LESSON 21

Cookies and Calories—Using the Elimination Method

solution

Graphing algebraically

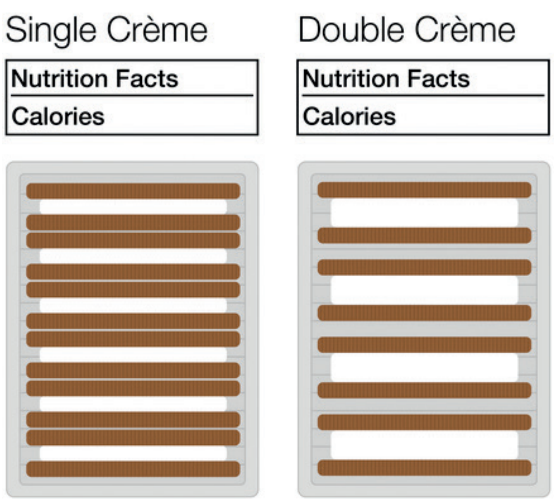
-sub

-elimination

LEARNING OBJECTIVES

- Today I am: completing the Desmos activity *Wafers and Crème.*
- So that I can: explore how a system of equations could be written for this situation.
- I'll know I have it when I can: solve system of linear equations algebraically using the Elimination Method.

Opening Exercise



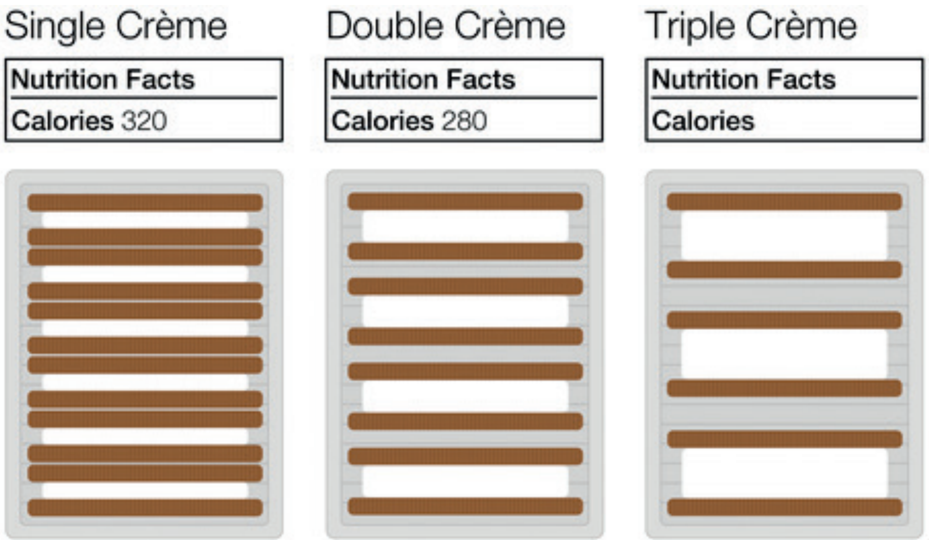
1. Go to student.desmos.com and type in the class code: ______________________ to start the Desmos activity *Wafers and Crème*.

2. Use the space below to make your calculations for the number of calories for the Triple Crème package.

3. What was your calculation for the number of calories in the Triple Crème?

4. How did you come up with your answer?

On the third screen you saw the following information. This type of problem can be solved with a *system of equations.*



5. What are the two quantities you don't know?

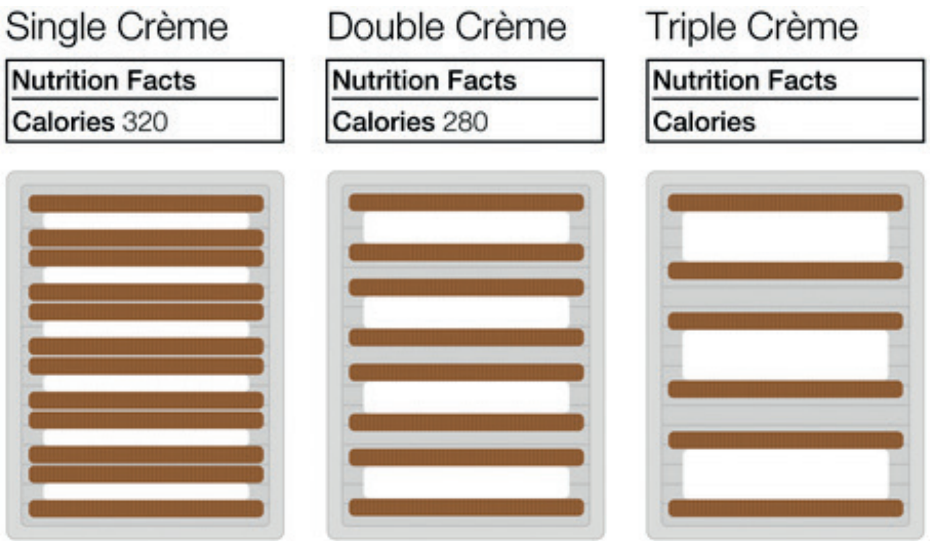
6. Dean wrote the equation $12w + 6c = 320$ for the Single Crème package.

