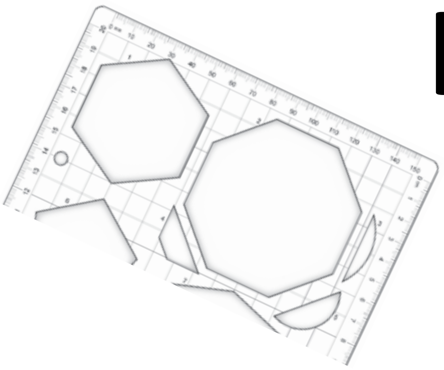
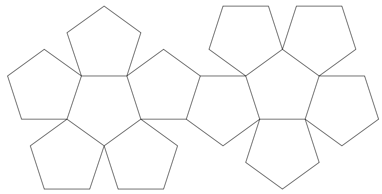
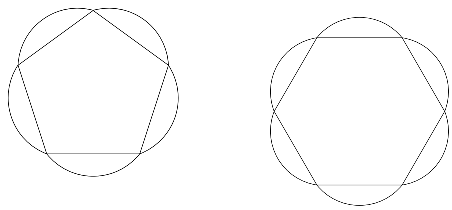
Platonic & Archimedean polyhedra



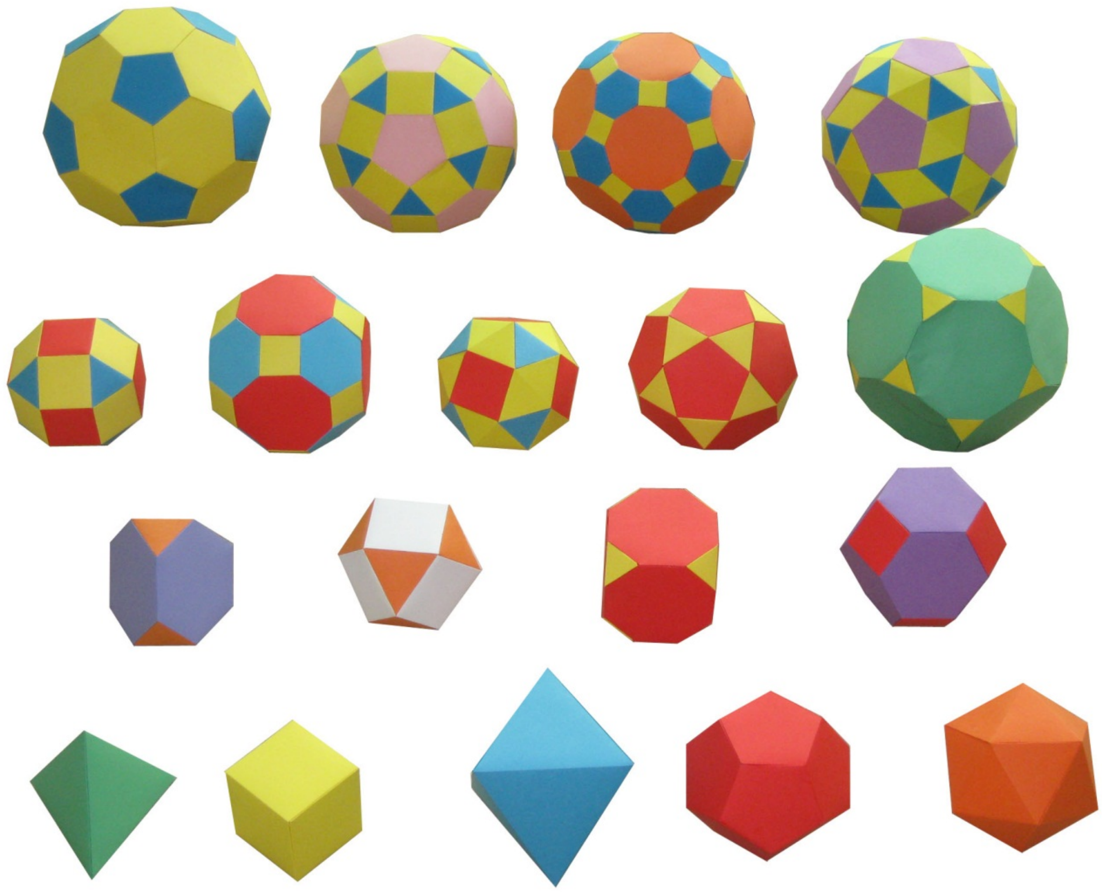




18 models, 4 construction methods

Create models up to 38 cm in diameter!

Geoff Phillips



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18 models, 4 construction methods

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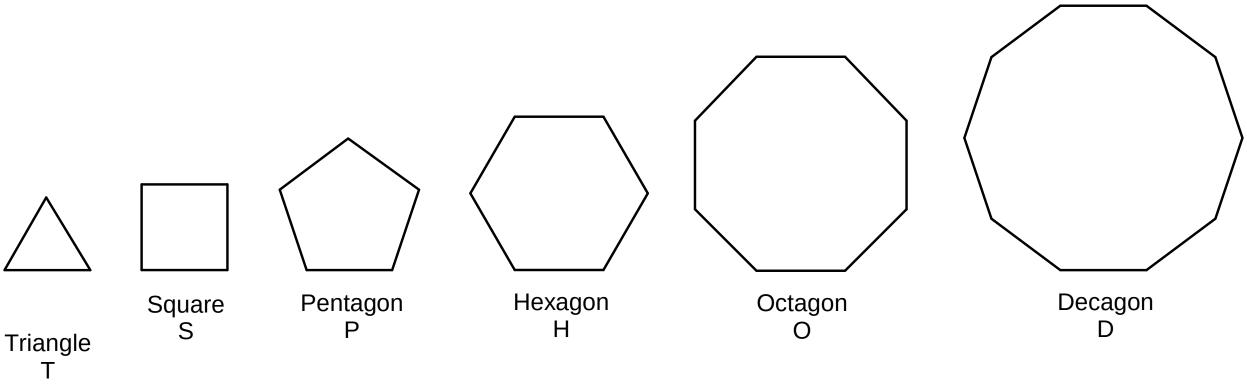
POLYGONS AND POLYHEDRA

Polygons

A polygon is a straight sided shape. A regular polygon has equal sides and equal angles.
The models in this book are all made up of panels or 'faces' which are all regular polygons.



The regular polygons used in this book and their symbols.

Polyhedra

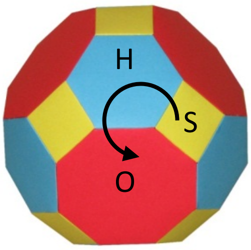
A polyhedron is a 3D solid whose faces are polygons. Polyhedra is the plural of polyhedron.
Polyhedra made up of only one type of regular polygon are called 'Platonic' polyhedra.
Polyhedra made up of different regular polygons are called 'Archimedean' polyhedra.
There are 5 different Platonic polyhedra and 13 different Archimedean polyhedra, which comprise the 18 models in this book.

Each model may be described by a 'formula' which gives the number of each type of polygon face required to make it.

e.g. $P_{12}H_{20}$ is the formula for a model containing 12 Pentagons and 20 Hexagons. The letters used in each formula are the first letters of the polygon names above, i.e. T, S, P, H, O and D.

Polyhedra corner patterns

The arrangement of regular polygons at each corner of a platonic or archimedean polyhedron is identical. By simply repeating the corner pattern, a polyhedron may be constructed without the need for a plan or 'net'. E.g. In the model below, the anticlockwise arrangement of regular polygons at every corner is SHO.



The anticlockwise corner pattern for this polyhedron is SHO.

Naming polyhedra

The following terms form parts of the names of the polyhedra in this book. They are, in many cases, derived from Latin words.

Term		**Meaning**
Regular	–	having the same side (edge) length
Poly	–	many
Gon	–	angles
Tri	–	3
Tetra	–	4
Pent	–	5
Hex	–	6
Oct	–	8
Deca	–	10
Dodeca	–	12
Icosa/Icosi	–	20
Hedron	–	solid with regular faces
Truncated	–	cut off
Cub(e)	–	includes squares
Rhomb(i)	–	includes squares
Great	–	has a large number of faces

Example 1: Truncated Tetra hedron

Cut off

4 faces

Regular solid

A Truncated Tetrahedron is a polyhedron that is a 4 faced regular solid with some corners cut off.

Example 2: Great Rhomb icosi dodeca hedron

Large number of faces

Includes square faces

Includes 20 of one type of face (in this case Hexagons)

Includes 12 of another type of face (in this case Decagons)

Regular solid

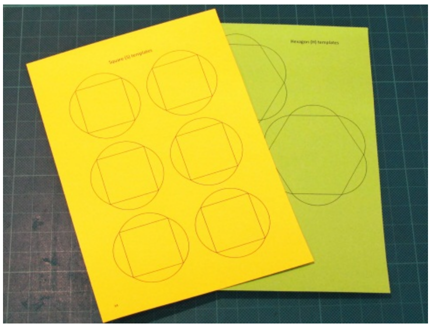
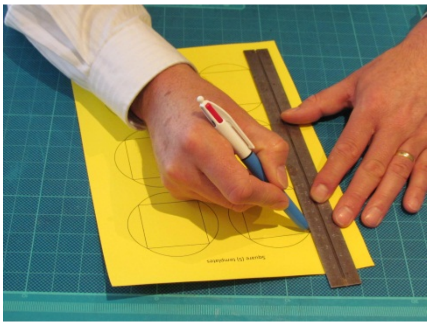
A Great Rhombicosidodecahedron is a regular solid that has a large number of faces including square ones. It has 20 of one type of face and 12 of another.

POLYHEDRA CONSTRUCTION

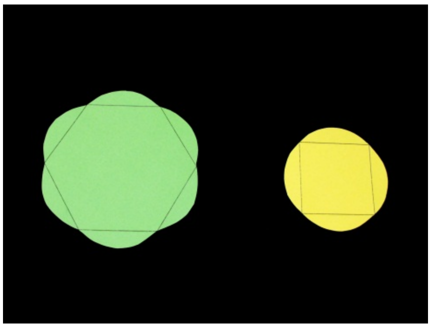
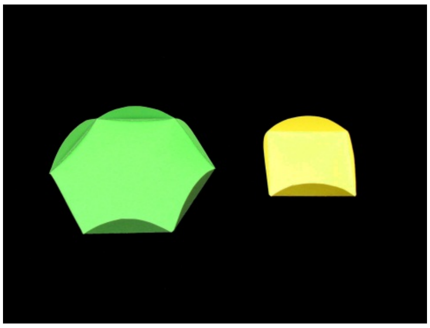
Method 1: External tabs

1. Print or trace the required polygons onto suitable card (160 gsm A4 card is recommended). Polygon templates begin on page 31 of this book, and may be downloaded from **www.maths-pro.com/polyhedraworksheets.htm**.
   Be sure to print/trace sufficient copies of each face.

2. Score the straight edges of each polygon before cutting out.

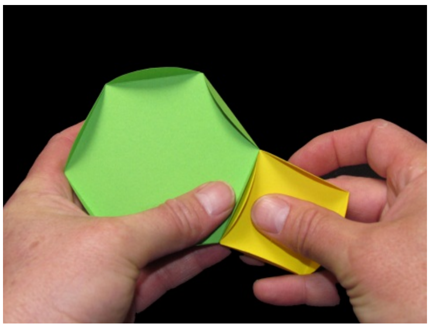
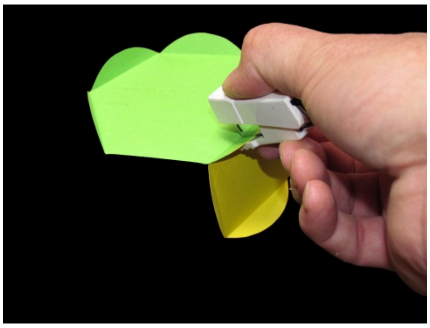



3. Cut out, then fold edges upwards with printing on the underside (so printing will be inside the completed model).

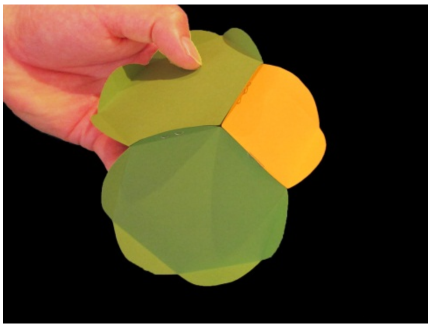
6. Note the corner pattern for the model to be constructed.

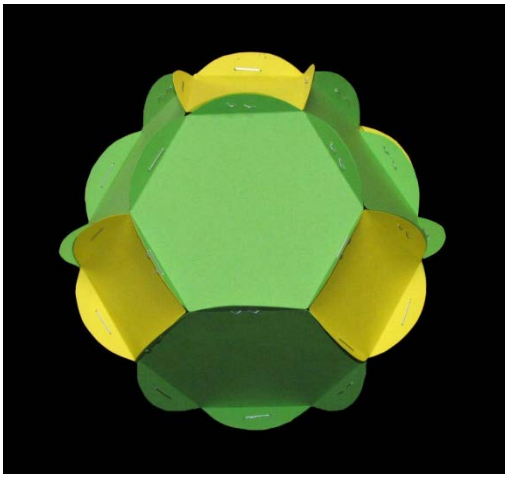
7. Align faces so tabs will on the outside of the completed model, and join using a single staple or thin smear of quickset glue applied to one tab at each join.

8. Continue to join faces , following the same corner pattern at each vertex. Here, the corner pattern is SHH (Square, Hexagon, Hexagon).

9. Continue with the same pattern at each corner until the model is complete.

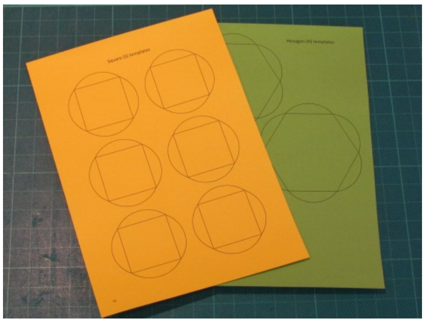
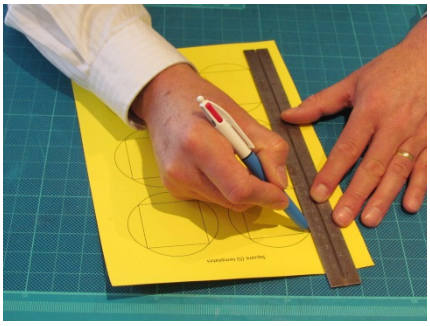




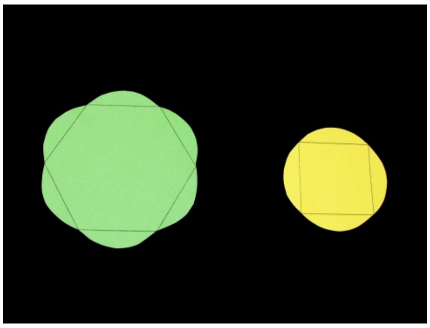
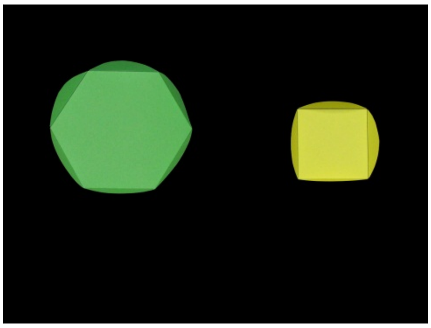
Method 2: Internal tabs

1. Print or trace the required polygons onto suitable card (160 gsm A4 card is recommended). Polygon templates begin on page 31 of this book, and may be downloaded from **www.maths-pro.com/polyhedraworksheets.htm**.
   Be sure to print/trace sufficient copies of each face.

2. Score the straight edges of each polygon before cutting out.

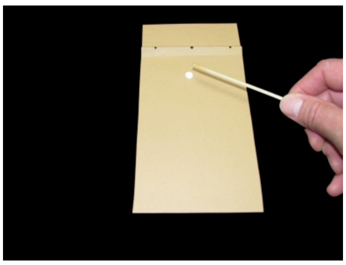
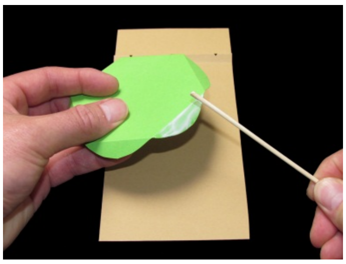
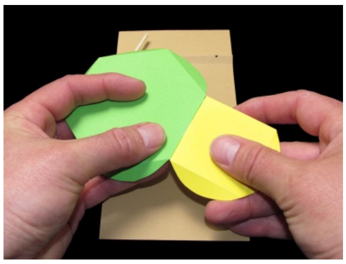



3. Cut out, then fold edges upwards with printing on the upper side (so printing will be inside the completed model).

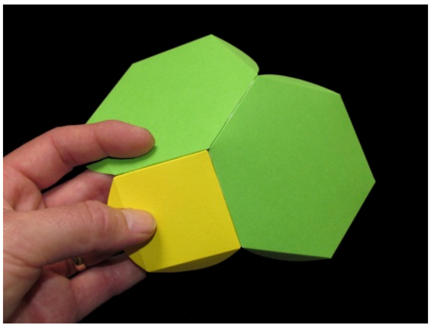
6. Note the corner pattern for the model to be constructed.

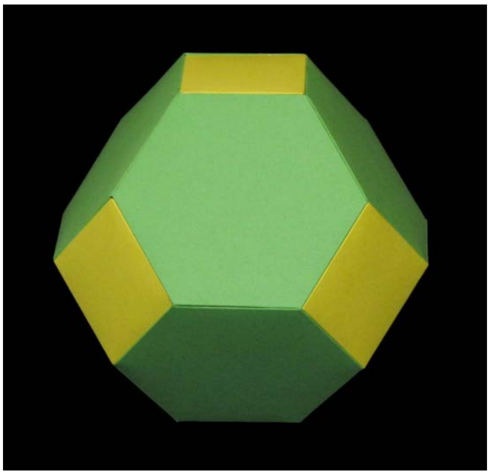
7. Apply a thin smear of Aquadhere quickset glue to one tab at each join. Align faces so tabs will on the outside of the completed model, and hold tabs together until secure.

8. Continue to join faces , following the same corner pattern at each vertex.
Here, the corner pattern is SHH (Square, Hexagon, Hexagon).

9. Continue with the same pattern at each corner until the model is complete.

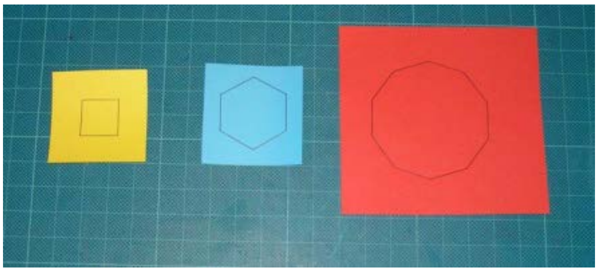


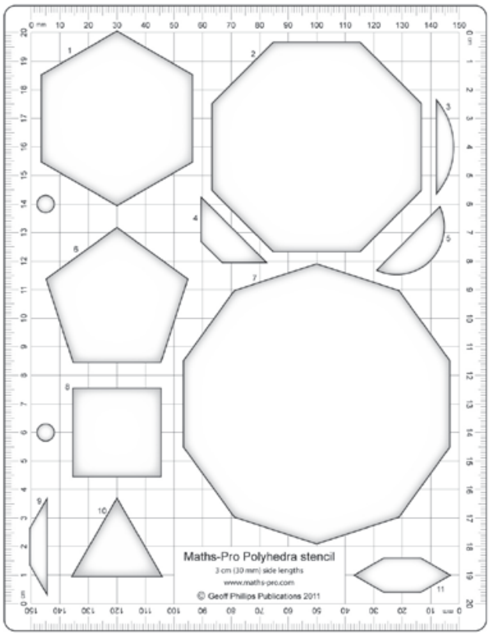


Method 3: Using Maths–Pro Polyhedra stencil

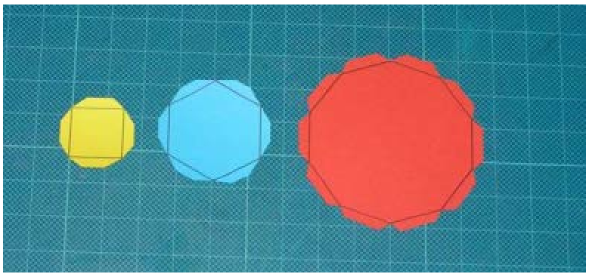
Maths–Pro Polyhedra stencil is available from Geoff Phillips Publications (www.maths-pro.com).

1. Use Maths–Pro Polyhedra stencil to trace the required polygons (of 3 cm side length) onto 160 gsm coloured card, pressing firmly enough to score edges.

