

### ***The Colorful Visualization of Linear Functions***

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This curriculum unit is recommended for:  
Math Grade 8

**Keywords:** linear, slope, comparing, rate of change, plotting, change in x, change in y, y-intercept, input, output, photosynthesis, linear, linear functions, slope intercept form, functions, coordinate, coordinate plane, graphing, x-axis, y-axis, proportional relationship, linear relationship, cellular respiration, point of intersection, intersection, ratios

**Teaching Standards:** See [Appendix I](#) for teaching standards addressed in this unit.

**Synopsis:** The purpose of this unit is to provide a hands on experience with comparing functions. In this unit the students will be able to define, evaluate and compare linear functions. The students also will be able to use linear functions to model relationships through quantities. This curriculum is looking to be cross curricular between science and mathematics. The science portion gives you the hands on interaction needed for the linear functions in this unit. The goal of this unit is to have the students take part in a lab where the goal would be to define, evaluate and compare linear functions. The students also will be able to use linear functions to model relationships through quantities. The standards that are being covered from the new North Carolina 8th Grade Common Core State Standards. The standard asks that the students demonstrate mastery in comparing properties of two linear functions each represented in different ways.

*I plan to teach this unit during the school year to 80 students in Grade 8 Math.*

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## Introduction

In this unit the students will be able to define, evaluate and compare linear functions. The students also will be able to use linear functions to model relationships through quantities. The objective of this experiment with aquarium plants in different light filters, is to assist in giving the students a hands on approach to linear functions. Student will be able to experience the concept of photosynthesis, which came across as a level of difficulty for them. This also gives them the opportunity to work with linear functions hands on by plotting, graphing and comparing linear functions while watching the photosynthesis in aquarium plants with different light filters take place. The lab will be differentiated to meet the needs of all students in the co-taught mathematics classroom, acknowledging that some students struggling with graphing on a coordinate plane, some have an understanding of the coordinate plane, and others are familiar and comfortable.

## School/Student Demographic

Martin Luther King, Jr. Middle School's population is currently 42.5% African American, 51% Hispanic, and 6.5% other ethnicities. We have approximately 942 students in grades 6-8. Our diverse population of students includes 18% percent of our students receiving ESL services and 8% of our students receiving EC services. Only 1% of our students receive TD services. All of our students receive free or reduced lunch due to the CAP program. Martin Luther King Jr. Middle School serves a supportive school community who are committed to student success. Martin Luther King Jr. Middle School is a Title I school. Title I is the cornerstone of the Elementary and Secondary Education Act (ESEA), previously known as No Child Left Behind Act (NCLB). It is the largest federal education program, today. Its intent is to help ensure that ALL children have the opportunity to obtain a high quality education and reach proficiency on challenging State academic content and performance standards. School-wide programs have flexibility in using their Title I funds, in conjunction with other funds in the school, to upgrade the operation of the entire school. School-wide programs must conduct a comprehensive need assessment, identify and commit to specific goals and strategies that address those needs, create a comprehensive plan and conduct an annual review of the effectiveness of the school-wide program that is revised as needed.

I am currently teacher Mathematics for 8th graders at Martin Luther King Jr. Middle School. Eighth grade mathematics is a course that closes out with an End of Grade Assessment, the EOG, which is administered by the state of North Carolina towards the end of the school year. The students in eighth grade have math everyday. Classes occur in 90 minute intervals. I have 75 students in 3 blocks, with class sizes ranging from 20 to 26 students. Eighth grade math includes students of all levels and abilities, including English Language Learners and Exceptional Children. Exceptional Children have math class in two different sections. One section is an inclusion class, which is where these students are removed by the co-teacher to receive 40 minutes of small setting interventions , per their educational plan. The other section is co-taught, which is where the co-teacher is in the room and helps with differentiation. Last year the 8th grade math department achieved moderate proficiency. Proficiency includes scores of 3, 4 and 5, meaning they are on grade level and college or career ready in mathematics.

## **Rationale**

Math is the science of numbers and their operations. Science is the exploration of math through observation and experiments. The experiments give you a hands on approach to rationalize the math. This curriculum is looking to be cross curricular between science and mathematics. The science portion gives you the hands on interaction needed for the linear functions in this unit. A vast amount of my scholars are disengaged in mathematics because they either have not had a teacher or think it is not interesting because there are no hands on activities in this course. When the students are disengaged in the content they are more likely to not gain any substance or curriculum needed to successfully pass end of year testing, which means they will not master the content.

As a teacher of 8th grade mathematics, I have learned that the students test scores on the End of Grade assessment are accentuated as a measurement of school achievement, teacher and at most the student. Standardized test are given multiple times throughout the school year whether it is North Carolina Check-Ins, MAP, Benchmarks are Quarterly assessments. The students ability to succeed in standardized testing seems to be the priority overall. There is a disconnect for a number of our scholars who fall under the Exceptional Children umbrella. At Martin Luther King Jr. Middle school there is no longer resource classrooms. This is the first year they have removed it. The scholars who were once in resource had math interventions and not specifically grade level content. These scholars are now mainstream and fall into my inclusion class. They have builded the mindset of “I am bad at math” or “ This is too hard” because they have not viewed the grade level content year around until the EOG. This is my second year having a co-taught teacher and we work closely together to have all the scholars engaged in the content. We work closely to reiterate perseverance through rigorous problems.

Last year, I continued to teach straight to the standard but with a curveball. My co-taught class had such a disconnect to the content because they struggled with the rigor. That is when I decided to implement hands on exploration. I would present them with a small task and a five minute timer. The task would be the upcoming lesson or belong to the class before lesson. I resulted to grab bag for them, where the pulled a piece of the prior lesson, the next scholar would pull a piece and sort them accordingly. The hands on activity gets them motivated and starts them making connections on their own.

