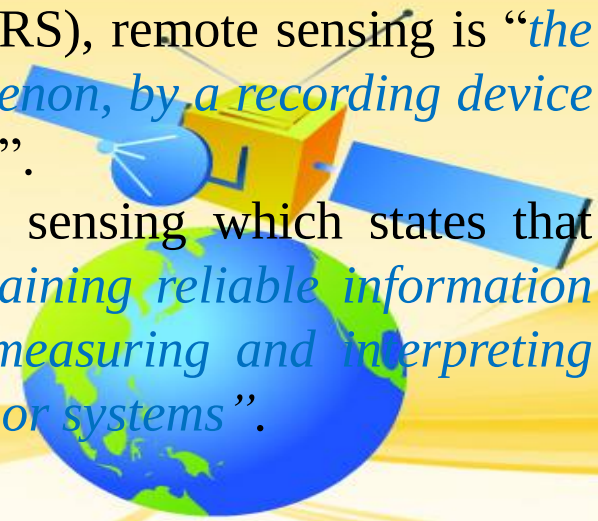
- Remote sensing includes not only what is visual, but also what can't be seen with the eyes.
- Remote sensing provides synoptic view of the earth surface by virtue of recording interactions of Earth surface features with electromagnetic radiation.
- These interactions are recorded in remote sensing images in the form of some numerical information.



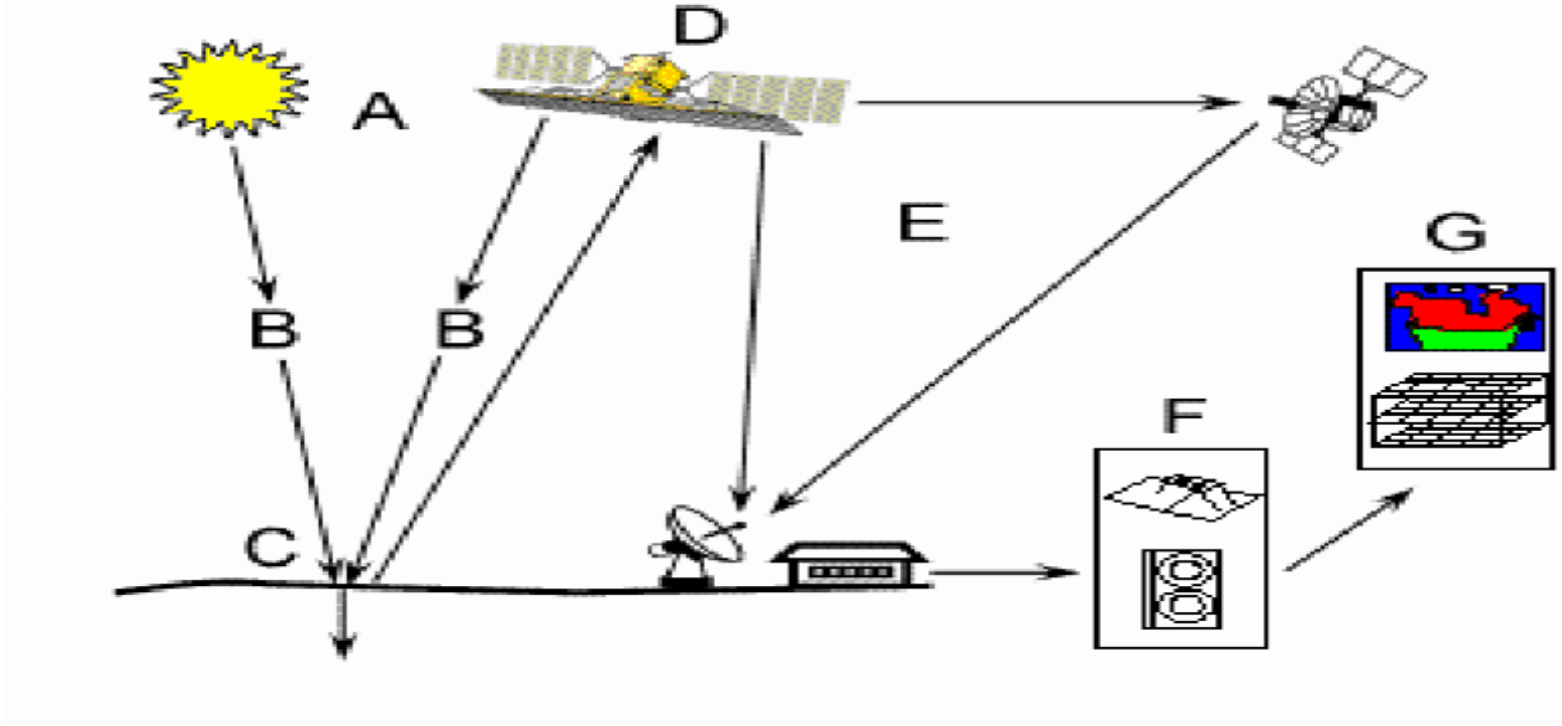
Definition

Remote sensing can be broadly defined as the process of sensing (i.e. acquiring information) from distance. It is formally defined as the science or technique of obtaining information about objects on surface of the Earth without physically coming into direct contact with them.

