

SCIENCE MUSEUM GROUP



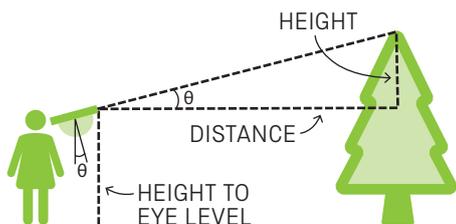
HOW TALL IS THAT TREE?

MAKING 	Age 11-14	Topic MATHS, GEOMETRY	 30 MIN
	Skills used MAKING OBSERVATIONS • CURIOSITY		

Overview for adults

Trigonometry is a branch of maths that relies on the relationships between the angles and sides of triangles. This activity uses trigonometry to estimate the heights of tall objects, by making a simple tool that can measure angles.

What's the maths?



In a right-angled triangle in which the other two angles are 45 degrees, two of the sides are equal in length, whatever the size of the triangle. In this activity, the line of sight to the top of a tall object forms the long side (hypotenuse) of such a triangle, making it possible to estimate the height of the object simply by measuring the distance to it and adding the height to your eye level. At different distances, you can work out the height using the tangent function, one of the so-called 'trigonometric ratios'.

For diagram:

$\tan \theta \times \text{distance to object} = \text{object height from eye level}$

$\text{object height from eye level} + \text{height to eye level} = \text{final object height}$

Maths in your world

This activity makes use of trigonometry – the relationships between the lengths and angles of triangles. Trigonometry has many applications in the real world, in science, engineering and construction. For example, surveyors use instruments called total stations to measure angles and distances before starting construction projects to work out the slope and topography (shape) of the land.

Explore more

A theodolite is a surveying instrument with a rotating telescope for measuring horizontal and vertical angles. The Science Museum Group has dozens in its collection.



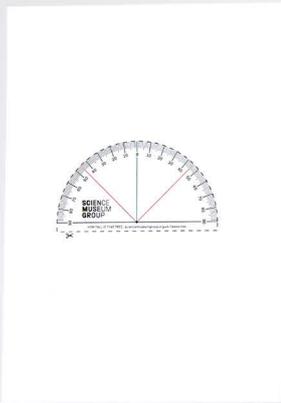
Did you know...?

Trigonometry was used over 2,000 years ago in astronomy to work out the patterns of movement of the Sun, Moon and stars.

Find the height of anything without even touching it, using this tool and a little trigonometry.

You will need...

Protractor template



A4 sheet of paper



50cm of string



Measuring tape



Scissors



Index card or A6 card



Hole punch



Sticky tape or glue



Metal washer, large button, keyring with something on it, or other small weight that can be tied with string

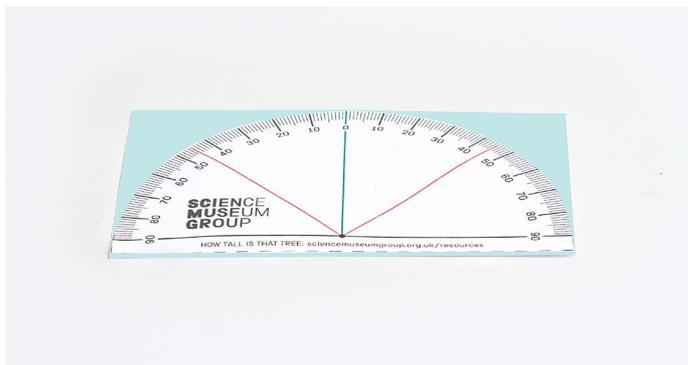
Think and talk about...

- If you could measure the height of anything, what would it be?
- How do you think trigonometry could be useful in construction? What about in making video games or in astronomy?

Investigate...

- Use your height estimator to calculate the height of something. Then measure its actual height with a tape measure. How accurate was your height estimator? Is it more accurate with something that is closer or further away?
- Try rolling your paper so that it's smaller or larger in diameter. Do you notice a change?

Follow these steps...



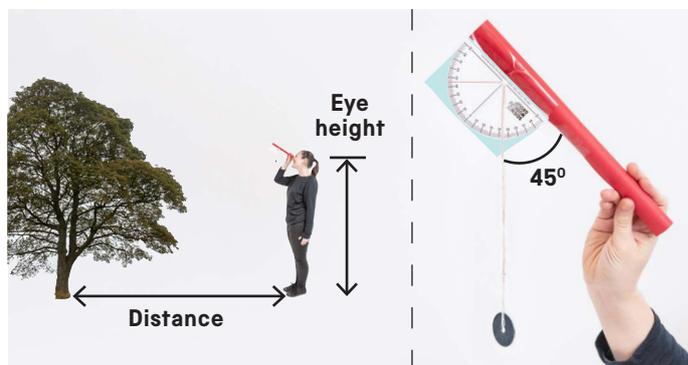
- 1 Print the protractor template and cut it out. Tape or glue it to a card.



- 2 Punch a hole through the centre. Loop the string through the hole, and put the washer onto the string before tying the loop.



- 3 Roll the A4 piece of paper so that it's about 2.5cm in diameter. Tape it in place. Line up the ends of the index card with the paper tube and tape the index card in place.



- 4 Look at the top of something tall through the paper tube. Move until the string falls at 45 degrees. Now measure the distance to the object along the ground. Add the distance to the height of your eye level, and the result is the object's height.



- 5 Look at something else through the tube. Hold the string where it has fallen and read the angle (θ). Now measure the distance to the object. Use this formula to calculate the height of the object from eye level:

$$\tan \theta \times \text{distance to object} = \text{object height from eye level}$$

Maths in your world

Trigonometry has many applications in the real world, such as when surveyors measure angles and distances before starting construction projects to work out the slope and topography (shape) of the land



