Royal Academy of Engineering

THIS IS ENGINEERING

ENGINEERING *IN THE* MOVIES

A PUZZLING PARALLAX

STEM

Science and Maths Focus

INTRODUCTION

Lifestyle pictures / Alamy Stock Photo

In a galaxy far far away, how are distances of planets and stars calculated? In a galaxy not so far away, how do film directors create a sense of depth in their scenes, making objects appear to move and change positions from two different locations or perspectives?

This visual phenomenon is called a parallax. Director Christopher Nolan used the effect in his movies **INCEPTION** and **INTERSTELLAR**. He could manipulate perspective because he understood the principle of parallax. Can you do the same?

CHALLENGE

- Teams of two
- 90 minutes
- KS3
- Developing

TERMS & CONCEPTS

- Stars
- Galaxy
- Parallax
- Perspectives
- Optical illusions
- Astronomy
- Earth's orbit

MATERIALS

- **2** Hula hoops
- **1** Meter stick
- **1** Metric measuring tape
- **1** Small table
- **1** Tennis ball

CHALLENGE

In this challenge, you will investigate how the distance of a nearby object is related to how far it appears to move when you view it from two perspectives.

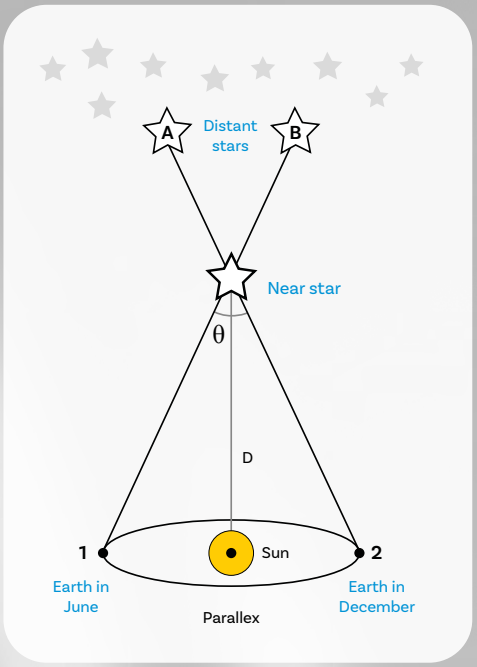
STARTER ACTIVITY

Hold out your arm and stick up your thumb. Closing one eye, line up your thumb with an object across the room. Now switch your eyes (while keeping your thumb in the same position) and you will notice that the object you were looking at is no longer lined up with your thumb.

Moviestore collection Ltd / Alamy Stock Photo

QUESTION

Explain why the object you lined your thumb up with appeared to move?



When an astronomer looks at stars from different places in Earth's orbit around the sun [labelled 1 and 2] the near star will appear to move position relative to the distant stars [labelled A and B].

This apparent movement, or parallax, can be used to find out the distance (the line labelled D) between Earth and the near star.

In the example you did using your thumb and an object across the room, the star whose distance you are measuring would be represented by your thumb, the two different positions of the Earth would be like your eyes, and the distant stars would be like the object across the room.

EXPERIMENTAL PROCEDURE

THE CHALLENGE

This challenge is best completed in a wide-open space. Find a tall and narrow distant object to use as a visual guide to represent a distant star.

Leaving as much distance between you and the distant object as possible, place the two hula hoops on the ground as seen in **Figure 1**. These are your observation towers.

Place a small table two metres from the hoops. Place the tennis ball and metre ruler with marking facing you on the table as shown in **Figure 2**.

1. Sit in the centre of the left hula hoop and look at the distant object. Which cm number on the metre ruler appears to line up with the object? Record this on the data table below in column B.
2. Repeat the process in the right-hand hoop and record data in column C.
3. Now move the table forward by two metres so that it is closer to the distant object and repeat steps one and two.
4. Repeat the process a total of 10 times moving the table two metres towards the distant object each time.
5. Now analyse your data. First figure out how much the distant object appeared to move along the metre stick when your perspective changed from one hula hoop to the other. Write the distance in column D.

