THE BEST DEAL

Focus: Formulation and solution of a system of linear equations.

Objective:

Algebra I TEKS, Linear Functions #7
The student formulates equations and inequalities based on linear functions, uses a variety of methods to solve them, and analyzes the solutions in terms of the situation.

Algebra I TEKS, Linear Functions #8
The student formulates systems of linear equations from problem situations, uses a variety of methods to solve them, and analyzes the solutions in terms of the situations.

Terms: Linear function, system of linear equations, linear inequalities

Set-Up: Participants should be seated at tables in groups of 3-4.

Materials: Transparencies #49-54, Activities #35-37, graphing calculators

Prerequisites: Graphs of linear functions, graphing features of calculator

Procedure:

Transparency #49: The Best Deal
Transparency #50-51: Pet Pantry or Canine Corner?

Introduce the problem situation. Ask for a function that would describe the relation between number of bottles purchased from *The Pet Pantry* and cost. ($y = 4x + 5$)
Ask for a function that would describe the relation between the number of bottles purchased from *The Canine Corner* and cost. ($y = 3x + 15$).

Emphasize Algebra I TEKS, Linear Functions #8
8.a. The student analyzes situations and formulates systems of linear equations to solve problems.

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Activity #35: The Best Deal

Allow time for participants to complete the chart and discuss which company would get their business. The important idea from this activity is that a table of values may not be particularly helpful if you look only at a limited number of values for x. Would students pay attention to the fact that the costs are getting closer and closer to one another? Or would students simply note that the costs for *The Canine Corner* are always greater than the costs for *The Pet Pantry* for the values of x that are shown? There are many patterns worth noting in the table of values, but this problem requires us to compare the output values of the two functions.

Transparency #52: Using Algebra Wisely
Activity #36: Using Algebra Wisely

Allow participants to note the problems with the graph that Cassandra created. Problems that need to be addressed include the following:

(a) Cassandra graphed the function using a domain of 1 through 6, and yet she planned to purchase 18 bottles. Her domain needs to be enlarged to a value greater than 18.

(b) Cassandra should recognize that the two graphs will intersect because the slopes are not the same. She did not find the point of intersection.

(c) Cassandra has made a decision based on a limited amount of information.

Emphasize Algebra I TEKS, Linear Functions #8

8.c. For given contexts, the student interprets and determines the reasonableness of solutions to systems of linear equations.

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Transparency #53: Interpreting Graphs
Activity #37: Interpreting Graphs

This activity is more for students than for participants. The purpose of the graphing exercise is to allow students to *see* what happens to the graphs for values of x>8 if they have not realized that the graphs intersect at x=10. It also provides an opportunity for them to interpret different segments of the graph, i.e., x>10 and x<10.

This part of the activity works well with the graphing calculator also. Allow participants to graph both functions, to select a reasonable viewing window, and to interpret the graphs. If calculators are used, introduce the CALC, 1:value, x=? feature of the calculator. Once a value for x is selected encourage participants to toggle (up and down arrows) between the two functions. Ask why the y values change.

Also use the 2nd, DRAW, 7:Shade, (lowerfunc, upperfunc) to visually illustrate where one function is greater than another.

Emphasize Algebra I TEKS, Linear Functions #7

7.c. For given contexts, the student interprets and determines the reasonableness of solutions to linear equations and inequalities.

Answers to Questions:

1. Cassandra should have realized that the lines would intersect because the slopes are different and therefore the lines are not parallel.
2. The point of intersection (10,45) indicates that the costs ($45) at both businesses are the same when the number of bottles purchased is 10.
3. *The Canine Corner* offers the better deal when x>10. *The Pet Pantry* offers the better deal when x<10. You can tell this from the graph because: (a) to the left of x=10 the *Pet Pantry* line is above the *Canine Corner* line, (b) at x=10 the costs are the same, and (c) to the right of x=10 the *Canine Corner* line is above the *Pet Pantry* line.