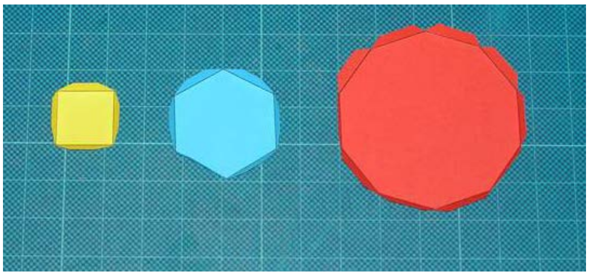


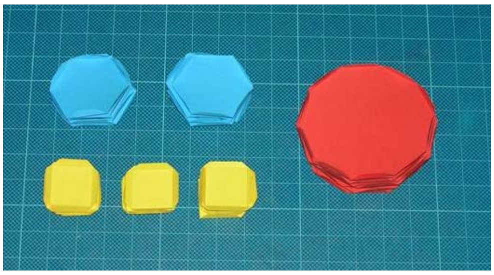


2. Cut out each face, allowing 5 mm or so of extra width for tabs. Tabs may be drawn using Maths–Pro Polyhedra stencil, or simply added as you cut around each polygon. Tabs need not be exact, as they will be hidden inside the completed model.

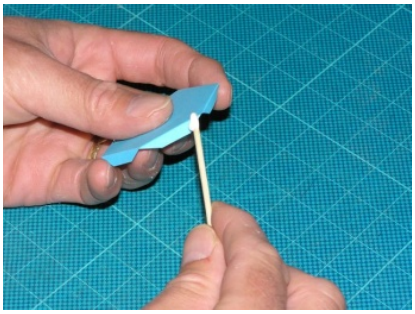


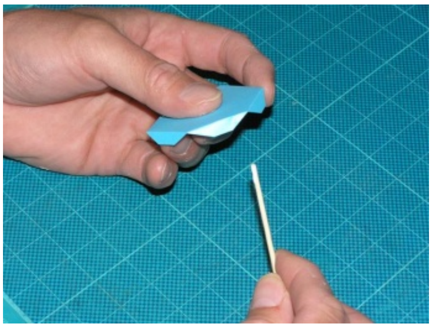
3. Fold edges upwards with printing on the top side (so printing will be inside the completed model). Make sufficient faces for the entire model.



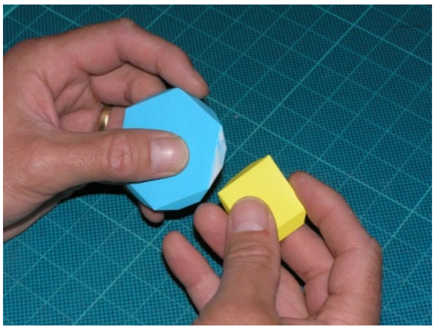


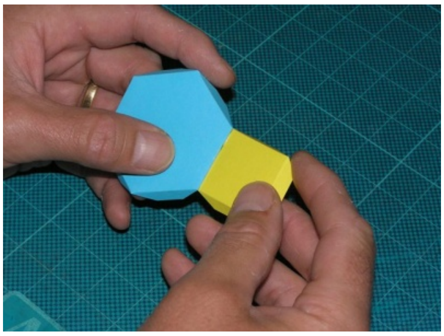
4. Note the corner pattern for the model to be constructed. Add a thin smear of quickset glue to one tab at each join.





5. Align faces so tabs will on the inside of the completed model, and hold faces together until firmly attached. (Alternatively, tabs may be joined externally using a staple or glue.)

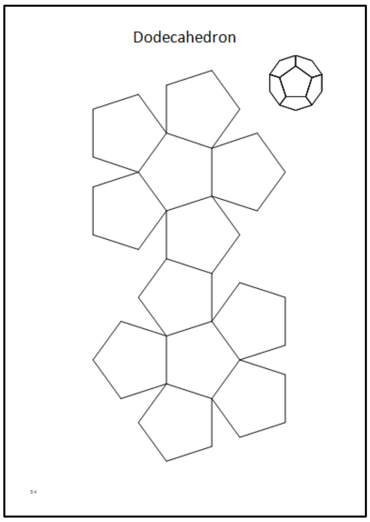




6. Join faces , following the same corner pattern at each vertex.
Here, the corner pattern is (clockwise from the yellow square): Square, Hexagon, Decagon (SHD).
Continue with the same pattern at each corner until the model is complete.

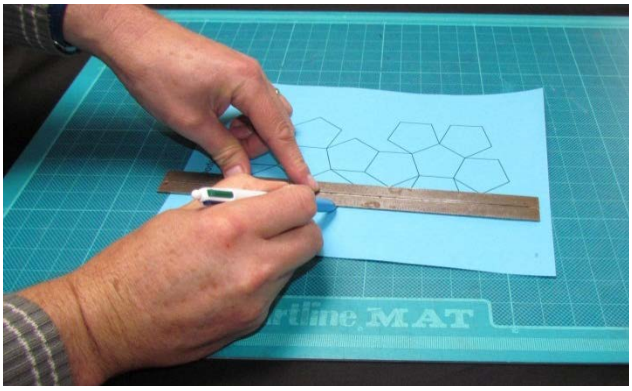
Method 4: Using single page nets

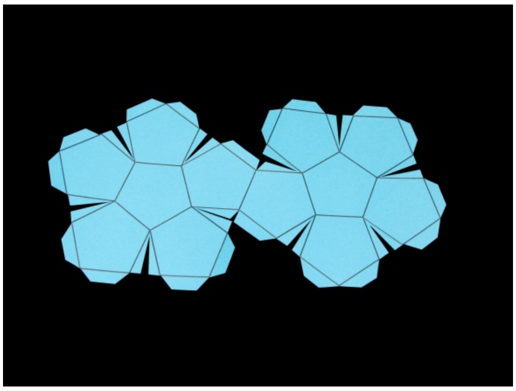
1. Print or trace the required net onto suitable card (160 gsm A4 card is recommended). Nets begin on page 46 of this book, and may be downloaded from www.maths-pro.com/polyhedraworksheets.htm.



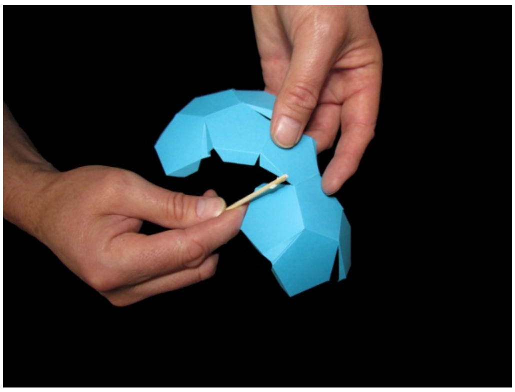
2. Score each edge of every polygon in the net using a ball point pen.

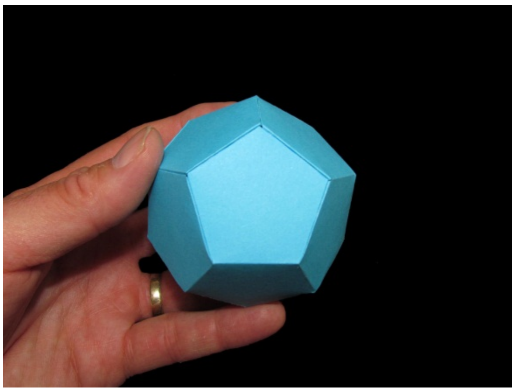
3. Cut around each net, adding tabs of width approximately 5 mm around each edge as you go.





4. Fold tabs and edges so printing will be inside the completed model and join edges using a quickset glue applied to one tab at each join.

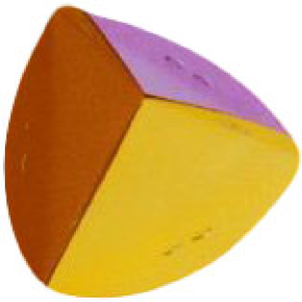
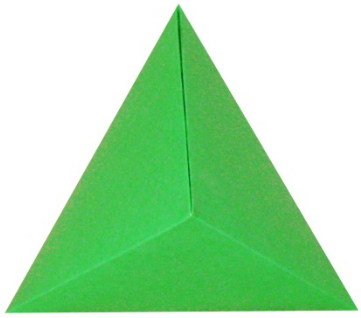




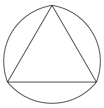
THE MODELS

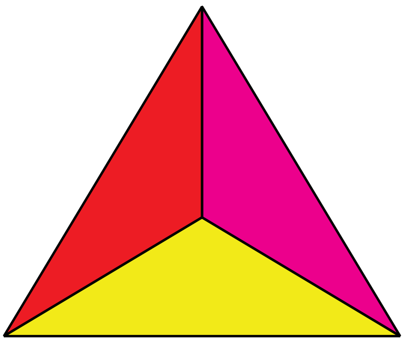
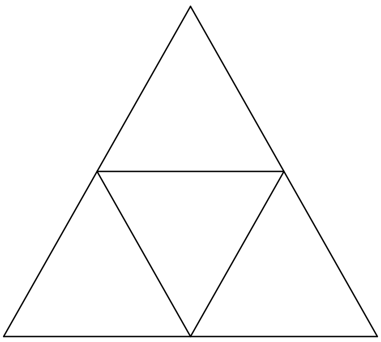
1	**Tetrahedron**	T_4

The completed model:

Tabs on outside	Tabs on inside
	

You will need:

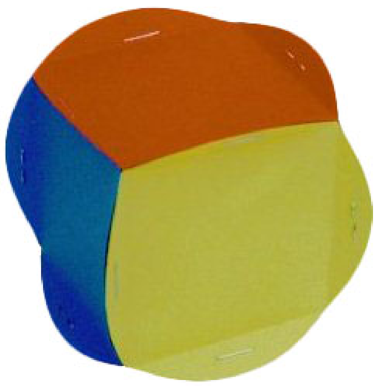
4 Triangles		
		

Corner pattern: T T T	Net:
	

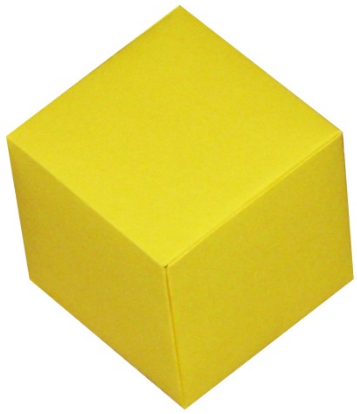
2	Cube	S_6

The completed model:

Tabs on outside

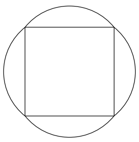


Tabs on inside

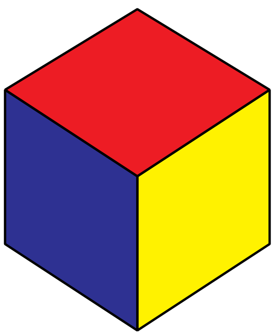


You will need:

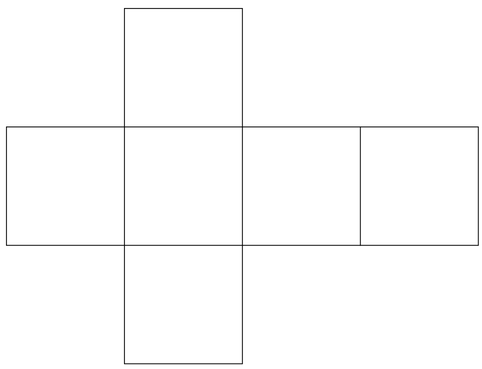
4 squares



Corner pattern: S S S

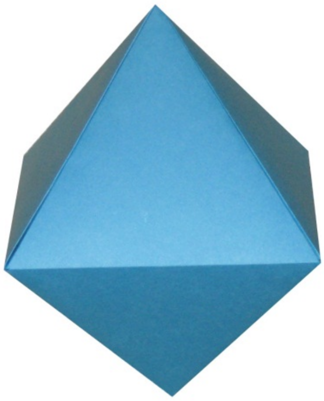


Net:



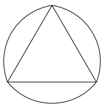
3 Octahedron T_8

The completed model:

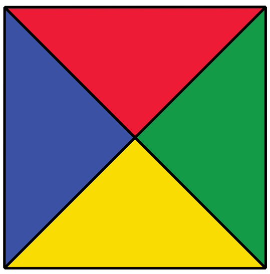
Tabs on outside	Tabs on inside
	

You will need:

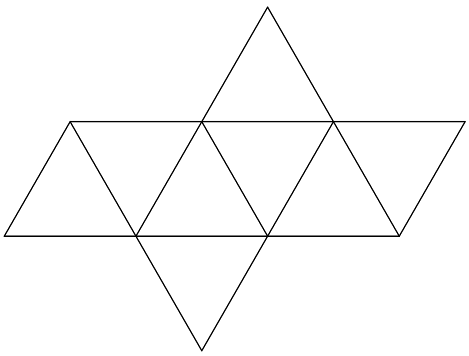
8 Triangles



Corner pattern: T T T T

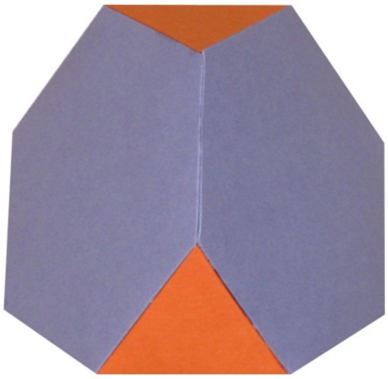


Net:

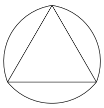
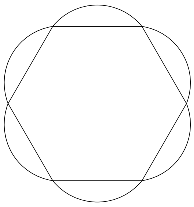


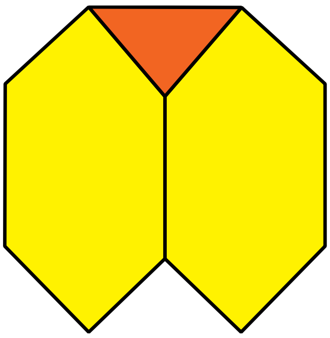
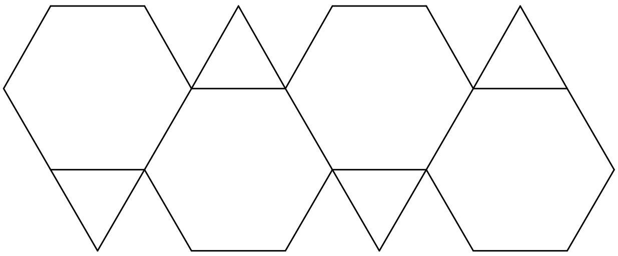
4	Truncated tetrahedron	T_4H_4

The completed model:

Tabs on outside	Tabs on inside
	

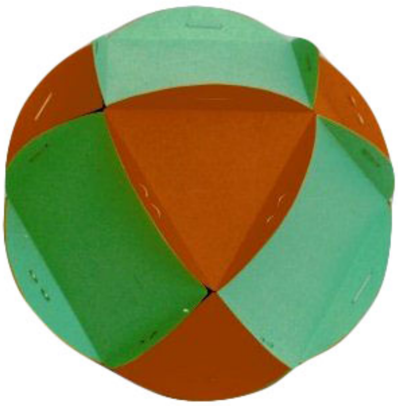
You will need:

4 Triangles	4 Hexagons	
		

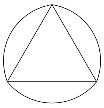
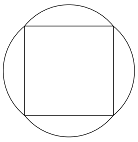
Corner pattern: T H H	Net:
	

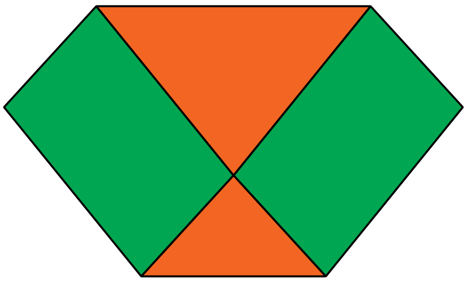
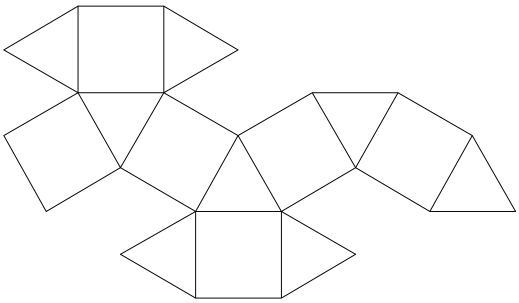
5	Cuboctahedron	T_8S_6

The completed model:

Tabs on outside	Tabs on inside
	

You will need:

8 Triangles	6 Squares	
		

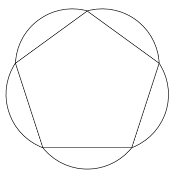
Corner pattern: T S T S	Net:
	

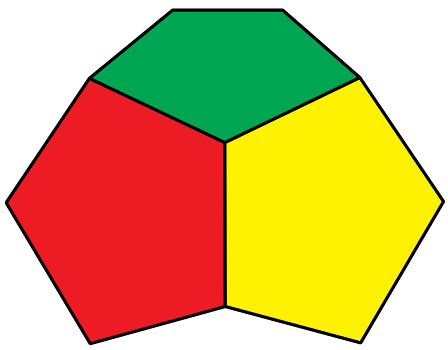
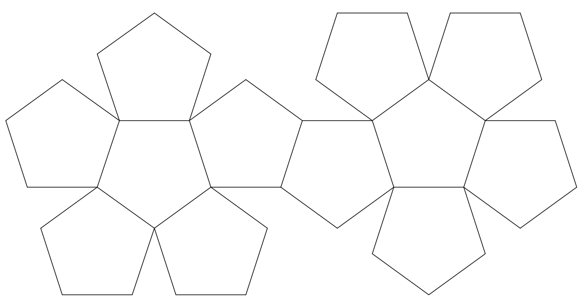
6	**Dodecahedron**	**P_{12}**

The completed model:

Tabs on outside	Tabs on inside
	

You will need:

12 Pentagons		
		

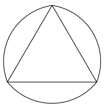
Corner pattern: P P P	Net:
	

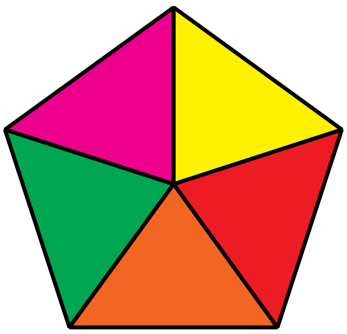
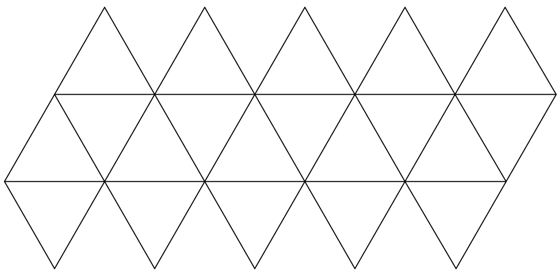
7	**Icosahedron**	**T_{20}**

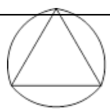
The completed model:

Tabs on outside	Tabs on inside
	

You will need:

20 Triangles		
		

Corner pattern: T T T T T	Net:
	

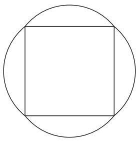
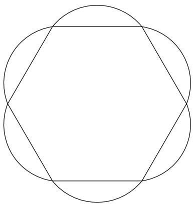


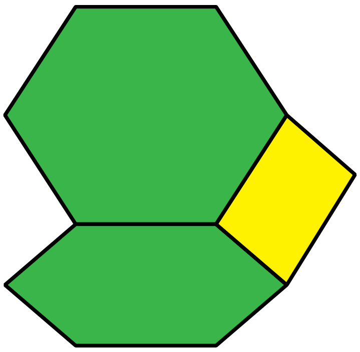
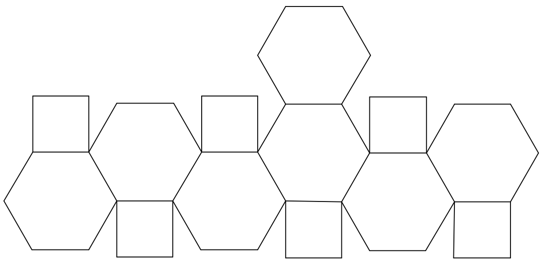
8 Truncated octahedron S_6H_8

The completed model:

Tabs on outside	Tabs on inside
	

You will need:

6 Squares	8 Hexagons	
		

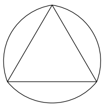
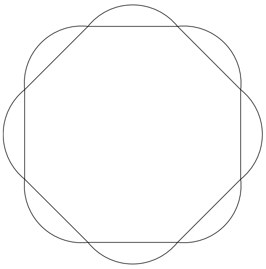
Corner pattern: S H H	Net:
	

