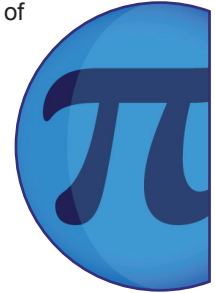


Key Learning Content

This film shows how arches have been used extensively in building since Roman times. Their property of becoming stronger as they bear more weight is illustrated with diagrams and in a practical experiment. The fragility of beams in comparison is also shown. Circular and parabolic-shaped curves are mentioned. The mathematics of load-bearing structures is beyond the scope of most school-level studies, but the film offers the opportunity to appreciate the diversity of mathematical shapes in building design.



Core Outcomes

Learning Points

- Be able to understand the benefits of arch versus beam construction.
- Be able to understand the difference between circular and parabolic curves.

Suggested Activities

- Survey all the different types of arches used in local buildings.
- Plot circles and parabolas.

Extension Outcomes

Learning Points

- Be able to understand the properties of a catenary curve.
- Be able to understand the properties of an ogee arch.

Suggested Activities

- Research the properties of particular types of arch.
- Find mathematical expressions for different types of arches.



The ancient Romans pioneered the use of arches in western civilisation and incorporated them into many structures.

Related Films



To use before the lesson plan:

Coordinate Geometry: Descartes

This film explores the x,y coordinate system that revolutionised the way mathematicians described curves.

Spirals in Nature

This film shows the many different forms of spiral that common occur in the natural world.

To use after the lesson plan:

Why Are Eggs Egg-Shaped?

This film describes the characteristics of the shapes of eggs.

Strengthening the Bank of China

This film explains how the properties of triangles make the Bank of China building more robust and able to withstand earthquakes.

Designing Chartres

This film looks at how circles were used to create one of the most beautiful cathedrals in the world.

Guide Lesson Plan

Introduction

Ask students to sketch the design of the building they would like to live in when they are grown up. Compare sketches and see how many incorporate arches.

Show Film



Arches

Main Activity

Foundation

Give students access to the internet and get them to find as many examples as they can of local buildings with arches in their design. Again using the internet, get them to list all the different types of arch and categorise the examples they have found.

Advanced

Take a list of different types of arch and get students to research, using the internet, the form of mathematical equations that characterise different types. Using graphing software, get students to check that the equations they find do indeed create the required shapes.

Extension Activity

Foundation

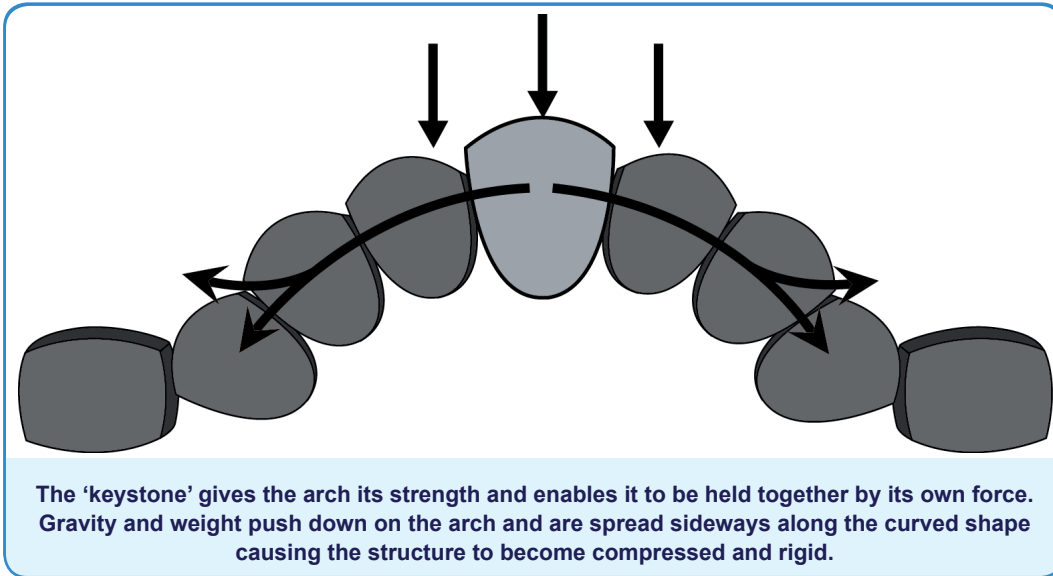
Recap the distinction made in the film between circular and parabolic arches. Give students the Cartesian equations of a circle and a parabola and get them to plot them on a graph and explore the difference in shape.

Advanced

Get students to research catenary curves and ogee arches. What physical object classically forms a catenary? What is the significance of a point of inflection (in calculus) for ogee arches?

Optional Extra

Suspension bridges are famous architecturally around the world, but there are many different forms. Research the many different claims for the curve that is formed by a suspension bridge.



The 'keystone' gives the arch its strength and enables it to be held together by its own force. Gravity and weight push down on the arch and are spread sideways along the curved shape causing the structure to become compressed and rigid.