Perspective: Parallax

Key Learning Content

This film explains the parallax effect: the apparent change in the position of an object when seen from two slightly different viewpoints. This is first illustrated using a pencil held in front of our eyes. The baseline of the observations is defined. The same principle is then used to estimate the distance of stars: nearby stars appear to move relative to more distant stars when the observation position is slightly changed. If the observations are made at opposite extreme points of the Earth's orbit, then the change in position (the baseline) can be as large as 300 million kilometres, allowing astronomical distances to be estimated. The use of trigonometry is referred to in the film, but knowledge of trigonometry is not essential for viewing.

Core Outcomes

Learning Points

- Be able to understand the parallax effect and relate it to the geometry of triangles.
- Be able to use angle properties of triangles to calculate missing lengths.
- Be able to estimate distances using the parallax effect.

Suggested Activities

- Design an experiment to calculate the distance of a nearby landmark using parallax.
- Measure angles of observation accurately using a straight edge and protractor.
- Draw scale diagrams to estimate distances.

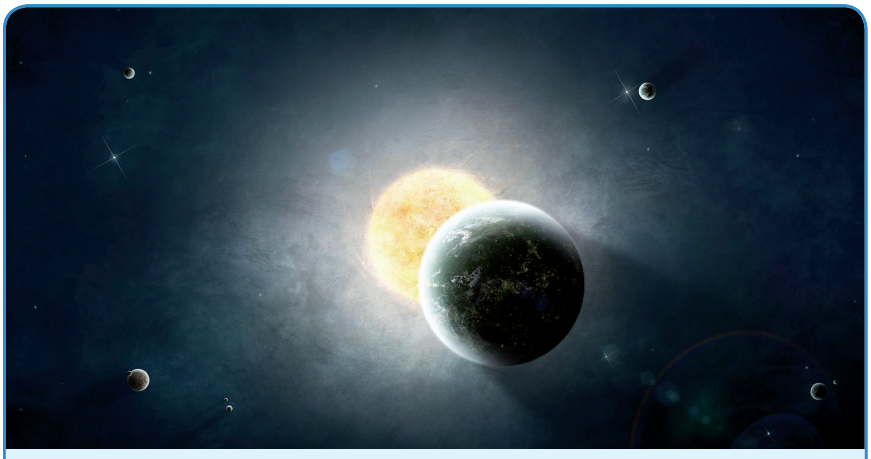
Extension Outcomes

Learning Points

- Be able to understand and use sine, cosine and tangent of acute angles to determine lengths and angles of a right-angled triangle.
- Be able to understand and know and use the sine rule for any triangle.

Suggested Activities

- Take measurements of distant objects and use the tangent function to estimate their distance.
- Use the sine rule to estimate the distance of objects.



Parallax has been used to measure some of the greatest distances imaginable.

Related Films

To use before the lesson plan:

Jai Singh	This film explains how early astronomers took incredibly accurate measurements of the stars.
Painting By Numbers	This film describes the use of mathematics to give the impression of distance in pictures.

To use after the lesson plan:

Escher and the Endless Staircase	This film illustrates the point that we do not simply see the world as it is, but interpret and make assumptions about what we are seeing.
Distance to the Sun and Moon	This film looks at an ingenious method to work out the relative distances of the Sun and Moon without ever leaving Earth.
Volume: Counting Stars	This film tackles the question of how many stars there are in the universe, by first asking how many grains of sand there are on a beach.

Guide Lesson Plan

Introduction

Ask students which of their eyes is stronger. Describe an experiment to work out the answer. Hold your finger 20–30cms in front of your eyes and look into the distance. Close each eye in turn. The position of your finger will shift in your field of vision as you close each eye. If closing your left eye makes the finger shift more than closing your right eye, then your left eye is stronger.

Show Film

Perspective: Parallax

Main Activity

Foundation

Go over the theory of parallax with the students and then tell them that they are going to try to use the parallax effect to work out the distance of a local landmark. Sketch the points of observation and the landmark and discuss precisely what measurements are necessary. Then get the students to work in teams to design their experiment, paying particular attention to how they are going to measure the angles. Then let teams make and record their measurements. Return to the classroom and get teams to draw detailed scale diagrams and hence estimate the distance to the landmark. Compare results from the different teams.

Main Activity cont ...

Advanced

Explain what the tangent button on a calculator does and give examples of how to find the opposite side of a right-angled triangle using tangent and adjacent side. Then get students to design an experiment to find the distance to a nearby landmark using the tangent function. Make measurements, calculate distance, and compare results.

Extension Activity

Foundation

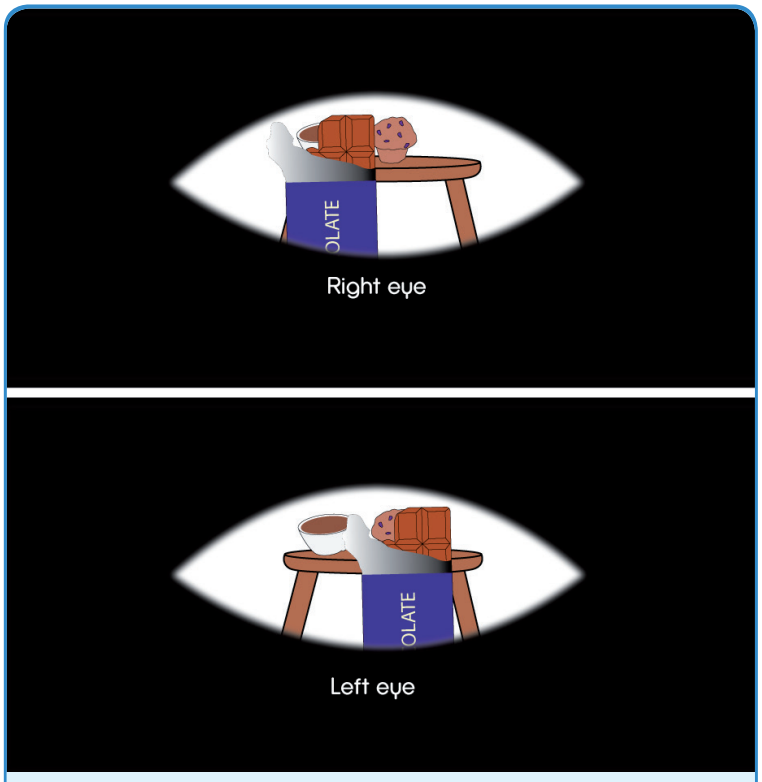
Take a local map with a scale and use it to double check the distance estimates made above.

Advanced

Explain how the sine rule works for any angled triangle and then use it to work out the distance of the landmark from two observation points a known distance apart.

Optional Extra

Research the triangulation method in map-making and surveying. What was the technological breakthrough that largely replaced this method in the 1980s?



Your brain uses the distance between your eyes, known as the baseline, and the angles with the object, to instantly calculate the unknown distance.