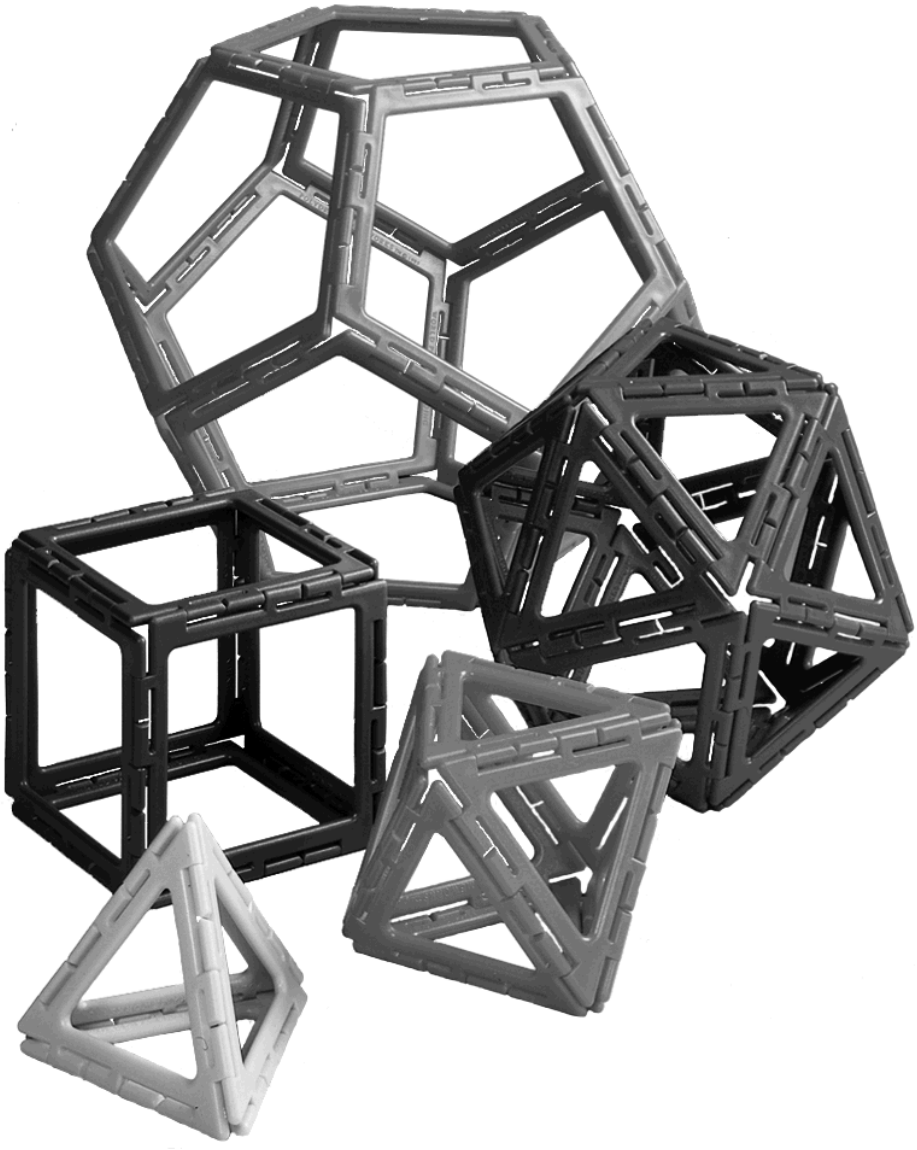
Exploring FRAMEWORKS™

Explore • Create • Understand



Bob Ansell

This booklet of 14 activities is reproduced with kind permission of Polydron International.

Author: Bob Ansell
Senior Lecturer in Mathematics Education at Nene-University College, Northampton and author of a number of mathematical resources and educational software.
Contact Email bob.ansell@edweb.co.uk

First Published 1998

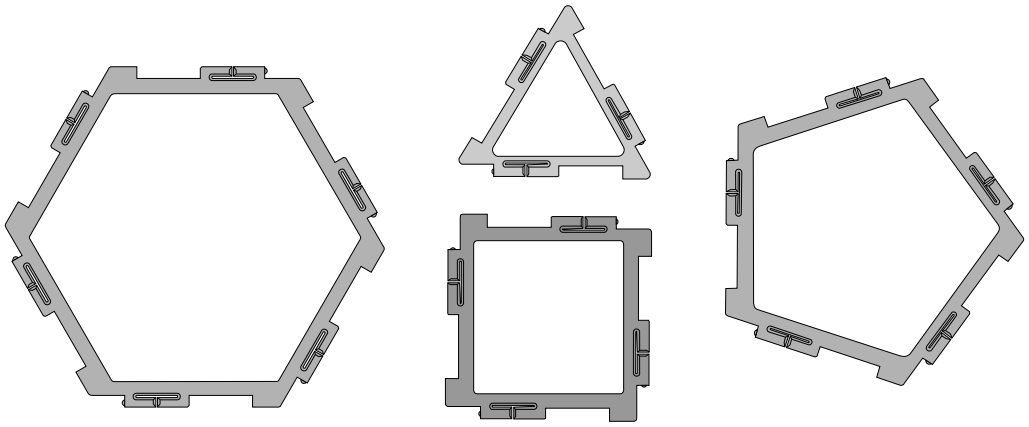
Polydron International Ltd.
Kemble
Cirencester
Gloucester
GL7 6BA
England

Tel 44(0)1285 770055
Fax 44(0)1285 770171

Contents

Introduction

Frameworks from Polydron is a system of strong, colourful, red, blue, green and yellow shapes which can be fixed together, edge to edge, by means of a unique clip hinge.



Frameworks is extremely versatile and has great potential in helping children to learn mathematics and to improve their spatial skills.

This booklet aims to help teachers and others to understand how Frameworks can improve their own teaching by providing a wide range of stimulating learning experiences for their pupils.

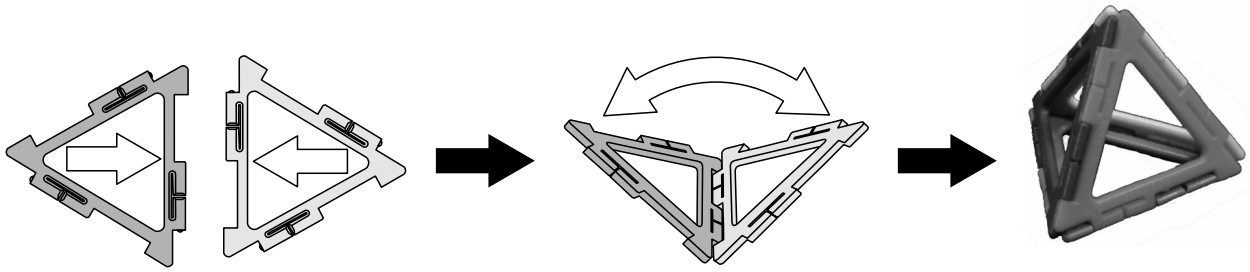
The guide will illustrate the use of Frameworks in the mathematics classroom and offer advice for teachers on the best way to use the material. However, a large section of the booklet is given over to activities for children. These are arranged with the teacher's notes just before the activities so that you can refer to them easily.