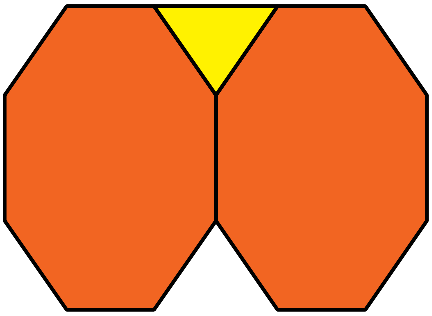
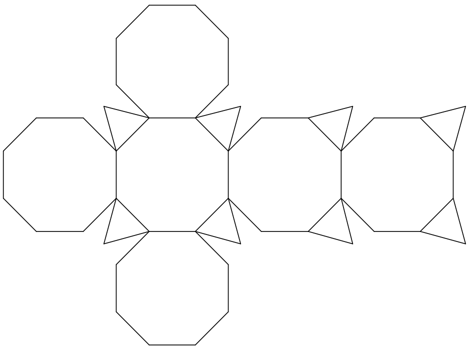
9	**Truncated cube**	T_8O_6

The completed model:

Tabs on outside	Tabs on inside
	

You will need:

8 Triangles	6 Octagons	
		

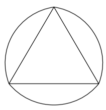
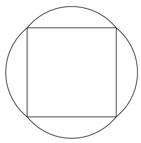
Corner pattern: T O O	Net:
	

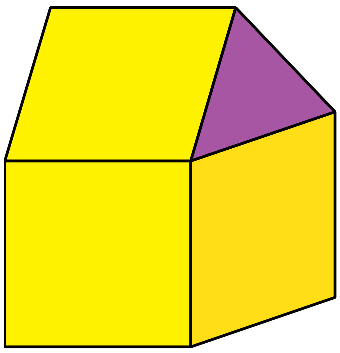
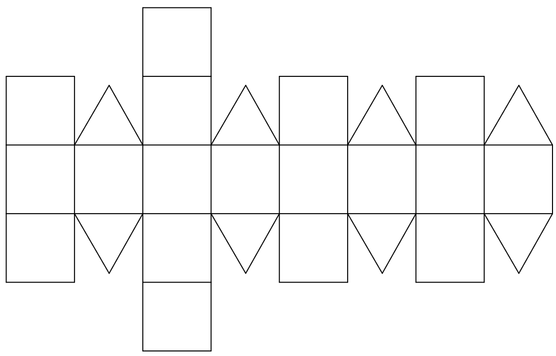
10	Small rhombicuboctahedron	T_8S_{18}

The completed model:

Tabs on outside	Tabs on inside
	

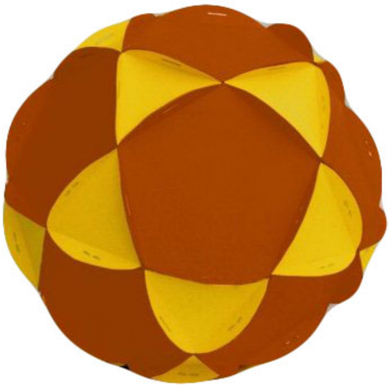
You will need:

8 Triangles	18 Squares	
		

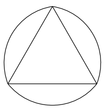
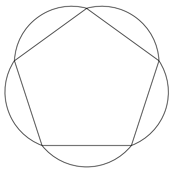
Corner pattern: T S S S	Net:
	

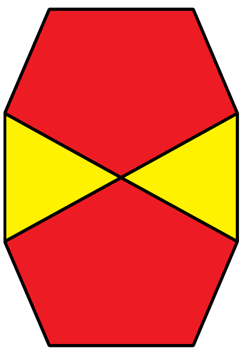
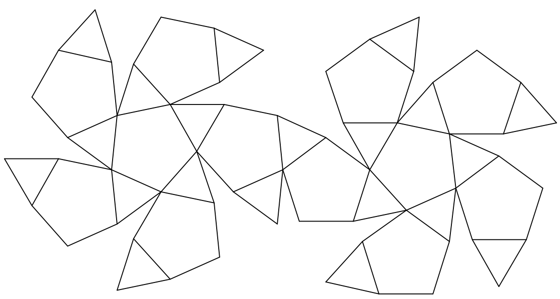
11	**Icosidodecahedron**	$T_{20}P_{12}$

The completed model:

Tabs on outside	Tabs on inside
	

You will need:

20 Triangles	12 Pentagons	
		

Corner pattern: T P T P	Net:
	

12 Snub cube $T_{32}S_6$

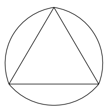
The completed model:

Tabs on outside

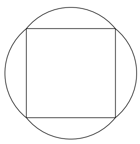
Tabs on inside

You will need:

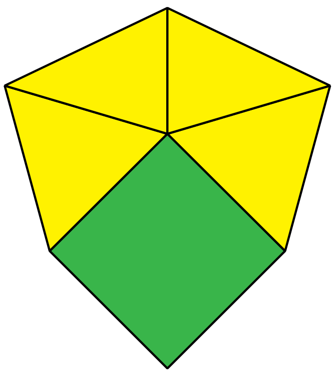
32 Triangles



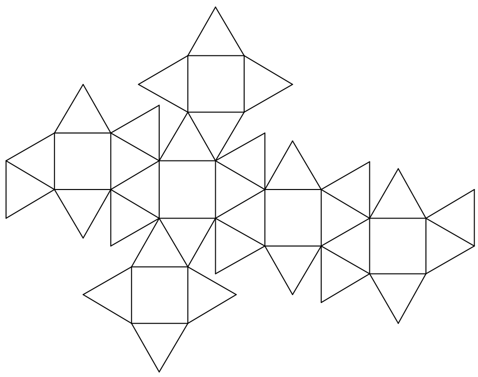
6 Squares



Corner pattern: T T T T S



Net:



13 Great rhombicuboctahedron $S_{12}H_8O_6$

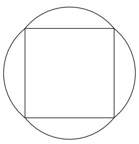
The completed model:

Tabs on outside

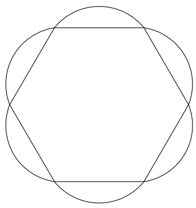
Tabs on inside

You will need:

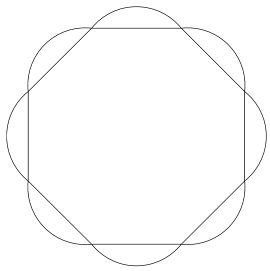
12 Squares



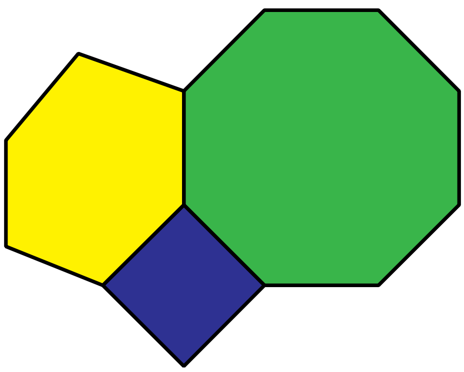
8 Hexagons



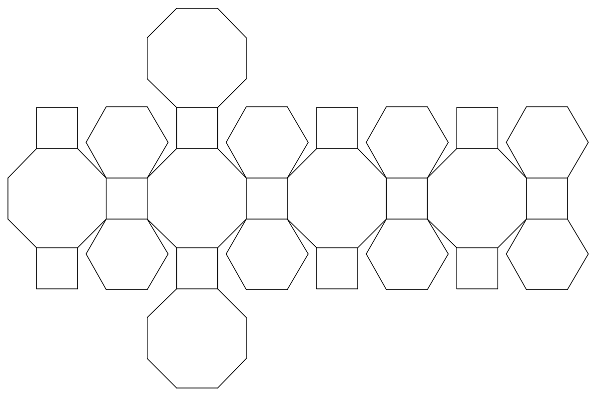
6 Octagons



Corner pattern: S H O

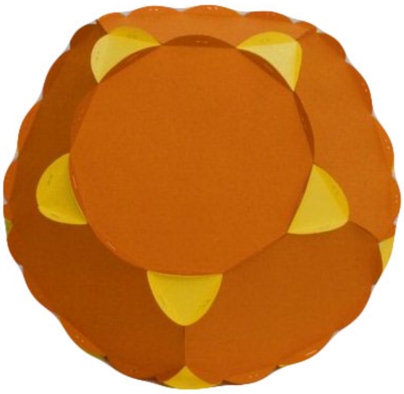
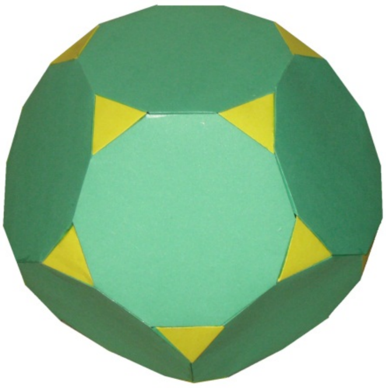


Net:

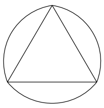
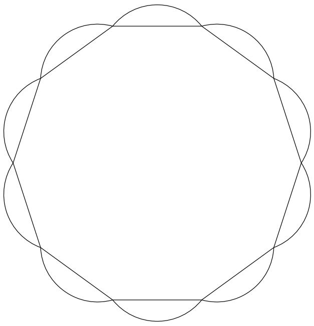


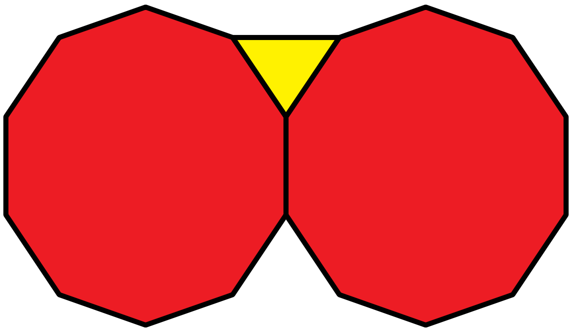
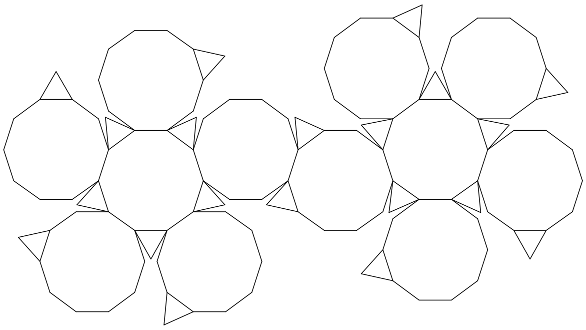
14	**Truncated dodecahedron**	$T_{20}D_{12}$

The completed model:

Tabs on outside	Tabs on inside
	

You will need:

20 Triangles	12 Decagons	
		

Corner pattern: T D D	Net:
	

15 Truncated icosahedron $P_{12}H_{20}$

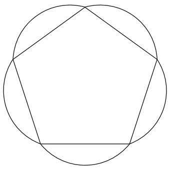
The completed model:

Tabs on outside

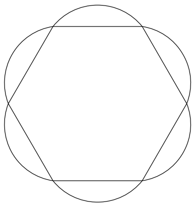
Tabs on inside

You will need:

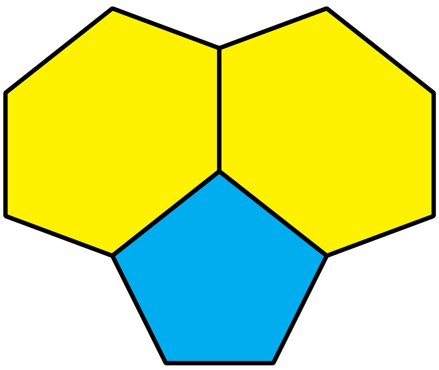
12 Pentagons



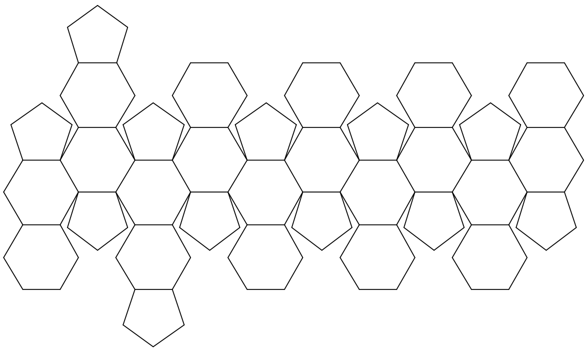
20 Hexagons



Corner pattern: P H H



Net:

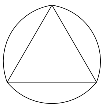
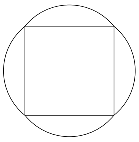
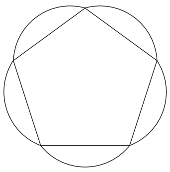


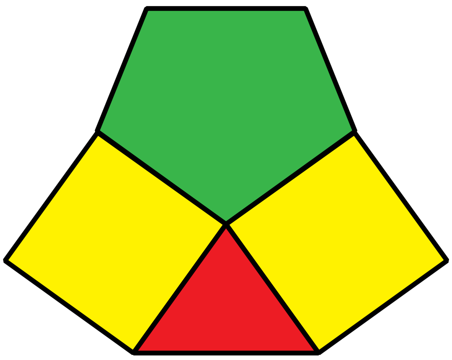
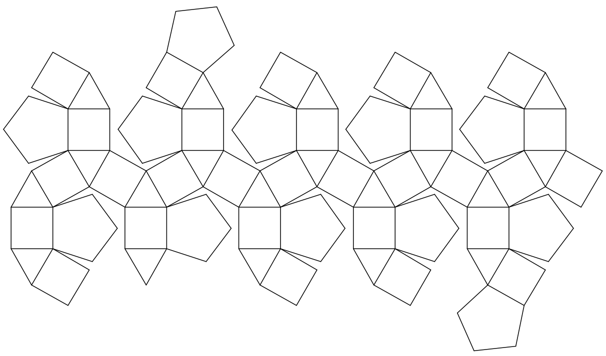
16 Small rhombicosidodecahedron $T_{20}S_{30}P_{12}$

The completed model:

Tabs on outside	Tabs on inside
	

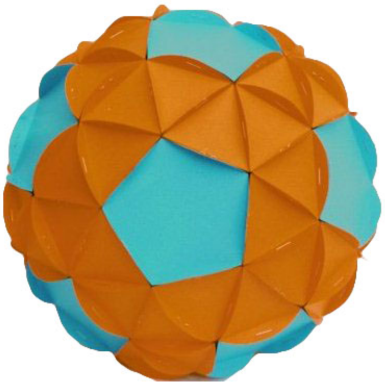
You will need:

20 Triangles	30 Squares	12 Pentagons
		

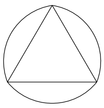
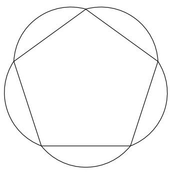
Corner pattern: T S P S	Net:
	

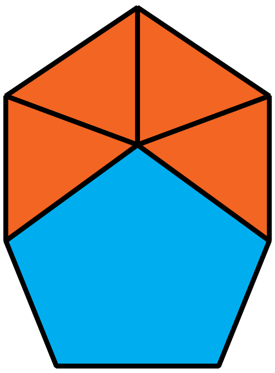
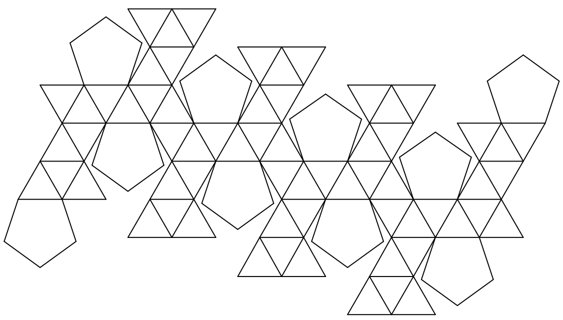
17 Snub dodecahedron $T_{80}P_{12}$

The completed model:

Tabs on outside	Tabs on inside
	

You will need:

80 Triangles	12 Pentagons	
		

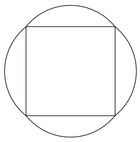
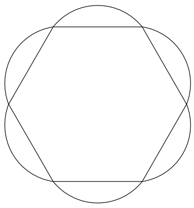
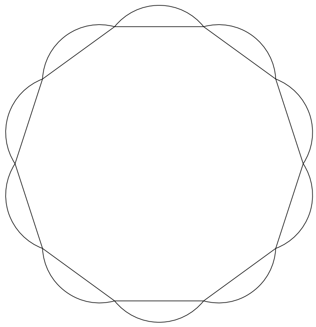
Corner pattern: T T T T P	Net:
	

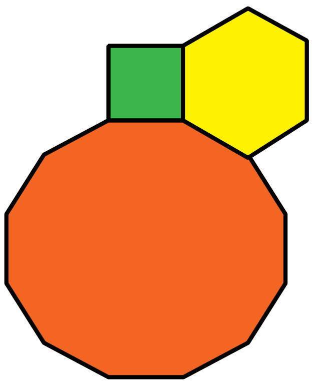
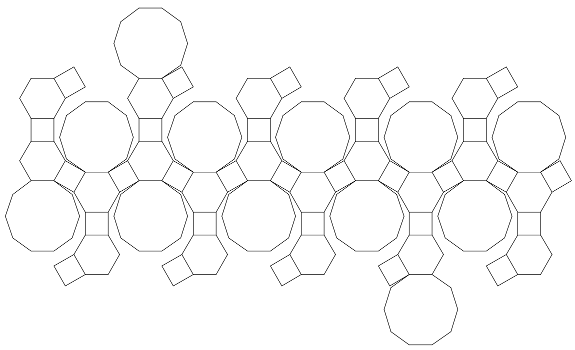
18 Great rhombicosidodecahedron $S_{30}H_{20}D_{12}$

The completed model:

Tabs on outside	Tabs on inside
	

You will need:

30 Squares	20 Hexagons	12 Decagons
		

Corner pattern: S H D	Net:
	

MODELS SUMMARY

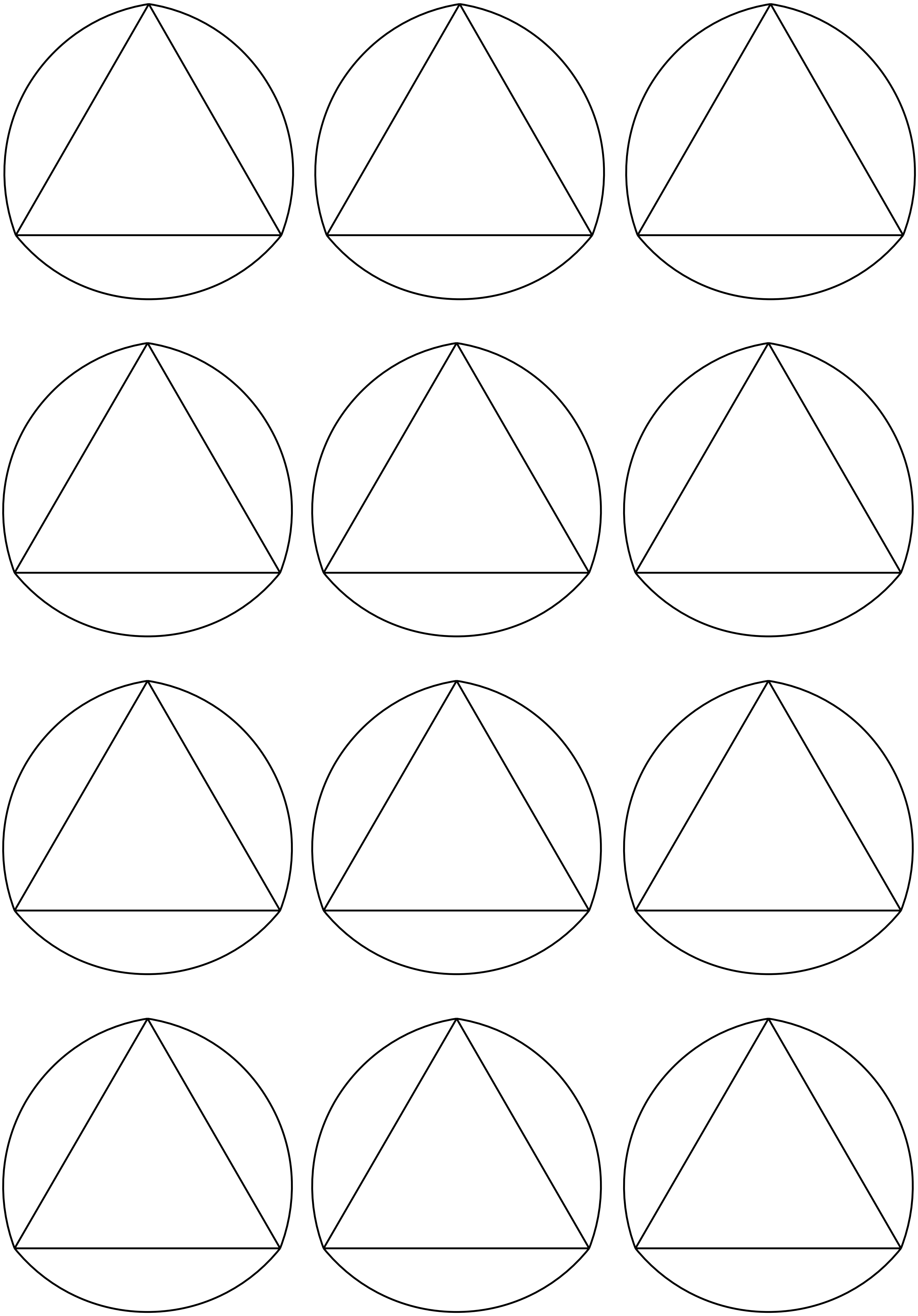
The polyhedra in the table below are in order of complexity with regard to the number of tabs that must be cut around during construction of faces. i.e. The quickest to make is listed first, and the most time consuming last.

