Seeing the Fun in Functions

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Introduction

I am writing this unit to help students find relevance in the seemingly mundane facts that present themselves in every textbook. I hope the content of my unit will facilitate a genuine appreciation for math and the mathematician. I hope that mathematicians will no longer be viewed as loners behind a pile of books and calculators. I hope they will be viewed as graphics experts, as website developers, as modern artists, as sports gurus, and even electronic matchmakers. I hope to weave a thread of pop culture through the algebra I curriculum. In particular, I would like to explore families of functions. Exploring algebra through pop culture will facilitate the success of both standard-level and honors-level students. Visualizing the abstract will become more effortless. Weaving pop culture throughout the curriculum will help students who have difficulty "seeing" concepts like domain and range. Students who already have a strong ability to apply simple concepts in complex settings will gain a more multidimensional perspective. It will help all students realize that algebra is meaningful beyond standardized tests and has relevance outside of the classroom. As they see math in the various contexts, I hope to pique their interest and curiosity. As students develop a greater appreciation for the power of math, they will be enticed to invest the time in really understanding the material. Enjoyment is a great facilitator. Functions can be fun. This unit will prove it.

Rationale

"Seeing the Fun in Functions" will be a thread throughout my algebra curriculum. Ideally, the concepts can be developed to a greater depth for my Algebra II students also. Families of functions are studied in both curriculums. The focus here will be their introduction and applications. Our Algebra I curriculum is divided into 6 large units. I have grouped the broad topic of functions into 5 sections. Section 1 of this unit introduces the concept of algebra as being a way to see data and make decisions and even predictions. Section 2 gives a context to the various types of functions we study in Algebra I. Students take very simple scenarios and start to see that every story has a graph and every graph has a story. We evaluate the similarities in the stories that have similar graphs. Without realizing it, students are determining whether data is linear, quadratic, or exponential. They are also beginning to determine input and output, and therefore independent and dependent variables. This is a very powerful section. Not only is it a great hook to start the course, it is an excellent cumulative review as we

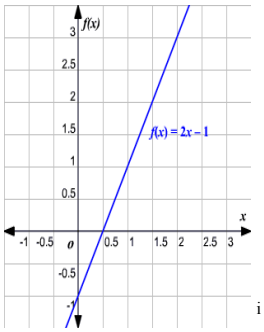
prepare for the North Carolina Algebra I End of Course Test. In Section 3 we study linear equations in much greater detail. We start to learn that equations are the directions for drawing the graph that tells the story. Section 4 applies quadratic functions. Section 5 applies exponential functions. Many of the concepts associated with functions are typically put in guided notes or study guides to be memorized. When students do not understand these concepts, they struggle with their applications. While honors students struggle less, some do not have a strong abstract thinking skills and become frustrated when they are unable to easily move from the math to a graph to a prediction. They are also easily discouraged when the same concepts are applied in different settings. Thinking about a scenario for longer than 30 seconds seems daunting and not worth the effort. Using pop culture applications within each section will improve students' comfort level with the theoretical and improve their depth of understanding.

Background

I teach high school Algebra I to current standard-level 9th grade students. Approximately 80% of the students I teach are trying to become a part of the honors IBMYP (International Baccalaureate Middle Years Program) by the end of the year. That means next semester they (current freshman) will remain with me for 10th grade honors algebra II. Approximately 70% have entered the class with a C or D in their previous math class. The ages range from 14-17. The typical class size is around 30. I have 38 students in one class and 25-28 in my others. All students have entered the course on or above grade-level. I teach in a large metropolitan area. Our school has very few math resources. Standard school supplies are the tools with which we are to teach. Considering pop culture applications without the need of extra supplies is tremendous. Technology will be a great asset. I have the privilege of a Promethean Board in my room this year. Not all students have computers at home. Research and finding math examples will have to be done in school.

Objectives

The overall objective of the "Seeing the Fun in Functions" unit is stated in the title. Students will see the properties of functions repeated throughout contextual examples. At this level, students must use and model linear functions, quadratic functions, and exponential functions.



