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

Option 1:

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

## *Unit Development*

### A. Statement of Purpose:

The "Astronauts, Space, and Microgravity: What a Unit!" unit was developed for a week-long portion of Algebra 1, that was being taught as a summer school course for students who had previously failed the course. The unit is component of the larger theme of the course, which was "Our Planet, Our Solar System, Our Universe: in Algebra" and the course incorporated engineering, physics, and problem solving into the Algebra 1 content. The course also included two field trips: one to the National Mall, where students visited the National Folklife Festival, which included displays such as how to build a tsunami-proof home; and a second field trip to the National Air and Space Museum, where students screened "Hubble 3D," and participated in a tour about African Americans in space.

The integration of science into this linear equations unit was an essential part of increasing student engagement and allowing students the opportunity be successful with the mathematics content that they had already failed. One of the students was taking Algebra 1 for the third time, and another student had never taken Algebra 1, so there was a wide range of abilities within the class. Incorporating NASA materials and activities into this unit (and the whole summer course) allowed me to put Algebra into context. Students were able to explore how NASA scientists like astrophysicists and astrobiologists use mathematics in their fields. The students were able to develop a much better understanding of how rates are applied with the real world, and how to evaluate data in a real-world context. The science content definitely contributed to the students' mathematical knowledge. On the other hand, the use of the NASA activities and tasks increased the students' scientific knowledge, because they were able to explore concepts such as global warming, the Space Shuttle STS 121 launch, and radiation dosages experienced by astronauts. Many students expressed that they never knew that it was possible to study science in a math class!

Typically students enrolled in Algebra 1 are between the ages of 13-14, yet most of my students were 15-19 years old, so my class had a much higher level of cognitive development. This unit met the developmental needs of my students in two main ways: 1) the unit build upon their previous knowledge and scaffolded their learning so that they could ultimately reach higher levels of understanding, and 2) the unit challenged the students by engaging them with tasks that were mathematically challenging, contexts that are complex, and a higher level of vocabulary and writing than they typically experience in an Algebra 1 class.

The unit "Astronauts, Space, and Microgravity: What a Unit!" was designed to introduce, reinforced, and extend the following mathematical concepts:

- ✓ Patterns
- ✓ Reading and drawing graphs
- ✓ Rate and slope

- ✓ Linear Equations in slope-intercept form (recognition and writing)
- ✓ Graphing linear equations
- ✓ Analyzing data with scatter plots and trend lines
- ✓ Use of mathematical models to understand scientific concepts

The students learned about rate, slope, and linear equations through activities about space (with Space Math). Students reviewed graphing linear equations and linear equations with Space Math materials as well, but they were taught these concepts and procedures as math lessons. The class had studied the STS 121 space trip to the Hubble Space Telescope in a previous unit, but within this mini-unit, the NASA Exploring Space Through Math "Suit Yourself" and "Space Shuttle Mass Vs. Altitude" activities and teacher resources were used to teach and reinforce the concepts of analyzing data with scatter plots and trend lines, and the use of mathematical models to understand scientific concepts. The NASA materials integrated into the mini-unit focused specifically on astronauts' use of oxygen while on a space walk, and the effects of gravity. Gravity was a theme throughout the course, and was explored more in detail in previous weeks of the course.

B. Overview of the Unit:

**1) Title of Unit:** Linear and Quadratic Equations: Astronauts, Space, and Microgravity! What a Unit!!

**2) Length:** This unit took place over 5 class periods. Since it was taught during summer school, each class period was approximately 2.5 hours in length. The unit was comprised of direct instruction of mathematical concepts, investigations of mathematical concepts, field work, group work, connections to Space Math and Exploring Space Through Math NASA resources, and whole-class discussions. Students also completed exit tickets, a unit pre and post reflection, and a pre and post exam from the entire summer school curriculum. The fact that the unit was implemented in summer school allowed for more time in developing student thinking, connecting to student interest, and integration of space and science concepts into the math classroom. This unit could be adapted to fit into approximately 7-8 class periods of 45-60 minutes.

**3) Standards:** The standards for the unit were drawn from the Common Core Mathematics Content Standards, the Common Core Standards for Mathematical Practice, and the National Science Education Standards.

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| **National Science Education Standards**<br><br>(National Committee on Science Education Standards and Assessment & National Research Committee, 1996, p. 111) | *Unifying Concepts and Processes:*<br>-Evidence, models, and explanation<br><br>*Earth and Space Science*<br>-Origin and evolution of the universe<br><br>*Science and Technology*<br>-Abilities of technological design<br><br>*Science in Personal and Social Perspectives*<br>-Science and technology in local, national, and global challenges |

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| | *History and Nature of Science*<br>-Nature of scientific knowledge |
| **Common Core Mathematics Content Standards**<br><br>(Common Core State Standards Initiative, 2012) | CCSS.Math.Content.HSA-CED.A.1 Create equations and inequalities in one variable and use them to solve problems. *Include equations arising from linear and quadratic functions, and simple rational and exponential functions*.<br><br>CCSS.Math.Content.HSF-IF.B.6 Calculate and interpret the average rate of change of a function (presented symbolically or as a table) over a specified interval. Estimate the rate of change from a graph.★<br><br>CCSS.Math.Content.HSF-BF.A.1 Write a function that describes a relationship between two quantities.★<br><br>CCSS.Math.Content.HSF-LE.A.2 Construct linear and exponential functions, including arithmetic and geometric sequences, given a graph, a description of a relationship, or two input-output pairs (include reading these from a table).<br><br>CCSS.Math.Content.HSF-LE.A.1b Recognize situations in which one quantity changes at a constant rate per unit interval relative to another.<br><br>CCSS.Math.Content.HSA-REI.B.3 Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters.<br><br>CCSS.Math.Content.HSN-Q.A.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays. |
| **Common Core Standards for Mathematical Practice**<br><br>(Common Core State Standards Initiative, 2012) | CCSS.Math.Practice.MP1 Make sense of problems and persevere in solving them.<br>CCSS.Math.Practice.MP4 Model with mathematics.<br>CCSS.Math.Practice.MP5 Use appropriate tools strategically. |
| **Capital City Public Charter School Habits of Mind and Habits of Work**<br><br>(Capital City Public Charter School, 2012) | *Habits of Mind:*<br>Reflection<br>Revision/Critique<br>Communication<br><br>*Habits of Work*<br>Organization<br>Timeliness<br>Quality<br>Accountability |

**4) and 5) Essential Questions:**
*For the whole Summer School Course (Essential Question and sub-guiding questions) "*Our Planet, Our Solar System, Our Universe: in Algebra"

- How does Algebra help us understand our planet, solar system, and universe?
    - Where are we? How does the universe work?
    - How does Algebra help us figure out if there are aliens?
    - How are we "stuck" to this planet, and what does gravity have to do with Algebra?
    - How do astrophysicists and astrobiologists use Algebra?
    - What major space expeditions are underway and how does Algebra relate?

*For the Unit: "Astronauts, Space, and Microgravity: What a Unit!" (Essential Questions and Sub-Guiding Questions)*

- How can Algebra represent data in different ways?
- What is a linear equation, and how can it save an astronaut's life?
    - What is rate of change? How is it used by NASA?
    - How does Kepler find planets? Why? What math do they use?
    - What is microgravity? How is it related to gravity and rockets?
    - What was space shuttle mission 121-STS? Why was it important?
    - How do astrophysicists and astrobiologists use linear equations?

C. Acceptable Evidence:

Throughout the unit, I utilized a variety of formative and summative assessments. The use of Entry Tasks and Exit Tickets was especially helpful, because they allowed me to stage interventions and re-teaching very quickly.

1) *Diagnostic Assessment:*
    - **Course Assessment**: I administered an Algebra 1 pre test at the start of summer school. The mathematics content taught in this unit was included in the pre test. Students scored themselves and reflected on their knowledge as a pre-cursor to our study of Algebra 1. This also set the stage for the reflective nature of the overall course.
    - **Unit Introductory Reflection:** At the start of the "Astronauts, Space, and Microgravity: What a Unit!" unit, students completed a short assessment of their content knowledge with linear and quadratic equations, and the science concepts of gravity, space suits, astronauts, and generally how math relates to space science.

2) *Formative Assessment:*
    - **Entry Tasks:** Students completed a short entry task at the start of each lesson. These entry tasks could be a worksheet, a pattern or problem solving problem, a written response to a prompt, a timed challenge, etc…
    - **Exit Tickets:** The Exit Tickets for each lesson were lined up with the learning targets for the lesson. The Exit Tickets were typically 4-8 problems in length. I used the Exit Tickets to determine how well the students understood the materials in the lesson. In this way, I could make immediate changes to the lessons for the next day or class period.
    - **Observations/Discussions:** The summer school class was relatively small (6-8 students depending on number of absences), and particularly because of our unit theme, we often discussed topics as a group. I listened to students'

ideas on our science and math concepts to gain an idea of their conceptual knowledge.

- **Group Work:** The students often worked in groups on problems such as the NASA Space Math problems. The students would also collaborate and share their findings/results. This allowed me to work one-on-one with students who needed more support, and it also gave a great opportunity to students to learn from teaching one another.
- **Field Work:** The class visited the Smithsonian Air and Space Museum on the National Mall in Washington, D.C. While there, we screened "Hubble 3D," which is a film about the solar system, and about the Hubble Space Telescope. The unit, "Astronauts, Space, and Microgravity: What a Unit!", includes an in-depth look at the Space Shuttle 121-STS trip to the Hubble Space Telescope, so the field work to the museum helped students connect the learning in class to the actual space trip. It was great, because we were able to look at a life-sized replica of the Hubble Space Telescope!

3) *Summative Assessment:*

- **Course Assessment:** Students completed a post course assessment that mirrored the pre course assessment. The assessment included content standards from the entire Algebra 1 course.
- **Unit Reflection:** Students re-wrote their unit reflections, and added materials and new content that they had learned to the reflection. This was the primary method that I used to evaluate their science content learning.
- **Projects:** The students completed a Pattern Project in which they created four tables of values for four linear patterns. Then, they needed to create the correct linear equations matching the tables and prove that the equations modeled the tables. The students then switched with another student and had to try to figure out the patterns.

