

# Relative motion



THE UNIVERSITY OF  
WESTERN AUSTRALIA  
*Achieving International Excellence*



Government of Western Australia  
Department of Education

**The Sun moved across the sky from east to west, so it must be moving around the Earth.**

**The Sun moved across the sky from east to west because the Earth is rotating.**



**Under what  
circumstances could  
each observer be  
correct?**

**Discuss with a partner.**



**Scientists recognise that  
what you observe  
depends on your frame  
of reference.**



## Example 1

A boy sitting in a train sees another train out of his window ...



Describe the motion he observes.



# Example 1

... and this is what observers on the other train see.



Which train is stationary? Which train is moving?

**Can you think of a test a person on either train could perform to tell them which train is moving ?**

**Discuss with a partner.**



Could you tell whether your train is moving by observing the motion of a falling object?

The following example shows what different observers see when an object is falling.



## Example 2



# Relative motion

If the boat is moving relative to you, you will see the object fall along a parabolic path.

## Example 2

# Relative motion

A wooden boat with a mast and a small cabin is shown on a blue sea with stylized waves. A dotted white line starts from the deck of the boat and curves downwards in a parabolic shape, ending at a point in the air. The background is a dark grey gradient.

If the boat is moving relative to you, you will see the object fall along a parabolic path.

## Example 2

# Relative motion

A silhouette of a person wearing a hat and holding a yellow ball, standing on a boat. The boat is on a blue sea with stylized waves. The person is holding the ball out to the right, and the word 'motion' from the title is partially obscured by the boat's mast.

If you aren't moving relative to the boat, you will see the object fall straight down.

## Example 2

# Relative motion

A silhouette of a person wearing a hat stands on a wooden boat. The person is leaning forward, dropping an object. A vertical dotted line extends from the object's release point down to the water's surface, illustrating that the object falls straight down relative to the boat.

If you aren't moving relative to the boat, you will see the object fall straight down.

If the object falls along a **parabolic path**, either you are moving or the boat is moving relative to you. If the object falls **straight down**, either you and the boat are moving at the same speed or neither is moving.

Dropping an object doesn't tell you whether you are stationary or moving with a constant velocity. The principle of relativity tells us...

Within a frame of reference, there is no measurement you can make that will tell you whether you are stationary or moving with a constant velocity.

We can only describe an object's motion by comparing it to another object or **frame of reference**. A frame of reference is simply a set of axes against which the motion or position of an object can be described.



Objects are always in motion relative to some other frame of reference.



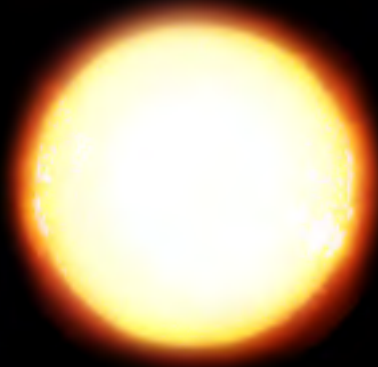
You may think you are stationary relative to the Earth's surface, but you are moving relative to other frames of reference.




The Earth's surface is moving relative to the centre of the Earth ...

and the Earth is moving relative to  
the Sun ...





and the Earth is moving relative to  
the Sun ...

A deep field image of the universe, showing a vast field of galaxies in various colors (yellow, orange, blue, green) and orientations, set against a black background. The galaxies are scattered across the frame, with some appearing as bright, distinct points and others as faint, elongated structures. A prominent bright yellow star with a four-pointed diffraction pattern is visible in the lower right quadrant.

The Sun is moving relative to the  
centre of our galaxy ...

... and our galaxy is moving relative to other galaxies.



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