

**LessonTitle: Systems of Linear Equations****Alg 6.5****Utah State Core Standard and Indicators** Algebra Standard 2.2 Process Standards 1-5**Summary**

In this activity, students solve systems of equations problems “Where does the money go,” and “Renting Skates” using graphs. Then, in 6.5c. they revisit the Chickens and Pigs problems to study the substitution and elimination strategies for solving systems of equations. Students can then practice solving problems using these methods.

**Enduring Understanding**

Algebra helps us solve complex problems involving interrelated situations with common variables

**Essential Questions**

How do you represent interrelated information mathematically? How does this communication help us solve problems

**Skill Focus**

- Writing and solving linear systems of equations using 3 methods

**Vocabulary Focus****Assessment**

See Systems of Equations Tests below. Students should do the first test as groups. The second could be individual or as partners. You might allow them to choose 3 problems from the page and solve all three using different methods. Or you could have them solve 2 problems three times, using all methods on the same problem.

**Materials** Calculators and Computers**Launch**

“Review the chickens and pigs problem that was solved by trial and error and graphing. Show an overhead transparency of the graphs of the lines and talk about the solution.”

**Explore**

“The students explore the substitution and elimination methods by doing the first page of the Alg 6.5c activity. They can check their accuracy by comparing their solutions with the graphing solution. Group work is probably the preferred method. However, some students chose to work alone.”

**Summarize**

“Solve a few systems where the equations are set up using either substitution or elimination and check the solution using the other method. Then finish pages 5 - 6 of the activity where you must set-up your own system. Check for basic understanding using Test 1. A higher level understanding can be evaluated with Test 2.”

**Apply**

**Directions:** The following activities include problems which utilize systems of equations. (Though technically the equations are step functions, they can be examined as two linear equations).

“Where does the money go,” and “Renting Skates” are meant to solve using graphs. After you have solved these problems, then go to 6.5c to introduce the substitution and elimination strategies. Revisit the Chickens and Pigs problem to teach these methods. Students can then practice solving problems by choosing the method of their preference—different problems lend themselves to different solution strategies.

Please note that TI interactive is effective for teaching all three methods of solving systems of equations. After students have a little “by-hand” practice with each method, TI interactive might be utilized. Making TI interactive solve the problems has the effect of making students focus on the concepts behind the steps for solving systems—In this way it helps them to be better at solving them by hand. Directions can be found in the TI Interactive book.

You may choose to access [Exploring Algebra with Geometer’s Sketchpad](#) pages 57-68

## Alg 6.5a      Where Does the Money Go!!

Kim currently has \$20 and decides to save \$6 per week from her weekly babysitting job.

Jenny currently has \$150 and decides to spend \$4 per week on entertainment.

- Create a scatter plot for Kim's money for 16 weeks.
- Create a scatter plot of Jenny's money for 16 weeks.

Graph the scatter plots on the graphing calculator. Select and record the window range that you would use. Draw a sketch of your graphs and label them.

X min =  
X max =  
X scl =  
Y min =  
Y max =  
Y scl =



1. Which axis represents the number of weeks?
2. Which axis represents the amount of money each girl will have?
3. How long will it take Jenny to run out of money at this rate if she has no additional income?
4. How long will it take Kim to have \$150?
5. What does it mean when the two graphs intersect?
6. When will Kim and Jenny have the same amount of money?
7. Who has more money after 10 weeks?
8. Who has more money after 15 weeks?

## Alg 6.5b

## Renting Skates

Young Rental rents inline skates for \$5 plus \$3.00 per hour. They charge to the nearest quarter hour.

1. What sentence and equation can you write to describe Young Rental's charges? Put the equation in Y1 on your calculator.
2. Write an equation for this problem: How many hours result in a charge of \$29?
3. Solve numerically by guess and check. What is your solution?
4. Find the solution using your TABLE on the calculator. What is the solution?
5. Find the solution using TRACE on the graph. What is the solution?

### *Comparing Strategies*

Riddle Rental Competes with Young Rental by renting inline skates for \$8 plus \$2.50 per hour.

