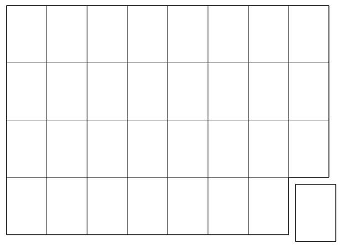
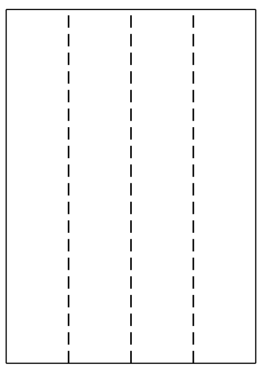
Wireframe Polyhedra Unit

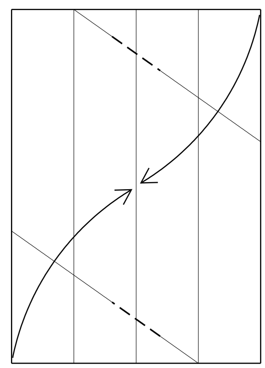


The starting proportions of paper control the relative "thickness" of the edges of the polyhedra. I used a sheet of letter paper torn into 32 pieces.

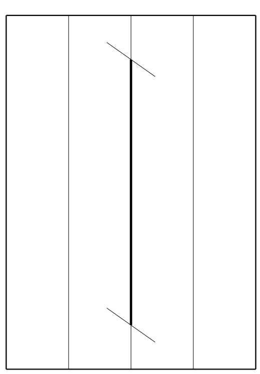
A set of folds to make units for all the Platonic, Archimedean, and Johnson solids with equal edge length. The angles created are not necessarily exact, but are relatively straightforward to fold and practical if you want to fold the 1000+ units for the uniform solids. Based on the fold for the "Outline Dodecahedron" in David Mitchell's **Mathematical Origami**.



1. Crease the sheet into quarters.

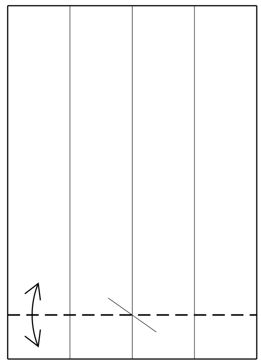


2. Make a small crease at the center of the sheet on the line made by bringing the lower left corner to the centerline and meeting the ¾ vertical crease. Repeat with the upper right corner.

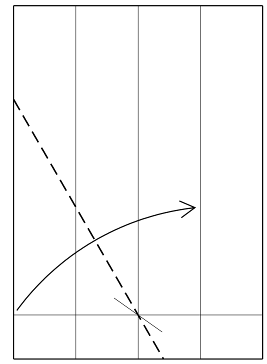


3. The distance between the two small creases is the unit length of the polyhedron edges. From here, choose the two face shapes the edge shares.

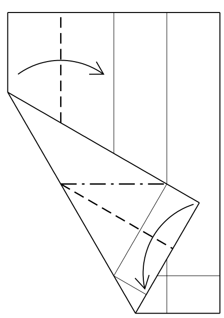
Triangle Edge (Non-Platonic) (Internal angle of 60° ideal, 60° folded)



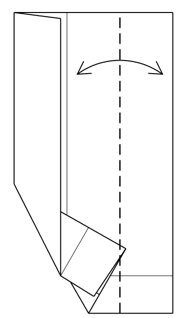
4. Crease horizontally through the intersection of creases from step 2.



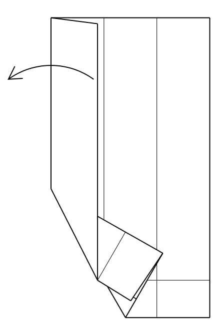
5. Tear across the crease.



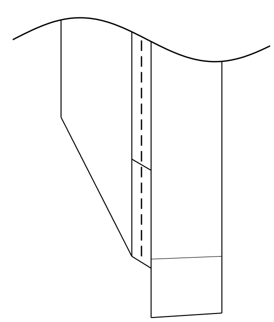
6. Fold the lower left corner to the ¾ vertical crease, going from the bottom centerline.