- Sabins (1978) has defined remote sensing as *"a method that employs electromagnetic energy such as light, heat, and radio waves as the means of detecting and measuring target characteristics*".
- According to Lillesand and Kiefer (1979), remote sensing is "*the science and art of obtaining useful information about an object, area or phenomenon through the analysis of data acquired by a device that is not in contact with the object, area, or phenomenon under investigation*".
- Campbell (2002) has defined remote sensing as "*the practice of deriving information about the Earth's land and water surfaces using images acquired from an overhead perspective, using electromagnetic radiation in one or more regions of the electromagnetic spectrum, reflected or emitted from the Earth's surface*".
- According to the American Society for Photogrammetry and Remote Sensing (ASPRS), remote sensing is "*the measurement or acquisition of information of some property of an object or phenomenon, by a recording device that is not in physical or intimate contact with the object or phenomenon under study*".
- In 1988, ASPRS adopted a combined definition of photogrammetry and remote sensing which states that *"Photogrammetry and remote sensing are the art, science and technology of obtaining reliable information about physical objects and the environment, through the process of recording, measuring and interpreting imagery and digital representations of energy patterns derived from non-contact sensor systems"*.

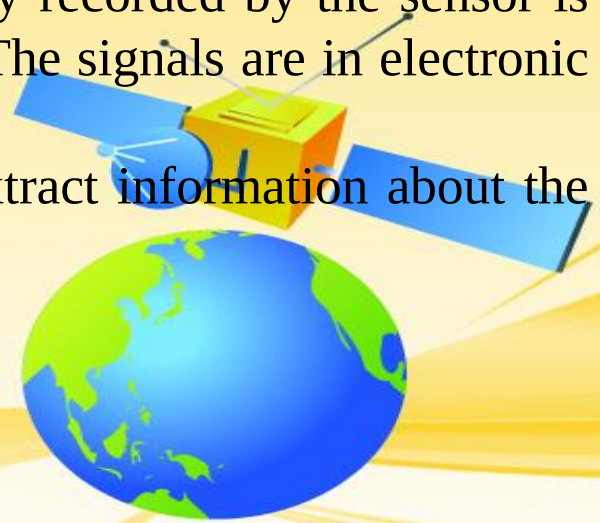


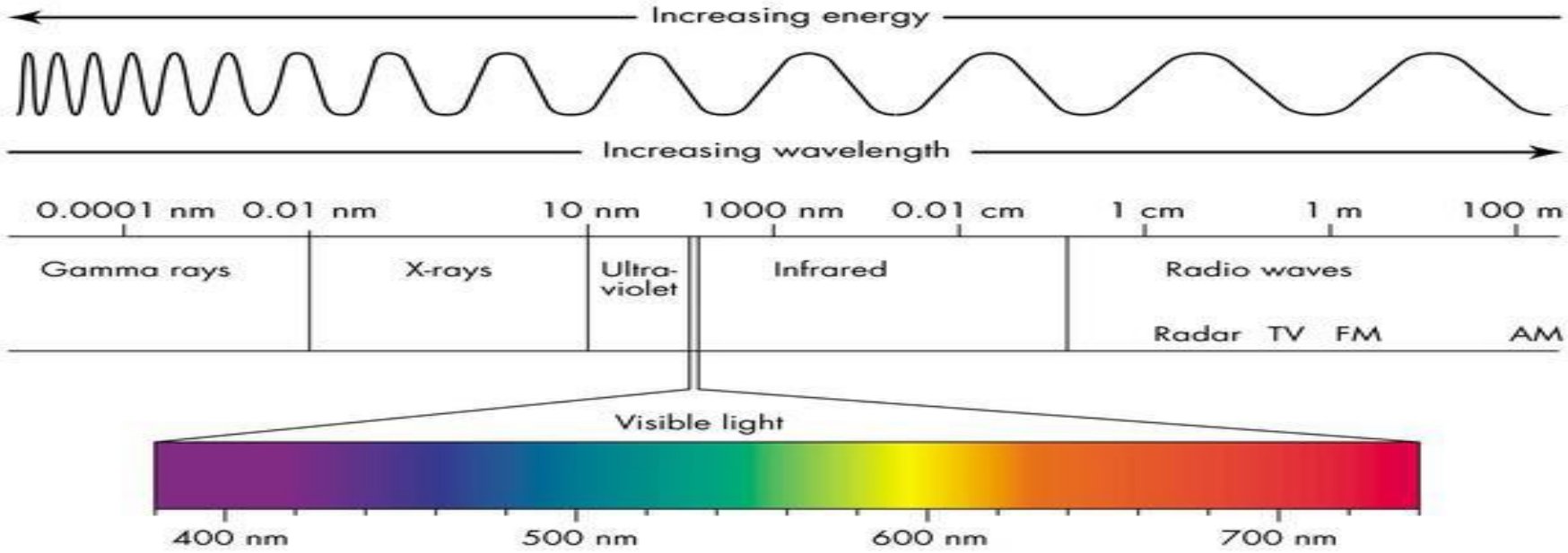
Components of Remote Sensing

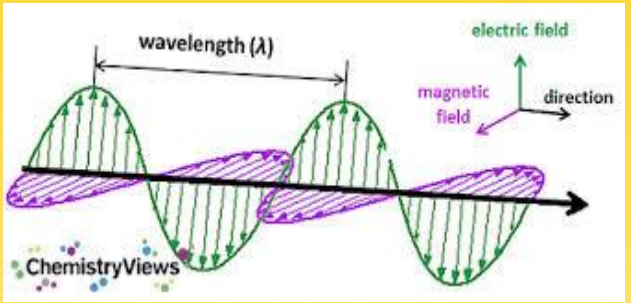


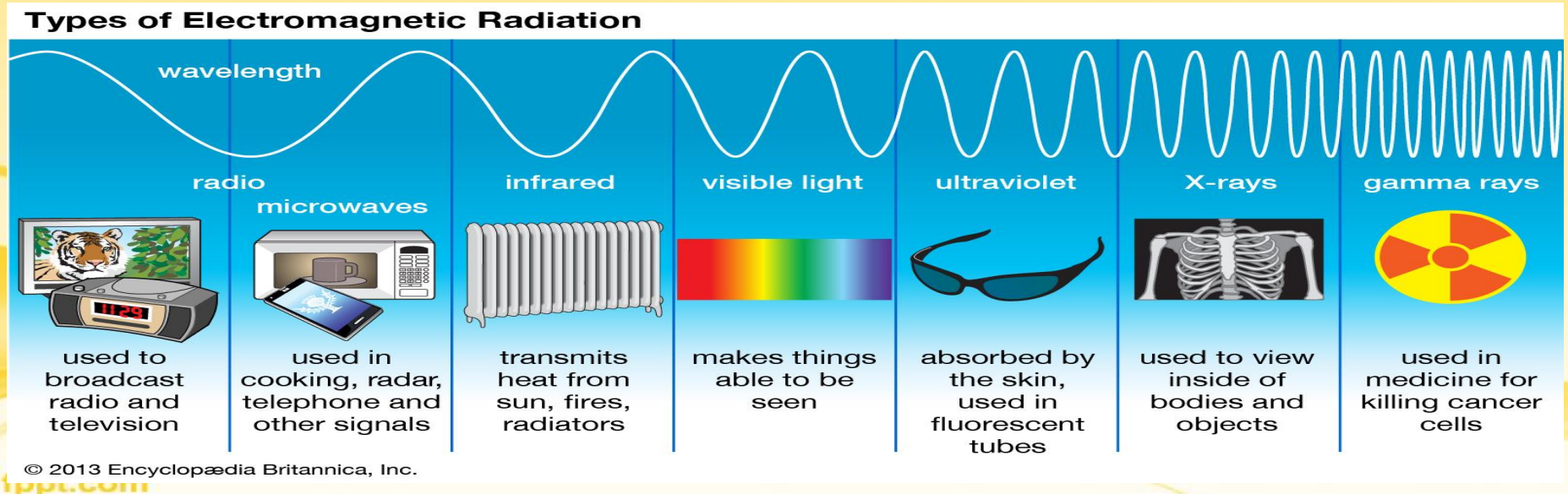
A	Energy Source of Illumination
B	Radiation and the Atmosphere
C	Interaction with the Target
D	Recording of Energy by the Sensor
E	Transmission, Reception and Processing
F	Interpretation and Analysis
G	Application

