Why Communicate?

Satellites Communications

Teachers' Guide

Physics S-Grade Syllabus :

Unit 1 Telecommunications Section 5 : *Satellite and Dish Aerials*

1. State that the period of satellite orbit depends on its height above the Earth.
2. State that a geostationary orbit stays at the same point on the Earth's surface.
3. Describe the principle of intercontinental telecommunication using a geostationary satellite and ground stations.
4. State that curved reflectors on certain aerials or receivers make the received signal stronger.
5. Explain why curved reflectors on certain aerials or receivers make the received signal stronger.
6. Describe an application of curved reflectors used in telecommunication eg TV link, boosters, repeaters or satellite communication.

This resource focuses on the science and technology of India. Part of this resource discusses the history of astronomy in India, and the second part is about satellite technology in India and its use in climatic predictions.

References used in preparing this resource -

"Great Indian Scientists", by Pranab Bandyopadhyay, Book Club, 1993.

Information supplied by Peter Barnes, VSO Science Network, and

Indian Space Research Organisation HQ, Dept. of Space, Govt. of India, Antariksh Bhavan, New BEL Road, Bangalore - 560 094, India.

Answers to Questions :

1. a)

radius = 36 000 + 6 400 = 42 400 km

Orbit = 2n

= 2 x 3.14 x 42 400 km

= 266 272 km

$$\text{Speed} = \frac{\text{distance (km)}}{\text{time (hours)}} = \frac{266\,272 \text{ (km)}}{24 \text{ (hr)}}$$

$= 1.1 \times 10^4$ km / hr **(5)**

b) It is a geostationary satellite. **(1)**

c) The satellite must be able to monitor the same area of the earth continuously. A geostationary satellite stays in the same position over the earth. **(1)**

2. a) They can focus the signals, so weak signals are made stronger. **(1)**

b) The villages may not have a regular supply of mains electricity. In India there is a lot of sunshine, so solar cells would be a more reliable power supply. **(1)**

3. $\text{time} = \frac{\text{distance (m)}}{\text{speed (m/s)}}$

distance = 2 x the distance from the earth to the satellite (km) x 1000

and, speed = 3×10^8 m/s

distance = 2 x 36 000 km x 1 000

= 72 000 000 m

$\text{time} = \frac{72\,000\,000 \text{ (m)}}{3 \times 10^8 \text{ (m/s)}}$

= 0.24 s **(5)**

Satellite Communications

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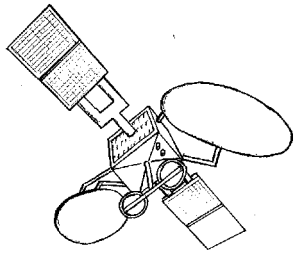
Pupils' Worksheet



Introduction

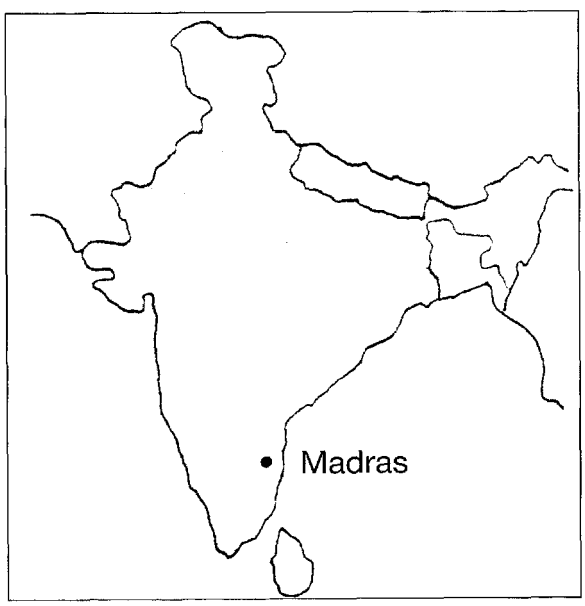
Countries all over the world have to contend with natural disasters like floods and earthquakes. In India, satellite communication is being put to good use to detect earthquakes and then transmit warning messages to rural places. Other forms of communications may be too slow to warn villagers in time.

