

WAMC Lab Template

Math Concept(s): Similar Triangles and Trigonometric Ratios

Source / Text:

Developed by: Heather Brase E-Mail: hbrase@northmasonschoools.org Date: June 21, 2022

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):

Students will answer the question “How far back to you have to stand from a practice goal to make the professional shot?” Students will take shots on a practice soccer goal out on the soccer field and measure their distance from the kicking spot to the center of the goal.

Lab Plan

Lab Title: Soccer Penalty Kick

Prerequisite skills: Students need to understand the relationships between similar triangles and how to use Pythagorean Theorem ($a^2 + b^2 = c^2$) to calculate missing sides.

Lab objective: Use trigonometric ratios to calculate different distances from a practice soccer goal and a professional soccer goal to determine where to best stand for practice shots.

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

Mathematics K–12 Learning Standards:

- HS.G.SRT.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.
- HS.G.SRT.8 Use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems.

Standards for Mathematical Practice:

- MP1 Make sense of problems and persevere in solving them.
- MP2 Reason abstractly and quantitatively.
- MP4 Model with mathematics.
- MP5 Use appropriate tools strategically.
- MP6 Attend to precision.

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

- CCSS.ELA-LITERACY.CCRA.SL.4

Present information, findings, and supporting evidence such that listeners can follow the

line of reasoning and the organization, development, and style are appropriate to task, purpose, and audience.

K-12 Science Standards

- HS-PS2-2 Motion and Stability: Forces and Interactions

Use mathematical representations to support the claim that the total momentum of a system of objects is conserved when there is no net force on the system

Technology

- 3.a. Students plan and employ effective research strategies to locate information and other resources for their intellectual or creative pursuits.
- 5.d. Students understand how automation works and use algorithmic thinking to develop a sequence of steps to create and test automated solutions.
- 6.a. Students choose the appropriate platforms and tools for meeting the desired objectives of their creation or communication.

Engineering

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Leadership/21st 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.)			
LEARNING AND INNOVATION	INFORMATION, MEDIA & TECHNOLOGY SKILLS	LIFE & CAREER SKILLS	Productivity and Accountability
<u>Creativity and Innovation</u>	<u>Information Literacy</u>	<u>Flexibility and Adaptability</u>	<u>Accountability</u>
B	<input checked="" type="checkbox"/> Access and Evaluate Information	<input type="checkbox"/> Adapt to Change	<input checked="" type="checkbox"/> Manage Projects
<input checked="" type="checkbox"/> Think Creatively	<input checked="" type="checkbox"/> Use and manage Information	<input type="checkbox"/> Be Flexible	<input type="checkbox"/> Produce Results
<input type="checkbox"/> Work Creatively with Others	<u>Media Literacy</u>	<u>Initiative and Self-Direction</u>	<u>Leadership and Responsibility</u>
<input type="checkbox"/> Implement Innovations	<input type="checkbox"/> Analyze Media	<input type="checkbox"/> Manage Goals and Time	<input type="checkbox"/> Guide and Lead Others
<u>Critical Thinking and Problem Solving</u>	<input type="checkbox"/> Create Media Products	<input type="checkbox"/> Work Independently	<input type="checkbox"/> Be Responsible to Others
<input checked="" type="checkbox"/> Reason Effectively	<u>Information, Communications and Technology (ICT Literacy)</u>	<input type="checkbox"/> Be Self-Directed Learners	<input checked="" type="checkbox"/> Be Responsible to Others
<input checked="" type="checkbox"/> Use Systems Thinking	<input checked="" type="checkbox"/> Apply Technology Effectively	<u>Social and Cross-Cultural</u>	
<input checked="" type="checkbox"/> Make Judgments and Decisions		<input checked="" type="checkbox"/> Interact Effectively with Others	
<input checked="" type="checkbox"/> Solve Problems		<input checked="" type="checkbox"/> Work Effectively in Diverse Teams	
<u>Communication and Collaboration</u>			
<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

- Rectangular pop-up soccer goals, soccer balls, measuring tapes, calculators

Set-Up Required:

- Set up for the lab needs to be either outside in an open area or in a gym area.

Lab Organization Strategies:

Cooperative Learning:

- Students will work in groups of 3: one kicking the ball, one taking measurements, and one documenting data.

Expectations:

- Students will work in groups of three, taking turns in the three designated roles of measuring, data keeping and kicking the ball. Each student will then take their own data and complete the student provided worksheet. Students should work together in their groups to help each other complete their worksheets and compare results.

Timeline:

- This lab should take about 15 minutes for data collecting and 40 minutes to complete the student worksheet and computations.

Post Lab Follow-Up/Conclusions:

Discuss real world application of learning from lab

- In this lab, students will practice the skill of data collecting and predicting an outcome based on that data.