- **Source of Energy (A):** The first and very important requirement for remote sensing is an energy source which provides electromagnetic energy to the Earth. It may be either from natural (e.g. solar radiation) or artificial (e.g. RADAR) sources. For remote sensing, Sun's radiations are commonly used as a source of energy.
- **Interaction of energy with the atmosphere (B):** When energy travels from its source to the Earth surface, it comes in contact with the Earth's atmosphere where it interacts with atmospheric constituents. The energy reflected from Earth's surface is received by remote sensors. In this process the energy once again interacts with atmosphere.
- **Interaction with Earth surface features (C):** Energy reaching the Earth surface through the atmosphere interacts with the Earth surface features. The interaction and its outcome depend on the characteristics of the features and the energy.
- **Recording of energy by the sensor (D):** After interacting with Earth surface features the reflected and emitted energy travels to the sensor. And, the sensor records the reflected and emitted energy.
- **Transmission, reception, and processing of the recorded signals (E):** The energy recorded by the sensor is transmitted in the form of signals to receiving and processing station on the Earth. The signals are in electronic form and are processed and converted into an image.
- **Utilisation of the data (F):** The processed image is interpreted and analysed to extract information about the object of interest.
- **Application (G):** Made available for users




Increasing energy
Increasing wavelength
0.0001 nm
0.01 nm
10 nm
1000 nm
0.01 cm
1 cm
1 m
100 m
Gamma rays
X-rays
Ultra-violet
Infrared
Radio waves
Radar
TV
FM
AM
Visible light
400 nm
500 nm
600 nm
700 nm


