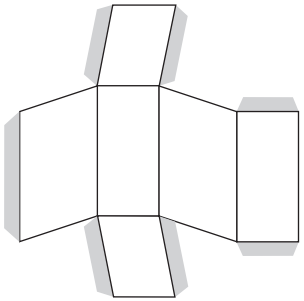
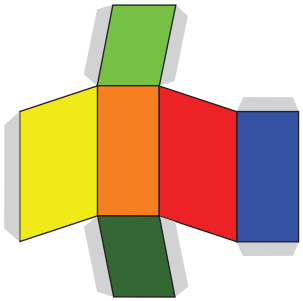
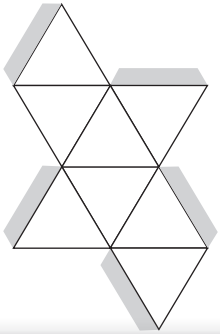
Crystals occur naturally, often as a result of **heat** and **pressure**.

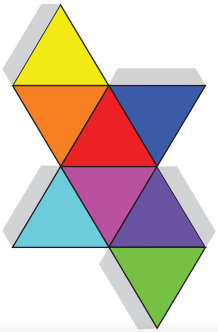
They range from valuable diamonds to common salt crystals. Many crystals have

rotational symmetries









Salt crystal

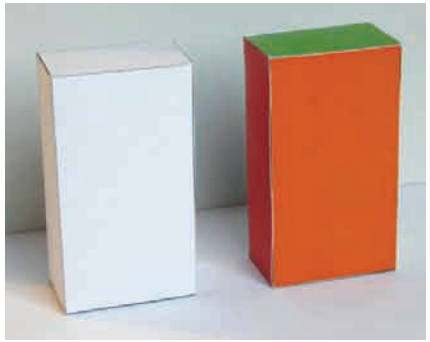
R.Weller/Cochise College

Pyrite crystal

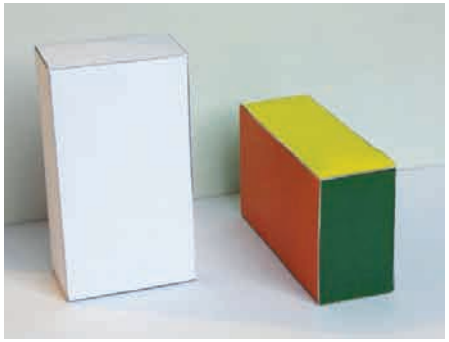
R.Weller/Cochise College

Find the ***different*** ways each coloured model can be placed so that it lines up with the plain model...

like this...



but not like this...



Each placing corresponds to a rotational symmetry.

For each symmetry find the axis of rotation.

Photos by Peter Smith Associates

Uncut diamond crystal

Uncut industrial grade diamond. Shieldforyoureyes Dave Fischer.31 August 2008. Source, Wikimedia Commons

Beryl crystal

R.Weller/Cochise College

Fluorite crystal

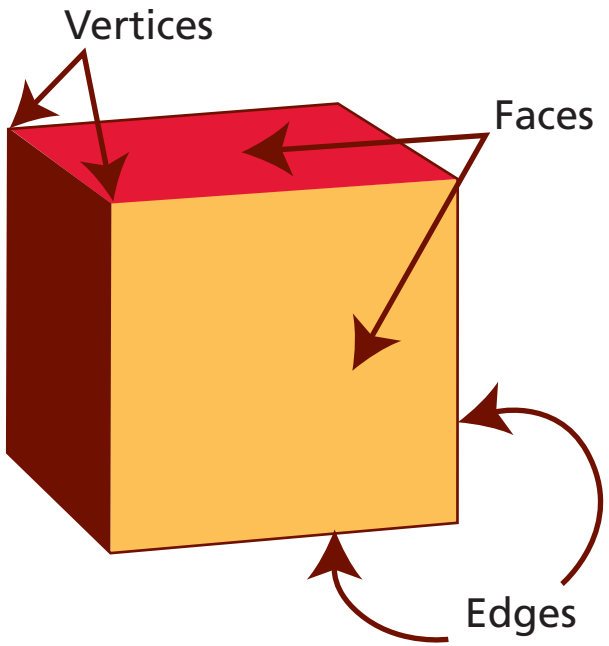
orbitaljoe, May 15 2005. Source, flickr

working with chemicals

Count the number of vertices, edges and faces of your **crystal models**.

