Jai Singh

Key Learning Content

This film tells the story of the 18th century Indian mathematician, Jai Singh, and the extraordinary astronomical observatories that he built. The film explains how he was able to measure time to an accuracy of around two seconds using only a giant sundial. Through astronomical observations he was also able to predict monsoons and eclipses.

No prior mathematical knowledge is assumed prior to watching the film although follow-on activities can make use of complex trigonometry.

Core Outcomes

Learning Points

- Be able to interpret scales on a range of measuring instruments.
- Be able to understand and carry out calculations using time.
- Be able to understand and use angles of elevation and depression.

Suggested Activities

- Construct a scale for a simple sundial based on the simplified (apparent) motion of the Sun across the sky.
- Build a real sundial.

Extension Outcomes

Learning Points

- Be able to apply trigonometry to solve problems in two dimensions.
- Be able to understand and use the relationship between average speed, distance and time.

Suggested Activities

- Calculate the speed of the hands of a clock.
- Calculate the speed of the shadow on a sundial.

The Jantar Mantar observatory contains nine huge instruments made from stone and marble.

Related Films

To use before the lesson plan:

Rounding: Snails and Rockets

This film looks at how it is possible to accurately record measurements as fast as the speed of light or as slow as the rate of continental drift.

To use after the lesson plan:

Distance to the Sun and Moon

This film shows how trigonometry and relatively simple measurements can enable the calculation of very large distances.

Perspective: Parallax

This film describes how early astronomers used parallax to measure the distance of the stars from Earth.

Measuring the Earth

This film demonstrates how it is possible to estimate the radius of the earth using a mountain and trigonometry.

Heptathlon

This film looks at how distance, speed and time are measured in the heptathlon event.

Guide Lesson Plan

Introduction

Tell students to imagine that they are stranded on a desert island with no watches or clocks. To stay healthy they need to take their pulse regularly after exercise. How could they work out how long one second was?

Show Film

Jai Singh

Main Activity

Foundation

Get students to imagine a simplified sundial. The sundial is a vertical post in the ground which casts a shadow as the Sun rises, moves across the sky and sets (assume the sun does not pass directly overhead). Suppose you knew that the Sun rose at 6am and set at 6pm. How could you use the shadow of the post to tell the time between these hours? (Suggest placing a large protractor at the base of the pole.) If the shadow traced out an angle of 120 degrees from dawn to dusk, what fraction of a degree would the shadow move each minute? Design a scale for this sundial from which to tell the time. If you wanted to be able to read the time to the nearest minute, how large would your scale realistically have to be?

Main Activity cont ...

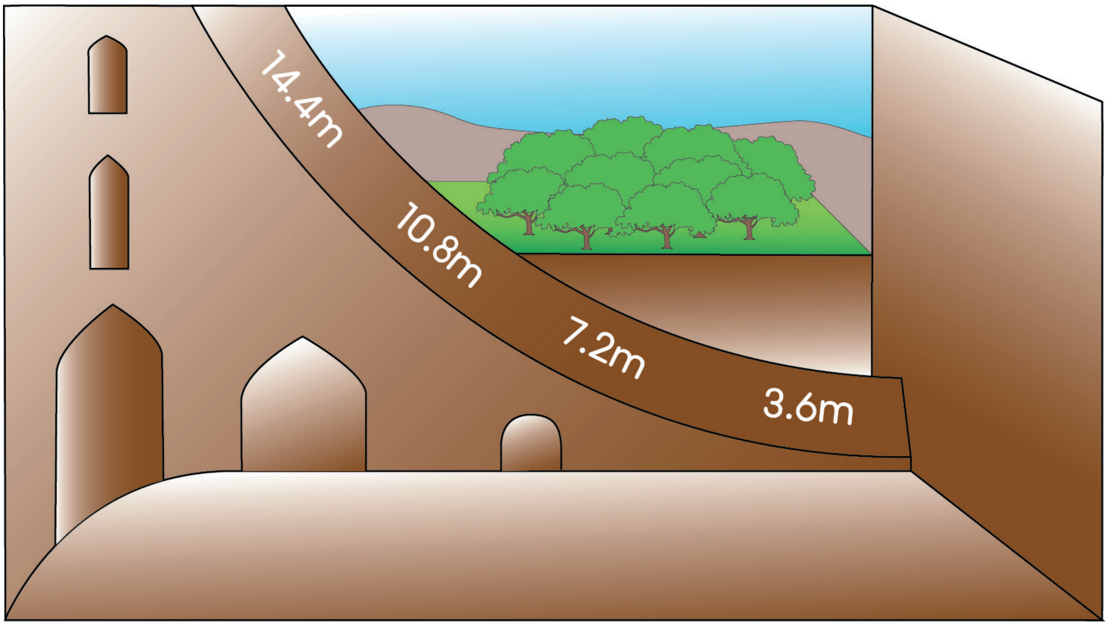
Advanced
Recap the formula for the circumference of a circle and the length of a circular arc. Then, for the simplified sundial described above, calculate the speed of the shadow as it moves across the scale, for scales of different sizes. Compare this with the speeds of the tips of minute and hour hands of a clock, for clocks of different sizes. How fast was the shadow moving on the giant sundial shown in the film?

Extension Activity

Explore how the scale of the simplified sundial described above would change, the further north or south the pole was on the globe. If the Sun rose and set along the equator, and the pole was on the equator, what would its shadow look like at different times of the day? How would you design a scale to tell the time for this version of the sundial? How quickly would its shadow move?

Optional Extra

Research the different types of sundial commonly used. Design and build a working sundial. Explore the adjustments to the sundial that you might make to take account of the change in position of the Sun in the sky at different times of year.



Jai Singh built the Samrat Yantra on such a large scale so that the shadow cast would be longer, providing the most detailed measurements in the world. Every hour the shadow cast by the dial moves approximately 3.6 metres.