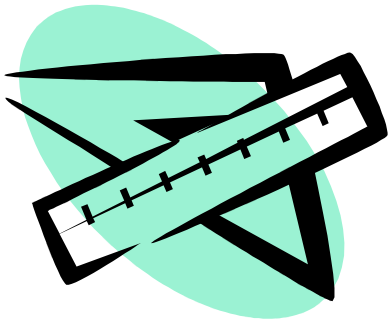
Algebra/Geometry Institute Summer 2007



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School: Coleman Middle, Greenville, MS
Grade Level: 7

1. Teaching Objective

- Create an argument using the Pythagorean Theorem principles to show that a triangle is a right triangle. (3e)

2. Instructional Activities

****This lesson is designed to take two to three class periods****

- Bell-ringer (5 minutes): "Draw a picture of a right triangle and label the following: leg, hypotenuse, right angle. Explain, in complete sentences, what these three vocabulary words mean." Allow 3 students to read their descriptions aloud and show where the legs, hypotenuse, and right angle are located on a triangle drawn on the board.
- Explain to students that today they will learn about a special relationship, called the Pythagorean Theorem, which all right triangles have in common. Tell students that not only will they discover the relationship on their own, but they will then apply their findings to solve other problems.
- Activity I (25 minutes)
    a. Pass out the "Discovering the Pythagorean Theorem" worksheet to each student. Divide the students into groups of four. Provide each group with rulers, scissors, calculators and one "Triangle Set" handout.
    b. Explain to students that they are to measure the length of each side of the triangle, to the nearest centimeter, and record their data in the correct column. Remind students that the longest side is always the hypotenuse and the other two sides are the legs. After measuring the side lengths, they will square the numbers and record them in the appropriate places. After measuring all five triangles, students will work together to discover the relationship.
- Post- Activity I Discussion (10 minutes): Call on students to share the data (leg and hypotenuse lengths) they collected for each of the triangles as well as the numbers they computed when the lengths were squared. After answers are agreed upon for the five triangles, ask students to describe the relationship that they discovered. Expect students to say that when the two leg lengths were squared and then added together, they equaled the length of the hypotenuse squared. Write the Pythagorean Theorem ($a^2 + b^2 = c^2$) on the board for students to copy onto their worksheets. Make sure that students

understand that a and b represent the lengths of the legs and that c represents the length of the hypotenuse. Emphasize that the Pythagorean Theorem is true for ALL right triangles.

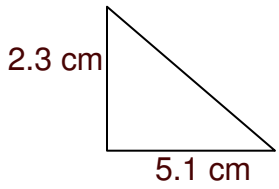
- Notes (15 minutes)
  a. Write the Pythagorean Theorem on the board: $a^2 + b^2 = c^2$
     - Remind students that a and b represent the lengths of the legs and c represents the length of the hypotenuse.
  b. Tell students that when they are given a problem, they will know the length of both the legs or the length of one leg and the hypotenuse.
  c. Provide students with 2 examples in which they are given the lengths of the legs:

     - Ex 1: What is the length of the hypotenuse if the legs measure 3 feet and 4 feet?

$$a^2 + b^2 = c^2$$
$$3^2 + 4^2 = c^2$$
$$9 + 16 = c^2$$
$$25 = c^2$$
$$5 = c$$

The hypotenuse is 5 feet long.

     - Ex 2: Find the length of the missing side.



$$a^2 + b^2 = c^2$$
$$2.3^2 + 5.1^2 = c^2$$
$$5.29 + 2.01 = c^2$$
$$31.3 = c^2$$
$$5.6 = c$$ (Round to the nearest tenth)

The hypotenuse is 5.6 cm long.

  d. Provide students with 2 examples in which they are given the lengths of one leg and the hypotenuse:

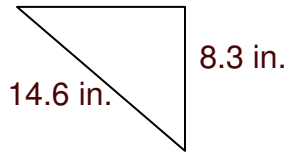
     - Ex 1: If the leg of a triangle is 6 meters long and its hypotenuse is 10 meters long, what is the length of the other leg?

$$a^2 + b^2 = c^2$$

$$6^2 + b^2 = 10^2$$
$$36 + b^2 = 100$$
$$-36 \qquad -36$$
$$b^2 = 64$$
$$b = 8$$

The other leg is 8 meters long.

