The Parallax Paradox

DISCOVERY WORLD @HOME

Introduction

We know that stars in the night sky are really far away, but not all stars are the same distance from Earth. Use objects in your home to explore how astronomers use the seasonal differences in the night sky to understand how far away stars really are.

Think About This

How do astronomers determine which stars are farthest from Earth?

Materials

- Marker, pencil, pen, or any thin object
- Measuring Device, such as:
  - Meterstick
  - Yardstick
  - Ruler
  - Tape measure
  - Make your own by marking off distances on a large piece of paper
- Table
- Tape (optional)

Do Ahead of Time

Set up the measuring device on the edge of the table, or tape it to the wall, so that the numbers are visible to the observer. The measuring device will be the background to focus on.

Directions

Parallax is the shift in position of an object when viewed from two different locations. Scientists can use parallax to measure distance. This activity will demonstrate how the concept of parallax works.

1. Position yourself about 6 feet from the measuring device.
2. Hold the marker about 6 inches from your face.
3. Cover the left eye and keep the right eye open. Look at the marker. What number does the marker appear to be in front of? Record this number in the Parallax 1 Table, Box 1.
4. Without moving the head, cover the right eye and keep the left eye open. Observe what number the marker appears in front of on the measuring device. Record this number in the Parallax 1 Table, Box 2.
5. Find the difference between the two numbers and record this number in the Parallax 1 Table, Box 3.

The Parallax Paradox Continued

Parallax 1 Table	RIGHT EYE OPEN, Left Eye Covered	LEFT EYE OPEN, Right Eye Covered	Difference between Box 1 and Box 2
Number object appeared in front of	1.	2.	3.

6. Now hold the marker as far out in front of you as you can by extending your arm completely.

7. Cover the left eye and keep the right eye open. Observe what number the marker appears in front of on the measuring device. Record this number in the Parallax 2 Table, Box 1.

8. Without moving the head, cover the right eye and keep the left eye open. Observe what number the marker appears in front of on the measuring device. Record this number in the Parallax 2 Table, Box 2.

9. Find the difference between the two numbers and record this number in the Parallax 2 Table, Box 3.

Parallax 2 Table	RIGHT EYE OPEN, Left Eye Covered	LEFT EYE OPEN, Right Eye Covered	Difference between Box 1 and Box 2
Number object appeared in front of	1.	2.	3.

Questions to Ponder

1. Which parallax had a bigger difference? Was the parallax with the largest difference the object closer or farther away from you?
2. If you had someone hold the marker even farther away from you and closer to the measuring device, what would you predict would happen to the difference? Would it get bigger or smaller? Give it a try and see if you are correct!

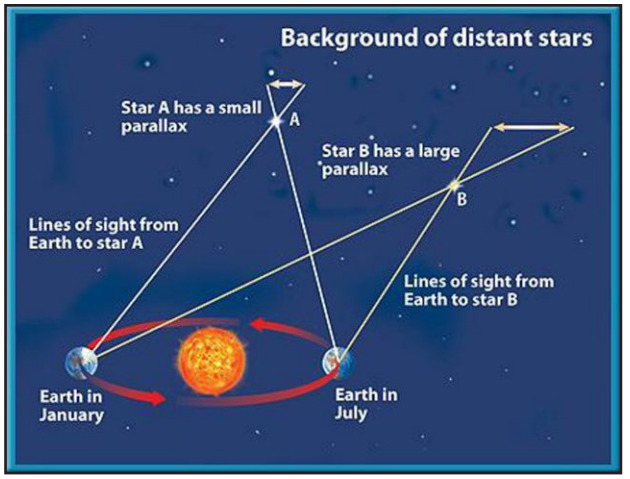
What's Happening?

The closer an object is to the viewer, the greater the difference between the two positions seen. We call this a paradox (or contradiction), because stars that are closer to Earth seem to move more, but we would expect them to move less. Stars that are farther away seem to move less and therefore have a smaller parallax.

How can stars be in two different places? As Earth orbits the sun, it is in different positions in space throughout the year. Stars that are really far away barely seem to move, providing a perfect background to compare movement of a star closer to Earth at two different times of year, like July and January. Watching how a closer star "moves" against the background helps astronomers calculate the star's distance from Earth.

In this experiment, your marker represented a star and your eyes were the position of Earth at different points in time.

Parallax also explains how we have three-dimensional vision. Our eyes view the same object from two different angles and our brain uses that to estimate distance, allowing us to see in three dimensions!



Source: Glencoe Science Level Blue. (2004). Glencoe/McGraw Hill.