Integrating Literacy Strategies into the Mathematics Classroom

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Integrating Literacy Strategies into the Mathematics Classroom

by

Whitney E. Davis

A thesis submitted to the Department of Education and Human Development of the State University of New York College at Brockport in partial fulfillment of the requirements for the degree of Master of Science in Education May 1, 2013
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Abstract

In mathematics education today, the restructuring and change from the National Council of Teachers of Mathematics (NCTM) standards to the Common Core State Standards (CCSS) have taken center stage. The CCSS focus on creating national standards and seek to better prepare students for college and career after graduating from high school. This curriculum project seeks to align Pythagorean Theorem content with the new CCSS as well as to present literacy strategies that may better prepare students for college or career. The Pythagorean Theorem unit is broken into meaningful lessons that may help students better understand the concepts. It also provides research based literacy strategies that can be implemented into each lesson. This project has been designed to be used as a guide to help middle school mathematics teachers implement the CCSS and provide a framework of literacy strategies to use in their own classroom.
Chapter I – Introduction

Problem Statement

With the implementation of the Common Core Standards, the use of literacy is becoming more widespread. The ability to critically read and write must be emphasized because the new CCSS standardized tests require students to interpret and communicate mathematical concepts effectively. This is because there is a push by the National Government and the CCSS, for students to be more college or career ready (Council of Chief State School Officers & National Governors Association Center for Best Practices, 2010). The CCSS state the need for students to have more literacy instruction within all of their core subjects (National Governors Association Center for Best Practices, Council of Chief State School Officers, 2010). Too often students are leaving high school without the necessary skills. Therefore, implementing literacy into the mathematics classroom is a necessary change that needs to be made by current teachers. As educators, we need to bridge the gap between literacy and mathematics.

Significance of the Problem

There are a plethora of reasons why this project will be useful to mathematics teachers. For example, there has been a recent push for every subject area to use literacy and for students to be college and career ready. This project presents literacy strategies that can be used in the mathematics classroom and provides information on how to implement them to enhance the curriculum.

Purpose

The purpose of this project is to create a unit plan that incorporates the CCSS along with research based literacy strategies. By looking at the concepts critical for understanding in the
unit and aligning literacy strategies with mathematics pedagogical practices, teachers may be able to better prepare students for college and career readiness.

**Rationale**

One of the most important aspects of a person’s life is the education they receive. As a teacher, making that education as valuable as possible includes seeking to prepare students for the challenges of college and career readiness. Students need to develop specific mathematical literacy skills before they leave high school. Mraz, Vacca & Vacca (2010) elude to that fact, “Adolescents entering the adult world in the 21st century will read and write more than at any other time in human history. They will need advanced levels of literacy to perform their jobs, run their households, act as citizens, and conduct their personal lives”. One of the skills that mathematics students need to have is the ability to use information that they find in a text in order to problem solve. For this reason, it is important to teach various literacy strategies in the mathematics classroom.

**Definition of Terms**

For the purpose of this study, the following definitions will be used:

- **Literacy** – “The ability to read and write,” mathematical literacy includes “the ability to read and write with numbers”
- **Key words** – specific words that guide the reader to determine the organizational structure and content focus of the written text
- **Visualization** – the use of mental images derived from the reading of a text to assist in understanding
- **Graphic organizer** – a visual representation of key concepts and related terms
• Common Core State Standards – literacy-based standards to be implemented into the core subject area and created by the Council of Chief State School Officers (CCSSO) and the National Governors Association Center for Best Practices (NGA Center, 2010)
Chapter II – Review of Literature

Introduction

Real world problem solving requires that students be able to use literacy in mathematics. In today’s ever-changing world, the ability to understand, utilize, and communicate mathematical concepts and procedures is essential for success. Within the CCSS there is a push for the use of real world problems and the ability to justify the problem solving process. Educators need to be aware of the importance of the connection between students’ mathematical literacy development and real world problem solving in mathematics. Teachers need to provide instruction and learning experiences for their students necessary for the development of this competency.

The inclusion of reading in mathematics is an essential component of the CCSS. There are many challenges inherent to reading in mathematics because mathematics is a language of its own. The inclusion of literacy instruction in mathematics is imperative when developing curriculum under the CCSS.

Literacy

Literacy is defined by The Merriam-Webster Dictionary as 1) the quality of state of being literate, 2) the ability to read and write, 3) knowledge that relates to a specified subject (Merriam-Webster, 2013).

Literacy in mathematics is described as “numeracy”, meaning “the ability to understand and work with numbers” (Oxford American Dictionary, 2013). Although educators are now using the CCSS, the NCTM process standards are still being implemented. The NCTM communication standard deals with the process to analyze, organize and communicate mathematical thinking coherently and clearly. In order for students to excel in the communication standard they need to have solid numeracy skills.
Reading and Comprehension

Teachers should implement pedagogical strategies that can help their students understand mathematical concepts. The term understanding has a synonym of comprehension (Merriam-Webster Dictionary, 2013). Reading comprehension refers to a student’s mental grasp of written material. “Teachers often have students demonstrate their comprehension of what they’ve read by asking them questions” (Minton, 2007, p. 34).

Minton (2007) presented several strategies that can be used to enhance students reading comprehension. In the table below, Minton compares the literacy strategies to numeracy strategies. These strategies are meant to eventually enable students to be more self-directed and to monitor their own learning.

Table 1

Strategies to Enhance Comprehension

<table>
<thead>
<tr>
<th>Literacy Strategies</th>
<th>Numeracy Strategies</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Making Text-to-Self, Text-to-Text, and Text-to-World Connections</strong> – bringing personal knowledge and life experiences to text</td>
<td><strong>Making Number-to-Self, Number-to-Number, and Number-to-World Connections</strong> – bringing personal knowledge and life experiences to numbers</td>
</tr>
<tr>
<td><strong>Creating Mental Images</strong> – visually assimilating text through the mind’s eye</td>
<td><strong>Creating Mental Images</strong> - visually assimilating problems through the mind’s eye</td>
</tr>
<tr>
<td><strong>Expanding Vocabulary</strong> – understanding (receptive) and using (expressive) new words</td>
<td><strong>Expanding Vocabulary</strong> – understanding (receptive) and using (expressive) mathematical terms</td>
</tr>
<tr>
<td><strong>Asking Questions</strong> – actively thinking about what is read by asking questions and seeking answers in the text (metacognition)</td>
<td><strong>Asking Questions</strong> – making sense of what one is doing by asking questions and seeking answers, and using this to make decisions and solve problems (metacognition)</td>
</tr>
<tr>
<td><strong>Determining Importance</strong> – giving conscious attention to deciding what is important in the text</td>
<td><strong>Determining Importance</strong> – giving conscious attention to deciding what is important in the problem</td>
</tr>
<tr>
<td><strong>Inferring</strong> – creating new meaning on the basis of life experiences and clues from text</td>
<td><strong>Inferring</strong> – creating new meaning on the basis of life experiences and clues from the context of problems</td>
</tr>
<tr>
<td><strong>Synthesizing</strong> – delving deeper into the message of the text by considering how each part contributes to the whole</td>
<td><strong>Synthesizing</strong> – combining ideas or models or strategies in a new way</td>
</tr>
</tbody>
</table>
**Reading Comprehension in Mathematics**

The goal of reading is comprehension of written text. Comprehension is the employment of higher level thinking to infer the meaning of text, consider its implications, and decide on applications (Flick & Lederman, 2002). Mathematics is composed of a wide variety of skills and concepts that are connected by an understanding of numbers. The knowledge of how numbers work is the base of mathematics. Decoding mathematics requires not only reading words but also numbers and symbols. Tall (2004) refers to this as symbolic literacy. The normal reading from left to right may be lost when students read an integer number line. Additionally tables and graphs are not always presented or read in the same manner. Mathematical vocabulary often means something different in mathematics than in everyday language. Students must be able to constantly translate between word symbols and number symbols (Barton & Heidema, 2002).

Several comprehension skills are necessary for a successful reading of mathematic story problems. These include determining the main ideas and details, seeing relationships among the details, making inferences, drawing conclusions, analyzing critically, and following directions (Burns, Roe, & Smith, 2002). The order of story problems may seem odd to students. Facts and details are usually at the beginning of the problem and the topic sentence appears at the end. Mathematics students can no longer use some of the reading strategies that they’ve learned in English class. Barton & Heidema (2002) noted that the complexity of reading mathematics is also increased by its conceptual density and the intricate overlap between mathematics vocabulary and the vocabulary used in “ordinary” English.
Solving Mathematical Word Problems

Students must use several different skills when solving word problems. Reading critically and thinking abstractly are only two of these skills. The use of these skills requires both active and directed thinking. Students must learn to integrate their reading comprehension and computational skills. They cannot be expected to think mathematically unless they can read the material (Blanton, 1991).

Students must understand the problem before attempting to solve it. Minton (2007) noted that mathematics is often referred to as sequential, meaning that students must demonstrate mastery of one idea before they move on to the next. For this to occur, a student must be able to comprehend the words used in the problem. It is impossible to solve a problem without the words making sense first. Once the vocabulary is understood the students can proceed to devise a plan, carry out the plan and obtain a solution.

Specific Reading Strategies

The complexity of mathematical text often presents a number of challenges for students. Mathematics is a “language” of its own. “The reader needs to understand the symbols that represent mathematics concepts just as a reader must understand how letters represent sounds.” (Bach, Bardsley, Gibb-Brown & Kester-Phillips, 2009). Educators need to teach students various reading strategies and how to use them appropriately to analyze the content in mathematical word problems. A student needs to be able to understand the written passage before attempting to solve the problem mathematically (Blanton, 1991).