   A. What does the *w* and *c* represent in Dean's equations?

   B. Using Dean's variables, write an equation for the Double Crème package.

7. It is also possible to solve the Triple Crème packaging problem without writing any equations. How might someone solve this problem without equations?

In the last two lessons, we've looked at solving systems of equations using graphing or substitution. In this lesson, we'll look at a method called ***elimination*** to solve the system.



Let $w =$ the number of calories in the top or bottom wafers

Let $c =$ the number of calories in the crème.

For the single crème package, we get $12w + 6c = 320$.

For the double crème package, we get $8w + 8c = 280$.

Discussion

8. What are ways we could simplify each equation?

9. Does simplifying an equation change the value of w or c?

In the last lesson, we looked at applications of systems of equations and found their solutions by either graphing or with algebra using substitution. In this lesson, we'll use the ideas from the Exploratory Exercise below to ***eliminate*** one variable.

Exploratory Exercise

10. A. Are the following statements true?

(A) $2 + 7 = 9$

(B) $5 - 8 = -3$

B. What if we multiply equation (A) by 3, will it still be true? Why? We'll call this new equation (C).

(C) $3(2+7) = (9)3$

$6 + 21 = 27$ ✓

C. What if we add equations (A) and (B)?

(A) + (B) $2 + 7 = 9$

$5 - 8 = -3$

$7 - 1 = 6$ ✓

D. How about if we add equations (B) and (C)?

(B) + (C) $5 - 8 = -3$

$6 + 21 = 27$

$11 + 13 = 24$ ✓

E. What about subtracting equations (A) and (B)?

(A) − (B) $2 + 7 = 9$

$-(5 - 8 = -3)$

$-3 + 15 = 12$ ✓

F. What can we do to true equations to make new, but also true equations?

11. A. Here is a system of two linear equations. Verify that the solution to this system is (3, 4).

Equation A1: $y = x + 1$

Equation A2: $y = -2x + 10$

B. Instead of using the substitution method, let's subtract Equation A2 from Equation A1.

Equation A1: $y = x + 1$

Equation A2: $-(y = -2x + 10)$ → $-y = 2x - 10$

$\boxed{} = \boxed{} + \boxed{}$

$\cancel{y} = x + 1$
$\cancel{-y} = 2x - 10$
$0 = 3x - 9$
$+9 \quad +9$
$9 = 3x$
$3 = x$

Back sub

$y = x + 1$
$y = 3 + 1$
$y = 4$

$\boxed{(3,4)}$

C. Solve for x and then determine the value of y. Your answer should be (3, 4).

12. Solve this system of linear equations algebraically using the Elimination Method.

ORIGINAL SYSTEM

$3(2x + y = 6)$ → Multiply by 3 → $6x + \cancel{3y} = 18$

$x - 3y = -11$ → Keep the same. → $x - \cancel{3y} = -11$

eliminate y

$7x = 7$
$x = 1$

NEW SYSTEM

Back sub $x = 1$

$2(1) + y = 6$

$y = 4$

$(1,4)$

SOLUTION

Check (1,4)

$2(1) + 4 \overset{?}{=} 6$

$2 + 4 = 6$ ✓

$1 - 3(4) \overset{?}{=} -11$

$1 - 12 = -11$ ✓

13. Solve this system of linear equations algebraically using the Elimination Method.

ORIGINAL SYSTEM		NEW SYSTEM	SOLUTION
$2x + 3y = 7$	Keep the same. →	$2x + \cancel{3y} = 7$	
$3(x - y = 1)$	Multiply by $\boxed{3}$ or -2 →	$3x - \cancel{3y} = 3$	

$5x = 10$

$x = 2$

Back Sub

$x - y = 1$

$2 - y = 1$

$-y = -1$

$y = 1$

$(2, 1)$

14. Solve this system of linear equations algebraically using the Elimination Method.

ORIGINAL SYSTEM	NEW SYSTEM	SOLUTION
$2x + 3y = 6$ →	$\cancel{2x} + 3y = 6$	
$-2(x - y = 3)$	$\cancel{-2x} + 2y = -6$	

$5y = 0$

$y = 0$

Back sub

$x - 0 = 3$

$x = 3$

$(3, 0)$

15. A. Let's look back on the Opening Exercise and solve this system using elimination. Be sure to explain what you did to change the equation(s).

Let w = the number of calories in the top or bottom wafers

Let c = the number of calories in the crème.