  Another project that students completed was the "Suit Yourself: Fitted for Space" NASA Exploring Space Through MATH activity. The final results for each student was included as a part of their overall grade in the unit.

D. Learning Experience and Instruction

<table>
<tr><th colspan="2">Lesson 1: Patterns and Equations</th></tr>
<tr><td>Standards:<br>Common Core<br>CCSS.Math.Content.HSA-REI.B.3 Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters.<br><br>CCSS.Math.Content.HSN-Q.A.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.<br><br>CCSS.Math.Practice.MP1 Make sense of problems and persevere in solving them.<br>CCSS.Math.Practice.MP4 Model with mathematics.<br>CCSS.Math.Practice.MP5 Use appropriate tools strategically.<br><br>National Science Education Standards<br>Unifying Concepts and Processes:<br>-Evidence, models, and explanation<br>Earth and Space Science<br>-Origin and evolution of the universe</td><td>Lesson Objectives:<br>I can evaluate equations for given values and explain what the answer means.<br><br>I can create tables of values from an algebraic pattern.<br><br>I can create an algebraic pattern from a table.<br><br>I can explore and explain how equations are used in space math.<br><br>I can use the tools of a calculator and graph paper to solve and create equations and patterns.<br><br>I can use scientific models of space concepts and interpret the results.</td></tr>
<tr><td>Assessment:<br>Formative: Entry Task, Class Discussion of Space Math Problems<br><br>Summative: Space Math “Variables and Expressions from Around the Cosmos,” Pattern Challenge Project</td><td>Materials and Resources:<br>•White board, markers<br>•Entry Task<br>•NASA Space Math “Variables and Expressions from Around the Cosmos”<br>•http://spacemath.gsfc.nasa.gov/weekly/5Page81.pdf<br><br>•Problem Solving Problems<br>•Pattern Challenge Project</td></tr>
<tr><td colspan="2">Differentiation<br>Content: This lesson starts with a problem-solving challenge based on patterns, which connects to prior learning from the course. The lesson has opportunities for whole group instruction (with examples of the pattern project, and modeling of one of the Space Math problems), as well as group work and independent work. The lesson engages students in a variety of ways, and uses a science theme to draw students into the lesson.<br><br>Diversity of Learners: The lesson provides for opportunities for competition and peer-teaching, with the Pattern Challenge Project. The lesson also provides a higher level students the opportunity for a challenge with the complexity of explaining the Space Math Problems and</td></tr>
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students can also create more challenge patter problems. The lesson provides opportunities for one-on-one interventions with the teacher, which is especially essential with the vocabulary used in the Space Math worksheets.

**Engage:** Problem-Solving Problem and Discussion of Field Work

1) Entry Task: As a component of the overall summer school curriculum, students practiced completed various problem-solving problems, and following a system to solve the problems. The students will individually complete 2 pattern-based problems in the first 15 minutes of class. Students can collaborate with one another, and receive a sticker when they complete parts of the problem-solving process:

1) Background: What information do you have?
2) Plan: How will you solve this problem?
3) Carry Out Plan: Find your answer
4) Reflect on your plan: What challenges did you have with this problem? What was easy with this problem?

Example problem: Tiana and Shauna 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. Shauna 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?

2) After the students complete the problem-solving problems, we will discuss the fieldwork to the Smithsonian Air and Space Museum. We will talk about what we learned, what they liked, etc… This conversation will be the tie-in to our lesson on how to use patterns and equations describing patterns in order to understand space math.

**Explore:**

1) We will talk about the "Astronauts, Space, and Microgravity: What a Unit!" unit introduction reflection, and what students think that linear equation are, and how they could be used in science.

Introduce the Space Math "Variables and Expressions from Around the Cosmos" worksheet as a connection to their previous learning on solving and evaluating problems.

Discuss vocabulary: Cosmos, Saturn, Andromeda galaxy, light years, Volts, electron, Centigrade, black hole, speed of sound, sunspot

2) Pattern Challenge Project: (to be completed after the Space Math problem)
Given tables of values, have students try to guess the pattern. Given an equation, ask students to think about how they would fill in a table of values.

**Explain:**

1) Space Math: As a class, we will work through Problem 1 together. We will focus on identifying the equation P = 24 hours + .0004 Y. We will talk about what the variables mean, and what the output will mean. We will also talk about how to use the calculators correctly with this type of problem.
2) Pattern Challenge Project: Explain how to determine an equation from a table of values. Explain how to create a table of values from an equation.

**Elaborate:**

1) Students work on the Space Math problems in small groups. Teacher assists students who

need support, and encourages peer-teaching. After the problems are complete, students volunteer to come write their solutions and steps and explanations on the board.
2) Pattern Challenge Project: Students each receive a copy of the Pattern Challenge Project worksheet. They choose 4 equations, and complete the tables for the equations. They also create an "answer key." After all students are complete, they switch with one another, and determine the equation from the given table. When they are done, they can check one another's work.

**Evaluate:**

1) Space Math: As a group, we talk about what all of the problems have in common (they all have a number plus or minus another number multiplied by a variable). Make a connection to linear equations.
2) Pattern Challenge: Share difficult patterns. Discuss what was difficult and easy about the task. Provide the class with some more difficult patterns to complete (such as exponential, or symbol patterns).
3) Exit Ticket: Using equations and patterns

**Lesson 2: Rates of Change and Slope**

**Standards:**

**Common Core**

CCSS.Math.Content.HSF-IF.B.6 Calculate and interpret the average rate of change of a function (presented symbolically or as a table) over a specified interval. Estimate the rate of change from a graph.*

CCSS.Math.Content.HSF-LE.A.1b Recognize situations in which one quantity changes at a constant rate per unit interval relative to another.

CCSS.Math.Content.HSN-Q.A.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.

CCSS.Math.Practice.MP1 Make sense of problems and persevere in solving them.
CCSS.Math.Practice.MP4 Model with mathematics.
CCSS.Math.Practice.MP5 Use appropriate tools strategically.

**National Science Education Standards**

*Unifying Concepts and Processes:*
-Evidence, models, and explanation
*Earth and Space Science*
-Origin and evolution of the universe
*Science and Technology*
-Abilities of technological design
*Science in Personal and Social Perspectives*
-Science and technology in local, national, and global challenges

**Lesson Objectives:**

I can determine slope by using a graph.

I can determine a graph by using the slope formula.

I can determine slope using a table.

I can determine when slope or rate of change is constant on a table, graph, or equation.

I can use the tools of a calculator and graph paper to solve and create equations and patterns.

I can determine rate of change on a real life problem and explain what this means.

I can determine rate of change in an in-class activity and explain how to increase the rate.

**Assessment:**

*Formative:* Entry Task, Class Discussion of Space Math Problems, Opening Activity of Balloon Rocket

*Summative:* Space Math "Working with Rates," Rates of Change and Slope Exit Ticket

**Materials and Resources:**

- White board, markers
- Balloon, string, straw, tape
- NASA Space Math "Rates and Slopes: An Astronomical Perspective" http://spacemath.gsfc.nasa.gov/weekly/5Page74.pdf
- NASA Space Math "Working with Rates" http://spacemath.gsfc.nasa.gov/weekly/5Page73.pdf
- Exit Ticket
- Calculators

**Differentiation**

*Content:* This lesson starts with a whole class hands-on activity where students find the velocity of

a balloon. The lesson has opportunities for whole group instruction (with the slope formula and rates) as well as group work and independent work. The lesson engages students in a variety of ways, and uses a science theme to draw students into the lesson.

*Diversity of Learners:* The lesson provides for opportunities for competition and peer-teaching, with the Space Math "Working with Rates" worksheet. The lesson also provides a challenge with the "Rates and Slopes: An Astronomical Perspective" Space Math Activity, because there are 3 very challenging problems. Each group of students will present the answer to one problem, but students who grasp the concept quickly can move on to the other 2 problems, while this leaves time for one-on-one help with the teacher. The lesson provides opportunities for one-on-one interventions with the teacher, which is especially essential with the vocabulary used in the Space Math worksheets.

**Engage and Explore:** Balloon Rocket Activity

1) To start the class, we will discuss 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 have put into the balloon. This activity is very hands-on and it provides 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 talk about how rockets would be affected by gravity.
2) Set up of activity: tie a string to two stable objects at a long distance from one another in the classroom. Then tape a piece of a straw to a blown-up balloon. Place the straw on the string. Make sure that the timer is ready, and release the balloon. Record the distance the balloon traveled, and the time that it took before the balloon stopped moving. Repeat at least 3 times.
3) Use the measurements to find the average velocity of the balloon. Use the average velocity to find how far the balloon would travel after different amounts of time have passed.
4) Discuss what types of things could be impacting the experiment.

**Explain:**

Rates and slope.
Finding rates and slope with a table (relates to previous day's lesson)
Finding slope using a graph – Space Math "Rates and Slopes: An Astronomical Perspective"
Finding rates given two values, and importance of maintaining the units—Space Math "Working with Rates"
Finding slope using the slope formula

**Elaborate:**

1) Students work on the Space Math "Rates and Slopes: An Astronomical Perspective" problems in small groups. Teacher assists students who need support, and encourages peer-teaching. Each group chooses one problem to complete and answer. The group presents their answer and results to the class.
2) Students work on the Space Math "Working with Rates" problems. The students complete problems 1-9 either individually, or with a partner. The students focus on making sure that the units are correct for each answer. As the students finish, they can move on to the next section (compound units and scientific notation).

**Evaluate:**

1) Discuss challenges with rates of change (in relation to the Space Math "Working with Rates" worksheet)
3) Exit Ticket: Rates of Change and Slope

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

**Standards:**
**Common Core**

CCSS.Math.Content.HSF-LE.A.2 Construct linear and exponential functions, including arithmetic and geometric sequences, given a graph, a description of a relationship, or two input-output pairs (include reading these from a table).

