1. # FRACTIONS AND PAPER FOLDING

Objectives:
The student will be able to develop the concept and properties of fractions using paper folding (origami).

Materials needed:
Each individual in a class should have the following:
1 ruler (in both english and metric units)
paper squares of varying sizes (at least 1 - 4 inch by 4 inch square)
1 sheet of directions

Strategy:
Taking the 4x4 square first, the student shall locate the midpoint of each side by folding the square in half. Next, fold in each of the corners of the square so that the vertices of the square meet in the center of the square.

2. Start a discussion about the new shape(s) by asking the following questions:
   - What new shape(s) have been formed?
   - How does the area of the new shape(s) compare to the area of the old shape?
3. Answering the first question, students may see triangles (the folded sides), squares (the final shape), and even other shapes depending upon the accuracy of the folds. The second question will show the relationship between the original shape and the new shape(s) formed. The students should be able to see that the four flaps cover the new square and, therefore, each flap is 1/4 of the new square. Also by either observation or by geometric proof, the students should be able to see that the new square has an area equal to half of the original square. Your level of vocabulary and mathematical concepts should be adjusted according to grade level.
4. Taking the vertex of the folded flap, fold the flap back so that the vertex now touches the midpoint of the outer edge of the new square.
   Asking the same two questions you started with, start a new discussion. Students may see some new shapes, such as trapezoids, have now been added to the mix. Draw their attention to the new shape inside of the second square. Hopefully, they will now see a new, even smaller square. Have the students try to find the area of the smallest square. If they have trouble, show that four of the new little tabs formed by the last fold will cover the smallest square. Then demonstrate how many of these little tabs it takes to cover the second square (16). Therefore, the area of the smallest square must be 4/16 ths of the second square. Since four of the smaller tabs equal one of the larger tabs, 4/16 = 1/4 and the area of smallest square equals 1/4 th of the second square. You may choose to go further and demonstrate how the smallest square is 1/8 th of the original square.
   With an advanced group, you can even introduce irrationals by looking at the lengths of sides of the squares produced and using the Pythagorean theorem to determine their value.
   Finally, fold the smallest tabs back under, producing a small picture frame which the students can now use to frame the picture of their choice. The above steps can be repeated with different sizes of squares to show that the above fractions (ratios) are

constant and to produce different sizes of picture frames.

Performance Assessment:
K-3 Students will be able to fold any square piece of paper, following the instructions on the direction sheet, into a picture frame for the picture of their choice.
4-6 Students will be able to find the areas of the resulting figures created by the paper folding and determine what fractional part of the whole square is represented by the new sections created.
7-10 Students will be able to do all of the above plus name the shapes created and use the Pythagorean formula to find the dimensions of the new shapes.

References:

- Bill Wagner, Hyde Park Career Academy, Chicago
- Sobel and Maletsky, **TEACHING MATHEMATICS:** A Sourcebook of Aids, Activities **and Strategies**, Prentice Hall, 1988