1. Describe Riddle's competing strategy.
2. Write a linear function for Riddle Rental's charges. Put the equation in Y2 on your calculator.
3. Compare strategies. When is Riddle cheaper than Young?
4. Compare strategies. When are Young and Riddle the same?
5. Show the solution in the TABLE on your calculator for question 4. What is the solution?
6. GRAPH and TRACE to point (6, 23). What does the point correspond to in the table?
7. How can you use the solution to solve the equation  $8 + 2.5x = 5 + 3x$ ?

### *Find a Competing Strategy*

The rentals are the same at 6 hours at a cost of \$23. Construct your own scheme that is the same at 6 hours. Be prepared to explain the reason for your price scheme.

## Alg 6.5c

## Systems of Equations Practice

**You can solve systems of equations using methods other than graphing. If you know these methods, then you can choose the easiest method for each problem. To study these methods, let's revisit the chickens and pigs problem.**

A farmer saw some chickens and pigs in a field. He counted 60 heads and 176 legs. Problem solve with your group to find out exactly how many chickens and how many pigs he saw.

a) The **substitution** method.

- Your goal in this method is to first work with only one variable and one equation to solve for that variable. After you find one variable, you go back and substitute to find the other.
  - Start with your equations in slope intercept form:  
Heads equations \_\_\_\_\_ Legs equation \_\_\_\_\_
  - Figure out a way you could substitute a value from one equation into the other so you can work with just one variable and one equation.
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- After you know the value of the first variable, go back and figure out the value of the other variable. Show your work.

b) The **elimination** method.

- Your goal is to eliminate one variable by adding or subtracting the equations together.
  - Begin with your equations in standard form.  
Heads equations \_\_\_\_\_ Legs equation \_\_\_\_\_
  - Line the equations up one above the other like an addition problem. Figure out what you can do to the equations so that if you add or subtract one from the other, you will eliminate a variable. (The teacher may decide to guide the students.)
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- After you know the value of the first variable, go back and figure out the value of the other variable. Show your work.

c) Which method do you like so far? Why?

d) Explain when you might use each of the following methods (When would the method be the easiest?).

- Trial and Error
- Graphing
- Substitution
- Elimination

**Solve the following problems. Decide which method would be easier. Use it first. Then check using a second method. Show both methods for each problem.**

- 1) Mr. Cassidy is trying to choose the best *one-day* rental plan from the A-1 Rental Agency. The agency offers two rental plans. How many miles could Mr. Cassidy go in a day before plan 2 becomes more expensive?  $y$  = money spent.  $x$  = miles traveled  
Plan 1: \$30 per day with unlimited mileage  $y = \$30$   
Plan 2: \$20 per day plus \$.10 cents per mile.  $y = \underline{\hspace{2cm}}$

- 2) Your younger sister wants to earn money by selling lemonade. The cost of starting the business is \$1.20. The cost to make the lemonade is \$.06 per cup. She sells the lemonade for \$.25 per cup. How many cups of lemonade must she sell before beginning to make a profit.

Expense equation:  $y = \underline{\hspace{2cm}}$       Income equation:  $y = \underline{\hspace{2cm}}$

Suppose the cost of making lemonade increases to 10 cents per cup. If she sells the lemonade for the same price, when will she begin to make a profit?  $\underline{\hspace{2cm}}$  Why?  $\underline{\hspace{2cm}}$

- 3) You are navigating a battleship during war games. Your course will take you across several enemy shipping lanes. Your mission is to lay mines at the points where the enemy lanes intersect. The enemy shipping lanes are represented by the following equations. At what points do you lay your mines?  
Enemy Lane 1:  $x - y = -4$   
Enemy Lane 2:  $3x - y = 10$   
Enemy Lane 3:  $x - 2y = -2$

- 4) A farmer plants two kinds of crops on his 2500 acre farm. The income from Crop X is \$230 per acre. The income from Crop Y is \$280 per acre. The farmer's goal is to earn \$625,000 from the sale of the crops. How many acres of each crop should the farmer plant?