CCSS.Math.Content.HSN-Q.A.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.

CCSS.Math.Practice.MP5 Use appropriate tools strategically.

**National Science Education Standards**
*Unifying Concepts and Processes:*
-Evidence, models, and explanation

**Lesson Objectives:**
I can graph a linear equation in slope-intercept form.

I can graph a linear equation in standard form, using intercepts.

I can write equations of lines from a graph.

I can use graph paper, label axes correctly, and use slope.

I can perform the mathematical tasks of graphing and writing linear equations, which is important for the next scientific concepts!

**Assessment:**
*Formative:* Entry Task, Graphing and Writing equations centers

*Summative:* Graphing and Writing Equations Exit Ticket

**Materials and Resources:**
- White board, markers
- Graph paper
- NASA Space Math "Rates and Slopes: An Astronomical Perspective" http://spacemath.gsfc.nasa.gov/weekly/5Page74.pdf
- Exit Ticket

**Differentiation**
*Content:* This lesson incorporates centers for movement and competition amongst students. The lesson has opportunities for whole group instruction (with guided notes) as well as group work and independent work.

*Diversity of Learners:* The lesson provides for opportunities for competition and peer-teaching, with the centers. The lesson also provides a challenge with the use of centers, because students can complete as many centers as possible, and get immediate feedback on how they did at the centers. The lesson also provides necessary structure with guided notes. The lesson provides opportunities for one-on-one interventions with the teacher during the centers and individual practice time.

**Engage:**
The class will begin with an entry task activity. The questions will be rate related, such as "if Ms. Cook buys 5 candy bars a week, how many will she have bought after 3 months?" Several problems like this will start the conversation in class to connect rates to graphs.

**Explore:**
The students will complete the first part of the Guided Notes with the teacher. The class will be

expected to know the definitions of slope, intercept, and the pieces of the coordinate plane. The class will also practice graphing some different types of equations on graphing calculators, and we will determine what a "linear" equation is, and what pieces it has (slope and y-intercept).

**Explain:**

Graphing linear equations in slope-intercept form. (with guided notes)
Identifying the Slope-Intercept equation from a graph (with guided notes)
(For advanced students—graphing a linear equation in standard form, using the x and y intercepts.)

**Elaborate:**

1) Graphing and Writing Linear Equations Centers: Students will work in the 5 centers. They will have 7-8 minutes on the clock at each center, and they can chose which center to work at. After they complete a center, they can turn in the problem to the teacher, who will give them immediate feedback so that they have an opportunity to correct their mistakes.
2) Advanced students will receive a mini-lesson on how to graph linear equations in slope-intercept form.
3) All students will go back to the Space Math "Rates and Slopes: An Astronomical Perspective" problems and try to write a linear equation to match it. The students will present their equations, informally, to one another and compare their results.

**Evaluate:**

1) Discuss which centers were challenging, and which were easy. Share out tips and shortcuts.
4) Exit Ticket: Graphing and Writing linear equations.

**Lesson 4: Reading and Using Graphs**

**Standards:**
**Common Core**

CCSS.Math.Content.HSF-LE.A.2 Construct linear and exponential functions, including arithmetic and geometric sequences, given a graph, a description of a relationship, or two input-output pairs (include reading these from a table).

CCSS.Math.Content.HSF-BF.A.1 Write a function that describes a relationship between two quantities.*

CCSS.Math.Content.HSN-Q.A.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.

CCSS.Math.Practice.MP4 Model with mathematics.
CCSS.Math.Practice.MP5 Use appropriate tools strategically.

**National Science Education Standards**
*Unifying Concepts and Processes:*
-Evidence, models, and explanation

**Lesson Objectives:**

I can explain how variables are related on a graph.

I can draw a graph relating to a situation.

I can determine which variables are independent and dependent.

I can use a table to model a real-life situation.

I can use an equation to model a real life situation.

I can graph a linear equation.

I can use graph paper, label axes correctly, and use slope.

**Assessment:**
*Formative:* Entry Task, Word Problems and Patterns Scaffolded Example, Practice

*Summative:* Word Problem and Patterns Mini-Project, Exit Ticket

**Materials and Resources:**
- White board, markers
- Graph paper
- Practice Sheets
- Guided Notes
- Word Problem and Patterns Mini Project and Teacher Example
- Exit Ticket

**Differentiation**
*Content:* This lesson incorporates student choice with their mini project. The lesson also has a high level of visual teaching. The lesson has opportunities for whole group instruction (with guided notes) as well as group work and independent work.

*Diversity of Learners:* The lesson also provides necessary structure with guided notes. The lesson provides a scaffolded example of the mini-project. The lesson provides opportunities for students to peer-teach during practice time, and to share out their results. The lesson provides opportunities for one-on-one interventions with the teacher during the practice. The lesson has multiple modalities, including visual, technology, use of guided notes, etc…

**Engage and Explore:**
The class will begin with an entry task activity. The task will to determine which scenario could match which graph. For example, the amount of money in Ms. Cook's bank account as the month goes by. Students will each design their own graph and write it on the board.

Students will examine other interesting and compelling graphs, such as trying to explain a position graph.

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| Quick review of graphing points on the coordinate plane (complete first part of the guided notes together). |
| **Explain:**<br>Analyzing a graph (with guided notes)<br>Matching a table and graph (with guided notes)<br>Sketching a graph (with guided notes)<br><br>Connecting graphs, tables, and equations—Scaffolded Word Problems and Patterns problem with Ms. Cook |
| **Elaborate:**<br>1) Practice of using graphs to relate two quantities<br>2) Completion of Scaffolded Word Problems and Patterns Problem<br>3) Individual Word Problems and Patterns Project |
| **Evaluate:**<br>1) Discuss the worksheets, and share projects<br>2) Exit Ticket: Using graphs to relate two quantities |

| **Lesson 5: Using Linear Equations, Graphs, and Models to Save Astronauts!!** | |
|---|---|
| **Standards:**<br>**Common Core**<br><br>CCSS.Math.Content.HSA-CED.A.1 Create equations and inequalities in one variable and use them to solve problems. *Include equations arising from linear and quadratic functions, and simple rational and exponential functions*.<br><br>CCSS.Math.Content.HSF-IF.B.6 Calculate and interpret the average rate of change of a function (presented symbolically or as a table) over a specified interval. Estimate the rate of change from a graph.★<br><br>CCSS.Math.Content.HSF-BF.A.1 Write a function that describes a relationship between two quantities.★<br><br>CCSS.Math.Content.HSF-LE.A.2 Construct linear and exponential functions, including arithmetic and geometric sequences, given a graph, a description of a relationship, or two input-output pairs (include reading these from a table).<br><br>CCSS.Math.Content.HSF-LE.A.1b Recognize situations in which one quantity changes at a constant rate per unit interval relative to another.<br><br>CCSS.Math.Content.HSA-REI.B.3 Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters.<br><br>CCSS.Math.Content.HSN-Q.A.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.<br><br>CCSS.Math.Practice.MP1 Make sense of problems and persevere in solving them.<br>CCSS.Math.Practice.MP4 Model with mathematics.<br>CCSS.Math.Practice.MP5 Use appropriate tools strategically.<br><br>**National Science Education Standards**<br>*Unifying Concepts and Processes:*<br>-Evidence, models, and explanation<br>*Earth and Space Science*<br>-Origin and evolution of the universe<br>*Science and Technology*<br>-Abilities of technological design<br>*Science in Personal and Social Perspectives*<br>-Science and technology in local, national, and global | **Lesson Objectives:**<br><br>I can identify slope and the effects of a change in slope.<br><br>I can determine what slope means in a real world situation.<br><br>I can draw a graph relating to a situation.<br><br>I can find the x-intercept, y-intercept, and determine what they represent in a real life situation.<br><br>I can create linear equations given y-intercept and slope.<br><br>I can solve linear equations and systems of linear equations using the substation method and the graphing calculator.<br><br>I can work with a group to create an equation that represents a real life situation<br><br>I can use equations that model a real life situation.<br><br>I can use graph paper and a graphing calculator efficiently.<br><br>I can explore challenges with space travel, such as oxygen supply and space suits. |

| | |
|---|---|
| challenges<br>*History and Nature of Science*<br>I can-Nature of scientific knowledge | I can solve a real problem about space travel and the space station.<br><br>I can solve a math problem in a similar way to the way that astrophysicists need to work. |
| **Assessment:**<br>*Formative:* Entry Task, Exploring Space Through Math "Suit Yourself" discussions<br><br>*Summative:* Exploring Space Through Math "Suit Yourself" final work | **Materials and Resources:**<br>•White board, markers<br>•Graph paper<br>•Exploring Space Through Math "Suit Yourself: Fitted for Space" teacher and student resources http://www.nasa.gov/audience/foreducators/exploringmath/algebra1/Prob_SuitYourself_detail.html<br><br>•Astronauts in space videos http://www.nasa.gov/audience/foreducators/topnav/materials/listbytype/Gravity_on_Earth_Versus.html http://www.nasa.gov/audience/foreducators/topnav/materials/listbytype/A_Day_Aboard.html<br><br>•Calculators |

**Differentiation**

*Content:* This lesson is a cumulation of everything that the students have studied for the whole summer school course, and within the unit "Astronauts, Space, and Microgravity: What a Unit!" One way that this particular lesson differentiates is through the use of visuals (videos), and drawing. Also, the class will discuss concepts quite a bit. The group will read the background info aloud and discuss. The lesson has opportunities for whole group instruction (with guided notes) as well as group work and independent work.

*Diversity of Learners:* The lesson has multiple modalities, including visual, technology, use of guided notes, etc… The activity also is scaffolded to go from easy problems to more difficult problems. The activity certainly has a high level of difficulty, so high-performing students should do well. Finally, the questions are quite easy to modify, making it more accessible for lower performing students.

**Engage:**

We will briefly discuss how we can bring all of our learning together. Reflect on experiences from the field work. Watch videos about life in the space station, and gravity in space.