Last school year, Student Government Association set out a Community Service Challenge. I redirected the challenge to my scholars to set it up as a giving to the upcoming classes at Martin Luther King Jr. They decided they wanted to restore the garden that is outside of my classroom window. We started our garden in the classroom, this was in January. My scholars were very excited to observe and nurture their beans. My Exceptional Children class was even more excited. This opportunity not only was a reward to them but worked as a behavior moderator. My homeroom scholars stated valid reasons for the garden in the classroom. They brought in seeds from home, set up water schedules and took plants home over the break. As their beans grew, so did their test scores and morale.

I chose to focus on the linear functions aspect of grade 8 mathematics with a dive into the science content. I chose to focus on this standard because it is a power standard for our students on the End of Grade assessment. This is a difficult concept for the students to grasp, prior to the linear functions unit we would discuss photosynthesis. We would touch photosynthesis because

they need to understand where the bubbles are coming from in the pre-lab regarding aqua plants in different filters of water. From there we would be revisiting plotting points better known as coordinates on a coordinate plane. Plotting coordinate proved to be a level of rigor for some students to grasp, which was reflected in low mastery on their exit ticket. Throughout the past lessons, our grade level professional learning community has brainstormed multiple ways to revisit how to plot on a coordinate plane. We have revisited plotting multiple times because they need it for the the linear functions unit. Allowing scholars to partake in a hands on activity gives them the interest in the lesson because they are eager to know if their partner or group took the right route to persevere. These type of activities benefit all students especially the visual and kinesthetic learners.

### **Unit Objective**

The objective of the unit is to have the students take part in a lab where the goal would be to define, evaluate and compare linear functions. The students also will be able to use linear functions to model relationships through quantities. The standards that are being covered are from the new North Carolina 8th Grade Common Core State Standards. The standard asks that the students demonstrate mastery in comparing properties of two linear functions each represented in different ways. In previous grade levels the students have worked with proportional relationships, which are sublets to linear functions.

This lab will be presented to scholars in two different ways, meaning they will be collecting data differently. They will all be provided the same materials. There will be scaffolding as far as plotting the data. This is one of the best possible ways to differentiate for our students who struggle with plotting ordered pairs, coordinates. The steps will not be given to them. This is an investigation for them to collect data. Some data will go straight into a table, the other will go straight onto the graph. This opportunity should raise academic ownership and increase student engagement. At a professional development I attended we were given materials and told to investigate making perfect squares from the area of 1 by 1 to 10 by 10. This was interesting because we had to communicate without partners. This lab grants the scholars the opportunity to be the main driver of their learning and the teachers to be the facilitators.

This also gives the students the opportunity to have academic conversations with their peers about the lab that is in front of them. They are being able to express their own ideas and thoughts. To take it a step further we can have them estimate how many oxygen bubbles will be produced in 30 seconds, 1 minute and 1.5 minutes. Next they would actually conduct the lab on their own and discuss with their group if their estimate was accurate or not. This gives them the opportunity to grow through valid mistakes and miscalculations. Our school has lessons set aside for every Wednesday where we are focusing on Social Emotional Lessons. These lessons are provided by the counselors with a purpose of having the scholars express themselves and prepare for the real world. Next year our students belong to high school where they are the advocates for their education. In high school they need to advocate for themselves without getting upset or aggressive when somebody does not understand or agree with them. These lessons are the foundation of them advocating for themselves in middle school and beyond.

## Content

### Standards

NC.8.F.2 requires the that the scholars compare properties of two linear functions each represented in a different way (algebraically, graphically, numerically in tables or by verbal descriptions). NC.8.F.4 requires that students interpret the rate of change and initial value of a linear function in terms of the situations it models. We have already laid the foundations to plotting on a coordinate plane. The unit that I will be focusing on covers all of linear functions with the inclusion of NC.8.EE.8. Systems of equations, where they need to solve the linear equations based on graphing. These standards will be cross curricular with Essential 8.L.5 where students will understand the composition of various substances as it relate to their ability to serve as a source of energy and building materials for growth and repair of organisms. This is the standard where the scholars discuss photosynthesis and cellular respiration. This is a standard they struggle with mastering. The goal is for them to master all four standards through this cross curriculum. This lab is really built upon linear function and comparing two or more.

### Pacing

Unit 4, which encompasses 8.F.2 and 8.F.4 should take 20 days. Throughout this unit the students will build on their understanding of ratios and proportions to dive deep into linear equations and functions. The students at the end of the unit should be able to derive  $y=mx+b$  as the equation of a line as it will apply to solve problems in mathematical and real world context. Students will be able to analyze linear functions represented in any form. They will determine and compare the rate of change and intercepts of linear functions from any representation.

### Key Vocabulary

*2nd Tier Words:* function, ratio, proportional relationships

*3rd Tier Words:* output, input, intercepts, rates of change, points of intersection, linear relationship, linear function, slope intercept form

### Prior Knowledge

In Unit 1 the students worked with coordinate planes and graphing as a pre-exercise to the grade level content. Unit 1 utilize the coordinate plane where students were able to explore transformations of shapes on the coordinate plane. The also learned the concepts of congruence which took them back to 7th grade. The unit builded upon their 7th grade proportional reasoning to calculate measurements. Unit 2 will be reviewing Students will build on their understanding of equality to solve single-variable equations and inequalities, both in real-world and mathematical contexts, with variables on one side or both sides. Through many of these equations students will also understand when equations have one solution, no solutions, or infinite solutions.

In Unit 3 Students will extend on their learning of proportional reasoning into linear equations and functions. Students will define functions as numerical relationships in which each input has exactly one output and represent written descriptions on these qualitative graphs. Students would also have covered characteristics of linear functions and differentiate them from non-linear functions in real world and mathematical contexts in different representations.

Students will need to derive the equation given a real world problem (seen below), graph, create a table and answer questions based on the information given and derived.