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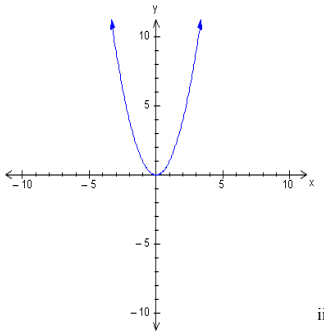

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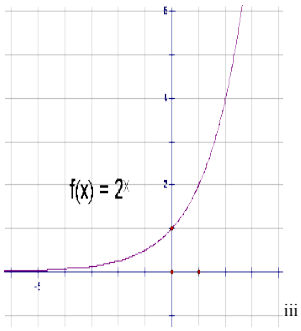

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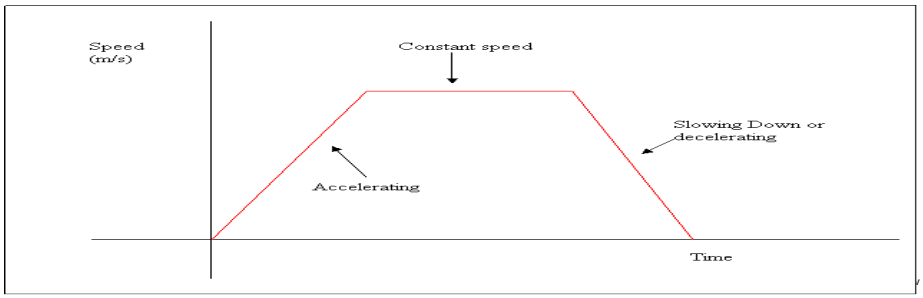
Linear Function Quadratic Function Exponential Function

By repeating the exposure to function applications, students will have a greater ability to actually see the basic principles illustrated in complex problems. They will be able to better visualize the abstract. Students need to be able to visualize height, speed, and time as relations. This is a difficult skill for most algebra I students. As they visualize a bike going downhill, students imagine a graph of a line going downhill (negative slope). However, showing speed as a function of time, the graph of the line would actually go uphill (positive slope). The speed of the bike increases as it goes down a hill.



To hone this skill, pop culture is great tool. Students start out graphing the height of a candle as it burns (linear data). They then leap to graphing the number of heads on a hydra as a warrior cuts off its heads (exponential data). This generates great enthusiasm for trying to illustrate another story…or trying to graph another function. Students see the fun while studying the functions. Using math doodles, sports ranking, font styles, and function grinders are just some of the many pop culture applications that will make functions visible outside of my classroom. The real objective is not just that students see the fun in functions, but that they cannot help but see functions all around them…in the

news, in sports, in apps and gaming, in art, in global issues (such as research and modern medicine at the cost of ecosystems) – which is the greater good, or lesser evil?

Specific math objectives covered within the unit are as follows. Students will understand the concept of slope and the y-intercept of a line. They will be able to identify the slope intercept form of a line. Students will be able to identify and model linear data.

Any straight line on the coordinate plane can be described by the equation

$$y = mx + b$$

Where:

x,y	are the coordinates of any point on the line
m	is the slope of the line
b	is the intercept (where the line crosses the y-axis)

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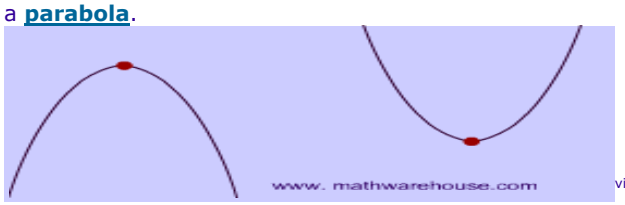
Students will understand and interpret data associated with quadratic functions. They will be able to use intercepts to determine time of flight. They will be able to use the vertex to draw conclusions, such as "the height of flight for a firework." Students will be able to identify and model quadratic data.