$2(12w + 6c = 320) \rightarrow \cancel{24w} + 12c = 640$

$-3(8w + 8c = 280) \rightarrow \cancel{-24w} - 24c = -840$

eliminate w

$12, 8 \rightarrow 24$

$-12c = -200$

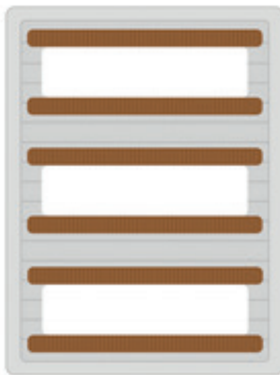
$c = 16\frac{2}{3}$

Back sub

B. How many calories are in the Triple Crème package? Explain how you know.

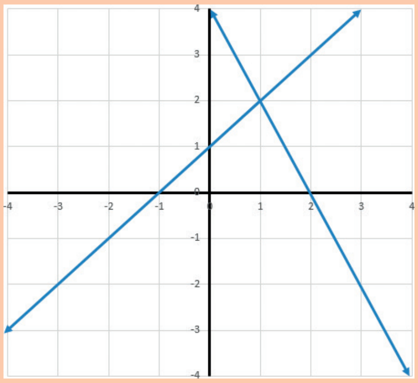
Triple Crème

Nutrition Facts
Calories



Lesson Summary

There are three ways to solve a system of equations.

Graphing	Substitution	Elimination
Graph the lines and find the point of ________.	Rearrange one equation to get one of the variables ________, then substitute into the other equation.	Add or subtract the equations to eliminate one of the variables. You may need to ________ one or both of the equations by a number before adding or subtracting.
	$x - y = -1 \rightarrow y = x + 1$ $2x + y = 4$ $2x + x + 1 = 4$ $3x \quad + 1 = 4$ $3x \quad = 3$ $x \quad = 1$ $y = x + 1 = 1 + 1 = 2$ solution: (1, 2)	$x - y = -1$ $\underline{2x + y = 4}$ $3x + 0 = 3$ $x \quad = 1$ $y = x + 1 = 1 + 1 = 2$ solution: (1, 2)

NAME: ____________________ PERIOD: __________________ DATE: ______________

Homework Problem Set

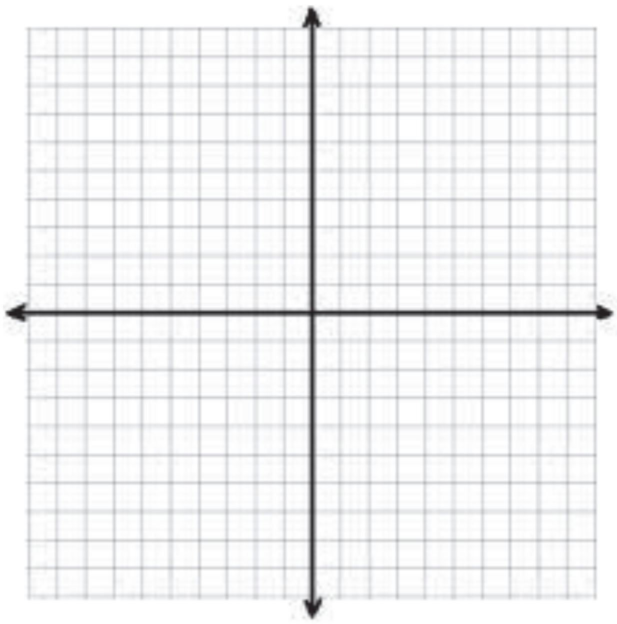
1. Try to answer the following without solving for x and y first.
   If $3x + 2y = 6$ and $x + y = 4$, then

   A. $2x + y = ?$

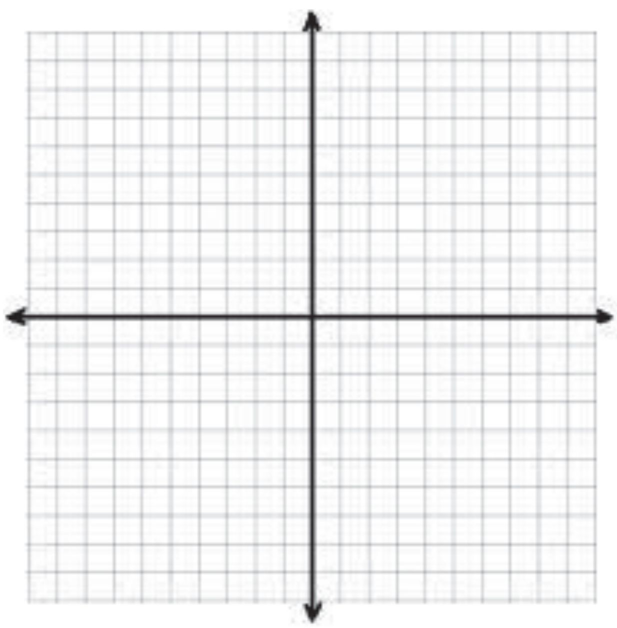
   B. $4x + 3y = ?$

2. Solve the system of equations by graphing. $\begin{cases} y = \frac{1}{4}x \\ y = -x + 5 \end{cases}$

   $\frac{1}{4}x = -x + 5$



3. Create a new system of equations that has the same solution as Problem 2. Show either algebraically or graphically that the systems have the same solution.



4. Without solving the systems, explain why the following systems must have the same solution.

System (i): $4x - 5y = 13$
$3x + 6y = 11$

System (ii): $8x - 10y = 26$
$x - 11y = 2$

Solve each system of equations by writing a new system that eliminates one of the variables.

5. $2x + y = 25$
$4x + 3y = 9$

6. $3x + 2y = 4$
$4x + 7y = 1$