Career Applications

- Data collection industries, Sports (ie. soccer, basketball), Construction, Crane work, Tree Cutting, Engineering

Optional or Extension Activities

- This lab can be adapted to cover laws of sine and cosine to find the angle of the kick, or force and motion relating to the force of the kick and the velocity of the ball.

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Student work:

1. Use the table below to record your own data

Distance from kick point to center of the goal	Distance from center of the goal to the goal post

2. Sketch a diagram

- a. A professional size goal and penalty kick area. (You will need to research this information).

- b. Your practice size goal and penalty kick area.

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3. Calculate the distance from the kick point to the goal post.

a. Professional

b. Practice

Washington

Applied

4. Calculate the distance from the kick point to the upper corner of the goal post

a. Professional

Math

b. Practice

Council

5. Are these triangles similar? Explain why or why not.

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6. Calculate the degree of the kick.

a. Professional

Washington

b. Practice

Applied

Math

7. Did you make your goal on the professional field? Explain why or why not.

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WAMC Lesson Plan

Name(s): Heather Brase
 Email Address: hbrase@northmasonschoools.org
 Lesson Title: Trigonometric Ratios
 Date: June 21, 2022
 Text: CORD: A Contextual Approach to Geometry
 STEM Correlation: Engineering & Construction
 Lesson Length: 60 minutes

Big Idea (Cluster): Right Triangle Relationships/Trigonometry/General Triangles	
Mathematics K–12 Learning Standards: HS.G.SRT.8 Use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems.	
Mathematical Practice(s): MP1, MP2, MP4, MP5, MP6	
Content Objectives: Students will be able to calculate an unknown angle of a right triangle using trigonometric ratios.	Language Objectives (ELL): Students will be able to define the vocabulary words with 80% accuracy.
Vocabulary: Tangent Cosine Sine Angle Degree Radian Arctan Arcsine Arccosine Inverse Angle of Elevation Angle of Depression	Connections to Prior Learning <ul style="list-style-type: none"> Calculating unknown sides of a right triangle using trigonometric ratios
Questions to Develop Mathematical Thinking: <ul style="list-style-type: none"> What relationships do you see between the unknown and given information? What trig ratio best fits with that unknown and given relationship? Is the unknown a side or an angle? Do we need to use the trig ratio as it is or the inverse? 	Common Misconceptions: <ul style="list-style-type: none"> Mixing up the opposite, adjacent and hypotenuse of the trig ratios Forgetting to apply the inverse of the ratio to calculate the degree Having the calculator in radian mode and not degree mode

Assessment (Formative and Summative):

- Formative: Student check in during independent practice and the wrap up activity
- Summative: End of Unit Test

Materials:

- Calculators
- Student Worksheets (KWL chart and examples, independent worksheets)
- Large Poster Paper (teacher use)
- Markers (teacher use)

WAMC Lesson Plan

Instruction Plan:

Introduction: Students will be presented with an entry task as they come into the classroom. The entry task will be a KWL chart with an introduction problem where students will need to write down what they know and then what they wonder. After 2-3 minutes of independent thinking time, students will turn to their partner and spend another 2-3 minutes sharing their knows and wonders. Review the KWL chart with the whole class and create a class chart to reference throughout the lesson.

Explore: Go over the entry problem as the first example with students and then one other example that are on the back of the KWL chart. After the examples, students will work in their pairs to complete the Rally Coach activity. Once they are done with their Rally Coach activity students will start on their independent practice.

When I observe students: When working in pairs I expect to see and hear students collaborating, talking, and working together. When working independently, I expect to see students working, reviewing their notes from the examples, and asking questions when they are stuck. I will be watching for those students who are doing nothing or I know struggle to seek help and sitting with them for one-on-one help and encouragement.

Questions to Develop Mathematical Thinking as you observe:

- What relationships do you see between the unknown and given information?
- What trig ratio best fits with that unknown and given relationship?
- Is the unknown a side or an angle?
- Do we need to use the trig ratio as it is or the inverse?

Answers:

- For the unknown angle I know the sides that are....opposite, adjacent, hypotenuse
- The given information matches with tangent, cosine, or sine.
- The unknown is an angle
- We should be using the inverse of the trig ratio to calculate the angle.

Summarize: When there is about 10 minutes of class time left, bring the class back together and have students independently complete the “What I Learned” column of the KWL chart. After about 2-3 minutes have students turn to their partner and discuss their learnings for 2 more minutes. Bring the whole class together and collectively complete the “What I learned” column on the class chart.

Career Application(s):

- Sports (ie. soccer, basketball), Construction, Crane work, Tree Cutting, Engineering

Leadership/21st 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.)

