

## **WAMC Lab Template**

Math Concept(s): Right Triangles, Similarity and Trigonometry

Source / Text: ME!

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### **Attach the following documents:**

- Lab Instructions
- Student Handout(s)
- Rubric and/or Assessment Tool

### **Short Description (Be sure to include where in your instruction this lab takes place):**

#### **Lab Plan**

Lab Title: How tall is that?!

Prerequisite skills: The student must have an understanding of how to use proportions to solve problems involving similarity, and trigonometric functions

Lab objective: The objective of this lab is for the student to gain an understanding of various ways to use tools to solve for the heights of objects using formulas for proportions and similarity, and trigonometric functions.

#### **Standards: (Note SPECIFIC relationship to Science, Technology, and/or Engineering)**

Mathematics K–12 Learning Standards:

- [CCSS.MATH.CONTENT.HSG.SRT.A.2](#): Given two figures, use the definition of similarity in terms of similarity transformations to decide if they are similar; explain using similarity transformations the meaning of similarity for triangles as the equality of all corresponding pairs of angles and the proportionality of all corresponding pairs of sides.
- [CCSS.MATH.CONTENT.HSG.SRT.C.8](#): Use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems.

Standards for Mathematical Practice:

- [CCSS.MATH.PRACTICE.MP1](#) Make sense of problems and persevere in solving them.
- [CCSS.MATH.PRACTICE.MP2](#) Reason abstractly and quantitatively.
- [CCSS.MATH.PRACTICE.MP4](#) Model with mathematics.
- [CCSS.MATH.PRACTICE.MP5](#) Use appropriate tools strategically.
- [CCSS.MATH.PRACTICE.MP6](#) Attend to precision.
- [CCSS.MATH.PRACTICE.MP7](#) Look for and make use of structure.

K-12 Learning Standards-ELA (Reading, Writing, Speaking & Listening):

- [CCSS.ELA-LITERACY.W.9-10.1](#)

Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant and sufficient evidence.

- [CCSS.ELA-LITERACY.W.9-10.2.D](#)

Use precise language and domain-specific vocabulary to manage the complexity of the topic.

### K-12 Science Standards

- HS-ETS1-2. Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.

### Technology

- 3.d. Students build knowledge by actively exploring real-world issues and problems, developing ideas and theories and pursuing answers and solutions

### Engineering

- HS-ETS1-2. Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.

### Leadership/21st Century Skills:

<u>21st Century Interdisciplinary themes</u> (Check those that apply to the above activity.)			
<input type="checkbox"/> Global Awareness	<input checked="" type="checkbox"/> Financial/Economic/Business/Entrepreneurial Literacy	<input type="checkbox"/> Civic Literacy	
<input type="checkbox"/> Health/Safety Literacy	<input type="checkbox"/> Environmental Literacy		
<u>21st Century Skills</u> (Check those that students will demonstrate in the above activity.)			
<b>LEARNING AND INNOVATION</b>	<b>INFORMATION, MEDIA &amp; TECHNOLOGY SKILLS</b>	<b>LIFE &amp; CAREER SKILLS</b>	<b>Productivity and Accountability</b>
<u>Creativity and Innovation</u>	<u>Information Literacy</u>	<u>Flexibility and Adaptability</u>	<input type="checkbox"/> Manage Projects
<input checked="" type="checkbox"/> Think Creatively	<input type="checkbox"/> Access and Evaluate Information	<input type="checkbox"/> Adapt to Change	<input checked="" type="checkbox"/> Produce Results
<input checked="" type="checkbox"/> Work Creatively with Others	<input type="checkbox"/> Use and manage Information	<input type="checkbox"/> Be Flexible	<b>Leadership and Responsibility</b>
<input type="checkbox"/> Implement Innovations	<u>Media Literacy</u>	<u>Initiative and Self-Direction</u>	<input type="checkbox"/> Guide and Lead Others
<u>Critical Thinking and Problem Solving</u>	<input type="checkbox"/> Analyze Media	<input checked="" type="checkbox"/> Manage Goals and Time	<input type="checkbox"/> Be Responsible to Others
<input checked="" type="checkbox"/> Reason Effectively	<input type="checkbox"/> Create Media Products	<input type="checkbox"/> Work Independently	
<input type="checkbox"/> Use Systems Thinking	<u>Information, Communications and Technology (ICT Literacy)</u>	<input checked="" type="checkbox"/> Be Self-Directed Learners	
<input type="checkbox"/> Make Judgments and Decisions	<input checked="" type="checkbox"/> Apply Technology Effectively	<u>Social and Cross-Cultural</u>	
<input checked="" type="checkbox"/> Solve Problems		<input checked="" type="checkbox"/> Interact Effectively with Others	
<u>Communication and Collaboration</u>		<input type="checkbox"/> Work Effectively in Diverse Teams	
<input checked="" type="checkbox"/> Communicate Clearly			
<input checked="" type="checkbox"/> Collaborate with Others			

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## **Teacher Preparation: (What materials and set-up are required for this lab?)**

### Materials

- Protractor
- String
- Weight
- Paper
- Tape
- Scientific Calculator
- Ruler

### Set-Up Required:

- Alert front office to our location
- Establish boundaries of outside learning environment for students
- Have supplies for students available

### **Lab Organization Strategies:**

Leadership (Connect to 21<sup>st</sup> Century Skills selected):

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### Cooperative Learning:

- Students will conduct the labs in pairs. Students will collaborate to configure a method to measure heights with tools. Students will then establish their roles for their own group to measure heights depending on their methods.

