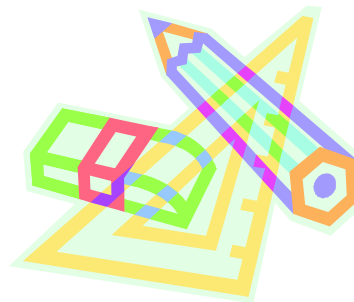# Algebra/Geometry Institute Summer 2009

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School: Quitman County Middle School

Grade Level: 8th

Why Use the Pythagorean Theorem?

1   Teaching objective(s)
- The student will solve geometric problems using the Pythagorean Theorem.
    ### Institute framework
- 3c. Develop measurement concepts and formulas through the use of geometry.
- 3d. Solve geometric problems using formulas.

2   Instructional Activities

A.   First, I will begin class by telling the students that the Pythagorean Theorem is a way to find the missing side of a right triangle. Next, I will ask the students to define theorem. I will tell the students that according to the Webster's Dictionary, "A theorem is a statement especially in mathematics that has been or is to be proven." Then, I will demonstrate the in-class activity (Attachment 3) by using the follow example: *Suppose two legs of a right triangle are 3units long and 4 units long, how long is the hypotenuse?*

         After the example is explained, the teacher will begin the in class activity. I will tell the students that the goal of this activity is to determine the formula for the Pythagorean Theorem. When students have completed the activity, I will ask for their version of the Pythagorean Theorem. Finally, I will provide the students with pictures of right triangles (Attachment 1) and the formula for the Pythagorean Theorem (Attachment 2). I will explain the formula stating, "The sum of each leg squared is equal to the square of the hypotenuse. I will pose a second example: *Suppose the leg of a right triangle is 6 units long and the hypotenuse is 10 units long, what is the length of the other leg?* The students will use the formula (Attachment 2) to answer the question. After listening to the students' responses, I will guide students through each step (Attachment 2).

B. In Class Activity #1 (Attachment #3)
I will divide the students in groups of fours. Each student will be given a blank sheet of graphing paper, a ruler, and a pair of scissors.

C. In Class Activity #2
The students will be divided into groups of fours to count floor tiles to find the dimensions of the room. The students will use the above Pythagorean Theorem activity #1 to determine the length of the room's diagonal. The students will use a tape measure to measure the room's diagonal and compare the actual measurement to the calculated measurement.

3   Materials:
          Pencil
          Scissors
          Ruler
          Graphing Paper
          Tape Measure
          Calculator
          Activity Sheets
          Overhead Projector

Resources:

1) Bailey, R., Day, R., Frey, P., & Howard, C. (2009). *Mathematics Application and Concepts*. New York, New York: McGraw-Hill Companies, Inc.

2) Frykholm, J., Johnson, A., Malloy, C., Preston, R., Pugalee, D. K., & Slovin, H. (2002). *Navigating through Geometry in Grades 6-8.* Virginia. Pgs.28-30

4   Assessment

I will assess the students by observing them while performing Testing the Pythagorean Theorem experiment. I will also grade the questions that are included in the experiment. Then, I will collect the students graphing paper for a grade to ensure that they followed the instructions rather than using the calculator to arrive at the solution to each problem.
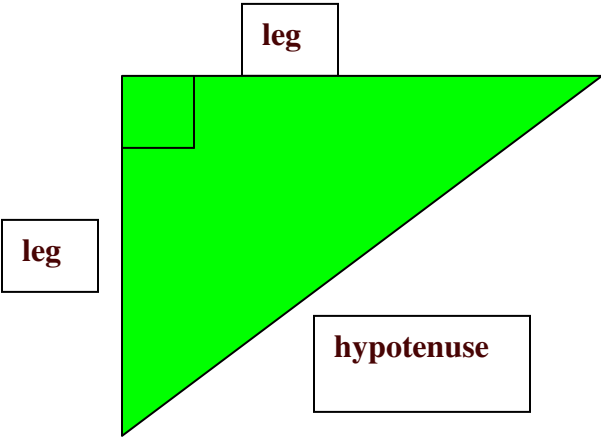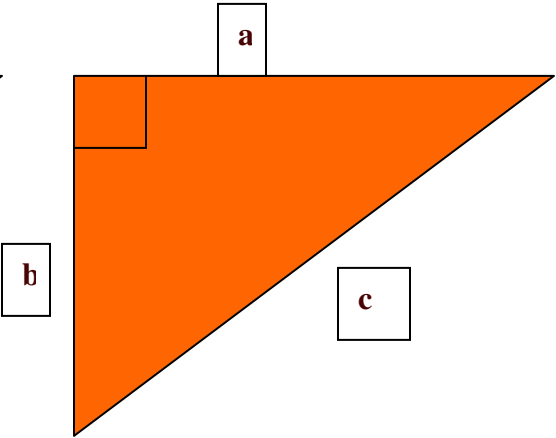
leg

a

leg
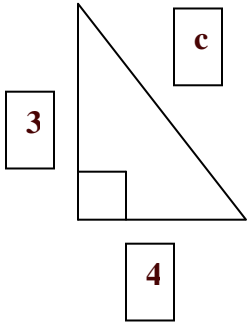
b

hypotenuse

c

Figure 1

Figure 2

Pythagorean Theorem: $a^2 + b^2 = c^2$

Example 1: $a^2 + b^2 = c^2$

$3^2 + 4^2 = c^2$ **Substitute "3 for a" and "4 for b".**

$9 + 16 = c^2$ **Evaluate exponents.**

$25 = c^2$ **Add.**

$\sqrt{25} = \sqrt{c}$ **Square root each side to determine c.**

$5 = c$ **The hypotenuse equals 5.**

c

3

4

Example 2: $a^2 + b^2 = c^2$
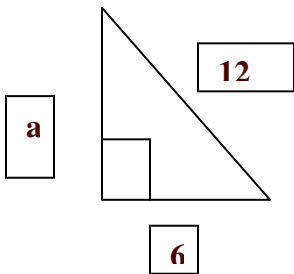
$a^2 + 6^2 = 12^2$ **Substitute "6 for a" and "10 for c".**

$a^2 + 36 = 144$ **Evaluate exponents.**

$a^2 = 108$ **Subtract 36 from both sides of the equation.**

$\sqrt{a^2} = \sqrt{108}$ **Square root each side to determine a.**

$a = 10.4$ **The leg is 10.4 rounded to the tenths place.**

12

a

6

Testing the Pythagorean Theorem

1. On the blank sheet of graphing paper draw a vertical line 6 blocks long. **(Note each block represents one square unit.)**
2. Draw an 8 block long line perpendicular to the first line.
3. Draw a line connecting the ends of the two lines to form a triangle.
4**. How long is the first line? How long is the second line?**
5. How long is the third side? It can be determined using the Pythagorean Theorem.
6. Draw a square along the 6 unit side.
7. **What is the area of the square?**
8. Draw a square along the 8 unit side.
9. **What is the area of that square?**
10. In a separate portion of the graphing paper draw a square with an area of 100 square units.
11. Use the scissors to cut the 100-unit^2 square out.
12. Use the square to measure the third side.
13. **What is the measure of the third side?**

14. Use the above steps to calculate the hypotenuse of a right triangle with legs

   a. 12 units and 5 units

   b. 8 units and 15 units

   c. 24 units and 7 units.

Answer Key for **Testing the Pythagorean Theorem** (Attachment 3)

4. The first line is 6 units long. The second line is 8 units long.

7. The area of the square is 36 square units.

9. The area of the square is 64 square units.

13. The measure of the third side is 10 square units.

14. a. 13 square units

b. 17 square units

c. 25 square units