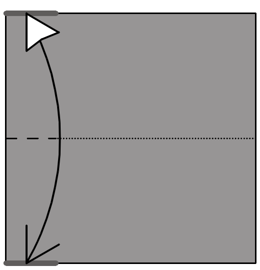
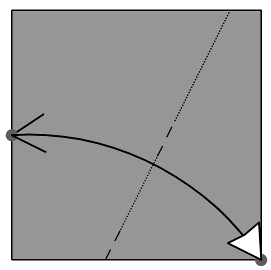
DeZZ Unit

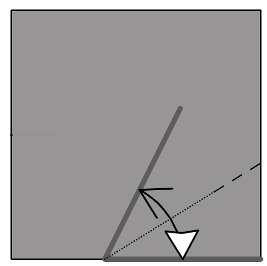
This is actually several units in one: a **De**ltahedron **Z**ig-**Z**ag unit, which can be used to fold any deltahedron (any polyhedron whose faces are equilateral triangles). A variation of the unit lets you fold a twisted-hole cube; another variation works for any deltahedrally elevated polyhedron; another variation folds a rhomboidal polyhedron that is the Wolfram Alpha logo. The units draw upon concepts identified and explored by Bob Neale, Lewis Simon, and Mitsunobu Sonobe, not to mention Tom Hull's famous PHiZZ unit, which provides, as well, the rationale for this module's name.



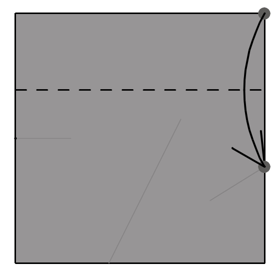
1. Begin with a square, colored side up. Fold in half vertically and unfold, making a pinch at the left.



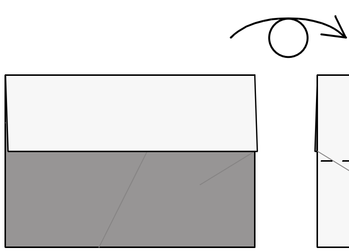
2. Fold the bottom left corner to the mark you just made, creasing as lightly as possible.



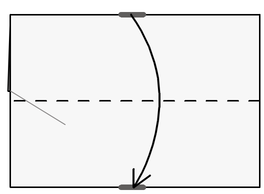
3. Fold and unfold along an angle bisector, making a pinch along the right edge.



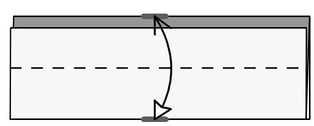
4. Fold the top left corner down to the crease intersection.



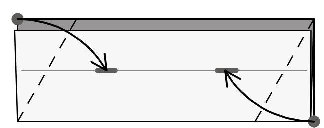
5. Turn the paper over.



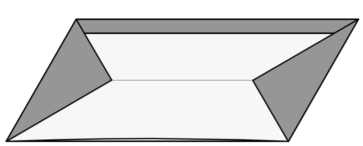
6. Fold the top folded edge down to the raw bottom edge.



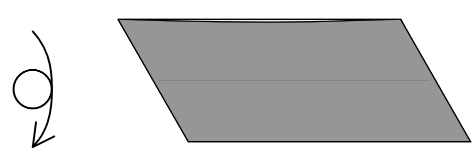
7. Fold the bottom folded edge (but not the raw edge behind it) up to the top and unfold.



8. Fold the top left corner and the bottom right corner to the crease you just made.



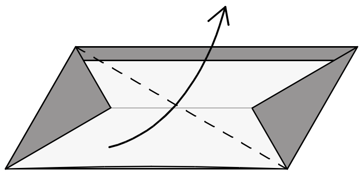
9. Here's the building block.



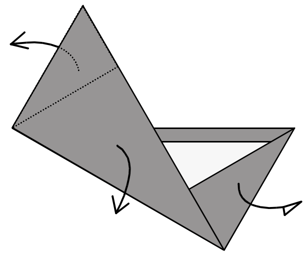
10. Here's the other side.

Deltahedra

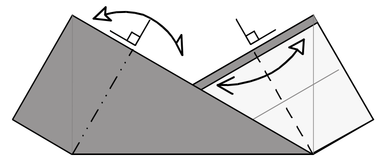
This unit can be used to make any polyhedron whose faces are equilateral triangles.



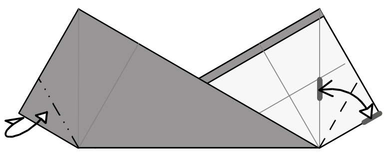
1. Begin with step 9 of the DeZZ building block. Fold the quadrilateral in half along the diagonal.