### Expectations:

- Students will collaborate to develop a method to measure heights with given tools
- Trigonometric functions or proportions will be used to measure heights of objects
- Students will create diagrams to represent their problem solving

### Timeline:

- This lab is expected to take 50 min. The introduction will be 5min, deciphering tool usage (15min), measuring objects (15min), creating diagram and solving for heights (15min)

### **Post Lab Follow-Up/Conclusions:**

Discuss real world application of learning from lab

- The skills involved for completing this lab relate to applications in engineering and surveying

### Career Applications

- Forestry, civil engineering, surveying

### Optional or Extension Activities

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# How Tall Is That?!

## Instructions:

- **Work with your partner** to accomplish the following
  - **Use the following tools** to find the heights of an object of your choice
    - Paper
    - Pencil
    - Tape
    - Ruler
    - Protractor
    - String
    - Weight
  - There are a few ways to use the tools above. Figure out how you can use your math knowledge and engineering creativity to solve the challenge.
  - **Create a 2-dimensional diagram** on paper to represent how you solved for the height of your object
    - **Write an explanation** of how you solved for the height of the object

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# How tall is it?!

Propose to the class:

We see a tree and we want to know how tall it is.

We only have:

33' tape measure

Protractor

Ruler

1' of String

Weight

Piece of Paper

One friend



How can we use these materials to find out?



## Create:

1. **Diagrams** of your problem solving
2. **Figure out 3 ways** to solve for the height
3. **Conclude** which method is most accurate. Defend your answer

# Possible Methods

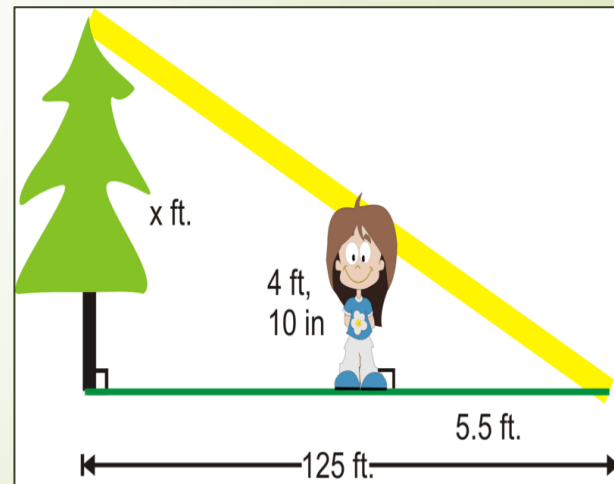
## ↳ Proportions



## ↳ Trigonometry



## ↳ Similar Triangles



## Rubric

CATEGORY	4	3	2	1
<b>Working with Others</b>	Student was an engaged partner, listening to suggestions of others and working cooperatively throughout lesson.	Student was an engaged partner but had trouble listening to others and/or working cooperatively.	Student cooperated with others, but needed prompting to stay on-task.	Student did not work effectively with others.
<b>Strategy/Procedures</b>	Typically, uses an efficient and effective strategy to solve the problem(s).	Typically, uses an effective strategy to solve the problem(s).	Sometimes uses an effective strategy to solve problems, but does not do it consistently.	Rarely uses an effective strategy to solve problems.
<b>Diagrams and Sketches</b>	Diagrams and/or sketches are clear and greatly add to the reader's understanding of the procedure(s).	Diagrams and/or sketches are clear and easy to understand.	Diagrams and/or sketches are somewhat difficult to understand.	Diagrams and/or sketches are difficult to understand or are not used.
<b>Mathematical Terminology and Notation</b>	Correct terminology and notation are always used, making it easy to understand what was done.	Correct terminology and notation are usually used, making it fairly easy to understand what was done.	Correct terminology and notation are used, but it is sometimes not easy to understand what was done.	There is little use, or a lot of inappropriate use, of terminology and notation.
<b>Neatness and Organization</b>	The work is presented in a neat, clear, organized fashion that is easy to read.	The work is presented in a neat and organized fashion that is usually easy to read.	The work is presented in an organized fashion but may be hard to read at times.	The work appears sloppy and unorganized. It is hard to know what information goes together.



## WAMC Lesson Plan

Name(s): Travis Finfrock

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Lesson Title: How tall is that?!

