

Alice Cook Henke  
Endeavor Cohort 4  
Math Connections in the STEM Classroom  
November 9<sup>th</sup>, 2012

Option 1:

**Linear and Quadratic Equations: Astronauts, Space, and Microgravity  
What a Unit!!**

*Unit Implementation*

Artifacts from Unit Implementation:

- A) Unit Bookends (Introduction and Conclusion)
  - 1. Course Pre/Post Test
  - 2. Fieldwork to Air and Space Museum Quiz
- B) Lesson 1: Patterns and Equations
  - 1. Problem-Solving Problem
  - 2. Space Math “Variables and Expressions from Around the Cosmos”
  - 3. Pattern Challenge Project
- C) Lesson 2: Rates of Change and Slope
  - 1. Balloon Activity Student Notes
  - 2. Space Math “Rates and Slopes: An Astronomical Perspective”
  - 3. Space Math “Working With Rates”
  - 4. Exit Ticket
- D) Lesson 3: Writing and Graphing Linear Equations
  - 1. Guided Notes
  - 2. Centers
  - 3. Exit Ticket
- E) Lesson 4: Reading and Using Graphs
  - 1. Practice Using Graphs to Relate Two Quantities
  - 2. Word Problems and Patters Projects
- F) Lesson 5: Using Linear Equations, Graphs, and Models to Save Astronauts!!
  - 1. Suit Yourself Sketches
  - 2. Suit Yourself Student Work



**A) Unit Bookends:**

1. Course Pre/Post Test: The following artifact is Osmin's initial assessment for the whole Algebra 1 course. The initial assessment includes questions and content for the entire summer school course. While Osmin did not score perfectly on the post test, his overall score was 12% higher than on the pre-test. Osmin's case is interesting, because his level of English proficiency is basic—he only recently moved to the United States at the age of 13 (he is 15 now). Considering all of the complex vocabulary within the word problems and overall pre and post test, Osmin

improved significantly. In the coursework, Osmin's vocabulary grew substantially, because he was very interested in the science connections to Algebra 1.

Name: Osmin Feauon Class: Algebra 1 Date: June 25/12 ID: A

**Summer School Algebra 1 Pre-Test**

**Multiple Choice**  
Identify the choice that best completes the statement or answers the question.

1. The table shows how the height of a stack of DVDs depends on the number of DVDs. What is a rule for the height?

Number of DVDs	Height (cm)
2	1.8
3	2.7
4	3.6
$n$	?

a.  $h = 9n$       c.  $h = 2n$   
 b.  $h = 8n$       d.  $h = \frac{n}{9}$

2. What is an expression for the sale price of a bracelet that has been discounted 60% from its sticker price? Evaluate the expression for sticker prices of \$90.

Use the variable  $s$  for the sale price and  $p$  for the sticker price.

a.  $s = p - 0.6p$ ; \$36      c.  $s = p + 60p$ ; \$5400  
 b.  $s = p - 0.4p$ ; \$54      d.  $s = p + 0.6p$ ; \$90

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3. Which number line model can you use to simplify  $-6 + 4$ ?

a.

b.

c.

d.

4. What is the value of  $\frac{x}{y}$  when  $x = \frac{9}{4}$  and  $y = \frac{3}{5}$ ?

a.  $\frac{15}{4}$       b.  $\frac{4}{3}$   
 c.  $\frac{27}{20}$       d.  $-\frac{13}{4}$

5. Is  $x = 1$  a solution of the equation  $2 - 8x = -6$ ?

a. yes      b. no

6. A souvenir maker wants to create a scale model of the Empire State Building. The Empire State Building is 1472 feet tall and has a base with dimensions 286 ft meters by 286 ft. If the model is 6 in. tall, approximately what are the dimensions of its base in inches?

a. 1.2 in. by 1.2 in.      c. 0.2 in. by 0.2 in.  
 b. 1 in. by 1 in.      d. 2.3 in. by 2.3 in.

7. Which ordered pair is a solution of the equation  $y = 3x$ ?

a.  $(-2, -9)$       c.  $(-8, -3)$   
 b.  $(-8, -18)$       d.  $(-10, -30)$

8. Which ordered pair is a solution of the equation  $y = -9x + 47$ ?

a.  $(10, -86)$       c.  $(6, -41)$   
 b.  $(-4, -38)$       d.  $(-6, 57)$

Name: \_\_\_\_\_

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D 14.  $3 + 6z = 13 + 6z$   $3 + 6z = 13 + 6z$   
 $-6z$   $-6z$   
 $3 = 13$   
 a.  $-\frac{5}{6}$  c. infinitely many solutions  
 b.  $2\frac{2}{3}$  d. no solution

What inequality represents the verbal expression?

D 15. 8 less than a number  $n$  is less than 11  
 a.  $11 - 8 < n$  c.  $8 - n < 11$   
 b.  $n - 8 < 11$  d.  $11 < 8 - n$

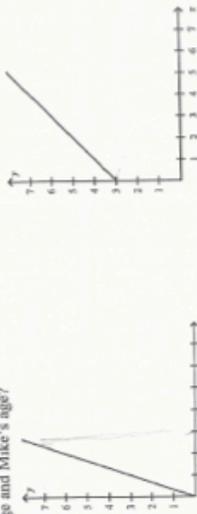
Which number is a solution of the inequality?

D 16.  $10.6 < b$   
 a.  $-18$  c.  $7$  d.  $14$   
 b.  $-9$   
D 17.  $8 < x(7 - x)$   
 a.  $2$  c.  $-1$  d.  $0$   
 b.  $8$

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9. Mike and his best friend Dan have the same birthday, but Mike is 3 years older than Dan. Let the variable  $x$  represent Mike's age and  $y$  represent Dan's age. Which graph represents the relationship between Dan's age and Mike's age?



a.



b.

What is the solution of the equation?

D 10.  $2.8 = 2y$   $2.8 = 2y$   
 $1.4 = y$   
 a.  $1.4$  c.  $2.8$   
 b.  $\frac{1}{2}$  d.  $0.6$

C 11.  $-4 = g + 1$   $-4 = g + 1$   
 $-1 = g$   
 a.  $-4$  c.  $-5$   
 b.  $4$  d.  $-3$

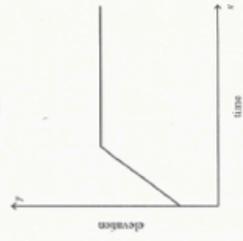
D 12. Which equation has no solution?  
 a.  $8 - (5v + 3) = 5v - 5$  c.  $3w + 4 - w = 5w - 2(w - 2)$   
 b.  $3m - 6 = 5m + 7 - m$  d.  $7y + 9 = 7y - 6$

What is the solution of each equation?

D 13.  $2(h - 8) - h = h - 16$   
 $2h - 16 - h = h - 16$   
 $h - 16 = h - 16$   
 a.  $8$  c. infinitely many solutions  
 b.  $-8$  d. no solution

Name: \_\_\_\_\_

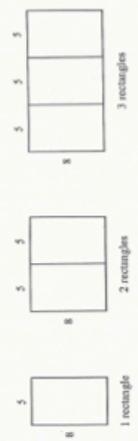
18. A hiker climbs up a steep bank and then rests for a minute. He then walks up a small hill and finally across a flat plateau. What sketch of a graph could represent the elevation of the hiker?



d. Any of the graphs could represent the situation, depending on the hiker's speed.

Name: \_\_\_\_\_

19. In the diagram below, what is the relationship between the number of rectangles and the perimeter of the figure they form?



19. Which of the following tables represent the relationship in the diagram above?

a.

Number of Rectangles	Perimeter
1	52
2	72
3	92

c.

Number of Rectangles	Perimeter
1	26
2	36
3	46

b.

Number of Rectangles	Perimeter
1	13
2	18
3	23

d.

Number of Rectangles	Perimeter
1	26
2	44
3	62

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B 22.

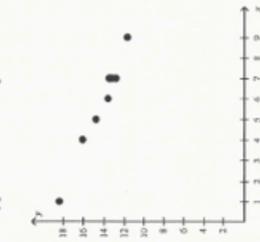
x	y
1	13.1
2	16.9
3	21.97
4	28.56
5	37.13

Graph the function shown by the table. Is the function linear or nonlinear?  
 a. linear  b. nonlinear

Tell whether the sequence is arithmetic. If it is, what is the common difference?

B 23. 2, 7, 13, 20, ...  
 a. yes; 5  b. yes; 6  c. yes; 2  d. no

What type of relationship does the scatter plot show?



B 24.

a. positive correlation   
 b. negative correlation   
 c. no correlation

A 25. Suppose that the amount of algae in a pond doubles every 4 hours. If the pond initially contains 90 pounds of algae, how much algae will be in the pond after 12 hours?  
 a. 720 pounds  b. 1440 pounds   
 c. 360 pounds  d. 114 pounds

Is the number written in scientific notation? If not, explain.

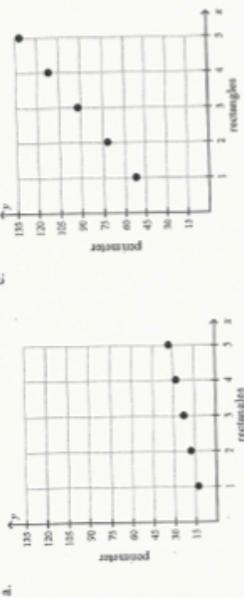
A 26.  $5.1 \times 10^{-4}$   
 a. Yes; the number is written in scientific notation.   
 b. No; the first factor is not a number between 1 and 10.   
 c. No; it is not written as a number times a power of 10.

Name: \_\_\_\_\_

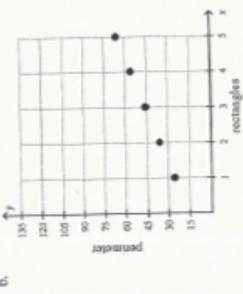
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C 20.

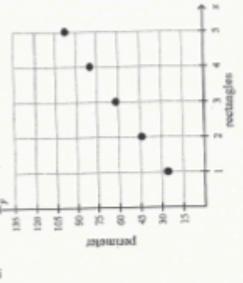
Which of the following graphs represents the relationship described above?



b.



d.



The table shows the relationship between the number of sports teams a person belongs to and the amount of free time the person has per week.

Number of Sports Teams	Free Time (hours)
0	4.6
1	3.9
2	3.2
3	2.5

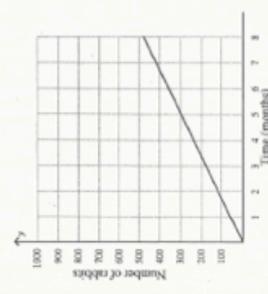
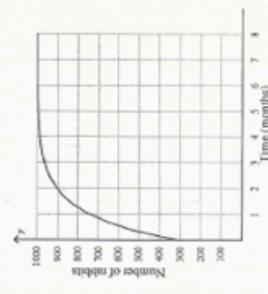
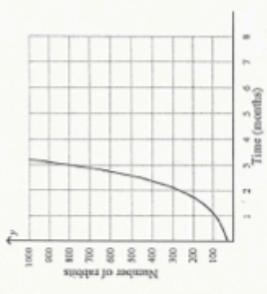
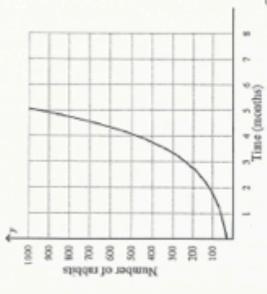
A 21. Is the above relationship a linear function?

a. yes  b. no

Name: \_\_\_\_\_

ID: A

29. Ken has decided to raise rabbits but has been warned that the number of rabbits he will have will double every month. Ken started out with 30 rabbits and the function  $y = 30 \cdot 2^x$  models the number of rabbits he will have after  $x$  months. Which graph represents this function?



30. A sports team is building a new stadium on a rectangular lot of land. If the lot measures  $6x$  by  $10x$  and the sports field will be  $1x$  by  $4x$ , how much of the lot will be left over to build bleachers on?

a.  $56x^2$   
 b.  $64x^2$   
 c.  $30x^2$   
 d.  $60x^2 - 4x^2$

Name: \_\_\_\_\_

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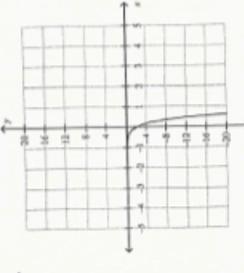
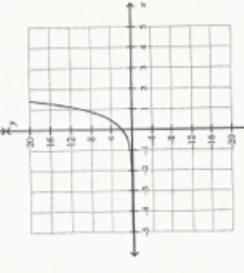
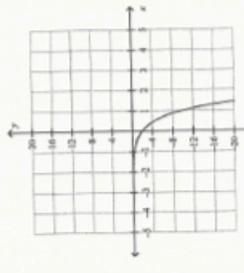
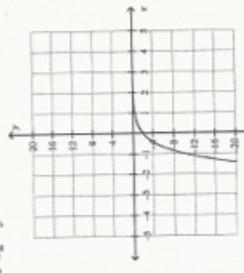
27. Does the table represent an exponential function?

x	1	2	3	4
y	-1	-8	-27	-64

a. yes  
 b. no

What is the graph of the function?