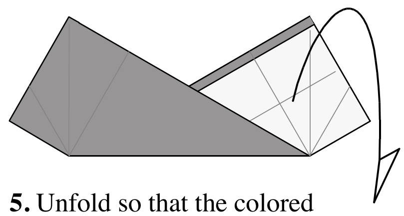
2. Unfold all the creases to 90° dhiedral angles. Make 12 units.



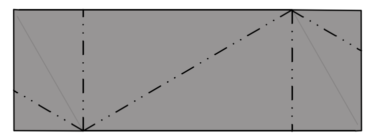
3. Fold and unfold. Repeat behind.



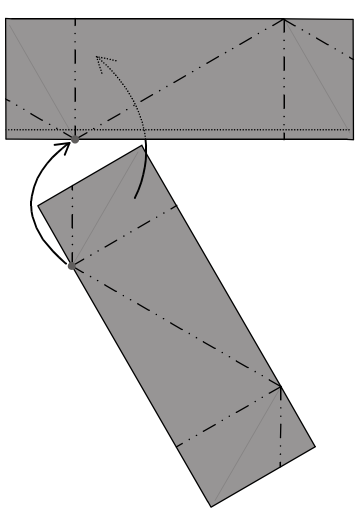
4. Fold and unfold. Repeat behind.



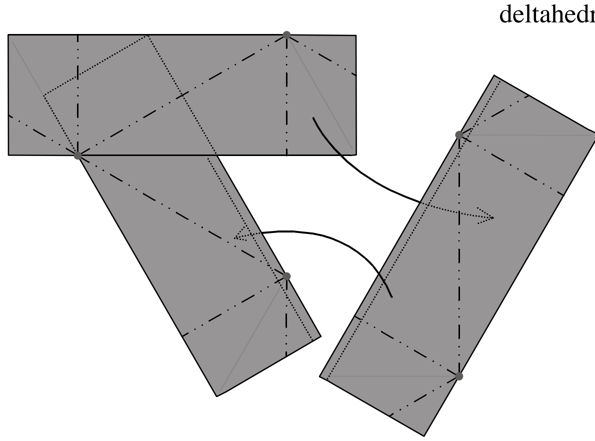
5. Unfold so that the colored side is visible.



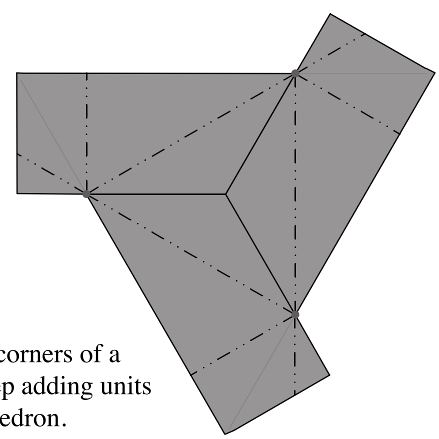
6. The mountain creases here show the folds that are used for the deltahedron. Fold $3N/2$ units for a deltahedron with N faces.



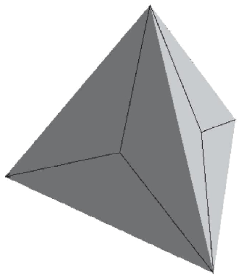
7. Here is how two units go together. The tab slips into the pocket on the back side, and the two points marked by dots come together.



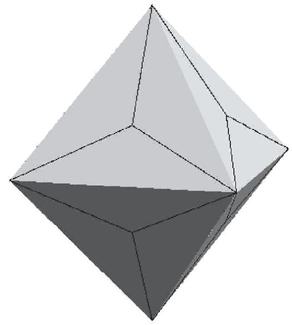
8. The third unit goes inside one pocket and outside one tab.



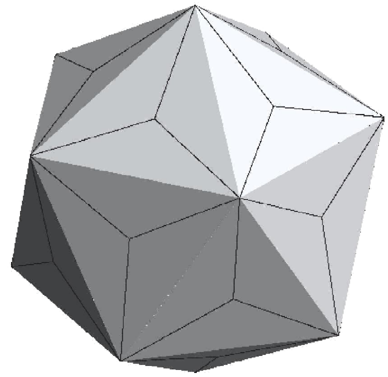
9. The dots are the corners of a triangular face. Keep adding units to create any deltahedron.