**Explore:**

Read the background information together and discuss.

Brainstorm your spacesuit activity. Each student has a specific job with the creation of a space suit. The students draw the component of the spacesuit that they are responsible for, and share it with the class.

**Explain:**

Quickly review the learning targets for the day, have students pull out the notes. Read through the questions and determine what the questions are asking for. It will be important in this part of the lesson for the teacher to pay attention to pacing. For example, it makes sense to discuss and explain what questions 1,2,and 3 are asking for, then let students work on them, etc…

**Elaborate:**

1) Students work in pairs or individually to complete problems 1-6. When the students have completed the problems, have each group share out 1 or 2 of their solutions. Discuss. Have the class determine the correct answers, and who is right.
2) Students work in pairs or individually to complete problems 7-10. When the students have completed the problems, have each group share out 1 or 2 of their solutions. Discuss. Have the class determine the correct answers, and who is right.
3) If there is time, have students work on problems 11-15 independently. Teacher should rotate through the classroom assisting when necessary. If a student or student(s) complete the problems, they can also rotate as an expert.

**Evaluate:**

1) Discuss the answers, how the math contents fit together, and what the students think of the task. Perhaps ask them about what they think it would be like to be an astronaut, and in what capacity they could see themselves working with NASA or astrophysicists.
3) Unit Reflection: students individually complete the reflection for the unit "Astronauts, Space, and Microgravity: What a Unit!" Have students share out 1 or 2 things that they reflected upon.

Appendix

1. Common Core Standards for Mathematical Practice
2. Lesson 1 Entry Task
3. Lesson 1 Pattern Challenge Project
4. Lesson 2: Guided Notes: Slope and Rates of Change
5. Lesson 2: Finding Slope and Rates of Change Practice
6. Lesson 2: Rates of Change and Slope Exit Ticket
7. Lesson 3: Guided Notes: Graphing and Writing Linear Equations
8. Lesson 3: Centers Graphing and Writing Linear Equations
9. Lesson 4: Guided Notes Using Graphs to Relate Quantities
10. Lesson 4: Practice Using Graphs to Relate Quantities
11. Lesson 4: Word Problems and Patterns Project
12. Lesson 5: Unit Reflection

1. Common Core Standards for Mathematical Practice

**CCSS.Math.Practice.MP1 Make sense of problems and persevere in solving them.**

Mathematically proficient students start by explaining to themselves the meaning of a problem and looking for entry points to its solution. They analyze givens, constraints, relationships, and goals. They make conjectures about the form and meaning of the solution and plan a solution pathway rather than simply jumping into a solution attempt. They consider analogous problems, and try special cases and simpler forms of the original problem in order to gain insight into its solution. They monitor and evaluate their progress and change course if necessary. Older students might, depending on the context of the problem, transform algebraic expressions or change the viewing window on their graphing calculator to get the information they need. Mathematically proficient students can explain correspondences between equations, verbal descriptions, tables, and graphs or draw diagrams of important features and relationships, graph data, and search for regularity or trends. Younger students might rely on using concrete objects or pictures to help conceptualize and solve a problem. Mathematically proficient students check their answers to problems using a different method, and they continually ask themselves, "Does this make sense?" They can understand the approaches of others to solving complex problems and identify correspondences

**CCSS.Math.Practice.MP4 Model with mathematics.**

Mathematically proficient students can apply the mathematics they know to solve problems arising in everyday life, society, and the workplace. In early grades, this might be as simple as writing an addition equation to describe a situation. In middle grades, a student might apply proportional reasoning to plan a school event or analyze a problem in the community. By high school, a student might use geometry to solve a design problem or use a function to describe how one quantity of interest depends on another. Mathematically proficient students who can apply what they know are comfortable making assumptions and approximations to simplify a complicated situation, realizing that these may need revision later. They are able to identify important quantities in a practical situation and map their relationships using such tools as diagrams, two-way tables, graphs, flowcharts and formulas. They can analyze those relationships mathematically to draw conclusions. They routinely interpret their mathematical results in the context of the situation and reflect on whether the results make sense, possibly improving the model if it has not served its purpose.

. **CCSS.Math.Practice.MP5 Use appropriate tools strategically.** Mathematically proficient students consider the available tools when solving a mathematical problem. These tools might include pencil and paper, concrete models, a ruler, a protractor, a calculator, a spreadsheet, a computer algebra system, a statistical package, or dynamic geometry software. Proficient students are sufficiently familiar with tools appropriate for their grade or course to make sound decisions about when each of these tools might be helpful, recognizing both the insight to be gained and their limitations. For example, mathematically proficient high school students analyze graphs of functions and solutions generated using a graphing calculator. They detect possible errors by strategically using estimation and other mathematical knowledge. When making mathematical models, they know that technology can enable them to visualize the results of varying assumptions, explore consequences, and compare predictions with data. Mathematically proficient students at various grade levels are able to identify relevant external mathematical resources, such as digital content located on a website, and use them to pose or solve problems. They are able to use technological tools to explore and deepen their understanding of concepts.

# Number Patterns

LT 12: Rates and Patterns

**Name:** _____ **Date:** _____

**Complete the number sequences with the values that should come next.**

(1) 2, 4, 8, 16, 32, 64, 128, 256, 512, 1024, 2,048 , 4,096
Pattern: Multiplying by 2

(2) 7, 7, 10, 10, 13, 13, 16, 16, 19, 19, _____, _____
Pattern:

(3) 4, 4, 4, 6, 6, 6, 8, 8, 8, 10, _____, _____
Pattern:

(4) 6, 24, 16, 64, 56, 224, 216, 864, 856, 3424, _____, _____
Pattern:

(5) 1, 1, 1, 0, 0, 0, -1, -1, -1, -2, _____, _____
Pattern:

(6) -2, -2, -1, -1, 0, 0, 1, 1, 2, 2, _____, _____
Pattern:

(7) 9, 27, 20, 60, 53, 159, 152, 456, 449, 1347, _____, _____
Pattern:

(8) 21, 20, 19, 18, 17, 16, 15, 14, 13, 12, _____, _____
Pattern:

(9) 44, 41, 38, 35, 32, 29, 26, 23, 20, 17, _____, _____
Pattern:

(10) 101, 89, 77, 65, 53, 41, 29, 17, 5, -7, _____, _____
Pattern:

(11) 11, 14, 17, 20, 23, 26, 29, 32, 35, 38, _____, _____
Pattern:

(12) 7, 7, 5, 3, 3, 1, -1, -1, -3, -5, _____, _____
Pattern:



# Making Number Patterns (A)

LT 12: Rates and Patterns

Name: _____

Instructions: Make a number pattern for each of the rules.

Start at 63 and subtract 4 each time. ____, ____, ____, ____, ____

Start at 1 and add 7 each time. ____, ____, ____, ____, ____

Start at 17 and add 8 each time. ____, ____, ____, ____, ____

Start at 50 and subtract 5 each time. ____, ____, ____, ____, ____

Start at 65 and subtract 6 each time. ____, ____, ____, ____, ____

Start at 9 and add 6 each time. ____, ____, ____, ____, ____

Start at 18 and add 3 each time. ____, ____, ____, ____, ____

Start at 70 and subtract 4 each time. ____, ____, ____, ____, ____

Start at 71 and subtract 2 each time. ____, ____, ____, ____, ____

Start at 64 and subtract 8 each time. ____, ____, ____, ____, ____

Start at 52 and subtract 1 each time. ____, ____, ____, ____, ____

Start at 58 and subtract 5 each time. ____, ____, ____, ____, ____

Start at 51 and subtract 1 each time. ____, ____, ____, ____, ____

Start at 56 and subtract 3 each time. ____, ____, ____, ____, ____

Start at 68 and subtract 6 each time. ____, ____, ____, ____, ____

3. Lesson 1 Pattern Challenge Project

**Pattern Challenge Project**

Name: _____ Date: _____

*LT 12: I can recognize patterns and equations*

**Problem 1:**

| X | Y |
|---|---|
| 1 | |
| 2 | |
| 3 | |
| 4 | |
| 5 | |

**Equation:** y = _____

**Problem 2:**

| X | Y |
|---|---|
| 1 | |
| 2 | |
| 3 | |
| 4 | |
| 5 | |

**Equation:** y = _____

**Problem 3:**

| X | Y |
|---|---|
| 1 | |
| 2 | |
| 3 | |
| 4 | |
| 5 | |

**Equation:** y = _____

**Problem 4:**

| X | Y |
|---|---|
| 1 | |
| 2 | |
| 3 | |
| 4 | |
| 5 | |

**Equation:** y = _____

# 5-1 Rate of Change and Slope

## Vocabulary

### Review

1. Circle the *rate* that matches this situation: Ron reads 5 books every 2 weeks.

$\frac{5 \text{ weeks}}{2 \text{ books}}$ $\frac{2 \text{ books}}{5 \text{ weeks}}$ $\frac{5 \text{ books}}{2 \text{ weeks}}$

2. Write *always*, *sometimes*, or *never*.

A *rate* is ? a ratio. _____

A ratio is ? a *rate*. _____

3. Underline the correct word to complete each sentence.

A *rate* compares two quantities by division / multiplication.

A *rate* compares quantities in different / the same unit(s).

### Vocabulary Builder

$\text{slope} = \frac{\text{vertical change}}{\text{horizontal change}} = \frac{\text{rise}}{\text{run}}$

**slope** (noun) slohp

**Definition:** **Slope** is the ratio of the vertical change (or rise) to the horizontal change (or run) between two points on a line. **Slope** is also called the rate of change.

**Main Idea:** **Slope** describes the steepness of a line in the coordinate plane.

**Examples:** You can measure the **slope** of a hill, mountain, road, or roof.

### Use Your Vocabulary

4. How does the *slope* of a road affect a person's driving?

_____

_____

5. What kind of ski *slope* would a beginner skier use?

_____

_____





## Problem 1 Finding Rate of Change Using a Table

**Got It?** The table at the right shows the distance a band marches over time. The rate of change from one row of the table to the next is 260 feet per minute. Do you get the rate of change of 260 feet per minute if you use nonconsecutive rows of the table? Explain.