28.  $y = -2 \cdot 5^x$



Name: \_\_\_\_\_

31. Simplify the product using a table.

$-2h$	$5h$	$7$
$4$		

- a.  $-10h^2 + 34h - 28$
- b.  $-10h^2 + 6h + 28$
- c.  $-10h^2 - 6h + 28$
- d.  $-10h^2 - 34h - 28$

32. What is  $82 \cdot 78$ ?

- a. 6396
- b. 6408
- c. 6400
- d. 6392

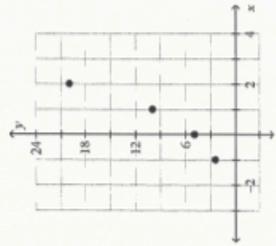
How many real-number solutions does the equation have?

- a. one solution
- b. two solutions
- c. no solutions
- d. infinitely many solutions

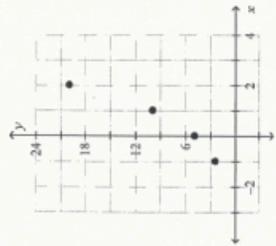
33.  $-8x^2 - 8x - 2 = 0$

Name: \_\_\_\_\_

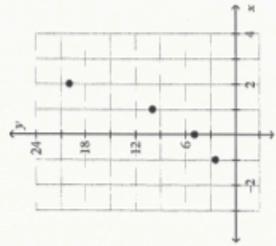
34. Graph the set of points. Which model is most appropriate for the set?  $(-1, 20), (0, 10), (1, 5), (2, 2.5)$



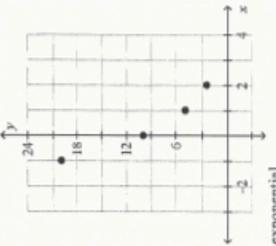
quadratic



quadratic



linear



exponential

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38. Which property of equality justifies step f?

- a.  $26 = -16 - 8x$
- b.  $26 = -16 + (-8x)$
- c.  $26 + 16 = -16 + (-8x) + 16$
- d.  $26 + 16 = -16 + 16 + (-8x)$
- e.  $42 = -8x$
- f.  $\frac{42}{-8} = \frac{-8x}{-8}$
- g.  $\frac{21}{4} = -x$

- a. Multiplication Property of Equality
- b. Subtraction Property of Equality
- c. Division Property of Equality
- d. Addition Property of Equality

What is the solution of the equation?

- 39.  $2 = 6p - 8 - 5p$ 
  - a.  $\frac{10}{3}$
  - b.  $-6$
  - c.  $2$
  - d.  $10$
- 40.  $5d - d - 2d + 8 - 3d = 0$ 
  - a.  $-5$
  - b.  $\frac{8}{3}$
  - c.  $\frac{8}{5}$
  - d.  $8$

What is the solution of the equation?

- 41.  $3(p - 5) + 2 = 5$ 
  - a.  $4$
  - b.  $7$
  - c.  $-4$
  - d.  $6$

What is the solution of the equation?

- 42.  $-4x - 9 = -5 - 6x$ 
  - a.  $4$
  - b.  $1$
  - c.  $-1$
  - d.  $2$

What is the solution of the equation?

- 43.  $3p - 1 = 5(p - 1) - 2(7 - 2p)$ 
  - a.  $3$
  - b.  $0$
  - c.  $-9$
  - d.  $-10$

14

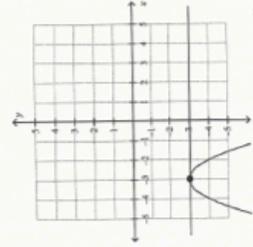
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What are the solutions of the system? Solve by graphing.

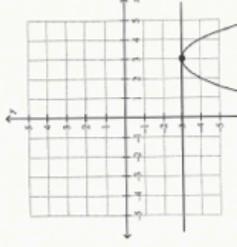
35.  $y = -x^2 - 6x - 12$   
 $y = -3$

a.



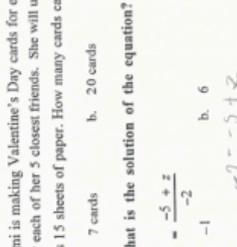
The solution of the system is  $(-3, -3)$ .

b.



The solution of the system is  $(3, -3)$ .

c.



The system has no solution.

d.



The solution of the system is  $(3, -3)$ .

e.



The system has no solution.

36. Aimi is making Valentine's Day cards for everyone in her class. She plans to use a whole sheet of paper for each of her 5 closest friends. She will use  $\frac{1}{2}$  of a sheet of paper for everyone else in the class. She has 15 sheets of paper. How many cards can she make?

- a. 7 cards
- b. 20 cards
- c. 5 cards
- d. 30 cards

What is the solution of the equation?

- 37.  $-2 = \frac{-5 + z}{-2}$ 
  - a.  $-1$
  - b.  $6$
  - c.  $9$
  - d.  $-4$

13

$-2 = \frac{-5 + z}{-2}$   
 $-2 \cdot -2 = \frac{-5 + z}{-2} \cdot -2$   
 $4 = -5 + z$   
 $4 + 5 = -5 + z + 5$   
 $9 = z$

**Problem**

Simplify each expression.

49.  $-1(9n)$  ✗  $\frac{90}{10}$

50. Rob and his best friend John have the same birthday, but Rob is 5 years younger than John. Complete the following table.

John's Age	Rob's Age
17	22
18	23
19	24
20	25
21	26
$n$	27

**Essay**

51. The table shows the relationship between the number of red triangles and the total number of square tiles in each figure. Complete the table and extend the pattern. What is the total number of red triangles in a figure with 12 square tiles?

Number of square tiles ( $s$ )	Number of red triangles ( $t$ )
1	2
2	4
3	6
4	8
5	10



52. Three consecutive even numbers have a sum between 84 and 96. Write an inequality to find the three numbers. Let  $n$  represent the smallest even number. Solve the inequality. 60

53.  $13 + \frac{w}{7} = -18$  ✗

$$\begin{aligned}
 13 + \frac{w}{7} &= -18 \\
 -7 \frac{w}{7} &= -18 \\
 6 + w &= -18 \\
 6 - 6 &= -18 - 6 \\
 w &= -24
 \end{aligned}$$

**Problem**

What is the given amount converted to the given units?

44. 195 s; minutes ✗

45. On a certain day 1 US dollar is equivalent in value to 90 Japanese yen. Lucy is going on a trip to Japan. She has \$900 to spend. How many yen is this? ✓

46. What percent of 160 is 48? ✗

47.  $6 = \frac{x+2}{3}$  ✗

Short Answer ✗

Use the vertical line test to determine whether the relation is a function.



## A) Unit Bookends

2. Fieldwork to Air and Space Museum Quiz: The class visited the Smithsonian Air and Space Museum to view the film, "Hubble 3D," as a key connection to our summer school Algebra 1 course theme. The film also tied well to the unit, Linear and Quadratic Equations: Astronauts, Space, and Microgravity What a Unit!! After we returned to the school from the fieldwork, the students completed a quiz on the material that they learned. The following artifacts are from Reyna and Douglas.

12.5 = 5.3

**Smithsonian Air and Space Museum Fieldwork Quiz**

Name: Reyna Gallo Date: 7-18-12

1. What is so special about the Hubble Telescope? What has it allowed us to do that we couldn't do before?  
 It gives you an image of what's going on space. Stay in space for many more time without running out of battery.
2. T or F The last repairs that they made to the Hubble Space Telescope were in 2009.  
 T
3. Where did the astronauts train to get ready to fix the telescope?  
 a. In Space  
 b. In a very fast airplane  
 c. In a pool  
 d. On top of a mountain
4. T or F The Orion Belt nebula is a planet nursery.  
 T
5. The baby stars produce lots of:  
 a. Bright Light  
 b. Wind  
 c. Gravity  
 d. Black Holes
6. The most vulnerable part of the space suit is:  
 a. The Hands  
 b. The Face Mask  
 c. The Arms  
 d. The Legs
7. T or F The reason that NASA wanted to shut down the Hubble Space Telescope is because they were worried that it would fall out of orbit and hit the moon.  
 T
8. T or F The Hubble Space Telescope is still working today.  
 T
9. How many African American Astronauts have their been?  
 a. 25  
 b. 10  
 c. 15  
 d. 20
10. T or F NASA has had three accidents where space shuttles blew up.  
 X

*What is so special about the Hubble Space Telescope? What has it allowed us to do that we couldn't do before?*

Reyna: It gives you an image of what's going on in space. Stay in space for many more time without running out of battery.

11. T or F The astronauts wear the white suits in outer space to protect them from the heat of the earth.  
 F
12. How many galaxies do astronomers think that there are?  
 a. billions  
 b. millions  
 c. Gazillions  
 d. thousands
13. What was the name of the first African American female astronaut?  
 a. Mae Jamison  
 b. Sally Fields  
 c. Eleanor Choa  
 d. Gwendolyn Brooks
14. T or F The first African American NASA Commander went to Anacostia High School in Washington, D.C.  
 T
15. What is the shortest and tallest that an astronaut can be?  
 6ft tall to 5ft tall
16. How many miles do you have to go above earth to be considered an astronaut?  
 a. 75 miles  
 b. 200 miles  
 c. 95 miles  
 d. 50 miles
17. T or F The astronaut with the most flights to space is Franklin Chang-Diaz, with 7 flights.  
 F
18. Who was the first African American in space?  
 a. Guy Bluford  
 b. Franklin Chang-Diaz  
 c. Bessie Coleman  
 d. Lee Melvin
19. T or F Most astronauts earned a Ph.D. or an M.D. before they went to space.  
 T
20. T or F The NASA program has three trips to space that include astronauts planned.  
 X

Douglas: What's so special about the Hubble Telescope is that it allows us to see into the distance of space and explore galaxies that are forming out in

## B) Lesson 1: Patterns and Equations

1. Problem Solving Problem Entry Task: One of the secondary themes of the course was problem-solving. The students completed challenging problems using a variety of techniques, including drawings or patterns, at the start of each class period. We would frequently discuss the problems and solutions in class. The students also participated in engineering Fridays throughout the whole summer. Below is a sample of Osmin's problem from the beginning of the unit.

**Mile Swim**



12. Tiana and Shana are training for a mile swim. Each time they tried to get better times. The first week the best time for each of them was 70 minutes. Then Tiana had a best time of 66 minutes the second week, 67 the third week, 63 the fourth week and 64 the fifth week. Shana had a best time of 69 minutes the second week, 67 the third week, 66 the fourth week, and 64 the fifth week. If they continued at this rate, who would have the best time after 12 weeks of training? What would that time be?

7/16/2016

1-) Background: The information that I have is Tiana and Shana are training for a mile swim. Each time they tried to get better times. The question is who would have the best time after 12 weeks of training? What would that time be?

2-) plan: make a table

3-) carry out plan:

Tiana			Shana		
weeks	Time	Change	weeks	Time	Change
1	70	-4	1	70	+1
2	66	+1	2	69	-2
3	67	-4	3	67	+1
4	63	+1	4	66	-2
5	64	-4	5	64	+1
6	60	+1	6	65	-2
7	61	-4	7	63	+1
8	57	+1	8	64	-2
9	58	-4	9	62	+1
10	54	+1	10	63	-2
11	55	-4	11	61	+1
12	51	-4	12	62	+1

the best time after 12 weeks of training was the last one.

4-) The difficult part was make the plane to solve the problem and the easy part was found the answer.

The figure would be 51 and 62.

## B) Lesson 1: Patterns and Equations

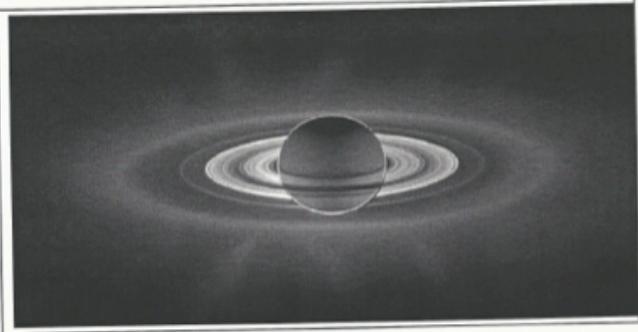
2. Space Math "Variables and Expressions from Around the Cosmos": The previous unit was about solving equations. This Space Math problem was an opportunity for students to practice evaluating equations in the context of our theme. We discussed the vocabulary on the worksheets, and students shared out their answers and what they thought their answers meant. We also looked for similarities amongst all of the problems and found that they all had the same format:  $y = mx + b$ , or the format of a linear equation.