- Find the length of the missing leg.



$$a^2 + b^2 = c^2$$
$$8.3^2 + b^2 = 14.6^2$$
$$68.89 + b^2 = 213.16$$
$$-68.89 \qquad -68.89$$
$$b^2 = 144.27$$
$$b \sim 12.0$$ (Round to the nearest tenth)

The other leg is approximately 12.0 inches long.

- Practice Problem Set (30 minutes)
  a. Hand out the "Pythagorean Theorem Practice" worksheet and a calculator to each student. Instruct students to round answers to the nearest tenth.
  b. Allow several students to write their problems on the board and present them to the class.
- Notes (15 minutes)
  a. Tell students that sometimes a triangle may look like a right triangle even though it is not. When all three side lengths of a triangle are known, they can be put into the Pythagorean Theorem to prove whether or not a triangle is a right triangle. Remind students that the longest side is always the hypotenuse (c) and the other two sides can be interchanged (trade places) (a and b). If the equation, $a^2 + b^2 = c^2$, is true, then the triangle is a right triangle.
  b. Provide students with 2 examples in which they are given the three side lengths and must prove whether or not the sides form a right triangle.
     - If a triangle has side lengths of 9 cm, 12 cm, and 15 cm, is it a right triangle?

$$a^2 + b^2 = c^2$$
$$9^2 + 12^2 = 15^2$$

$$81 + 144 = 225$$
$$225 = 225$$

Both sides of the equation are equal to one another. Therefore, this triangle is a right triangle.

- If a triangle has side lengths of 5.3 cm, 7.8 cm, and 10.4 cm, is it a right triangle?

$$a^2 + b^2 = c^2$$
$$5.3^2 + 7.8^2 = 10.4^2$$
$$28.09 + 60.84 = 108.16$$
$$88.93 \neq 108.16$$

The sides of the equation are not equal to one another. Therefore, this triangle is not a right triangle.

- Activity II (35 minutes)
  a. Pass out the "Do We Make a Right Triangle?" worksheet to each student. Divide the students into groups of four. Provide each group with scissors, calculators, rulers, and 15 strips of paper. Instruct them to cut the strips of paper into the given three lengths and construct a triangle. Students will then use the Pythagorean Theorem to prove whether the triangles are right triangles or not.
- Post- activity II discussion (10 minutes)
  a. Call on several students to write their problems on the board and share their answers with the class.
  b. Ask students whether there were any answers that were surprising to them. Were there any triangles that looked like right triangles when they were constructed out of the paper strips but, actually, were not once the Pythagorean Theorem was used to test it? What does this say about how much our eyes can tell us?
- Closing (5 minutes)
  a. Ask students to summarize aloud, or on paper:
     - How did you discover the Pythagorean Theorem?
     - What is the Pythagorean Theorem?
     - How can you use the Pythagorean Theorem to find the length of the missing side of a triangle if you know the length of the other two sides?
     - How can you use the Pythagorean Theorem to test whether or not a triangle is a right triangle?
  b. Administer the "Benchmark 3e Quiz".

