

**Activity Revision Collaboration (ARC) for Mathematical Inquiry Project (MIP)**

**Activity: Systems of Linear Equations Exploration**

**Course: Functions & Modeling**

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## **Instructional Plan: Systems of Linear Equations Exploration**

**Abstract:** In this systems of linear equations exploration for a Functions & Modeling course, students work with tables, graphs, and algebra to investigate the definition of a solution to a linear equation and apply that definition to a solution of a system of linear equations. In part one, students explore the definition through making tables of values in a scenario involving money. In part two, students transition to equations and graphs to see the visual representation of a solution and how it applies to a patio scenario. In part three, students find a solution using algebra and check the answer with graphing in a brunch item scenario.

### **Rationale for selecting/designing this problem/task sequence:**

This multi-part activity builds on students' prior knowledge of solving linear equations to expand to the knowledge of the definition of a solution to a system of two linear equations. In this activity, students will work with three different scenarios to develop the concept of a solution to a system of linear equations through tables, equations, graphing, and algebra. By the end of the activity, students will have three strategies for solving a system of linear equations and should understand how each method results in the same solution. In the final part of the activity, students are presented two additional scenarios that they can solve with the method of their choice.

### **Prerequisite Knowledge:**

- Students must have an understanding of money; in particular, coins and their values.
- Students must be able to perform basic calculations with coins.
- Students should be able to write equations from words.
- Students should be able to graph linear equations (either by hand or with the graphing calculator).
- Students should be able to solve linear equations for a specified variable.
- Students should be able to solve linear equations.

### **Learning objective(s) and alignment with Student Learning Outcomes (SLO From CEP Matrix):**

- Interpret functions using real-world contexts by translating across multiple representations, including symbols, tables, graphs, and words.
- Identify and analyze families of functions, including linear, polynomial, rational, exponential, and logarithmic functions.
- Apply algebraic techniques and digital resources to create, analyze, and interpret appropriate models (either functions or systems of equations) of real-life phenomena.

## **MIP Components of Inquiry:**

**This section outlines how our activity will meet the Mathematical Inquiry Project (MIP) criteria for active learning, meaningful applications, and academic success skills.**

**Active Learning:** Students engage in active learning when they work to resolve a problematic situation whose resolution requires them to select, perform, and evaluate actions whose structures are equivalent to the structures of the concepts to be learned.

- Students will informally explore the question through building tables of options. They will consider options for 20 coins and options for money totaling \$3.95 to realize that both constraints must be satisfied at the same time. This provides students opportunities for selecting different values for each constraint, performing calculations (to ensure the values meet the constraint), and evaluating how the values relate to the scenario.
- Students will select the options for the constraints and select the option that satisfies both. This supplies students with an opportunity to evaluate which set of values will satisfy both constraints and which sets of values only satisfy one constraint.
- Students will solve the systems of linear equations by tables (guess and check), graphing, and substitution. With using multiple methods to solve a system, students can reason through which method may be most beneficial to them when solving a given system.
- In part four, students are given two more scenarios for independent work with solving systems. They are provided the opportunity of creating their own equations and selecting which method they want to perform. Discussion to evaluate the advantages and disadvantages of each method would help students evaluate their actions.

**Meaningful Applications:** Applications are meaningfully incorporated in a mathematics class to the extent that they support students in identifying mathematical relationships, making and justifying claims, and generalizing across contexts to extract common mathematical structure.

- This problem will lead students through understanding the meaning of finding a solution by allowing them to informally explore with values in a table, then building to finding the solution that works in both equations.
- Students will then formalize their approach by creating equations and making graphs to verify their findings (from the tables).
- Through the four-part activity, students will see the connection that a solution to a system of equations is similar to a solution to a single equation, but that the solution to a system must satisfy both equations (rather than one).

**Academic Success Skills:** Academic success skills foster students' construction of their identity as learners in ways that enable productive engagement in their education and the associated academic community.

- This problem relates to students because money is part of everyday life. This gives them an automatic "in" for understanding the problem/scenario.
- Students will develop an understanding of a solution to a system rather than simply memorizing the process.
- Students will see how the solution can be found in multiple ways and how they are all connected (same answer by a different process).

## Conceptual Analysis (HLT): Solution to a Linear System

- [Boxes] What are the milestones of a task sequence?
- [Arrows] How are the prerequisite topics relied on or used in order to reach the learning objective?

### Part One:

Prerequisite Knowledge:  
Understanding of money  
Basic calculations with coins

↓Recognize how to calculate correct values for the table.

Identify a solution of a linear equation.

↓Recognize a common pair or solution in both tables.

Identify a solution of a linear system.

### Part Two:

Prerequisite Knowledge:  
Write equations from words

↓Write an equation for the first constraint.

↓Write an equation for the second constraint.

Recognize that the equations are linear equations that would graph as lines.

Prerequisite Knowledge:  
Solve linear equations for a specified variable.

↓Solve each equation for the same variable,  $s$ .

↓Graph each equation in the graphing calculator.

Target Knowledge: Identify the intersection point as the solution to the system of equations.

↓Solve each equation for the same variable,  $r$ .

↓Graph each equation in the graphing calculator.

Target Knowledge: Identify the

Recognize that solving for either variable

intersection point as the solution to the system of equations.

will result in the same solution in terms of the scenario (but with the  $x$  and  $y$  values switched on the graphing calculator).

### Part Three:

Prerequisite Knowledge:  
Write equations from words

↓ Write an equation for the first constraint.

↓ Write an equation for the second constraint.

↓ Solve each equation for  $m$ .

Prerequisite Knowledge:  
Solve linear equations.

↓ Set equations equal and solve for  $h$ .

Find the value for  $h$ .

↓ Use substitution to find the value for  $m$ .

Target Knowledge: Identify the point as the solution to the system of equations.

↓ Check by graphing.

Target Knowledge: Identify that algebra or graphing can find the solution to the system of equations.