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Transparency #54: Using Inequalities

This transparency should be used to illustrate another method for investigating Cassandra's dilemma. It shows how Cassandra could have written a linear inequality using the two functions that she had created and found a solution very quickly.

Emphasize Algebra I TEKS, Linear Functions #7

7.a. The student analyzes situations involving linear functions and formulates linear equations or inequalities to solve problems.

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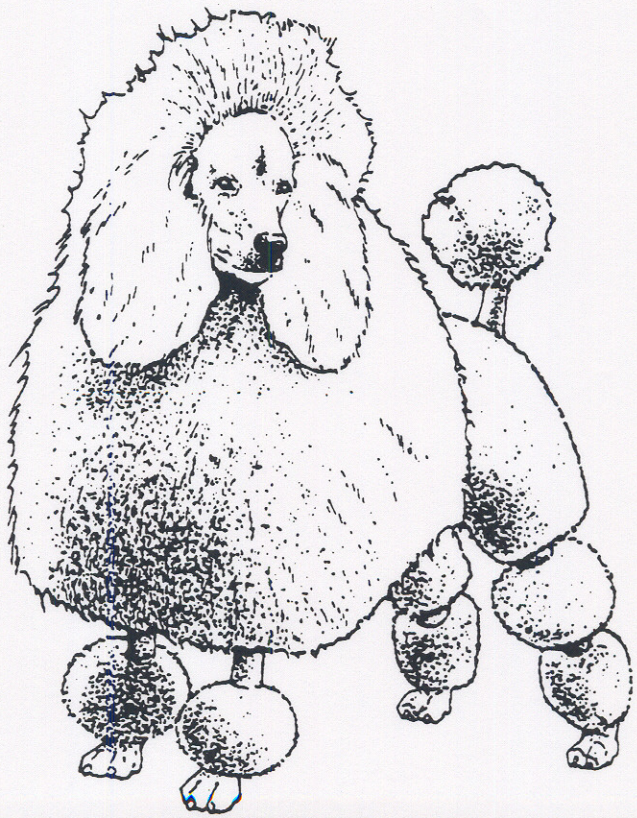
THE BEST DEAL

Cassandra wants to begin her own business, *Pets-to-Luv Grooming Shop*. Each month she will have to order flea shampoo. Two local companies across town supply flea shampoo. *The Pet Pantry* charges $4 per quart bottle plus a $5 handling fee for the whole order. *The Canine Corner* charges only $3 per quart bottle for the same shampoo, but charges a $15 handling fee per order. Which company, *The Pet Pantry* or *The Canine Corner*, offers the best deal?



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PET PANTRY OR CANINE CORNER?

Cassandra believes that setting up a table of values will help her to determine which company offers the best deal on flea shampoo.

She lets x = # of bottles purchased per month and lets y = total cost of order for the month.

Write an expression (in terms of x and y) that represents the cost of purchasing the bottles of shampoo from each company and complete the table.

# bottles	x	1	2	3	4	5	6	7	8
cost at Pet Pantry									
cost at Canine Corner									

Will her table of values assist her in making a good decision?

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PET PANTRY OR CANINE CORNER?

Cassandra believes that setting up a table of values will help her to determine which company offers the best deal on flea shampoo.

She lets x = # of bottles purchased per month and lets y = total cost of order for the month.

Write an expression (in terms of x and y) that represents the cost of purchasing the bottles of shampoo from each company and complete the table.

# bottles	x	1	2	3	4	5	6	7	8
cost at Pet Pantry	4x + 5	9	13	17	21	25	29	33	37
cost at Canine Corner	3x + 15	18	21	24	27	30	33	36	39

Will her table of values assist her in making a good decision?

