Lab Template

Text: CORD Hard Bound
Volume: 3rd Edition Chapter: 8
Unit number: 26 Title of unit: Systems of Equations
Developed by *(Include contact information)***: Justin Timothy (timotjj@puyallup.k12.wa.us)**
Date: 6-27-12

Attach the Following Documents:

1. **Lab Instructions**
2. **Student Handout(s)**
3. **Rubric and/or Assessment Tool**

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

This lab is intended to be an extension of learning how to solve systems of linear equations by graphing. The lab would take place after students have learned how to solve systems of equations using the three methods; graphing, substitution and elimination. This lab will help students understand the practical application of systems of equations and linear equations in context of geographical points. Students will be discovering the how rates of change and solutions to systems correlate. Students will be given the opportunity to work in small groups and as a class to figure out how to sink the enemy's ship as we play SOE Battleship.

SOE Battleship

LAB PLAN

TEACHER: *(Teacher Prep/Lab Plan)*

- **Lab Objective**

Students will be able work in cooperatively in solving systems of equations
Students will determine what method or methods will best suite them in finding the coordinate of attack
Students will conceptualize graphing systems of linear equations in their various forms (slope-intercept, point-slope and standard form)
Students will make connections between solutions of systems of linear equations and rates of change

- **Statement of prerequisite skills needed**

Graphing linear equations in their various forms (slope-intercept, point-slope and standard form)
Solving systems of equations through graphing, substitution and elimination
Coordinate points and Coordinate grid
Finding solutions to linear systems and points of intersection of linear systems of equations

- **Vocabulary**

intersection, solution of system of linear equation,

- **State Standards addressed:**
  - **Math:**

    A1.1.A Select and justify functions and equations to model and solve problems.
    A1.1.C Solve problems that can be represented by a system of two linear equations or inequalities.
    A1.4.D Write and solve systems of two linear equations and inequalities in two variables.

    Common Core Standards:
    F-IF-7e, F-IF-8b Analyze functions using different representations
    F-LE-1c, F-LE-2, F-LE-5 Construct and compare linear, quadratic, and exponential models and solve problems
  - **Reading:**
  - **Writing:**
  - **Leadership:**

  Organize materials, demonstrate knowledge in helping a peer

- **Teacher Preparation:** *(What materials and set-up are required for this lesson?)*
  - Materials: A very large Quadrant I or tiles in the commons (preferably a 20x20 grid that students can see visually and is a big display) I used masking tape on the wall to make a huge coordinate grid. Sticky pads or something for the bombs for the students battleships
  - Set-Up Required: Coordinate grid Quadrant 1, intervals, handouts, bombs (I use sticky pads cut into 4^{ths})

- **Lab Organizational Strategies:**
  - Grouping/Leadership/Presentation Opportunities: Students will work in groups of three or four. Leadership points will be given to students who take on the group leader role and students that assist in materials management. Students will be given the opportunity to place their bombs on the coordinate grid thus presenting their solutions visually to the class.
  - Cooperative Learning: Students are expected to work together to find the correct point of intersection or solution to the system in order to sink the enemy ship. Students will also have the opportunity to work together in writing a bonus equation that will intersect an enemy ships route.
  - Expectations: Students are expected to stay on task (group leader will be responsible for off task group members) Students are expected to solve their systems and begin working on a bonus equation if time allows.
  - Time-line: 1 Day Lab
    - Intro: 10 min
    - Work time: 10 min
    - Discussion: 10 min
    - Blowing up the Enemy: 15 min
    - Further Discussion and Bonus Equations: 10 min

- **Post Lab Follow-Up/Conclusions** *(to be covered after student completes lab)*

- Discuss real world application of learning from lab:
  - Scientists write and solve systems to determine how one condition affects an outcome.
  - Pharmacists use this to mix prescriptions.
  - Bankers find the cost differences in payment plans, for example, by using substitution.
  - We, as consumers, can write and solve systems of equations to figure out which companies/stores have a better deals.
  - Supply Chain Operations managers use this system to identify points in the supply chain that share commonalities
  - Military: many uses, aeronautics, warfare/guided missiles, defense missiles.
  - Economics: Break even points, equilibrium points

- Career Applications: Doctors, Scientists, Economics, Military, Pharmacists, Chemists, Marketing, Finance

- Optional or Extension Activities: Students creating a battleship game using the other three quadrants.

Lab Instructions

Problem Statement
You are navigating a battleship during wargames. Your course will take you across several enemy shipping lanes. Your mission is to lay mines at the points where your course crosses the enemy lanes. The enemy shipping lanes are represented by the following equations.