Distance Marched

| Time (min) | Distance (ft) |
|---|---|
| 1 | 260 |
| 2 | 520 |
| 3 | 780 |
| 4 | 1040 |

6. Use the values from the second and fourth rows to find the rate of change.

rate of change = $\frac{\text{change in distance}}{\text{change in time}}$

$= \frac{\square - 520}{4 - \square}$

$= \frac{\square}{2}$

$= \frac{\square}{1}$

When you use nonconsecutive rows, the rate of change is ____ ft per min.

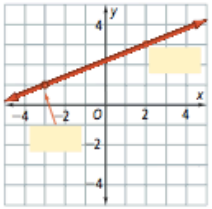
7. Is the rate of change you found in Exercise 6 the same as if you had used two consecutive rows? Explain why or why not.

_____

_____

## Problem 2 Finding Slope Using a Graph

**Got It?** What is the slope of the line?




8. Label each point on the graph with its coordinates.

9. Draw a vertical arrow to represent the rise.

rise = ____

10. Draw a horizontal arrow to represent the run.

run = ____

11. Underline the correct word to complete the sentence.

Because the points are on the same line, the rate of change from point to point is constant / differs.

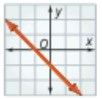
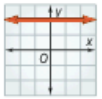
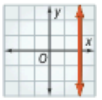
12. Write the slope of the line.

slope = $\frac{\text{vertical change}}{\text{horizontal change}} = \frac{\text{rise}}{\text{run}} = \frac{\square}{\square}$

Take note

## Concept Summary Slopes of Lines

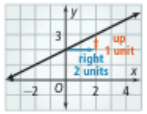
**20.** Label each graph with one of the descriptions in the box at the right.

negative slope
positive slope
slope of 0
undefined slope

## Lesson Check • Do you UNDERSTAND?

**Error Analysis** **A student calculated the slope of the line at the right to be 2. Explain the mistake. What is the correct slope?**




**21.** The rise of the graphed line is ____.

**22.** The run of the graphed line is ____.

**23.** What mistake did the student make by calculating the slope to be 2? Explain how to find the correct slope.

## Math Success

**Check off the vocabulary words that you understand.**

☐ rate of change ☐ slope

**Rate how well you can *find the slope of a line.***

Need to review 0 2 4 6 8 10 Now I get it!

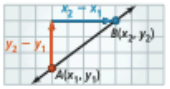




Take note

## Key Concept The Slope Formula

In the diagram, $(x_1, y_1)$ are the coordinates of point $A$, and $(x_2, y_2)$ are the coordinates of point $B$. To find the slope of $\overline{AB}$, you can use the *slope formula*.




$$\text{slope} = \frac{\text{rise}}{\text{run}} = \frac{y_2 - y_1}{x_2 - x_1}, \text{ where } x_2 - x_1 \neq 0$$

When using the *slope formula*, the $x$-coordinate you use first in the denominator must belong to the same ordered pair as the $y$-coordinate you use first in the numerator.

**13.** To find the change in $x$- or $y$-coordinates, do you add or subtract?

**14.** What number will you get in the denominator if the $x$-coordinates are the same? Explain how that will affect the answer you find for the slope.

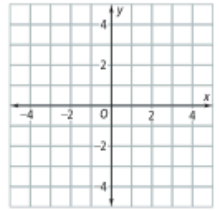
## Problem 3 Finding Slope Using Points

**Got It?** **What is the slope of the line through (1, 3) and (4, −1)?**

**15.** You can use either pair for $(x_2, y_2)$ and complete the equation.

$$\text{slope} = \frac{y_2 - y_1}{x_2 - x_1} = \frac{\square - \square}{\square - \square} = \frac{\square}{\square}$$

**16.** **Reasoning** Plot the points and draw a line through them. Does the slope of the line look as you expected it to? Explain.



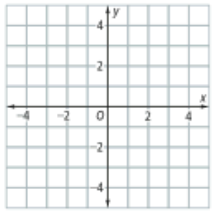
## Problem 4 Finding Slopes of Horizontal and Vertical Lines

**Got It?** **What is the slope of the line through (4, −3) and (4, 2)?**

**17.** Graph the points (4, −3) and (4, 2) and draw the line that goes through the points.

**18.** Is the line that you drew *horizontal* or *vertical*?

**19.** What is the slope of the line through (4, −3) and (4, 2)?



Name _____ Class _____ Date _____

# 5-1 Practice (continued) *Form G*

## Rate of Change and Slope

**Without graphing, tell whether the slope of a line that models each situation is *positive*, *negative*, *zero*, or *undefined*. Then find the slope.**

**16.** The cost of tickets to the amusement park is $19.50 for 1 ticket and $78 for 4 tickets.

**17.** The late fee is $2 regardless of the number of days the movie is late.

**18.** On the trip, Jerry had his cruise control set at 60 mi/h for 4 hours.

**19.** The contract states that every day past the agreed upon completion date the project is not finished, the price is reduced by $25.

**State the independent variable and the dependent variable in each situation. Then find the rate of change for each situation.**

**20.** Shelly delivered 12 newspapers after 20 minutes and 36 papers after 60 minutes.

**21.** Two pounds of apples cost $3.98. Six pounds cost $11.94.

**22.** An airplane ascended 3000 feet in 10 minutes and 4500 feet in 15 minutes.

**Find the slope of the line that passes through each pair of points.**

**23.** (−5, 0), (−5, 5)

**24.** (−2, −4), (−1.5, −1.5)

**25.** (4.75, −3.575), (2.25, 1.425)

**26.** $\left(-\frac{1}{4}, \frac{3}{4}\right), \left(\frac{1}{2}, -\frac{3}{4}\right)$

**27.** $\left(\frac{2}{9}, \frac{3}{7}\right), \left(\frac{1}{9}, \frac{4}{7}\right)$

**28.** (−3.35, 6.5), (5.65, −3.5)

**29. Writing** Explain why the slope of a horizontal line is always zero.

**30. Writing** Describe how to draw a line that passes through the origin and has a slope of $-\frac{2}{3}$.

**Each pair of points lies on a line with the given slope. Find *x* or *y*.**

**31.** (7, 4), (3, *y*); slope = $\frac{1}{4}$

**32.** (5, *y*), (6, 4); slope = 0

**33.** (*x*, 5), (−3, 6); slope = −1

**34.** (−12, 9), (*x*, −2); slope = $-\frac{1}{2}$





Name _____ Class _____ Date _____

# 5-1 Practice *Form G*

## Rate of Change and Slope

**Determine whether each rate of change is constant. If it is, find the rate of change and explain what it represents.**

1. **Hockey Team's Offense**

| Games | Goals |
|---|---|
| 1 | 2 |
| 2 | 4 |
| 3 | 6 |

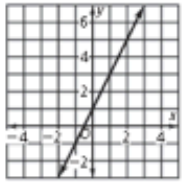
2. **Miles Per Gallon**

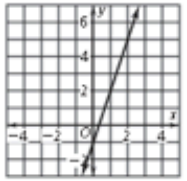
| Gallons | Miles |
|---|---|
| 1 | 28 |
| 3 | 84 |
| 5 | 140 |
| 7 | 196 |

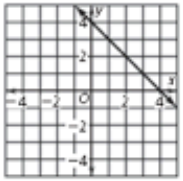
3. **Cars Washed**

| Hours | Cars |
|---|---|
| 1 | 4 |
| 2 | 8 |
| 3 | 12 |
| 4 | 16 |

**Find the slope of each line.**

4. 

5. 

6. 

**Find the slope of the line that passes through each pair of points.**

**7.** (2, 1), (0, 0)

**8.** (4, 5), (6, 2)

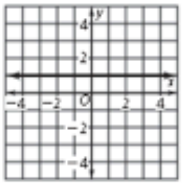
**9.** (3, 8), (7, 3)

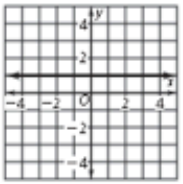
**10.** (1, 0), (−4, 2)

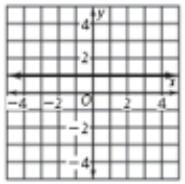
**11.** (8, −4), (−6, −3)

**12.** (−2, −3), (6, 5)

**Find the slope of each line.**

13. 

14. 

15. 

6. Lesson 2 Exit Ticket: Rates of Change and Slope

**Rates of Change and Slope Exit Ticket**

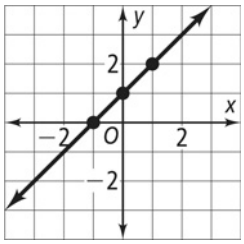
Name: _____ Date: _____

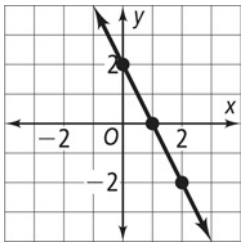
1. Find the rate and show all your work

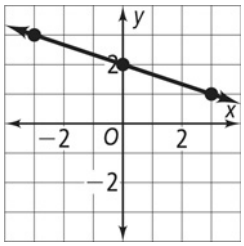
| Hours | Fences |
|---|---|
| 3 | 1 |
| 6 | 2 |
| 9 | 3 |
| 12 | 4 |

| Hours | Miles |
|---|---|
| 2 | 70 |
| 4 | 140 |
| 6 | 210 |
| 8 | 280 |

2. Find the slope by using the graph




3. Find the slope between the two points:

(0, 4) and (3, 5)