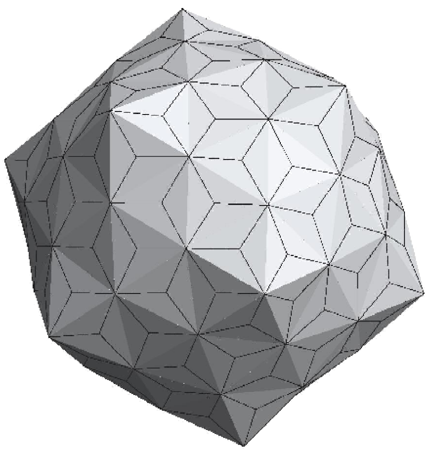
10. Here is a tetrahedron, from 6 units.



11. An octahedron takes 12 units.



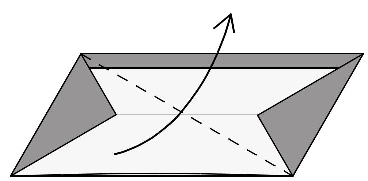
12. And an icosahedron takes 30 units.



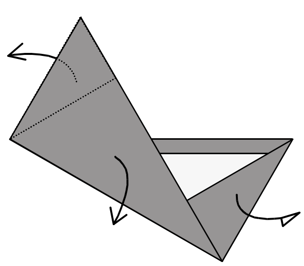
13. With 210 units, one can make a deltahedrified snub dodecahedron. However, the very shallow angles means that it doesn't hold together very well.

Plain Twisted-Hole Cube

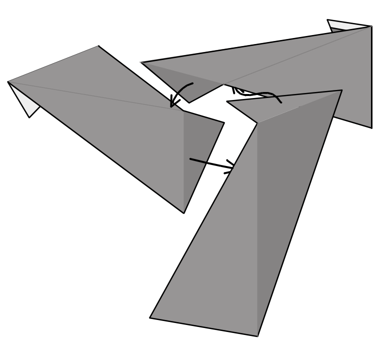
This structure is similar to Lewis Simon's many twist-hole cubes, but uses the assembly technique of Robert Neale's dodecahedron.



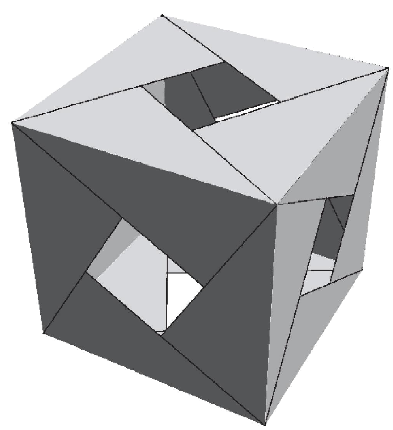
1. Begin with step 9 of the DeZZ building block. Fold the quadrilateral in half along the diagonal.



2. Unfold all the creases to 90° dhiedral angles. Make 12 units.



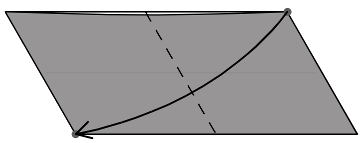
3. Join three units at a corner by sliding tabs into pockets.



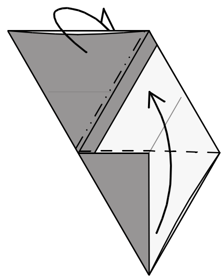
4. The finished cube.

Deltahedrally Elevated Polyhedra

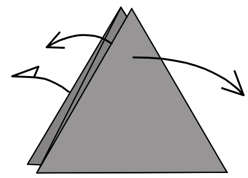
Elevation is the result of erecting a pyramid on each face. If the resulting new faces are equilateral triangles, then we can fold them from still another version of this unit that makes each face a seamless equilateral triangle.



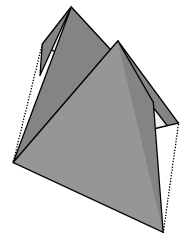
1. Begin with step 10 of the DeZZ building block. Bring two points together.



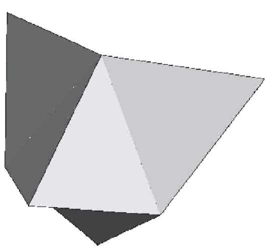
2. Fold the upper left triangle behind and the bottom triangle up.



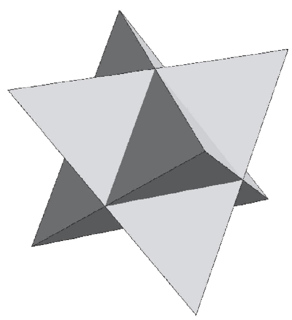
3. Partially unfold all of the folds along the strip.



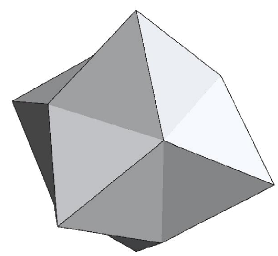
4. One unit makes a portion of a double pyramid.



