

Cubes: Slicings, Projections, and Foldouts

CUBES

Slicings:

1. What kinds of quadrilaterals can you get by slicing a cube? Square? Rectangle? Rhombus? Trapezoid?
2. What kind of triangles can you get by slicing a cube? Right? Isosceles? Scalene? Given a triangle in the plane, when is it congruent to a cube slice?
3. Which other polygons can you get by slicing a cube? Pentagons? Hexagons? Octagons? More sides?
4. How many regular polygons can you find?
5. What are the areas of some of your slices? Perimeter? Volumes of the two pieces?
6. Describe the movie as a cube passes through Flatland in different ways.

Foldouts:

1. What are all possible ways to arrange six squares in the plane so that each square shares an edge with another square? Say two arrangements are the same if they differ by a rotation and/or flip.
2. How many of these arrangements can be folded into a cube?
3. Start with a cube with labeled sides labeled? Now how many different foldouts are there?
4. Which foldout requires the least amount of tape to fold? The least amount of folding? What combination of arrangements allow you to fit the most foldouts on one sheet of paper?
5. Can any non-cubical arrangements be folded up into something nice?
6. Are any foldouts particularly symmetrical?
7. For the polygons you created by slicing, draw the corresponding images on the foldouts. Do you get any nice patterns?
8. Do Problem 1 for cubes.

Projections:

1. How many different projections of a cube can you get?
2. Describe different movies you can get as the cube rotates.
3. Which projections have the most symmetries?