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Variables and Expressions from Around the Cosmos 81

LT 10  
I can use equations in real life situations.

Name: Douglas Castillon



There are many simple mathematical formulae that astronomers use to describe different aspects of the universe and the physical world. (The above photo of Saturn was taken by NASA's Cassini spacecraft from behind Saturn looking back towards the Sun.)

**Problem 1:** Find,  $P$ , the length of Earth's day 500 million years in the future if  $P = 24 \text{ hours} + 0.004 Y$ , where  $Y$  is the number of millions of years that have elapsed.

**Problem 2:** Find the distance to the Andromeda galaxy in light years,  $L$ , if its distance in parsecs,  $P = 770,000$  and  $L = 3.26 P$ .

**Problem 3:** Find the temperature,  $T$ , of a gas cloud emitting X-rays if the energy of the X-rays is  $E = 12,000$  electron Volts and  $T = 11,500 E$ .

**Problem 4:** Find the temperature in degrees Centigrade of the air at an altitude of 20 kilometers if  $H = 20$  and  $T = 25.0 - 6.5 H$ .

**Problem 5:** Find the diameter in kilometers,  $D$ , of a black hole with a mass of 10 times the sun if  $D = 5.6 M$  and  $M = 10.0$ .

**Problem 6:** Calculate the speed of sound,  $S$ , in meters/second for a temperature of  $T = 200$  Centigrade (that's 392 F), if  $S = 331 + 0.6 T$ .

**Problem 7:** Calculate the sunspot number,  $N$ , if there are  $X = 15$  individual sunspots and  $Y = 10$  groups of sunspots is  $N = X + 11 Y$ .

Space Math <http://spacemath.gsfc.nasa.gov>

Douglas's work

problem 6)  $S = 331 + 0.6t$   
 $S = 331 + 0.6(700)$  Given  $x = 200$  centigrade  
 8151

The speed of sound in meters/seconds would be 451

problem #7)  $N = x + 11y$  given  $x = 15$   
 $N = 15 + 11(10)$  given  $y = 10$   
 $N = 26(10)$   
 $N = 260$

The sun spot number is 2600

problem 1)  $P = 24 \text{ hours} + 6.000y$  given  $x = 500$   
 $P = 24 + 0.001(500)$

$P = 26$

The length of earth's day in 500 million years will be 26 hours

problem 2)  $L = 3.26P = 770,000$   
 $L = 3.26(770,000)$   
 $L = 2510$

The distance to the Andromeda is 2510

2510200 light years

problem 3)  $T = 11,500E$   
 $T = 11,500(12,000)$  given  $E = 12,000$   
 $T = 1380000$  writing exponents

The temperature of gas could work by 13,800,000

problem 4)  $T = 25.0 - 6.5h$  given  $H = 20$   
 $T = 25.0 - 6.5(20)$   
 $T = -105$

The temperature in degrees centigrade of the

Air would be -105

problem 5)  $D = 5 - 6M$  given  $m = 10 - 0$   
 $D = 5 - 6(10.0)$   
 $D = -56$

The Diameter of a black hole would be 56

Douglas's Work

(11)

Problem 1  $P = 24 + 0.004Y$ , given  $Y = 500$   
 $P = 24 + 0.004(500)$   
 $P = 26$   
 the length of Earth's day in 500 million years will be 26 hours

Problem 2  $F = 3.26P$ , given  $P = 770,000$   
 $L = 3.26P (770,000)$   
 $L = 251,000$   
 the distance to andromeda galaxy is 251,000 light years.

Problem 3  $t = 11,500$  given  $F = 12,000$   
 $t = 11,500 (12,000)$   
 $= 138,000,000$   
 the temperature of a gas cloud is 138,000,000 Electron Volts

Problem 4  $t = 25.0 - 6.5$  given  $H = 20$   
 $t = 25.0 - 6.5 (20)$   
 $= -105$   
 the temperature of a degrees centigrade of a planet is  $-105^{\circ}\text{C}$

Problem 5  $D = 5.6M$  given  $M = 10.0$   
 $D = 5.6 (10.0)$   
 $= 56$   
 the diameter in kilometers is 56

Problem 6  $S = 33 + 0.14t$  given  $t = 2000$   
 $S = 33 + 0.14(2000)$   
 $= 315$   
 the calculation of the speed of sound in meters per second is 315 meters per second

Problem 7  $N = X + 11Y$  given  $X = 15$   
 $N = 15 + 11(10)$   
 $= 125$   
 the calculation of the suspension number is 125

Dalonte's Work

problem 5

$$D = 5.6 \text{ m} = 10.0$$

$$D = 5.6 (10.0)$$

$$D = 56$$

The diameter in kilometers,  $D$ , of a black hole is 56 kilometers.

problem 6

$$S = 331 + 0.6 (200)$$

$$S = 451$$

The speed of sound,  $S$ , is 451 meters/second

problem 7

$$N = 15 + 11 (10)$$

$$N = 125$$

The sunspot number,  $N$ , is 125 individual sunspots.

problem 1

$$P = 24 + 0.004Y \text{ give } Y = 500$$

$$P = 24 + 0.004(500)$$

$$P = 26$$

The length of Earth's day in 500 years will be 26 hours.

problem 2

$$L = 3.26 (770,000)$$

$$L = 2410200$$

The distance to the Andromeda galaxy in light years is 2,410,200 light years.

problem 3

$$T = 11,500 (12,000)$$

$$T = 138000000$$

The temperature,  $T$ , of a gas cloud emitting X-rays is 138,000,000 temperature.

problem 4

$$T = 25.0 - 6.5 (20)$$

$$T = -105$$

$$T = -105$$

The temperature in degrees centigrade of the air at an altitude of 20 kilometers is -105 degrees centigrade.

Osmin's Work

Problem 6:  $S = 331 + 0.6(200)$   
 $S = 451$

451 is the speed of sound.

Problem 7:  $N = X + 11Y$

$N = 15 + 11(10)$

$N = 125$

125 is the sunspot

Reyna's Work

Reyna Gallo  
7-18-12

Classwork:

Problem 1:  $p = 24 + .0004y$   
 $p = 24 + 0.004(500)$

$p = 24.2$

The length is 24.2 hours in 500 million years.

PROBLEM 2:

$L = 3.26p$

$L = 3.26(770,000)$

$L = 2,510,200$

The distance is 2,510,200 in light years.

PROBLEM 3:  $T = 11,500(12,000)$

$T = 138,000,000$

138,000,000 is the temperature T, of gas cloud emitting.

Problem 4:  $T = 25.0 - 6.5(20)$

$T = 18.5(20)$

in degrees Centigrade of the air at an altitude of 20 kilometers

Problem 5:  $D = 5.6(10.0)$

$D = 56$

diameter in kilometers

## B) Lesson 1: Patterns and Equations

3. Pattern Challenge Project: With this project, students each received a copy of the Pattern Challenge Project worksheet. They chose 4 equations, and completed the tables for the equations. They also created an "answer key." After all students completed their tables, they switched with one another, and determined the equation from the given tables. When they finished, they can check one another's work.

For this work sample, Osmin and Dalonte switched projects to check one another's work.

Osmin's Work

Pattern Challenge Project  
 Name: Dalonte Adams Date: \_\_\_\_\_  
 LT 12: I can recognize patterns and equations (3.5)

Problem 1:

X	Y
1	4
2	7
3	10
4	13
5	16

Equation:  $y = 3x + 1$

Problem 2:

X	Y
1	8
2	12
3	16
4	20
5	24

Equation:  $y = 4x + 4$

Problem 3:

X	Y
1	3
2	9
3	15
4	21
5	27

Equation:  $y = 6x - 3$

Problem 4:

X	Y
1	3
2	9
3	15
4	21
5	27

Equation:  $y = -6x + 3$

①

X	Y
1	4
2	7
3	10
4	13
5	16

$3x + 1$

②

X	Y
1	8
2	12
3	16
4	20
5	24

$4x + 4$

③

X	Y
1	3
2	9
3	15
4	21
5	27

$6x - 3$

④

X	Y
1	3
2	9
3	15
4	21
5	27

$-6x + 3$

①

X	Y
1	11
2	14
3	17
4	20
5	23

$y = 10x + 1$

②

X	Y
1	20
2	35
3	50
4	65
5	80

$y = 15x + 5$

③

X	Y
1	10
2	18
3	26
4	34
5	42

$y = 8x + 2$

④

X	Y
1	4
2	12
3	20
4	28
5	36

$y = 8x - 4$

Pattern Challenge Project  
 Name: Osmin Ferrero Date: 7/19/12  
 LT 12: I can recognize patterns and equations (4.5)

Problem 1:

X	Y
1	11
2	21
3	31
4	41
5	51

Equation:  $y = 10x + 1$

Problem 2:

X	Y
1	20
2	35
3	50
4	65
5	80

Equation:  $y = 15x + 5$

Problem 3:

X	Y
1	10
2	18
3	26
4	34
5	42

Equation:  $y = 8x + 2$

Problem 4:

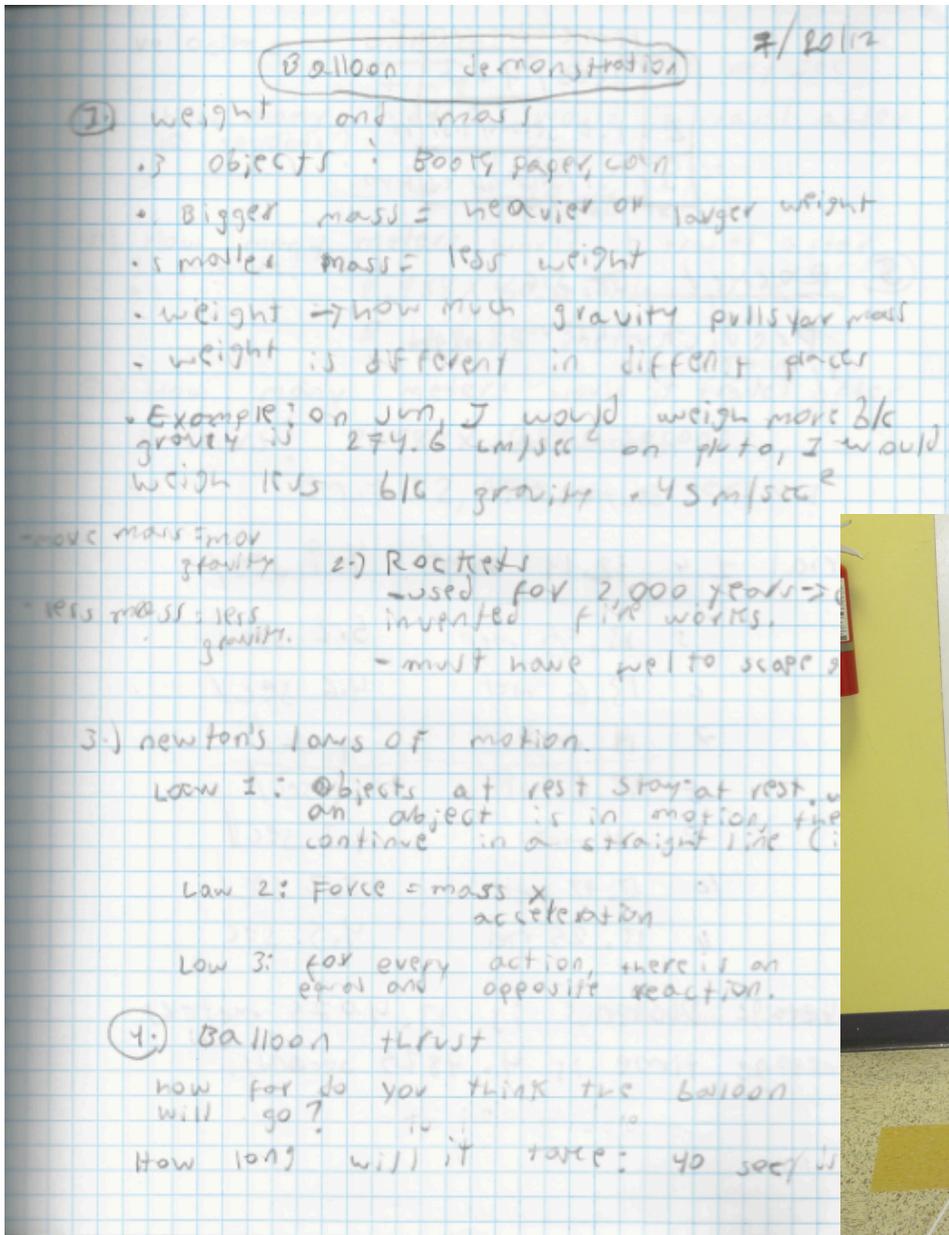
X	Y
1	4
2	12
3	20
4	28
5	36

Equation:  $y = 8x - 4$

Dalonte's Project

## C) Lesson 2: Rates and Slopes

1. Balloon Activity Notes: To start the class, we discussed rockets, balloons, and fireworks. As a whole class, we will use a balloon on a string to figure out velocity depending on how many breaths we put into the balloon. This activity was very hands-on and it provided the students with a chance to learn about rates at an introductory level. The students will do a mini-review of Newton's Laws of Motion (from our previous unit on gravity), and talked about how rockets would be affected by gravity. The following notes are from Osmin's notebook. Osmin completed a more in-depth version of this activity and used the velocity to make predictions.