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

7. Lesson 3: Guided Notes Graphing and Writing Linear Equations

**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:_____Section:_____

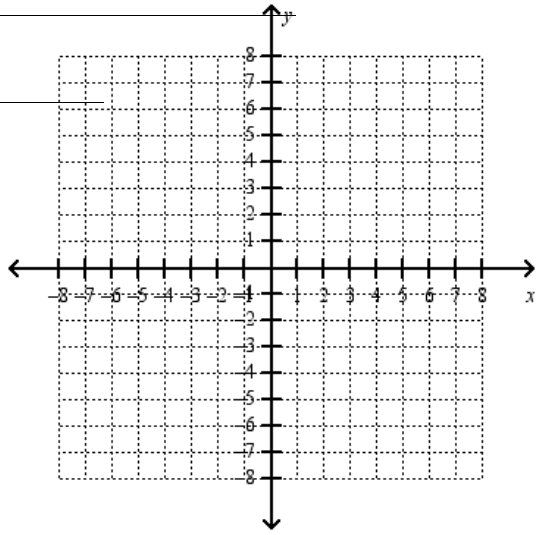
## *Anatomy of a Graph and Equation*

**Slope:** _____

**Y-Intercept:** _____

**x-Intercept:** _____

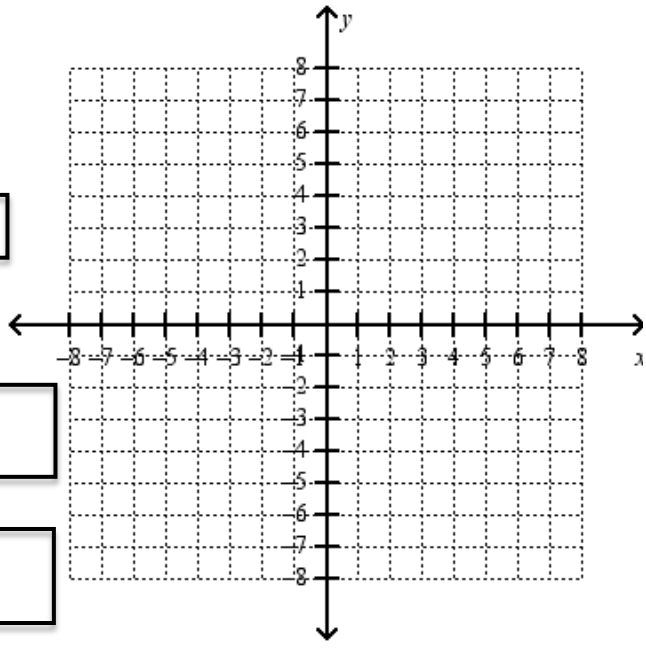
y = -2x + 1




## *Graphing Lines*

SLOPE-INTERCEPT FORM:

Y = mx + b




1) Find the y-intercept ( 0, b )

2) Graph the y-intercept

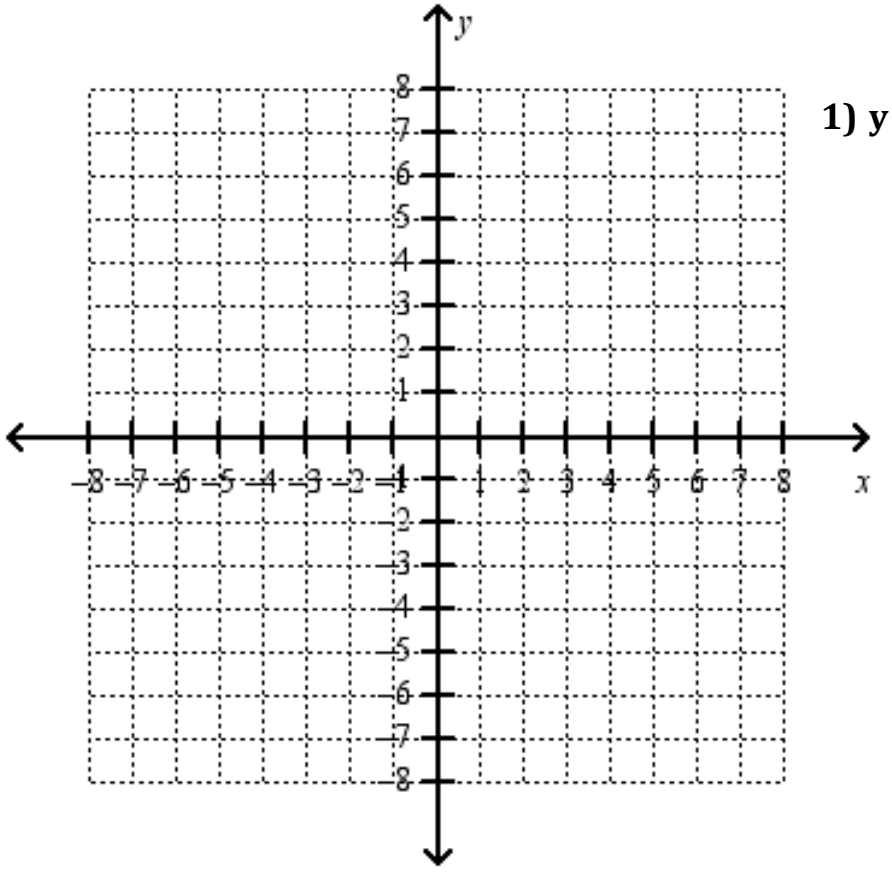
3) Identify the slope: m

4) Draw the next point by using the slope

5) Connect the two points into a line using a straightedge

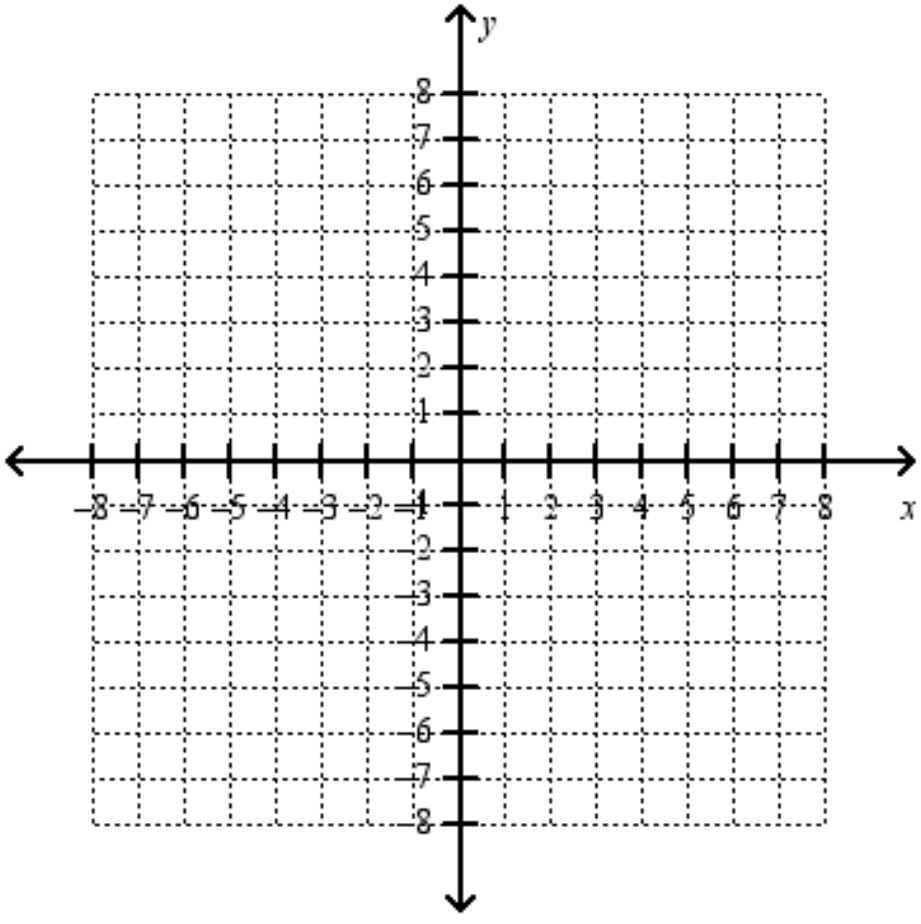
**Example: y = 2x + 4**

**Try Yourself and** Show your work




**1) y = -3x + 1**

**2) y = x – 2**



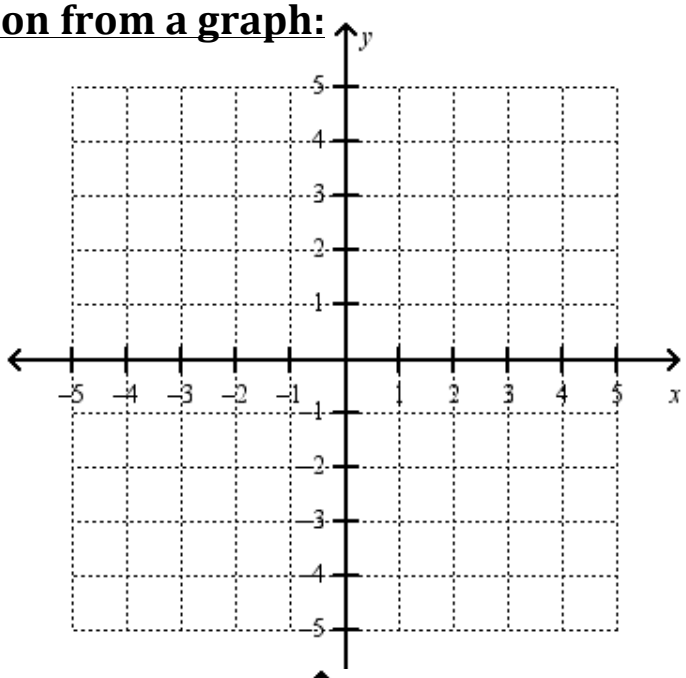
## Identifying Slope-Intercept Equation from a graph:

1) Determine the slope: m

2) Find the y-intercept: ( 0, __b__ )