Key Words

Often words in the English language mean something different in the mathematics classroom. “Key words” are defined as words that are essential to a conceptual understanding of
the lesson (Angotti & Smith, 2012, p. 45). Identifying these words is the first step to successful reading. A student must decode the words in order to continue problem solving. Without this step solving a story problem may get more difficult.

Identifying key words is an important skill to develop in mathematics for comprehension and problem solving. “Some students get lost in the details in the beginning of the mathematics problem and cannot find the main idea. They may also have difficulty sorting out which details are important,” (Bernstein et al., 2008, p. 69). Eliminating unnecessary words in a word problem may allow students to concentrate on the words that will eventually allow them to successfully problem solve. Kresse (1984) states the questions, “Are any of these words specific concepts or difficult vocabulary”. The responses to Kresse’s question will inform the teacher of what terms need to be clearly defined and explained deeper to the students.

Braselton and Decker (1994) stated that students who were taught the strategy of locating key words showed increased performance in correct problem solving. This finding supports the research by Compton, Elleman, Lindo and Morphy (2009) that student achievement increased significantly when vocabulary instruction focused on specific words that were important to what students were learning. Kepner and Smith (1981) state that “mathematics teachers have an obligation to help students acquire proficiency with words, symbols, and expressions” (p. 23). A student who cannot sufficiently decode word problems is at a disadvantage in comprehending and solving problems.

**Visualization**

Visualization, or the use of mental images to assist in understanding, is often the most utilized strategy to develop better comprehension of a written passage. A “dual-coding” theory of information storage was discussed by Paivio (1986). He stated that knowledge is stored in
two forms, both in a linguistic mode and an imagery form. According to Marzano, Pickering, and Pollock (2001), “the more we use both systems of representation-linguistic and nonlinguistic-the better we are able to think about and recall knowledge” (p. 73). Drawing pictures or pictographs is an example of nonlinguistic representation. By developing visual images it allows students to further develop their own knowledge base. Students understanding of problems may be enhanced through visualization.

According to Harvey and Goudvis (2000), “When we visualize, we are in fact inferring, but with mental images rather than words and thoughts. Visualizing and inferring are strategies that enhance understanding…” (p. 114). Visualization assists in the organizing of ideas, creating categories and clarification of connections. Visual imagery is a strategy that has the potential for assisting students in comprehension (Hodes, 1992).

**Graphic Organizers**

A graphic organizer is a visual representation of key concepts and related terms. Braselton and Decker (1994) share a five step graphic organizer strategy. First, a student must restate the question in their own words, and then a student must decide what is necessary information for solving the problem. After those steps the student should plan the mathematical calculations that are going to occur. The fourth step the student carries out the calculations. The final step, the student should go back and check their answer using the restate question from step one.

Graphic organizers may help develop the understanding of concepts by engaging students in their use and by placing an emphasis on a greater comprehension of the words used in the problem. The organizer serves as retrieval cues for information and makes possible the transition to a higher level of thinking (Monroe, 1997).
The problem-solving process is illustrated through visual organization when represented graphically. “This serves to reduce a learner’s cognitive processing load and make available mental resources for engaging in problem analysis and solution” (Jitendra, 2002, p. 34). As an educational strategy, it is an effective tool for thinking, note taking, and learning. The graphic organizer helps students make connections, explain relationships, and elaborate on what they have learned (Barton & Heidema, 2002).

**Conclusion**

Students often cannot solve word problems because they cannot comprehend them. Students have to read the problem, decode it and identify important information. After that students need to make a plan and then solve and check the problem.

Students want to be successful, but they need to be given tools to succeed. Thus teachers should seek to give students various strategies to use and then students must personalize learning strategies. Different students rely on different strategies to help them develop their own understanding. The various techniques that students may use most likely overlap and interact since students will utilize more than one strategy to gain understanding.

In this project, the author taught the reading comprehension skills of identification and comprehension of key words, visualization of problems, and the use of graphic organizers. Students could use one or all of these skills throughout the unit and a test was administered at the end to determine if the strategies helped the students. Formal assessment was a test at the end of the unit to determine if the strategies taught increased student performances.
Chapter III – Application

Project Description

The Curriculum Project is appropriate to use when teaching about the Pythagorean Theorem. The unit was created to concentrate on literacy the mathematics classroom and to teach the Pythagorean Theorem standards. Throughout the unit literacy strategies were incorporated into the instruction of the Pythagorean Theorem. The specific strategies used included the identification and comprehension of key words, visualization of problems, and the use of graphic organizers. This unit is aligned with the CCSS. The specific standards are listed below:


8.G.7. Apply the Pythagorean Theorem to determine unknown side lengths in right triangles in real-world and mathematical problems in two and three dimensions.

8.G.8. Apply the Pythagorean Theorem to find the distance between two points in a coordinate system.

Timeline for Pythagorean Theorem Unit

Day 1 – Reading of “What’s Your Angle, Pythagoras? A Math Adventure”

Day 2 – Puzzle proofs of Pythagorean Theorem

Day 3 – Developing Pythagorean Theorem

Day 4 – Finding the Hypotenuse of a Right Triangle

Day 5 – Find missing legs of a Right Triangle

Day 6 & 7 – Converse of Pythagorean Theorem: Is it Right?

Day 8 – Quiz
Day 9 – Right Triangle word problems

Day 10 – Right Triangle word problems

Day 11 – Distance on the Coordinate Plane

Day 12 – Real World link of distance on the coordinate plane

Day 13 – Review

Day 14 – Review

Day 15 – Unit Test

**Vocabulary for Word Wall**

Triangle – A polygon having three sides

Right Triangle - *A triangle where one of its interior angles is a right angle (90°)*

Theorem - *A statement or conjecture that has been proven and can be used as a reason to justify statements in other proofs.*

Pythagorean Theorem - *In a right triangle, the square of the hypotenuse is equal to the sum of the squares of the other two sides (legs).*

Vertices – *Corner/point of the triangle. The intersection of two or more line segments.*

Hypotenuse - *The longest side of a right triangle. The side opposite the right angle.*

Leg(s) – *The two shorter sides of a right triangle that forms the right angle.*

Pythagorean Triple - *A right triangle where the sides are in the ratio of integers.*
Day 1 Lesson – Reading of “What’s Your Angle, Pythagoras? A Math Adventure” by Julie Ellis

Objectives:

Students will be able to:

- Answer questions about the book while the teacher reads
- Have a brief understanding about the Pythagorean Theorem and why it is important

Common Core Standard:


Materials needed:

- Book “What’s Your Angle, Pythagoras? A Math Adventure”, worksheet

Outline of Activities:

1. Read “What’s Your Angle Pythagoras? A Math Adventure” to the class. While reading the book the students should be filling in the worksheet.

2. Once the reading is done, go over the questions and have a class discussion on where in the real world you could use the Pythagorean Theorem. What jobs would use it?
Pythagorean Theorem

Complete the following questions as your teacher reads What’s Your Angle, Pythagoras? by Julie Ellis.

- Pythagoras’ father transported _____________ to Crete.

- Nef, the builder, showed Pythagoras a rope in which he had made a triangle. He called the triangle a ________________ triangle because it helped him make a square corner which was exactly the right angle for cutting stone.

- Pythagoras found a rope and tied knots in it and pulled the rope into different triangles until he made a triangle that seemed right. It had _____ lengths on one side, _____ lengths on another side, and ______ lengths on the longest side.

- Pythagoras got in trouble when he used the tiles to make squares along each side of a statue base. It took ______ tiles to make a square along the side that was 3 tiles long, ______ tiles to make a square along the side that was 4 tiles long, and ______ tiles to make a square along the side that was 5 tiles long.

- Pythagoras used his right triangle pattern ________(Pythagorean Theorem) to figure out the distance from his house to Crete.

In the space below, draw a diagram depicting the way you think Pythagoras placed the tiles around the statue base as described in the story.
Day 2 Lesson – Puzzle Proofs of the Pythagorean Theorem

Objectives:

Students will be able to:

- State that the area of squares built on the legs of a right triangle is equal to the area of the square built on the hypotenuse.
- Conjecture that the same relationship applies to all right triangles.

Common Core Standard:


Materials needed:

- Scissors, glue sticks, copies of Pythagorean Theorem worksheets puzzle proof one, puzzle proof two and puzzle pieces, transparency of proof puzzle one, right triangle tray and green and blue tiles

Outline of Activities:

1. Review right triangles. Students should define right angle and find examples in the classroom.
2. Students should begin puzzle proof one. Their task is to tile over the largest square off the hypotenuse with pieces from the two other squares off of the legs of the triangle and look for the relationships between the areas of the squares. Read through the directions with the students. Have them cut out the pieces and tile over the largest square. There may be students who can work ahead and begin puzzle 2 on their own. Demonstrate the solution to the puzzle using the transparency.
3. Students should begin puzzle two. Their task is to cover the largest square with pieces of the smaller squares and look for the relationships between the areas of the squares. Read
through the directions with the students. Have them cut out the pieces. They should tile
over the two small squares and then use the same pieces to cover the largest square.
Students who finish the puzzle proofs quickly and identify the relationship can begin
work on an alternate activity. Demonstrate the solution to the puzzle proof using the right
triangle tray and green and blue tiles.

4. Class discussion. Can the pieces of the two smaller squares be used to cover the larger
square? Invite students to form conjectures about whether they think this will work for all
right triangles. We did two proofs of the Pythagorean Theorem, point out that there are
many different proofs including one by President Garfield.
1. Cut out pieces 1, 2, 3, 4, and 5.

2. Tile over the smaller squares with pieces. Piece 1 covers the smallest square, pieces 2, 3, 4, 5 cover the medium square.