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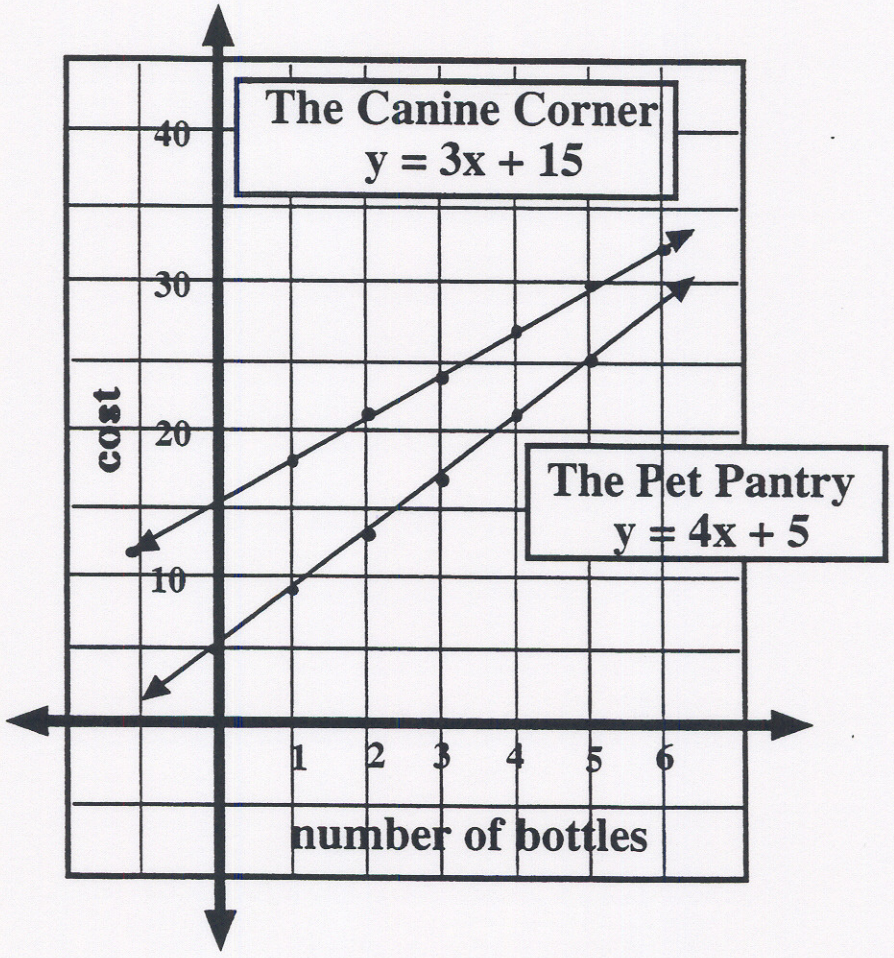
USING ALGEBRA WISELY

Cassandra graphs each function which represents the cost of purchasing shampoo from one of the local companies. From the graph she concludes that *The Canine Corner* is clearly more expensive. She orders 18 bottles of shampoo from *The Pet Pantry*. Has Cassandra used her algebra wisely?