3) Plug in the slope and y-intercept into the equation

| y = __m__ x + __b__ |
|---|



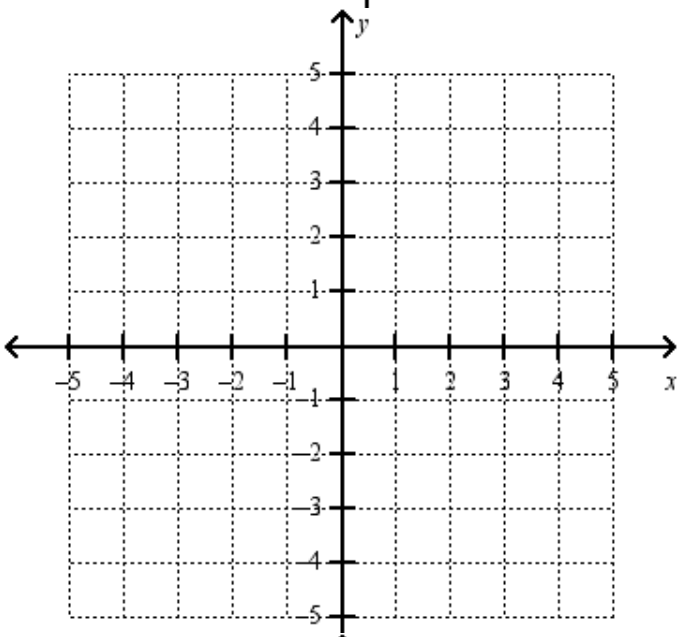

**Example 1:**

**m =**

**b =**

**y = ____ x + _____**

**bonus: what is the x-intercept? ____**



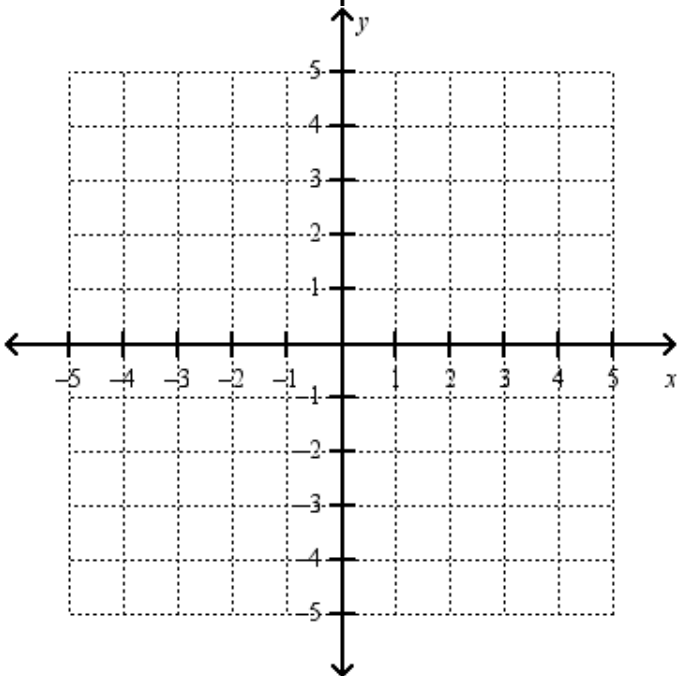

**Example 2:**

**m =**

**b =**

**y = ____ x + _____**

**bonus: what is the x-intercept?**




**Example 3:**

**m =**

**b =**

**y = ____ x + _____**

8. Lesson 3: Centers Graphing and Writing Linear Equations

**Topic 12: Equations and Graphs**
Center 1: Understanding Equations

Directions: Find the slope and y-intercept of the graph of each equation. *Make sure to simplify first!!*

1) $y = 3x - 5$

2) $y = -5x + 13$

3) $y = -x - 1$

4) $y = -11x + 6$

5) $y = -6.75x + 8.54$

6) $y = 2.25$

7) $y = 2x + 4x - 10$

8) $y = 4 + 6x - 12$

**Topic 12: Equations and Graphs**
Center 2: Writing Equations

Directions: Use the information to write an equation of the line with the given slope and y-intercept

1) $m = -1; b = 3$

2) $m = 4, b = 2$

3) $m = -5, b = -8$

4) $m = 0.25, b = 6$

5) $m = 0, b = -11$

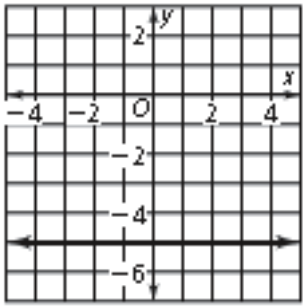
6) $m = 4, b = 0$

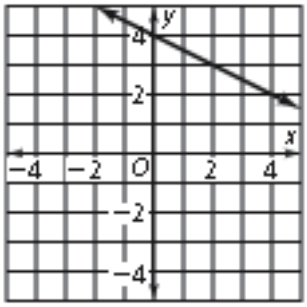
7) $m = DNE, b = 0$

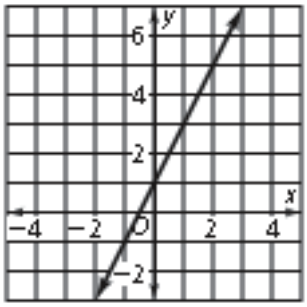
8) $m = 0, b = 0$

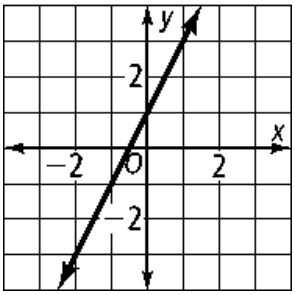
**Topic 12: Equations and Graphs**
Center 3: Writing Equations of Graphs

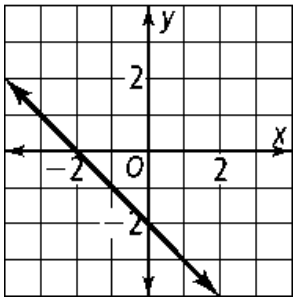
Directions: Given the following graphs, write the equation of each line

1) 


2) 


3) 


4) 


5) 

**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 = ____
b = _____

2) $y = 4x - 1$
m = _____
b = _____

3) $y = -x + 6$
m = ____
b = _____

4) $y = 3x - 2$
m = _____
b = _____

5) $y = -5x + 1$
m = ____
b = _____

6) $y = -7x - 4$
m = _____
b = _____

**Topic 12: Equations and Graphs**
Center 5: Putting it all together

Directions: Graph the two points on the coordinate plane. Connect them to draw a line. Write the equation of the line. Identify the x and y intercepts.

1) ( 3, 5) and (0, 4)

2) (2, 6) and (-4, -2)

3) (-1, -1) and (-3, 1)

4) (-7, 5) and (3, 0)

5) ( 10, 2) and (-2, -2)

6) (0, -1) and (5, 6)

Center 1 Answers:

1) m = 3, b = -5
2) m = -5, b = 13
3) m = -1, b = -1
4) m = -11, b = 6
5) m = -6.75, b = 8.54
6) m = 0, b = 2.25
7) m = 6, b = -10
8) m = 6, b = -8

Center 2 Answers

1) $y = -1x + 3$
2) $y = 4x - 2$
3) $y = -5x - 8$
4) $y = .25x + 6$
5) $y = -11$
6) $y = 4x$
7) $x = 0$
8) $y = 0$

Answers Center 3

1) $y = -5$

2) $y = -1/2x + 4$

3) $y = 2x + 1$

4) $y = 2x + 1$

5) $y = -1x - 2$

Answers Center 4:

Vary—check graphs

Answers Center 5:

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

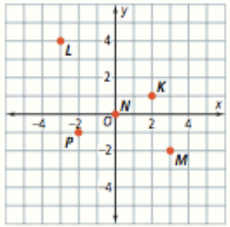
2)

# 4-1 Using Graphs to Relate Two Quantities

## Vocabulary

### Review

Use the *graph* at the right. Draw a line from each point in Column A to its coordinates in Column B.




| Column A | Column B |
|---|---|
| 1. point $K$ | $(-3, 4)$ |
| 2. point $L$ | $(-2, -1)$ |
| 3. point $M$ | $(0, 0)$ |
| 4. point $N$ | $(2, 1)$ |
| 5. point $P$ | $(3, -2)$ |

### Vocabulary Builder

**analyze** (verb) AN uh lyz

**Other Word Forms:** analyzed (verb), analysis (noun)

**Definition:** to examine carefully in detail; to identify the nature and relationship of its parts

**What It Means:** break down, dissect

**Word Origin:** from the Greek word *analusis*, meaning "a dissolving"

### Use Your Vocabulary

**Complete each statement with the appropriate word from the list.**

analyze analysis analyzed

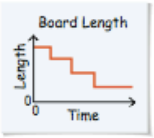
6. The chemist ? the data to draw a conclusion.
7. Jean needed to ? the data she gathered in her experiment.
8. An ? of the traffic at an intersection showed the need for a traffic light.





### Problem 1 Analyzing a Graph

**Got It?** What are the variables in the graph? Describe how the variables are related at various points on the graph.




9. Circle the two variables being related in the graph.

time cut board length

10. Show how the variables are related by underlining the correct word or words to complete each sentence.

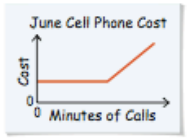
The length of the board increases / decreases with time.

The length of the board is constant / decreasing while you are actually cutting the board.

During the time shown on the graph, there are three / four cuts.

There is / is not a piece of the board left at the end of the time shown.

**Got It?** What are the variables in the graph? Describe how the variables are related at various points on the graph.




11. Show how the variables are related by underlining the correct word to complete each sentence.

The cost of the cell phone in June increases / decreases with number of minutes of calls.

The cost of the cell phone in June is constant / increasing for the first part of the month.

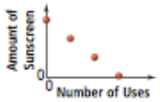
12. Use your answers from Exercise 11 to describe how the variables in the graph are related.

## Problem 2 Matching a Table and a Graph

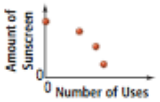
**Got It?** The table shows the amount of sunscreen left in a can based on the number of times the sunscreen has been used. Which graph could represent the data shown in the table?

| Sunscreen | | | | |
|---|---|---|---|---|
| Number of Uses | 0 | 1 | 2 | 3 |
| Amount of Sunscreen (oz) | 5 | 4.8 | 4.6 | 4.4 |

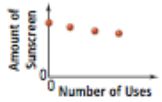
A.