Date: 6/21/2022

Text: STEM Correlation: Math, Engineering, Tech Lesson Length: 50min

**Big Idea (Cluster): Similarity, Right Triangles, and Trigonometry**

**Mathematics K–12 Learning Standards:**

- [CCSS.MATH.CONTENT.HSG.SRT.A.2](#): Given two figures, use the definition of similarity in terms of similarity transformations to decide if they are similar; explain using similarity transformations the meaning of similarity for triangles as the equality of all corresponding pairs of angles and the proportionality of all corresponding pairs of sides.
- [CCSS.MATH.CONTENT.HSG.SRT.C.8](#): Use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems.

**NGSS Standards:**

- HS-ETS1-2. Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.

**Mathematical Practice(s):**

- [CCSS.MATH.PRACTICE.MP1](#) Make sense of problems and persevere in solving them.
- [CCSS.MATH.PRACTICE.MP2](#) Reason abstractly and quantitatively.
- [CCSS.MATH.PRACTICE.MP4](#) Model with mathematics.
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**Content Objectives:**

- Students to apply knowledge of similar triangles and trigonometric ratios to solving for the height of an object with a given set of tools

**Language Objectives (ELL):**

- Students will be able to identify components of the learning objectives using the lesson's vocabulary in the correct syntax.

**Vocabulary:**

- Similarity
- Trigonometric Ratios

**Connections to Prior Learning**

- Apply formulas of trigonometry and similarity

**Questions to Develop Mathematical Thinking:**

- How can we use the given tools to solve for the heights of various objects?
- What shape resembles the points of me and the bottom and top of something else?
- What information is available to us?

**Common Misconceptions:**

- Climbing the object to measure the height
- Forgetting to add the height of the person recording the angle from ground to object height.
- Confusing adjacent, opposite and hypotenuse
- Using trig inverse to solve for angles

**Assessment (Formative and Summative):**



## WAMC Lesson Plan

- Informal Formative Assessment: Listening to student conversation about solving the various scenarios on the given worksheet
- Formal Formative Assessment: Looking and grading the scenarios worksheet
- Summative Assessment: Unit Test on Trigonometry, Similarity, Special Right Triangles, Law of Sine, Law of Cosine

### Materials:

- *How Tall IS That?! Scenarios Worksheet*
- Smart Project
- Computer

### Instruction Plan:

#### Introduction:

- Explain that we will be figuring out the heights of various objects for our lab the following day using trigonometric ratios and similar triangles. I will then review the previously learned material about trigonometry, proportions, and similar triangles. I will introduce the *How Tall IS That?! Scenarios Worksheet* by working out the first scenario together. Table groups will then solve the second scenario together followed by me reviewing the strategies to solve the scenario. Lastly, students will work independently and with the help of their team members to solve the remaining scenarios.

#### Explore:

- Students will

#### When I observe students:

#### Questions to Develop Mathematical Thinking as you observe:

- How can we use the given tools to solve for the heights of various objects?
- What shape resembles the points of me and the bottom and top of something else?
- What information is available to us?

#### Answers:

- Answers will vary depending on scenario (Protractor to find angle or ruler to create similar triangles or proportions)
- Triangle
- Sides and/or angle of a triangle

#### Summarize:

- To solve for the heights of objects, students should equate the scenario to solving a triangle. Some information needs to be known but if you know the value of one side and one angle of a right triangle, you are able to use trigonometric ratios to solve for the other values.

### Career Application(s):

- These mathematical concepts are applicable to engineering, aerospace, construction, and surveying.

### Leadership/21<sup>st</sup> Century Skills:

21st Century Interdisciplinary themes (Check those that apply to the above activity.)

- |   |   |   |
|---|---|---|
| <input type="checkbox"/> Global Awareness       | <input type="checkbox"/> Financial/Economic/Business/Entrepreneurial Literacy | <input type="checkbox"/> Civic Literacy |
| <input type="checkbox"/> Health/Safety Literacy | <input type="checkbox"/> Environmental Literacy                               |   |

21st Century Skills (Check those that students will demonstrate in the above activity.)

## WAMC Lesson Plan

### **LEARNING AND INNOVATION**

#### Creativity and Innovation

- Think Creatively
- Work Creatively with Others
- Implement Innovations

#### Critical Thinking and Problem Solving

- Reason Effectively
- Use Systems Thinking
- Make Judgments and Decisions
- Solve Problems

#### Communication and Collaboration

- Communicate Clearly
- Collaborate with Others

### **INFORMATION, MEDIA & TECHNOLOGY SKILLS**

#### Information Literacy

- Access and Evaluate

#### Information

- Use and manage Information

#### Media Literacy

- Analyze Media
- Create Media Products

#### Information, Communications and Technology (ICT Literacy)

- Apply Technology Effectively

### **LIFE & CAREER SKILLS**

#### Flexibility and Adaptability

- Adapt to Change

- Be Flexible

#### Initiative and Self-Direction

- Manage Goals and Time

- Work Independently

- Be Self-Directed Learners

#### Social and Cross-Cultural

- Interact Effectively with Others

- Work Effectively in Diverse Teams

### **Productivity and Accountability**

- Manage Projects

- Produce Results

#### Leadership and

#### Responsibility

- Guide and Lead Others

- Be Responsible to Others

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