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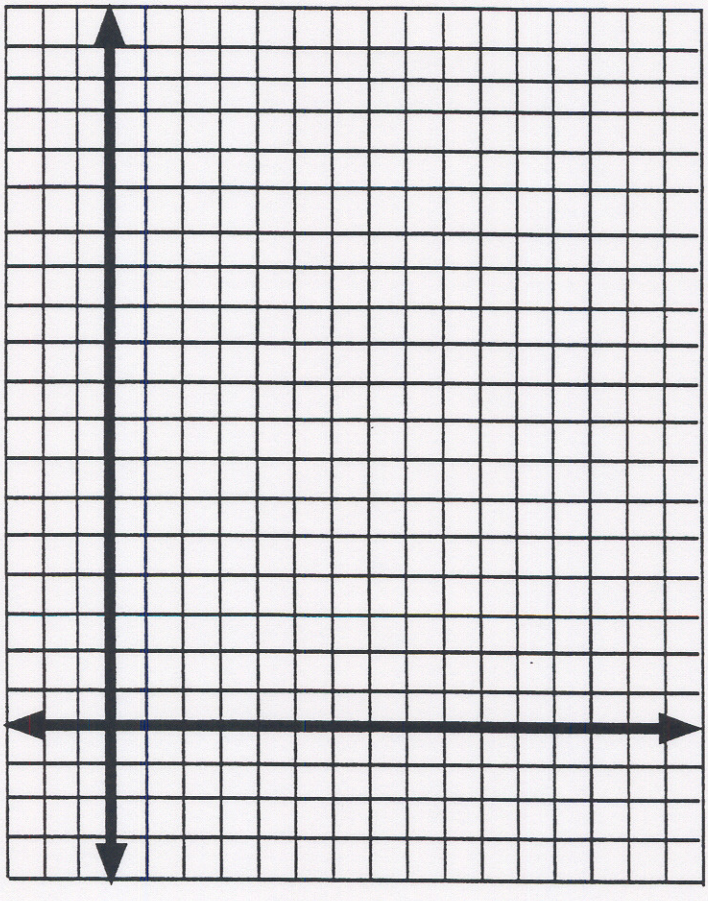
INTERPRETING GRAPHS

Graph Cassandra's two functions on the graph paper below and answer the questions.



1. **The two functions cross when they are graphed. Why should Cassandra have realized that they would intersect before she graphed them?**
2. **What is the meaning of the point of intersection of the graphs of the two functions?**
3. **For what number of bottles does each company offer the best deal? How can you tell from the graph?**

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USING INEQUALITIES

Cassandra's two functions could have been used to solve her dilemma. She could have asked herself, "When will the *Pet Pantry* cost be greater than the *Canine Corner* cost?" In which case she would have had a simple inequality to solve.

$$\textit{Pet Pantry} > \textit{Canine Corner}$$

$$4x + 5 > 3x + 15$$

$$x > 10$$

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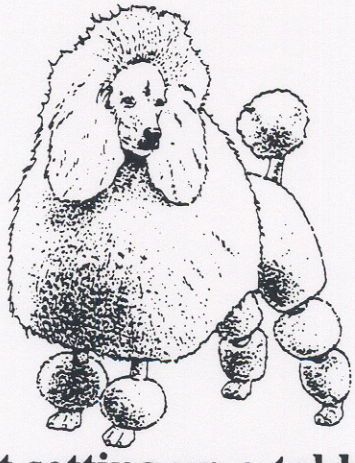
THE BEST DEAL

Cassandra wants to begin her own business, *Pets-to-Luv Grooming Shop*. Each month she will have to order flea shampoo. Two local companies across town supply flea shampoo. *The Pet Pantry* charges $4 per quart bottle plus a $5 handling fee for the whole order, *The Canine Corner* charges only $3 per quart bottle for the same shampoo, but charges a $15 handling fee per order. Which company, *The Pet Pantry* or *The Canine Corner*, offers the best deal?



Cassandra believes that setting up a table of values will help her to determine which company offers the best deal on flea shampoo. She lets x = number of quart bottles purchased per month and lets y = total cost of order for the month.

	x	1	2	3	4	5	6	7	8
Pet Pantry	y =								
Canine Corner	y =								

Complete the table and decide which company would get your business.

