

# Roofing and Right Triangles Lesson Plan

## Concept/principle to be demonstrated:

The Pythagorean Theorem is used extensively in designing and building structures. This lesson demonstrates the relationship between the hypotenuse of a right triangle and the length of a gable roof rafter, which is a common style that protects homes, particularly in the Northwest, from weather conditions. Understanding is demonstrated when students can use and apply the Pythagorean Theorem to a variety of construction-related problems.

## Lesson objectives/Evidence of Learning:

- Uses physical, symbolic and technological models to explore conjectures.
- Calculates the area and perimeter of triangles
- Applies concept right triangle to gable roofs
- Calculates hypotenuse of right triangle
- Identifies roof terms
- Determines area of roof
- Estimates roofing material

## How this math connects to construction jobs:

The right triangle is used extensively in construction, roofs are an excellent example of how three-dimensions are envisioned and built by craft workers. This lesson will help students comprehend how the application of the Pythagorean Theorem is used to establish the roof size.

- **Framers** use the Pythagorean Theorem to cut roof rafters.
- **Roofers** use formulas to determine the amount of roofing material needed.
- **Heating Ventilation and Air Conditioning (HVAC) installers** use the surface area to compute energy loss.
- **Carpenters** apply the formula for area to verify how sheets of sheathing are required to cover the roof framing.

## Teacher used training aids:

- Piece of 3-tab roofing if available
- Scaled house model with gable roof

## Materials needed per student:

- Roofing worksheet
- Pencil
- Calculator with  $\sqrt{\quad}$  key & memory +/- functions
- ***Roofing and Right Triangles Worksheet***

## Terms:

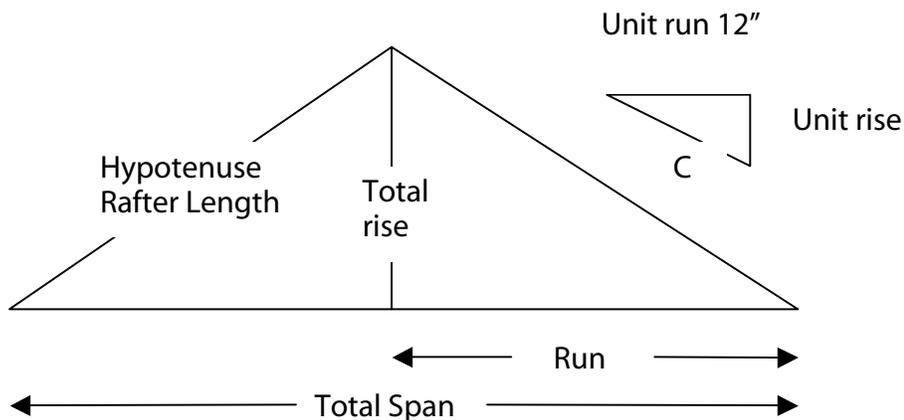
- **Gable roof:** roof shape formed by two right triangles
- **Hypotenuse:** Longest side of right triangle
- **Right triangle:** 90° triangle
- **Run:** distance from outside wall to the center of the building (one-half the span)
- **Span:** length from outside wall to outside wall
- **Square of roofing:** amount of material needed to cover 100 square feet
- **Unit of run:** unit of the total run based on 12"

## Lesson Introduction:

The right triangle is the basis of the gable roof structure. Once the framing has been completed, it is covered with a moisture proof covering. Calculating the amount of roofing materials required involves several steps.

