

- **Pathway:** Animal, Plant, and Soil Science
- **Lesson:** APSR E5–9: Pesticide Application
- **Common Core State Standards for Mathematics:** 9-12.A-CED.2
 - Domain:** Creating Equations A-CED
 - Cluster:** Create equations that describe numbers or relationships.
 - Standard:** 2. Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.
- **Student Objective:** Students will create equations to estimate the time needed for a crop protection business to apply pesticides to its customers' crops.

BACKGROUND KNOWLEDGE for Teachers and Students

➤ **Math Concepts:**

Dependent Variable: A variable that depends on one or more other variables. For equations such as $y = 3x - 2$, the dependent variable is y . The value of y depends on the value chosen for x .

Independent Variable: A variable in an equation that may have its value freely chosen without considering values of any other variables. For equations such as $y = 3x - 2$, the independent variable is x .

Function: An equation for which any x that can be plugged into the equation will yield exactly one y out of the equation.

$$f(x) = 3x - 2$$

If x is 4; then $f(x) = 3(4) - 2$; $f(x) = 10$

How to graph a function:

Khan Academy—Video

(<http://www.khanacademy.org/math/algebra/algebra-functions/v/graphing-a-basic-function>)

► Agriculture Concepts:

Pesticides are used in crop production and horticulture settings to protect plants from weeds, diseases, or insects. Herbicides are used to kill unwanted weeds, fungicides are used to prevent plants from becoming infected with fungal diseases, and insecticides are used to control damaging insects.

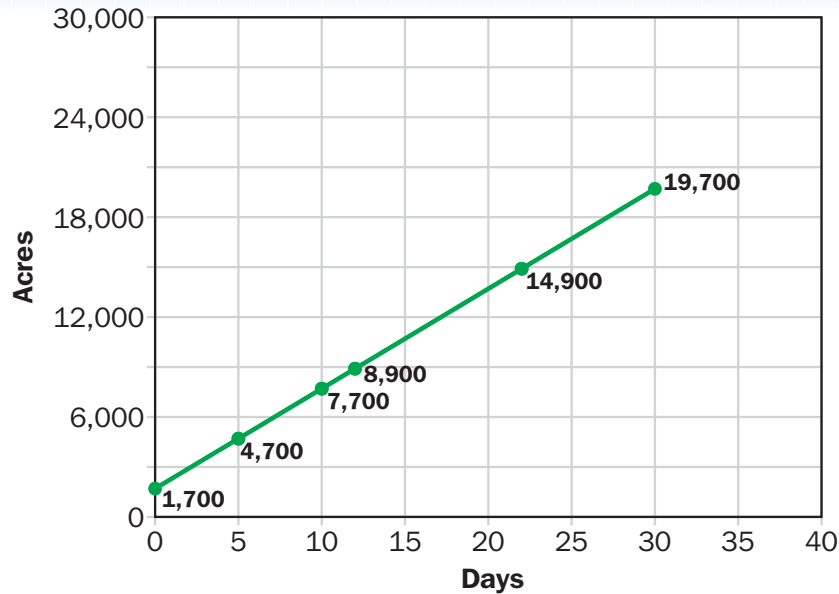
Successful crop protection businesses must be able to determine the most appropriate types and rates of pesticides to use and must have adequate labor and machinery to handle customer requests in a timely manner.

Guided Practice Exercises: ANSWER KEY

1. $f(x) = 600x + 1,700$
2. Independent variable = x ; unit = days
Dependent variable = y ; unit = acres

Independent Quantity	Dependent Quantity
0	1,700
5	4,700
10	7,700
12	8,900
22	14,900
30	19,700

3.



4. Approximately 40

5. $f(x) = 600x + 1,700$

$$26,000 = 600x + 1,700$$

$$26,000 - 1,700 = 600x$$

$$24,300 = 600x$$

$$24,300 \div 600 = x$$

$$40.5 \text{ days} = x$$

Crop Protection, Inc., will be very close to being able to meet its spraying obligations. Joe and Mike anticipate 40 days conducive to spraying but estimate 40.5 days needed to complete the work with one sprayer and one person to apply the pesticides.