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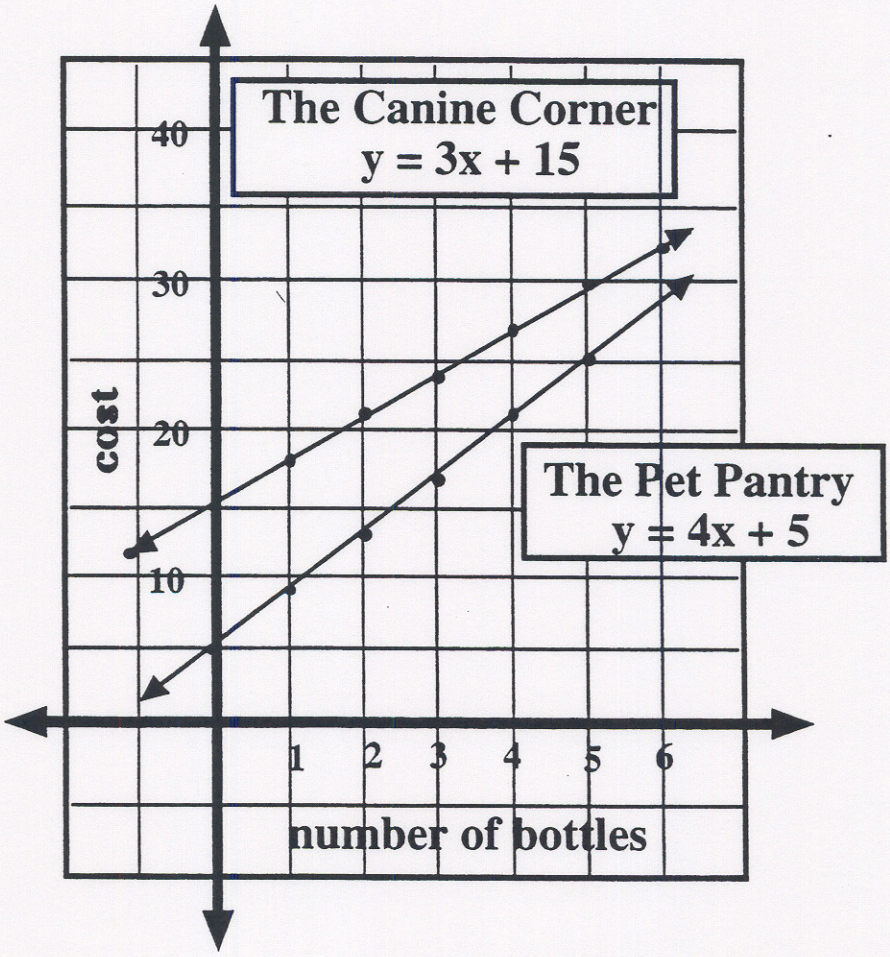
USING ALGEBRA WISELY

Cassandra graphs each function which represents the cost of purchasing shampoo from one of the local companies. From the graph she concludes that *The Canine Corner* is clearly more expensive. She orders 18 bottles of shampoo from *The Pet Pantry*. Has Cassandra used her algebra wisely?



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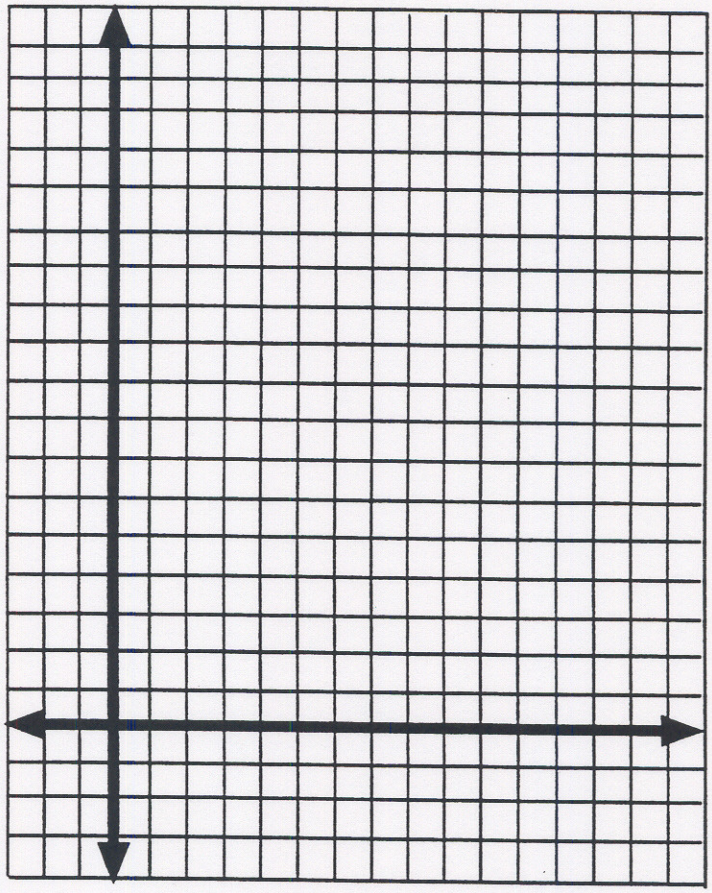
INTERPRETING GRAPHS