The vertex of a parabola is the highest or lowest point, also known as the maximum or minimum of a **parabola**.



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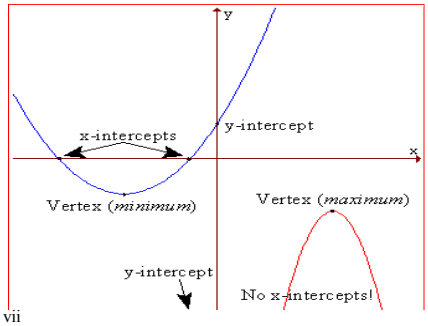

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Students will be able to identify and model exponential data (significant growth or decay in a relatively small amount of time). For example: Double your money every day, starting with a penny. See table below.

Day 1: $.01
Day 2: $.02
Day 3: $.04
Day 4: $.08
Day 5: $.16
Day 6: $.32
Day 7: $.64
Day 8: $1.28
Day 9: $2.56
Day 10: $5.12
Day 11: $10.24
Day 12: $20.48
Day 13: $40.96
Day 14: $81.92
Day 15: $163.84
Day 16: $327.68
Day 17: $655.36
Day 18: $1,310.72
Day 19: $2,621.44
Day 20: $5,242.88
Day 21: $10,485.76
Day 22: $20,971.52
Day 23: $41,943.04
Day 24: $83,886.08
Day 25: $167,772.16
Day 26: $335,544.32
Day 27: $671,088.64
Day 28: $1,342,177.28
Day 29: $2,684,354.56
Day 30: $5,368,709.12
[viii]

Finally, students will be able to discuss functions with the appropriate language. "Age is a function of time." "Heart rate is a function of time one has run." "Calories burned is a function of the number of miles one has run." Students will be able to read and understand function notation, f(x), where f(x) is the output and x is the input. Students will be able to apply it to problem solve. For example:

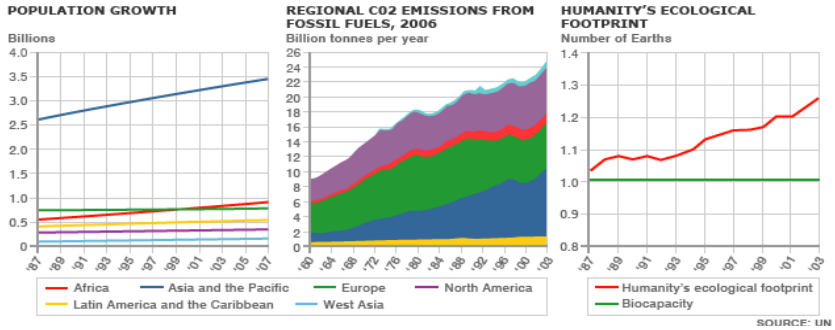
Jason's used car dealership has modeled its profit using the following function: $P(t) = 5000t^2+300t-200$, where P(t) is the profit (in dollars), and t is the time in years. What is the dealership's profit after 12 years?
[ix]

Strategies

Section 1 out of 5: Introduction to Algebra

The "Seeing the Fun in Functions" unit is essentially 5 sections related to the families of functions that are studied in Algebra I: linear, quadratic, and exponential. In the first section of this unit, students will explore algebra as a concept itself. Most students do not know what algebra is. They just know it is math, and most students would rather not be in math. When I tell them that algebra helped to pick their clothes today, they look at me in disbelief. We start to reflect on what determines fashion. We reflect on what determines style. As they start to believe that there was an evaluation process to get the clothes in the stores and even in their closet, they are willing to admit they evaluated data. As we connect data analysis with decisions, however small – from a group of friends making a movie suggestion to a group of scientists or politicians making a global decision – I have already begun to introduce the function. We talk about graphs representing data and equations being the directions for drawing the graphs. We put a visual on the seemingly abstract. In this section students connect cause and effect with data analysis. Students will connect real world situations with data, graphs, and ultimately with algebra. At this point, the math is pre-algebra review. The algebra conversations are very broad but also very relevant.