1. Billy and his sister Brenda are racing 30 meters to their swimming pool. Billy is younger so his sister decides to give him a head start of 6 meters. The graph below shows the distance that Billy runs during the race:

**Create a table and write an equation that models the distance that Billy ran during the race.**

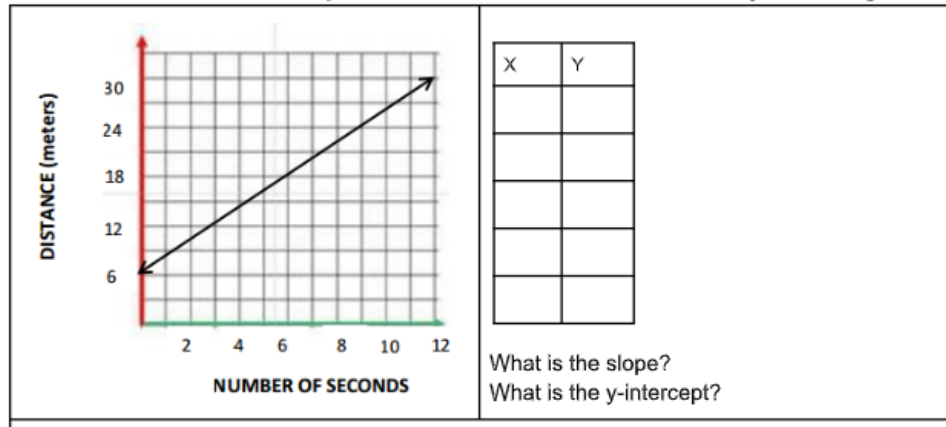
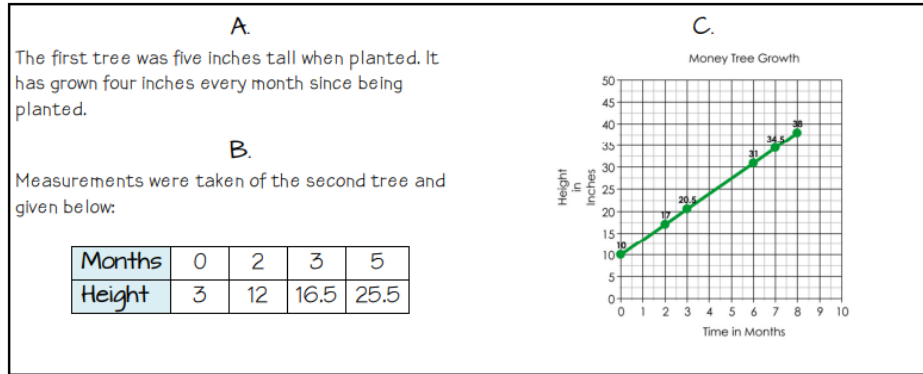


Figure 1: Part of linear functions representation

### Is It Even Growing?

The pre-lab is having the scholars count the bubbles and plot the information or place it in a table. The scholars will plant seeds and will keep track of their growth. They will track growth by measuring the height of the plants. The plants will be measured for growth every Monday and Thursday. The plants will be watered every Friday and Tuesday. We will plot this data on a table that compares days and plant height. Plant height will be on the y-axis and days will be on the x-axis. Each wavelength will have its own graph, all comparing the same thing. After 30 days, we will plot all wavelengths on the same graph in different colors to compare and contrast the data. We will look at the slope of the lines, which is part of the Eighth Grade Math Standard according to North Carolina Common Core State Standards. To take it a step further we can additionally find the equation of the line and compare the functions based on the equation. Figure 2 (seen below) shows the rigor of where I need to get the scholars before the End of Grade Assessment.



- Which of the trees is growing the fastest?  
*Tree B.* It is growing 4.5 inches per month; Tree A grows  $4 \frac{\text{in}}{\text{mo}}$  and Tree C grows  $3.5 \frac{\text{in}}{\text{mo}}$ .
- Which tree was the tallest when it was first planted?  
*Tree C.* It was 10 inches tall when planted. Tree A was 5 inches, and Tree B was 3 inches.
- Challenge: Which tree is the tallest after 6 months?  
*Tree C.* It will be 31 inches tall. Tree A will be 29 inches tall, and Tree B will be 30 inches tall.

Figure 2: Rigor of 8th grade comparing linear functions with answers

Photosynthesis is the process by which plants receive energy from sunlight, carbon dioxide and water. Photosynthesis is observable in some aquatic plants because the oxygen that is produced from photosynthesis process emerge as bubbles coming from the plant. Figure 3 illustrate photosynthesis in aquatic plants. Photosynthetic cells inside the leaves and tissue contain chlorophyll. This pigment traps light energy to break down the molecular structure of water into hydrogen and oxygen. Chlorophyll traps the energy and uses it to power photosynthesis. Carbon dioxide supplies the carbon to build carbohydrates. The glucose produced from photosynthesis is stored and used as a source of food for the plants. In exchange oxygen is released as a waste product.