3. Tile over the largest square with the pieces from the smaller two squares (pieces 1, 2, 3, 4, and 5). Glue the pieces down.

1. What kind of triangle was formed by the squares? ______________

2. Can you cover the larger square with the smaller squares? _______
1. Cut out pieces 6, 7, 8, 9, 10, 11 and 12.

2. Tile over the smaller squares with pieces. Pieces 6, 7, 8 cover the smallest square, pieces 9, 10, 11 and 12 cover the medium square.

3. Tile over the largest square with the pieces from the smaller two squares (pieces 6, 7, 8, 9, 10, 11 and 12). Glue the pieces down.

1. What kind of triangle is created by the squares? ______________
2. Can you cover the largest square with pieces from the smaller square? ____
Day 3 Lesson: Developing Pythagorean Theorem

**Objectives:**

Students will be able to:

- Identify the legs and hypotenuse of a right triangle
- State the Pythagorean Theorem

**Materials:**

- Copies of notes, transparency of notes, Right triangle tray and green and blue tiles

**Outline of Activities:**

1. Review right triangles and the area of a square. Draw a right triangle on the board and use it to introduce right triangle vocabulary. Ask students what kind of triangle it is? Where is the right angle? The hypotenuse is across from the right angle, also the longest side. The other sides of a right triangle are called the legs. Draw a square with side s on the board. Students should be able to identify the area.

2. Develop the Pythagorean Theorem formally. Ask a student to remind the class of the activity we did yesterday. What does this tell us about the area of the squares off of the sides of the triangle? The area of the small square off of the short side of the triangle + the area of the medium square = the area of the large square. Using the right angle tray, green and blue tiles follow the directions for proving the Pythagorean Theorem. Emphasize that the hypotenuse is always opposite of the hypotenuse.
Day 3 notes

**Draw a right triangle:**

1. _________: Corner/point of the triangle
   a. You must label the vertices with _________ _________.
   b. In a right triangle we generally use ___, ___, ___.
   c. ___ is always at the right angle.

2. The sides of a right triangle have special names.
   a. _________: the ___ sides of a right triangle that ______ the right angle. They are ____________ to each other.
   b. ____________: (Hi-pot-en-oose) the __________ side of a right triangle; it is __________ the right angle.

3. The sides get labeled with the _________ _________ as the _________ it is opposite from. But with a _________ _________ _________.
   a. (We use this because it is a variable, which represents a number, and the sides of a triangle have lengths.)

4. You can name a side with its _________ _________ name or with the 2 _________ it _________.
Label the vertices, legs and the hypotenuse of each triangle.

1. Legs: _______________________
   Hypotenuse: _________________

2. Legs: _______________________
   Hypotenuse: _________________

3. Legs: _______________________
   Hypotenuse: _________________
From the activity:
The two squares constructed by the legs of the right triangle can be cut apart and used to fill the square built on the hypotenuse of the right triangle. What does this tell us about the area of the squares?

Count the blocks in the small and medium squares. What should the area of the largest square be?

The area of the smallest square is __ or $3^2$. The area of the medium square is __ or $4^2$. The area of the largest square is __ or $5^2$. __________ or __________.

Pythagorean Theorem: the legs of a right triangle have the lengths $a$ and $b$ and the hypotenuse has a length of $c$. Remember that the area of a square = side x side or $s^2$. Then the areas of the squares built on the sides are $a^2$, $b^2$, and $c^2$.

So ________________
Day 4 Lesson: Finding the Hypotenuse of a Right Triangle

Objectives:

Students will be able to:

- State the Pythagorean Theorem
- Use a calculator to estimate a square root
- Use the Pythagorean Theorem to find the hypotenuse of a right triangle

Common Core Standard:

- 8.G.7. Apply the Pythagorean Theorem to determine unknown side lengths in right triangles

Materials needed:

- Copies of notes, transparency of notes, calculator, homework

Outline of Activities:

1. Review parts of a right triangle and ask the students to point out which side are the legs and which side is the hypotenuse. Have students put the vocabulary terms (triangle, right triangle, theorem, Pythagorean Theorem, vertices, hypotenuse, and leg(s)) on the word wall. Review what each of them means as they are placed on the wall.

2. Review how to find a square root using a calculator. Have students fill in the boxes with key strokes. Press the 2nd key, then $x^2$, and be sure to close the parentheses.

3. List the steps in finding hypotenuse of right triangle.

4. Practice finding hypotenuse. Be sure to stress students showing every step.
Name: _______________________________________

Day 4 notes – Finding Hypotenuse using Pythagorean Theorem

Pythagorean Theorem: The sum of the square of the legs is equal to the square of the hypotenuse.

Review – How to find a square root on the calculator.

Record the key strokes for finding the square root of 18 below.

Using your calculator to find the following (round to the nearest tenth):

\[ \sqrt{5} = \quad \sqrt{12} = \quad \sqrt{22} = \quad \sqrt{154} = \quad \sqrt{41} = \]

If asked to find c:
1. __________________________________________________________________
2. __________________________________________________________________
3. __________________________________________________________________
4. __________________________________________________________________

Practice:

1. 

\[ \begin{array}{c}
3 \\
4 \\
c
\end{array} \]
2. Find the missing side to the nearest tenth.
   \[a = 3 \quad b = 8 \quad c = ?\]

4. Find the missing side to the nearest hundredth

   \[c \quad 20m\]
   \[33.5m\]
Directions: Find the missing side of each right triangle. Make sure you show your work. Round to the nearest tenth if need be.

1. \[ \sqrt{20^2 + 21^2} \]

2. \[ \sqrt{9^2 + 40^2} \]

3. \[ \sqrt{3^2 + 1^2} \]

Directions: Answer each question in complete sentences.

4. What is the relationship among the legs and the hypotenuse of a right triangle?

   ________________________________________________________________
   ________________________________________________________________
   ________________________________________________________________

5. Explain to a classmate why you can use any two sides of a right triangle to find the third side.

   ________________________________________________________________
   ________________________________________________________________
   ________________________________________________________________
Day 5 Lesson - Find missing legs of a Right Triangle

Objectives:

Students will be able to:

- State the Pythagorean Theorem
- Use the Pythagorean Theorem to find the lengths of the sides of right triangles

Common Core Standard:
- 8.G.7. Apply the Pythagorean Theorem to determine unknown side lengths in right triangles

Materials needed:

- copies of notes, transparency of notes, calculator, homework

Outline of Activities:

1. Go over homework problems.

2. Review vocabulary that we’ve use thus far using word wall. Review parts of a right triangle and ask the students to point out which side are the legs and which side is the hypotenuse.

3. List the steps in finding the legs using the Pythagorean Theorem.

4. Practice finding the legs. Be sure to stress students showing every step.
Name: ___________________________________________

Day 5 notes – Finding missing legs of a Right Triangle

**Pythagorean Theorem**

If a leg is missing:
1. __________________________________________________________________
2. ___________________________________________________________________
3. ___________________________________________________________________
4. ___________________________________________________________________

Practice:

1.  
   
   16 in

   ![Diagram of a right triangle with sides 16 in and 34 in]

   a

   34in

2.  
   
   61 m

   ![Diagram of a right triangle with sides 60 m and 61 m]

   b

   60 m
Directions: For each problem, use the Pythagorean Theorem to solve for the missing side. Round to the nearest tenth when necessary.

1. \[ a \]
2. \[ b \]

3. \[ b \]

4. \[ b = 99 \text{ mm}, c = 101 \text{ mm}, \text{ Find } a. \]
Day 6 & 7 Lesson: Converse of Pythagorean Theorem: Is it Right?

Objectives:

Students will be able to:

- Identify the legs and hypotenuse of a right triangle
- State the Pythagorean Theorem
- Use the Pythagorean Theorem to determine if a triangle is a right triangle

Common Core Standard:


Materials Needed:

- Calculator, string, tape, notes, homework

Outline of Activities:

1. Go over the homework problems. Use this as an opportunity to review how to use the Pythagorean Theorem to find missing side lengths.

2. Review right triangle vocabulary and the formula for the Pythagorean Theorem. Ask students, if the side lengths of a triangle do not reflect the Pythagorean Theorem, does this mean that the triangle is not a right triangle?

3. Students should begin ancient Egyptian surveying activity. It may be necessary to demonstrate how to divide the string into twelve equal sections. Fold string in half, fold haves in half, divide quarters into thirds by trial and error. Have a student demonstrate the solution on the overhead. Ask students again, if the side lengths of a triangle do not reflect the Pythagorean Theorem, does this mean that the triangle is not a right triangle?

4. Demonstrate using the Pythagorean Theorem to identify a non-right triangle.
5. Write the following side lengths on the board and have students determine whether or not the triangles are right triangles. Which of these triangles are right triangles, 12, 16, 20 (right triangle), 8, 15, 17 (right triangle), 12, 9, 16 (not a right triangle), 4, 7, 8 (not a right triangle), 9, 8, 12 (not a right triangle), 20, 21, 29 (right triangle)? Use this as an opportunity to work with students who are having difficulties.

6. While going over the examples on the board point out that the lengths that form a right triangle are considered Pythagorean Triples.
Activity: Ancient Egyptian Surveying

The Nile River flooded annually destroying property boundaries in ancient Egypt. The ancient Egyptians used the Pythagorean Theorem to make a land surveying tool which they used to reestablish boundaries.

1. Use a pen or marker to divide your string into 12 equal segments. Tape the ends of the string together to form a loop.

2. Try to form a right triangle with the side lengths that are whole numbers. If you are having difficulty, ask someone to help you hold your string. Use the corner of a sheet of paper to measure your angle.

What are the side lengths of the triangle you formed?

____________________________________________________________________________

Do these side lengths reflect the Pythagorean Theorem?