The activity pages have been produced in such a way that you can use them as they are or enlarge them on a photocopier. You will find the activities have been graded, so that the first few are easier than the later ones. This will allow you to offer different levels of work to different children.

Generally, these activities offer you a flavour of the range of mathematical work which can can covered successfully with Frameworks.

Putting Frameworks together

Frameworks is very easy to fit together. A hard surface is best used to help steady the pieces. Alternatively, you can push them together in a V shape.



Snap together **Fold into shape** **Assemble model**

When you are nearing the completion of a Frameworks model, it is a good idea to arrange for the final piece which is to be inserted to be part of a corner of your model. This make is much easier to snap the final part into place.

To take Frameworks apart

To take pieces apart again, especially when you have a solid model to dismantle, it is a good idea to use another Frameworks piece, such as a triangle, as a key. Simply insert this piece into a gap in the model and twist.

Remember, models should never be banged or dropped to disassemble them, since this could damage the material.

Frameworks in the classroom

> The words: **Explore • Create • Understand**, as seen on the front cover are a fitting maxim for any class of young mathematicians engaged on such activities.
>
> Edith Biggs
> former HM Staff Inspector in her foreword to Primary Mathematics with Polydron making a case which applies to the use of both Polydron and Frameworks

Frameworks is designed to promote exploration and creativity as a vehicle for understanding through the practical application of ideas. In the classroom you can exploit the opportunities offered with the material by encouraging your pupils to investigate many aspects of mathematics or technology.

Through extensive 'hands on' experience in a structured classroom environment children are better able to understand the underlying principles involved. It is also important that children should be provided with a large range of challenging work and be offered the chance to discuss the principles and practice of mathematics or technology with other children and with teachers.

Creating a classroom environment

Creating the right learning environment is not easy. Polydron and Frameworks are well known for their use as a motivator in free play and each has great strength in this context. However, the benefits of careful planning by teachers and the use of reflective intervention to support and extend children's learning turns these good resources into great ones.

Many teachers would agree that they are most successful when they are able to focus the attention of children on a particular aspect of mathematics or technology by using a stimulus. Frameworks provides not only that stimulus to learning but also a focus for discussion, a means of recording an activity by making something and perhaps most importantly, a way for pupils to gain satisfaction by completing a challenge. When using Frameworks always try to see beyond the immediate construction.

Above all, try to recognise and exploit the opportunities for intellectual curiosity and challenge.

A Guide to the activities

The first activity is teacher led and uses Frameworks as a material for sorting. Pieces can be sorted with simple attributes, such as shape and colour. In this way Frameworks provides a useful alternative to logiblocs or other sorting materials.

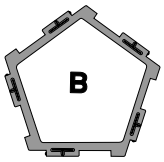
❑ **One difference dominoes**
This is an activity for pairs or a small group, led at first by the teacher.

Red Square

Red Triangle

Yellow Triangle

Yellow Pentagon



Blue Pentagon

The first player places a piece such as a red square on the table.

The next player in turn then places a piece next to it. The piece chosen must differ in one attribute from the previous piece. In the sequence shown you can see how one attribute is altered at each step.

To encourage mathematical language, try to insist that the change in attribute is spoken as the piece is played. For example, when moving down the sequence from a red square to a red triangle a child might say, "Same colour different shape".

If a player cannot go then they miss that turn. The winner of the game is the last player to place a piece.

❑ **1 Continue these patterns**
This activity is about asking children what comes next in a sequence. The first few are about colour while they next two are about colour and shape. With young children, make up sequences of your own and ask them to complete them. More experienced children should make up their own sequences and give them to each other.

❑ **2 & 3 Outlines**
This pair of activities encourages spatial awareness by asking children to fill in the pieces when they can only see the outline of the shapes.

❑ **4 to 7 Buildings**
These four activities are about constructing and modifying buildings. This is a natural activity for children and they enjoy making a variety of real or imaginary buildings.

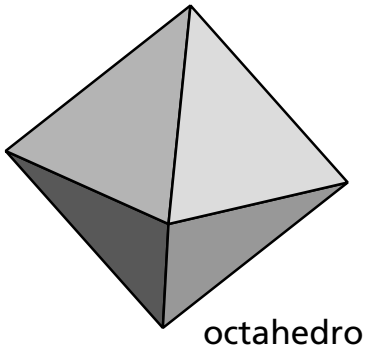
You may need to give some children help with the construction of the more difficult buildings. Some of them are quite demanding to construct.

❑ **8 Nets and Pyramids**
This activity explores the nets of a cube. There are 11 of them altogether and searching for them is a good activity for children to work on as a class. Finding all 11 nets and proving that there are no more would make a useful extension. The second part of the activity extends this idea to nets of a pyramid.

❑ **9 and 10 Pyramids and Prisms**
These activities focus on these two important families of solids. In Activity 9 children make a pyramid and then explore how to make it larger and larger. Activity 10 looks at the family of prisms. These are solids which have a polygon at each end and have the same cross section all the way through.

❑ **11 The Platonic Solids**
The family of Platonic Solids were known to the Ancient Greeks. Each Platonic Solid is made from just one sort of shape and at each corner you must have the same arrangement of shapes.

For example, at each corner of the octahedron shown here, 4 triangles meet.


octahedron

❑ **12 Guess the solid**
This activity offers children three different nets and invites them to guess what the solid will look like when folded up. Working with nets in this way helps to improve children's spatial awareness.

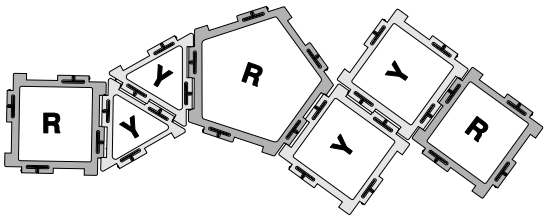
❑ **13 Some solids to make**
Whatever else children do, it is important that they have the opportunity to make a range of interesting and challenging solids like these.

❑ **14 A Tetrahedron Puzzle**
This fascinating puzzle challenges children (and adults) to join together two simple solids to make a tetrahedron.

