# Having an edge

# Own activity

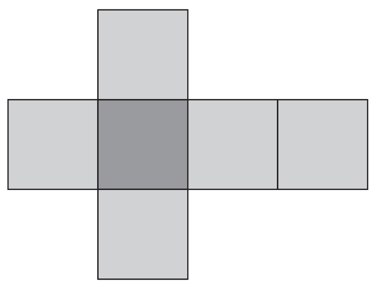
## MERO node or ORBIT sphere

The exhibit consists of ORBIT spheres and rods of seven different lengths from the product range of Syma-System AG.

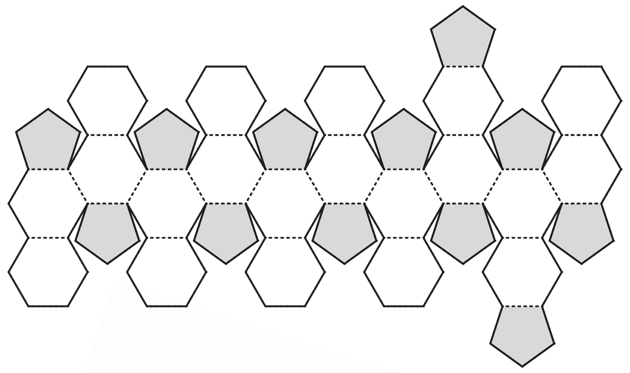
**1. The shortest rod** is 250 millimetres long – measured from node centre to node centre. How long are the other rods? (State exact and, if necessary, rounded values.)
What else can be found in this object in terms of mathematics?

## Nets of solids

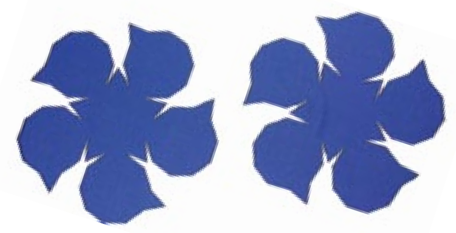
**2. Every polyhedron has** several different nets – thousands, sometimes. A cube, for example, has eleven. Draw as many as possible of these.



**3. Cutting the nets** for the polyhedron models resulted in the net negatives below. Collate each of them to its polyhedron. As an example, this is the net negative of a football:

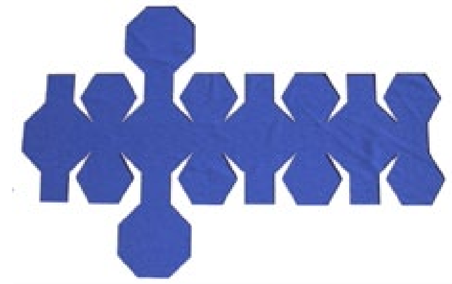


a)

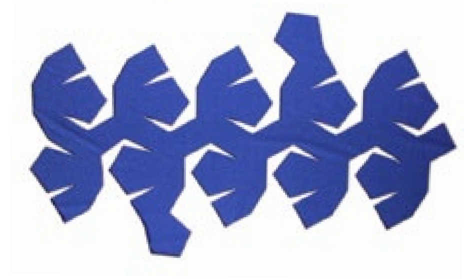


b)

c)



d)



## Euler's polyhedron theorem

Check Euler's polyhedron theorem against the Platonic solids and other solids.

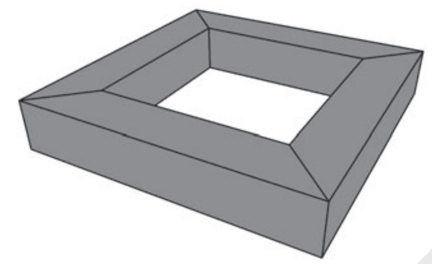
| body | *e* | *f* | *k* | *e+f-k* |
|---|---|---|---|---|
| tetrahedron | | | | |
| hexahedron | | | | |
| octahedron | | | | |
| dodecahedron | | | | |
| icosahedron | | | | |

**4. How can one** recognise the duality of certain solids in the spreadsheet?

**5. Use parts from** the polyhedron kit to build solids of your choice. Determine ***e***, ***f***, and ***k***.

**6. Choose Archimedean solids** and collate them with their Archimedean duals.

**7. Why was it** the icosahedron rather than the dodecahedron that was chosen as the underlying solid for the standard model of the football?



**8. The 'napkin ring'** shown above is a non-convex polyhedron. Show that it violates Euler's polyhedron theorem.

## Angular defects in convex polyhedra

The sum of planar angles in a convex corner of a polyhedron is smaller than the full angle of 360°. Therefore, there is an angular defect to 360° for each corner of any polyhedron. Two examples:

| polyhedron | *e* | *angular defect at one corner* | *total angular defect* |
|---|---|---|---|
| regular tetrahedron | 4 | 360° – 180° = 180° | 720° |
| cube | 8 | 360° – 270° = 90° | 720° |

**Test other examples** to corroborate the theorem of the French philosopher and mathematician René Descartes (1596-1650): **"The total angular defect of a convex polyhedron is 720°."**



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