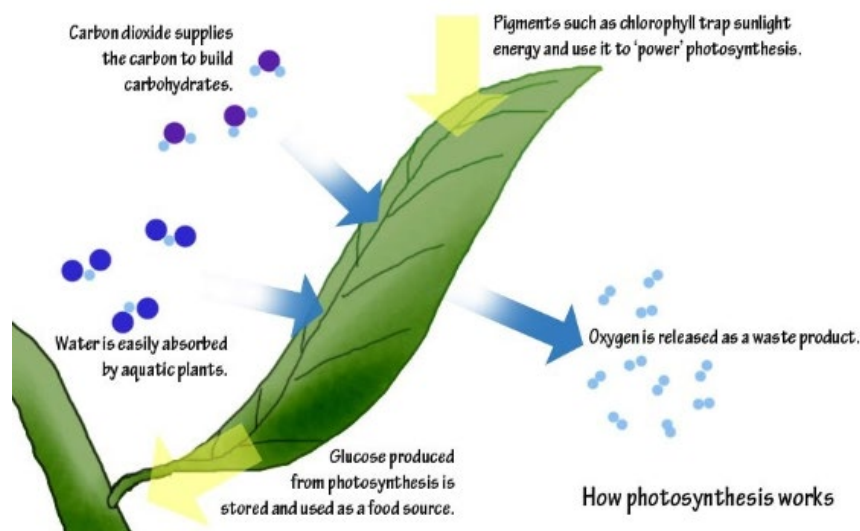


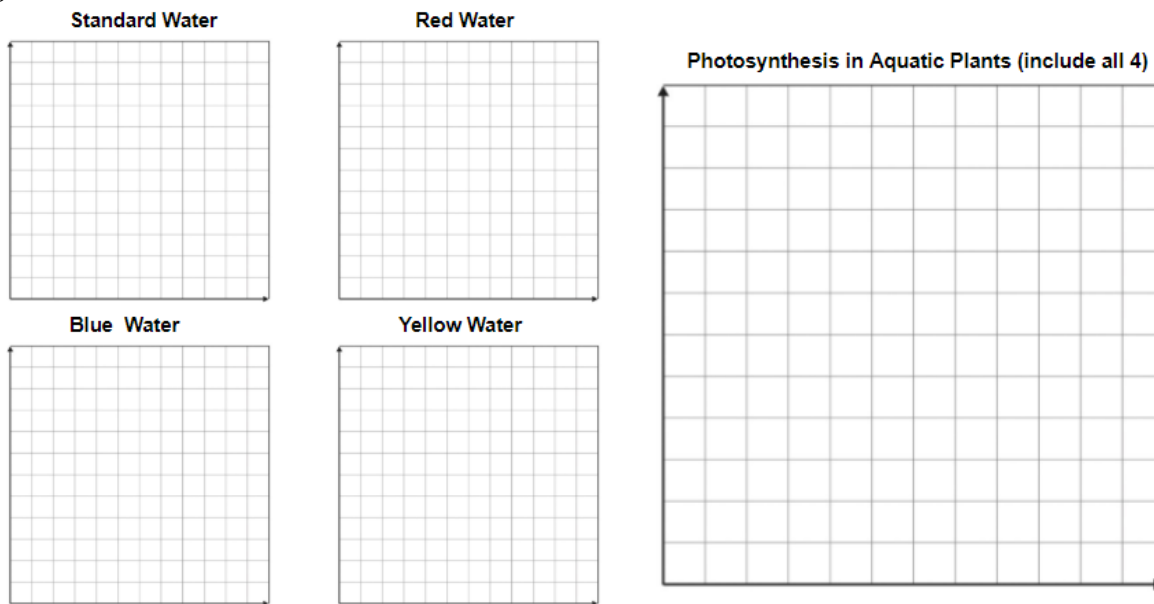
Figure 3: Photosynthesis in Aquarium Plants

## Introduction to Functions: Pre- lab

The goal is to have to scholars realize that the different filters of light causes different graphs to be formed. The scholars will be observing aquatic plants in 4 different water filters. We will observe water in standard water and water with red food dye, yellow food dye, and blue food dye. The scholars will fill in their tables (figure 4) with the information while the lab is taking place. Next they plot all their point on the graph and label the axis with their titles which would be “Oxygen bubble count” and “Time (seconds)”. Scholars will plot all data on one chart and color code, that way they can analyze the data of all 4 water sources.

Standard Water		Red Water		Blue Water		Yellow Water	
Input	Output	Input	Output	Input	Output	Input	Output

**Figure 4:** Table for data collection



**Figure 5:** The Graphs the scholars will create with the data collected



## Instructional Implementation

### Teaching Strategies

Throughout lessons the scholars partake in different teaching strategies. We utilize Partner Talk, Stop, Jot, Pair and share, Gallery walk and Paper talk.

**Partner Talk:** Gives the scholars a way to provide students with another learning opportunity to make learning their own through collaboration and discussion. Partner Talk can be used for assessing classwork, making connections to prior knowledge, discussing vocabulary, or simplifying concepts.

**Stop, Jot, Pair and Share:** This processing activity gives the students the opportunity to respond to questions in writing. Asking students to think and write about what they are being asked. Next they pair up with their elbow partner and share what they have written. After that you choose a few to share with the class.

**Gallery Walk:** This technique allows students to be actively engaged as they walk throughout the classroom. They work together in small groups to answer questions.

**Paper Talk:** This is where the scholars are posed a question. The teacher reads the question outloud and the question is written on the paper that is located in the middle of the group. Each individual answers the question and then they comment on their peers' responses on the paper. This strategy promotes academic conversations, without talking.

### Activities

#### *Activity 1: Linear Versus Nonlinear*

**Objective:** Students will be able to determine whether a table, graph, set of points or equation represents a linear or nonlinear function.

**Activator:** Scholars will look at two graphs. They will determine if the graphs are functions. Question to guide their Stop, jot, pair and share: What is the difference between the two graphs displayed? Give scholars minute to jot their thoughts, 1 minute to pair and talk with an elbow partner and then call on three to share their attained information.

**Focused Instruction (I Do):** In focused instruction give them the information needed on how to identify linear functions from a graph. They are shown the equation for a linear graph and equation which is  $y=mx+b$ . The scholars are made aware that in  $y=mx+b$  there is no exponent greater than 1 in the equation. An equation of a nonlinear function has an exponent greater than 1. As an extension have the scholars plot the points on the coordinate plane and identify if it creates a linear function or not. If it creates a straight line it is a linear function. The scholars get introduced to rate of change in this lesson. Rate of change is the change in x over the change in y.

Guided Instruction (We Do): Start identifying linear functions from different representations with the scholars. When given a table make sure they find the rate of change between the two points. If they are given coordinate points, they can plot them or turn them into a table and determining if it is linear or not.

