Rope Bridge

Episode 3: Gravity

Rope bridge 3 Gravity

Introduction

In the Rope Bridge unit, students take role on internship engineers for a company which is commissioned to build various types of bridges around Kazakhstan. From the news, there is a broken bridge, which was built in the era of the Soviet Union and has been used for crossing the Kigash river between Kotyaevka village of Kurmangazy district, Atyrau region, Kazakhstan and Koshelevka village of Krasnoyarsk district, Astrakhan region, Russia. The company aims to involve the local people in the design of the bridge so you have been asked to explain the science behind the various possible bridges in a way that non-scientists can understand.

In this unit, students learn about the factors causing damage to the bridge, forces and result of forces acting on an object, how to calculate a resultant force, Newton's First Law of Motion, and the size of gravitational forces acting on an object.

Episode 3, *Gravity*, takes one hour and looks at the relationship between the force of gravity and the weight of objects on Earth in the context of a platform for a ropebridge.

Key words

Force, gravity, weight, balanced forces.

Learning Objectives

Students will:
Explore the force of gravity and calculate the weight of a variety of objects
Consider the weight of the bridge platform

Learning Activities 110 min

Engage 20 min

Introduce students to the context and ask them to consider the advantages and disadvantages of having gaps between the slats on a bridge platform.

Slides 1-2	Introduce the unit and explain the objectives for this episode to the students.

Slides 3 - 4	The chief engineer shows the students a video clip of a bridge in Nepal - described as the most dangerous rope bridge in the world! Ask students to consider what makes it dangerous and to think about why the builders of the bridge made it that way - presumably they did not want it to be dangerous to use!
Slide 5	Introduce the notion of weight and ask students what they mean by 'weight'. -most will say it is a measure of how much stuff something contains and it is measured in kilograms. In fact, this is a definition of 'mass' not 'weight'.

Explore — 30 min

Students are introduced to the notion of weight as a force and compare the results of spring balances and weighing machines as a way to measure weight.

Slides 6 - 7	Go through these slides to explain the difference between mass and weight and show how weight is a force. Many students find this quite difficult at first because the common use of the word weight usually means mass.
Slide 8	Go through an example of a weight calculation on the board - perhaps converting a 2kg bag of sugar into a weight of 2 x 9.8 = 19.6 newtons.
Slide 9 - 10	Introduce the experiment to find out the weight of a variety of objects in the laboratory. It is a simple calculation but Student Support Sheet 1 might help students to organise their data.

Explain — 20 min

Students present their experimental results.

Slide 11	Review the data from the students - how close were the results for the spring balances and weighing machines? How can they explain any differences?

Elaborate — 30 min

Students apply the results from their investigations and their growing understanding of the forces acting on a bridge to explain the choices made by two bridge designers.

Slides 12 - 14	Ask students to calculate the weight of the platforms for these bridges. This will involve working out the number of wooden slats on the bridge and using the formula:

Weight of platform = (number of wooden slats) x (mass of slats in kg) x 9.8m/s^2.

Evaluate — 10 min

Students calculate the weight their proposed bridge can carry and suggest a limit for people walking across it.

Slides 15 - 16	Students should now apply their ideas about weight to a real world problem. The bridge needed in Sagyz village is 27.5 m wide and has 20 cm wooden slats in its platform spaced 2cm apart. Each slat has a mass of 8kg. This means there are 125 slats with a total mass of 1000 kg and a weight of 9,800 N.

Assessment and differentiation

Formative assessment

Take the opportunity to assess the students during questioning and whilst facilitating through questioning and observation when the students are completing the tasks.

Differentiation

Some students will find some of the calculations in this episode demanding and will need more support.

Preparing for the Lesson

RESOURCES USED

Student Support Sheet 1: Mass and weight

EQUIPMENT REQUIRED

Engage
None

Explore
Spring balances of assorted size
A weighing machine
Assorted weights

Explain
None

Elaborate

Evaluate