	Name	Formula	Corner pattern
1.	Tetrahedron◆	T_4	TTT
2.	Cube◆	S_6	SSS
3.	Octahedron◆	T_8	TTTT
4.	Truncated tetrahedron	T_4H_4	THH
5.	Cuboctahedron	T_8S_6	TSTS
6.	Dodecahedron◆	P_{12}	PPP
7.	Icosahedron◆	T_{20}	TTTTT
8.	Truncated octahedron	S_6H_8	SHH
9.	Truncated cube	T_8O_6	TOO
10.	Small rhombicuboctahedron	T_8S_{18}	TSSS
11.	Icosidodecahedron	$T_{20}P_{12}$	TPTP
12.	Snub cube	$T_{32}S_6$	TTTTS
13.	Great rhombicubocahedron	$S_{12}H_8O_6$	SHO
14.	Truncated dodecahedron	$T_{20}D_{12}$	TDD
15.	Truncated icosahedron	$P_{12}H_{20}$	PHH
16.	Small rhombicosidodecahedron	$T_{20}S_{30}P_{12}$	TSPS
17.	Snub dodecahedron	$T_{80}P_{12}$	TTTTP
18.	Great rhombicosidodecahedron	$S_{30}H_{20}D_{12}$	SHD

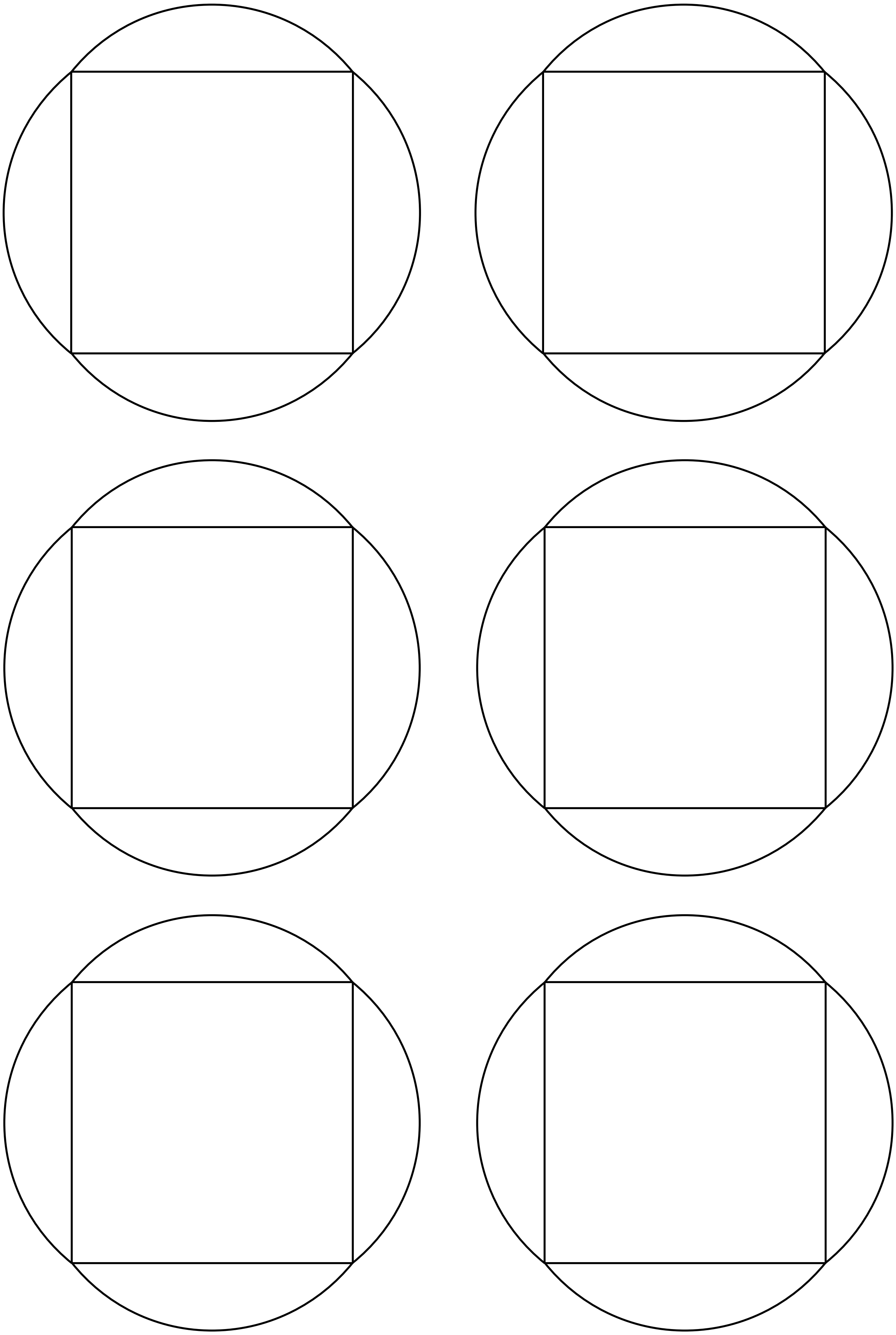
◆ = Platonic solid.

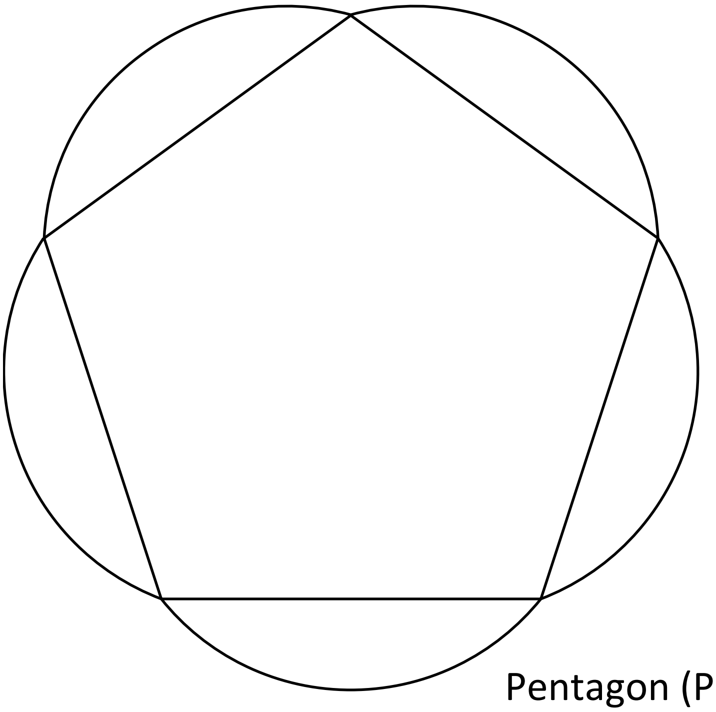
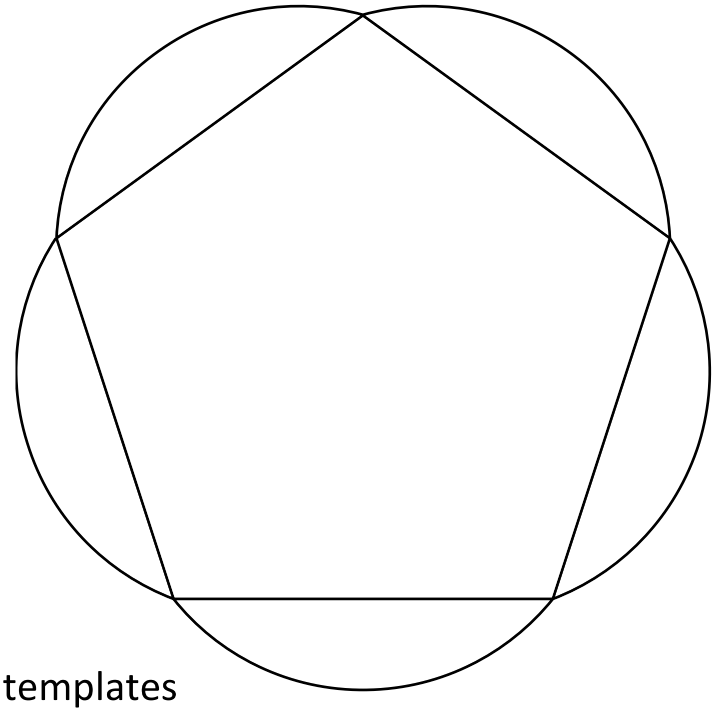
POLYGON TEMPLATES

Triangle (T) templates

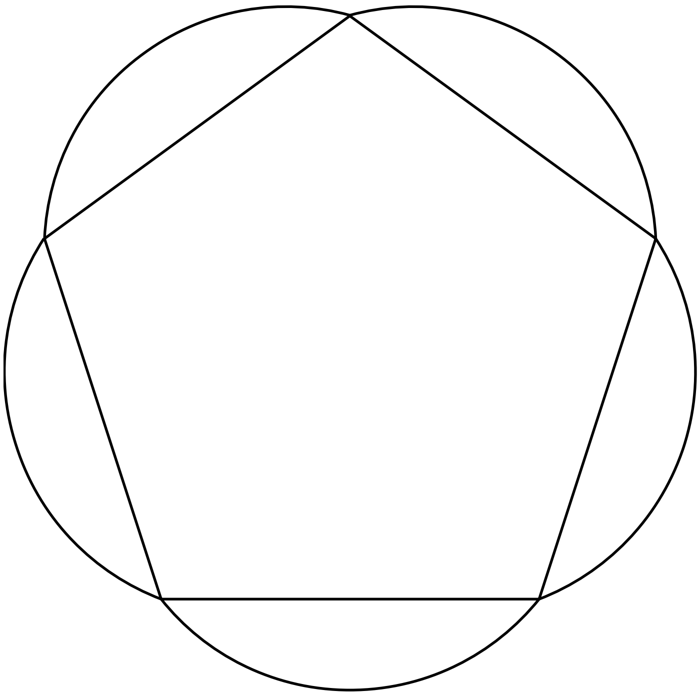
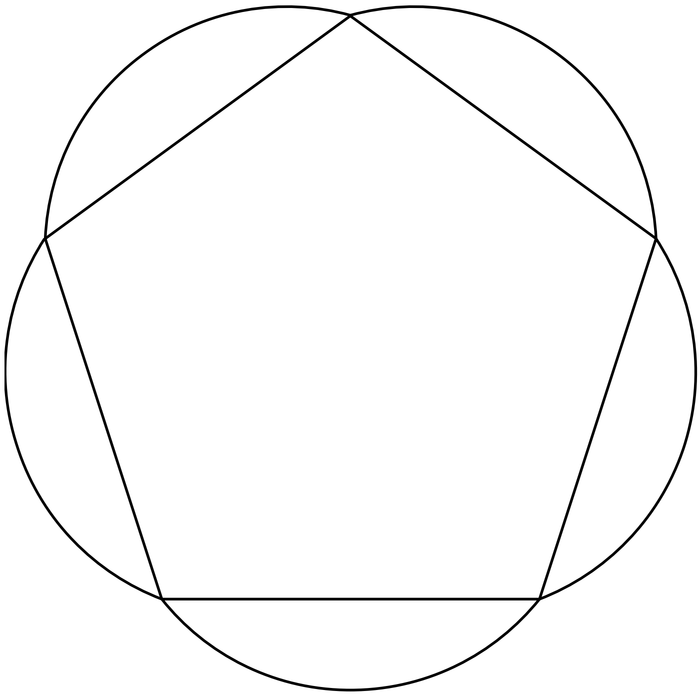
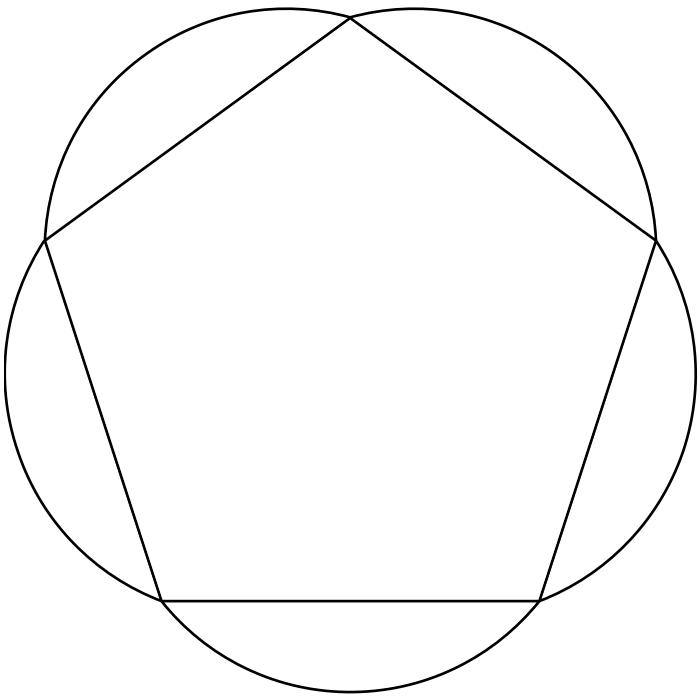
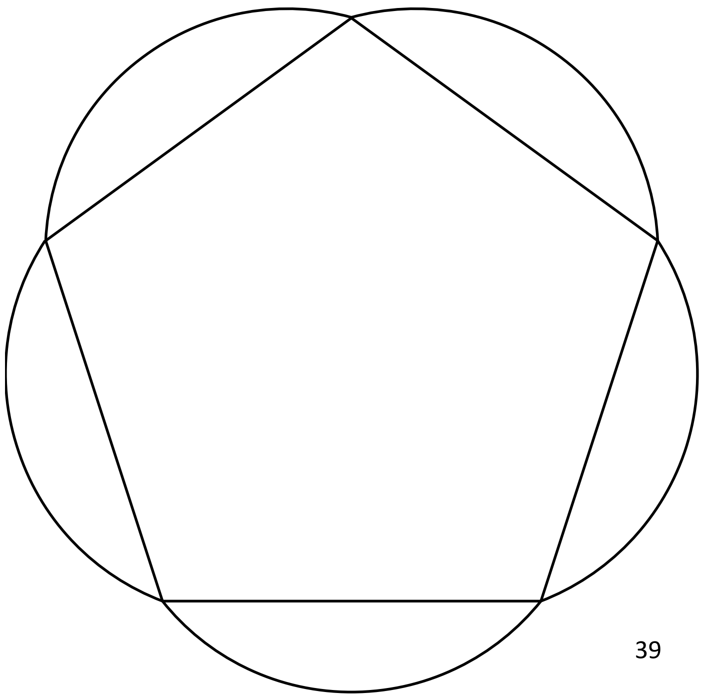