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

- Manage Projects

Produce Results

- Produce Results

Leadership and Responsibility

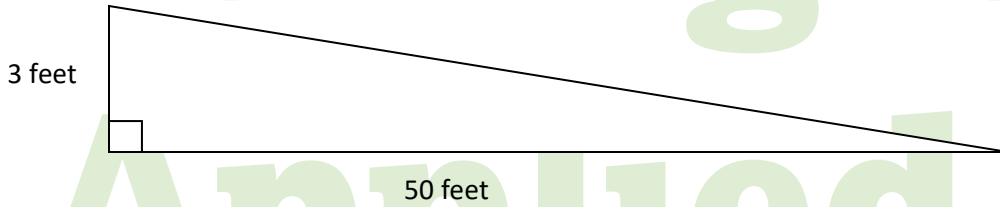
- Guide and Lead Others
- Be Responsible to Others

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Name: _____ Date: _____ Period: _____

Entry Task

Problem: The district is needing to build a new wheelchair ramp in front of the school. The ADA requirements state that the angle of elevation must be between 2.86 degrees and 4.76 degrees. The district plans for the ramp are shown below. Do these meet the requirements?



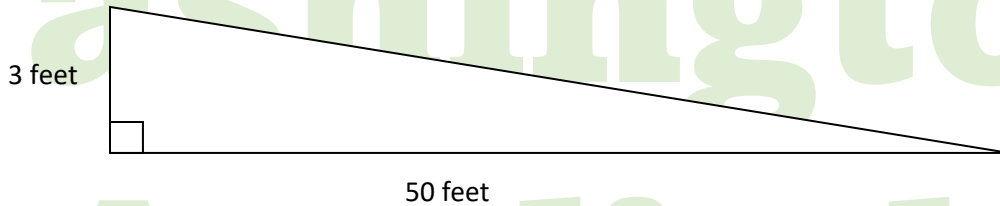
What I K now	What I W onder	What I L earned

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WAMC Lesson Plan

Examples

1. The district is needing to build a new wheelchair ramp in front of the school. The ADA requirements state that the angle of elevation must be between 2.86 degrees and 4.76 degrees. The district plans for the ramp are shown below. Do these meet the requirements?



2. A 20-foot fire truck extension ladder is positioned 8 feet from a building. What angle does the ladder make with the fire truck?

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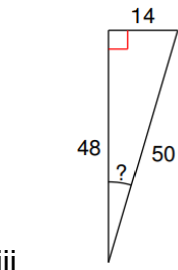
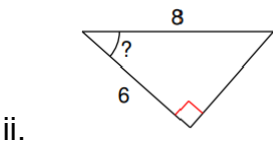
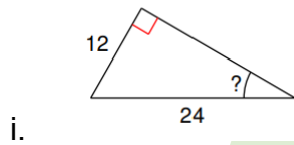
WAMC Lesson Plan

Name: _____ Date: _____ Period: _____

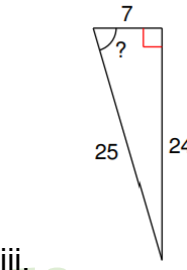
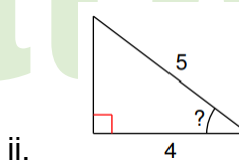
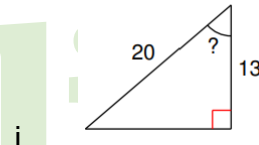
Rally Coach

Choose who will be Partner A and Partner B. Partner A will solve the problems marked A, with Partner B coaching them through if they get stuck. Partner B is NOT allowed a pencil during this time. Then, switch for the problems marked B. When all sections are done, please raise your hand for a check in with the teacher.

A. Find the unknown angle. Be sure to show all work.



B. Find the unknown angle. Be sure to show all work.



WAMC Lesson Plan

Name: _____ Date: _____ Period: _____

Independent Practice

Find each angle measure to the nearest degree.

1) $\sin B = 0.4848$

2) $\sin A = 0.5150$

3) $\cos A = 0.7431$

4) $\cos W = 0.6157$

5) $\cos A = 0.5878$

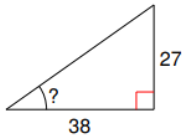
6) $\tan W = 19.0811$

7) $\cos A = 0.4226$

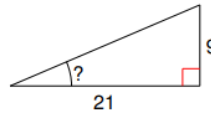
8) $\tan W = 0.5317$

Find the measure of the indicated angle to the nearest degree.

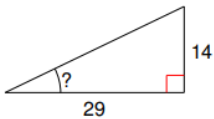
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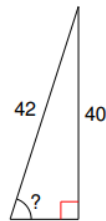
10)



11)



12)



13)



14)