	Time	Distance
1	2 sec	4.67 m
2	1.2 seconds	4.67 m
3	1.1 seconds	4.67 m

### 5 Rocket Basics

predict it how high?  
1, 2, 3.

Trial	Distance	Time
1	12.14 met.	4.9 sec
5	13.55 met	5.2 sec
6	13.6 met	4.6 sec
7	14 met	4 sec
8	13.6 met	4.8 sec
9	14 met	4.7 sec
10	13.12 met	3.7 sec
11	13.25 met	4.5 sec

Average Distance is 13.4075 meters.

Average time is 4.4875 seconds.

$$\text{velocity} = \frac{\text{distance}}{\text{time}} = 2.988 \text{ m/sec.}$$

1.) How many meters would it travel after 10 seconds?

$$2.988 \times 10 \text{ seconds.} \\ = 29.88 \text{ meters.}$$

2.) How many meters would it travel after 1 minute?

$$2.988 \times 60 \text{ seconds.} \\ = 179.28 \text{ meters.}$$

3.) How many meters would it travel after 3 hours?

$$2.988 \times 10800 \text{ seconds} \\ = 32,270.4 \text{ meters.}$$

### C) Lesson 2: Rates and Slopes

2. Space Math “Rates and Slopes An Astronomical Perspective”: Students worked on the Space Math “Rates and Slopes: An Astronomical Perspective” problems in small groups. Teacher assisted students who needed support, and encouraged peer-teaching. Each student chooses one problem to complete and answer. Reyna presented her problem on global warming to the class, and Osmin presented his problem on the speed of the galaxy to the class.

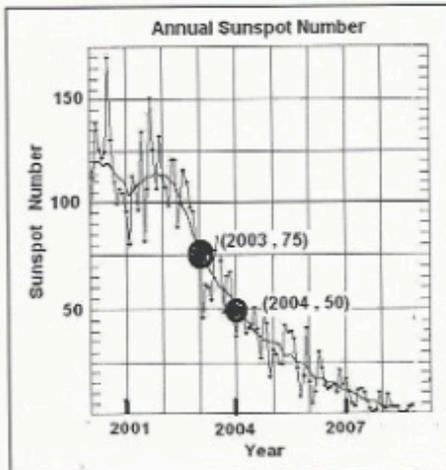
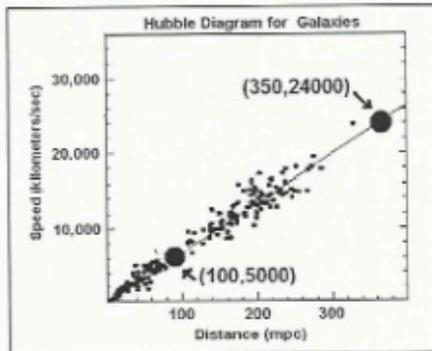
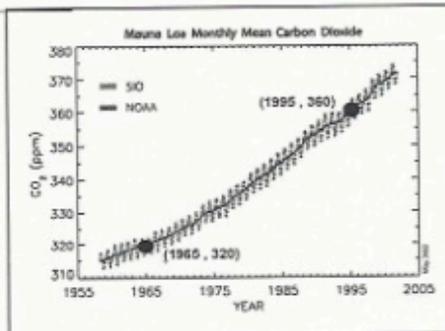
Reyna Gallo

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LT 12: Rates and Slopes  
ne:

#### Rates and Slopes: An Astronomical Perspective

4.0



A 'rate' is defined as the ratio of two quantities which have different units of measurement.

For example, if you travel in a car 200 kilometers in 2 hours, the rate is  $R = 200 \text{ kilometers}/2 \text{ hours}$  or  $R = 100 \text{ kilometers/hour}$ . You recognize this particular rate as just the speed of the car! Scientists work with other kinds of rates as well.

Graphically, a rate is a measure of the difference between two values along the Y-axis, divided by the difference between two corresponding values along the X-axis. It also represents the slope of a curve plotted on a graph.

For example, let's look at the top graph to the left. It shows how the amount of carbon dioxide in the atmosphere is increasing between 1955 and 2005. The two points along the data curve can be used to find the rate of change of the carbon dioxide in time, which is the slope of the line connecting these two points.

The change along the X-axis is just the difference '1995-1965' or +30 years. The difference along the Y-axis corresponding to these same years is just '360 ppm - 320 ppm' or +40 ppm. The rate is then  $R = +40 \text{ ppm}/+30 \text{ years}$  or +1.3 ppm/year.

Note that we have kept careful track of the signs and units in the calculations. This is because rates can represent both increases (positive) or decreases (negative) changes.

**Problem 1** - Calculate the Rate corresponding to the speed of the galaxies in the Hubble Diagram. (Called the Hubble Constant, it is a measure of how fast the universe is expanding).

**Problem 2** - Calculate the rate of sunspot number change between the indicated years.

Osmin Feltman  
rates and slopes

(Uo)

bubble diagram

$(350, 24000)$ ,  $(100, 5000)$   
 $x_1$   $y_1$   $x_2$   $y_2$

$$\frac{5000 - 24000}{100 - 350} = \frac{-19000}{-250} = 76 \text{ speed km/distance (mpg)}$$

Classwork:

Rates and Slope

Reyna Gallo  
7-24-12

$(x_1, y_1)$  and  $(x_2, y_2)$   
 $(1965, 320)$  and  $(1995, 360)$

$$\frac{360 - 320 \text{ (CO}_2\text{)}}{1995 - 1965 \text{ (year)}} = \frac{40}{30} = \frac{1.\bar{3}}{1} = (1.\bar{3} \text{ CO}_2 \text{ per year (ppm)})$$

✓

### C) Lesson 2: Rates and Slopes

3. Space Math: "Working with Rates" Students worked on the Space Math "Working with Rates" problems. The students completed problems 1-9 either individually, or with a partner. The students focused on making sure that the units were correct for each answer. As the students finished, they could move on to the next section (compound units and scientific notation). Both Osmin and Reyna advanced quite far with this task!!

LT Connections  
Name: Osmin, Reyna  
Date: 2/24/12

## Working with Rates

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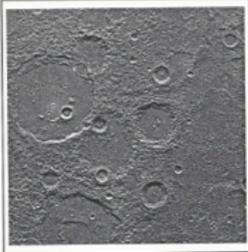


Image of craters on Mercury taken by the MESSENGER spacecraft.

Because things change in the universe, astronomers often have to work with mathematical quantities that describe complex rates.

Definition: A rate is the ratio of two quantities with different units.

In the problems below, convert the indicated quantities into a rate.

Example: 15 solar storms in 2 weeks becomes the rate:

$$R = \frac{15 \text{ solar storms}}{2 \text{ weeks}} = \dots \text{ storms/week}$$

$$R = \frac{7 \text{ solar storms/week}}{1 \text{ or } 7 \text{ solar storms per week}}$$

**Problem 1** - 15 meteor impacts in 3 months. *15 - 5 craters/month*

**Problem 2** - 2,555 days in 7 years. *2,555 - 365 - 7 = 180 days/year*

**Problem 3** - 1,000 atomic collisions in 10 seconds. *1,000 - 100 atomic collisions/seconds*

**Problem 4** - 36 galaxies in 2 two clusters. *36 - 2 clusters = 18 galaxies/cluster*

**Problem 5** - 1800 novas in 800 years. *1800 - 800 = 2.25 novas/year*

**Problem 6** - 416 gamma-ray bursts spotted in 52 weeks. *416 - 52 = 8 gamma-ray bursts/weeks*

**Problem 7** - 3000 kilometers traveled in 200 hours. *3000 - 200 = 15 kilometers traveled/hour*

**Problem 8** - 320 Joules of energy consumed in 2 seconds. *320 - 2 = 160 Joules/seconds*

**Problem 9** - 30 planets orbiting 160 years. *30 - 160 = 0.1875 planets orbiting/years*

**Compound Units:** *30 - 160 = 0.1875 planets orbiting/years*

**Problem 10** - 240 craters covering 8 square miles of area. *240 - 8 = 30 craters/square miles*

**Problem 11** - 3600 watts of energy used over 18 square meters. *3600 - 18 = 200 watts/square meters*

**Problem 12** - 6 milligrams for 30 magnetic reversals. *6 - 30 = 0.2 milligrams/reversals*

**Problem 14** - 1,820 Joules over 20 square meters of area. *1,820 - 20 = 91 Joules/square meters*

**Problem 15** - A speed change of 50 kilometers/sec in 10 seconds. *50 - 10 = 5 kilometers/sec in 10 seconds*

**Scientific Notation:**

**Problem 16** -  $3 \times 10^{13}$  kilometers traveled in  $3 \times 10^7$  seconds. *10<sup>13</sup> - 10<sup>7</sup> = 10<sup>6</sup> kilometers/seconds*

**Problem 17** - 70,000 tons of gas accumulated over 20 million square kilometers. *70,000 - 20 million = 3.5 tons/square kilometers*

**Problem 18** - 360,000 Newtons of force over an area of  $1.2 \times 10^8$  square meters. *360,000 - 1.2 x 10<sup>8</sup> = 3000 Newtons/square meters*

**Problem 19** -  $1.5 \times 10^8$  kilometers traveled in 50 hours. *1.5 x 10<sup>8</sup> - 50 = 3 million kilometers/hour*

**Problem 20** -  $4.5 \times 10^8$  stars in a cluster with a volume of  $1.5 \times 10^3$  cubic lightyears. *4.5 x 10<sup>8</sup> - 1.5 x 10<sup>3</sup> = 300,000 stars/cubic lightyears*

Space Math <http://spacemath.gsfc.nasa.gov>

1)  $\frac{15}{3} = 5 \text{ meters/month}$

2)  $\frac{2,555}{7} = 364.28 \text{ days/year}$

3)  $\frac{1,000}{10} = 100 \text{ atomic collisions/seconds}$

4)  $\frac{36}{2} = 18 \text{ galaxies/cluster}$

5)  $\frac{1,800}{800} = 2.25 \text{ novas/year}$

6)  $\frac{416}{52} = 8 \text{ gamma-ray bursts/weeks}$

7)  $\frac{3,000}{200} = 15 \text{ kilometers traveled/hour}$

8)  $\frac{320}{2} = 160 \text{ Joules/seconds}$

9)  $\frac{30}{160} = 0.1875 \text{ planets orbiting/years}$

10) 20 craters/mi<sup>2</sup>

11)  $\frac{3,600 \text{ watts}}{18 \text{ m}^2} = 200 \text{ watts/m}^2$

12)  $\frac{360,000 \text{ Newtons}}{1.2 \times 10^8 \text{ m}^2} = 3,000 \text{ Newtons/m}^2$

13)  $\frac{1.5 \times 10^8 \text{ km}}{50 \text{ hours}} = 3 \text{ million kilometers/hour}$

14)  $\frac{1,820 \text{ Joules}}{20 \text{ m}^2} = 91 \text{ Joules/m}^2$

15)  $\frac{4.5 \times 10^8 \text{ stars}}{1.5 \times 10^3 \text{ lightyears}^3} = 300,000 \text{ stars/cubic lightyears}$

Working with Rates 7-24-12

Reyna Gallo

- # 1. 5 meteor/month
- # 2. 364.23 days
- # 3. 100 atomic collisions
- # 4. 13 galaxies per cluster
- # 5. 2 novas per year
- # 6. 8 gamma-ray bursts spotted per week
- # 7.  $\frac{3000 \div 200}{200 \div 200} = 15$  kilometers per hour
- # 8.  $\frac{320 \div 160}{160 \div 160} = 2$  planets orbiting per star
- # 9.  $\frac{30 \div 2}{2} = 15$  joules of energy consumed per second.
- # 10.  $\frac{240 \div 8}{8 \div 8} = 30$  craters per square meter
- # 11.  $\frac{16000 \div 16}{16 \div 16} = 1000$  watts per meter.
- # 12.  $\frac{380 \div 20}{20 \div 20} = 19$  kilograms per cubic meters.
- # 13.  $\frac{6 \div 30}{30 \div 6} = \frac{1}{5} = 5$  million years per magnetic reversals.
- # 14.  $\frac{1820 \div 20}{20 \div 20} = 91$  joules per square meters.
- # 15.  $\frac{50 \div 10}{10 \div 10} = 5$  kilometers per second
- # 16.  $\frac{(3 \times 10^{13})}{(3 \times 10^7)} = 1 \times 10^6$  kilometers per second

LT Connections

Name: Reyna Gallo

Date: 7-24-12

LT I can identify parts of equation and graphs, write equations, and graph equation.