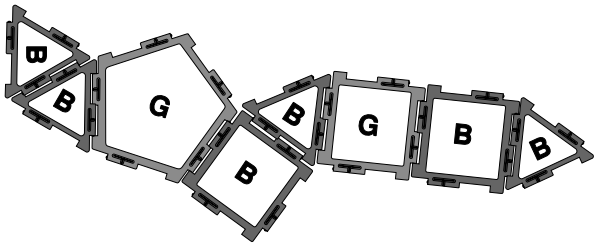
Continue these patterns

ACTIVITY 1

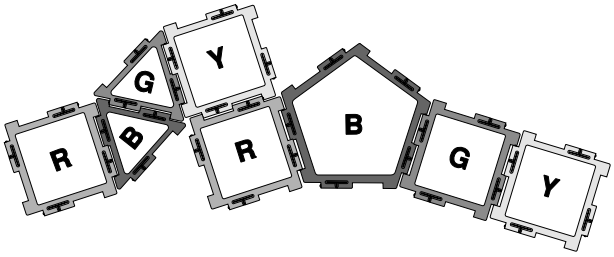
❑ Continue the colours.

1 

.....

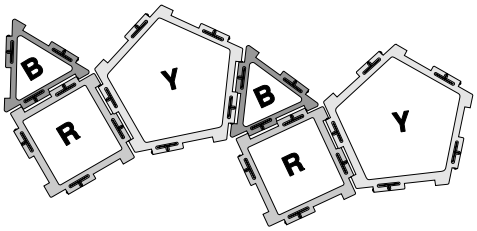
2 

.....

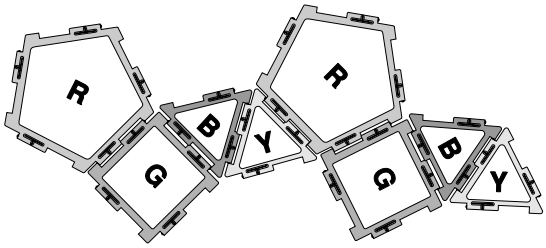
3 

.....

❑ Continue the colours and the shapes.

4 

.....

5 

.....

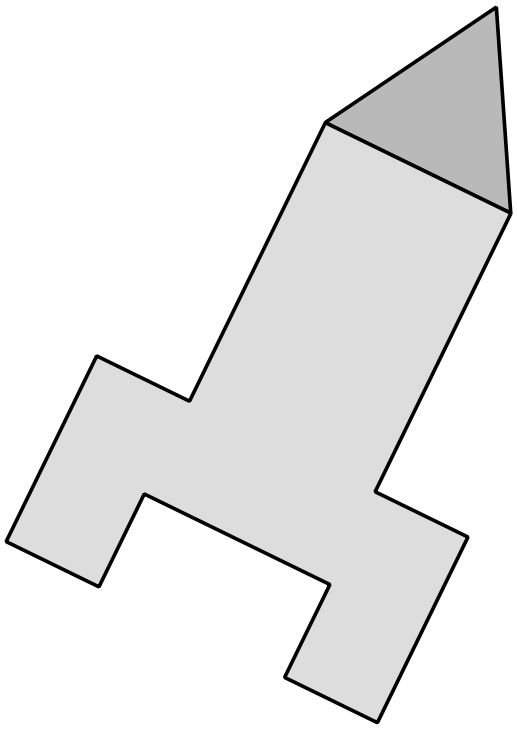
❑ Now make some patterns of your own.

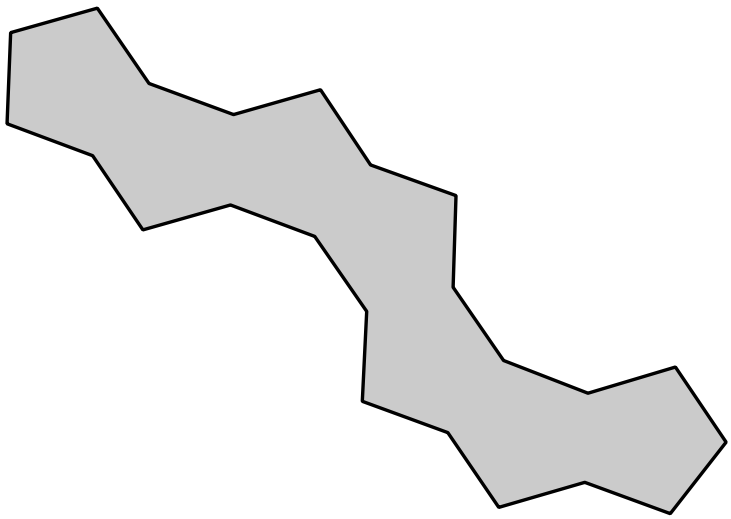
Outlines - 1

ACTIVITY 2

- ❑ Here are some outlines of two shapes. You must work out which pieces are needed.

- ❑ Make this flat rocket shape.
- ❑ Can you make it longer?
- ❑ Can you make it wider?



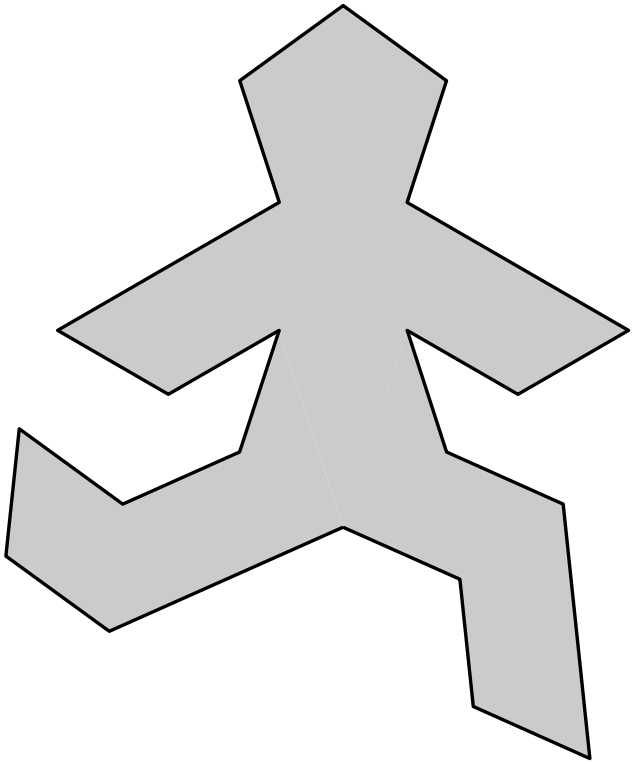


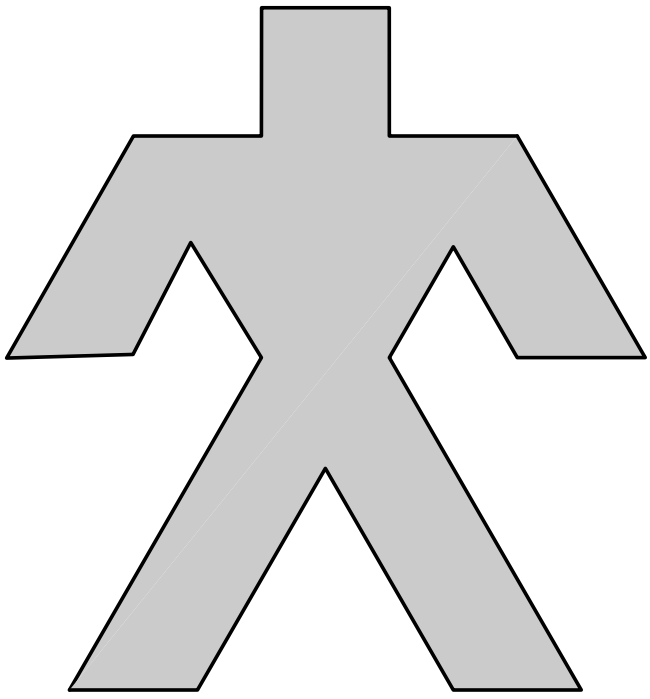
- ❑ Make this snake.
- ❑ Now, make it longer.
- ❑ Make a snake of your own.