____________________________________________________________________________
Name: ______________________________________________________________

Day 6 & 7 notes - Converse of Pythagorean Theorem: Is it Right?

Pythagorean Theorem: In a right triangle, the sum of the squares of the lengths on the legs is equal to the square of the length of the hypotenuse.

Converse of Pythagorean Theorem: _________________________________

_____________________________________________________________________

If given 3 numbers for possible sides:
1. ________________________________________
2. ________________________________________
3. ________________________________________

Practice:
Determine whether the numbers given make a right triangle:

1. 7, 25, 20             2. 5, 15, 30             3.

4.                                5.                                6.

7.                                8.                                
Name: _______________________________________  Day 6& 7 HW

Directions: Determine whether each triangle with sides of given lengths is a right triangle. Justify your answer.

1. 5 in, 10 in, 12 in  
2. 9 mm, 40 mm, 41 mm

3. 28 yd, 195 yd, 197 yd  
4. 30 cm, 122 cm, 125 cm

5. Fill in the missing blanks to complete the graphic organizer of some Pythagorean Triples

<table>
<thead>
<tr>
<th>Pythagorean Triples</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
</tr>
<tr>
<td>6</td>
</tr>
<tr>
<td>9</td>
</tr>
<tr>
<td>5</td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>
Day 8 Quiz

Objectives:
Students will be able to:

- State the Pythagorean Theorem
- Use the Pythagorean Theorem to find missing lengths of a right triangle
- Determine if given lengths form a right triangle.

Common Core Standards:

- 8.G.7. Apply the Pythagorean Theorem to determine unknown side lengths in right triangles in real-world and mathematical problems in two and three dimensions.

Materials Needed:

- Calculator, Quiz

Outline of Activities:

1. Review as a class the Pythagorean Theorem and its converse. Do two examples on board of each type of solving (missing hypotenuse, missing leg).
2. Quiz *Note: Students with testing accommodations will be sent to their testing locations.
Directions: Read every question carefully. Show work when appropriate. Round to the nearest tenth when necessary.

1. What is the Pythagorean Theorem and who developed the theorem?

2. Calculate the length of the diagonal of the state of Wyoming.

3. Calculate the length of the diagonal of the state of Wyoming.
5. Determine whether each triangle is a right triangle. Justify your answer.

a) 56 ft, 65 ft, 16 ft  
b) 5 in, 12 in, 13 in
Day 9 Lesson – Right Triangle word problems

Objectives:

Students will be able to:

- Use literacy strategies (key words, visualization, and graphic organizers) to solve Right Triangle word problems

Common Core Standard:

- 8.G.7 Apply the Pythagorean Theorem to determine unknown side lengths in right triangles in real-world and mathematical problems.

Materials needed:

- Highlighters, graphic organizers, word problem note sheet, homework

Outline of Activities:

1. Review right triangles. Students should be able to state what sides are the legs and what side is the hypotenuse.

2. Students will be lead through guided notes using the different literacy strategies.

   - Highlighting key words
   - Drawing a picture if not provided with one
   - Using a graphic organizer

3. Students will use think-pair-share for the remainder of the problems.
1. A ladder is placed 5 feet from the foot of a wall. The top of the ladder reaches a point 12 feet above the ground. Find the length of the ladder.

2. Suppose a ladder 20 feet long is placed against a vertical wall 20 feet high. How far would the top of the ladder move down the wall by pulling out the bottom of the ladder 5 feet? Explain your reasoning.

3. A door frame is 80 inches tall and 36 inches wide. What is the length of a diagonal of the door frame? Round to the nearest tenth of an inch

4. Isaac’s television is 25 inches wide and 18 inches high. What is the diagonal size of Isaac’s television? Round to the nearest tenth if necessary.
1. A pool table is 8 feet long and 4 feet wide. How far is it from one corner pocket to the diagonally opposite corner pocket? Round to the nearest tenth.

2. Quadrilateral STUV is a softball “diamond” (or, square). If ST = TU = 60 ft, what is SU, the distance from home to second base? Round to nearest tenth of a foot.

3. A ladder 39 feet long leans against a building and reaches the ledge of a window. If the foot of the ladder is 15 feet from the foot of the building, how high is the window ledge above the ground?
Directions: Come up with a word problem in which you need to use the Pythagorean Theorem to solve it. Then solve your word problem.
Day 10 Lesson – Right Triangle Word problems

Objectives:

Students will be able to:

- Use literacy strategies (key words, visualization) to solve Right Triangle word problems

Common Core Standard:

- 8.G.7 Apply the Pythagorean Theorem to determine unknown side lengths in right triangles in real-world and mathematical problems.

Materials needed:

- Highlighters, graphic organizers, word problem note sheet

Outline of Activities:

1. Go over homework problems.
2. Review right triangles. Students should be able to state what sides are the legs and what side is the hypotenuse.
3. Students will be lead through guided notes using the different literacy strategies.
   - Highlighting key words
   - Drawing a picture if not provided with one
4. Students will use think-pair-share for the remainder of the problems.
1. Miss Davis traveled 24 kilometers north and then 10 kilometers east. How far was she from her starting point?

2. Tara drives due north for 22 miles then east for 11 miles. How far is Tara from her starting point? Round to the nearest tenth if necessary.

3. Troy drove 8 miles due east and then 5 miles due north. How far is Troy from his starting point? Round the answer to the nearest tenth of a mile.
1. Solve each other’s word problems from Day 8 HW.

2. Tina measures the distances between three cities on a map. The distances between the three cities are 45 miles, 56 miles, and 72 miles. Do the positions of the three cities form a right triangle?

3. One day, Ronnie walked from his home at A to his school at C by walking along AB (50 yd) and BC (120 yd), the sides of a rectangular open field that was muddy. When he returned home, the field was dry and Ronnie decided to take a short cut by walking diagonally across the field along AC. How much shorter was the trip home than the trip to school.
Day 11 Lesson – Distance on the Coordinate Plane

Objectives:

Students will be able to:

- Know two different ways to solve for a leg or hypotenuse on the coordinate plane.
  - Pythagorean Theorem \(a^2 + b^2 = c^2\)
  - Distance formula \(\sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}\)
- Use literacy strategies (key words, visualization, and graphic organizers) to solve right triangle word problems

Common Core Standard:

- 8.G.8. Apply the Pythagorean Theorem to find the distance between two points in a coordinate system.

Materials needed:

- Highlighters, graph paper, note sheet, calculator

Outline of Activities:

1. Review vocabulary learned using word wall.
2. Introduce the distance formula.
3. Students will use the distance formula and Pythagorean Theorem to determine distances between points in several examples.
Did you know…?

That the distance formula is based on the Pythagorean Theorem!!
Here’s how:

Ex. What is the distance between the two points? (Use the distance formula)
a. (1, 3) (-2, 4)  
b. (3, 0), (7, -5)

Ex. On the map, each unit represents 45 miles. West Point, New York, is located at (1.5, 2) and Annapolis, Maryland, is located at (-1.5, -1.5). What is the approximate distance between West Point and Annapolis?

<table>
<thead>
<tr>
<th>Method 1 (Pythagorean Theorem)</th>
<th>Method 2 (Distance Formula)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

51
Ex. Cromwell Field is located at (2.5, 3.5) and Dedeaux Field at (1.5, 4.5) on a map. If each map unit is 0.1 mile, about how far apart are the fields? Plot the coordinates on the grid, and then find the distance.
Day 12 Lesson – Real World link of distance on the coordinate plane

**Objectives:**

Students will be able to:

- Know how to compute the distance between two points using the distance formula: 
  \[ \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2} \]

**Common Core Standard:**

- 8.G.8. Apply the Pythagorean Theorem to find the distance between two points in a coordinate system.

**Materials needed:**

- Highlighters, note sheet, calculator

**Outline of Activities:**

1. Review distance formula and how to use it.

2. Students will use the distance formula to complete the activity linked to being a travel agent.
Travel Agent

Do you love to travel? Would you be interested in helping others plan their ideal vacation getaways? You should consider a career in travel and tourism. Travel agents offer advice on destination locations and make arrangements for transportation, lodging, car rentals, and tours for their clients. In addition to having personal travel experience and being knowledgeable about popular vacation destinations, travel agents also need to be detail-oriented and have excellent communication, math, and computer skills.

Time to get away!
Use the map to solve each problem. Round to the nearest tenth if necessary.

1. What is the approximate distance between Key Largo and Islamorada?

2. Draw and label a right triangle to find the distance between Plantation Key and Islamorada. Then find the approximate distance.

3. Describe the ordered pairs that represent Layton and Plantation Key. Then find the approximate distance between Layton and Plantation Key.
4. To the nearest 0.5 unit, name the ordered pairs that represent Key West and Cudjoe Key. Then use the ordered pairs to estimate the distance between the keys.

5. What is the approximate distance between Key West and Layton?

6. What is the approximate distance between Tavernier and Big Pine Key?
Day 13 Lesson – Review

**Objectives:**

Students will be able to:

- Use the Pythagorean Theorem to find the hypotenuse of a right triangle
- Use the Pythagorean Theorem to find a leg of a right triangle.

