

WAMC Lab Template

Math Concept(s): Solving Systems of Equations

Source / Text: CORD Algebra 1, Ch. 6

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Date: WAMC Summer 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):

This lab takes place at the end of the unit where students learned to solving systems of equations. It is meant to be a review to get students ready for the unit test. In this lab, students will have a mixture of items and a scale and will have to use systems to find out how many of each item there is.

Lab Plan

Lab Title: Unmixing a Mixture

Prerequisite skills: Students need to be able to solve a system of equations using a method of their choice.

Lab objective: Students will be able to:

- Find the number of items in a mixed set by applying systems of equations.

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

Mathematics K–12 Learning Standards:

- A.CED.2 – Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.
- A.CED.3 – Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or nonviable options in a modeling context.
- A.REI.5 – Prove that, given a system of two equations in two variables, replacing one equation by the sum of that equation and a multiple of the other produces a system with the same solutions.
- A.REI.6 – Solve systems of linear equations exactly and approximately (e.g., with graphs), focusing on pairs of linear equations in two variables.
- A.REI.10 – Understand that the graph of an equation in two variables is the set of all its solutions plotted in the coordinate plane, often forming a curve (which could be a line).
- A.REI.11 – Explain why the x-coordinates of the points where the graphs of the equations $y = f(x)$ and $y = g(x)$ intersect are the solutions of the equation $f(x) = g(x)$; find the solutions approximately, e.g., using technology to graph the functions, make tables of values, or find

successive approximations. Include cases where $f(x)$ and/or $g(x)$ are linear, polynomial, rational, absolute value, exponential, and logarithmic functions.

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.
- MP7 – Look for and make use of structure.

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

- ELA-Literacy.SL.9-10.1 – Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grades 9-10 topics, texts, and issues, building on others’ ideas and expressing their own clearly and persuasively.
- 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 purpose, audience, and task.

K-12 Science Standards

- SEP 2 – Developing and using models
- SEP 4 – Analyzing and interpreting data
- SEP 5 – Using mathematics and computational thinking
- SEP 8 – Obtaining, evaluating, and communicating information
- CCC 4 – Systems and system models

Technology

- 4.a – Students know and use a deliberate design process for generating ideas, testing theories, creating innovative artifacts or solving authentic problems.
- 5.a – Students formulate problem definitions suited for technology-assisted methods such as data analysis, abstract models and algorithmic thinking in exploring and finding solutions.
- 5.b – Students collect data or identify relevant data sets, use digital tools to analyze them, and represent data in various ways to facilitate problem-solving and decision-making.

Leadership/21st Century Skills:

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

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

Materials

- Boxes of small bolts
- Boxes of small nuts
- Boxes of washers (optional/for extension)
- Paper cup (about 6 ounces)
- Scale

Set-Up Required:

- Have a tub of bolts and a tub of nuts available for students
- Extension – create bags with bolts, nuts, and washers in it.

Lab Organization Strategies:

Leadership (Connect to 21st Century Skills selected):

- See checkbox above.

Cooperative Learning:

- Students will work in pairs or groups of 3.

Expectations:

- Students will practice using systems of equations to find the number of each item within their bag.

Timeline:

- 50 minutes

Post Lab Follow-Up/Conclusions:

Discuss real world application of learning from lab

- Discuss the idea of a break-even point where profit and cost are equivalent.

Career Applications

- Banking
- Manufacturing

Optional or Extension Activities

- Include washers into the mix and have students solve a 3-variable system.

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Lab Instructions: Unmixing the Mixture

Materials:

- Tub of small bolts
- Tub of small nuts
- Paper cup
- Scale
- Student worksheet

Setup:

1. Put students into pairs or groups of 3.
2. Hand out the student worksheet, paper cup, and scale to each group.

Instructions:

1. Students will follow the directions on the student worksheet to find the number of nuts and bolts in a cup.
2. If students finish early, provide them a cup of nuts, bolts, and washers as an extension.

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Student Worksheet: Unmixing the Mixture

Problem Statement:

Suppose you have a mixture containing two different items. You know the total count and the total weight of the mixture. You also know the weight of each type of item. But you do not know the number of each item in the mixture. You will determine how many items of each type are in the mixture with a simulation using nuts and bolts.

Materials:

Paper cup

Scale

Bolts

Nuts

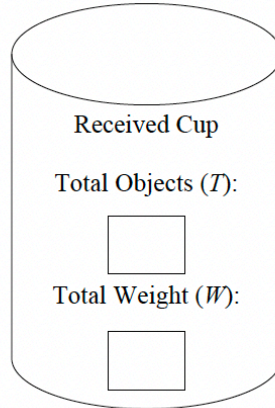
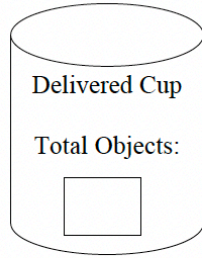
Recording sheet

Procedure:

