

## Paper Folding with Envelopes & Paper Bags

Purpose: Students will use simple objects of a small business envelope and a lunch bag to fold to create various geometric shapes and investigate various geometric concepts.

Materials Needed: Small business envelopes, brown paper lunch bags, scissors, tape, rulers, coloring pencils.

### Part One, the Envelope:

1. Take a small business envelope and seal it. Calculate the surface area of the envelope.
2. Draw the diagonals of the rectangle with a straight edge.
3. Fold across one of the diagonals and crease the fold.
4. Fold across the other diagonal and crease the fold.
5. Identify and classify all of the triangles that can be seen on the side of the diagonals.

Answer: Four congruent right triangles, two pairs of congruent isosceles triangles (one pair equilateral, one pair obtuse).

6. Cut out one of the obtuse isosceles triangles.
7. Pull out from the vertex of the isosceles cut, and stuff one end inside the other to create a tetrahedron.
8. Identify the number of faces and determine if it is a regular polyhedron.
9. Shade/color the faces.
10. Open the tetrahedron and flatten it. Calculate the surface area of the tetrahedron.
11. Compare the surface area of the original envelope and the tetrahedron.

Answer: Tetrahedron's surface area should be one-half of the envelope's surface area.

### Part Two, the Paper Bag:

1. Take a generic brown paper lunch bag and fold the bag so that the bottom forms a "T" with the rest of the bag.
2. Cut off the top of the "T" (bottom of the bag).
3. Fold out the side creases of the bag and crease them so that the bag will lie flat.
4. Fold the flattened bag in half to create a crease down the middle.

5. Fold the bottom right vertex A along the middle crease until you get a sharp point at the bottom left vertex of the bag. Note: Where the vertex meets the crease is point A.
6. Take the top left vertex of the bag and fold it down across the right triangle created in step 5. You have now trisected the right angle at the bottom left vertex of the bag.
7. Fold the top of the bag down away from the side you have been working with so that you get a straight line at point A across the new top of the figure.
8. Cut off the piece just folded down.
9. Seal this new top with tape.
10. Hold the flat bag and take the two open vertices and push together until they meet, then tape this new edge.
11. Find two one-taped vertices and pull out to get rid of the dents.
12. Crease along created edges and it will form a regular tetrahedron.

Developed by the "Geometry for All" network for the 1998 Kentucky Christa McAuliffe Fellowship, Lisa Willian, fellow. Permission granted for classroom use only.