B.




C.




**13.** Analyze the data in the table. Complete each statement with the correct choice from the list. Use each word only once.

slowly fall decreases

The amount of sunscreen in the container ? after each use. _____

The amount of sunscreen in the container changes ?. _____

The graph should ? at a slow rate. _____

**14.** The graph that could represent the data shown in the table is Graph ____.

## Problem 3 Sketching a Graph

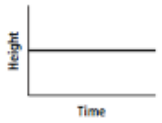
**Got It?** Suppose you start to swing yourself on a playground swing. You move back and forth and swing higher in the air. Then you slowly swing to a stop. What sketch of a graph could represent how your height from the ground might change over time? Label each section.

**15.** **Multiple Choice** The two variables being related are time and ?.

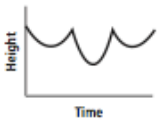
(A) length of swing (B) distance from top of swing (C) your height from ground (D) your height

**16.** Consider the three cycles during the middle of your time on the swing. Circle the best sketch of your height from the ground during that time.

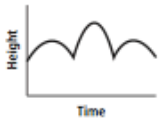
constant distance from ground




start high, swing low, end high




start low, swing high, end low

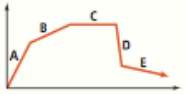







## Lesson Check • Do you UNDERSTAND?

**Reasoning** Describe a real-world relationship that could be represented by the graph sketched at the right.




**17.** Draw a line from the name of each segment in Column A to its verbal description in Column B.

| Column A | Column B |
|---|---|
| A | spilling water from a cup |
| B | pouring water into a cup quickly |
| C | stop pouring water into a cup |
| D | water leaking from a hole in a cup |
| E | pouring water into a cup slowly |

**18.** Use the verbal descriptions above to help you write a situation that could be represented by the sketch.

## Math Success

Check off the vocabulary words that you understand.

☐ variable quantities ☐ increase ☐ decrease

Rate how well you can *use graphs*.

Need to review 0 2 4 6 8 10 Now I get it!

10. Lesson 4: Using graphs to Relate Two Quantities Practice

Name_____

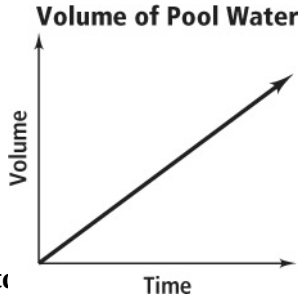
# 4-1 Practice

*Form G*

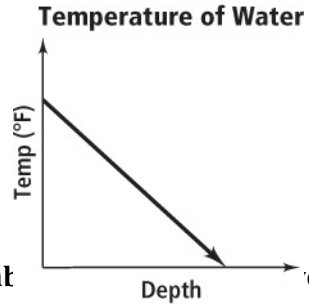
Using Graphs to Relate Two Quantities

**What are the variables in each graph? Describe how the variables are related at various points on the graph.**

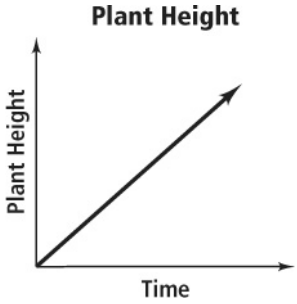
**1.**




**2.**

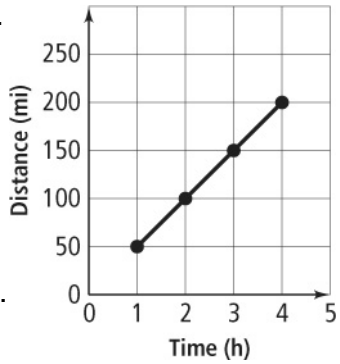



**3.**




**Mat related tab ers.**

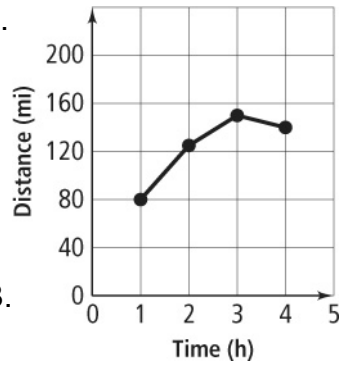
**4.**




A.

| Time (h) | Distance (mi) |
|---|---|
| 1 | 60 |
| 2 | 120 |
| 3 | 180 |
| 4 | 240 |

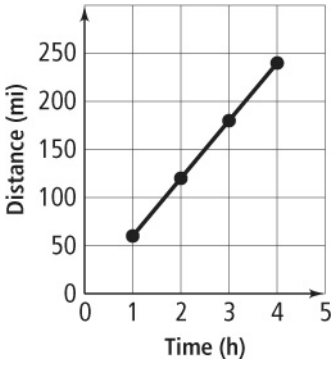
**5.**




B.

| Time (h) | Distance (mi) |
|---|---|
| 1 | 80 |
| 2 | 125 |
| 3 | 150 |
| 4 | 140 |

**6.**




C.

| Time (h) | Distance (mi) |
|---|---|
| 1 | 50 |
| 2 | 100 |
| 3 | 150 |
| 4 | 200 |

Name_____ Class_____ Date_____

# 4-1 Practice *Form G*

## Using Graphs to Relate Two Quantities

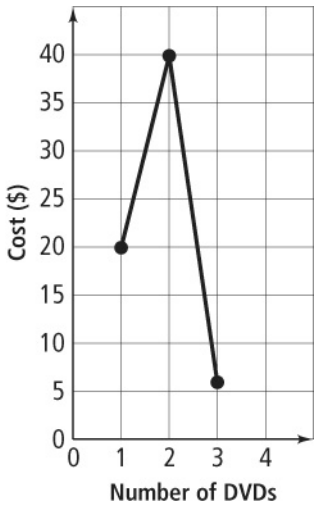
**Sketch a graph to represent the situation. Label each section.**

**7.** You buy two shirts. The third one is free.

**8.** You warm up for gym class, play basketball, and then cool down.

**9.** The temperature warms up during the day and then decreases at night.

**10.** **Error Analysis** DVDs cost $19.99 each for the first 2 purchased. After that, they cost $5.99 each. Describe and correct the error in sketching a graph to represent the relationship between the total cost and the number of DVDs purchased.




**11.** Sketch a graph of the situations. Are they the same?

**a.** your distance from school as you leave your house and walk to school

**b.** your distance from school as you leave school and walk to your house

11. Lesson 4: Word Problems and Patterns Project

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

**Example:** Ms. Cook walks for 40 minutes each week day. She has to walk to the metro each morning, and then from the metro to work. When she goes home, she does the opposite.

a. Make a table of values to find how much she walks in 4 weeks.
b. Write an equation to show how much she walks
c. Create a graph of how much she walks over the 4 weeks

A) Table

| Day | Time Walked |
|---|---|
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
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| | |
| | |
| | |
| | |

B) The equation that models how much Ms. Cook has walked is: _____

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

**Problem 1)** Lonte drinks a sugary drink each morning. The drink has 45 grams of sugar in it. That's a lot of sugar!!

a. Make a table of values to find how many grams of sugar he consumes for breakfast after 8 days.
b. Write an equation to show how much sugar he is drinking.
c. Create a graph of how much sugar he is drinking over 8 days.

A) Table

| Day | Sugar |
|---|---|
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |

B) The equation that models how much sugar Lonte has drank is: _____

**Algebra 1: Word Problems and Patterns**
Name: _____ Date: _____
*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.

A) Table

| Day | Minutes in Summer School |
|---|---|
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |

B) The equation that models how many minutes Osmin has been in summer school is:
_____

1. Use the equation to find out how many minutes Osmin attended summer school after 15 days.

2. Use the equation to find out how many minutes Osmin attended summer school after 22 days.

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).

**Algebra 1: Word Problems and Patterns**
Name: _____ Date: _____
*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.

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

A) Table

| Day | Texts |
|---|---|
| | |
| | |
| | |
| | |
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| | |

B) The equation that models how many texts that Reyna sends is: _____

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

2. Use the equation to find out how many texts that Reyna sent after 3 months.

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

**Algebra 1: Word Problems and Patterns**
Name: _____ 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!

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

A) Table

| Day | Hours playing soccer |
|---|---|
| | |
| | |
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B) The equation that models how many hours the Douglas plays soccer is:
_____

1. Use the equation to find out how many hours of soccer that Douglas has played after 17 days.

2. Use the equation to find out how hours of soccer that Douglas has played after 2 months.

3. Use the equation to find out how many hours Douglas would play soccer if he played soccer every day for 2 years.

12. Lesson 5: Unit Reflection

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

Name: _____ Date: _____

*Introductory Reflection*

1) Which of the following is a quadratic function?

a. $y = 5x - 2$
b. $4x + 6y = -9$
c. $y = 3x^2 - 4x + 9$
d. $-2x^3 + 6x^2 - 2x + 8$

2) What kind of shape does a quadratic function make? Draw a sketch below:

3) What kinds of things can you use a quadratic function to do?

_____

_____

4) What do quadratic functions have to do with science?

_____

_____

5) Which of the following is a linear function?

a. $y = 8x - 9$
b. $-2x^3 + 6x^2 - 2x + 8$
c. $y = 3x^2 - 4x + 9$
d. $y = \sqrt{2}x$

6) What kind of shape does a linear equation make? Draw a sketch below:

7) What kinds of things can you use a linear function to do?

_____

_____

8) What do linear equations have to do with science?

_____

_____

9) What is the difference between weight and mass?

_____

10) What is zero gravity?

_____

11) How do you think that math and science are connected? (make drawings, lists, or explain…)

12) Complete the table:

| What do you know about linear equations? | What do you know about quadratic equations? | What do you know about space suits? | What do you know about space? | What do you know about space shuttle launches? | What do you know about zero gravity? Or gravity in space? |
|---|---|---|---|---|---|
| | | | | | |

| What do you want to know about these things? What questions do you have? |
|---|
| |

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