Outlines - 2

ACTIVITY 3

- Here are the outlines of two people. Can you make each one?



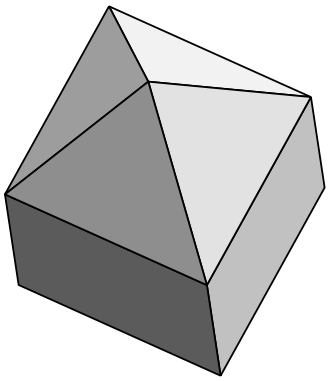


- Now make a person of your own.

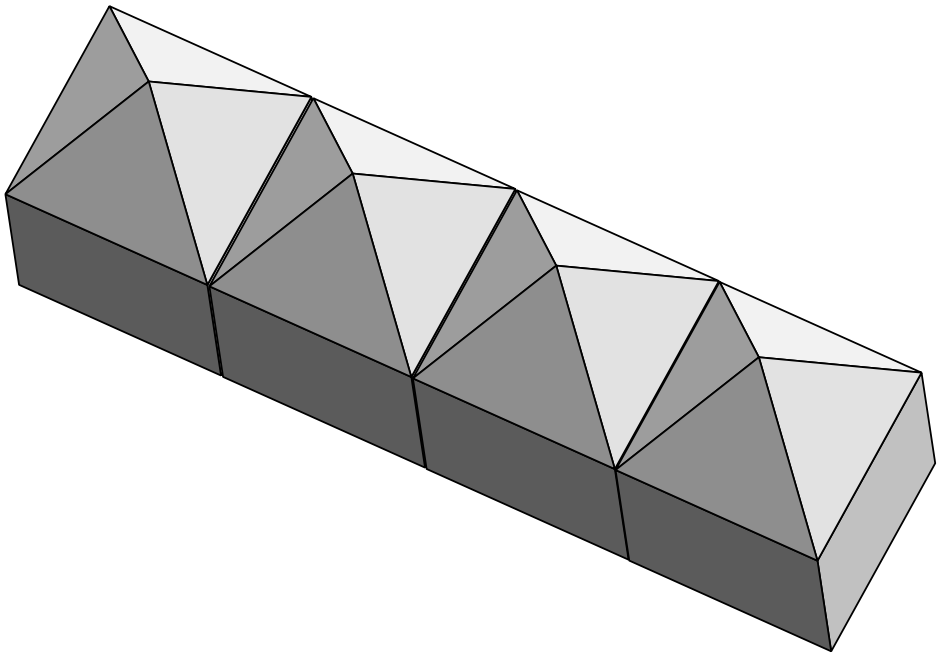
Houses

ACTIVITY 4

- ❑ Make a house like this.



- ❑ Now make a row of houses.

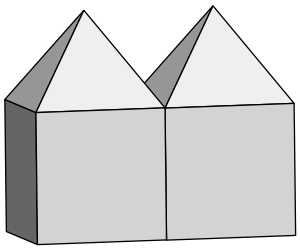


- ❑ Make your row of houses longer.
- ❑ Find another way to join four houses together.

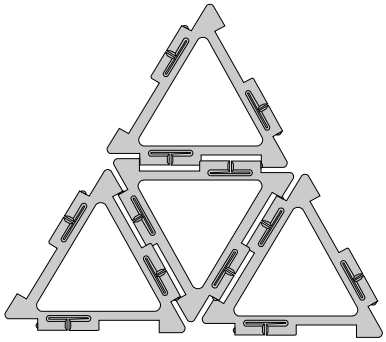
Roofs

ACTIVITY 5

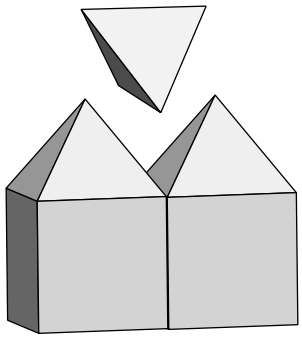
- ❑ Make a row of two houses joined together.

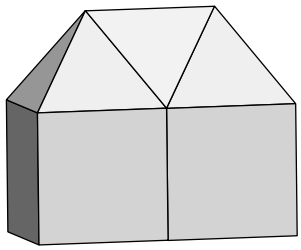


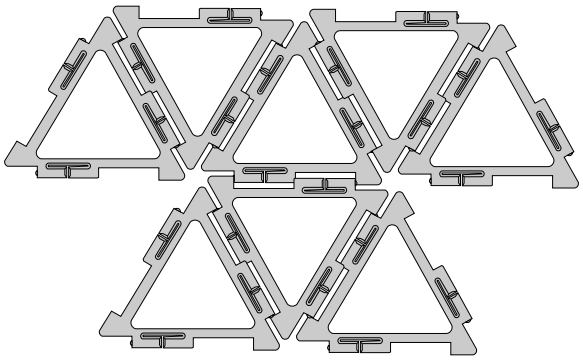
- ❑ Now make a tetrahedron using this net.



- ❑ Drop the tetrahedron into the V shape in the roof.





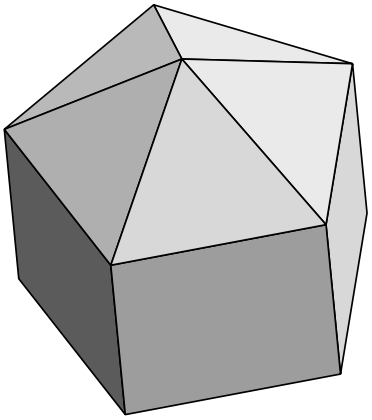


- ❑ Take off the roof of each house.
- ❑ Use this net to make one large roof.

Funny houses

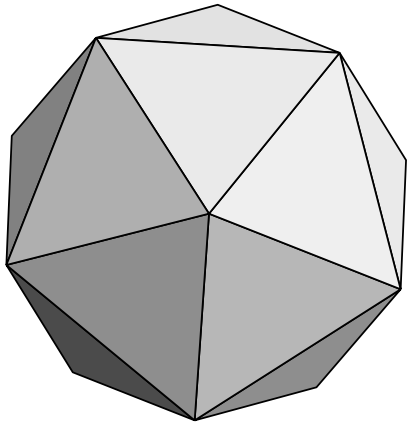
ACTIVITY 6

- Build these funny houses.