Figure 1: While facing the distant object, place the two hula hoops on the ground, so that they are almost touching

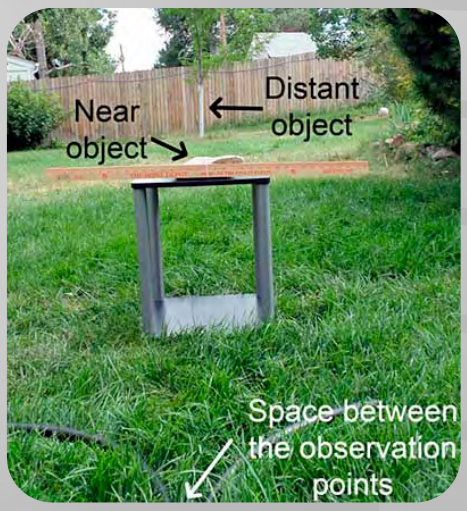


Figure 2: The hoops, table and distant object should be in line with each other

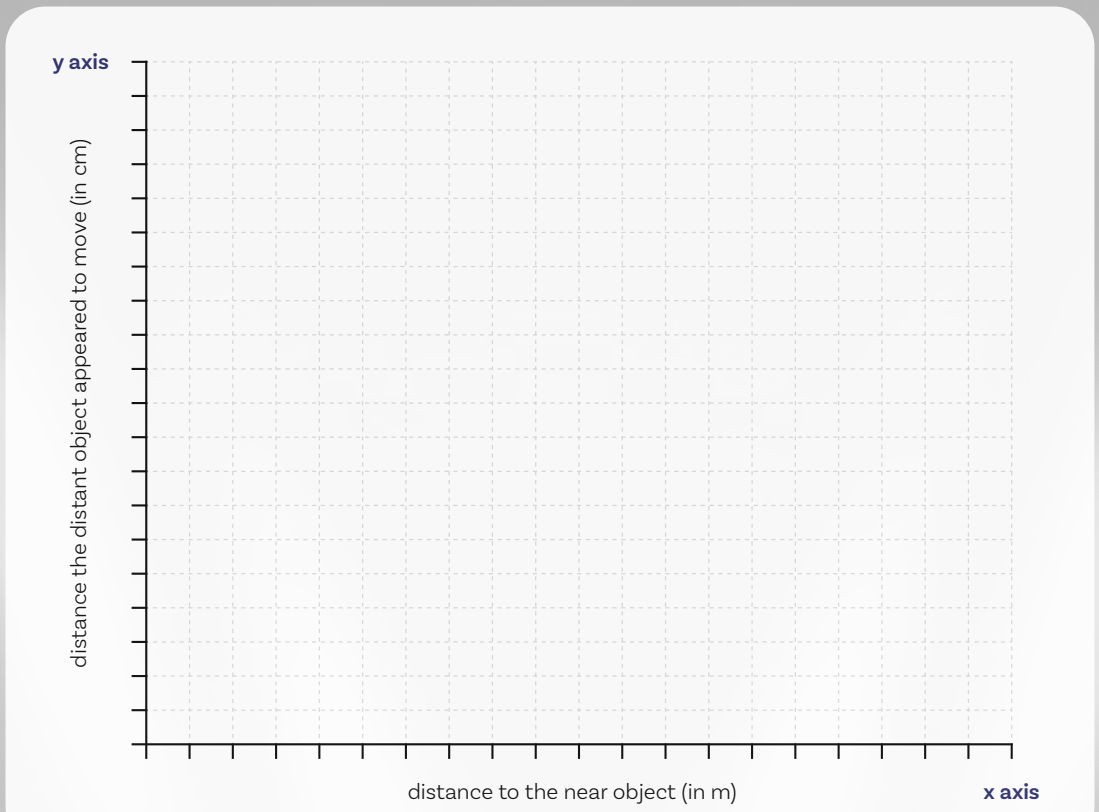
DATA TABLE			
A	B	C	D
Distance to the near object (m)	Measurement from the left (cm)	Measurement from the right (cm)	Distance the distant object appeared to move (cm)
2			
4			
6			
8			
10			
12			
14			
16			
18			
20			

QUESTIONS

What is parallax? How can astronomers use it to measure stellar distances?

How can changing perspective change the apparent position of an object?

6. Make a line graph of your data. On the x axis of the graph, put the distance to the near object (in m). On the y axis, put the distance the distant object appeared to move (in cm).



QUESTIONS

What patterns do you see in your data on the graph?

Is there a relationship between how far the near object is from the observation points and the apparent movement of the distant object (when measured from different perspectives)?

What do you think this tells you about how astronomers use parallax to measure how far away a relatively nearby star is?

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