6. $f(x) = 600x + 1,700$

$$38,000 = 600x + 1,700$$

$$38,000 - 1,700 = 600x$$

$$36,300 = 600x$$

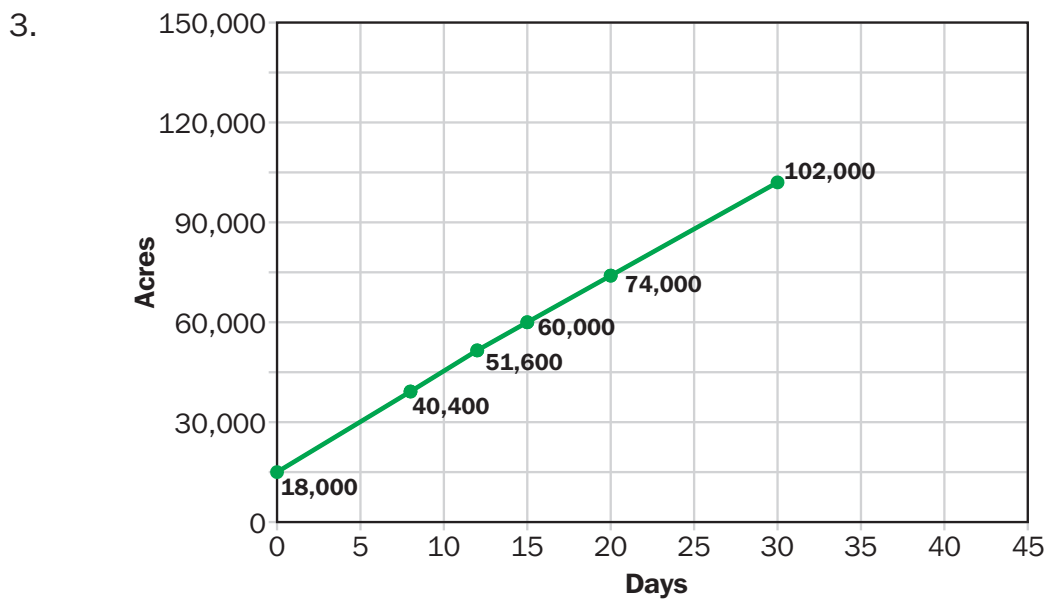
$$60.5 \text{ days} = x$$

Joe and Mike's business needs $60\frac{1}{2}$ days to meet its spraying obligations. With only one sprayer and one person to apply the pesticides, Joe and Mike will not be able to spray all 38,000 acres. Either they will need to turn down some business (which they obviously don't want to do), or they can hire a part-time applicator and lease or purchase an additional sprayer.

Independent Practice Exercises: ANSWER KEY

- $f(x) = 2800x + 18,000$
- Independent variable = x ; unit = days
Dependent variable = y ; unit = acres

Independent Quantity	Dependent Quantity
0	18,000
8	40,400
12	51,600
15	60,000
20	74,000
30	102,000



- Approximately 35
- $f(x) = 2,800x + 18,000$
 $120,000 = 2,800x + 18,000$
 $120,000 - 18,000 = 2,800x$
 $102,000 = 2,800x$

$$102,000 \div 2,800 = x$$

$$36.43 \text{ days} = x$$

Crop Protection, Inc., will be able to meet its spraying obligations with four sprayers and with four applicators to run the sprayers for those 35 days of spraying. Joe and Mike anticipate needing 35 days conducive to spraying but estimate just over 36 days needed to complete the work. They'll either need to work an hour or two longer one week or hope for an additional day that is conducive to spraying.

6. $f(x) = 2,800x + 18,000$

$$160,000 = 2,800x + 18,000$$

$$160,000 - 18,000 = 2,800x$$

$$142,000 = 2,800x$$

$$50.7 \text{ days} = x$$

Crop Protection, Inc., will not be able to meet its spraying obligations adequately if it sprays an additional 40,000 acres and does not have more than four sprayers and four persons to run the sprayers. A full-time sprayer should be able to spray 30,000 acres. Thus, Crop Protection, Inc., should purchase or lease one sprayer and hire one full-time custom applicator. Additionally, it should hire a part-time custom applicator and purchase or lease another sprayer.

Guided Practice Exercises:

Joe and his brother Mike own and operate Crop Protection, Inc., which mainly involves the custom application of fertilizer and chemicals. The spring planting season has just begun, and they have already sprayed 1,700 acres. They currently operate only one sprayer and can spray an average of 600 acres per day.

1. Write a function $f(x)$ to represent this problem.
2. Identify the independent variable and unit; identify the dependent variable and unit; then complete the table.

Independent Quantity	Dependent Quantity
0	
5	
10	
12	8,900
	14,900
	19,700

3. Graph the function $f(x)$ representing this problem, using the data in the table above. The independent variable should go on the x axis, and the dependent variable should go on the y axis.

4. Joe and Mike expect to spray 26,000 acres this year. Estimate the number of days it will take for them to finish their spraying.
5. Algebraically determine the number of days it will take Joe and Mike to spray 26,000 acres. If they anticipate having 40 days conducive to spraying, will they be able to complete their spraying with only one sprayer and one applicator?
6. Assume Joe and Mike's business continues to grow, and next year they are hired to spray 38,000 acres. If they anticipate having 40 days conducive to spraying, will they be able to complete their spraying with one sprayer and one applicator? If not, what should they do?

Independent Practice Exercises:

It is late April, and Crop Protection, Inc., has already sprayed 18,000 acres of corn. The company currently operates four sprayers with 100-foot booms and can spray an average of 700 acres per day per machine.

1. Write a function $f(x)$ to represent this problem.
2. Identify the independent variable and unit; identify the dependent variable and unit; then complete the table.

Independent Quantity	Dependent Quantity
0	
8	
12	
15	60,000
	74,000
	102,000

3. Graph the function $f(x)$ representing this problem, using the data in the table above. Put the independent variable on the x axis and the dependent variable on the y axis.

4. Joe and Mike expect to spray 120,000 acres this year. Estimate the number of days that it will take for them to finish their spraying.

5. Algebraically determine the number of days it will take Joe and Mike to spray 120,000 acres. If they anticipate having 35 days conducive to spraying, will they be able to complete their spraying with four sprayers and four applicators?

6. A competitor recently retired, and Crop Protection, Inc., is expected to spray an additional 40,000 acres next year. You are the manager of Crop Protection, Inc. Do you need to purchase an additional sprayer and hire an additional custom applicator? Explain your answer.