Independent Learning (You do it alone): Give them coordinate pairs, an equation and a table. Have them decide if it is a linear function or not. This will serve as a check for understanding. You can utilize this data to create your small group. Your group should consist of scholars who got one question right on the Check for Understanding. (Appendix III)

Collaborative Learning ( You do it together): Scholars will create a foldable by sorting their cut outs in to linear and nonlinear columns (Appendix III)

Exit Ticket: Determine if y is a linear function of x in the table and set of points. (Appendix III)

### *Activity 2: Identifying Slope (Rate of Change)*

Objective: Students will be able to identify slope when given a graph, coordinate point or an equations.

Activator: Paper Talk Activity - Question on the paper: When you hear the word slope what do you think? Time is 2 minutes. This teaches the scholars about academic conversation. They write their answer on the paper along with their partner(s). They then comment on their peers answers and then keep it going until the time runs out.

Focused Instruction: Review the equation  $y=mx+b$ . The variable y means output, m represents slope, x represents input and b represents y-intercept. This day they will also see “ The Slope Tree”. The slope tree helps them identify if the slope is positive, negative, zero or undefined. Walk the scholars through a think aloud. This is where you model the process of finding slope. First we will look at a graph. Choose 2 point. Show the scholars the rise over run method. Rise is y-value, run is the x-value. This gives the scholars a visual representation of slope. Based on the position of the line the slope will then be determined as positive, negative, zero or undefined. Then we will look as slope from points. They learn to label the x values and y values  $(x_1, y_1)$  and  $(x_2, y_2)$ . They then learn that  $m = \frac{(y_2 - y_1)}{(x_2 - x_1)}$ . That is the formula for slope from two points. The last one would be identifying slope in an equation. The scholars need to understand that slope is the represented by the variable m. It is the coefficient of x, in  $y=mx+b$ .

We Do: Work through 4-5 problems where the scholars identify the slope from a two points, graph and equation. If you would like to increase the rigor give the scholars a table as well. They can either plot the table or use the slope formula.

Collaborative Learning (You do it together): Give the scholars through 4-5 problems where the scholars identify the slope from a two points, graph and equation. Give them 3 minutes, review the problems

You Do: Worksheet (Appendix IV) Scholars need to find the slope from tables, points and equations.

Exit Ticket: Have the scholars write a note to an absent student about how to find slope from different representations.

### *Activity 3: Comparing Functions (1-2 day activity)*

Objective: Student will be able to compare linear equations and their relationships using various forms of data such as tables, graphs, and word problems.

Activator: The scholars are given four situations to assess. Have them choose 2. They are given a table and asked “Do all the points on the table satisfy the equation  $y=2x+1$ ? Explain your answer.” They are given a graph where they are asked “What is the slope of the line?”. They are asked also asked “What is the monthly fee after the person joins the gym?”. They are also told to write the equations of a line with a slope of -3 and the point (0,-3). ( Appendix V)

Focused Instruction (I Do): Give the scholars the background knowledge needed to assess the task. They are given steps to follow:

1. Read the entire equations through.
2. Look at any graphs, word problems, or tables that you have been given.
3. Since you are comparing two equations, write out at least 2 equations.
4. Answer the question that is asked.

You will walk the scholars through a think aloud. This is for the scholars to see how to assess the problem at hand. Walk them through the problem. Identifying your slope and y-intercept for each equation.

Guided Instruction (We Do): Work through 2 problems. Have them identify what the problem is comparing. Have them decipher what the slope and y-intercept is. Ask the scholars how do you know that. Have them now try to set up two equations. What is the slope of the two equations? What is the y-intercept of the equations? What is the different of the two equations? Who has the greater slope?

Collaborative Learning (You do it together): Continue practicing on the worksheet. The worksheet is due at the end of class. (Appendix V)

#### *Activity 4: Photosynthesis Lab*

**Objective:** Students will be able to realize photosynthesis occurring in aquarium plants as they witness the rate of change of oxygen bubble production.

**Activator:** We will have a class discussion about photosynthesis. Place a 3 minute timer on the board. Pose the following questions to the scholars: What is photosynthesis? Why does photosynthesis happen? What is needed for photosynthesis to happen? What do you think will happen if you change a part of the process of photosynthesis? Allow for this activator to be a turn and talk (Appendix VI)

**Focused Instruction (I Do):** In focused instruction give them the information in regards to photosynthesis. Discuss the photosynthesis process of aquarium plants. Have the scholars draw the image of the aquarium plants during photosynthesis (Appendix VI). Discuss the bubbles and what the bubbles represent?

**Guided Instruction (We Do):** With the scholars watch the video in the Appendix VI. With the scholars show them the bubbles and how to count them over time. From the video show the scholars how to plot them on the coordinate plane.

**Collaborative Learning ( You do it together):** Scholars will set up for the lab. We will place 2 drops of food coloring in 8oz of water. We will need 4 colors. Place aquarium plant in each solution. Have a light source available to act as the light in the photosynthesis process. Together the scholar will look for bubbles forming. They will track data in a table.

**Independent Learning (You do it alone):** The scholar will then graph there data separately and then plot them all on one graph. (Appendix VI). As an extension have the scholars right the linear equations.

**Exit Ticket:** Determine which solution created a faster process of photosynthesis occurring in aquarium plants

## Appendix I: Teaching Standards

### Current NC state standards followed by corresponding Common Core Standards

Understand the connections between proportional relationships, lines, and linear equations.

#### CCSS.MATH.CONTENT.8.EE.B.5

Graph proportional relationships, interpreting the unit rate as the slope of the graph. Compare two different proportional relationships represented in different ways. For example, compare a distance-time graph to a distance-time equation to determine which of two moving objects has greater speed.

Analyze and solve pairs of simultaneous linear equations.

#### CCSS.MATH.CONTENT.8.EE.C.8.A

Understand that solutions to a system of two linear equations in two variables correspond to points of intersection of their graphs, because points of intersection satisfy both equations simultaneously.

Define, evaluate, and compare functions.