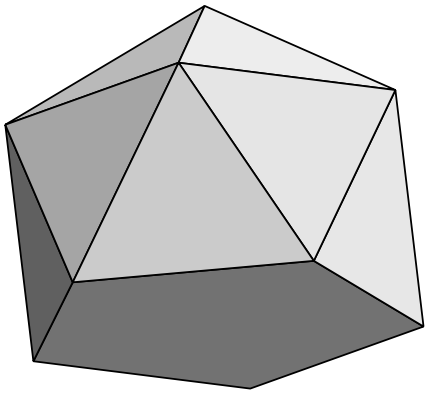
- You need 5 triangles, 5 squares and 1 pentagon for this one.

- Here are two different views of another funny house.
- To build it, start with the pentagon at the bottom.



looking down onto the roof

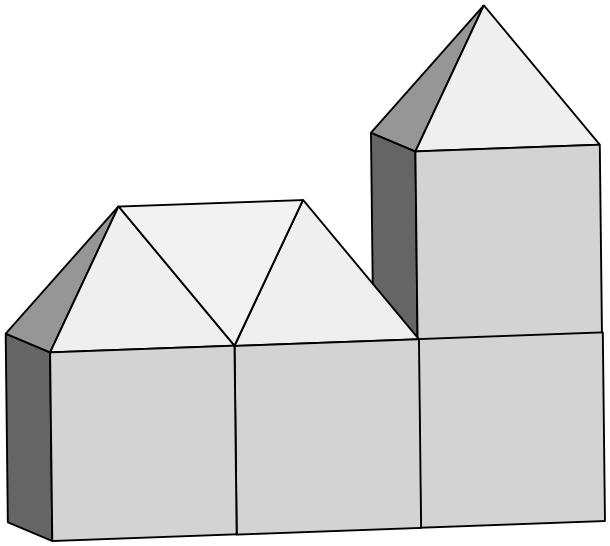
from the side you can see the bottom



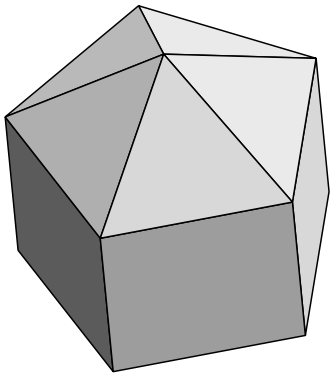
Towers

ACTIVITY 7

- ❑ Make this building with a tower.



- ❑ Make your tower taller.
- ❑ Build a tower at the other end of the building as well.



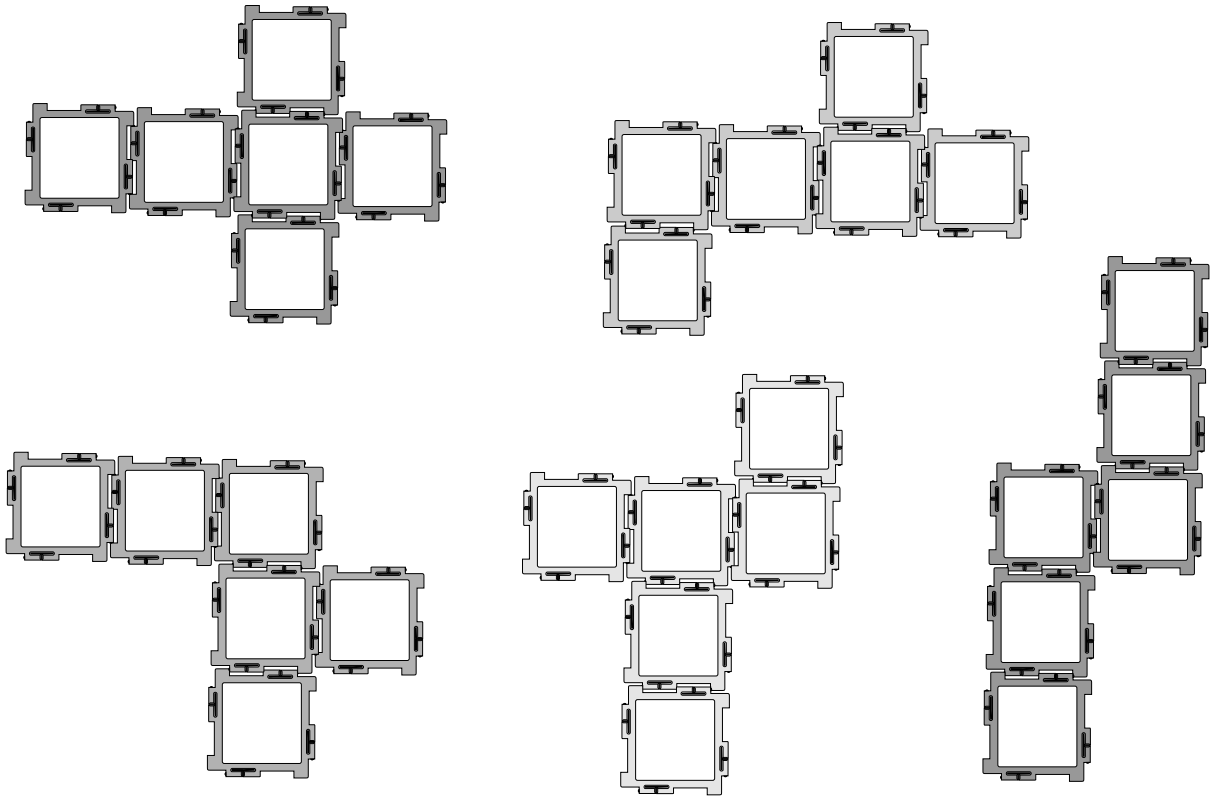
- ❑ Make this small tower taller.
- ❑ Add a building to one side of it.

- ❑ Design a building of your own with a tower.

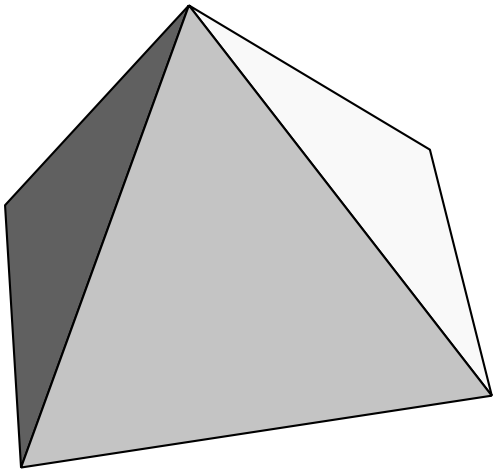
Nets of cubes and pyramids

ACTIVITY 8

- Which of these nets will fold to make a cube? Make each one and check.



- Find other nets of a cube and draw them on squared paper.