3. Materials and Resources

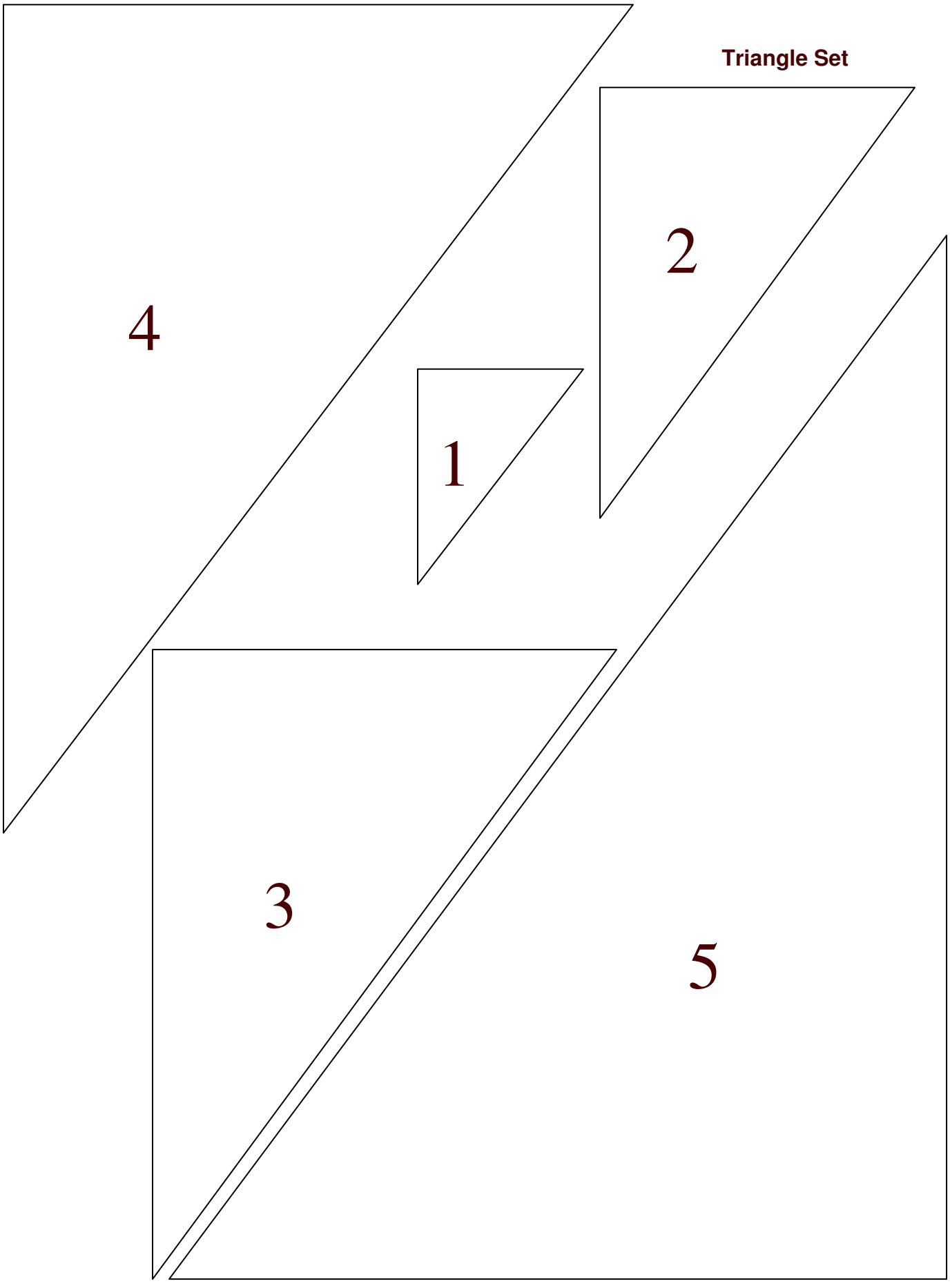
- Materials

a. Bell-ringer
b. “Discovering the Pythagorean Theorem” worksheet
c. Rulers
d. Scissors
e. Calculators
f. “Triangle Set” handout
g. “Pythagorean Theorem Practice” worksheet
h. “Do We Make a Right Triangle?” worksheet
i. ¼ inch × 11 inch strips of paper (copy paper cut into 34 strips)
j. “Benchmark 3e Quiz” worksheet

- Resources
  a. *JBHM 7th Grade Math, Teacher’s Edition* (JBHM Education Group, 2005)
  b. All worksheets created by Charmaine Lau

4. Assessment

- Observation of student participation during bell-ringer, introduction, and post- activity discussions
- Grade “Discovering the Pythagorean Theorem” worksheet
- Grade “Pythagorean Theorem Practice” worksheet
- Grade “Do We Make a Right Triangle” worksheet
- Grade “Benchmark 3e Quiz”


Triangle Set
4
2
1
3
5

Discovering the Pythagorean Theorem

Group Members: A. _____ Date: _____ Block: ___
B. _____
C. _____
D. _____

Round measurements to the nearest centimeter

Triangle	Leg (cm)	Leg (cm)	Hypotenuse (cm)	What relationship do you see using the squared numbers?
1				
Squared				
2				
Squared				
3				
Squared				
4				
Squared				
5				
Squared				

Pythagorean Theorem: _____

Pythagorean Theorem Practice

Name: _____ Date: _____ Block:: _____

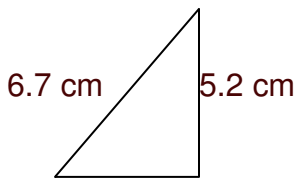
Find the missing side length to complete the table. Round your answers to the nearest tenth.