#### CCSS.MATH.CONTENT.8.F.A.2

Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). *For example, given a linear function represented by a table of values and a linear function represented by an algebraic expression, determine which function has the greater rate of change.*

#### CCSS.MATH.CONTENT.8.F.A.3

Interpret the equation  $y = mx + b$  as defining a linear function, whose graph is a straight line; give examples of functions that are not linear. *For example, the function  $A = s^2$  giving the area of a square as a function of its side length is not linear because its graph contains the points  $(1,1)$ ,  $(2,4)$  and  $(3,9)$ , which are not on a straight line.*

Use functions to model relationships between quantities.

#### CCSS.MATH.CONTENT.8.F.B.4

Construct a function to model a linear relationship between two quantities. Determine the rate of change and initial value of the function from a description of a relationship or from two  $(x, y)$  values, including reading these from a table or from a graph. Interpret the rate of change and initial value of a linear function in terms of the situation it models, and in terms of its graph or a table of values.

#### Life Science: Molecular Biology 8.L.5.1

Understand the composition of various substances as it relates to their ability to serve as a source of energy and building materials for growth and repair of organisms.

## **Appendix II:**

### **Materials Needed for Activities:**

Scissors

Worksheets

White paper

Post-Its

Color Pencils

Crayons

Highlighters

Glue

Calculators

Graph Paper

Rulers

Food Dye

### Appendix III:

#### Activity 1:

#### Check For Understanding

1. $\{(2,4), (3,6), (4,8)\}$	2. $y = x^3 + 4$	3. <table><tr><th><math>x</math></th><th><math>y</math></th></tr><tr><td>-1</td><td>-5</td></tr><tr><td>0</td><td>-2</td></tr><tr><td>1</td><td>1</td></tr><tr><td>2</td><td>4</td></tr></table>	$x$	$y$	-1	-5	0	-2	1	1	2	4
$x$	$y$											
-1	-5											
0	-2											
1	1											
2	4											

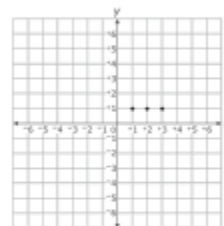
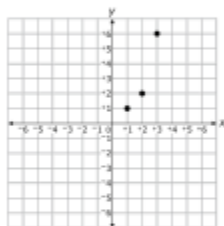
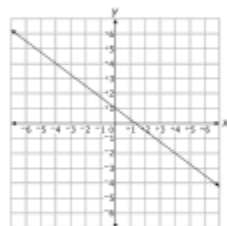
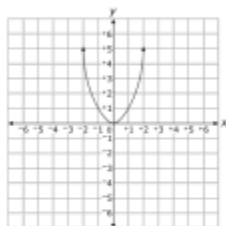
#### Collaborative Learning Worksheet: Use for Sorting Foldable

$x$	$y$
0	-6
1	-2
2	2
3	6

$x$	-3	-2	-1	0
$y$	6	3	0	-3

$x$	$y$
0	2
1	4
2	8
3	16

$x$	$f(x)$
-4	-1
-2	1
0	3
2	5
4	7



$$y = -x$$

$$y = 2x(x - 4)$$

$$y = 2x + 4 - 3x$$

$$y = 3x - 9$$

$$y = x^2 - 3$$

$$\{(0, 0), (1, 1), (2, 8), (3, 27)\}$$

$$\{(-1, 0), (2, -3), (5, -6)\}$$

$$\{(-1, -5), (0, -2), (1, 1)\}$$

$$\{(2, -6), (0, -2), (-2, 2)\}$$

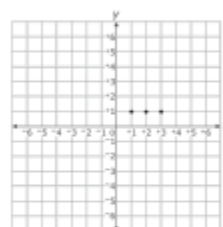
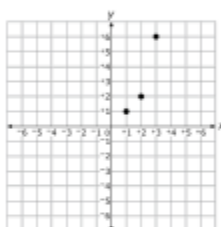
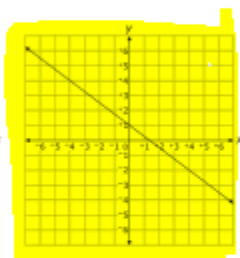
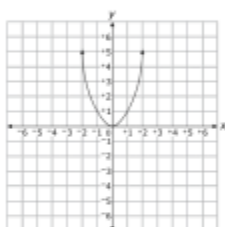
## Foldable Answer Key: Highlighted are the Linear Functions

x	y
0	-6
1	-2
2	2
3	6

x	-3	-2	-1	0
y	6	3	0	-3

x	y
0	2
1	4
2	8
3	16

x	f(x)
-4	-1
-2	1
0	3
2	5
4	7



$$y = -x$$

$$y = 2x(x - 4)$$

$$y = 2x + 4 - 3x$$

$$y = 3x - 9$$

$$y = x^2 - 3$$

$$\{(0, 0), (1, 1), (2, 8), (3, 27)\}$$

$$\{(-1, 0), (2, -3), (5, -6)\}$$

$$\{(-1, -5), (0, -2), (1, 1)\}$$

$$\{(2, -6), (0, -2), (-2, 2)\}$$

## Exit Ticket

Determine if y is a linear function of x in the table and set of points.

1.

x	y
-1	3
1	7
3	11
5	15

2.  $\{(4, 3), (1, 5), (-2, 7)\}$

1. Linear

2. Non Linear



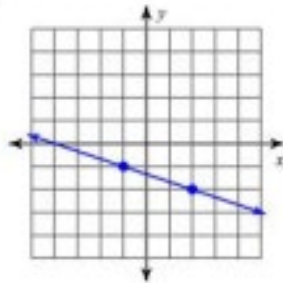
## Appendix IV

### Activity 2 : Practice Worksheet

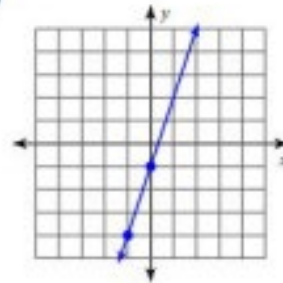
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Find the slope of each line.

