VARIABLES AND EQUATIONS
Teaching Guidelines

Subject: Mathematics

Topics: Algebra, Geometry (circles, polygons)

Grades: 4 - 6

Concepts:

- Variable
- Equation

Knowledge and Skills:

- Can express relationships of variables as equations, inequalities and expressions

Materials (for each student):

- Six equilateral triangles (cut from card stock or construction paper, sides approximately 2"). You may wish to have the students cut out the triangles themselves, from the pattern provided in the handout.

Procedure:

1. Ask students to work with their 6 equilateral triangles and see how many other polygons they can make from two or more of those triangles in 1 minute. Time this activity.

2. Have some students tell you about the polygons they made and anything they noticed (such as, "you can make one large triangle from four smaller triangles").

3. Ask, "How does the area of the rhombus compare to the area of the triangles?" Lead discussion to the point that (ideally under the direction of the students) you write "r = 2t" on the blackboard, where "r" = the area of the rhombus and "t" = the area of the triangle.

4. Ask students if this relationship is true no matter how big the triangles are. Introduce/review the fact that "r" and "t" are *variables*—they stand for a quantity that may not always be the same (in this case, areas), but we can use them to write down how those quantities are related to each other even when we don't know how big they are.

5. Introduce/review the fact that the statement you have written on the board is an *equation*--a mathematical way of saying that the things you write on each side of the equals sign both stand for the same amount of something.

6. Ask the class to come up with another such relationship amongst the shapes they can make with the triangles, and write it down on the board.

7. Have each student, individually, determine and write down as many such relationships as possible in a few minutes. Circulate while students are doing this. (Important: Watch for students using the same variable name to stand for two different shapes—for example, "t" for both the single triangle and the larger triangle or the trapezoid, or "p" for both the parallelogram that can be made with four triangles and for the parallelogram that can be made with 6 triangles.)

8. Have some of the students describe their results and write down their relationships on the blackboard. (Be sure that the class understands that each student may be using different letter names for their variables.)

9. Give the class this problem: "We found that we could make one large triangle from some of the small triangles. Suppose I know that the area of the large triangle was 12 square inches. How could I use these relationships and equations to find the area of the hexagon?"

10. Have students work on this individually (or in teams of two, if you wish). Tell them that you don't just want the answer, they have to prove their answer by using some of the relationships they've written down. Circulate while students are working on this.

11. When most or all students have completed the activity, have some of the students explain their answers and their reasoning. Guide the discussion so that students see and understand this algebraic proof:

    $t = 4s$ (area of large triangle = 4 x area of small triangle)

    If t is 12 square inches, then s must = 3 square inches.

    $h = 6s$ (area of hexagon is 6 times area of small triangle)

    If s is 3 square inches, then h must equal 18 square inches.

10. Review through discussion the main points of the lesson: the definition of variables and how variables can be used to show how things are related.

Variables and Equations