Square (S) templates

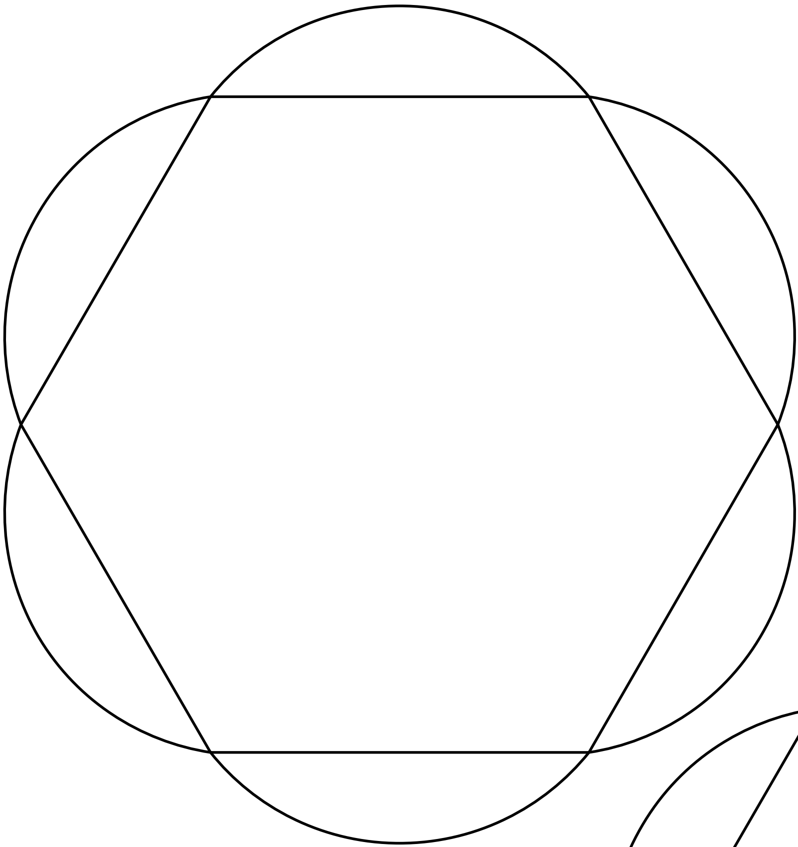


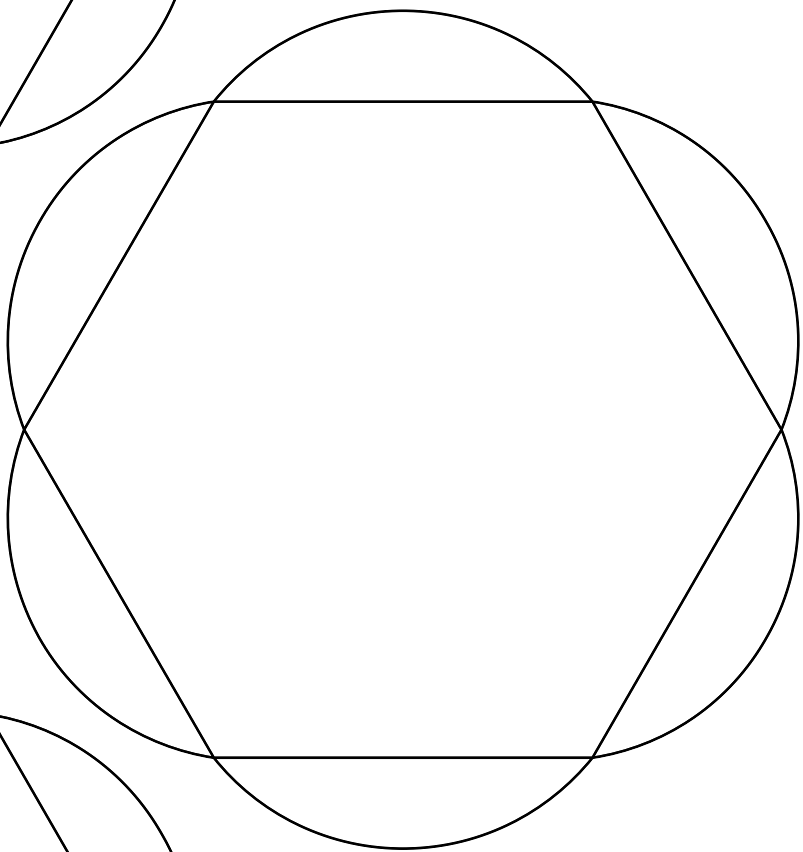



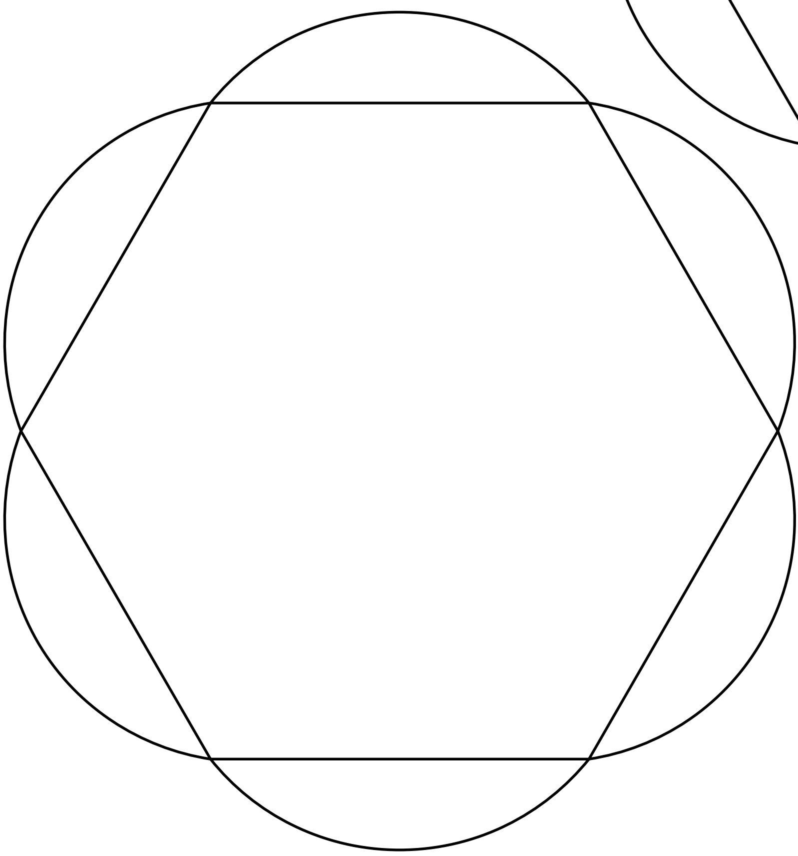
Pentagon (P) templates

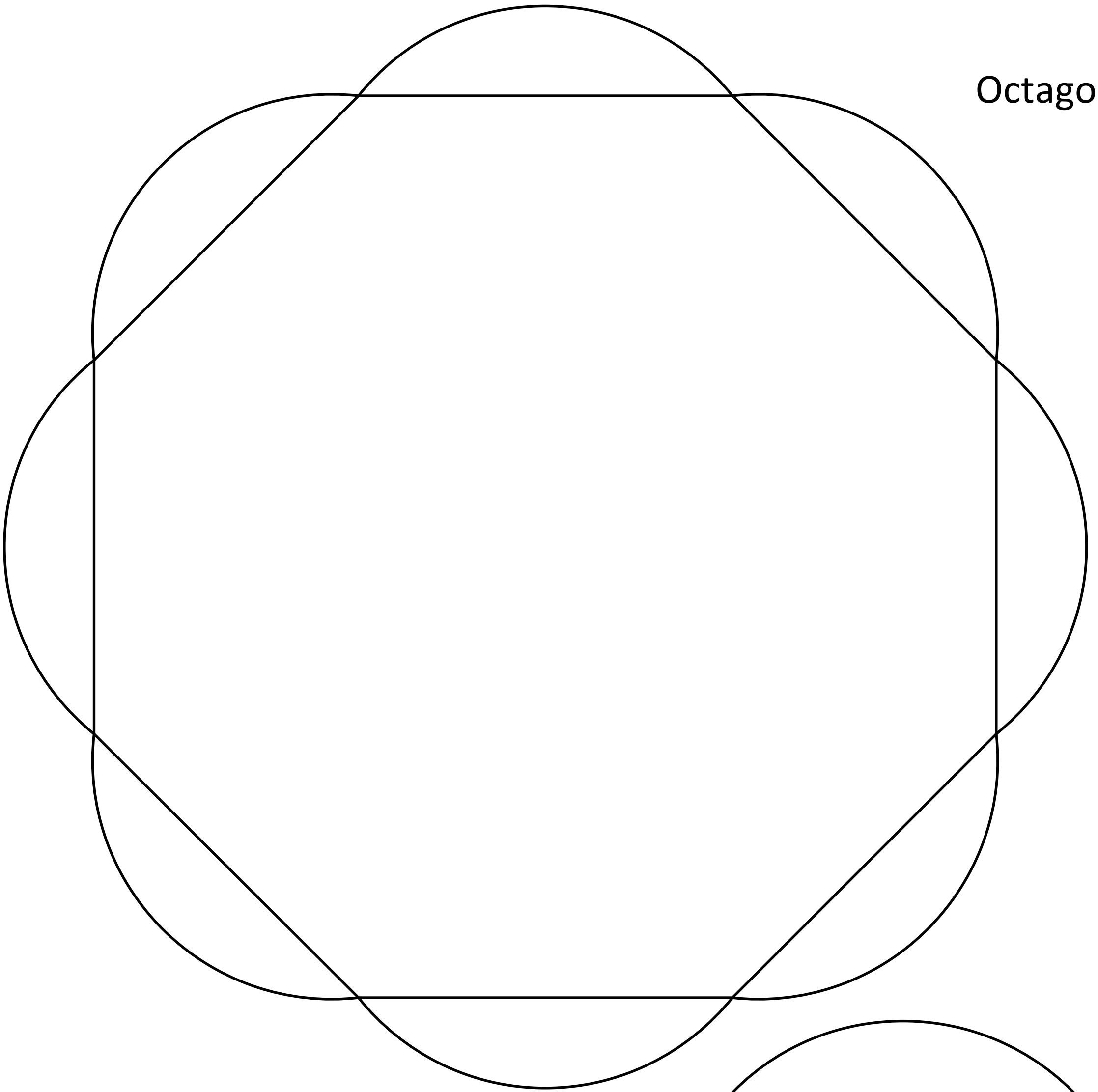
Hexagon (H) templates

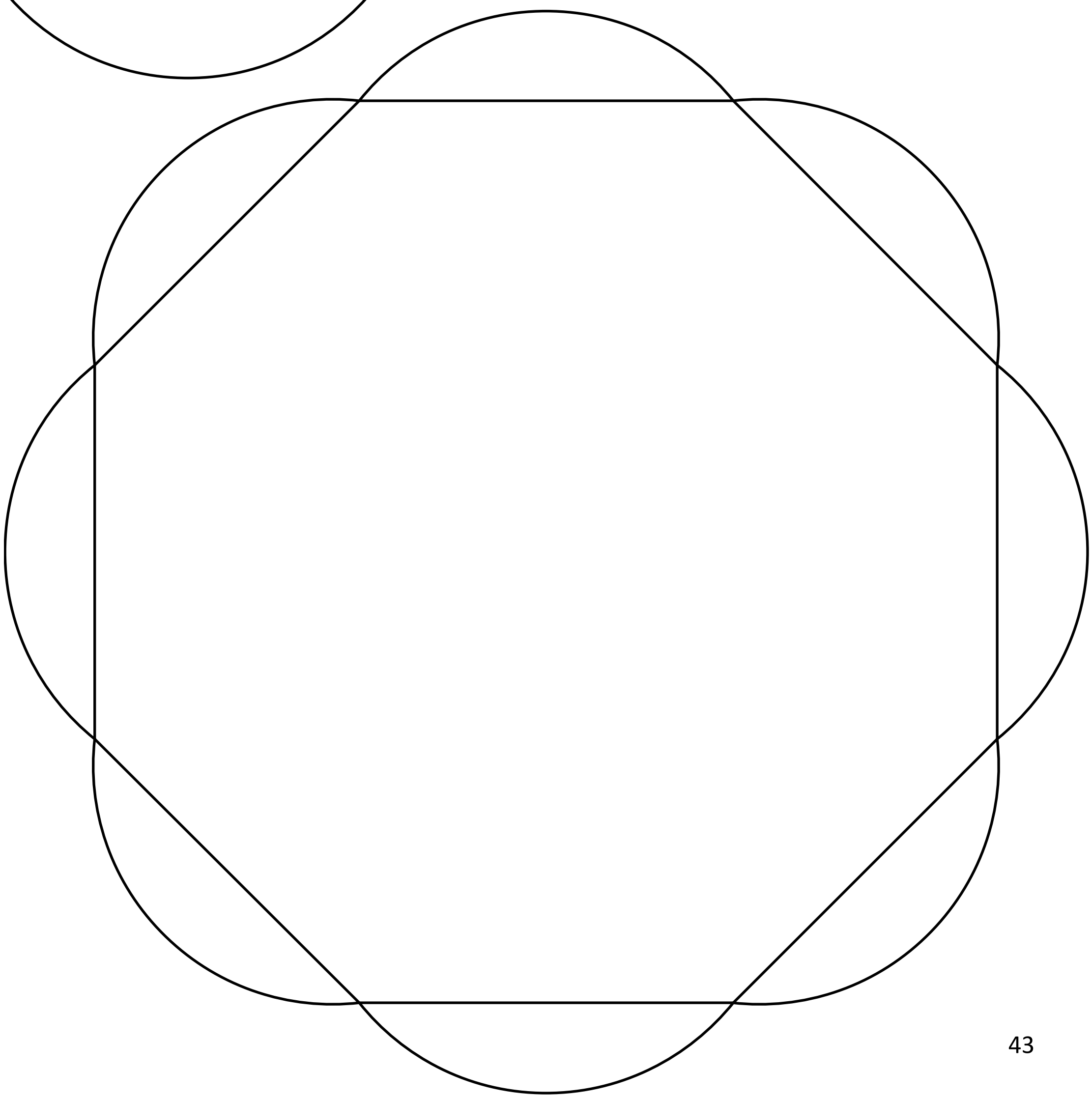




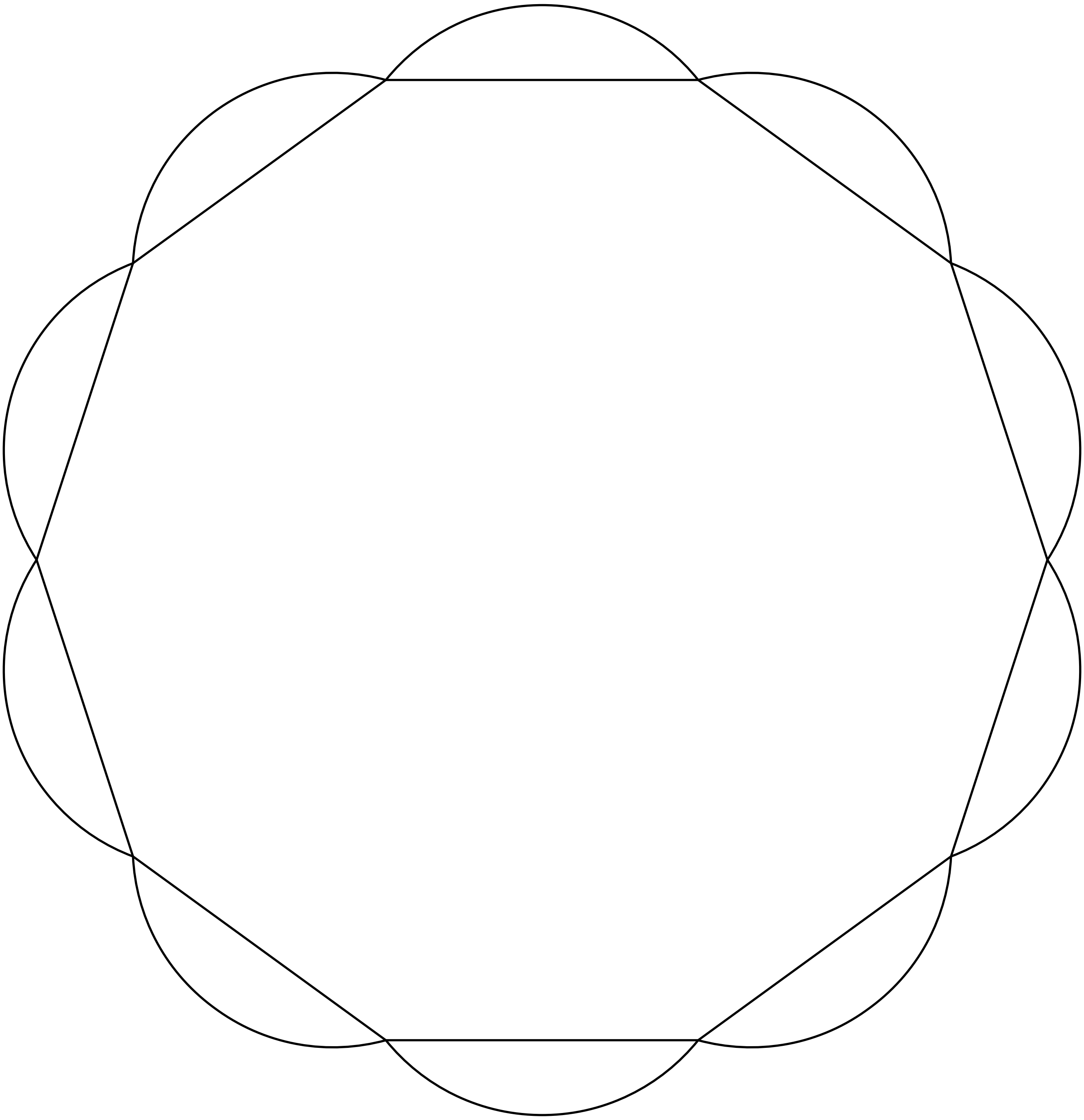


Octagon (O) templates



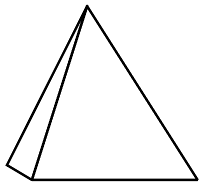


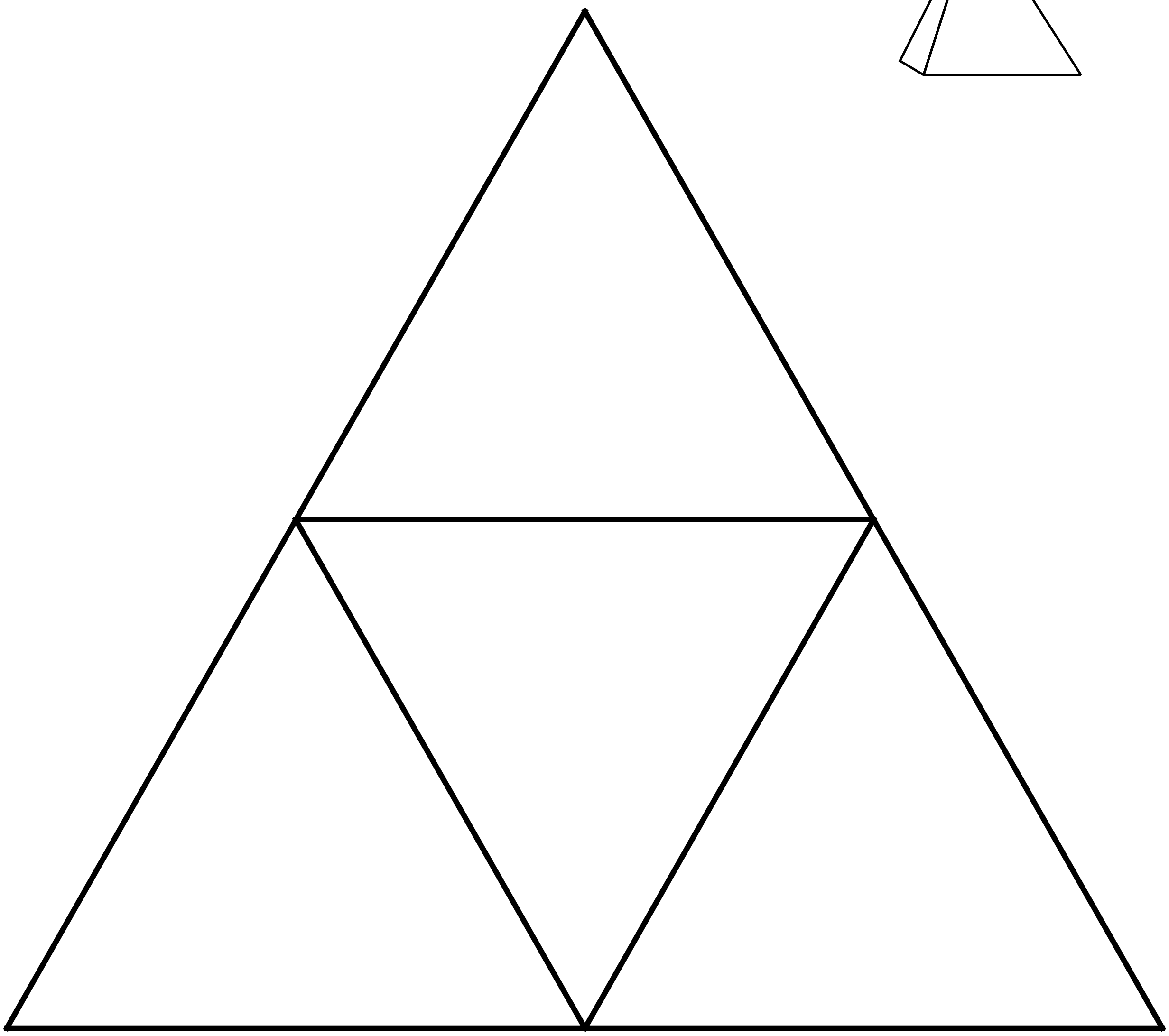
Decagon (D) template



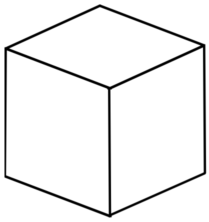
SINGLE PAGE NETS