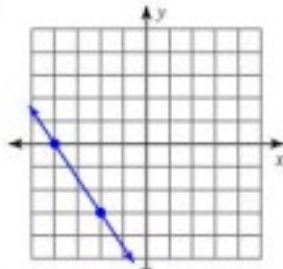
1)



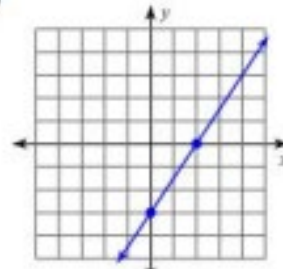
2)



3)



4)



Find the slope of the line through each pair of points.

9)  $(8, 10), (-7, 14)$

10)  $(-3, 1), (-17, 2)$

11)  $(-20, -4), (-12, -10)$

12)  $(-12, -5), (0, -8)$

13)  $(-19, -6), (15, 16)$

14)  $(-6, 9), (7, -9)$

Find the slope of each line.

17)  $y = -5x - 1$

18)  $y = \frac{1}{3}x - 4$

25)  $2x + 3y = 9$

26)  $5x + 2y = 6$

## Appendix V

### Activity 3

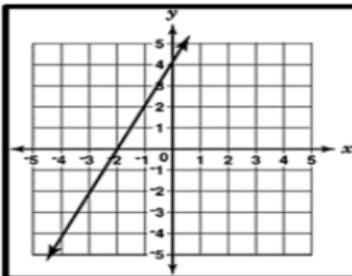
#### Activator

Do all the points on the table satisfy the equation  $y = 2x + 1$ ? Explain your answer.

x	y
0	1
1	3
2	5



What is the slope of the line?



The cost to join a gym includes a one-time membership fee, plus a monthly fee.

- Alice joined the gym and paid \$250 for 6 months.
- Peter joined and paid \$400 for 9 months.

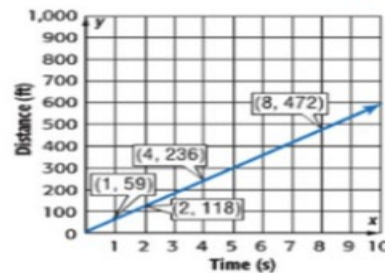
What is the monthly fee after the person joins the gym?

Write the equation of a line with a slope of -2 and the point  $(0, -3)$

Collaborative Learning: Finish The worksheet

#### Example one :

A zebra's main predator is a lion. Lions can run at a speed of 53 feet per second over short distances. The graph below shows the speed of a zebra. Compare the speeds of the two animals .



### Example two :

The equation  $m = 140h$ , where  $m$  is the miles traveled in  $h$  hours, represents the speed of the first Japanese high speed train. The speed of a high speed train operating today in China is shown in the table. Assume the relationship between the two equations are linear.

Train Rate in China	
Hours	Miles
1	217
2	434
3	651



- Compare the equations' y-intercepts and rates of change.
- If you ride each train for 5 hours, how far will you travel on each?

### Example three :

The number of new movies a store receives can be represented by the equation  $m = 7w + 2$ , where  $m$  represents the number of movies and  $w$  represents the number of weeks. The number of games the same store receives is shown in the table.



Week	Number of New Games
1	3
2	6
3	9



- Compare the equations' y-intercepts and rate of change.
- How many new movies and games will the store have in 6 weeks?

### Example four :

Angela and Benjamin each have a monthly cell phone bill. Angela's monthly cell phone bill is represented by the equation  $y = 0.15x + 49$ , where  $x$  represents the minutes and  $y$  represents the cost. Benjamin's monthly cost is shown in the graph.



Which of the two has the better deal? When will the bills be the same? What will the monthly bill be for 200 minutes?

**Example five :**

A museum charges \$12.50 per adult ticket. The price of a student ticket is represented in the table.



Student Ticket Price			
Tickets	1	2	3
Price (\$)	8.50	17	25.50

Which statement is NOT true?

- a. The adult ticket price has a greater rate of change.
- b. Both equations have the same y-intercept.
- c. The student ticket price has a greater rate of change?
- d. Both equations go through the origin.

**Example six :**

Gabe gets a 1.5 mile head start and runs at a rate of 4.5 miles per hour. Taylor's progress is represented by a graph that goes through the points (1, 10), (2, 20), and (3,30). How long will Taylor need to run to catch up to Gabe?



## Appendix VI

### Activity 4: Photosynthesis Lab

#### Materials Needed:

Glass Beakers

Food Dye (red, blue, yellow)

Water

Aquarium Plants

Graph Paper

Notebook paper

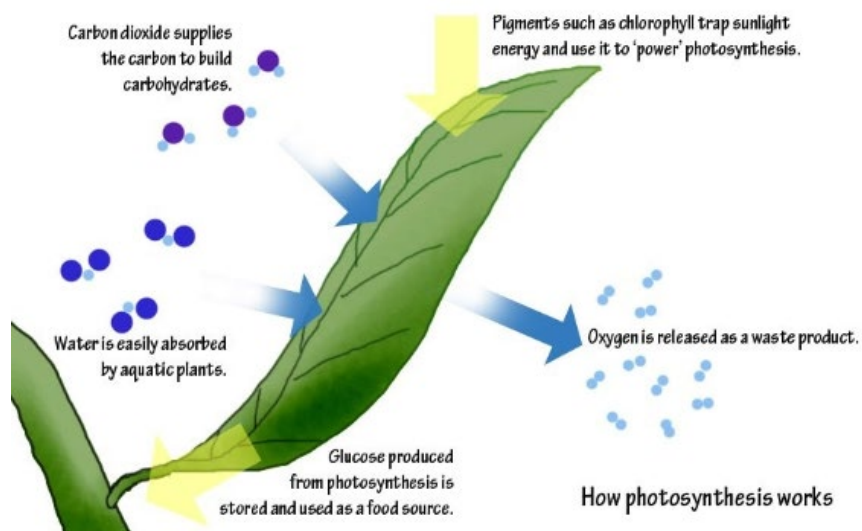
#### Activator: Questions to ask:

- What is photosynthesis?
- Why does photosynthesis happen?
- What is needed for photosynthesis to happen?
- What do you think will happen if you changed a part of the photosynthesis?