wavelength (λ)
electric field
magnetic field
direction
ChemistryViews


Types of Electromagnetic Radiation
wavelength
radio
microwaves
infrared
visible light
ultraviolet
X-rays
gamma rays
used to broadcast radio and television
used in cooking, radar, telephone and other signals
transmits heat from sun, fires, radiators
makes things able to be seen
absorbed by the skin, used in fluorescent tubes
used to view inside of bodies and objects
used in medicine for killing cancer cells
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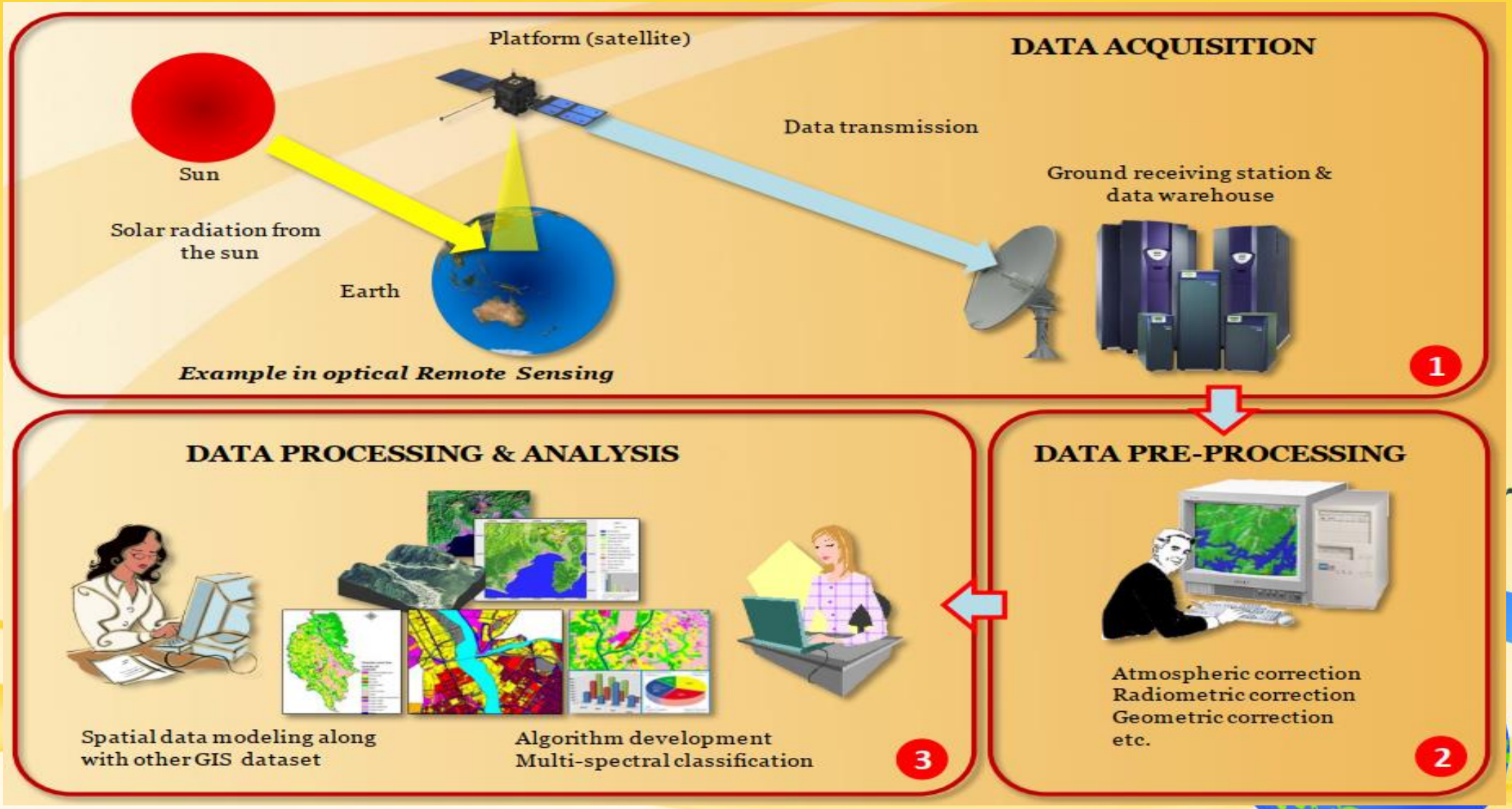
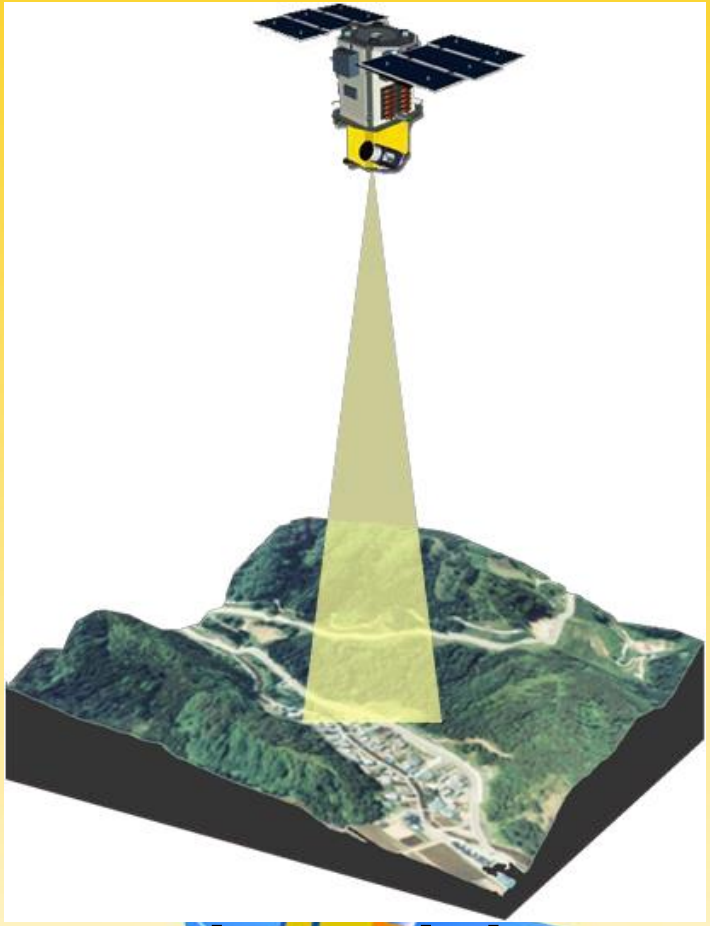
VIBGYOR

Remote Sensing and GIS Work Flow



Advantages and Limitations of RS



Remote sensing has several advantages as listed below:

- ✓ it provides a synoptic view
- ✓ it is a cost effective means of data collection
- ✓ it can provide data in wavelengths beyond the sensing capability of human eye
- ✓ it can acquire data of inaccessible areas
- ✓ it is an unobtrusive means of data collection which does not change characteristics of the object or phenomenon being observed
- ✓ it provides historical data sets which is useful to know characteristics of an object in a given point of time in past.

Remote sensing has following limitations:

- ✓ it is sometimes found that appropriate data is not available or easily acquired particularly in the tropical regions where cloud cover obstructs acquisition of image because not all sensors can ‘see’ through cloud
- ✓ remote sensing equipment's can become uncalibrated with time resulting into errors in data collected

Applications of Remote Sensing

Remote sensing imagery has many applications:

- in mapping land-use and land cover,
- agriculture,
- soil mapping,
- forestry,
- city planning,
- Archaeological investigations,
- military observation,
- geomorphological surveying,
- Mineral exploration, among other uses.

One of the common examples of the use of remote sensing is the weather maps which you see in the news channels providing forecast of weather conditions.