## Lesson Components:

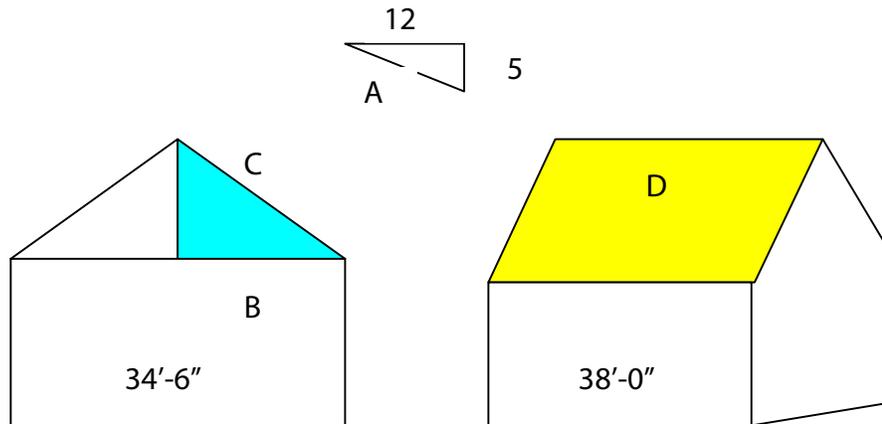
1. Right triangles are special:
  - a. Used extensively in construction.
  - b. Gable roofs are made by placing two right triangles together.
2. There are terms used to explain the relationship of the right triangle in roof mathematics.
  - a. The Span is the length from outside wall to outside wall.
  - b. The run is one-half of the Span.
  - c. The unit of run is 12" for a gable roof.
  - d. The unit rise varies depending on the slope of the roof.
  - e. The square root of the sum of the unit run squared and the unit rise squared is proportionate to the hypotenuse of the roof.
  - f. The hypotenuse of the total run and total rise is the length of the rafters.
3. Draw on white board and explain the relationship of the components



4. The formula to find the hypotenuse is:  
 $A^2 + B^2 = C^2$       Where A is the Unit rise and B is the Unit run (12").
5. The Run is one-half of the Span.
6. The Run in feet and decimal portions are multiplied by the hypotenuse (C).
7. This is the same math process that carpenters use to determine the rafter length.
8. Multiply the rafter length by the building length. This is the area of one side. This is doubled to provide the total roof area.
9. Roofing material is ordered by the square. This means 100 square feet of roofing material.
10. Hand out the *Roofing and Right Triangles Worksheet*.



# Roofing and Right Triangles Worksheet



## Problem #1

What is the length of the hypotenuse of the right triangle formed by the roof slope?

## Problem #2

How many units of run are there?

## Problem #3

How long is the hypotenuse formed by the roof?

## Problem #4

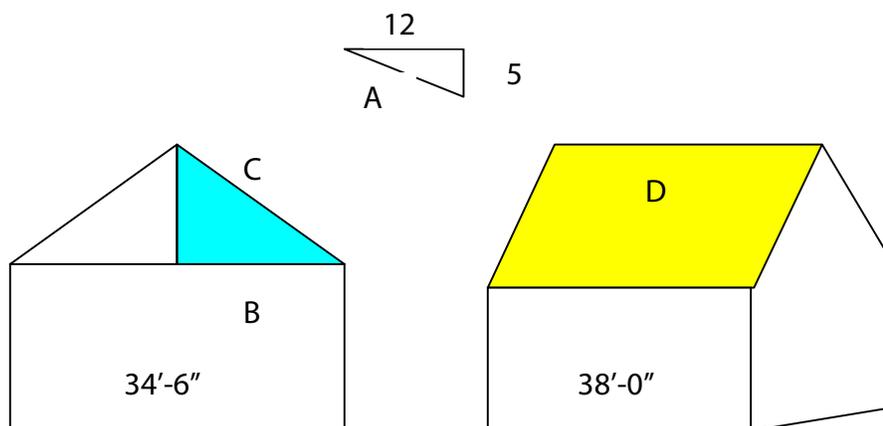
What is the area of one side of the roof?

## Problem #5

Determine the number of roofing squares needed to cover the complete roof, adding 10% for waste.



# Roofing and Right Triangles Worksheet



## Problem #1

What is the length of the hypotenuse of the right triangle formed by the roof slope?

$$5^2 + 12^2 = 25 + 144 = 169 \quad \sqrt{169} = 13$$

## Problem #2

How many units of run are there?

$$34'-0'' \div 2 = 17'-0'' \text{ is the total run.}$$

**There are 17 units of run (units are each 12'')**

## Problem #3

How long is the hypotenuse formed by the roof?

$$170 \times 13 = 221'' \quad 221'' \div 12 = 18.42'$$

## Problem #4

What is the area of one side of the roof?

$$18.42' \times 38' = 699.96 \text{ ft}^2 \text{ or } 700 \text{ ft}^2$$

## Problem #5

Determine the number of roofing squares needed to cover the complete roof, adding 10% for waste.

$$700 \times 2 = 1400 \times 10\% = 140$$

$$1400 + 140 = 1540 \text{ ft}^2$$

$$1540 \text{ ft}^2 \div 100 = 15.4 \text{ rounded to } 16 \text{ squares}$$

