Spring Fling Carnival: Applying Systems of Linear Equations

Strand:	Equations and Inequalities
Topic:	Applying systems of linear equations to solve practical problems
Primary SOL:	A.4 The student will solve

        d) systems of two linear equations in two variables algebraically and graphically; and

        e) practical problems involving equations and systems of equations

Related SOL:	A.4a**,** A.7f

Materials

- Graphing utilities
- Graph paper

Vocabulary

coordinate, infinite solutions, ordered pair (earlier grades)
intersection, linear equation, solution set, system of linear equations (A.4)
function (A.7)

Student/Teacher Actions: What should students be doing? What should teachers be doing?

1. Display the following situation: "Two teams need to raise $100 each for their end-of-the-year field trips. Team A wants to sell popcorn at the Spring Fling Carnival, and Team B wants to sell cotton candy. It costs $15 to rent a popcorn machine, whereas it costs $25 to rent a cotton candy maker. The cost of additional supplies for the popcorn is $0.05 per bag, and the additional cost for the cotton candy is $0.10 per stick. Team A will sell the bags of popcorn for $0.50 each. Team B will sell the cotton candy for $0.75 per stick."

2. Ask students the following questions:
   - How many bags of popcorn will Team A need to sell to reach their goal?
   - How many sticks of cotton candy will Team B need to sell to reach their goal?
   - What is the least number of items each team would need to sell to avoid losing money?
   - At what point do both teams earn the same amount of profit? How do you know?

3. Guide students through the process of finding reasonable answers to the questions above. Ask students to
   - define variables;
   - create a system of equations to model the problem;
   - solve the system of equations; and
   - verify the solution in the context of the problem.

4. When students have finished, discuss their results and lead them step-by-step through the process, using a graphing utility.

5. Have students work with a partner. Give two examples of practical problems involving systems of equations. For each problem, both students will work together to define variables and create a system of equations to model the problem. Separately, though, one student will solve the system of equations by using graph paper or a graphing utility, and the other will solve the system by using an algebraic method (substitution or elimination). Then, they will verify their solutions in the context of the problem. They will switch roles for the second example. Two examples you can give are:

   • Your school is selling tickets for the band concert. On the first day of ticket sales the school sold five adult tickets and three student tickets for a total of $18. The school took in $22 on the second day by selling seven adult tickets and one student ticket. Find the price of an adult ticket and the price of a student ticket.

   • A total of 27 students are in your class. There are nine more males than females. How many male males and females are in your class?

Assessment

• **Questions**

   o Imagine that you are an ecologist studying the population of two types of fish in a lake. Use the data in the table below to predict when the populations of the two types of fish will be the same.

Fish Type	Current Population	Change (No. per Year)
A	5,750	−250
B	3,500	+500

   o You and your sister are saving money from your allowances. You have $25, and you save $3 each week. Your sister has $40, and she saves $2 each week. After how many weeks will you and your sister have the same amount of money? How much money will each of you have then? How much money will you need to save each week to have that same amount of money after 10 weeks? How much money will each of you have at that point?

   o How do you determine whether a system of two linear equations has one solution, an infinite number of solutions, or no solution?

• **Journal/writing prompts**

   o Describe a real-world situation that can be solved using systems of equations.

   o Explain when each method (algebraic or graphic) is best to use for solving systems of equations.

• **Other Assessments**

   o Explain two different methods for confirming solutions to a system of two linear equations?

   o Explain the process of solving systems of equations to another student.

Extensions and Connections (for all students)

- Have students rework the Spring Fling Carnival problem, changing the selling price of popcorn to $.75 and of cotton candy to $.80.

- We are often tasked with important financial decisions that involve determining how much money to invest and how much we can gain from the investment. Systems of equations are important in making those financial decisions. Some examples include which cellphone plan to use, which internet provider is most cost-efficient, what type of retirement plan to choose, and which kind of car loan to take out for the purchase of a vehicle.

- Students could research and gather data relating to one of the situations described above. Then, they could create a system of equations to analyze which option is best for various scenarios.

Strategies for Differentiation

- Encourage the use of graph paper, graphing calculators, pictorial representations of the problems, and graphic organizers to represent the information.

- Use the following outline instead of the written problem for students who have trouble processing written information.

   Team A—Popcorn

      i. Cost of renting a popcorn machine—$15
      ii. Cost of popcorn bags—$0.05 each
      iii. Sale price—$0.50 each

   Team B—Cotton Candy

      i. Cost of renting a cotton candy maker—$25
      ii. Cost of cotton candy sticks—$0.10 each
      iii. Sale price—$0.75 each

   Goal of each team—$100

- When solving a system of equations with substitution, use "rectangles" or a certain color to represent which expression is going to be substituted for *y* in the second equation.

- Dry-erase boards with use of different colors may aide in solving systems using the substitution method for solving algebraically.

- Use tables to keep linear equations in two variables aligned when using the elimination method. For example:

Ax	+/-	By	=	C
-2x	—	4y	=	-1
2x	+	3y	=	30

- Have students create a graphic organizer, or provide a graphic organizer, that students can complete for determining which method of solving systems of equations is most appropriate.

- Allow students to work with a partner before step 5.