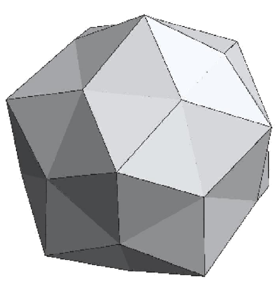
5. 4 units makes an elevated tetrahedron, which resembles a caltrop.



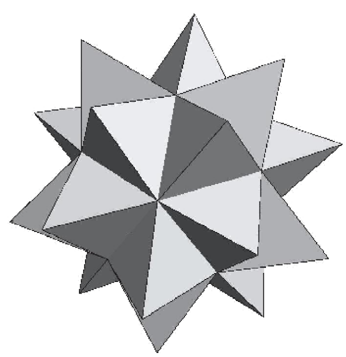
6. The 12-unit elevated octahedron is also a stellation of the octahedron; Kepler called it the *Stella Octangula*.



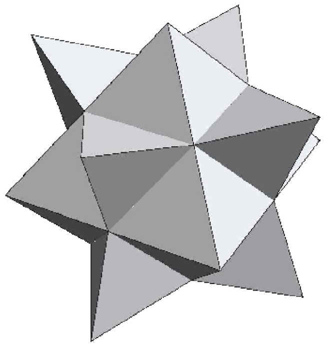
8. The elevated cube takes 12 units, and resembles a slightly stubbier version of the origami model called the *Jackstone*.



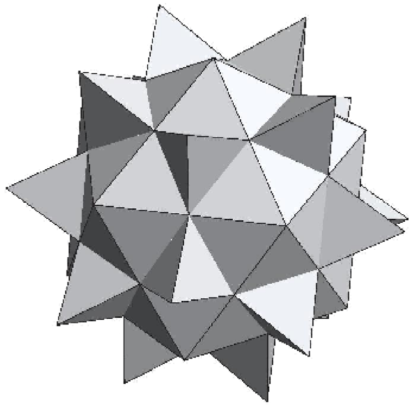
9. The 30-unit elevated dodecahedron is a slightly bumpy ball that is close to, but not exactly, a rhombic triacontahedron.



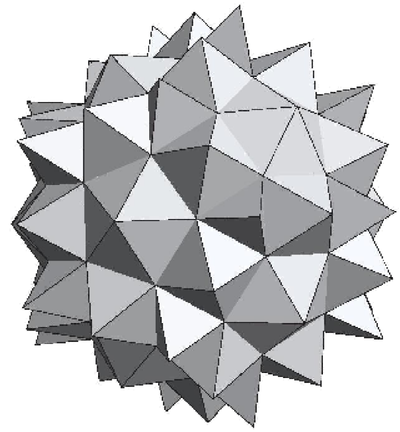
10. The 30-unit elevated icosahedron is considerably bumpier. It is close to, but not exactly, a stellation of the dodecahedron.



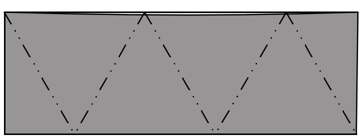
11. The elevated cuboctahedron takes 24 units.



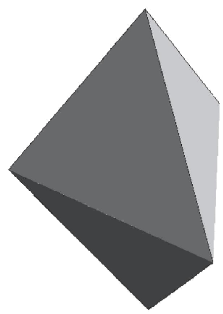
12. The elevated icosidodecahedron takes 60 units. Leonardo da Vinci described (and named) this solid.



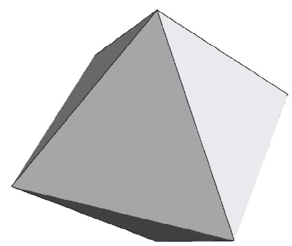
13. And finally, 200 units will build you the elevated small rhombicosidodecahedron.



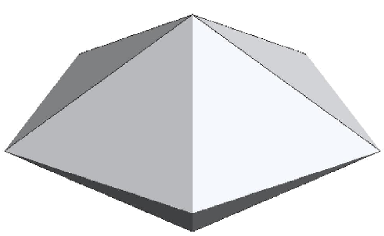
14. If you make 3 units with all mountain folds, they can be assembled into the deltahedral equivalent of *Takahama's Jewel*.



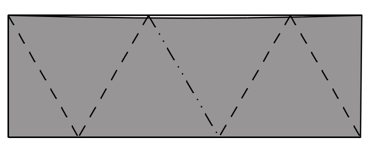
15 . Which is a deltahedrally elevated trigonal dihedron, or, more simply, a tetrahedral dipyramid.