Working with Rates 73

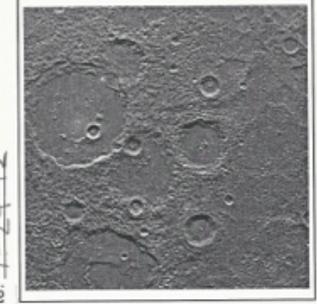


Image of craters on Mercury taken by the MESSENGER spacecraft.

Because things change in the universe, astronomers often have to work with mathematical quantities that describe complex rates.

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In the problems below, convert the indicated quantities into a rate.

Example: 15 solar storms in 2 weeks becomes the rate:

$$R = \frac{15 \text{ solar storms}}{2 \text{ weeks}} = \frac{15}{2}$$

$$R = \frac{7 \text{ solar storms/week}}{\text{or } 7 \text{ solar storms per week}}$$

- Problem 1 - 15 meteor impacts in 3 months.  $\frac{15}{3} = 5$  meteor/month
- Problem 2 - 2,555 days in 7 years
- Problem 3 - 1,000 atomic collisions in 10 seconds
- Problem 4 - 36 galaxies in 2 two clusters  $\frac{36}{2} = 18$  galaxies per cluster
- Problem 5 - 1600 novas in 800 years  $\frac{1600}{800} = 2$  novas per year
- Problem 6 - 416 gamma-ray bursts spotted in 52 weeks  $\frac{416}{52} = 8$  gamma-ray bursts per week
- Problem 7 - 3000 kilometers traveled in 200 hours  $\frac{3000}{200} = 15$  kilometers per hour
- Problem 8 - 320 planets orbiting 160 stars  $\frac{320}{160} = 2$  planets per star
- Problem 9 - 30 Joules of energy consumed in 2 seconds  $\frac{30}{2} = 15$  Joules per second

Compound Units:

- Problem 10 - 240 craters covering 8 square miles of area
- Problem 11 - 16,000 watts of energy collected over 16 square meters
- Problem 12 - 380 kilograms in a volume of 20 cubic meters
- Problem 13 - 6 million years for 30 magnetic reversals
- Problem 14 - 1,820 Joules over 20 square meters of area
- Problem 15 - A speed change of 50 kilometers/sec in 10 seconds.

Scientific Notation:

- Problem 16 -  $3 \times 10^{13}$  kilometers traveled in  $3 \times 10^7$  seconds.
- Problem 17 - 70,000 tons of gas accumulated over 20 million square kilometers
- Problem 18 - 360,000 Newtons of force over an area of  $1.2 \times 10^6$  square meters
- Problem 19 -  $1.5 \times 10^8$  kilometers traveled in 50 hours
- Problem 20 -  $4.5 \times 10^6$  stars in a cluster with a volume of  $1.5 \times 10^3$  cubic lightyears

Space Math

<http://spacemath.gsfc.nasa.gov>

### C) Lesson 2: Rates and Slopes

#### 4. Exit Ticket

(10)

**Rates of Change and Slope Exit Ticket**  
 Name: Keyna Gallo Date: 7-23-12

1. Find the rate and show all your work

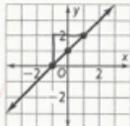
Hours	Fences
3	1
6	2
9	3
12	4

$$\frac{4-1}{12-3} = \frac{3}{9} = \frac{1}{3}$$

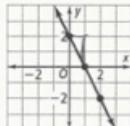
Hours	Miles
2	70
4	140
6	210
8	280

$$\frac{280-70}{8-2} = \frac{210}{6} = 35$$

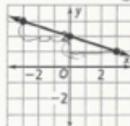
2. Find the slope by using the graph



$\frac{2}{2} = 1$  ✓



$\frac{2}{1}$  ✗



$\frac{1}{3}$  ✓

3. Find the slope between the two points:

(0, 4) and (3, 5)

$$\frac{5-4}{3-0} = \frac{1}{3}$$

✓

(3, -1) and (5, 9)

$$\frac{9-(-1)}{5-3} = \frac{10}{2} = 5$$

✓

(30)

**Rates of Change and Slope Exit Ticket**  
 Name: Douglas Astorian Date: 2-23-12

1. Find the rate and show all your work

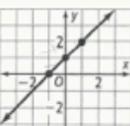
Hours	Fences
3	1
6	2
9	3
12	4

$$\frac{4-1}{12-3} = \frac{3}{9} = \frac{1}{3}$$

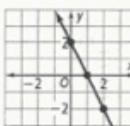
Hours	Miles
2	70
4	140
6	210
8	280

$$\frac{280-70}{8-2} = \frac{210}{6} = 35$$

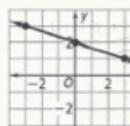
2. Find the slope by using the graph



$\frac{2}{2} = 1$  ✓



$\frac{4}{2}$  ✗



$\frac{2}{6}$  ✗

3. Find the slope between the two points:

(0, 4) and (3, 5)

$$\frac{5-4}{3-0} = \frac{1}{3}$$

✓

(3, -1) and (5, 9)

$$\frac{9-(-1)}{5-3} = \frac{10}{2} = 5$$

✗

## D) Lesson 3: Writing and Graphing Linear Equations

1. Guided Notes: The following images are from Reyna's in-class guided notes.

**Guided Notes**  
**Topic 12:** I can identify the slope and intercepts from an equation or graph and use these to graph equations and write equations of lines.  
 Name: Reyna Gallo Section: \_\_\_\_\_

**Anatomy of a Graph and Equation**  
**Slope:** Ratio of rise,  $\frac{y_2 - y_1}{x_2 - x_1}$ , steepness of a line  
**Y-Intercept:** Where the graph crosses y-axis  
**X-Intercept:** Where the graph crosses the x-axis  
 $y = -2x + 1$

**X-intercept**  
 $M = \frac{\text{down } 2}{\text{right } 1} = -\frac{2}{1} = -2$   
 $b = 1 \text{ or } (0, 1)$

**Graphing Lines**  
**SLOPE-INTERCEPT FORM:**  
 $Y = mx + b$   
 Slope  $\leftarrow$   $m$        $b$   $\leftarrow$  y-intercept

- Find the y-intercept (0, b)
- Graph the y-intercept  $(0, 4)$
- Identify the slope:  $m$
- Draw the next point by using the slope  $\frac{2}{1}$  up  $\frac{1}{1}$  right
- Connect the two points into a line using a straightedge

**Example:**  $y = 2x + 4$   
 $m = 2$        $b = 4$

**Try Yourself and Show your work**

1)  $y = -3x + 1$   
 Slope  $\leftarrow$        $\leftarrow$  y-intercept

2)  $y = 1x - 2$   
 Slope  $\leftarrow$        $\leftarrow$  y-intercept

**Identifying Slope-Intercept Equation from a graph:**

- Determine the slope:  $m$
- Find the y-intercept: (0, b)
- Plug in the slope and y-intercept into the equation  
 $y = m \cdot x + b$

**Example 1:**  
 $m = -\frac{3}{2}$   
 $b = 0$   
 $y = -\frac{3}{2}x + 0$   
 bonus: what is the x-intercept?  $0$

**Example 2:**  
 $m = \frac{4}{1}$   
 $b = -3$   
 $y = 4x + -3$   
 bonus: what is the x-intercept?  $0.75$

**Example 3:**  
 $m = \frac{7}{1}$   
 $b = -3$   
 $y = 7x + -3$   
 $0.4$

**Try Yourself and Show your work!!**

1.  $m = -\frac{4}{2}$   
 $b = 0$   
 $y = -\frac{4}{2}x + 0$   
 $y = -2x + 0$   
 bonus: what is the x-intercept?  $0$

2.  $\frac{2}{1} = 2$   
 $b = 3$   
 $y = 2x + 3$   
 bonus: what is the x-intercept?  $-1.5$

3.  $m = \frac{2}{1}$   
 $b = 1$   
 $y = 2x + 1$   
 bonus: what is the x-intercept?  $-0.5$

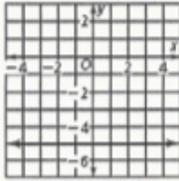
### D) Lesson 3: Writing and Graphing Linear Equations

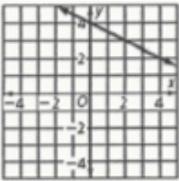
2. Centers: Students will work in the 5 centers. They had 7-8 minutes on the clock at each center, and they chose which centers to work at. After they completed a center, they turned in the problem to the teacher, who will give them immediate feedback so that they had an opportunity to correct their mistakes. The following work is from Osmin.

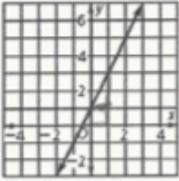
Osmin Ferman

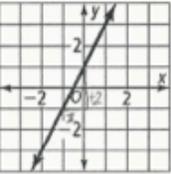
**Topic 12: Equations and Graphs**  
**Center 3: Writing Equations of Graphs**

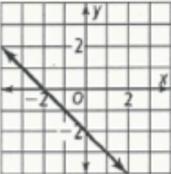
**Directions:** Given the following graphs, write the equation of each line

1) 

2) 

3) 

4) 

5) 

$y = x + 2$

$y = -2x - 2$

$y = x + 2$

Osmin Ferman

**Topic 12: Equations and Graphs**  
**Center 4: Graphing Equations**

**Directions:** Use your notes to graph each equation on a coordinate plane

1)  $y = x + 3$   
 $m = \underline{1}$   
 $b = \underline{3}$

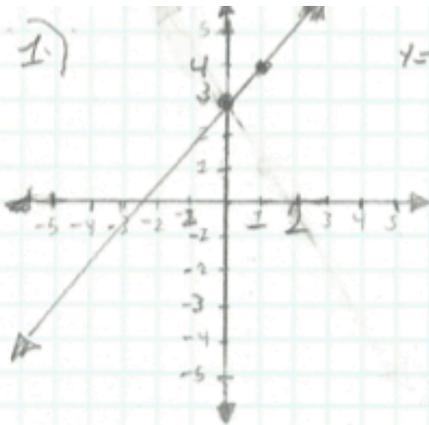
2)  $y = 4x - 1$   
 $m = \underline{4}$   
 $b = \underline{-1}$

3)  $y = -x + 6$   
 $m = \underline{-1}$   
 $b = \underline{6}$

4)  $y = 3x - 2$   
 $m = \underline{3}$   
 $b = \underline{-2}$

5)  $y = -5x + 1$   
 $m = \underline{-5}$   
 $b = \underline{1}$

6)  $y = -7x - 4$   
 $m = \underline{-7}$   
 $b = \underline{-4}$

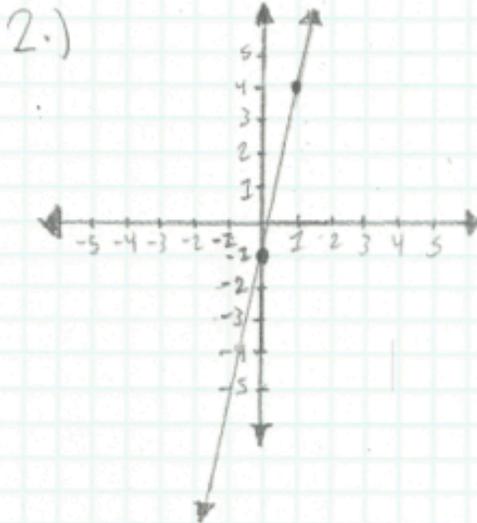


$$y = x + 3$$

$$m = \frac{1 \text{ up}}{1 \text{ right}}$$

$$B = 3 \quad (0, 3)$$

x-intercept is -3.



$$y = 4x - 1$$

$$m = \frac{4 \text{ up}}{1 \text{ right}}$$

$$B = -1 \quad (0, -1)$$

x-intercept is 0.25.

