# Rope Bridge Episode 4: The model bridge

# 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 villagers need it repaired. 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 4, *The Model bridge*, takes one hour and asks thew students to produce a design for the bridge they propose to build along with an explanation of the design decisions they have made. They then build a model of the bridge using this plan.

# Key words

Force, gravity, weight, balanced forces.

# Learning Objectives

Students will:

Apply their understanding about forces to the design of a bridge Explain the design decisions made in the planning of the bridge Build a model of a rope bridge for the village

# Learning Activities 110 min

## Engage

20 min

Introduce students to the context and ask them to consider how they will design their bridge and explain their thinking to the villagers that will have to use it.

- Slides 1-2 Introduce the unit and explain the objectives for this episode to the students.
- Slide 3 The chief engineer asks the students to produce a plan for a bridge that will solve the villagers' problems. Divide the class into teams of about four or five and hand out the Student Support Sheet 1, *Kotyaevka bridge design*. Be prepared to answer any questions about the detailed requirements of the villagers before the students actually start the design.

## Explore

30 min

Students develop a plan for a bridge that will solve the problems identified by the villagers and a presentation to explain why they have chosen to design it in this particular way.

Slide 4 Use this slide to make sure students understand that they must produce a plan on paper first alongside an explanation of their design decisions. Since the plan will be used to explain the science behind the design decisions it is sensible to produce this as a poster on a large sheet of paper.

## Explain

20 min

Students share their designs with other teams and receive feedback on their efforts.

Slide 5 Teams should show their plans to the team working next to them, answer any questions and take feedback on their design. They should then swap over and listen tot he plans from their neighbours. Both teams should be able to build in any improvements to their designs before they start building their models.

### Elaborate

Students build models of their bridges based on the designs produced earlier.

Slide 6 Students should now construct their model bridges.

#### Evaluate

10 min

30 min

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

Slide 7 Ask students to put their posters on the wall with their models in front of them so that everyone can see everyone else's models. Each student should then go round and view every other teams' designs and models and give them marks out of ten for:

How well does the bridge make use of scientific understanding?

How well are these scientific ideas explained?

How well is the model constructed?

Each team effort should have a mark out of 30 from each student in the class. These can then be added up and the best design and model identified. Use Student Support Sheet 2: *Bridge evaluation* to collect this data, each student will need a copy of the sheet.

# 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: *U-Ta-Pao bridge design* Student Support Sheet 2: *Bridge evaluation* 

### EQUIPMENT REQUIRED

#### Engage

None

#### Explore

Large sheet of paper to draw design for the bridge, large marker pens may be useful here.

#### Explain

None

#### Elaborate

Materials to make the bridge models, e.g. Assorted string or thin yarn Small flat sticks to make the platform Larger sticks or stands to make the supports Knife or scissors to cut the string

Evaluate