Equipment
String or cord, approximately 20 feet long
Paper (different color for each lab group)
Scissors
Masking tape
Tape measure Optional:
Graphing calculator

Enemy Lane 1: $6x - 12y = -18$

Enemy Lane 2: $3x + y = 19$

Enemy Lane 3: $x + y = 10 + x$

Procedure
1. Clear an area of the classroom floor for use as a coordinate system. If your floor has square tiles, use the lines between the tiles as a grid for the *x*- and *y*-coordinate plane. If not, measure a uniform grid with a tape measure.

2. This lab will focus on only Quadrant I of the xy-coordinate system.

Identify two perpendicular reference lines to serve as the positive x- and y-axes. For example, you can select two perpendicular rows of tiles near a corner of the classroom.

3. As a class, identify a length that will serve as "one unit." On a tile floor, the length of one tile is very convenient. For floors without tiles, use a length of about 10 inches or 20 centimeters.

4. Measure the units along each axis with the tape measure (or count tiles on a tile floor). Using small pieces of masking tape, label the units along your "axes" from x = 0 to x = 24 and y = 0 to y = 24. For convenience you may label every other unit. Create the coordinate system as a class. Only one coordinate system is needed for all the lab groups.

5. Each group should use a different equation to represent the course of its battleship. Choose from the following equations.

Equation 1: $2y - 28 = -x$

Equation 2: $y = \frac{6}{5}x - \frac{31}{5}$

Equation 3: $y - \frac{1}{4}x = 6$

Equation 4: $4x=16$

Equation 5: $-y + 10 = \frac{3}{4}x$

Equation 6: $x + 3y = 51$

Equation 7: $50y = 50x$

Equation 8: $15 + 3y = 13 + 15$

Equation 9: $10y = 100x - 200$

Equation 10: $y = -\frac{1}{6}x + 61$

6. Determine the points where your equation (the path of your ba+ttleship) will intersect each of the enemy shipping lanes. Use any of the methods discussed in the text for solving a system of equations. Round your answers to the nearest 0.1 unit before they are recorded.

Points of Intersection	
Enemy Lane	***xy*-coordinates**
1	
2	
3	

7. Cut out three 1-inch squares of colored paper. Each square represents a "mine" dropped by your battleship. Each group should use a different color.

8. For each point of intersection, locate the corresponding point on the classroom floor. Use masking tape to fasten a piece of colored paper to the floor at each point of intersection. This will indicate where your battleship has dropped a "mine."

9. After all the lab groups have completed "dropping their mines," check each group's success. The equations for the shipping lanes are linear and represent lines. Find two ordered pairs on each of these lines. Use a string to connect the ordered pairs for each line. These three strings represent the three enemy shipping lanes. Did your "mines" lie within the shipping lanes?

Student Handouts

Graph Paper: Any graph paper that students can use to make two to four 20x20 grids.
Procedures and scoring rubric (at bottom of this lab)
Group equations half sheets (at bottom of this lab)

Assessment Tool

SOE Battleship

Teacher Name: **Mr. Timothy**

Student Name: _____

CATEGORY	4	3	2	1
Mathematical Reasoning	Uses complex and refined mathematical reasoning.	Uses effective mathematical reasoning	Some evidence of mathematical reasoning.	Little evidence of mathematical reasoning.
Mathematical Errors	90-100% of the steps and solutions have no mathematical errors.	Almost all (85-89%) of the steps and solutions have no mathematical errors.	Most (75-84%) of the steps and solutions have no mathematical errors.	More than 75% of the steps and solutions have mathematical errors.
Coorerative Learning	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.
Completion	All problems are completed.	All but one of the problems are completed.	All but two of the problems are completed.	Several of the problems are not completed.

Mathematical Concepts	Explanation shows complete understanding of the mathematical concepts used to solve the problem(s).	Explanation shows substantial understanding of the mathematical concepts used to solve the problem(s).	Explanation shows some understanding of the mathematical concepts needed to solve the problem(s).	Explanation shows very limited understanding of the underlying concepts needed to solve the problem(s) OR is not written.
Mine Accuracy	Each mine placed is accurate and reflects a point of intersection or solution to the system.	One point is accurate and reflects a point of intersection or solution to the system	No points are accurate, but student work is shown and points are reasonable as to a point of intersection or solution to the system	No points reflect a reasonable point of intersection or solution to the system

Systems Battleship – Student Handout

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Scoring Rubric

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Student Name: _____

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