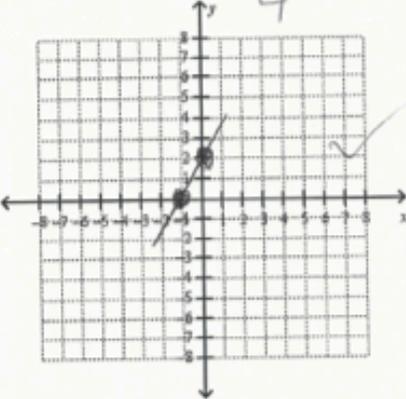
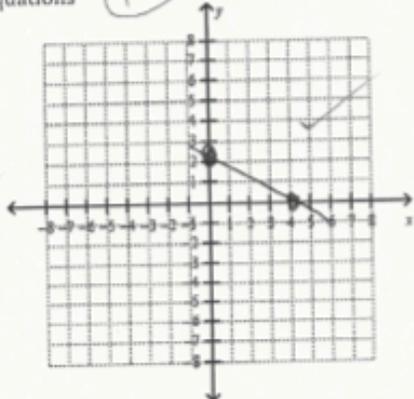
**D) Lesson 3: Writing and Graphing Linear Equations**

3. Exit Ticket: The following is a copy of Dalonte's Exit Ticket:

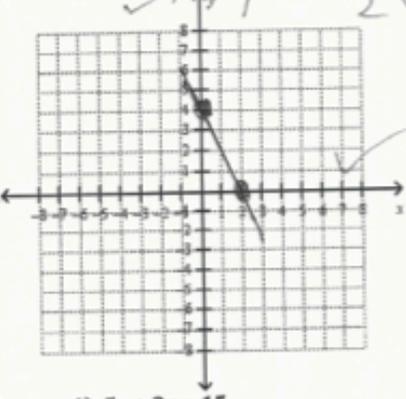
**Exit Ticket: Topic 12: Graphing Lines with Intercepts**  
 Name: Dalonte (with) Date: \_\_\_\_\_

Directions: Find the x and y intercepts and graph the equations 4.0

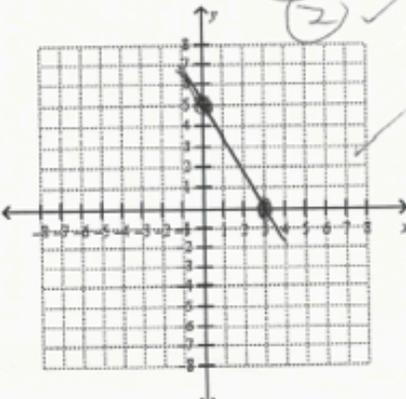
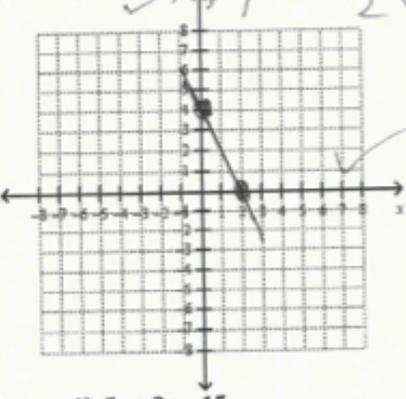
**1)  $2x + 4y = 8$**   
 $2x + 4(0) = 8$   $2(\cancel{x}) + 4y = 8$   
 $2x = 8$   $\frac{4}{4}$   
 $2x = \frac{8}{2}$  ✓  $\frac{4}{4}$   
 $x = 4$  ✓

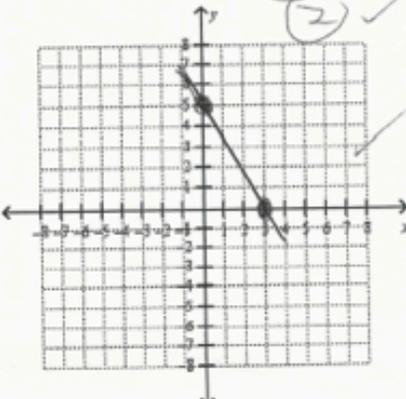
**2)  $-4x + 2y = 4$**   
 $-4x + 2(0) = 4$   $-\cancel{4}x + 2y = 4$   
 $-4x = 4$   $2y = 4$   
 $-4 \quad -4$   $2y = 4$   
 $= 1$   $\frac{2y}{2} = \frac{4}{2}$  ✓  
 $x = -1$  ✓  $y = 2$  ✓



**3)  $6x + 3y = 12$**   
 $6x + 3(0) = 12$   $\cancel{6}x + 3y = 12$   
 $6x = 12$   $3y = 12$   
 $6x \quad \frac{6x}{2}$   $3y \quad \frac{3y}{3}$   
 $(2)$  ✓  $4$  ✓  
 $x = 2$  ✓  $y = 4$  ✓

**4)  $5x + 3y = 15$**   
 $5x + 3(0) = 15$   $5\cancel{x} + 3y = 15$   
 $5x = 15$   $y = 5$   
 $\frac{5x}{5} = \frac{15}{5}$  ✓  $y = 5$  ✓  
 $x = 3$  ✓



# E) Lesson 4: Reading and Using Graphs

## 1. Practice Using Graphs to Relate Two Quantities:

LT  
12

Name Dante Curtis Class \_\_\_\_\_ Date \_\_\_\_\_

### 4-1

### Standardized Test Prep

Using Graphs to Relate Two Quantities

4.0

#### Multiple Choice

For Exercises 1-3, choose the correct letter.

1. The graph shows your distance from the practice field as you go home after practice. You received a ride from a friend back to his house where you ate supper. You then walked home from there. Which point represents a time when you are walking home?



- A. A      B. B      C. C      D. D

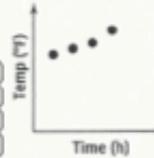
2. Which table is related to the graph at the right?

F.

Time (h)	Temp. (°F)
1	68
2	73
3	78
4	85

H.

Time (h)	Temp. (°F)
68	1
73	2
78	3
85	4



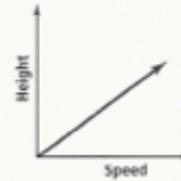
G.

Temp. (°F)	Time (h)
1	85
2	78
3	73
4	68

I.

Temp. (°F)	Time (h)
85	1
78	2
73	3
68	4

3. How are the variables related on the graph?
- A. as speed decreases, height stay constant  
 B. as speed decreases, height increases  
 C. as speed increases, height decreases  
 D. as speed increases, height increases



#### Short Response

4. For the race you swim 1 mile, run 10 miles, and bike 25 miles. Sketch a graph to represent the relationship. Label the axes with the related variables. What are the important points on the graph?



## E) Lesson 4: Reading and Using Graphs

2. Word Problems and Patterns Project: Given a scenario, students completed the table, graphed the values, wrote the equation modeling the graph, and then used the equation to make predictions about their topic.

Date: 2/20/12

**Algebra 1: Word Problems and Patterns**  
 Name: Osmin Ferrer  
 LT 10: I can solve equations in real life

**Problem 2)** Osmin attends Algebra 1 Summer School for 330 minutes per day. He attends both the morning and the afternoon session with Ms. Cook. He is taking the class so that he can get credit for Algebra 1 before his junior year.

a. Make a table of values to find how many minutes he attended summer school after 9 days.

b. Write an equation to show how many minutes he is attending school.

c. Create a graph of how many minutes he attends school as the summer goes on.

Day	Minutes in Summer School
1	330
2	660
3	990
4	1320
5	1650
6	1980
7	2310
8	2640
9	2970

B) The equation that models how many minutes Osmin has been in summer school is:  $y = 330x$

1. Use the equation to find out how many minutes Osmin attended summer school after 15 days.  
 $330 \times 15 = 4,950$  minutes hours =  $4,950 \div 60 = 82.5$  hours

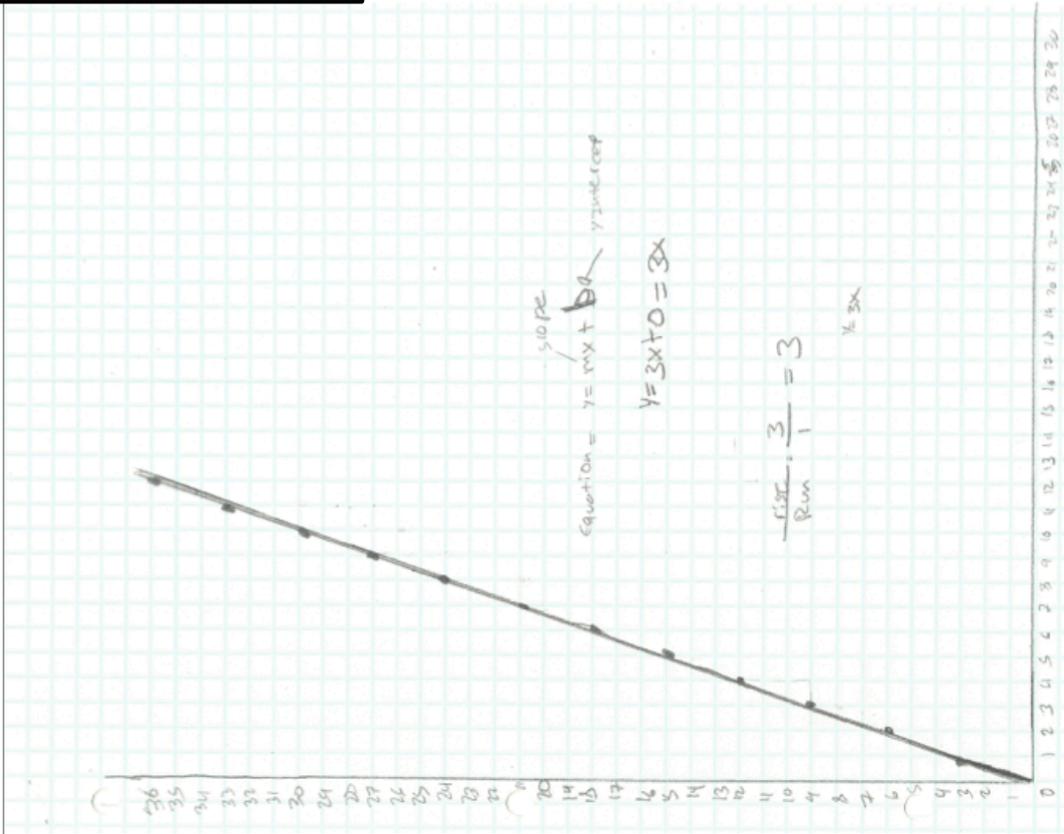
2. Use the equation to find out how many minutes Osmin attended summer school after 22 days.  
 $330 \times 22 = 7,260$  minutes hours =  $7,260 \div 60 = 121$  hours

3. Use the equation to find out how many minutes Osmin would attend summer school if he had to attend for 3 summers (each summer has 22 school days).  
 $22 \times 3 = 66$  days  
 $330 \times 66 = 21,780$  minutes hours =  $21,780 \div 60 = 363$  hours

Osmin's project about number of minutes in class



Douglas's problem about hours of soccer played



43

**Algebra 1: Word Problems and Patterns**  
 Name: Douglas Costello Date: \_\_\_\_\_  
 LT 10: I can solve equations in real life

**Problem 4)** Douglas plays 3 hours of soccer a day to prepare for the regular season. He gets a lot of exercise!

- Make a table of values to find how many hours of soccer he has played after 12 days have passed.
- Write an equation to show how many hours he plays soccer.
- Create a graph of how many hours he plays soccer.

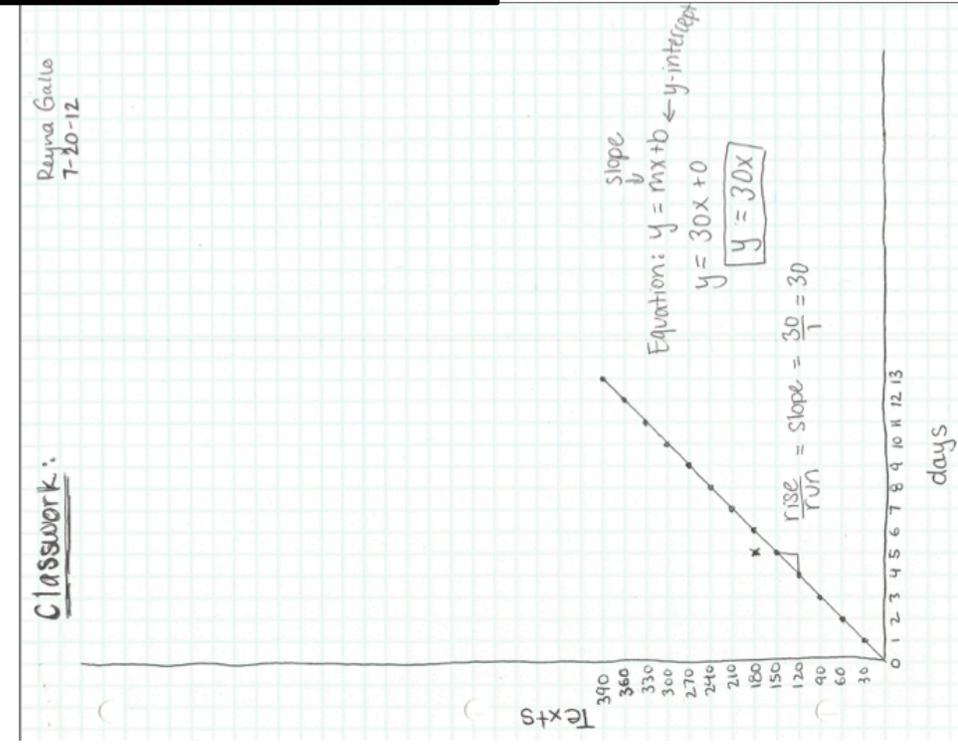
A) Table

Day	Hours playing soccer
1	3
2	6
3	9
4	12
5	15
6	18
7	21
8	24
9	27
10	30
11	33
12	36

B) The equation that models how many hours the Douglas plays soccer is:  
 $y = 3x$

- Use the equation to find out how many hours of soccer that Douglas has played after 17 days.  
 $y = 3(17) = 51$
- Use the equation to find out how hours of soccer that Douglas has played after 2 months. *2 months = 60 days*  
 $y = 3(60) = 180 \text{ hours}$
- Use the equation to find out how many hours Douglas would play soccer if he played soccer every day for 2 years. *2 years = 365 days*  
 $y = 3(365) = 1095$

Reyna's project about number of texts sent to a friend



Algebra 1: Word Problems and Patterns  
 Name: Reyna Gallo Date: 7-20-12  
 LT 10: I can solve equations in real life

Problem 3) Reyna sent 150 texts to her best friend, Jocelyn, over the course of 5 days. How many texts per day is that? She continues to text at this rate for the rest of the summer.