Equation for total acreage: \_\_\_\_\_

Equation for money earned \_\_\_\_\_

- 5) You have been offered a job marketing medical products. The company has two salary plans. Plan A pays a monthly salary of \$700 plus a commission of \$50 for each medical product you sell. Plan B pays a monthly salary of \$500 plus a commission of \$70 for each product sold. Analyze the income for the two plans.

Equation A: \_\_\_\_\_

Equation B: \_\_\_\_\_

- 6) On Mon., Tues., and Wed. of their vacation the Mortons traveled a total of 870 miles. On Tuesday they traveled 150 miles more than on Monday. On Wednesday they traveled thirty miles less than on Tuesday. How many miles did they travel each day?

Equation for total miles: \_\_\_\_\_

Equation for Monday \_\_\_\_\_

Equation for Tuesday \_\_\_\_\_

Equation for Wednesday \_\_\_\_\_

# Systems of Equations TEST

Name \_\_\_\_\_

- 1) Solve these systems of equations **graphically**.

$$\begin{aligned}y &= -x + 2 \\y &= 2x - 1\end{aligned}$$

$$\begin{aligned}y &= -2x + 2 \\y &= x + 5\end{aligned}$$

- 2) State whether the following system of equations will have one solution, no solutions, or infinite solutions.

$$\begin{aligned}y &= 2x + 3 \\y &= 2x - 3\end{aligned}$$

$$\begin{aligned}x + y &= 10 \\2x + 2y &= 20\end{aligned}$$

$$\begin{aligned}y &= \frac{1}{3}x + 2 \\y &= 3x + 2\end{aligned}$$

- 3) Solve these systems of equations using **substitution**.

$$3x - y = -10 \quad x = 2y - 10$$

$$y = x + 4 \quad 3x - y = -14$$

- 4) Solve these systems of equations using **addition or subtraction**.

$$\begin{aligned}x - y &= 7 \\3x + y &= 5\end{aligned}$$

$$\begin{aligned}3x - 2y &= 8 \\x - 2y &= 0\end{aligned}$$

$$\begin{aligned}2x - 5y &= -16 \\3y &= 2x + 12\end{aligned}$$

- 5) Solve these systems using **multiplication** and **then addition or subtraction**.

$$\begin{aligned}2x - 4y &= 8 \\3x - 2y &= 8\end{aligned}$$

$$\begin{aligned}x - 5y &= 10 \\2x - 10y &= 20\end{aligned}$$

$$\begin{aligned}2x + 5y &= 3 \\x - 3y &= 7\end{aligned}$$

## Systems of Equations TEST 2

Name s \_\_\_\_\_

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- 1) A hunter saw some hyenas and ostriches in a field in Australia. He counted 17 heads and 60 legs. How many hyenas and ostriches were there?

- 2) Your younger sister wants to earn money by selling lemonade. The cost of starting the business is \$1.80, and each cup of lemonade costs five cents to make. How many cups of lemonade must she sell before beginning to make a profit if she sells each cup for a quarter?

(Expense)  $y =$  \_\_\_\_\_                      (Income)  $y =$  \_\_\_\_\_

- 3) You are navigating a battleship during war games. Your course will take you across several enemy shipping lanes. Your mission is to lay mines at the points where the enemy lanes intersect. The enemy shipping lanes are represented by the following equations. At what points do you lay your mines?

Enemy Lane 1:  $x - y = 5$

Enemy Lane 2:  $6x - 2y = -6$

Enemy Lane 3:  $x - 2y = 4$

- 4) A farmer plants two kinds of crops on his 2500 acre farm. The income from Crop A is \$230 per acre. The income from Crop B is \$280 per acre. The farmer's goal is to earn \$625,000 from the sale of the crops. How many acres of each crop should the farmer plant?
- 5) You have been offered a job selling mechanical equipment. The company has two salary plans. Plan A pays a monthly salary of \$2000 plus a commission of \$80 for each medical product you sell. Plan B pays a monthly salary of \$500 plus a commission of \$100 for each product sold. Analyze the income for the two plans.
- 6) On Mon., Tues., and Wed. John read a total of 580 pages. On Tuesday he read 150 pages more than on Monday. On Wednesday he read 30 less than twice as much as on Tuesday. How many pages did he read each day?