#### Focused Instruction:

- Photosynthesis is the process by which the plants receive energy from sunlight, carbon dioxide and water.
- Photosynthesis is observable in some aquatic plants because the oxygen that is produced from the photosynthesis process emerging as bubbles coming from the plant.
- Have the scholars copy the image below.

Have the scholars copy the image below



#### Guided Instruction

Video: [https://www.youtube.com/watch?v=eDhd\\_DTECgk](https://www.youtube.com/watch?v=eDhd_DTECgk)

Video Question: What do the bubbles represent?

Collaborative Instruction:

Set up the lab: Food coloring, Beakers, aquarium plants, light source

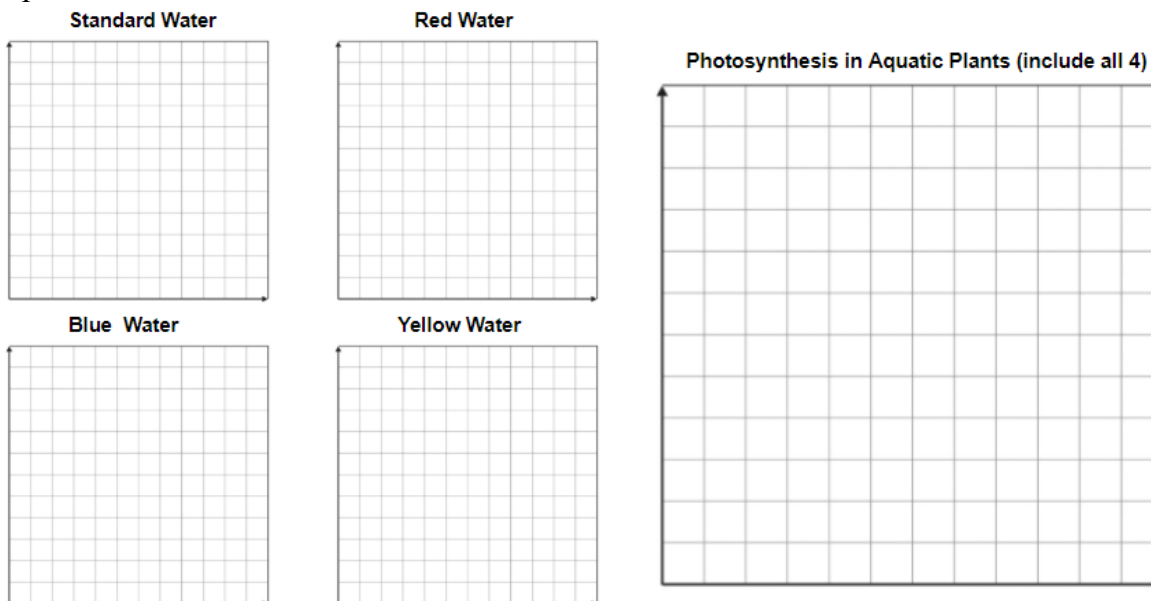
Have the scholars create the following tables:

Have the conversation that the input value is seconds. The output value is bubbles counted.

Standard Water		Red Water		Blue Water		Yellow Water	
Input	Output	Input	Output	Input	Output	Input	Output

Independent Learning:

Scholars will need to plot all four of the water types data. Then they will transfer it onto one graph.



Exit ticket: Based on your data, which solution created a faster process for photosynthesis to take place in aquarium plants?

## Appendix VII

### Additional Teacher Resources

#### [Finding Slope](#)

- Scholars will have to find slope represented in different forms.

#### [The Slope Tree](#)

- Visual representation of slope types

#### [The Slope Man](#)

- Visual representation of slope types

#### [Comparing Functions \(F.1, F.2 and F.3\) Practice](#)

- Scholars will work on comparing functions which are to the rigor of End of Grade Testing.

#### [Comparing Functions \(F.1, F.2 and F.3\) Practice Answer Key](#)

- Answers Key to Comparing Functions Practice

#### [Comparing Functions Practice Worksheet](#)

- Scholars will compare properties of two functions each represented in a different ways (algebraically, graphically, numerically in tables, or by verbal descriptions).

#### [Linear Equations Practice \(F.4 and F.5\)](#)

- Scholars will practice constructing a function to model a linear relationship between two quantities. Determine the rate of change and initial value of the function

#### [Linear Equations Practice \(F.4 and F.5\) Answer Key](#)

- Scholars will practice constructing a function to model a linear relationship between two quantities. Determine the rate of change and initial value of the function

#### [Plant Cell Vocabulary](#)

- Scholars will name the parts of a plant cell and identify the function of each.
- Scholars will name and label each part and function of the plant cell.

## References

CMS Mathematics 8 Curriculum Guide. 2018.

Martin Luther King Jr. Middle School - School Improvement Plan

National Governors Association Center for Best Practices, Council of Chief State School Officers. "Common Core State Standards Initiative Preparing America's Students for Success." *Common Core State Standards Math 8*, National Governors Association Center for Best Practices, Council of Chief State School Officers, Washington D.C., 2010, [www.corestandards.org/Math/Content/8/introduction/](http://www.corestandards.org/Math/Content/8/introduction/).

North Carolina Essential Standards. Science 6-8  
<http://www.dpi.state.nc.us/docs/curriculum/science/scos/support-tools/newstandards/science/6-8.pdf> (Accessed September 12, 2018)