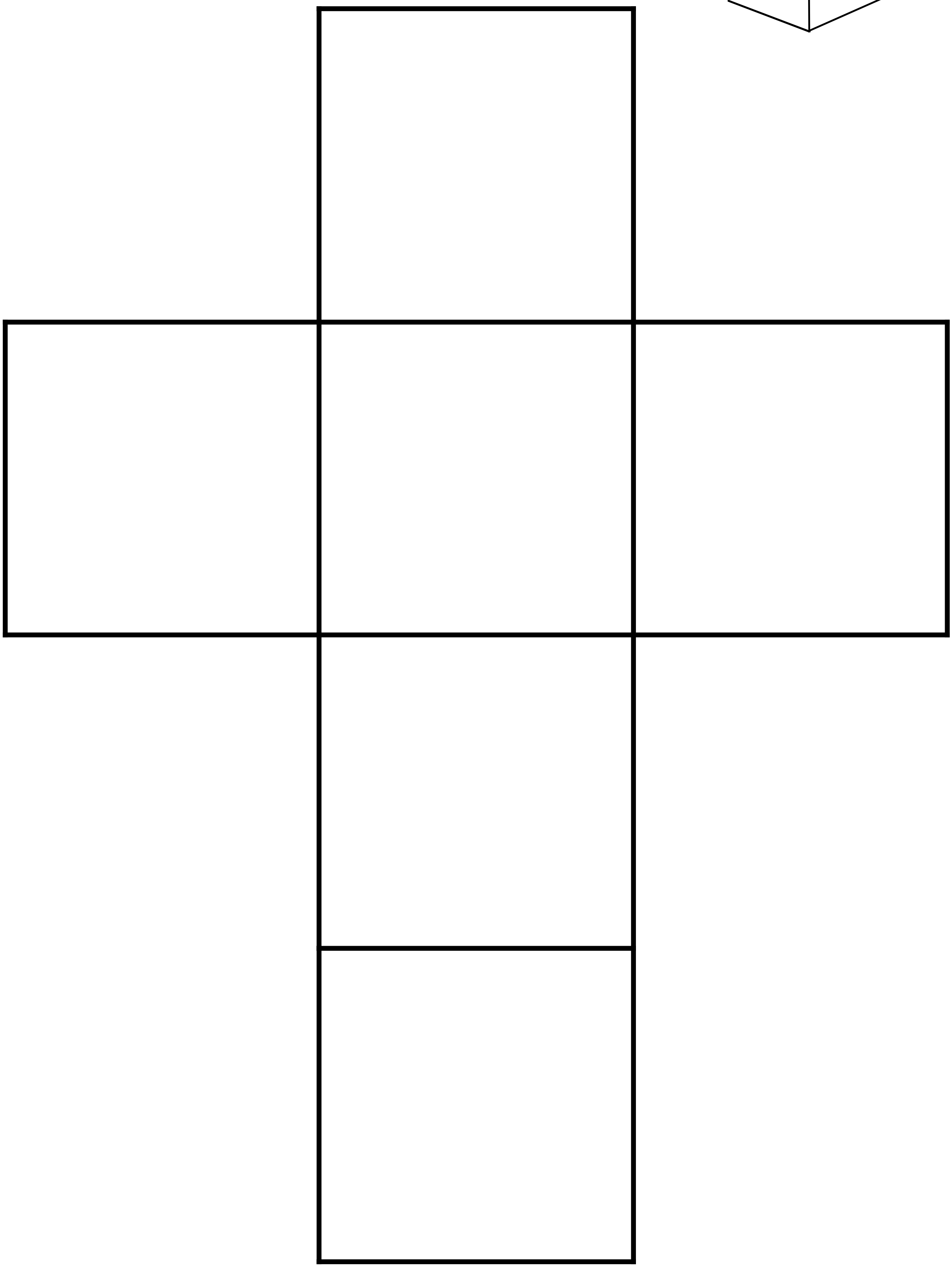
Tetrahedron



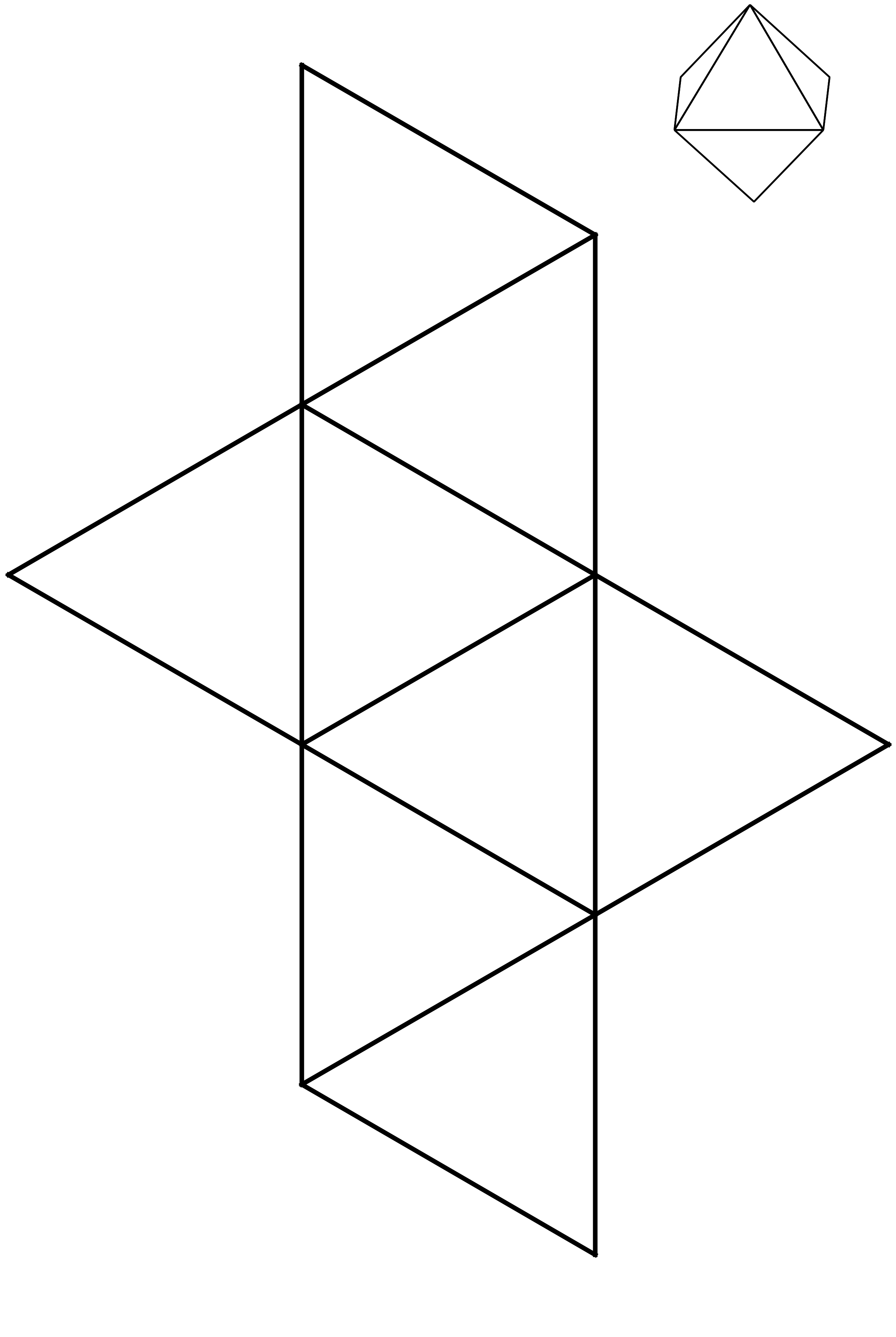


Cube

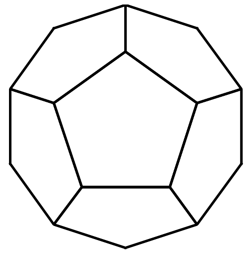


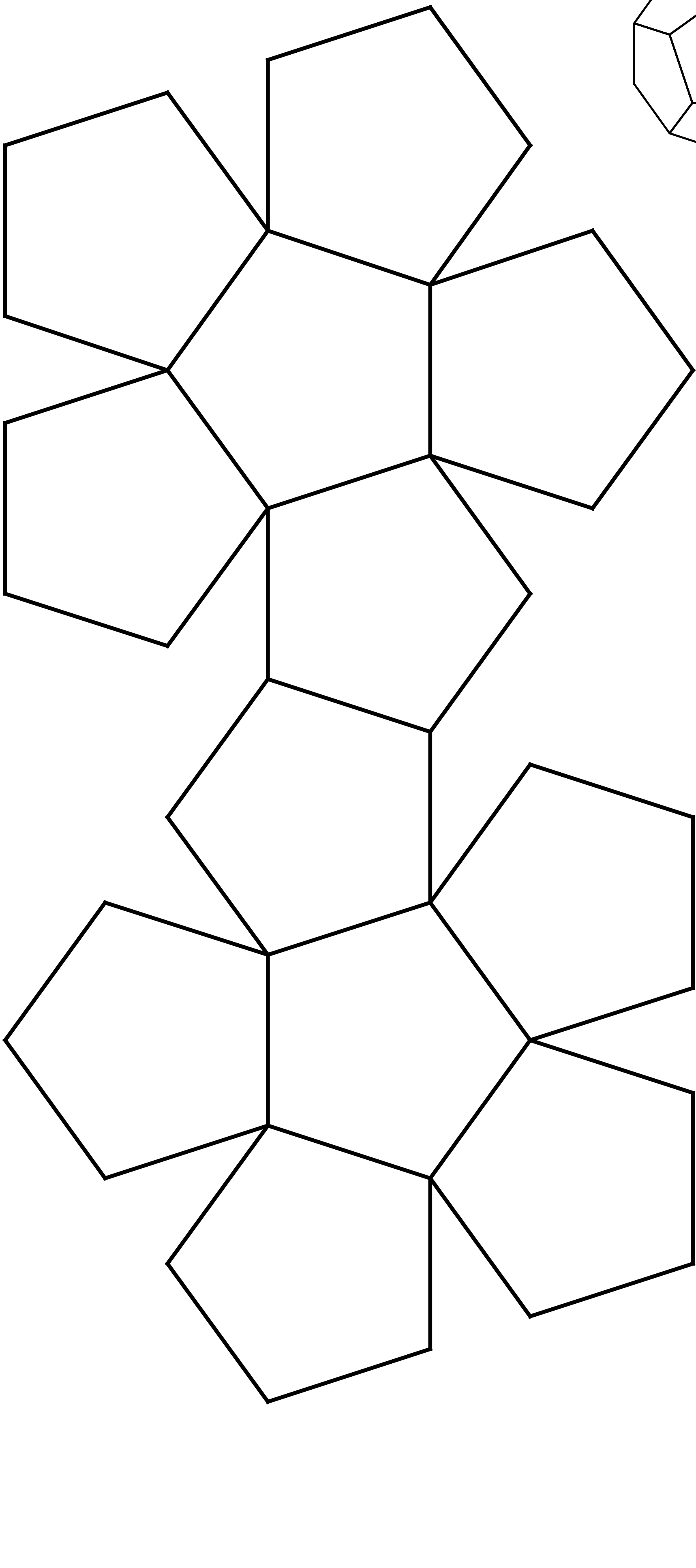


Octahedron

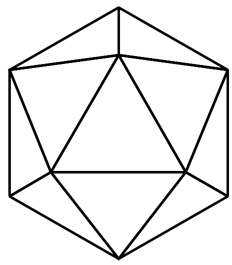


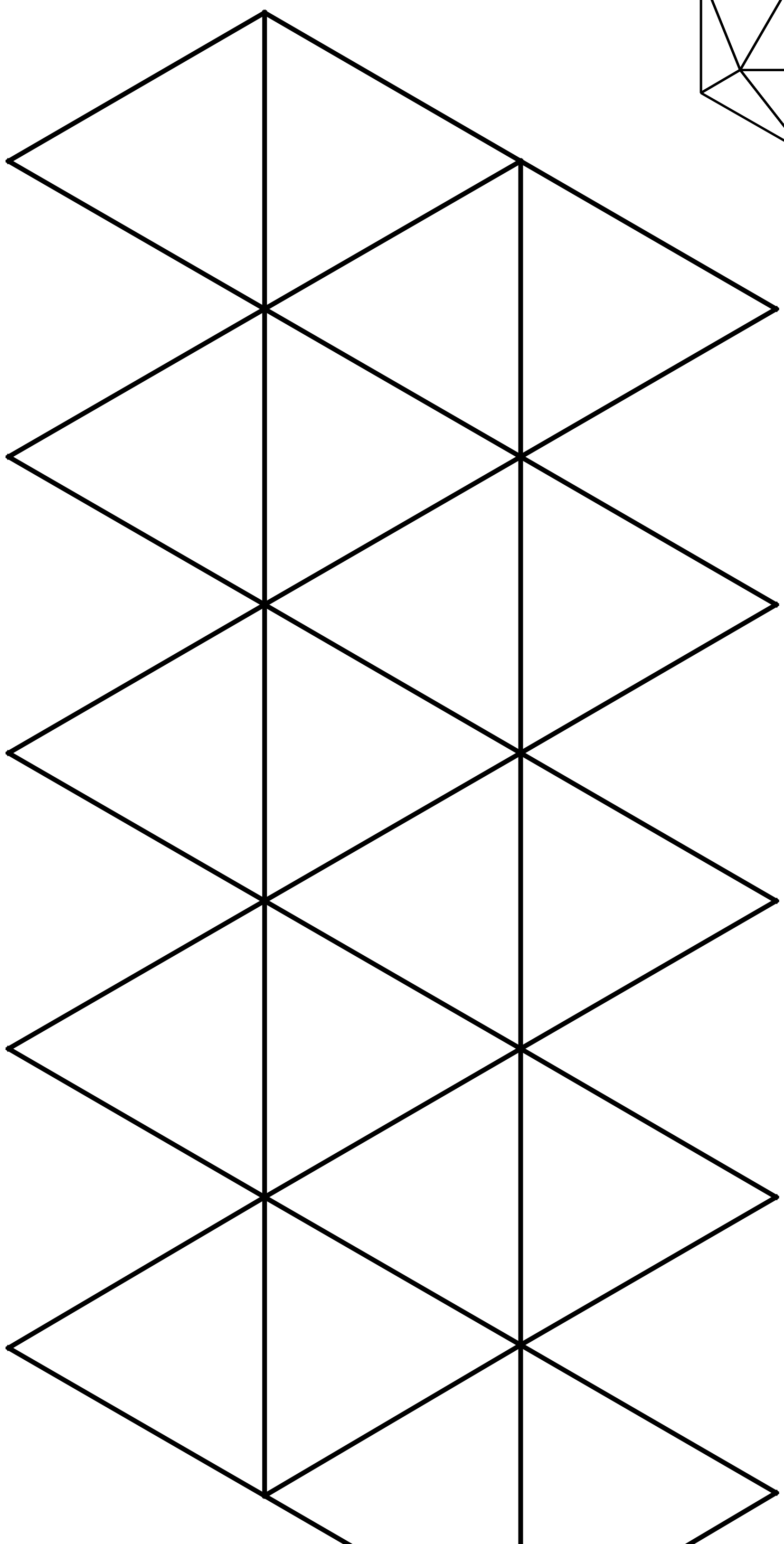
Dodecahedron



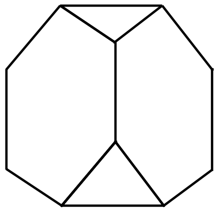


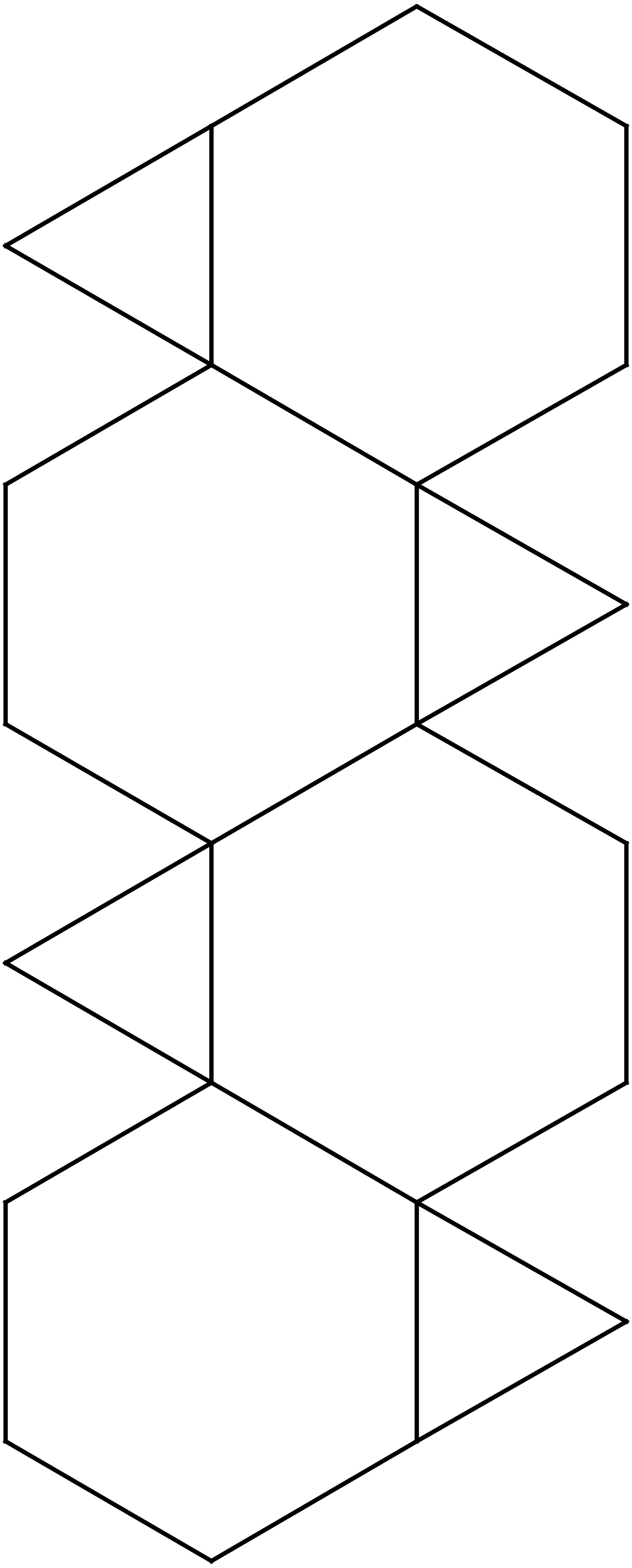
Icosahedron



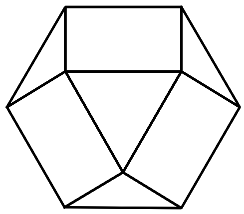


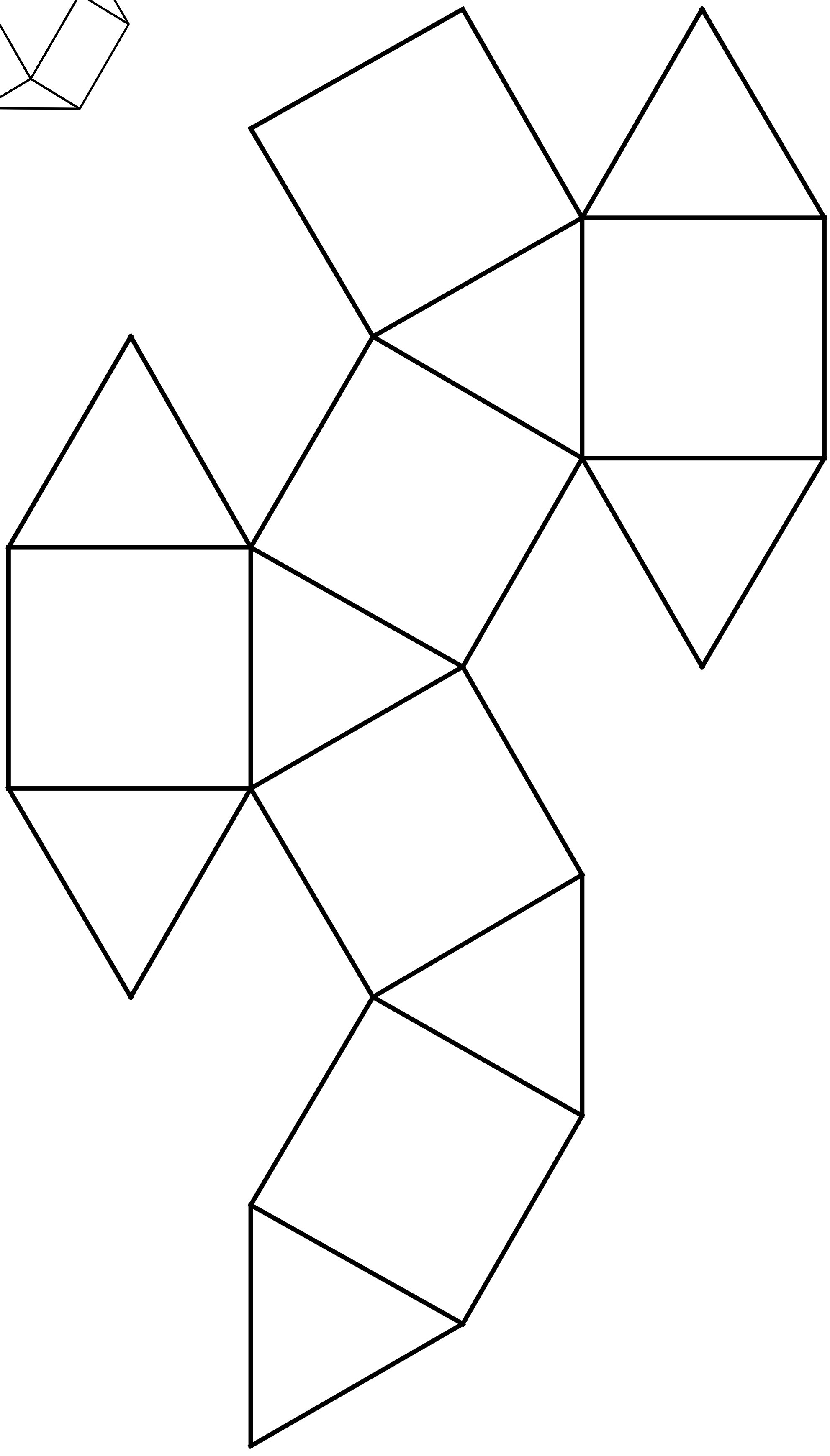
Truncated Tetrahedron