Students complete 4 performance tasks asking them to reflect on 4 scenarios that involve data analysis. These reflections are the impetus for students to start to connect subjective answers to objective data. In scenario 1, students are asked about helping third world countries with clean water solutions. Immediately they all want to create these solutions. In discussing how this can be done, industrialization becomes an element. Finally students are asked if they will help create viable solutions for a greater good or will they ultimately damage or destroy ecosystems in the process of trying? They have to decide if data analysis can help us help others and help us preserve the planet. They have to give a graphic to help justify their point of view. This is deep thought on a complex topic condensed into a simple graph. It is like they have instantly become journalists for USAToday. What? Journalism in algebra class? How can graphs summarize environmental data and help us make decisions?



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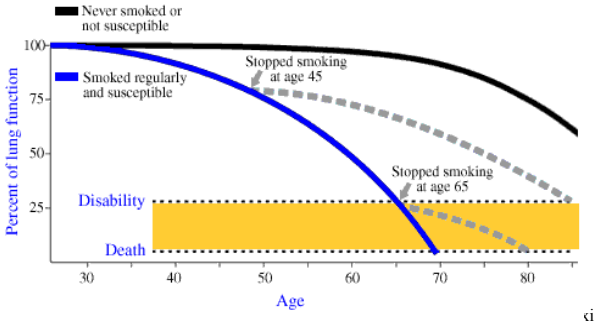
In performance task 2, students address their health. They are asked if their decisions today about smoking, drinking, eating, and exercising will affect their health later in life. Will their habits now affect their health in 10yrs? In 20yrs? In 30 yrs? After we discuss these issues and look at some statistics, students are asked if evaluating data can determine how healthy they will be? Can it predict? Again, students are asked to give a graphic representation to justify their point of view.



ci

In performance task 3, students evaluate social aspects of our culture and another culture. We look at fashionable clothes and shoes. Students make conjectures about where the pictures are from…USA, China, Holland, Middle East, etc. They are then asked to consider what makes something in style in one place but not in another. They must ask themselves, "Can evaluating data determine what we like? Can it help us

appreciate what others like?" Of course, they must give a graphic to help justify their point of view.

In our final performance task for the introduction to algebra, students are given a picture of one of the Mars rovers. We talk about the unmanned craft sending down data and some of the possible purposes. We also talk about prioritizing a budget at a national and global level. They are then asked if evaluating data can help us make decisions about exploration and discovery. They must give a graphic to justify their point of view.

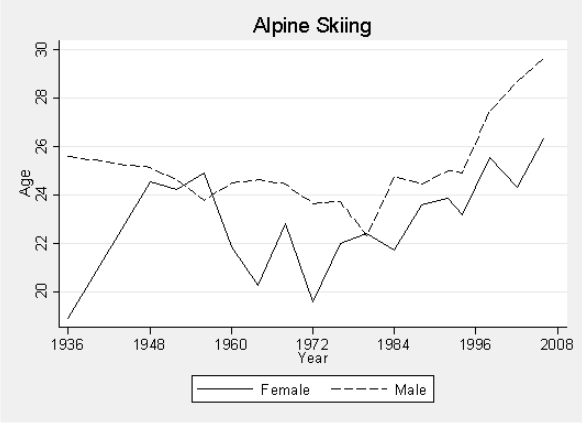
Finally we look at the graphs and start to classify them: Lines, curves, increasing, decreasing, gradual, steep. We talk about how to title and label the graphs. The students have taken a great step forward in an in-depth understanding of interpreting graphs. They did this using our own current events, our current culture, even our pop-culture.