7. Crease, taking notice that the corner created by the previous fold goes over the ¾ vertical crease.

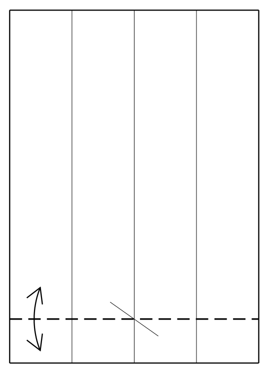


8. Unfold, rotate by 180° and fold the second side.

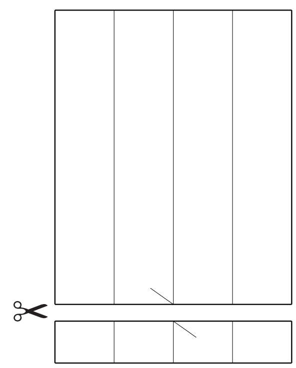


9. Finished view of the bottom half when both sides are folded. Crease the centerline.

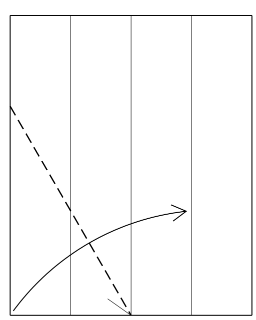
Triangle Edge (Platonic) (Internal angle of 60° ideal, 60° folded)



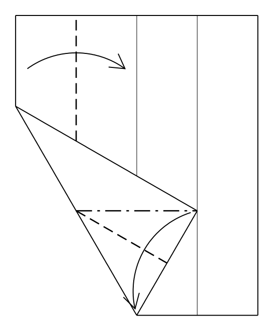
4. Crease horizontally through the intersection of creases from step 2.



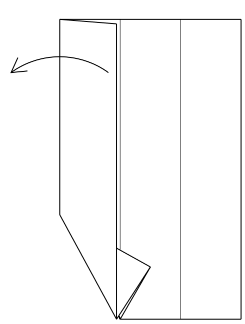
5. Tear across the crease.



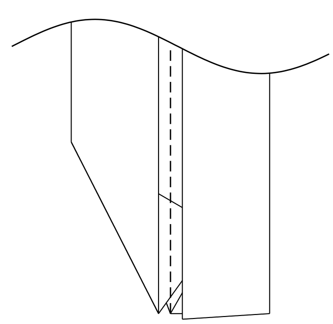
6. Fold the lower left corner to the ¾ vertical crease, going from the bottom centerline.



7. Fold.

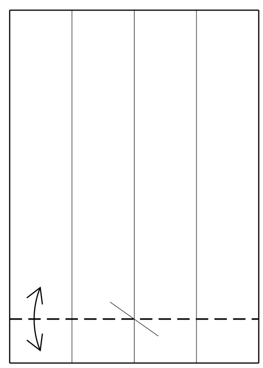


8. Unfold, rotate by 180° and fold the second side.

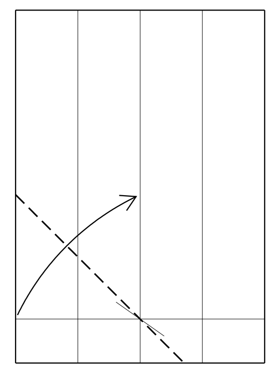


9. Finished view of the bottom half when both sides are folded. Crease the centerline.

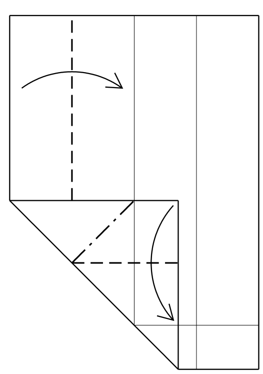
Square Edge (Internal angle of 90° ideal, 90° folded)



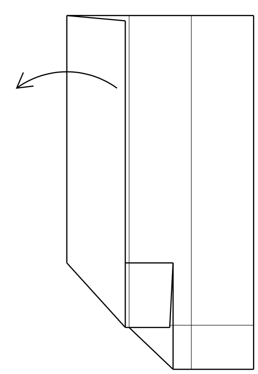
4. Crease horizontally through the intersection of creases from step 2.



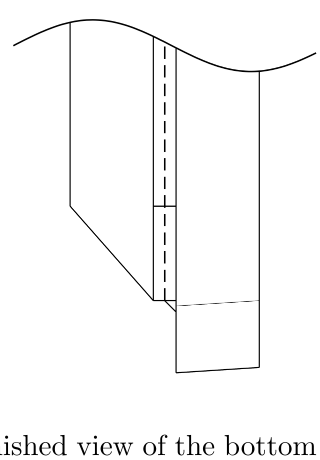
5. Fold the left edge where the crease from step 6 is to the centerline going though the intersection of creases from step 2.



