BANANALEARN LEARNING LIBRARY

Length, position and motion







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Length, position and motion

The broken ruler twist

Read the two end marks

Start	1.3 cm
End	7.8 cm
Length	End minus start

THE IDEA

A broken zero can still give you a good length. The strip starts at 1.3 cm and ends at 7.8 cm. The first 1.3 cm of the scale lies outside the strip.

Subtract the start: 7.8 − 1.3 = 6.5 cm. Check by adding: 1.3 + 6.5 = 7.8 cm. The remaining ruler marks must be accurate.

CHECK YOUR THINKING

What is the length of the strip?

A Report 7.8 cm

B Report 9.1 cm

C Subtract: the strip is 6.5 cm

C. Exactly: 7.8 − 1.3 = 6.5 cm.

WORK THROUGH A CASE

Slide a 6.5 cm strip from a 1.3 cm start to a 2.3 cm start. What should both readings do?

The end advances from 7.8 to 8.8 cm. Both positions gained 1 cm, so their difference stayed 6.5 cm. If the printed divisions themselves were stretched, moving to an intact starting mark would no longer solve the problem.

Length, position and motion

The trail refuses to be straight



THE IDEA

Let the thread follow the bend. The thread follows one leaf edge from its base to its tip. Once marked, the same piece can be straightened gently beside a ruler.

Why would pulling hard give a poor reading? Stretching the thread changes its length. A shortcut from base to tip also misses the bend.

CHECK YOUR THINKING

How can you measure the curved edge?

A Pull an elastic band tight between the endpoints

B Join the endpoints with a straight ruler

C Follow the route with thread, mark its ends, then straighten without stretching

C. Yes. Preserve the path length when transferring it to a straight scale.

WORK THROUGH A CASE

Two threads join the same points on a leaf. One runs straight and the other follows the edge. Which piece should the builder order?

Imagine laying each thread flat without stretching it. The edge-following thread must cover each bend and will be longer than the shortcut along a straight line. Mark the ends before lifting so the chosen path is preserved.

Length, position and motion

Where is the moving gate?



THE IDEA

Choose a reference point before describing motion. “40 metres east of the library” tells you where to look. Distance alone leaves the direction open.

On a moving bus, you stay beside your seat but travel past a tree. Your position changes relative to the tree.

CHECK YOUR THINKING

Which observation shows motion relative to the tree?

A The passenger's position relative to the tree changes over time.

B The passenger keeps touching the seat.

A. The passenger's position relative to the tree changes over time.

WORK THROUGH A CASE

A bus passes the library. The distance from a passenger to her seat remains zero. How can both observations be true?

Describe each comparison explicitly. Her position changes relative to the library but stays fixed relative to the seat. Motion is a change over time relative to a chosen reference.

Length, position and motion

Trace a car at equal times



THE IDEA

Which clue tells you how motion changed? In four snapshots one second apart, a car is at 0, 2, 5 and 9 cm. Its jumps are 2, 3 and 4 cm.

The track is straight. Is the speed steady? The growing gaps show that the car covers more ground in each second.

CHECK YOUR THINKING

What can the car do on a straight path?

A. Travel exactly the same distance every second by definition.

B. Travel farther in each equal time interval.

B. A straight path describes direction, not how fast the car travels.

A RELATED EXAMPLE

Trace one moving point

Follow the coloured spot on the wheel. Seen from the bicycle frame, the spot circles the hub. Seen from the roadside, the hub moves forwards and the spot travels forwards as it turns. A swing moves to and fro about its middle. This is oscillatory motion. A movement that repeats at equal time intervals is periodic.

Length, position and motion

Count one whole swing



THE IDEA

When has a pendulum completed one oscillation? Follow the bob from the left end, through the middle, to the right end and back to the left. That is one complete swing.

Suppose five complete swings take 10 seconds. How long is one swing on average? Divide 10 by 5 to get 2 seconds.

CHECK YOUR THINKING

Starting at the left end, when should you count one?

A When the bob returns to the left end after visiting the right.

B As soon as it first reaches the middle.

A. A complete oscillation returns to the starting position and phase.

A RELATED EXAMPLE

One loop, two descriptions

Can motion be circular and periodic? A train passes the same station at 0, 8, 16 and 24 seconds. Its path is circular and its returns have a regular period of 8 seconds. Now imagine a different pause on every lap. Which stays the same: the shape of the track or the time between returns?

ONE LAST CHALLENGE

Why do the cameras record different paths?

One camera travels with the centre of a rolling wheel. Another watches a spot on its rim from the pavement.



THE REVEAL

They use different reference frames.

Relative to the moving centre the spot circles. Relative to the road it also moves forwards.

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