Lab Framework

Text: CORD

Unit number and title: Unit 18 *Solving Problems That Involve Nonlinear Equations*

Short Description: A hands-on introduction to trigonometry through creating the graph of the sine function from 0 to 90 degrees. This is a direct follow-up to the Lab, What's Your Sine?, where students create a rudimentary sine table for the angles between 0 and 90 degrees.

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What's Your Sine Look Like?

LAB PLAN

TEACHER: Teacher Prep/ Lesson Plan

- **Lab Objective**

  Participants will work together to plot the values they calculated in the previous lab, *What's Your Sine*? The size of the angle is the independent variable, and the sine ratio is the dependent variable. Discussion regarding the rate of change and what happens when the angle is larger than 90 will ensue.

  Statement of pre-requisite skills needed (i.e., vocabulary, measurement techniques, formulas, etc.)

  Completion of the first stage of this lab, *What's Your Sine?*
  Ability to graph on a coordinate plane
  Skill and understanding regarding the conversion of a ratio in fraction form to a decimal
  Skill and experience with slope, and rate of change
  Ability to judge rate of change visually by steepness of slope

- **Vocabulary**

  Ratio
  Rate of change
  Slope
  Coordinates
  Independent variable
  Dependent variable

- **Materials List**

  Protractors
  Centimeter rulers
  Calculators
  Graph paper

(http://mathbits.com/mathbits/studentresources/GraphPaper/Trig0to2pi2DEGREES.pdf)

- **State Standards addressed**

  Math:

G.3.B Determine and prove triangle congruence, triangle similarity, and other properties of triangles
G.3.E Solve problems involving the basic trigonometric ratios of sine,cosine, and tangent.

Reading & Writing:

1.2 Use vocabulary (word meaning) strategies to comprehend text.
1.2.2 Apply strategies to comprehend words and ideas.

1.3 Build vocabulary through wide reading.
2.1 Demonstrate evidence of reading comprehension.
2.1.4 Apply comprehension monitoring strategies for informational and technical materials, complex narratives, and expositions: use prior knowledge.
2.1.5 Apply comprehension-monitoring strategies for informational and technical materials, complex narratives, and expositions; synthesize ideas form selections to make predictions and inferences.
2.1.6 Apply comprehension monitoring strategies for informational and technical materials, complex narratives, and expositions: monitor for meaning, create mental images, and generate and answer questions

- **Leadership Skills**
  1.4 The student will be involved in activities that require applying theory, problem-solving, and using critical and creative thinking skills while understanding outcomes of related decisions
  2.1 The student will communicate, participate, and advocate effectively in pairs, small groups, teams, and large groups in order to reach common goals
  2.2 The student will demonstrate knowledge of conflict resolution and challenge management.
  3.4 The student will understand the organizational skills necessary to be a successful leader and citizen and practices those skills in real-life.
- **SCAN Skills/Workplace Skills**
  Information: Acquires and uses information
  A. *Acquires and Evaluates Information*
  B. *Organizes and Maintains Information*
  C. *Interprets and Communicates Information*
  D. *Uses Computers to Process Information*

Technology: Works with a variety of technologies
A. *Selects Technology*—chooses procedures, tools or equipment including computers and related technologies
B. *Applies Technology to Task*—Understands overall intent and proper procedures for setup and operation of equipment
C. *Maintains and Troubleshoots Equipment*—Prevents, identifies, or solves problems with equipment, including computers and other technologies

- **Set-up information**
  Lab 1, drawing, measuring and computing sine ratios, must be completed before this lab begins.

- **Lab organization**(-Grouping/leadership opportunities/cooperative learning expectations; -**Timeline required)**

1. Distribute completed recording sheets to each student.
2. Discuss with your partner and be ready to present your point of view to the class:
   Which of these two sentences makes the most sense to you?
   The sine ratio depends on the size of the angle.
   The angle depends on the magnitude of the sine ratio.

3. Pass out graph paper (http://mathbits.com/mathbits/studentresources/GraphPaper/Trig0to2pi2DEGREES.pdf)

3.

Note to the Teacher: *Listen attentively as you pass out the graph paper. Write down the comments and observations your hear from students. Save these to start the discussion when students have finished graphing their sine values.*

4. Carefully plot the values you computed in Lab 1.

While students are plotting values from 0-90 degrees, write the comments and observations you heard so that all can see them. As students finish plotting, they will see what you're doing and begin to discuss why the graph paper gives room for 360 degrees.

5. Discuss why students think the graph paper extends to 360 degrees.

This Lab is #2 in a series of labs investigating trigonometry. Subsequent labs will include:

- Repeating Labs 1 and 2 with cosine and tangent
- Plotting the values from a unit circle (central angle and sine, cosine, tangent)
- Connecting radius to circumference: a radian is born (Using string lengths that equal the radius of a circle, how many will it take to go around the entire circle?)
- Playing with 30-60-90 triangles: Constructing an equilateral triangle (with compass and straightedge); Folding triangle to bisect one of the angles; Measure sides and create all 3 ratios for both acute angles
- Repeat the 30-60-90 lab on Geometer's Sketchpad.
- Playing with isosceles right triangles: Create a square by paper folding or construction; fold on the diagonal and cut; measure the resultant angles; measure the sides and create all three ratios for the two acute angles
- Repeat with Geometer's Sketchpad

- **Teacher Assessment of student learning** (scoring guide, rubric)
  Students

- **Summary of learning** (to be finished after student completes lab)
  -What evidence do you have that this is not a linear function?

  -opportunity for students to share/present learning

- **Optional activities**
  Comparing Lab values for Sine with the values available in a table or on a calculator.
  Imagining what might happen if the angle of interest is greater than 90?

- **Career Applications**

  Periodic functions are applicable wherever anything oscillates. So, the math underlying oscillation supports machines that calibrate sound, heart beats, AC power, and the use of springs.

  "An **electronic oscillator** is an electronic circuit that produces a repetitive electronic signal, often a sine wave or a square wave. They are widely used in innumerable electronic devices. Common examples of signals generated by oscillators include signals broadcast by radio and television transmitters, clock signals that regulate computers and quartz clocks, and the sounds produced by electronic beepers and video games. "
  (http://en.wikipedia.org/wiki/Electronic_oscillator,Retrieved 6/24/10**)**

What's Your Sine Look Like?

1. Is the sine function a line shape? Can we use y = mx + b to describe it? How do you know?

2. Why do YOU think the graph paper gives you room for 360 degrees' worth of sine to compute and plot?

Lab Data Collection

Student: _____ **Date:** _____

Unit: _____

Lab Title:

Criteria: Write the problem/objective in statement form

Data Collection: Record the collected/given data

Calculations: Complete the given calculations to solve for an answer(s)

Summary Statement:

Other Assessment(s)