**Common Core Standard:**


**Materials needed:**

- Highlighters, calculator, copies of word problems for stations

**Outline of Activities:**

1. Review Pythagorean Theorem

2. Students will go to six stations as pre assigned groups. At these stations the groups will read the word problems, use the literacy strategies we’ve covered and solve the problems.
Station 1 Word Problem: Derek Jeter is on second base. He is wondering what the distance is between 2nd base and home plate. If 1st base forms a 90° angle with the base lines, and the base lines are each 90 feet long, what is the distance from 2nd base to home plate? *Use the red line* (Picture included at station)

Station 2 Word Problem: Serena Williams is playing a singles game against her sister Venus. Serena is serving from the top right corner of the singles box. She wants to make her ball land right inside the serving box on the other side of the court. What is the distance her ball traveled? *Use the green line* (Picture included at station)

Station 3 Word Problem: Serena Williams and her sister, Venus are playing a doubles game against Canada. Venus is serving from the bottom right corner of the doubles box. She wants her ball to land right inside the serving box on the other side of the court. What is the distance her ball traveled? *Use the red line* (Picture included at station)

Station 4 Word Problem: Michael Jordan is doing sprints from one corner of the court to the other. He wants to make his workout harder so he decides to run diagonally across the court. Jordan sprints from the bottom right of the court to the top left. Is the distance of his new sprints longer? *Use the yellow line* (Picture included at station)

Station 5 Word Problem: The kicker of the Buffalo Bills, Rian Lindell, wants to kick the ball from the corner of the field goal line (bottom right) to the top left corner of the opponent’s side. How far does Rian have to punt to the ball? *Use the blue line* (Picture included at station)

Station 6 Word Problem: Fitzpatrick missed a few practices and Chan Gailey is mad. He decides to punish Fitzpatrick by making him run continuous sprints diagonally across the entire field. How far does Fitzpatrick have to run? If he has to do 10 sprints, how far did Fitzpatrick run? *Use the yellow line* (Picture included at station)
Day 14 Lesson – Review

Objectives:

Students will be able to:

- Identify the legs and hypotenuse of a right triangle
- State the Pythagorean Theorem
- Use the Pythagorean Theorem to find the hypotenuse of a right triangle
- Use the Pythagorean Theorem to find the lengths of the sides of right triangles
- Use the Pythagorean Theorem to determine if a triangle is a right triangle
- Use literacy strategies (key words, visualization, and graphic organizers) to solve Right Triangle word problems
- Use two different ways to solve for a leg or hypotenuse on the coordinate plane.
  - Pythagorean Theorem \(a^2 + b^2 = c^2\)
  - Distance formula \(\sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}\)

Common Core Standards:

- 8.G.8. Apply the Pythagorean Theorem to find the distance between two points in a coordinate system.

Materials needed:

- Practice Test, calculators
Outline of Activities:

1. Students will work on the practice test individually for half the class so they may ask the teacher questions. For the second half of class, students will work together in pairs on the remainder of the practice test.
Directions: Fill in the blank with a vocabulary term that best fits the definition. Word Blank: Leg(s), Vertices, Right Triangle, Hypotenuse, Triangle, Theory, Pythagorean Triple, Pythagorean Theorem.

A _______________ polygon having three sides.

A __________________________ where one of its interior angles is a right angle (90°)

A ___________ is a statement or conjecture that has been proven and can be used as a reason to justify statements in other proofs.

The ______________ describes the relationship between the lengths of the legs and the hypotenuse of any right triangle.

A _______________ is the corner/point of the triangle. The intersection of two or more line segments.

The ________________________ is the longest side of a right triangle, the side opposite the right angle.

The _______________ are two shorter sides of a right triangle that forms the right angle.

________________________ are when the sides of a right triangle are in the ratio of integers.

Directions: Label the vertices and sides of the right triangle. Name the legs and hypotenuse.

Legs: ______________________

Hypotenuse: _______________
**Directions:** Find the missing side, to the nearest tenth.

1. \[ \begin{array}{c}
    c \\
    4 \\
    3 \\
  \end{array} \]

2. \[ \begin{array}{c}
    b \\
    9.4 \text{ yd} \\
    4.5 \text{ yd} \\
  \end{array} \]

3. \[ \begin{array}{c}
    34 \text{ in} \\
    16 \text{ in} \\
    a \\
  \end{array} \]

4. \[ \begin{array}{c}
    12 \\
    9 \\
    c \\
  \end{array} \]

5. Explain in words how you would determine if three lengths make a right triangle.

6. Do the following three lengths make a right triangle? [Show your work!]
   5, 9, 13
7. A baseball diamond is a square with sides of 90 feet. What is the shortest distance, to the nearest tenth of a foot, between first base and third base? DRAW A PICTURE. (5 points)

8. A ladder 40 feet long leans against a building and reaches the ledge of a window. If the foot of the ladder is 20 feet from the foot of the building, how high is the window ledge above the ground? DRAW A PICTURE. (5 points)

9. Isaac’s television is 25 inches wide and 18 inches high. What is the diagonal size of Isaac’s television? Round to the nearest tenth if necessary.

10. Troy drove 8 miles due east and then 5 miles due north. How far is Troy from his starting point? Round the answer to the nearest tenth of a mile.
11. Plot the points on the coordinate plane provided and then determine the distance between the two points with the Pythagorean Theorem AND the distance formula.

\((1, 3) (-2, 4)\)
Day 15 Lesson – Unit Test

Objectives:

Students will be able to:

- Identify the legs and hypotenuse of a right triangle
- State the Pythagorean Theorem
- Use the Pythagorean Theorem to find the hypotenuse of a right triangle
- Use the Pythagorean Theorem to find the lengths of the sides of right triangles
- Use the Pythagorean Theorem to determine if a triangle is a right triangle
- Use literacy strategies (key words, visualization, and graphic organizers) to solve Right Triangle word problems
- Use two different ways to solve for a leg or hypotenuse on the coordinate plane.
  - Pythagorean Theorem \( a^2 + b^2 = c^2 \)
  - Distance formula \( \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2} \)

Common Core Standards:

- 8.G.8. Apply the Pythagorean Theorem to find the distance between two points in a coordinate system.

Materials needed:

- Unit Test, calculators
Outline of Activities:

1. Ask if students have any questions and go over any that they have.

2. Students will complete the Unit Test. **Note: Students with testing accommodations will be sent to their testing locations.
Directions: Draw a line connecting the vocabulary term with the definition.

A polygon having three sides

A triangle where one of its interior angles is a right angle (90°)

A statement or conjecture that has been proven and can be used as a reason to justify statements in other proofs.

In a right triangle, the square of the hypotenuse is equal to the sum of the squares of the other two sides (legs).

Corner/point of the triangle. The intersection of two or more line segments.

The longest side of a right triangle, the side opposite the right angle.

The two shorter sides of a right triangle that forms the right angle.

A right triangle where the sides are in the ratio of integers.

Directions: Label the vertices and sides of the right triangle. Name the legs and hypotenuse.

Legs: _____________________

Hypotenuse: _____________
**Directions:** Find the missing side, to the nearest tenth.

1. [Diagram of a right triangle with sides 24, 8, and 3.]
2. [Diagram of a right triangle with sides 5, 12, and unknown c.]
3. [Diagram of a right triangle with sides 60 yd, 51 yd, and unknown a.]
4. [Diagram of a right triangle with sides 12 and 9, and unknown c.]

5. Explain to a classmate why you can use any two sides of a right triangle to find the third side.

______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________

6. Do the following three lengths make a right triangle? [Show your work!]
   a) 28, 195, 197
   b) 30, 122, 125
7. A door frame is 80 inches tall and 36 inches wide. What is the length of a diagonal of the door frame? Round to the nearest tenth of an inch

8. A ladder 39 feet long leans against a building and reaches the ledge of a window. If the foot of the ladder is 15 feet from the foot of the building, how high is the window ledge above the ground?

9. A pool table is 8 feet long and 4 feet wide. How far is it from one corner pocket to the diagonally opposite corner pocket? Round to the nearest tenth.

10. Tara drives due north for 22 miles then east for 11 miles. How far is Tara from her starting point? Round to the nearest tenth if necessary.
11. Miss Davis traveled 24 kilometers north and then 10 kilometers east. How far was she from her starting point?

12. Plot the points on the coordinate plane provided and then determine the distance between the two points with the Pythagorean Theorem AND the distance formula.

(1.5, 2) (-1.5, -1.5)
Chapter IV – Conclusions and Recommendations

Upon completion of the project *Integrating Literacy Strategies into the Mathematics Classroom*, it is clear that there are many applications for literacy in mathematics as well as some limitations. The strategies presented that include picking out and decoding key words, visualizations and graphic organizers can help to enhance instruction of word problems. The strategies can be used to implement the CCSS into the mathematics curriculum in order to make students more college and career ready.

The project presented a number of ways that these strategies can be implemented into the content. The limitations of the project include but are not limited to the number of ways the strategies can be implemented. There could be many other ways that educators can implement these and other strategies into their curriculum to meet the new CCSS.

The goal of this project was not to say that these are the only literacy strategies that can be used in the mathematics classroom but more of a blue print for mathematics teachers. Some future research that could be done to enhance the usage of literacy strategies in the mathematics classroom include: Do students from diverse demographic populations respond differently to various literacy strategies? Is the effectiveness of specific literacy strategies dependent on the reading level of the students?
References


Hodes, C. (1992). The effectiveness of mental imagery and visual illustrations:


Appendix A: Day 1 key

Pythagorean Theorem

Complete the following questions as your teacher reads What’s Your Angle, Pythagoras? by Julie Ellis.

- Pythagoras’ father transported tiles to Crete.

- Nef, the builder, showed Pythagoras a rope in which he had made a triangle. He called the triangle a right triangle because it helped him make a square corner which was exactly the right angle for cutting stone.

- Pythagoras found a rope and tied knots in it and pulled the rope into different triangles until he made a triangle that seemed right. It had 3 lengths on one side, 4 lengths on another side, and 5 lengths on the longest side.

- Pythagoras got in trouble when he used the tiles to make squares along each side of a statue base. It took 9 tiles to make a square along the side that was 3 tiles long, 16 tiles to make a square along the side that was 4 tiles long, and 25 tiles to make a square along the side that was 5 tiles long.