- Make a table of values to find how text she sends Jocelyn after 13 days.
- Write an equation to show how much she is texting.
- Create a graph of how many texts she sends over the days.

$$\begin{array}{r} 5 \overline{)150} \\ -150 \\ \hline 000 \end{array}$$

A) Table

Day	Texts
1	30
2	60
3	90
4	120
5	150
6	180
7	210
8	240
9	270
10	300
11	330
12	360
13	390

B) The equation that models how many texts that Reyna sends is:  $y = 30x$

- Use the equation to find out how many texts that Reyna sent after 4 weeks.
- Use the equation to find out how many texts that Reyna sent after 3 months.
- Use the equation to find out how many texts that Reyna sent after 1 year.

$$\begin{array}{r} 128 \\ \times 36 \\ \hline 768 \\ 3840 \\ \hline 4608 \end{array}$$

840 texts

2,700 texts

10,950 texts

$$\begin{array}{r} 90 \\ \times 30 \\ \hline 2700 \end{array}$$

$$\begin{array}{r} 10000 \\ + 245 \\ \hline 10950 \\ - 950 \\ \hline 10000 \end{array}$$

## F) Lesson 5: Using Linear Equations, Graphs, and Models to Save Astronauts!!

1. Suit Yourself Space Suit Sketches: The class brainstormed spacesuit components. Each student had a specific job with the creation of a space suit. The students drew the component of the spacesuit that they were responsible for, and shared it with the class.



### Brainstorm Your Spacesuit

Name: Reyna Gallo Date: 7-24-12 Period     

You are a member of the NASA engineering team asked to design a spacesuit that can be used for many Extra-Vehicular Activities (EVAs). A group of 4 cards, each representing a different job on the team have been given to your group. Each member should select a card. It might be helpful to reread the last paragraph of the Background.

1. Write the job title on your card in the space below.
2. Make a list of the components of your system and the purpose of each one.
3. Explain how your system will work.
4. Draw a picture of your spacesuit design on the astronaut.

Job Title: Breathable Air Engineer (BAE)

the oxygen <sup>tank</sup> will go inside the suit it's going to be like a backpack hanging from the back.



 Reyna



## Appendix B

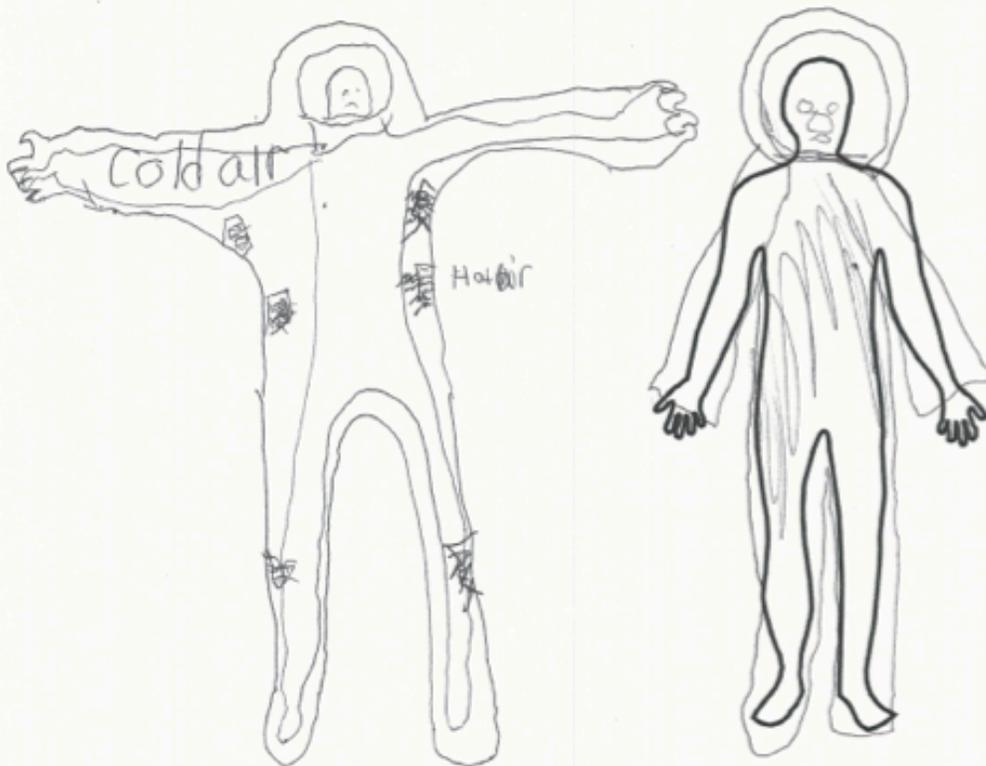
## Brainstorm Your Spacesuit

Name: Lante Date: \_\_\_\_\_ Period \_\_\_\_\_

You are a member of the NASA engineering team asked to design a spacesuit that can be used for many Extra-Vehicular Activities (EVAs). A group of 4 cards, each representing a different job on the team have been given to your group. Each member should select a card. It might be helpful to reread the last paragraph of the Background.

1. Write the job title on your card in the space below.
2. Make a list of the components of your system and the purpose of each one.
3. Explain how your system will work.
4. Draw a picture of your spacesuit design on the astronaut.

Job Title: \_\_\_\_\_ ( )





## Appendix B

## Brainstorm Your Spacesuit

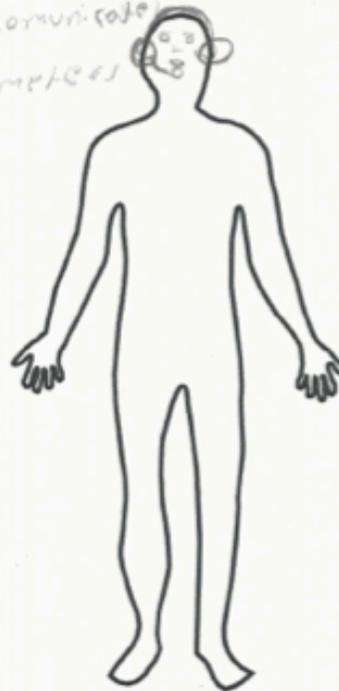
Name: Osmin Ferman Date: 7/24/12 Period \_\_\_\_\_

You are a member of the NASA engineering team asked to design a spacesuit that can be used for many Extra-Vehicular Activities (EVAs). A group of 4 cards, each representing a different job on the team have been given to your group. Each member should select a card. It might be helpful to reread the last paragraph of the Background.

1. Write the job title on your card in the space below.
2. Make a list of the components of your system and the purpose of each one.
3. Explain how your system will work.
4. Draw a picture of your spacesuit design on the astronaut.

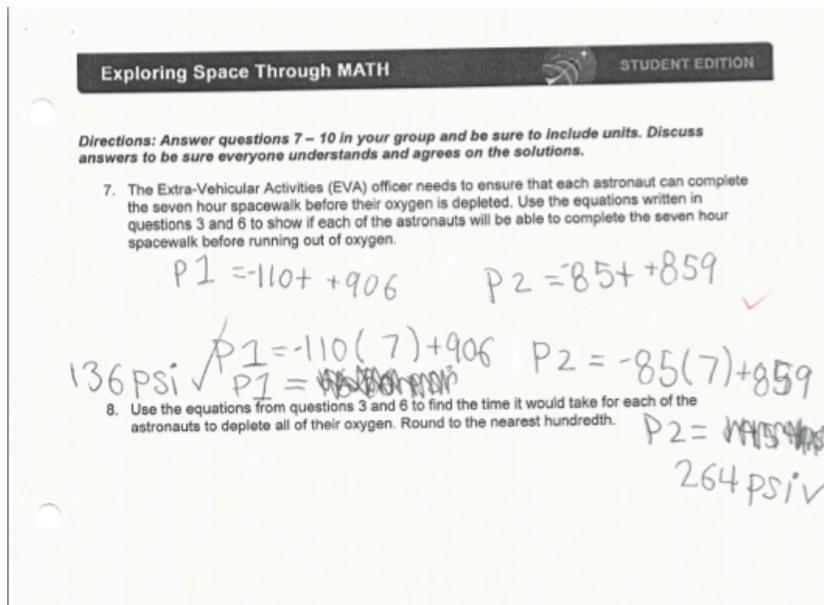
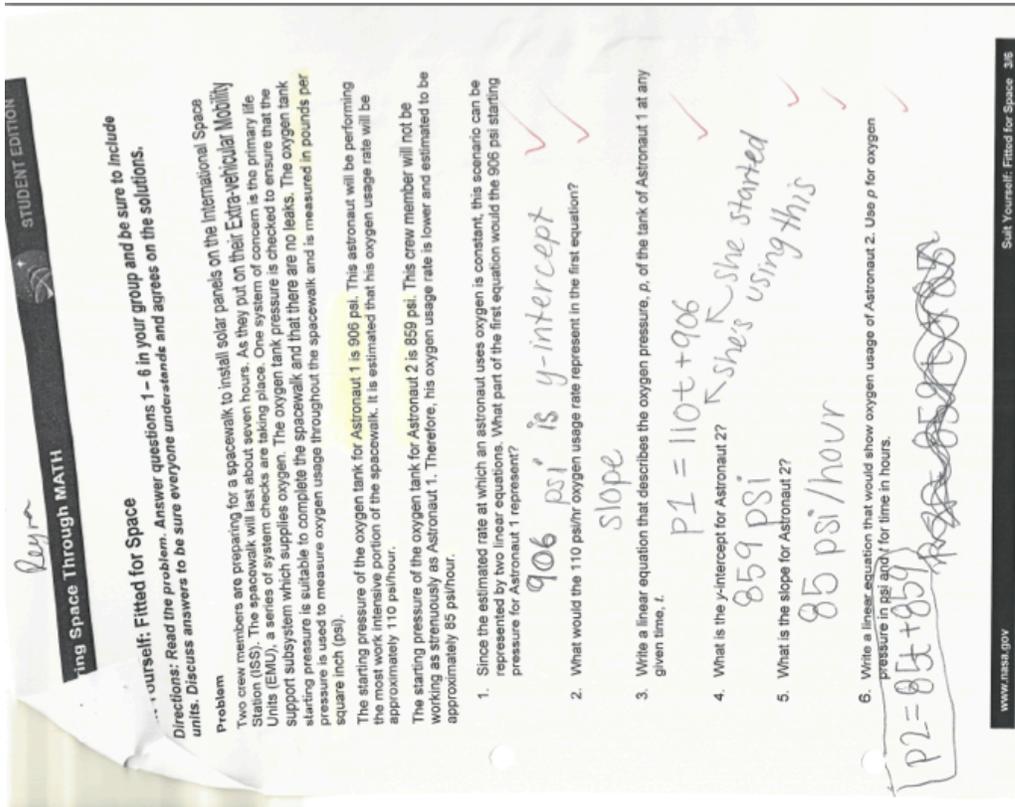
Job Title: Communication and telemetry Engineer (CTE)

headset, the astronaut can communicate with another astronaut of kilometers or distance.



**F) Lesson 5: Using Linear Equations, Graphs, and Models to Save Astronauts!!**

2. Suit Yourself Worksheets: The class worked on the math problems presented by the Suit Yourself activity individually, in pairs, and as a whole-class group. The problems are about the fact that astronauts can only work a certain number of hours on the Space Station or Hubble Telescope because of a limit of oxygen. The problems required students to write a linear equation for two astronauts' oxygen capabilities, and manipulate the equations. The work completed by the students is of varied quality, given that this was the culminating activity. In retrospect, I would have like to have been able to spend more time on this activity!