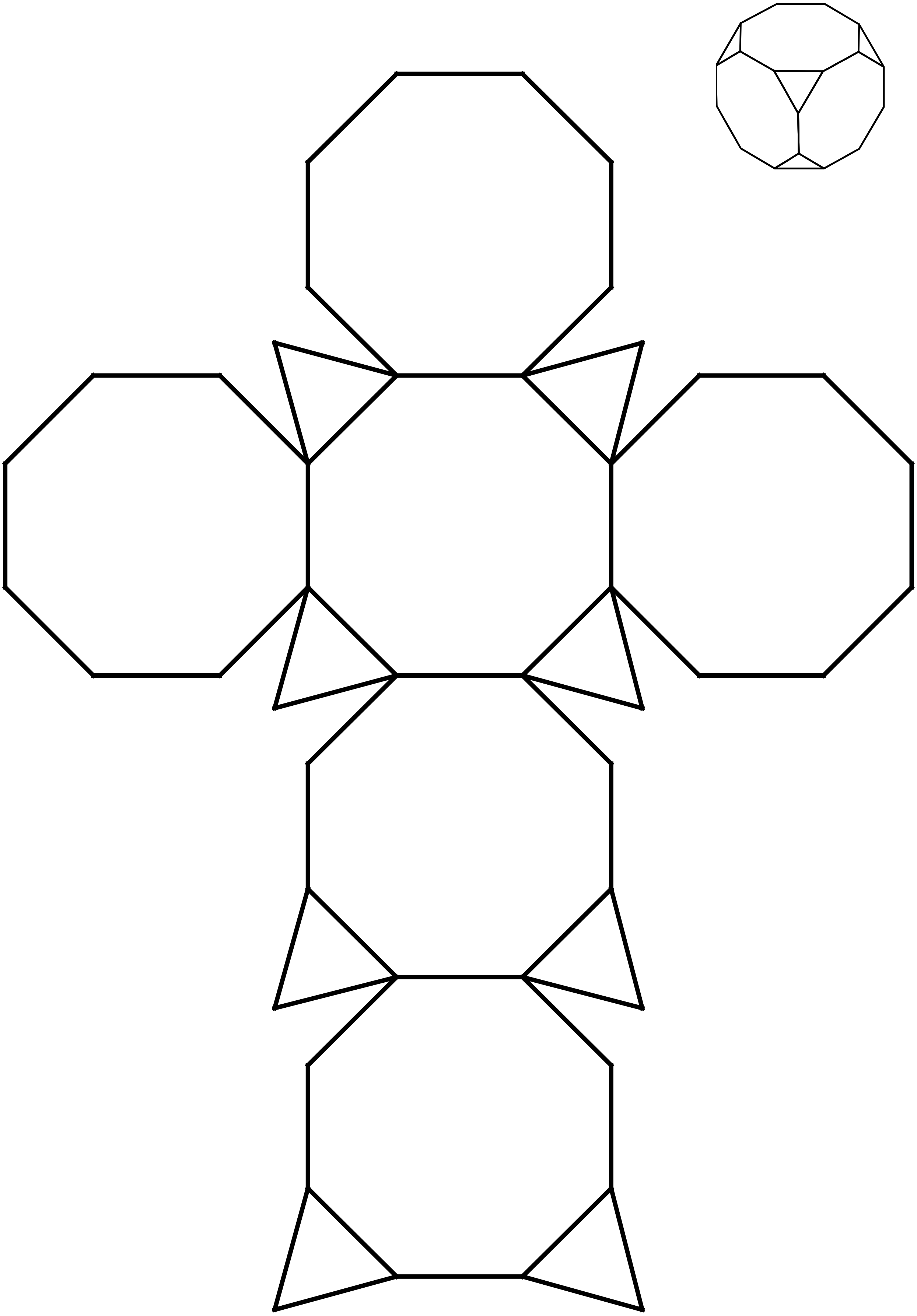


Cuboctahedron

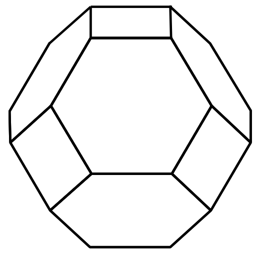


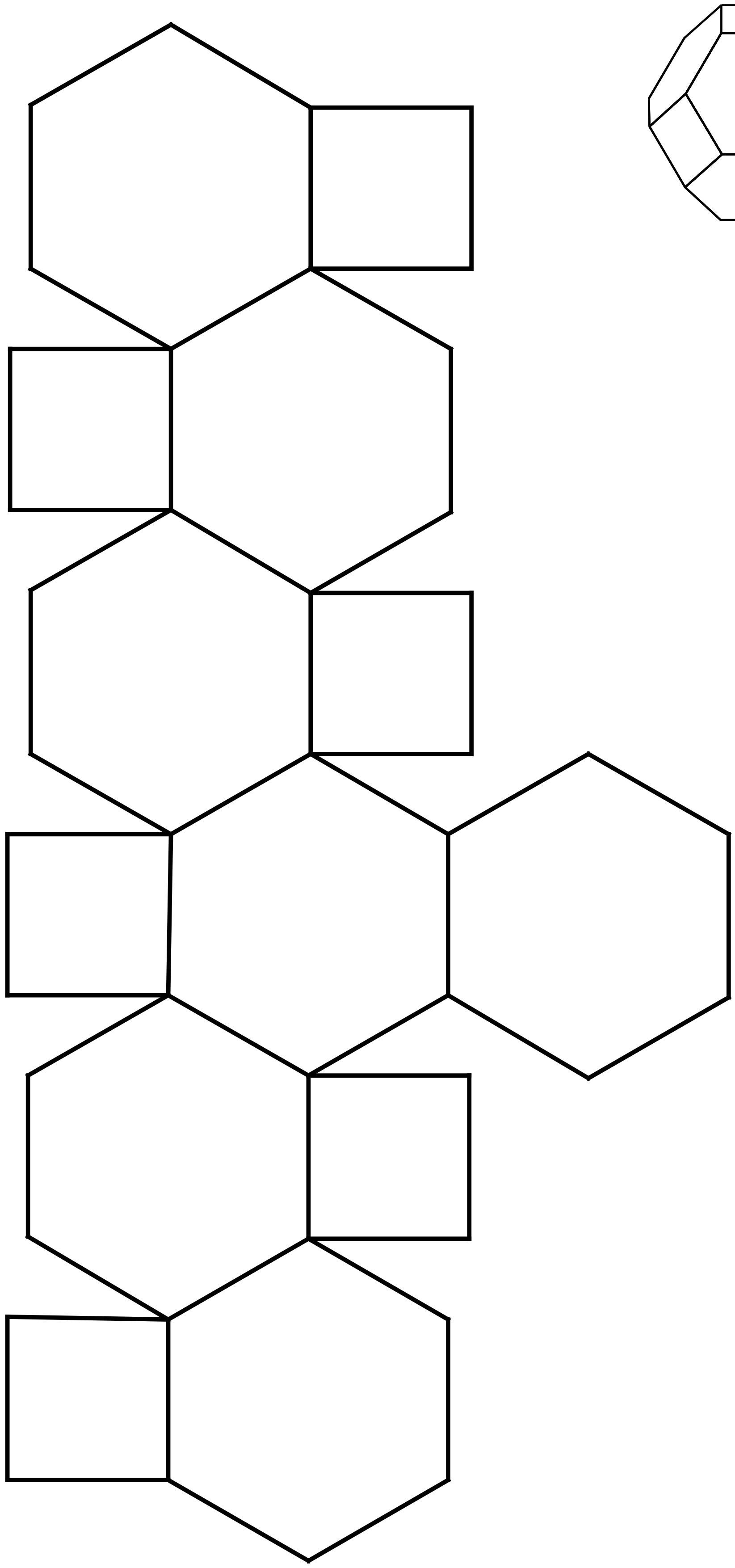


Truncated cube

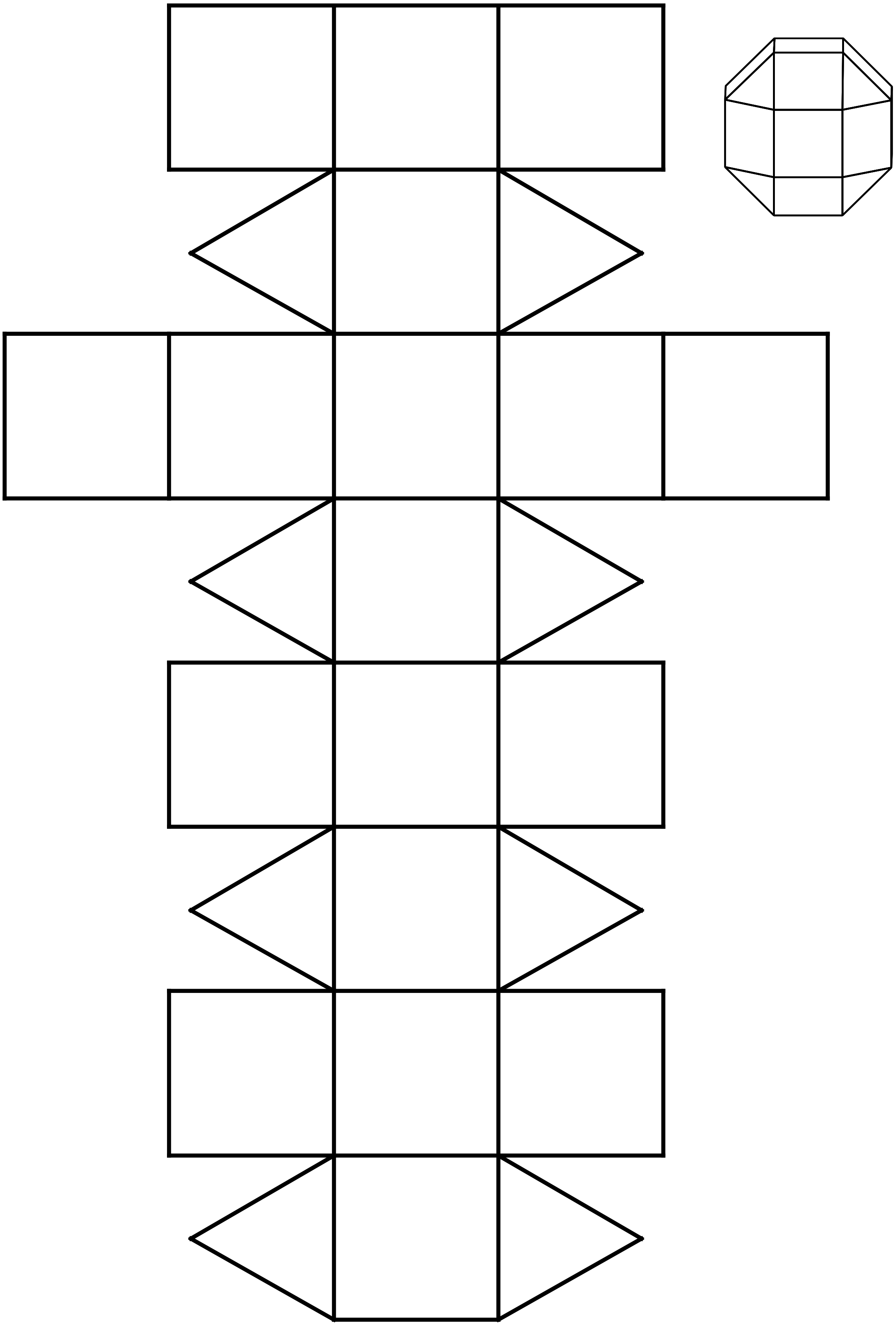


Truncated Octahedron

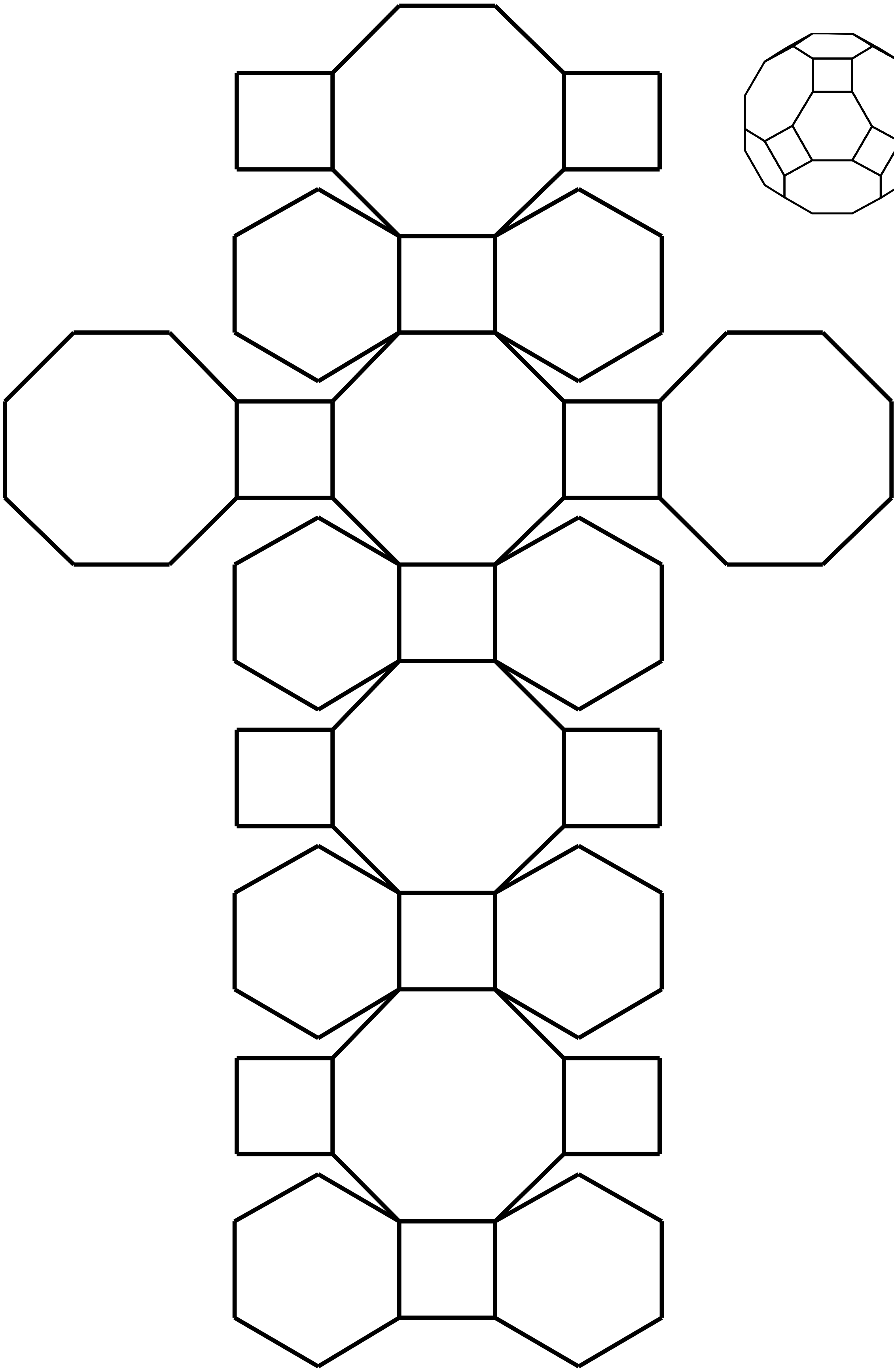


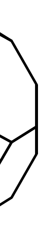


Small rhombicuboctahedron

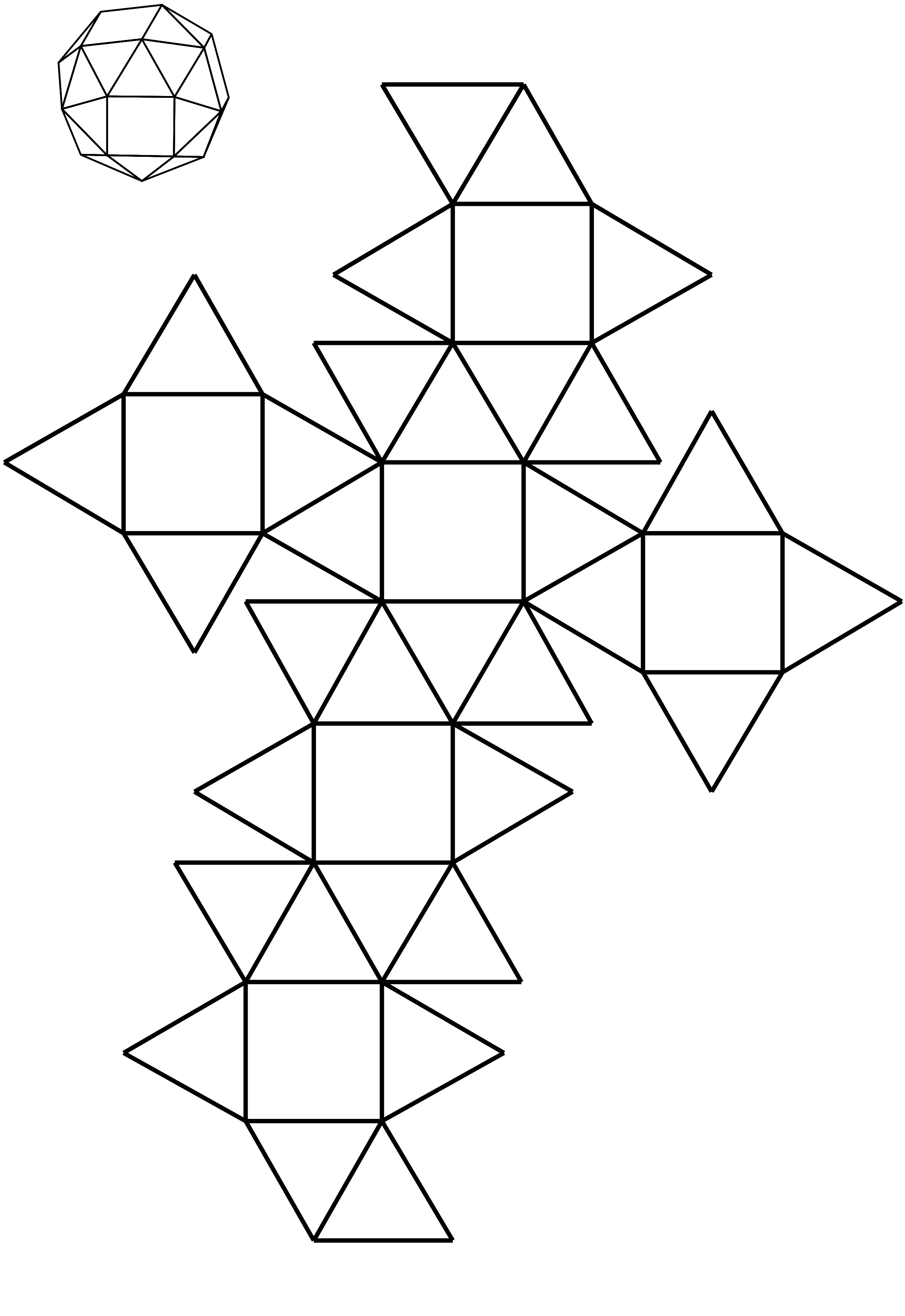


Great rhombicuboctahedron

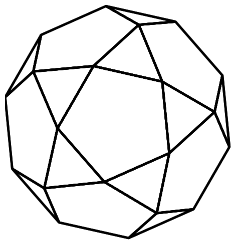


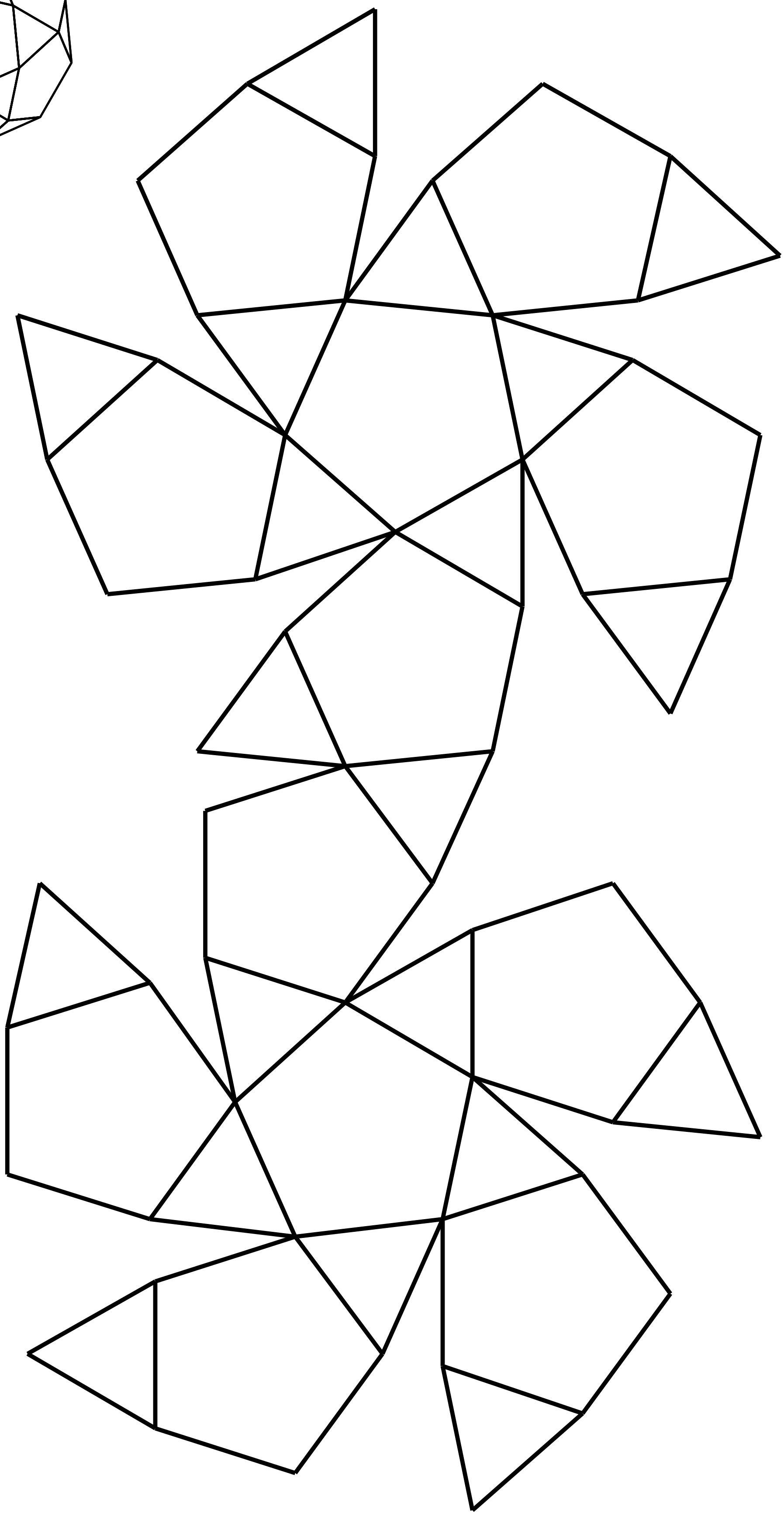


Snub cube

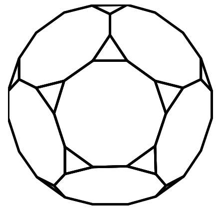