Graph Cassandra's two functions on the graph paper below and answer the questions.



1. **The two functions cross when they are graphed. Why should Cassandra have realized that they would intersect before she graphed them?**
2. **What is the meaning of the point of intersection of the graphs of the two functions?**
3. **For what number of bottles does each company offer the best deal? How can you tell from the graph?**

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YOU'LL NOT SINK MY BATTLESHIP!

Focus: Solution of systems of equations using a method of the student's choice.

Objective: **Algebra I TEKS, Linear Functions #8**
The student formulates systems of linear equations from problem situations, uses a variety of methods to solve them, and analyzes the solutions in terms of the situations.

Terms: Slope-intercept form of linear equation, system of linear equations, substitution method, linear combination method

Set-Up: Participants should be seated at tables in groups of 3-4.

Materials: Transparency #57, Activities #38-39, graphing calculators

Prerequisites: Strategies for solving systems of linear equations

Procedure: **Transparency #57: You'll Not Sink My Battleship!**
Activity #38: You'll Not Sink My Battleship!

Participants must navigate a battleship during wartime avoiding encounters with enemy scouting vessels. The captains of the battleships have determined the equations of the scouting lanes of three enemy vessels. The mission of the group is to determine the points at which the battleship's course will cross the enemy scouting lanes so that they can avoid an encounter.

Assign each group of participants one of the Battleship Course numbers. (Note that the intersection points for Group #7 are much easier to determine than the others.) They are to determine the point of intersection of their ship with each of the three enemy vessels. They may use any algebraic method for determining the points of intersection: graphing, substitution, linear combination (addition/subtraction).

Each of the equations should be expressed in the slope-intercept form and graphed using graphing calculators to determine if the intersection points found by each group appear to be reasonable. To find points of intersection on the calculator use the trace or 2nd CALC, 5:intersection features.

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Answers to Activity:

Battleship Course #	Enemy Scouting Lane	Intersection
1	A	(24/5, 54/5)
1	B	(8, 6)
1	C	(102/11, 45/11)
2	A	(-5, 1)
2	B	(17/5, -16/5)
2	C	(-3, 0)
3	A	(9, 15)
3	B	(2, -6)
3	C	(39/8, 21/8)
4	A	(0, 6)
4	B	(64/11, 18/11)
4	C	(60/13, 33/13)
5	A	(-6, 0)
5	B	(9/4, -11/2)
5	C	(-5, -2/3)
6	A	(-3/2, 9/2)
6	B	(1, -8)
6	C	(-3/4, 3/4)
7	A	(-2, 4)
7	B	(-11, -32)
7	C	(-3, 0)

Activity #39: You'll Not Sink My Scouting Vessel!

This activity provides an alternative approach for some of the groups. Allow three groups to approach the problem from the enemy's perspective. They are to determine the point of intersection of their vessel with each of the seven battleships (or the teacher may select three or four battleships on which they are to concentrate). They may use any algebraic method for determining the points of intersection: graphing, substitution, linear combination (addition/subtraction).

The effective part about having some groups determining intersection points from the battleship perspective and others from the enemy vessel perspective is that they can compare to see if they are expecting one another at the same point of intersection.

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Emphasize Algebra I TEKS, Linear Functions #8

8.b. The student investigates solving systems of linear equations using concrete models, graphs, tables, and algebraic methods and solves using a method of the student's choice.

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