Reyna's Work

Dalonte

Exploring Space Through MATH

Suit Yourself: Fitted for Space

Directions: Read the problem. Answer questions 1 - 6 in your group and be sure to include units. Discuss answers to be sure everyone understands and agrees on the solutions.

Problem

Two crew members are preparing for a spacewalk to install solar panels on the International Space Station (ISS). The spacewalk will last about seven hours. As they put on their Extra-Vehicular Mobility Units (EMU), a series of system checks are taking place. One system of concern is the primary life support subsystem which supplies oxygen. The oxygen tank pressure is checked to ensure that the starting pressure is suitable to complete the spacewalk and that there are no leaks. The oxygen tank pressure is used to measure oxygen usage throughout the spacewalk and is measured in pounds per square inch (psi).

The starting pressure of the oxygen tank for Astronaut 1 is 906 psi. This astronaut will be performing the most work intensive portion of the spacewalk. It is estimated that his oxygen usage rate will be approximately 110 psi/hour.

The starting pressure of the oxygen tank for Astronaut 2 is 859 psi. This crew member will not be working as strenuously as Astronaut 1. Therefore, his oxygen usage rate is lower and estimated to be approximately 85 psi/hour.

1. Since the estimated rate at which an astronaut uses oxygen is constant, this scenario can be represented by two linear equations. What part of the first equation would the 906 psi starting pressure for Astronaut 1 represent?

906 psi is y-intercept

2. What would the 110 psi/hr oxygen usage rate represent in the first equation?

slope

3. Write a linear equation that describes the oxygen pressure, p, of the tank of Astronaut 1 at any given time, t.

$P_1 = 110t + 906$

using the slope

4. What is the y-intercept for Astronaut 2?

859

5. What is the slope for Astronaut 2?

85

6. Write a linear equation that would show oxygen usage of Astronaut 2. Use p for oxygen pressure in psi and t for time in hours.

$P_2 = 85t + 859$

Exploring Space Through MATH

Directions: Answer questions 7 - 10 in your group and be sure to include units. Discuss answers to be sure everyone understands and agrees on the solutions.

7. The Extra-Vehicular Activities (EVA) officer needs to ensure that each astronaut can complete the seven hour spacewalk before their oxygen is depleted. Use the equations written in questions 3 and 6 to show if each of the astronauts will be able to complete the seven hour spacewalk before running out of oxygen.

$P_1 = 110t + 906$

$P_2 = 100t + 906$

$P_1 = 126 \text{ psi}$

$P_2 = 85t + 859$

$P_2 = 85(7) + 859$

$P_2 = 859 + 595$

8. Use the equations from questions 3 and 6 to find the time it would take for each of the astronauts to deplete all of their oxygen. Round to the nearest hundredth.

Astronaut 1

$0 = 110t + 906$

$-906 = 110t$

$t = 906$

$0 = -85t + 859$

$-859 = -85t$

$\frac{-859}{-85} = \frac{-85t}{-85}$

$10.10588235$

9. State your answers to question eight in hours and minutes. Round your answer to the nearest minute.

Astronaut 1

906 hours

minutes

$106 \times 60 = 316 \text{ min}$

10. Write the two points that were found in questions 8 as coordinates (t, p). What would each point represent on a graph and why?

Lonte's Work

**Suit Yourself: Fitted for Space**

**Directions:** Read the problem. Answer questions 1 – 6 in your group and be sure to include units. Discuss answers to be sure everyone understands and agrees on the solutions.

**Problem**

Two crew members are preparing for a spacewalk to install solar panels on the International Space Station (ISS). The spacewalk will last about seven hours. As they put on their Extra-Vehicular Mobility Units (EMU), a series of system checks are taking place. One system of concern is the primary life support subsystem which supplies oxygen. The oxygen tank pressure is checked to ensure that the starting pressure is suitable to complete the spacewalk and that there are no leaks. The oxygen tank pressure is used to measure oxygen usage throughout the spacewalk and is measured in pounds per square inch (psi).

The starting pressure of the oxygen tank for Astronaut 1 is 906 psi. This astronaut will be performing the most work intensive portion of the spacewalk. It is estimated that his oxygen usage rate will be approximately 110 psi/hour.

The starting pressure of the oxygen tank for Astronaut 2 is 859 psi. This crew member will not be working as strenuously as Astronaut 1. Therefore, his oxygen usage rate is lower and estimated to be approximately 85 psi/hour.

- Since the estimated rate at which an astronaut uses oxygen is constant, this scenario can be represented by two linear equations. What part of the first equation would the 906 psi starting pressure for Astronaut 1 represent?  
 $906 \text{ PSI}$  IS Y-INTERCEPT
- What would the 110 psi/hr oxygen usage rate represent in the first equation?  
 Slope
- Write a linear equation that describes the oxygen pressure,  $p$ , of the tank of Astronaut 1 at any given time,  $t$ .  
 $P_1 = 110t + 906$   
 USING PSI HOUR STARTED
- What is the y-intercept for Astronaut 2?  
 $859$
- What is the slope for Astronaut 2?  
 $85 \text{ PSI}$   
 Astronaut two 85 PSI
- Write a linear equation that would show oxygen usage of Astronaut 2. Use  $p$  for oxygen pressure in psi and  $t$  for time in hours.  
 $P_2 = 85t + 859$  slope is negative

**Directions:** Answer questions 7 – 10 in your group and be sure to include units. Discuss answers to be sure everyone understands and agrees on the solutions.

- The Extra-Vehicular Activities (EVA) officer needs to ensure that each astronaut can complete the seven hour spacewalk before their oxygen is depleted. Use the equations written in questions 3 and 6 to show if each of the astronauts will be able to complete the seven hour spacewalk before running out of oxygen.

$$P_1 = 110t + 906$$

$$P_2 = 85t + 859$$

$$P_1 = 110(7) + 906$$

$$P_2 = 85(7) + 859$$

$$P_1 = 1676$$

$$P_2 = 1367$$

- Use the equations from questions 3 and 6 to find the time it would take for each of the astronauts to deplete all of their oxygen. Round to the nearest hundredth.

$$0 = -110t + 906$$

$$-906 = -110t$$

$$\frac{-906}{-110} = \frac{-110t}{-110}$$

$$8.236 = t$$

$$t = 9.06 \text{ hours}$$

$$0 = -85t + 859$$

$$-859 = -85t$$

$$\frac{-859}{-85} = \frac{-85t}{-85}$$

$$10.10 = t$$

- State your answers to question eight in hours and minutes. Round your answer to the nearest minute.

Astronaut #1  
 $9.06 \text{ hours}$   
 $0.6 \text{ hours}$

Astronaut #2  
 $10.10 \text{ hours}$   
 $0.6 \text{ hours}$

- Write the two points that were found in questions 8 as coordinates  $(t, p)$ . What would each point represent on a graph and why?

$(9.06, 0)$

$(10.10, 0)$

Douglas's work

Directions: Answer questions 7 – 10 in your group and be sure to include units. Discuss answers to be sure everyone understands and agrees on the solutions.

7. The Extra-Vehicular Activities (EVA) officer needs to ensure that each astronaut can complete the seven hour spacewalk before their oxygen is depleted. Use the equations written in questions 3 and 6 to show if each of the astronauts will be able to complete the seven hour spacewalk before running out of oxygen.

$$P_1 = 110t + 906$$

$$P_2 = 85(7) + 859$$

$$P_2 = 264$$

8. Use the equations from questions 3 and 6 to find the time it would take for each of the astronauts to deplete all of their oxygen. Round to the nearest hundredth.

Astronaut 1

$$0 = -100t + 906$$

$$\begin{array}{r} -906 = -100t \\ -100 \quad -100 \\ \hline t = 9.06 \text{ hours} \end{array}$$

Astronaut 2

$$0 = -85t + 859$$

$$\begin{array}{r} -859 = -85t \\ -85 \quad -85 \\ \hline t = 10.1059 \text{ hours} \end{array}$$

9. State your answers to question eight in hours and minutes. Round your answer to the nearest minute.

Astronaut 1

$$9.06 \text{ hours}$$

$$0.06 \times 60 = 3.6 \text{ minutes}$$

The astronaut can be in space 9 hours, 3 minutes, 36 seconds.

10. Write the two points that were found in questions 8 as coordinates (t, p). What would each point represent on a graph and why?

$$(9.06, 0)$$

this is an x-intercept

$$(10.1059, 0)$$

This is an x-intercept.

Osmin

Suit Yourself: Fitted for Space

Directions: Read the problem. Answer questions 1 – 6 in your group and be sure to include units. Discuss answers to be sure everyone understands and agrees on the solutions.

Problem

Two crew members are preparing for a spacewalk to install solar panels on the International Space Station (ISS). The spacewalk will last about seven hours. As they put on their Extra-Vehicular Mobility Units (EMU), a series of system checks are taking place. One system of concern is the primary life support subsystem which supplies oxygen. The oxygen tank pressure is checked to ensure that the starting pressure is suitable to complete the spacewalk and that there are no leaks. The oxygen tank pressure is used to measure oxygen usage throughout the spacewalk, and is measured in pounds per square inch (psi).

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906 psi is y-intercept
- What would the 110 psi/hr oxygen usage rate represent in the first equation?  
slope
- Write a linear equation that describes the oxygen pressure,  $P$ , of the tank of Astronaut 1 at any given time,  $t$ .  
 $P_1 = 110t + 906$
- What is the y-intercept for Astronaut 2?  $P_2 = 859$  psi  
859 psi is y-intercept
- What is the slope for Astronaut 2?  
85 psi/hours
- Write a linear equation that would show oxygen usage of Astronaut 2. Use  $p$  for oxygen pressure in psi and  $t$  for time in hours.  
 $P_2 = 859t + 859$  psi/hours

Osmin's work

### *Unit Implementation*

Student Reflection: The students completed a reflection about the “Linear and Quadratic Equations: Astronauts, Space, and Microgravity What a Unit!!” unit prior to our study, and after the study. Below, I have recorded student responses on the concluding reflection.

#### **1) What kinds of things can you use a linear function to do?**

*Douglas:* You can use linear functions to calculate the distances from one point to another

*Dalonte:* Rate of something, time, distances, etc...

#### **2) What do linear equations have to do with science?**

*Douglas:* Scientists can use them to calculate distance from a new planet to another one.

*Osmín:* To predict the future and the past

*Dalonte:* You can use a linear equation to see the distance when astronauts fly

#### **3) How do you think that science and math are connected?**

*Osmín:* The math connected when the scientific make some maths to see the predictions of an experiment.

*Douglas:* Math → science = reasoning

When math and numbers are used you get a reasonable and logical answer. If someone doesn't believe it you can back it up by showing your calculations and show your proof. Math can be used to back up science and theories.

#### **4) What do you know about linear functions?**

*Douglas:* Line or equations that will always go straight.

*Osmín:* It's a line that has a slope and a graph.

*Dalonte:* Linear equations have a slope and a graph.

#### **5) What do you know about space suits?**

*Douglas:* Space suits are very vital for people to go to space. It holds oxygen, AC system, communication devices, protection from deadly space, and a personal spaceship for a person.

*Osmín:* A space suit is on the aircraft that astronauts use in the space.

*Dalonte:* Space suits have air conditioning in it. They are heavy. They have a jet pack.

#### **6) What do you know about space?**

*Douglas:* It's like a huge vacuum and it can be very dangerous. Complex yet wondrous.

*Osmín:* In the space no exist humans because there exist no gravity.

*Dalonte:* Space is cold and if you go out in space without a suit you would instantly freeze or boil.

**7) What do you know about space shuttle launches?**

*Douglas:* That it takes massive amounts of fuel in order to break through the atmosphere.

*Osmín:* The astronauts eat lunch in the space shuttles.

*Dalonte:* It's how an astronaut goes to space.

**8) What do you know about zero gravity? Or gravity in space?**

*Douglas:* Gravity in space is very unstable. In many parts gravity in space is so low that it allows you to float around freely and become weightless.

*Osmín:* Zero gravity is when we can't feeling force of gravity. In space don't exist gravity.

*Dalonte:* Gravity is a force. Anything with mass has gravity. More mass = more gravity.

**9) What do you want to know about these things? What questions do you have?**

*Douglas:* Is it possible to calculate or find out where does the universe end and when or where does all the space end and what would happen if we or something was to run on to it? Also what would happen if there is a bigger planet than us and the sun would we be pulled by its gravitational pull or would we just float in space? If there was a huge meteoroid bigger than the sun and it crashed, would it destroy the whole solar system?

*Osmín:* I want to know who was the first person that thought about going to space? How did humans discover space? Who created the first aircraft?