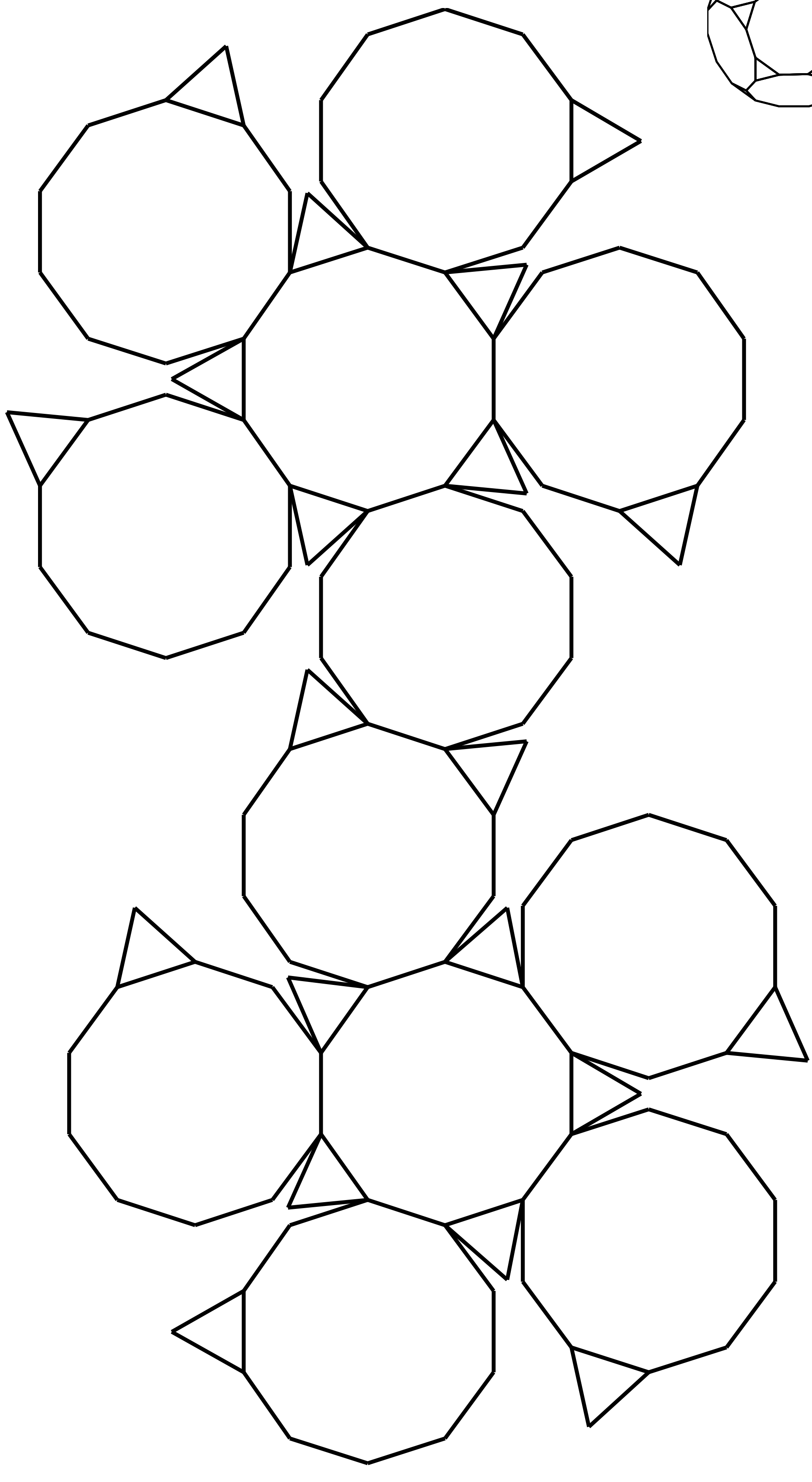
Icosidodecahedron



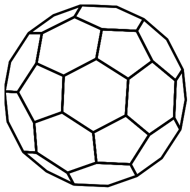


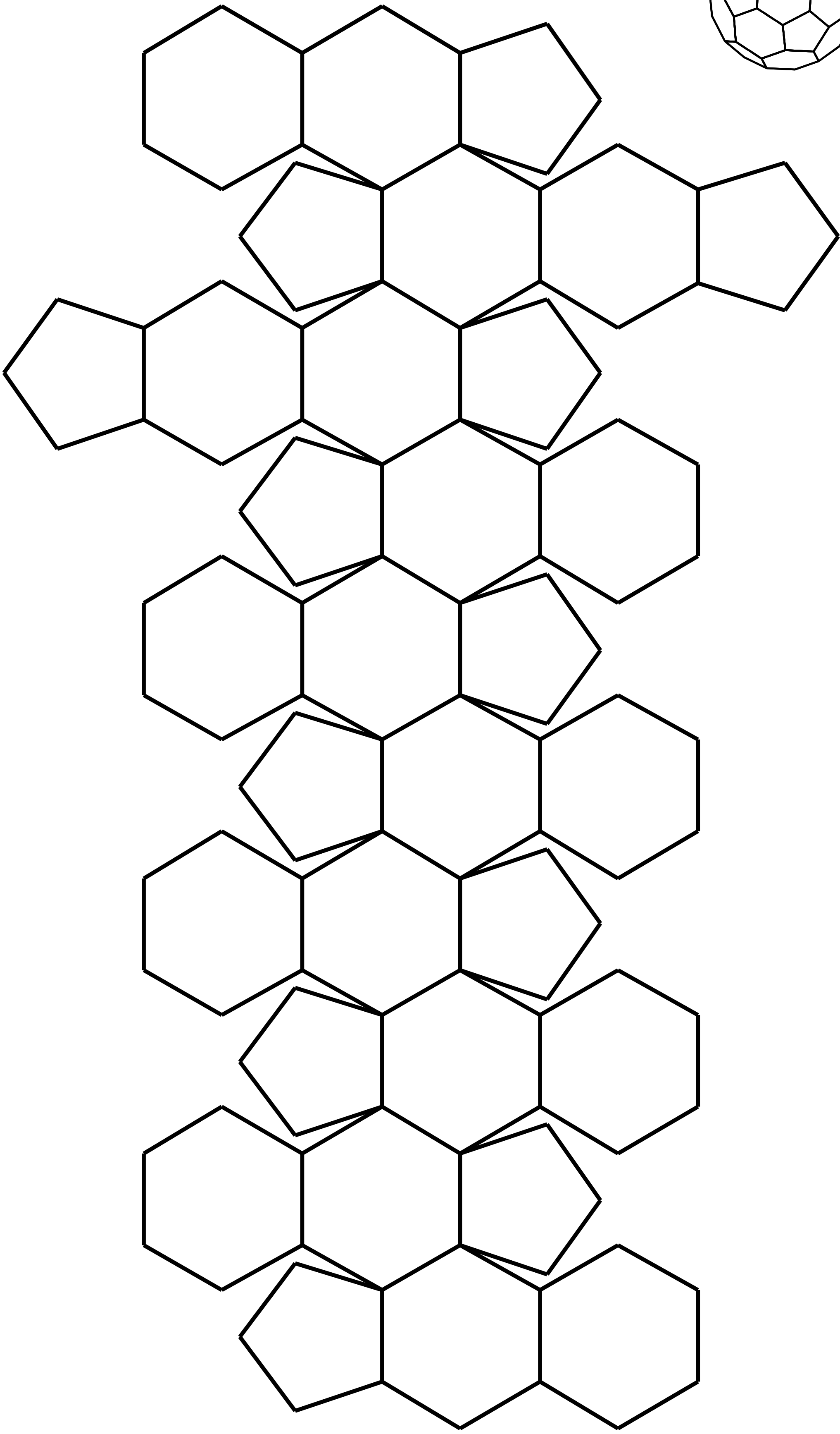
Truncated dodecahedron



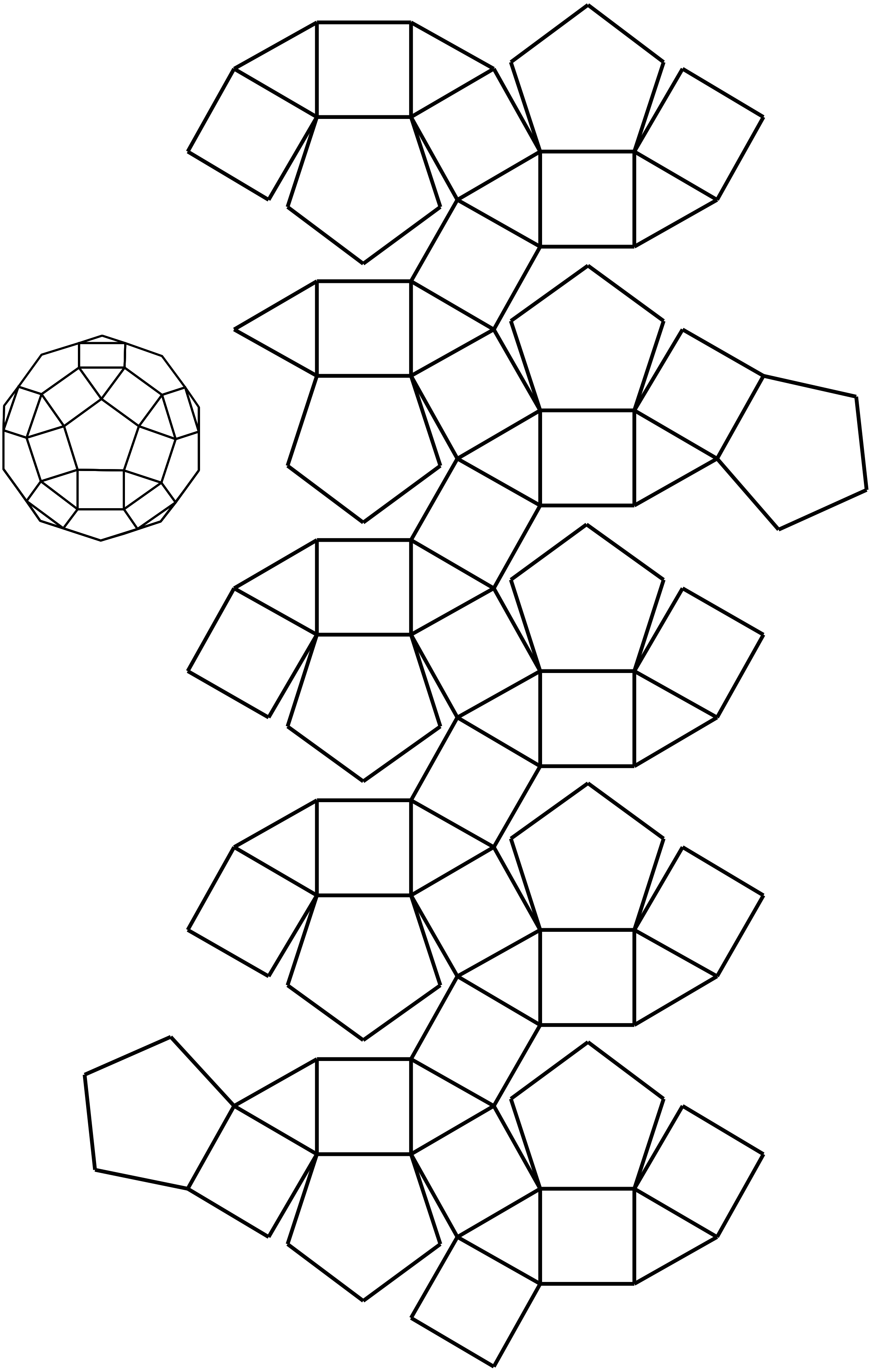


Truncated icosahedron

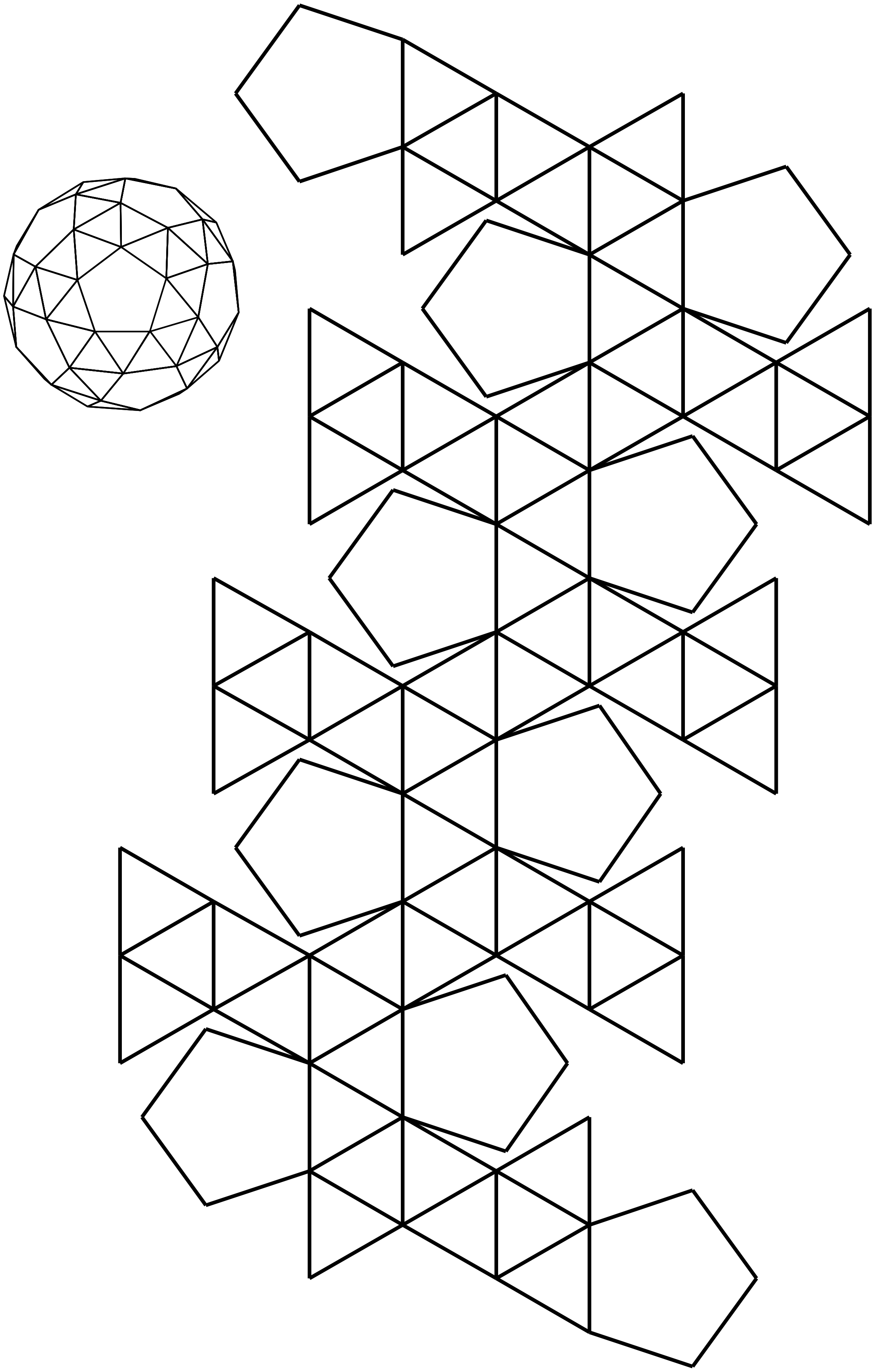




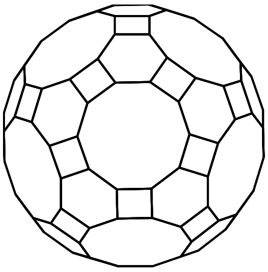
Small rhombicosidodecahedron

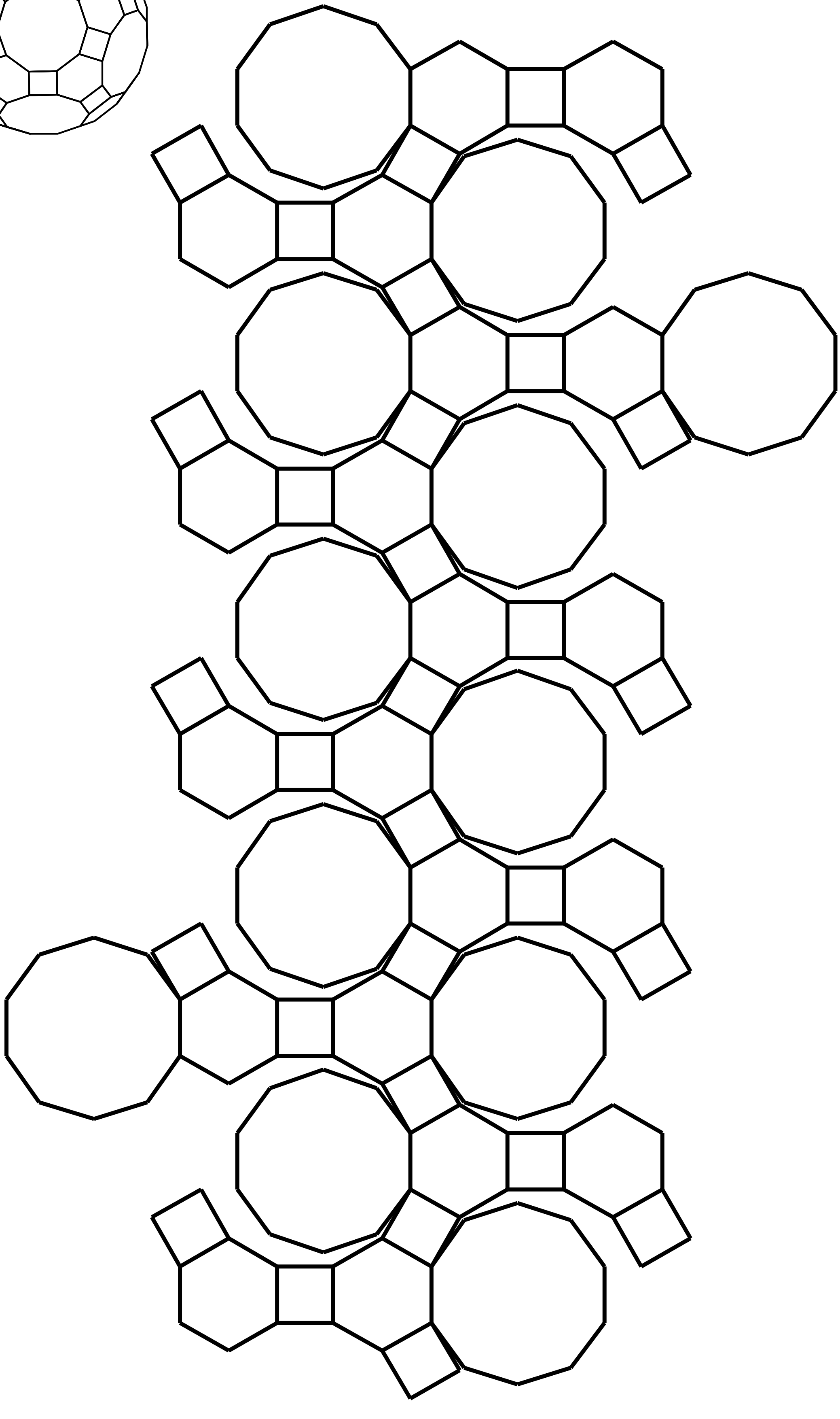


Snub dodecahedron



Great rhombicosidodecahedron





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