**Unit 4: Investigation 7 (3 Days)**

**Special Right Triangles**

**Common Core State Standards**

* G-SRT.C.6 Understand that by similarity, side ratios in right triangles are properties of the angles in the triangle, leading to definitions of trigonometric ratios for acute angles.
* G-SRT.C.7 Explain and use the relationship between the sine and cosine of complementary angles.
* G-SRT.C.8 Use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems.\*

**Overview**

Overall, this investigation informally introduces students to the sine, cosine, and tangent ratios for the angle measures 30o, 45o, and 60o. Students begin this investigation by exploring the equivalence of expressions that involve irrational square roots to express the ratios in standard form. With this understanding, students will use square dot paper and isometric dot paper to discover the special ratios found in the 30o-60o-90o and 45o-45o-90o triangles. Students will then apply this knowledge to real world applications involving right triangles with special angle measures.

**Assessment Activities**

**Evidence of Success: What Will Students Be Able to Do?**

* Write irrational square roots in standard form.
* Determine missing side lengths in a special right triangle.
* Determine acute angle measures in a given right triangle with side lengths that determine a special right triangle.

**Assessment Strategies: How Will They Show What They Know?**

* **Exit Slip 4.7.1** requires students to simplify an irrational square root.
* **Exit Slip 4.7.2** requires students to solve a real-world problem using special right triangles.
* **Journal Entry** asks students to explain how they will remember the trigonometric ratios for special right triangles.

**Launch Notes**

If your students have not mastered the skill of writing irrational square roots in standard form then you should begin this investigation with **Activity 4.7.1 Irrational Square Roots in Standard Form**. This activity will help students learn or review this skill.

(Note: Simplifying radicals is not included in the Connecticut Core Algebra 1 curriculum.)

**Exit Slip 4.7.1** may be used as a pretest, if you are not sure students will need **Activity 4.7.1.**

Emphasize to students the distinction between an exact number such as $\sqrt{2}$ and a decimal approximation such as 1.414.

If your students have mastered the skills of **Activity 4.7.1** then you may begin this investigation with **Activity 4.7.2 Special Right Triangles Discovery**.

**Teaching Strategies**

In preparation for working with special right triangles, **Activity 4.7.1** will guide students through how to simplify square roots. In **Activity 4.7.2**, students will need to know how to simplify square roots so that they are able to see a mathematical pattern among the sides in special right triangles.

**Exit Slip 4.7.1** may be given any time after Activity **4.7.1** or, as mentioned above, used as a pre-test.

In **Activity 4.7.2 Special Right Triangles Discovery** students will use square dot paper to draw 45o-45o-90o triangles of various sizes. In each case, students will know the length of the two legs and will use the Pythagorean Theorem to determine the length of the hypotenuse. Once students complete this part of the task they will be asked to check for relationships that may exist among the sides in each of the triangles. Students should realize that the length of the hypotenuse is the square root of 2 multiplied by the length of a leg. Next students will be asked to use isometric dot paper to draw 30o-60o-90o triangles of various sizes. In each case, students will have the length of the short leg and the length of the hypotenuse. They will use the Pythagorean Theorem to determine the length of the long leg. Next students will examine each of the 30o-60o-90o triangles to determine a relationship that exists among the sides. Students should discover that the length of the hypotenuse is twice the length of the short leg and the long leg is the square root of 3 multiplied by the length of the short leg.

In **Activity 4.7.3** **Special Right Triangles and Trigonometric Ratios** Students apply what they learned in the previous investigation to find the values of sine, cosine, and tangent for 30°, 45°, and 60° angles.

**Differentiated Instruction (For Learners Needing More Help)**

Encourage students who struggle to draw and label a picture of the special right triangle every time they asked to work with one of these angles.

**Differentiated Instruction (Enrichment)**

Students who explored the other trigonometric ratios in the previous activity may be asked to figure out the values of cotangent, secant and cosecant for 30°, 45°, and 60°.

**Group Activity**

Students may play a matching game to help learn the trigonometric ratios for special right triangles. Use the template provided. Cut 32 cards from each template. Shuffle the cards and give five to each player and place the remaining cards in a stack. On each turn the player draws a card. They lay out a pair that match (e.g cos(60°) and $\frac{1}{2}$ or cos(60°) and sin(30°)). They may also play a card to match one that is already on the table. If they can’t play, they discard one card and draw another card. First player to play all their cards wins.

In **Activity 4.7.4 Applications of Special Right Triangles**, students solve real world problems that involve special right triangles and trigonometry.

Following **Activity 4.7.4** you may give **Exit Slip 4.7.2**.

**Journal Entry**

Describe how you can remember the trigonometric ratios for the special right triangles. Look for students to draw diagrams of the two special right triangles.

**Closure Notes**

Have students design their own real-world problem that can be solved using special right triangles. As the teacher, once you examine their problems, have them exchange their problems.

You might also have a whole class discussion about the relationship that exists among the sides of any 30o-60o-90o triangle or any 45o-45o-90o triangle. Help students to understand that the relationship among the sides is the ratio between them. These ratios are special in the sense that they are exact. And they form the basis for knowing and remembering the values of the trigonometric functions for 30°, 45° and 60° angle.

**Vocabulary**

Square root

Special Right Triangle

30o-60o-90o triangle

45o-45o-90o triangle

**Resources and Materials**

Activities:

 Activity 4.7.1 Irrational Square Roots in Standard Form (if needed)

 Activity 4.7.2 Special Right Triangles Discovery

 Activity 4.7.3 Special Right Triangles and Trigonometric Ratios

 Activity 4.7.3 Applications of Special Right Triangle

Template for group activity: Unit\_4\_Investigation\_7\_matching\_game.docx