6. Fold.

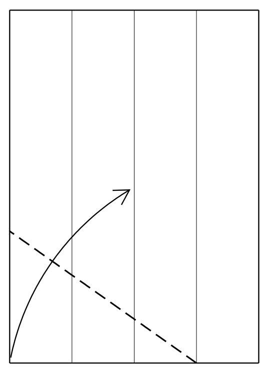


7. Unfold, rotate by 180° and fold the second side.

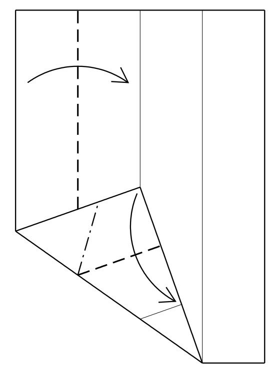


8. Finished view of the bottom half when both sides are folded. Crease the centerline.

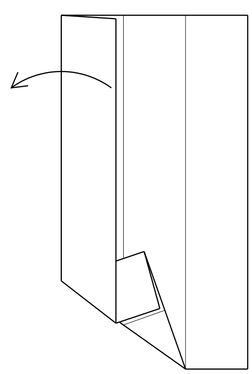
Pentagon Edge (Internal angle of 108° ideal, ∼109.5° folded)



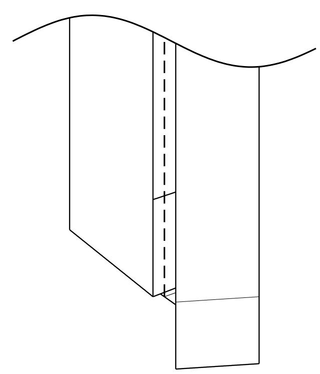
4. Complete the full fold referenced in step 2.



5. Fold.

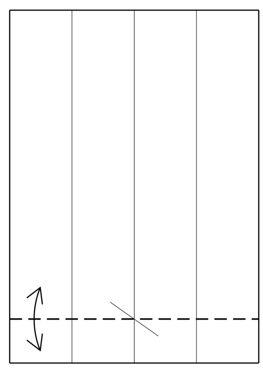


6. Unfold, rotate by 180° and fold the second side.

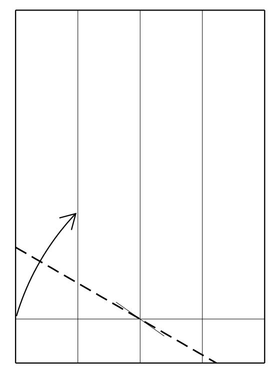


7. Finished view of the bottom half when both sides are folded. Crease the centerline.

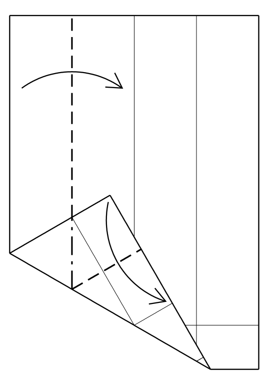
Hexagon Edge (Internal angle of 120° ideal, 120° folded)



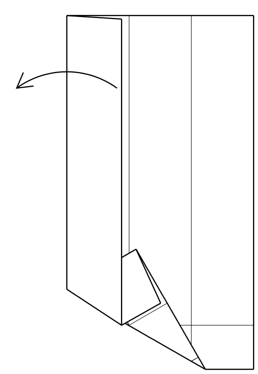
4. Crease horizontally through the intersection of creases from step 2.



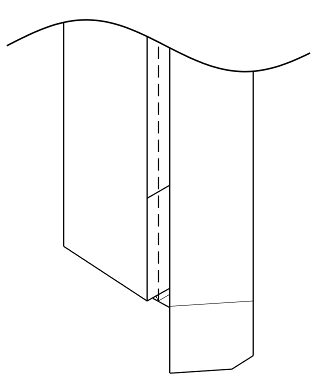
5. Fold the left edge where the crease from step 6 is to the ¼ vertical crease going though the intersection of creases from step 2.



6. Fold.

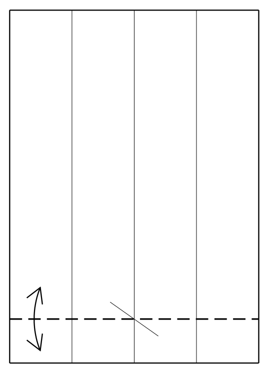


7. Unfold, rotate by 180° and fold the second side.

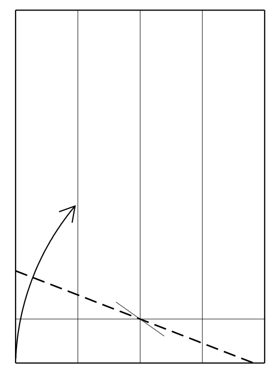


8. Finished view of the bottom half when both sides are folded. Crease the centerline.

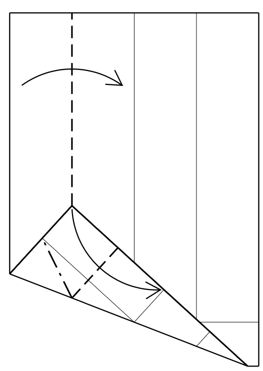
Octagon Edge (Internal angle of 135° ideal, ~137.6° folded)



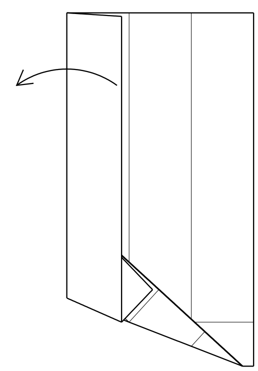
4. Crease horizontally through the intersection of creases from step 2.