- Pythagoras used his right triangle pattern $a^2 + b^2 = c^2$ (Pythagorean Theorem) to figure out the distance from his house to Crete.

In the space below, draw a diagram depicting the way you think Pythagoras placed the tiles around the statue base as described in the story.
Appendix B: Puzzle Pieces

Pieces from Puzzle Proof #1

Pieces of Puzzle Proof #2
Appendix C: Day 3 key

Name: _________________________________________

Day 3 notes

Draw a right triangle:

* Vertices: Corner/point of the triangle
  - You must label the vertices with **upper case letters**.
  - In a right triangle we generally use **A, B, C**.
  - **C** is always at the right angle.

* The sides of a right triangle have special names.
  - **Legs**: the 2 sides of a right triangle that **form** the right angle. They are **perpendicular** to each other.
  - **Hypotenuse**: (Hi-pot-en-oose) the **longest** side of a right triangle; it is **opposite** the right angle.

* The sides get labeled with the **same letter** as the **angle** it is opposite from. But with a **lower case letter**. (We use this because it is a variable, which represents a number, and the sides of a triangle have lengths.)

* You can name a side with its **lower case** name or with the 2 **vertices** it connects.
Label the vertices, legs and the hypotenuse of each triangle.

1. \[ \triangle ABC \]
   - Legs: ______________________
   - Hypotenuse: _________________

2. \[ \triangle XYZ \]
   - Legs: ______________________
   - Hypotenuse: _________________

3. \[ \triangle PQR \]
   - Legs: ______________________
   - Hypotenuse: _________________
From the activity:
The two squares constructed by the legs of the right triangle can be cut apart and used to fill the square built on the hypotenuse of the right triangle.
What does this tell us about the area of the squares?

Count the blocks in the small and medium squares. What should the area of the largest square be?

The area of the smallest square is 9 or $3^2$. The area of the medium square is 16 or $4^2$. The area of the largest square is 25 or $5^2$.

Pythagorean Theorem: the legs of a right triangle have the lengths $a$ and $b$ and the hypotenuse has a length of $c$. Remember that the area of a square = side x side or $s^2$. Then the areas of the squares built on the sides are $a^2$, $b^2$, and $c^2$.

So $a^2 + b^2 = c^2$
Appendix D: Day 4 key

Name: _______________________________________

Day 4 notes – Finding Hypotenuse using Pythagorean Theorem

Pythagorean Theorem: The sum of the square of the legs is equal to the square of the hypotenuse.

\[ a^2 + b^2 = c^2 \]

Review – How to find a square root on the calculator.

Record the key strokes for finding the square root of 18 below.

\[
\begin{array}{cccc}
\text{2nd} & \text{x}^2 & 18 & ) \\
\end{array}
\]

Using your calculator to find the following (round to the nearest tenth):

\[
\begin{array}{cccc}
\sqrt{5} = 2.2 & \sqrt{12} = 3.5 & \sqrt{22} = 4.7 & \sqrt{154} = 12.4 & \sqrt{41} = 6.4
\end{array}
\]

If asked to find c:

1. square of a
2. square of b
3. add answers for steps 1 and 2
4. take square root of answer from step 3

Practice:

1. \[ a^2 + b^2 = c^2 \]
   \[ 4^2 + 3^2 = c^2 \]
   \[ 16 + 9 = c^2 \]
   \[ 25 = c^2 \]
   \[ 5 = c \]
2. \[ \begin{align*}
&\quad a^2 + b^2 = c^2 \\
&9^2 + 12^2 = c^2 \\
&81 + 144 = c^2 \\
&225 = c^2 \\
&15 = c
\end{align*} \]

3. Find the missing side to the nearest tenth.
   \[ \begin{align*}
   a &= 3 \\
   b &= 8 \\
   c &= \ ?
   \end{align*} \]
   \[ \begin{align*}
   a^2 + b^2 &= c^2 \\
   3^2 + 8^2 &= c^2 \\
   9 + 64 &= c^2 \\
   73 &= c^2 \\
   8.5 &= c
   \end{align*} \]

4. Find the missing side to the nearest hundredth
   \[ \begin{align*}
   c &= \ ? \\
   a^2 + b^2 &= c^2 \\
   20^2 + 33.5^2 &= c^2 \\
   400 + 1122.25 &= c^2 \\
   1522.25 &= c^2 \\
   39.02 &= c
   \end{align*} \]
Appendix E: Day 4 HW key

Name: ___________________________________  Day 4 HW

Directions: Find the missing side of each right triangle. Make sure you show your work. Round to the nearest tenth if need be.

1. \[ a^2 + b^2 = c^2 \]
   \[ 20^2 + 21^2 = c^2 \]
   \[ 400 + 441 = c^2 \]
   \[ 841 = c^2 \]
   \[ 29 = c \]

2. \[ a^2 + b^2 = c^2 \]
   \[ 9^2 + 40^2 = c^2 \]
   \[ 81 + 1600 = c^2 \]
   \[ 1681 = c^2 \]
   \[ 41 = c \]

3. \[ a^2 + b^2 = c^2 \]
   \[ 1^2 + 3^2 = c^2 \]
   \[ 1 + 9 = c^2 \]
   \[ 10 = c^2 \]
   \[ 3.2 = c \]

Directions: Answer each question in complete sentences.

4. What is the relationship among the legs and the hypotenuse of a right triangle? Student answers will vary

5. Explain to a classmate why you can use any two sides of a right triangle to find the third side. Student answers will vary
Appendix F: Day 5 key

Name: ___________________________________________

Day 5 notes – Finding missing legs of a Right Triangle

Pythagorean Theorem

\[ a^2 + b^2 = c^2 \]

If a leg is missing:
1. square c
2. square the given leg
3. subtract (step 1 – step 2)
4. take square root of answer from step 3

Practice:

1. 
   \[
   a^2 + b^2 = c^2 \\
   16^2 + b^2 = 34^2 \\
   256 + b^2 = 1156 \\
   -256 - 256 \\
   b^2 = 900 \\
   b = 30
   \]

2. 
   \[
   a^2 + b^2 = c^2 \\
   a^2 + 60^2 = 61^2 \\
   a^2 + 3600 = 3721 \\
   -3600 -3600 \\
   a^2 = 121 \\
   a = 11
   \]
Appendix G: Day 5 HW key

Directions: For each problem, use the Pythagorean Theorem to solve for the missing side. Round to the nearest tenth when necessary.

1. \(a^2 + b^2 = c^2\)
   \[a^2 + 10^2 = 15^2\]
   \[a^2 + 100 = 225\]
   \[-100\]
   \[a^2 = 125\]
   \[a = 11.2\ cm\]

2. \(a^2 + b^2 = c^2\)
   \[15^2 + b^2 = 18^2\]
   \[225 + b^2 = 324\]
   \[-225\]
   \[b^2 = 99\]
   \[b = 10\ m\]

3. \(a^2 + b^2 = c^2\)
   \[4.5^2 + b^2 = 9.4^2\]
   \[20.25 + b^2 = 88.36\]
   \[-20.25\]
   \[b^2 = 68.11\]
   \[b = 8.2\ yd\]

4. \(b = 99\ mm, c = 101\ mm, \) Find \(a\).
   \[a^2 + b^2 = c^2\]
   \[a^2 + 99^2 = 101^2\]
   \[a^2 + 9801 = 10201\]
   \[-9801\]
   \[a^2 = 400\]
   \[a = 20\ mm\]
Appendix H: Day 6 & 7 Key

Name: ______________________________________________________________

Day 6 & 7 notes – Converse of Pythagorean Theorem: Is it Right?

Pythagorean Theorem: In a right triangle, the sum of the squares of the lengths on the legs is equal to the square of the length of the hypotenuse.

Converse of Pythagorean Theorem: if the square of the longest side of a triangle is equal to the sum of the squares of the two shorter sides, then the triangle is a right triangle.

If given 3 numbers for possible sides:
1. square all three numbers
2. add the two smaller numbers together
3. see if the two numbers equal each other. If so, it is a right triangle. If not, it is not a right triangle.

Practice:
Determine whether the numbers given make a right triangle:

1. 7, 25, 20
   49, 625, 400
   49 + 400 = 449
   Not a right triangle

2. 5, 15, 30
   25, 225, 900
   25 + 225 = 250
   Not a right triangle

3. 49, 625, 400
   49 + 400 = 449
   449 ≠ 625
   Not a right triangle

4. 5, 15, 30
   25, 225, 900
   25 + 225 = 250
   Not a right triangle

5. 49, 625, 400
   49 + 400 = 449
   449 ≠ 625
   Not a right triangle

6. 5, 15, 30
   25, 225, 900
   25 + 225 = 250
   Not a right triangle

7. 49, 625, 400
   49 + 400 = 449
   449 ≠ 625
   Not a right triangle

8. 5, 15, 30
   25, 225, 900
   25 + 225 = 250
   Not a right triangle
Appendix I: Day 6 & 7 HW key

Name: _______________________________________  Day 6 & 7 HW

Directions: Determine whether each triangle with sides of given lengths is a right triangle. Justify your answer.

1. 5 in, 10 in, 12 in
   25, 100, 144
   100 + 25 = 125
   125 ≠ 144
   Not a right triangle

2. 9 mm, 40 mm, 41 mm
   81, 1600, 1681
   81 + 1600 = 1681
   1681 = 1681
   They make a right triangle.