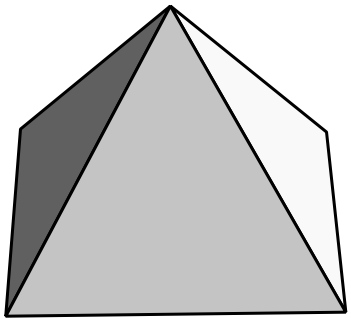


- Here is a square based pyramid.
- Make it and then unfold it to form a net.
- Draw your net.
- Find as many different nets of this pyramid as you can. Draw each one.

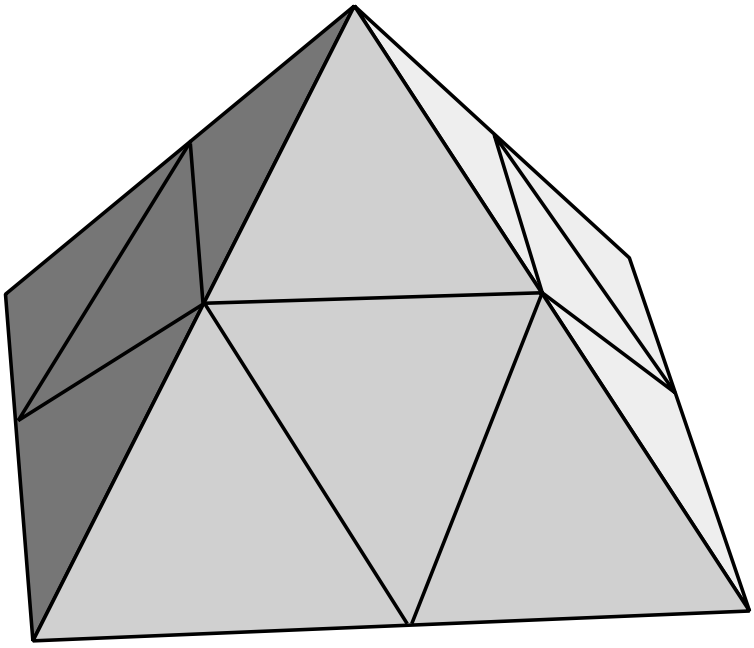
Larger pyramids

ACTIVITY 9

- ❑ Make this small pyramid.



- ❑ Now look at this large pyramid and decide how many pieces you need to make it.

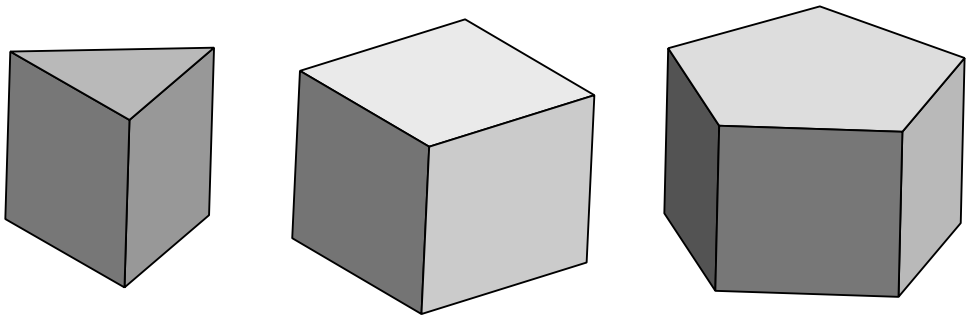


- ❑ Make an even larger pyramid with nine squares for the base. Work out how many triangles you need before you begin.

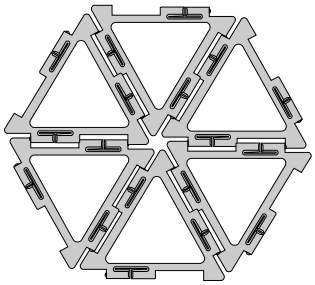
Prisms

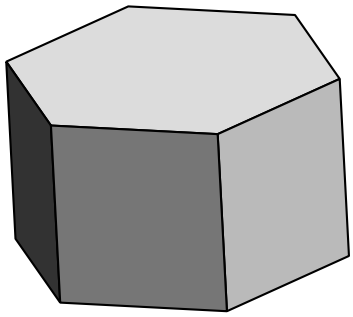
ACTIVITY 10

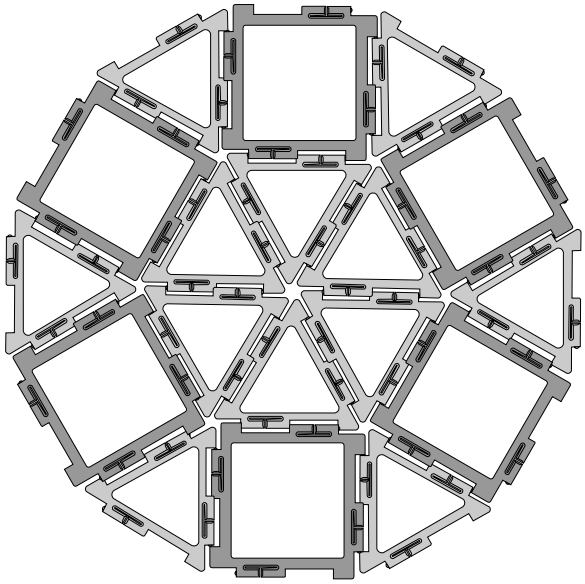
❑ Here are three different prisms. Make each one and then make each one longer.



❑ Join six triangles together to make the top and bottom of for a hexagonal prism.





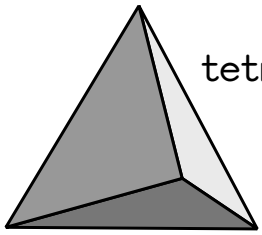


❑ Make a giant prism with this shape for the top and the bottom.

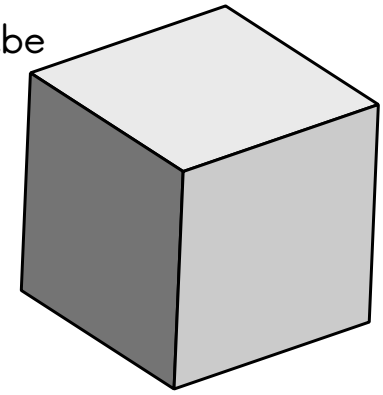
Platonic Solids

ACTIVITY 11

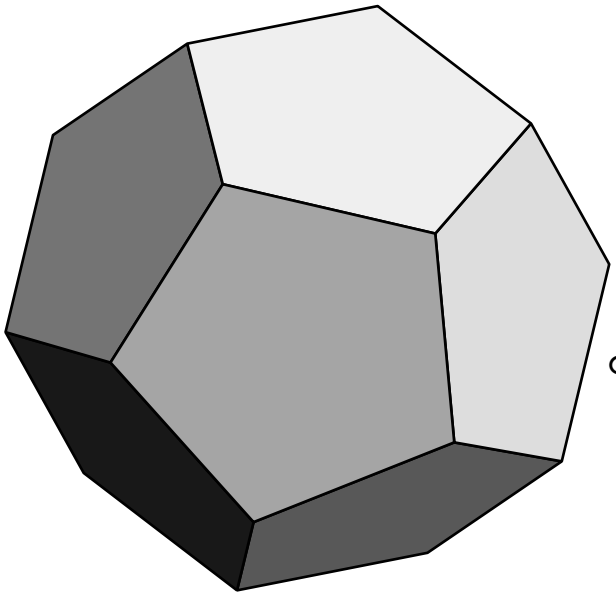
- Here are five famous solids to make.
- They were known to the Ancient Greeks more than two thousand years ago.



