

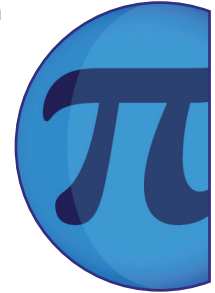


Gradients: Fold Mountains

Key Learning Content

This film introduces the idea of a gradient by looking at fold mountains: mountains formed by long-term movements of the Earth's crust. A gradient is defined on screen, in terms of distances, and examples given using mountain slopes. Zero, infinite and negative gradients are covered. Gradients are referred to in fractional, decimal and percentage form.

Familiarity with fractions, decimals and percentages is necessary prior to watching the film. Follow-on work from the film could introduce the ideas of basic trigonometry.



Core Outcomes

Learning Points

- Be able to understand the concept of the gradient of a straight line.
- Be able to convert between fractions, decimals and percentages.
- Be able to use and interpret maps and scale drawings.

Suggested Activities

- Calculate gradients given real-world information.
- Practise writing gradients in alternative forms.
- Relate gradients to the equation of a line.

Extension Outcomes

Learning Points

- Be able to understand and use sine, cosine and tangent of acute angles to determine lengths and angles of a right-angled triangle.
- Be able to find the gradients of non-linear graphs or curves by drawing a tangent.

Suggested Activities

- Use the tangent button on a calculator to work out the gradient of a line given the angle of incline.
- Use simple trigonometry to calculate lengths from gradients.
- Estimate the gradients of curves.



Fold mountains are formed gradually by powerful movements of the Earth's crust which forces rock upwards; these gradual folds add up to create a steeper and steeper gradient.

Related Films

To use before the lesson plan:

The Sardine Run

This film illustrates the use of negative numbers in measuring deep ocean habitats.

Geometry: Euclid

This film focuses on the work of the mathematician who laid the foundations of modern geometry by defining straight lines, circles and angles.

To use after the lesson plan:

Calculus: Newton

This film demonstrates a simple way to find a gradient.

Measuring the Earth

This film shows how establishing the height and distance from a mountain can help a person to work out the diameter of the Earth.

Guide Lesson Plan

Introduction

Ask students about any hill climbing, mountaineering or skiing they have done, and get them to estimate how steep the slopes were that they climbed or descended. Explore intuitive ways of describing steepness, and develop the idea of a gradient as a fraction.

Show Film

Gradients: Fold Mountains

Main Activity

Foundation

Show students road signs where gradients are given in percentage, ratio and fractional forms and get them to convert between them, ranking the slopes in terms of steepness. Then give them maps of mountainous areas where the heights of different points are shown, and get them to work out the gradients of lines between different points. Finally, give the coordinates of two points on a graph and show how to work out the gradient of a line joining the points using the change in the value of the coordinates.

Advanced

Get students to draw right-angled triangles and measure the lengths of the sides and the angle of inclination. Then get them to calculate the gradients of the lines they have drawn. Introduce the tan button on their calculators and ask them to use it to work out the tangent of the base angle in their triangle. Ask them what they notice, and then check that the tangent is the same as the gradient by drawing other triangles. Then see if they can work out the purpose of the sin and cos buttons.

Extension Activity

Foundation

Give students graphs of straight lines with the equations of the lines given on the graphs. By taking points on the lines, get students to calculate their gradients. Then ask if they can see any connection between the gradients of the lines, and the coefficients used in the equations of the lines. Generalise the result and check it by drawing lines from equations, and then calculating their gradients from plotted points.

Advanced

Explain that, from Latin, tangent means 'touching line', and show how to draw tangents to curves using a ruler. Get students to estimate the gradients of curves at a point by drawing tangents and working out the gradient of the tangent line. Compare students' results for the same questions and comment on the accuracy of this method.

Optional Extra

Explain that a gradient can also be defined as a rate of change and explore what the gradients of distance/time and speed/time graphs then represent.

Gradient = $\frac{\text{Vertical}}{\text{Horizontal}}$

The gradient of a straight line is calculated by dividing the change in vertical height by the change in horizontal distance.