1. First determine and record the mass of one nut (N) and the weight of one bolt (B). If the scale is not accurate enough to measure just one nut, count and weigh 20 nuts. Divide this weight by 20 to find the weight in grams of a single nut. Similarly, use 20 bolts to determine the weight in grams of a single bolt. Record your weights on the recording sheet.
2. Find the mass of your paper cup. Record this mass P on your recording sheet.
3. Place a handful of nuts and bolts into the cup. Do not attempt to put an equal number of each into the cup. However, you need to know the total number of objects in the cup.
4. Give your cup to another group. Tell this group only the total number of objects in the cup.
5. At the same time, you will receive a cup of nuts and bolts from another group. They should tell you the number of items in the cup. Record this total as T on your recording sheet. Do **not** remove the nuts and bolts from the cup.
6. Use the scale to determine the total mass of the cup with nuts and bolts. Record this total mass M on the recording sheet.
7. Write a system of equations on your recording sheet. Let x represent the number of nuts and y the number of bolts in the cup. Write an equation for the total number of nuts and bolts in the cup. Write an equation for the total mass of the nuts and bolts. (Can you safely ignore the mass of the paper cup?)
8. Solve this system of equations for x and y using a method of your choice. Show your work on the recording sheet. Check your solution by substituting back into your equations.
9. Examine your solution from Step 8. Did your mathematical solution result in whole numbers? If not, why do you think so?
10. Now count the nuts and bolts in the cup. Compare this to your solution for x and y . If the actual number of nuts and bolts is different than you predicted, explain why. Will the actual values of x and y make your equations true (or almost true)?

Recording Sheet: Unmixing the Mixture

Mass of 1 nut (g)	
Mass of 1 bolt (g)	
Mass of paper cup (g)	



"Total Weight" Equation

"Total Number" Equation

Step 8 - Calculations & Solution:

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Math

Step 9 - Did your mathematical solution result in whole numbers? If not, why do you think so?

Council

Step 10 - Actual Count Nuts:

Step 10 - Actual Count Bolts:

Step 10 - If the actual number of nuts and bolts is different than you predicted, explain why. Will the actual values of x and y make your equations true (or almost true)?

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WAMC Lesson Plan

Name(s): Angela Frye

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Lesson Title: 4.2 – Interpreting Solutions to a Linear System Graphically

Date: WAMC Summer 2022

Text: Math Medic Algebra 1

STEM Correlation:

Lesson Length: 50 minutes

Big Idea (Cluster): Systems of Equations	
Mathematics K–12 Learning Standards: A.CED.2, A.REI.C.6, A.REI.C.11	
Mathematical Practice(s): MP1, MP5, MP6, MP7	
Content Objectives: <ul style="list-style-type: none">Understand that a solution to an equation is any ordered pair on its graph and the solution to a system of equations is the ordered pair that lies on the graphs of both equations.Explain what the graph of a linear system looks like with 0, 1, or infinitely many solutions by describing the slopes and y-intercepts of the equations.	Language Objectives (ELL): <ul style="list-style-type: none">Students will be able to use the vocabulary correctly at least 90% of the time.
Vocabulary: <ul style="list-style-type: none">SolutionSystem of Linear Equations	Connections to Prior Learning: <ul style="list-style-type: none">How to graph a linear equationHow to write ordered pairs
Questions to Develop Mathematical Thinking: <ul style="list-style-type: none">How do you know if a certain point is on the line or not?What do you notice about the slopes of lines that do not intersect?If the slopes of two lines are different, how many times will they intersect? Why?	Common Misconceptions: <ul style="list-style-type: none">Graphing the equations incorrectlyMisinterpreting the y-intercept as a x-intercept

Assessment (Formative and Summative):

- Formative: Check Your Understanding worksheet, Quiz
- Summative: Unit project, End of unit test

Materials:

- Student activity worksheet
- Notes worksheet
- Check Your Understanding worksheet
- Colored pencils
- Pencil

Instruction Plan:

Introduction:

Spend 2 minutes reviewing the prior lesson.
Hand out the student activity worksheet.

WAMC Lesson Plan

Put students into pairs or groups of 3 using visibly random grouping.

Explore:

Students will work through the activity worksheet where they will graph different lines by hand and answer questions about them. They will work in pairs or groups of 3 to have someone to confer with in case they get stuck. They will then check their answers using a graphing calculator.

After about 15 minutes, we will go over the activity together and complete the notes worksheet to solidify learning.

Students will then spend the rest of the class period completing the Check Your Understanding worksheet.

When I observe students:

During the activity time, I will be looking for individuals and/or groups that are struggling with getting to graph the equations either using the slope-intercept form or a table without the graphing calculator. I will use that time to reteach that concept as needed.

During the Check Your Understanding work time, I will look for individuals that are misunderstanding the solution of a system found by graphing and use that time to reteach/clarify the concept.

Questions to Develop Mathematical Thinking as you observe:

1. How do you know if a certain point is on the line or not?
2. What do you notice about the slopes of lines that do not intersect?
3. If the slopes of two lines are different, how many times will they intersect? Why?

Answers:

1. When the x-value is substituted into the equation, the y-value results when the equation is in slope-intercept form. If the equation is in standard form, when both the x- and y-values are substituted in and simplified, the value provided results.
2. They have the same slope.
3. They will intersect only one time because the lines are "moving" in different directions.

Summarize:

To find the solution of a system of equations graphically, each lines needs to be graphed and the intersection of the two lines identified. If the two lines are parallel (have the same slope), then there is no solution. If the two lines are identical, then there are an infinite number of solutions.

Career Application(s):

- Finding the break-even point between profit and cost.

WAMC Lesson Plan

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

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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