WAMC Lab Template

Math Concept(s): Law of Cosines

Source / Text:

Developed by: Andrew Goodwin E-Mail: andrew.goodwin@oceanbeachschools.org

Date: 6/21/22

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: Finding Distance Indirectly

Prerequisite skills: use of protractor, familiarity with law of cosines

Lab objective: Students will calculate the distance between two objects indirectly using the law of cosines.The distance will not be able to be measured directly due to obstacles, therefore students will have to make two measurements and record the angle between these measurements in order to create a model that can find the direct distance.

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

Mathematics K–12 Learning Standards:

- CCSS.MATH.CONTENT.HSG.SRT.D.11 Understand and apply the Law of Sines and the Law of Cosines to find unknown measurements in right and non-right triangles

Standards for Mathematical Practice:

- CCSS.MATH.PRACTICE.MP5 Use appropriate tools strategically

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

- CCSS.ELA-LITERACY.SL.9-10.4 Present information, findings, and supporting evidence clearly, concisely, and logically such that listeners can follow the line of reasoning and the organization, development, substance, and style are appropriate to the purpose, audience, and task.

K-12 Science Standards

-

Technology

-

Engineering

-

Leadership/21st Century Skills:

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

☐ Global Awareness ☐ Financial/Economic/Business/Entrepreneurial Literacy ☐ Civic Literacy
☐ Health/Safety Literacy ☐ 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
X Reason Effectively
☐ Use Systems Thinking
☐ Make Judgments and Decisions
X Solve Problems

Communication and Collaboration
☐ Communicate Clearly
X Collaborate with Others

INFORMATION, MEDIA & TECHNOLOGY SKILLS

Information Literacy
X 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
X Produce Results

Leadership and Responsibility
☐ Guide and Lead Others
☐ Be Responsible to Others

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

Materials

- Measuring tape (1 per pair)
- Protractor (1 per pair)

Set-Up Required:

- Find two objects that students cannot measure the direct distance between due to obstacles (furniture, buildings, natural objects).

Lab Organization Strategies:

Leadership (Connect to 21st Century Skills selected):

-

Cooperative Learning:

- Students will work in pairs, with one student responsible for making measurements, and the other responsible for recording measurements.

Expectations:

- Students will use their measurements to calculate the direct distance between two objects

Timeline:

- This lab is expected to take about 25 minutes to complete.

Post Lab Follow-Up/Conclusions:

Discuss real world application of learning from lab

- gathering and recording data
- determining distances between objects

Career Applications

- cartography, astronomy

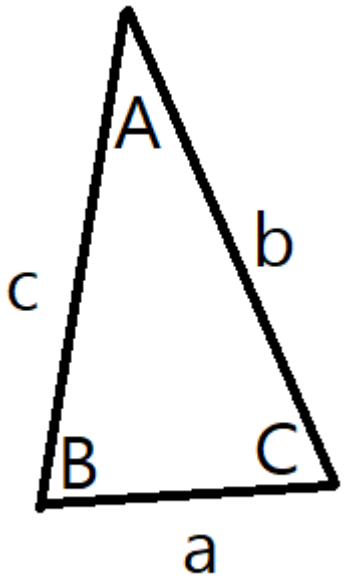
Optional or Extension Activities

- Verify your result by finding the distance again, using a different set of measurements than the first time.
- change which measurements students take to have students use the law of sines instead.

For display on projector

Law of Cosines:

$$c^2 = a^2 + b^2 - 2abcos(C)$$



WAMC Lesson Plan

Name(s): Andrew Goodwin
Email Address: andrew.goodwin@oceanbeachschools.org
Lesson Title: Law of Cosines
Date: 6/21/22
Text: STEM Correlation: Engineering Lesson Length: 50m

Big Idea (Cluster): Apply trigonometry to general triangles	
Mathematics K–12 Learning Standards: HSG.SRT.D.10, HSG.SRT.D.11	
Mathematical Practice(s): MP2, MP4, MP5, MP6	
Content Objectives: Students will be able to use the law of cosines to find unknown sides and angles in triangles	Language Objectives (ELL): Most students will be able to identify 4 out of 5 vocab terms correctly
Vocabulary: Sides Angles Cosine Protractor Measuring tape	Connections to Prior Learning using trig functions to solve problems sketching triangles labeling sides and angles of triangles
Questions to Develop Mathematical Thinking: ● Which measurement(s) are you taking? ● Which part(s) of your triangle would these measurement(s) represent? ● What measurement are you trying to find? ● Which part of the triangle would this measurement represent? ● Do your labeled measurements on your diagram match the description in the problem?	Common Misconceptions: ● labeling sides and angles of the triangle incorrectly ● evaluating trig functions with calculator in radian mode when angles are being measured in degrees

Assessment (Formative and Summative):

- Formative - observing students as they work on lab problem and practice problems
- Summative - end of unit test

Materials:

- measuring tape (1 per pair)
- protractor (1 per pair)

Instruction Plan:

Introduction:

Have law of cosines (formula and illustration) posted on board as students enter classroom. Students will record in their notebooks. After a few minutes, answer questions about formula.

Explore:

Explain activity to students. They will be working in pairs to find the distance between two locations on the school grounds. These two locations will not have direct line of sight due to building features or fences, so they will need to take two measurements, and measure the angle between them in order to use the law of cosines to find the angle.

After taking measurements and finding the correct distance, students will have a set of practice problems to complete with their partner to continue to practice using the law of cosines.

When I observe students:

Students will be working together to make and record their measurements during the first portion of the lesson. When working on the partner problems, they will work together to make sure they are correctly diagramming the situations described in the problems and are correctly using the law of cosines to find the unknown side or angle.

Questions to Develop Mathematical Thinking as you observe:

1) Which measurement(s) are you taking?
2) Which part(s) of your triangle would these measurement(s) represent?
3) What measurement are you trying to find?
4) Which part of the triangle would this measurement represent?
5) Do your labeled measurements on your diagram match the description in the problem?

Answers:

1) two sides lengths and the interior angle (for the lab, may be different for partner problems)
2) two of the sides and the angle in between the two (for the lab, may be different for partner problems)
3) the third side of the triangle (for the lab, may be different for partner problems)
4) answer will vary
5) answer will vary

Summarize:

Students will develop their ability to use the Law of Cosines to find an unknown side or angle of a triangle, starting with a lab activity finding the distance between two objects indirectly, and then solving other story problems with a partner.

Career Application(s):

- Surveying, measuring distances
- Architecture, taking measurements for blueprints

Leadership/21st Century Skills:

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Partner Practice Problems:

1. A vacant lot, in the shape of a scalene triangle, is between two streets that intersect at an 85.9^{o} angle. Each of the sides of the lots that face these streets are 150.0 and 127.0 feet long. Find the length of the third side.
2. One of the congruent sides of an isosceles triangle is 10.00 cm long. One of the congruent angles has a measure of 54.00^{o}. Find the perimeter of the triangle.
3. A pilot is flying from city A to city B which is 85.0 miles due North. After flying 20.0 miles, the pilot must change course and fly 10.0^{o} East of North to avoid a cloudbank. If the pilot remains on this course for 20.0 miles, how far will the plane be from city B at that time?
4. The lengths of the adjacent sides of a parallelogram are 54.0 cm and 78.0 cm. The larger angle measures 110.0^{o}. What is the length of the longer diagonal?
5. A pendulum, exactly one yard in length, swings from an amplitude of 30.0^{o} from the vertical. How high, in inches, above its lowest position is the pendulum at the top of its swing?