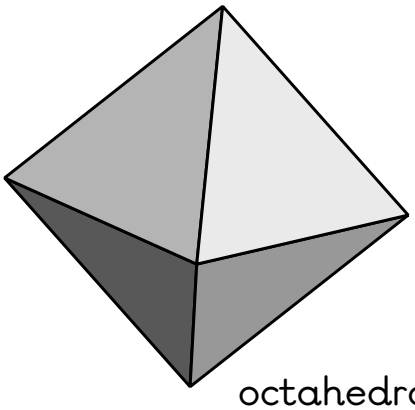
tetrahedron



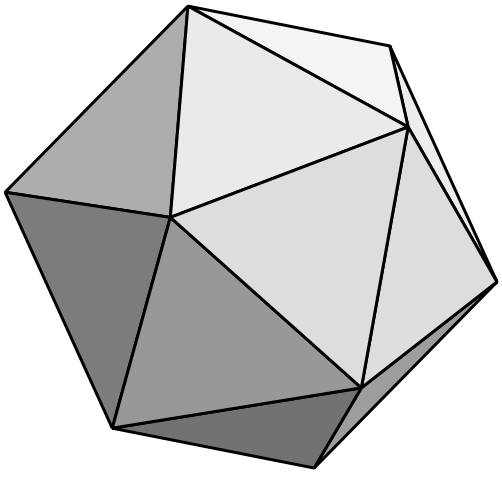
cube



dodecahedron



octahedron

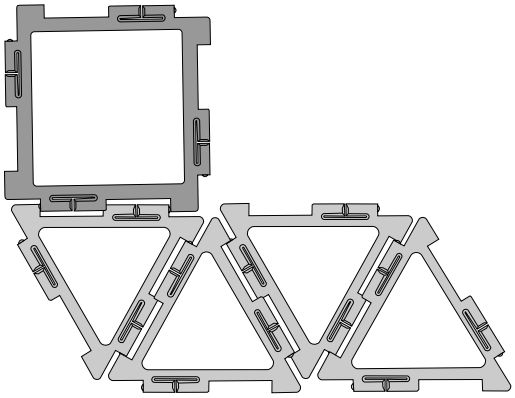


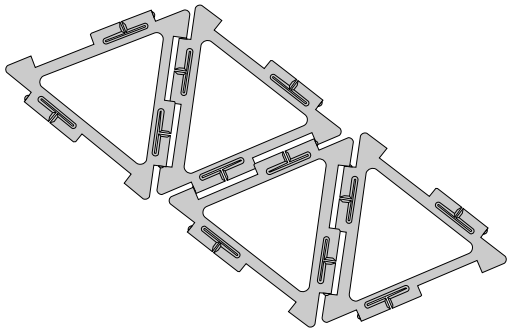
icosahedron

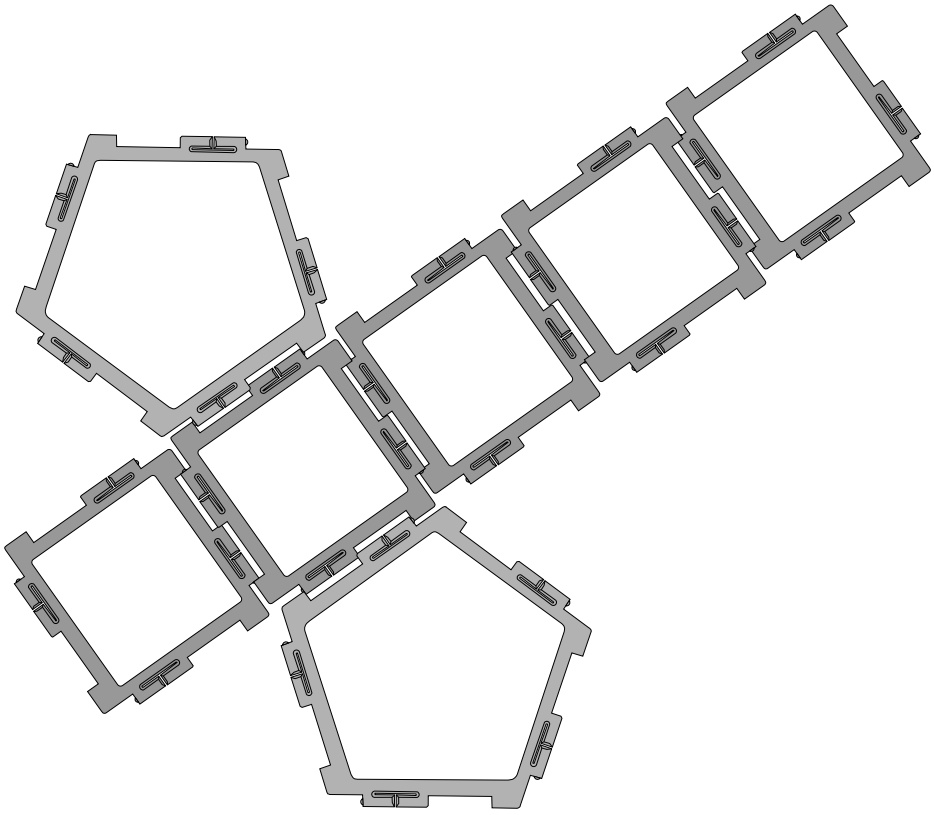
Guess the solid

ACTIVITY 12

❑ Here are some nets of solids. Look at each one carefully and try to decide what the solid will look like.







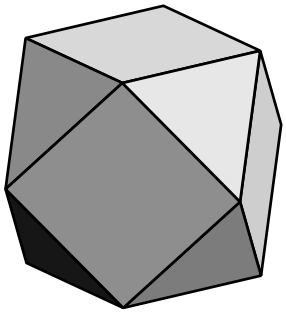
❑ Make each net and fold it up to see if you are right.