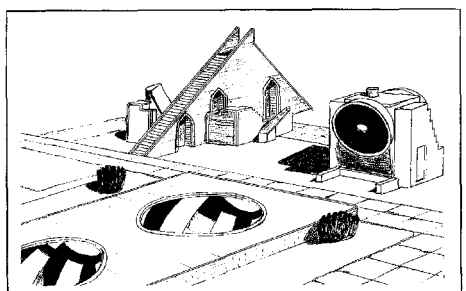
INSAT SYSTEM is the Indian Satellite system, which is used for telecommunications, radio and TV broadcasts, as well as meteorological applications. The first Indian satellite, launched in 1975, was named after a famous Indian astronomer, *Aryabhata.* India has a very long history of research in astronomy.

Did you know?
Aryabhata was a famous Indian astronomer, who was born in 476AD. He put forward the idea that the earth is spinning on its axis, and he calculated the number of days in a year very accurately.

Did you know?
Another Indian astronomer, Jai Sing, was best known for building an open air naked-eye observatory in New Dehli, in the 18th century. It is one of two such observations which can still be seen today

Map of India

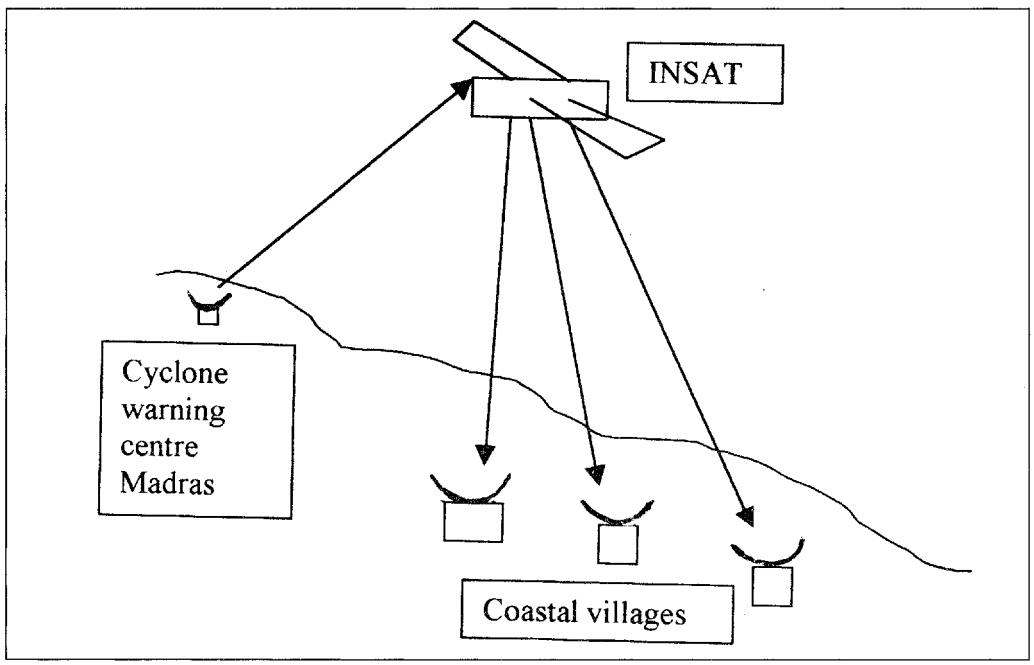




Naked-eye observatory, in Jaipur, India

Satellite Early Warning System

India's INSAT communications are used for cyclone warning on the east coast of India. Once a cyclone is detected, the warning centre in Madras sends information to the satellite as shown in the diagram below.



The satellite sends a code to receivers in the appropriate village, which triggers a warning siren.These receivers work continuously and are powered by solar cells.

Questions :

1. a) If the INSAT satellite is 36 000 km above the earth's surface, and the time it takes to orbit the earth is 24 hours, calculate the speed at which it travels. You are given the radius of the earth, 6 400 km. **(5)**

b) The period, which is the time for one rotation, of the INSAT satellite is 24 hours, and the satellite is above the equator, what type of satellite is INSAT? **(1)**

c) Why is it important that the iNSAT satellite is in the same position above the earth's surface at all times? **(1)**

2. a) Why are curved reflectors used for receiving the signals from the satellite? **(1)**

b) Why do you think solar cells are used to power the receivers in the villages? **(1)**

3. Calculate the time it takes for the warning message to reach the villages from the warning centre in Madras.

(Assume that the distance travelled by the signals is twice the distance from the earth's surface to the satellite. **(5)**

c , the speed of light, is 300 000 000 m/s or 3 x 10^8 m/s.