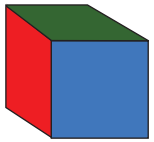
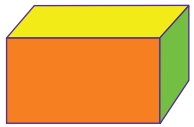
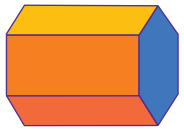
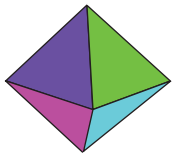
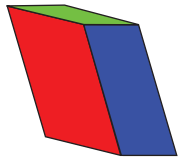
Find a relationship between the number of **vertices**, **edges** and **faces**.

Test your relationship on some **other solids**.




R.Weller/Cochise College


R.Weller/Cochise College

Shape		Vertices	Faces	Edges
Cube				
Cuboid				
Hexagonal prism				
Octahedron				
Parallelepiped				

working with chemicals

Teacher notes

create maths

Working with chemicals : Crystal shapes 1

Description

This topic looks at the mathematical structure of some naturally occurring crystals. Many crystals have less symmetrical forms than the few considered here which have been carefully chosen so that their symmetries can be considered.

Resources

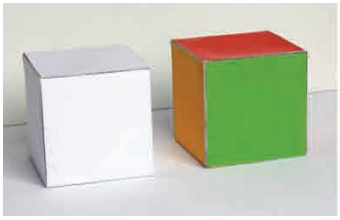
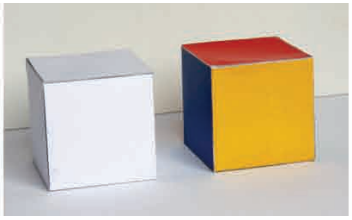
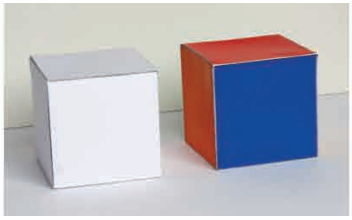
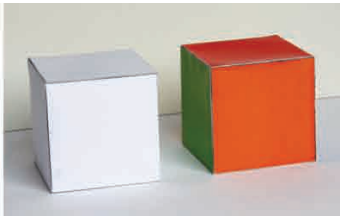
scissors and glue

Activity 1: Exploring symmetry

Activity 2: Vertices, edges and faces

In Exploring symmetry pupils make models of crystals and explore their rotational symmetry. Pupils work in small groups of 3 or 4 to construct plain and coloured models from the nets provided.

Pupils then explore the rotational symmetries of each shape using the plain model as a 'reference'. Pupils can start by using trial and improvement methods to find different possible rotations before exploring ways to be systematic in their investigation. For example, they might find all the rotations of the model which leave a particular face on top.

Discuss this in terms of the axis of rotation between the centres of opposite faces and move on to consider the axes of rotation between the centres of opposite edges and between opposite vertices. Encourage your pupils to find suitable ways of recording their results paying attention to the type and number of axes of symmetry and the corresponding orders of rotational symmetry.

Photos by Peter Smith Associates

Pupils record the numbers of vertices, edges and faces for the crystal shapes from the first activity on the Vertices, edges and faces worksheet.

Ask your pupils to look for a relationship between the number of vertices 'V', faces 'F', and edges 'E'. They may formulate and express this in words – for example, they might discover that if they add the number of vertices and faces, this is always two less than the number of edges – or as a formula $V + F - E = 2$ (discovered by the Swiss mathematicial Leonard Euler in the 18th century).

Ask them to think of other solids and encourage them to check that their relationship continues to work. They may be surprised by non-convex solids and those with holes in them.

The Mathematics

Exploring symmetry helps pupils build an awareness of the properties of some solids particularly their rotational symmetries. Looking for Euler's formula in Vertices, edges and faces encourages working systematically and testing conjectures.