3. 28 yd, 195 yd, 197 yd
   784, 38025, 38809
   784 + 38025 = 38809
   38809 = 38809
   They make a right triangle

4. 30 cm, 122 cm, 125 cm
   900, 14884, 15625
   900 + 14884 = 15784
   15784 ≠ 15625
   Not a right triangle

5. Fill in the missing blanks to complete the graphic organizer of some Pythagorean Triples

<table>
<thead>
<tr>
<th>Pythagorean Triples</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
</tr>
<tr>
<td>6</td>
</tr>
<tr>
<td>9</td>
</tr>
<tr>
<td>5</td>
</tr>
<tr>
<td>8</td>
</tr>
</tbody>
</table>
Appendix J: Quiz key

Name: ____________________________       Math 8, Quiz

Directions: Read every question carefully. Show work when appropriate. Round to the nearest tenth when necessary.

1. What is the Pythagorean Theorem and who developed the theorem?
   student answers will vary

2. \[ a^2 + b^2 = c^2 \]
   \[ 12^2 + 5^2 = c^2 \]
   \[ 144 + 25 = c^2 \]
   \[ 169 = c^2 \]
   \[ c = 13 \text{ in} \]

3. \[ a^2 + b^2 = c^2 \]
   \[ 15^2 + b^2 = 25^2 \]
   \[ 225 + b^2 = 625 \]
   \[ -225 -225 \]
   \[ b^2 = 400 \]
   \[ b = 20 \]

3. Calculate the length of the diagonal of the state of Wyoming.

\[ a^2 + b^2 = c^2 \]
\[ 275^2 + 365^2 = c^2 \]
\[ 75625 + 133225 = c^2 \]
\[ 208850 = c^2 \]
\[ c = 457 \text{ miles} \]
4. Determine whether each triangle is a right triangle. Justify your answer.

a) 56 ft, 65 ft, 16 ft
   \[ 3136, 4225, 256 \]
   \[ 256 + 3136 = 3392 \]
   \[ 3392 \neq 4225 \]
   Not a right triangle

b) 5 in, 12 in, 13 in
   \[ 25, 144, 169 \]
   \[ 25 + 144 = 169 \]
   \[ 169 = 169 \]
   Make a right triangle

5. Determine whether each triangle is a right triangle. Justify your answer.

a) 56 ft, 65 ft, 16 ft
   \[ a^2 + b^2 = c^2 \]
   \[ 8^2 + b^2 = 24^2 \]
   \[ 64 + b^2 = 576 \]
   \[ -64 - 64 \]
   \[ b^2 = 512 \]
   \[ c = 22.6 \text{ m} \]

b) 5 in, 12 in, 13 in
   \[ a^2 + b^2 = c^2 \]
   \[ 25 + 144 = 169 \]
   \[ 169 = 169 \]
   Make a right triangle
Appendix K: Graphic Organizer

1. Restate the question

2. Find needed data:
   a. 
   b. 
   c. 
   d. 

3. Plan what to do:
   a. 
   b. 
   c. 

4. Find the answer.

5. Check your answer.
1. A ladder is placed 5 feet from the foot of a wall. The top of the ladder reaches a point 12 feet above the ground. Find the length of the ladder.

\[ a^2 + b^2 = c^2 \]

\[ 12^2 + 5^2 = c^2 \]

\[ 144 + 25 = c^2 \]

\[ 169 = c^2 \]

\[ c = 13 \text{ in} \]

2. Suppose a ladder 20 feet long is placed against a vertical wall 20 feet high. How far would the top of the ladder move down the wall by pulling out the bottom of the ladder 5 feet? Explain your reasoning.

move down 1 foot

\[ a^2 + b^2 = c^2 \]

\[ 5^2 + b^2 = 20^2 \]

\[ 25 + b^2 = 400 \]

\[ -25 \quad -25 \]

\[ b^2 = 375 \]

\[ b = 19 \text{ ft} \]

3. A door frame is 80 inches tall and 36 inches wide. What is the length of a diagonal of the door frame? Round to the nearest tenth of an inch

\[ a^2 + b^2 = c^2 \]

\[ 80^2 + 36^2 = c^2 \]

\[ 6400 + 1296 = c^2 \]

\[ 7696 = c^2 \]

\[ c = 87.7 \text{ in} \]

4. Isaac’s television is 25 inches wide and 18 inches high. What is the diagonal size of Isaac’s television? Round to the nearest tenth if necessary.

\[ a^2 + b^2 = c^2 \]

\[ 25^2 + 18^2 = c^2 \]

\[ 625 + 324 = c^2 \]

\[ 949 = c^2 \]

\[ c = 30.8 \text{ in} \]
1. A pool table is 8 feet long and 4 feet wide. How far is it from one corner pocket to the diagonally opposite corner pocket? Round to the nearest tenth.

\[ a^2 + b^2 = c^2 \]
\[ 8^2 + 4^2 = c^2 \]
\[ 64 + 16 = c^2 \]
\[ 80 = c^2 \]
\[ c = 8.9 \text{ ft} \]

2. Quadrilateral STUV is a softball “diamond” (or, square). If ST = TU = 60 ft, what is SU, the distance from home to second base? Round to nearest tenth of a foot.

\[ a^2 + b^2 = c^2 \]
\[ 60^2 + 60^2 = c^2 \]
\[ 3600 + 3600 = c^2 \]
\[ 7200 = c^2 \]
\[ c = 84.8 \text{ ft} \]

3. A ladder 39 feet long leans against a building and reaches the ledge of a window. If the foot of the ladder is 15 feet from the foot of the building, how high is the window ledge above the ground?

\[ a^2 + b^2 = c^2 \]
\[ 15^2 + b^2 = 39^2 \]
\[ 225 + b^2 = 1521 \]
\[ -225 - 225 \]
\[ b^2 = 1296 \]
\[ b = 36 \text{ ft} \]
Appendix M: Day 10 key

Name: _________________________________________

Day 10

Word Problems
(Guided Notes)

1. Miss Davis traveled 24 kilometers north and then 10 kilometers east. How far was she from her starting point?

\[
\begin{align*}
& a^2 + b^2 = c^2 \\
& 24^2 + 10^2 = c^2 \\
& 576 + 100 = c^2 \\
& 676 = c^2 \\
& c = 26 \text{ km}
\end{align*}
\]

2. Tara drives due north for 22 miles then east for 11 miles. How far is Tara from her starting point? Round to the nearest tenth if necessary

\[
\begin{align*}
& a^2 + b^2 = c^2 \\
& 22^2 + 11^2 = c^2 \\
& 484 + 121 = c^2 \\
& 605 = c^2 \\
& c = 24.6 \text{ mi}
\end{align*}
\]

3. Troy drove 8 miles due east and then 5 miles due north. How far is Troy from his starting point? Round the answer to the nearest tenth of a mile.

\[
\begin{align*}
& a^2 + b^2 = c^2 \\
& 8^2 + 5^2 = c^2 \\
& 64 + 25 = c^2 \\
& 89 = c^2 \\
& c = 9.4 \text{ mi}
\end{align*}
\]
1. Solve each other’s word problems from Day 8 HW.

2. Tina measures the distances between three cities on a map. The distances between the three cities are 45 miles, 56 miles, and 72 miles. Do the positions of the three cities form a right triangle?

\[2025, 3136, 5184\]
\[2025 + 3136 = 5161\]
\[5161 \neq 5184\]
Not a right triangle

3. One day, Ronnie walked from his home at A to his school at C by walking along AB (50 yd) and BC (120 yd), the sides of a rectangular open field that was muddy. When he returned home, the field was dry and Ronnie decided to take a short cut by walking diagonally across the field along AC. How much shorter was the trip home than the trip to school.

\[a^2 + b^2 = c^2\]
\[50^2 + 120^2 = c^2\]
\[2500 + 14400 = c^2\]
\[16900 = c^2\]
\[c = 130 \text{ yd}\]

\[50 + 120 = 170\]
\[170 - 130 = 40 \text{ yd shorter}\]
Appendix N: Day 11 key

Name: ____________________________________________

Day 11 notes

### Distance Formula

\[ d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2} \]

Did you know…?

That the distance formula is based on the Pythagorean Theorem!!

Here’s how:
- subtract the x values and y values separately
- square the differences
- take the square root of the answer

Ex. What is the distance between the two points? (Use the distance formula)

a. (1, 3) (-2, 4)  
\[ d = \sqrt{(-2 - 1)^2 + (4 - 3)^2} \]
\[ d = \sqrt{10} \]
\[ d = 3.2 \]

b. (3, 0), (7, -5)  
\[ d = \sqrt{(7 - 3)^2 + (0 - (-5))^2} \]
\[ d = \sqrt{41} \]
\[ d = 6.4 \]

Ex. On the map, each unit represents 45 miles. West Point, New York, is located at (1.5, 2) and Annapolis, Maryland, is located at (-1.5, -1.5). What is the approximate distance between West Point and Annapolis?

