Strengthening the Bank of China

Key Learning Content

This film shows how triangles are an integral part of the design of the Bank of China building in Hong Kong. The building is made up of four triangular prisms which distribute the weight evenly onto the foundations. The film explains that a triangular structure gives rigidity and strength against high winds and earthquakes.

No knowledge of mechanics or engineering is assumed in the film.

Core Outcomes

Learning Points

- Be able to understand the properties of triangles and recognise the advantages of triangular design in construction.
- Be able to understand the properties of a right prism.

Suggested Activities

- Give students a pack of cards and tell them to build the tallest structure they can.
- Build a structure to support a weight using only plastic straws and sticky tape.

Triangles are an integral part of the design and construction of the Bank of China.

Extension Outcomes

Learning Points

- Be able to understand and use the geometrical properties wherein similar figures have corresponding lengths in the same ratio but corresponding angles remain unchanged.
- Be able to recognise and give the names of polygons, to include rectangle, parallelogram, square and rhombus.
- Be able to understand the properties of a tetrahedron.

Suggested Activities

- Construct a triangle with three given sides.
- Explore the number of different shapes that can be constructed with 3, 4, 5 or more given sides.
- Find examples of tetrahedral structures in nature.

Related Films

To use before the lesson plan:

Building the Pyramids	This film explains how Egyptian master builders relied on Pythagorean triangles to design the pyramids.

To use after the lesson plan:

Where Is the Centre of a Triangle?	This film considers what is meant by the centre of a triangle and reflects on the many different answers to this simple question.
Arches	This film shows how arches get stronger the more weight they bear.
Why Are Eggs Egg-Shaped?	This film explores the characteristics of eggs, pointing out that some parts are remarkably strong, while others are weak enough to allow chicks to hatch.
Tessellated Designs	This film examines the use of triangles and other polygons to enhance the beauty of buildings.

Guide Lesson Plan

Introduction

Ask students what types of shape can be made out of triangles. List suggestions, review and agree that the list ranges from all polygons to geodesic domes.

Show Film

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Main Activity

Foundation

Set students practical construction tasks based on triangular structures, e.g:

1) Give students a pack of cards and tell them to build the tallest structure they can, using only the cards.

2) Build a structure to support a weight using only a specified number of plastic straws and sticky tape. Give a prize for the greatest weight supported.

Main Activity cont...

Advanced

Explore the idea that triangles cannot be deformed into different shapes by considering the conditions for shapes to be similar or congruent. Define similar shapes as having the same corresponding angles and sides in the same ratio, and congruent shapes as having identical angles and sides. Then get students to draw a triangle with three given sides and agree that this can be done in only one way. Next, get students to draw a quadrilateral with four given sides and agree this can be done in many different ways. Observe that triangles are the only polygons where identical sides imply congruency and relate this to the rigidity of triangular structures.

Extension Activity

Use straws of equal length to construct a large number of equilateral triangles. Then join the triangles together to make solids. What solids can students construct? Explore the properties of a regular tetrahedron and find examples from nature of tetrahedral structures.

Optional Extra

It is often claimed that tetrahedrons can 'tessellate space', i.e. they can fit together with no gaps in order to fill any 3D space. If true, this could have applications in packaging. Is it indeed true?

Triangles are one of the strongest geometric shapes because their sides have fixed angles, with each side supporting the other against the force of gravity. This is why the Bank of China has a triangular framework.