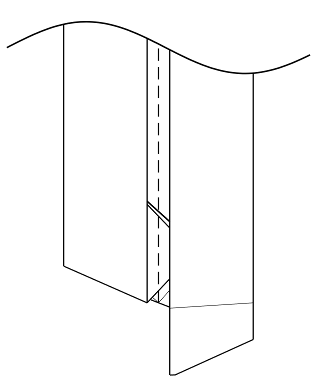
5. Fold the left corner to the ¼ vertical crease going though the intersection of creases from step 2.



6. Fold.

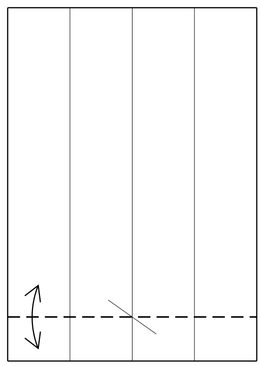


7. Unfold, rotate by 180° and fold the second side.

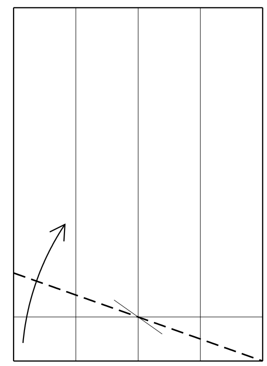


8. Finished view of the bottom half when both sides are folded. Crease the centerline.

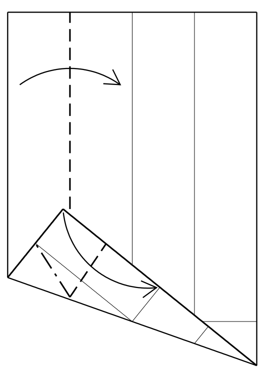
Decagon Edge (Internal angle of 144° ideal, ~141.1° folded)



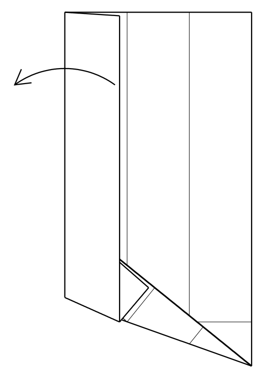
4. Crease horizontally through the intersection of creases from step 2.



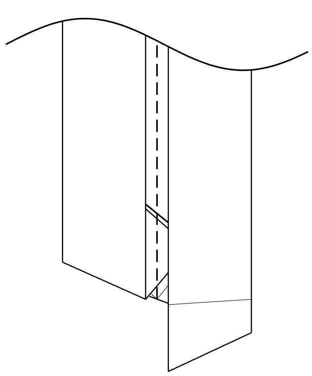
5. Fold going though the right corner and the intersection of creases from step 2.



6. Fold.



7. Unfold, rotate by 180° and fold the second side.



8. Finished view of the bottom half when both sides are folded. Crease the centerline.

Notes

- I have not included diagramming for joining the units together. In general, the left side of the unit found in each "Finished view..." step is the "pocket" and the right side of the unit is the "tab". A vertex of the polyhedra is formed by inserting the tabs into the pockets of adjacent edges around the vertex.

- It is in general a good idea to pre-fold the tabs of the units while in the corresponding pocket.

- The dihedral angle between adjacent faces forms naturally when all the units of a given vertex are snugly fit together.

- The Platonic and Archimedean solids all come together nicely and form stable models. The hardest ones to assemble would be the tetrahedron, cube (very tight dihedral angles) and the snub polyhedra (very loose dihedral angles). The snub polyhedra are particularly annoying. With patience and coaxing the pieces back together as they fall apart, the snub polyhedra eventually come together nicely.

- The fold for the triangle faces are different for Platonic and Archimedean solids. This difference is because the extra paper at the bottom add too much bulk in the vertex for the Platonic solids. By tearing the bottom tab off, there is less material to weave together making it easier to assemble the figures. I didn't have any problems like this for the Archimedean solids with triangular faces, so I have kept the tab in those cases.

- When the bottom tab of the triangular face is left intact, notice that the pocket is clipped when folding the unit together (as seen in Step 7). The corner of the corresponding tab that fits into this pocket may need to be folded in, likewise, to fit properly.