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

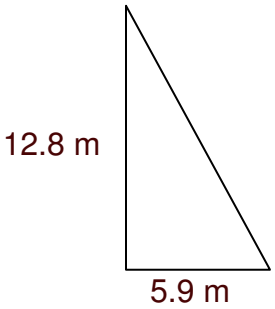
Right Triangle	Length of Leg	Length of Leg	Length of Hypotenuse
1	9	12	
2	16		20
3		15	25
4	18		30
5	9.3	8	
6		4.7	12.5
7	5.1		23.2
8	11.5	6.2	
9		13.9	19.6
10	7.91	14.22	

Find the missing side length in the right triangles drawn below.

11.



12.



Do We Make a Right Triangle?

Name: _____ Date: _____ Block:: _____

For each problem:
1. Cut the strips of paper into the given side lengths.
2. Put the pieces of paper together and create a triangle.
3. Just by looking at it, decide whether or not the given side lengths form a right triangle.
4. Prove whether your answer is correct or not by using the Pythagorean Theorem. Show all your work.

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

1. 2.4 cm, 3.2 cm, 4.0 cm

2. 5.7 cm, 8.5 cm, 10.3 cm

3. 6.3 cm, 8.4 cm, 10.5 cm

4. 9.6 cm, 12.8 cm, 16.0 cm

5. 8.6 cm, 13.5 cm, 16.6 cm

6. 18.9 cm, 22.2 cm, 12.4 cm

7. 13.5 cm, 22.5 cm, 18.0 cm

8. 13.0 cm, 10.4 cm, 7.8 cm

9. 14.7 cm, 22.9 cm, 18.8 cm

10. 23.3 cm, 16.7 cm, 15.8 cm

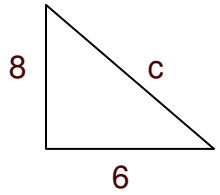
Benchmark 3e Quiz

Name: _____ Date: _____ Block:: _____

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

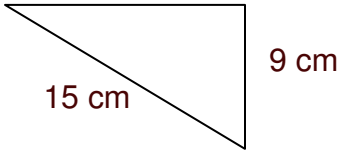
1) What is the length of side c in the right triangle?

a) 2
b) 10
c) 12
d) 14



2) What is the length of the third side in the right triangle below?

a) 9 cm
b) 10 cm
c) 11 cm
d) 12 cm



3) If the lengths of the legs in a right triangle are 15 feet and 20 feet, what is the length of the hypotenuse?

a) 21 feet
b) 23 feet
c) 25 feet
d) 27 feet

4) What is the measure of the hypotenuse in a triangle if the measurements of the legs are 8 and 15?

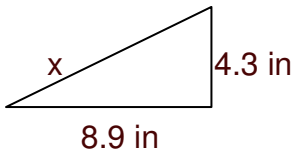
a) $\sqrt{161}$
b) 17
c) 23
d) 120

5) If a right triangle has a leg that is 4.3 yards long and a hypotenuse that is 9.8 yards long, how long is the other leg, rounded to the nearest tenth?

a) 8.8 yards
b) 9.8 yards
c) 10.8 yards
d) 11.8 yards

6) For the figure below, what is the value of x, rounded to the nearest tenth?

a) 9.9 inches
b) 13.2 inches
c) 97.7 inches
d) 174.2 inches

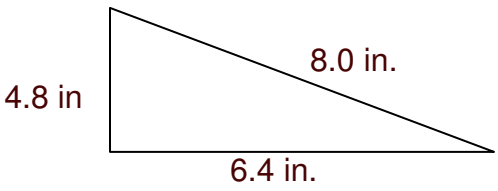


7) If the lengths of the sides of a triangle are 12 inches, 16 inches, and 20 inches, is the triangle a right triangle? Show your work.

8) A triangle has sides that are 8.7 cm, 9.8 cm, and 14.1 cm long. Do the sides form a right triangle? Show your work.

For problems 9 & 10, determine whether the triangles are right triangles. Show your work.

9.



10.