<table>
<thead>
<tr>
<th>Method 1 (Pythagorean Theorem)</th>
<th>Method 2 (Distance Formula)</th>
</tr>
</thead>
<tbody>
<tr>
<td>[ 2 - - 1.5 = 3.5 ]</td>
<td>[ d = \sqrt{(1.5 - -1.5)^2 + (2 - -1.5)^2} ]</td>
</tr>
<tr>
<td>[ 1.5 - - 1.5 = 3 ]</td>
<td>[ d = \sqrt{21.25} ]</td>
</tr>
<tr>
<td>[ a^2 + b^2 = c^2 ]</td>
<td>[ d = 4.6 ]</td>
</tr>
<tr>
<td>[ 3.5^2 + 3^2 = c^2 ]</td>
<td>[ 4.6 \times 45 = 207 \text{ miles} ]</td>
</tr>
<tr>
<td>[ 12.25 + 9 = c^2 ]</td>
<td></td>
</tr>
<tr>
<td>[ 21.25 = c^2 ]</td>
<td></td>
</tr>
<tr>
<td>[ c = 4.6 ]</td>
<td></td>
</tr>
<tr>
<td>[ 4.6 \times 45 = 207 \text{ miles} ]</td>
<td></td>
</tr>
</tbody>
</table>
Ex. Cromwell Field is located at (2.5, 3.5) and Dedeaux Field at (1.5, 4.5) on a map. If each map unit is 0.1 mile, about how far apart are the fields? Plot the coordinates on the grid, and then find the distance.

\[ d = \sqrt{(2.5 - 1.5)^2 + (3.5 - 4.5)^2} \]
\[ d = \sqrt{2} \]
\[ d = 1.4 \]

0.1 \times 1.4 = .14 \text{ mile}
Appendix O: Practice Test key

Name: ___________________________________      Practice Test
Math 8

Directions: Fill in the blank with a vocabulary term that best fits the definition. Word Blank: Leg(s), Vertices, Right Triangle, Hypotenuse, Triangle, Theory, Pythagorean Triple, Pythagorean Theorem.

A triangle polygon having three sides.

A right triangle where one of its interior angles is a right angle (90°)

A theory is a statement or conjecture that has been proven and can be used as a reason to justify statements in other proofs.

The Pythagorean Theorem describes the relationship between the lengths of the legs and the hypotenuse of any right triangle.

A vertices is the corner/point of the triangle. The intersection of two or more line segments.

The hypotenuse is the longest side of a right triangle, the side opposite the right angle.

The legs are two shorter sides of a right triangle that forms the right angle.

Pythagorean Triple are when the sides of a right triangle are in the ratio of integers.

Directions: Label the vertices and sides of the right triangle. Name the legs and hypotenuse.

Legs: _____________________

Hypotenuse: _____________
**Directions:** Find the missing side, to the nearest tenth.

1. \[ a^2 + b^2 = c^2 \]
   \[ 3^2 + 4^2 = c^2 \]
   \[ 9 + 16 = c^2 \]
   \[ 25 = c^2 \]
   \[ c = 5 \]

2. \[ a^2 + b^2 = c^2 \]
   \[ 4.5^2 + b^2 = 9.4^2 \]
   \[ 20.25 + b^2 = 88.36 \]
   \[ -20.25 \]
   \[ b^2 = 68.11 \]
   \[ b = 8.3 \text{ yd} \]

3. \[ a^2 + b^2 = c^2 \]
   \[ a^2 + 16^2 = 34^2 \]
   \[ a^2 + 256 = 1156 \]
   \[ -256 \]
   \[ a^2 = 900 \]
   \[ a = 30 \text{ in} \]

4. \[ a^2 + b^2 = c^2 \]
   \[ 9^2 + 12^2 = c^2 \]
   \[ 81 + 144 = c^2 \]
   \[ 225 = c^2 \]
   \[ c = 15 \]

5. Explain in words how you would determine if three lengths make a right triangle.
   
   **Student answers will vary**

6. Do the following three lengths make a right triangle? [Show your work!]
   
   \[ 5, 9, 13 \]
   \[ 25, 81, 169 \]
   \[ 25 + 81 = 106 \]
   \[ 106 \neq 169 \] Not a right triangle
7. A baseball diamond is a square with sides of 90 feet. What is the shortest distance, to the nearest tenth of a foot, between first base and third base? DRAW A PICTURE. (5 points)

\[a^2 + b^2 = c^2\]
\[90^2 + 90^2 = c^2\]
\[8100 + 8100 = c^2\]
\[16200 = c^2\]
\[c = 127.3 \text{ ft}\]

8. A ladder 40 feet long leans against a building and reaches the ledge of a window. If the foot of the ladder is 20 feet from the foot of the building, how high is the window ledge above the ground? DRAW A PICTURE. (5 points)

\[a^2 + b^2 = c^2\]
\[20^2 + b^2 = 40^2\]
\[400 + b^2 = 1600\]
\[\quad -400 \quad -400\]
\[b^2 = 1200\]
\[b = 34.6 \text{ ft}\]

9. Isaac’s television is 25 inches wide and 18 inches high. What is the diagonal size of Isaac’s television? Round to the nearest tenth if necessary.

\[a^2 + b^2 = c^2\]
\[25^2 + 18^2 = c^2\]
\[625 + 324 = c^2\]
\[949 = c^2\]
\[c = 30.8 \text{ in}\]
10. Troy drove 8 miles due east and then 5 miles due north. How far is Troy from his starting point? Round the answer to the nearest tenth of a mile.

\[ a^2 + b^2 = c^2 \]
\[ 8^2 + 5^2 = c^2 \]
\[ 64 + 25 = c^2 \]
\[ 89 = c^2 \]
\[ c = 9.4 \text{ miles} \]

11. Plot the points on the coordinate plane provided and then determine the distance between the two points with the Pythagorean Theorem AND the distance formula.

\((-2, 4)\)  \((1, 3)\)

Pythagorean Theorem
\[ a^2 + b^2 = c^2 \]
\[ 1^2 + (-3)^2 = c^2 \]
\[ 1 + 9 = c^2 \]
\[ 10 = c^2 \]
\[ c = 3.2 \]

Distance Formula
\[ d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2} \]
\[ d = \sqrt{(-2 - 1)^2 + (4 - 3)^2} \]
\[ d = \sqrt{10} \]
\[ d = 3.2 \]
Appendix P: Unit Test key

Name: ___________________________________    Unit Test
Math 8

Directions: Draw a line connecting the vocabulary term with the definition.

A polygon having three sides

A triangle where one of its interior angles is a right angle (90°)

A statement or conjecture that has been proven and can be used as a reason to justify statements in other proofs.

In a right triangle, the square of the hypotenuse is equal to the sum of the squares of the other two sides (legs).

Corner/point of the triangle. The intersection of two or more line segments.

The longest side of a right triangle, the side opposite the right angle.

The two shorter sides of a right triangle that forms the right angle.

A right triangle where the sides are in the ratio of integers.

Directions: Label the vertices and sides of the right triangle. Name the legs and hypotenuse.

Legs: _____________________

Hypotenuse: _____________
**Directions:** Find the missing side, to the nearest tenth.

1. \[a^2 + b^2 = c^2\]
   \[3^2 + 8^2 = c^2\]
   \[9 + 64 = c^2\]
   \[73 = c^2\]
   \[c = 8.5\]

2. \[a^2 + b^2 = c^2\]
   \[5^2 + 12^2 = c^2\]
   \[25 + 144 = c^2\]
   \[169 = c^2\]
   \[c = 13\]

3. \[a^2 + b^2 = c^2\]
   \[a^2 + 51^2 = 60^2\]
   \[a^2 + 2601 = 3600\]
   \[-2601\]
   \[a^2 = 999\]
   \[a = 31.6\text{ yd}\]

4. \[a^2 + b^2 = c^2\]
   \[12^2 + 9^2 = c^2\]
   \[144 + 81 = c^2\]
   \[225 = c^2\]
   \[c = 15\]

5. Explain to a classmate why you can use any two sides of a right triangle to find the third side. 
   
   Students answers will vary

6. Do the following three lengths make a right triangle? [Show your work!]
   
   a) 28, 195, 197
   
   \[784, 38025, 38809\]
   
   \[784 + 38025 = 38809\]
   
   \[38809 = 38809\]
   
   Right Triangle

   b) 30, 122, 125
   
   \[900, 14884, 15625\]
   
   \[900 + 14884 = 15784\]
   
   \[15784 \neq 15625\]
   
   Not a right triangle
7. A door frame is 80 inches tall and 36 inches wide. What is the length of a diagonal of the door frame? Round to the nearest tenth of an inch

\[ a^2 + b^2 = c^2 \]
\[ 80^2 + 36^2 = c^2 \]
\[ 6400 + 1296 = c^2 \]
\[ 7696 = c^2 \]
\[ c = 87.7 \text{ in} \]

8. A ladder 39 feet long leans against a building and reaches the ledge of a window. If the foot of the ladder is 15 feet from the foot of the building, how high is the window ledge above the ground?

\[ a^2 + b^2 = c^2 \]
\[ a^2 + 15^2 = 39^2 \]
\[ a^2 + 225 = 1521 \]
\[ -225 -225 \]
\[ a^2 = 1296 \]
\[ a = 36 \text{ ft} \]

9. A pool table is 8 feet long and 4 feet wide. How far is it from one corner pocket to the diagonally opposite corner pocket? Round to the nearest tenth.

\[ a^2 + b^2 = c^2 \]
\[ 8^2 + 4^2 = c^2 \]
\[ 64 + 16 = c^2 \]
\[ 80 = c^2 \]
\[ c = 8.9 \text{ ft} \]

10. Tara drives due north for 22 miles then east for 11 miles. How far is Tara from her starting point? Round to the nearest tenth if necessary.

\[ a^2 + b^2 = c^2 \]
\[ 22^2 + 11^2 = c^2 \]
\[ 484 + 121 = c^2 \]
\[ 605 = c^2 \]
\[ c = 24.6 \text{ miles} \]
11. Miss Davis traveled 24 kilometers north and then 10 kilometers east. How far was she from her starting point?

\[
\begin{align*}
\text{Distance Formula} & \quad d = \sqrt{(1.5 - -1.5)^2 + (2 - -1.5)^2} \\
\text{Pythagorean Theorem} & \quad d = \sqrt{21.25} \\
& \quad d = 4.6
\end{align*}
\]

\[
\begin{align*}
\text{a}^2 + b^2 &= c^2 \\
24^2 + 10^2 &= c^2 \\
576 + 100 &= c^2 \\
676 &= c^2 \\
c &= 26 \text{ km}
\end{align*}
\]