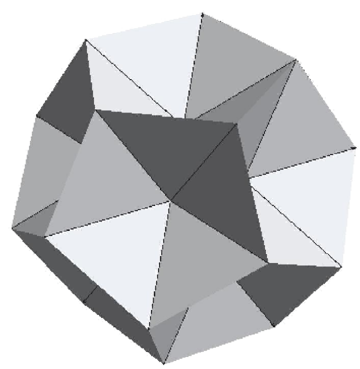
16 . Four units gives a deltahedrally elevated square dihedron, or a square dipyramid, or simply, an octahedron.



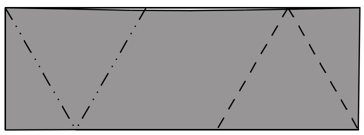
17. And 5 such units gives a pentagonal dipyramid.



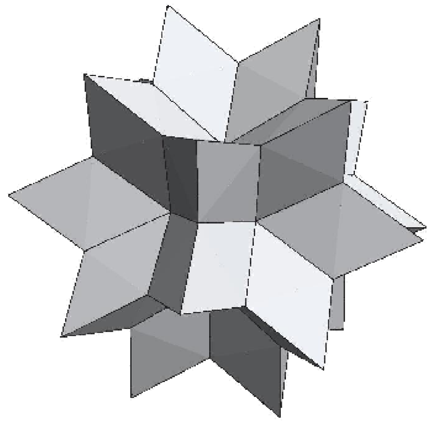
18. If a polyhedron is elevated with negative height, we call it "depressed." You can fold depressed polyhedra by changing the parity of some of the creases like this.



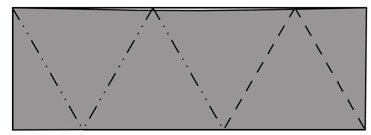
19 . This depressed dodecahedron requires 30 units, like its elevated kin.



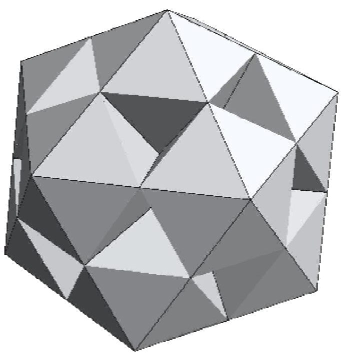
20. Leaving out the middle crease gives a unit that has an interesting application...



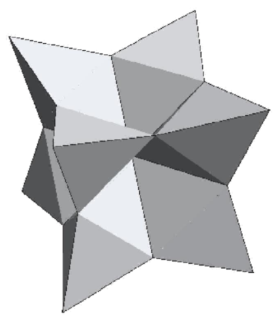
21. If you elevate the triangles and depress the pentagons of an icosidodecahedron, you get this shape, which also happens to be the logo of Wolfram | Alpha.



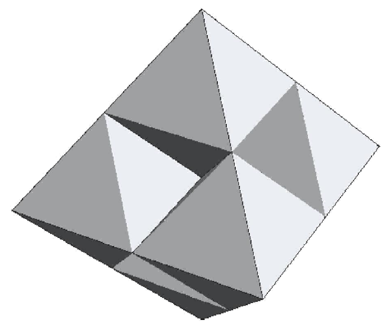
22. With the mountain fold back in place, we can make other mixed elevated/depressed polyhedra...



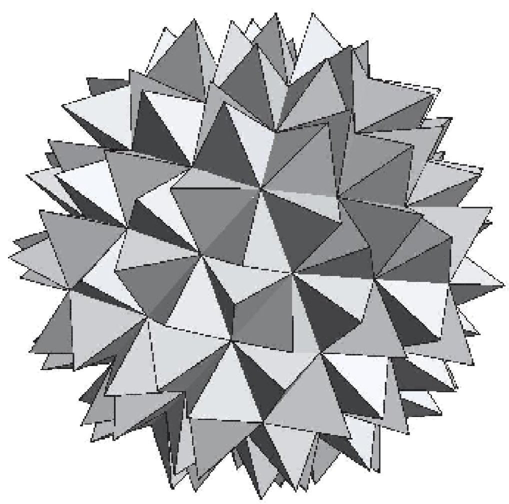
23. If you depress the triangles and elevate the pentagons of the icosidodecahedron, you get an icosahedron with holes.



24. We can treat the cuboctahedron similarly. Elevated triangles, depressed squares in a cuboctahedron.



25. Elevated squares, depressed triangles in a cuboctahedron.



26. And finally, to wrap up, going back to the original elevated unit, 210 units give a deltahedrally-elevated deltahedrified snub dodecahedron. (Yes, that's double-deltahedrification!)