Some solids to make

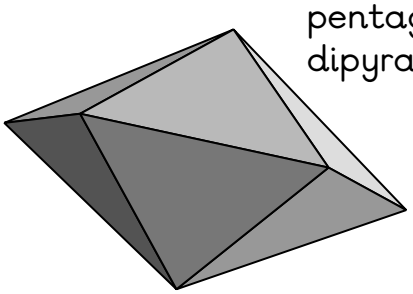
ACTIVITY 13

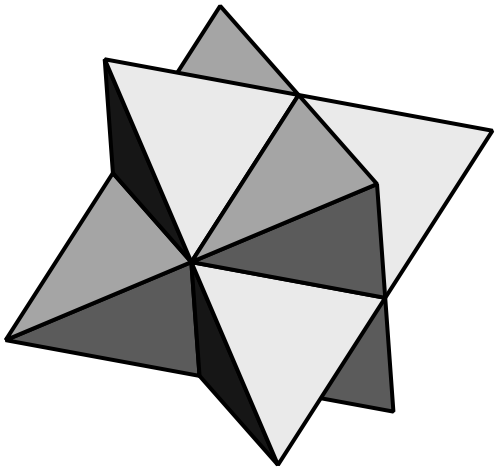
❑ Here are some solids for you to make. The back of each solid has the same shape as the front.

cuboctahedron



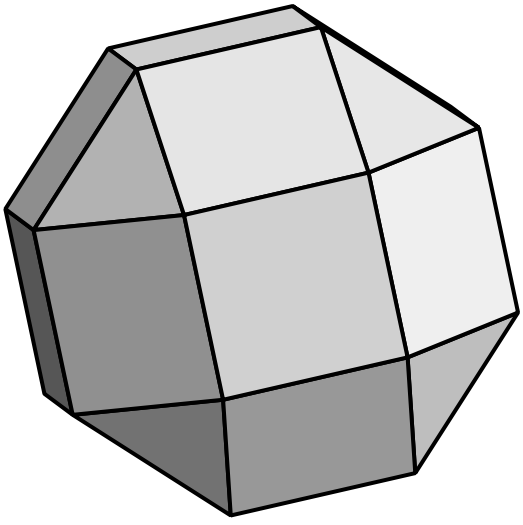
pentagonal dipyramid

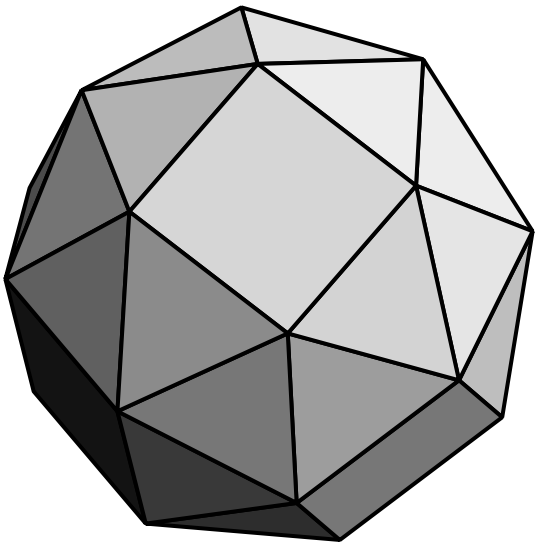




stella octangula

rhombicuboctahedron



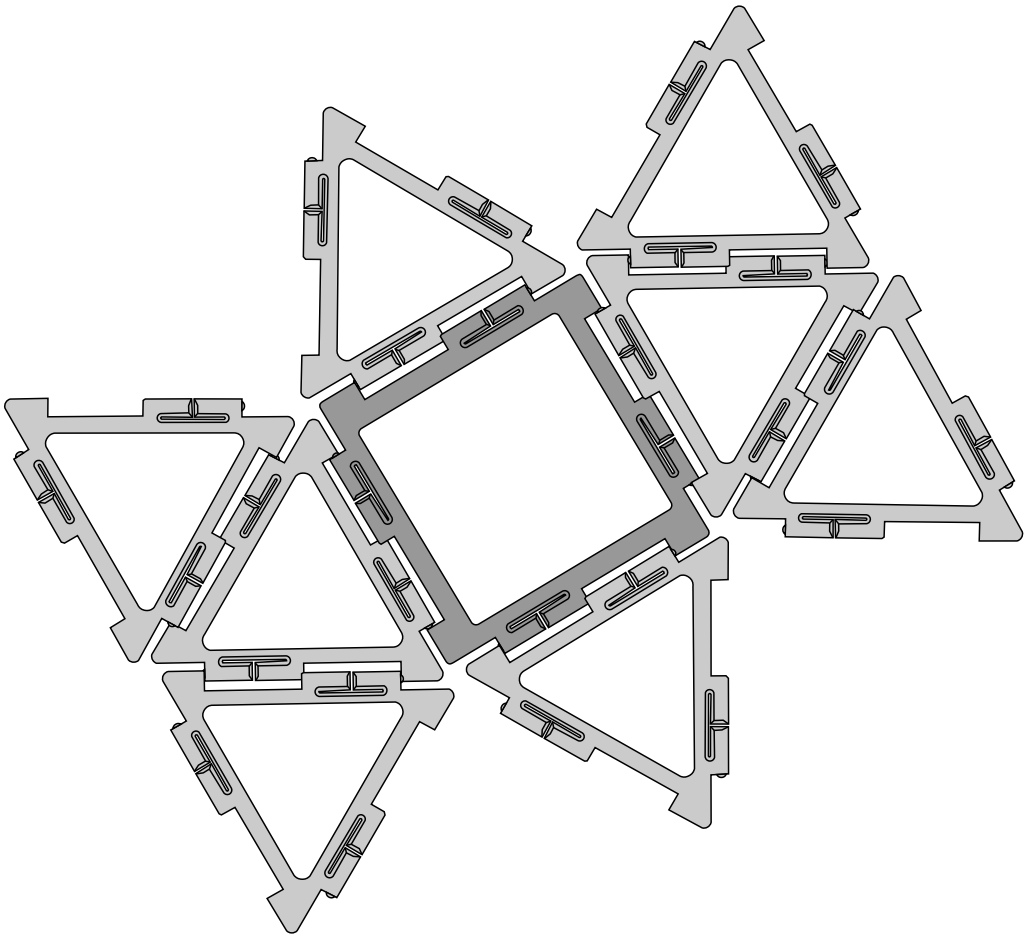


snub cube

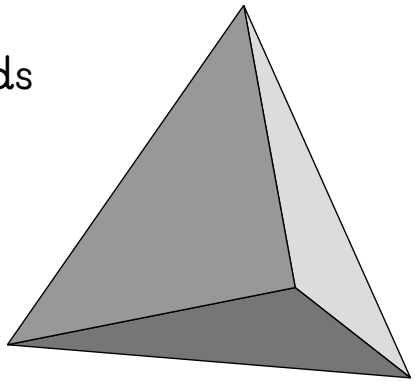
A tetrahedron puzzle

ACTIVITY 14

❑ Here is the net of a solid. Make two copies of it.



❑ The puzzle is to place the two solids solids together to make a large tetrahedron.



❑ Give the puzzle to someone else to try.