Section 2 out of 5: Families of Functions – An introduction

In the second section of the unit students really start to get hooked. Pop culture does a tremendous job in helping get students to want to graph functions. In this section, students are given a one-page summary of graphs, properties, and formulas associated with linear, quadratic, and exponential functions. Unfortunately, students are often left to memorize the strange drawings and "weird" formulas. Students become disengaged and are not invested in trying to learn. Certainly adding relevance is a great tool. That in itself does not motivate in the way that pop culture can. Considering a speed time graph as a car goes up a hill or down a hill is barely interesting. Certainly modeling this helps with that. However, pop culture saves the day.

Students are given a handout of 15 scenarios. Each scenario has a graph above it. On the graph 3 different functions are graphed. Students must try to match the correct function graph with the scenario. First we start with modeling and almost a form of charades. First in whole group, with me, and then in small groups, I model the action in the scenario and students match the pattern of movement. For example, "The height of a candle as it burns." As I start to emulate a candle burning, I start to "shrink." Students have to know we are looking at the graph from left to right. They know that shrinking is decreasing. However, we have to make sure they do not choose a vertical line. For this to be better illustrated we graph the height of my head. We start to add in mathematical words and phrases like "change over time." We do a few more of these for students to start to feel comfortable. Of course, then I must give them a speed as a function of time graph as a bike is going downhill. Almost all students want to first choose the function with a negative slope – as it seems to be going downhill. However, when they *model* the behavior of the speed of a bike going downhill – they realize that the speed increases. In going through only a few scenarios, we have already modeled increasing and decreasing functions, input, output, independent, and dependent variables. Students continue in this manner in small groups. This success is a function of their charades. They are excited about working through what seemed complex to start. (Most kids think multiple choice functions on one graph look like an EKG read out). They are also excited about getting up and moving to do math. There is little to no writing at this point. Here is a short

example. This particular example does require a student to choose the appropriate graph out of several choices. It requires students to interpret a seemingly complex set of data. This is a graph of the age of the medal winners in the winter Olympics. Can students read it? Can they determine if it is increasing? Can they make conjectures why? Can they make predictions?



[xii]

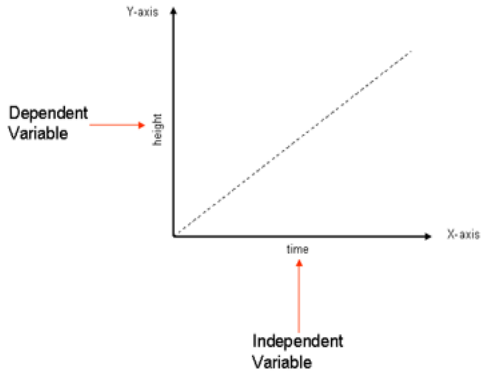
Once students are somewhat comfortable with interpreting graphs, the real fun begins. I ask them if they can slay dragons. I tell them the story of the hydra. As Hercules cut one head off, two more grew in its place.

[xiii]

We start to simulate the beast on the large dry erase board at the front of my room. Students come up and chop and add heads. After only a few warriors take on the hydra at the board, we have taken up a great deal of space. I ask students how many they can get on their paper and over how many lines (or sword strikes). This idea was inspired by the Vihart video[xiv]. I highly recommend the watch. While she has a bit of a dark presentation, she speaks a lot of truth, and shares some great math doodles. As students draw hydra, and dragons are completely happy that I have forgotten about the math lesson, I ask them how this could be our math lesson. The room goes silent. I ask them

how many lines it takes them before they run out of room. I ask them how many sword strikes that would be and how many hydra heads would result. We talk about the number of heads being a "function of" the number of decapitations. Students must do their best to give me a quick graph. Some draw a steep line with positive slope. We have to add a small table of values to make the graph more accurate. This is where some great discussion comes in about linear vs. exponential data. There is a story of a Roman general Terentius. The general is going to be rewarded by Caesar for his great contributions to the Roman Empire. Caesar allows the general to go to his treasury and take one coin. Then he can go and get double the value of the first coin and so on. He can repeat the pattern until he can no longer carry the treasure on his own.[xv] This is another great example of exponential growth because the students love the story. Again we think about the graph, and the independent and dependent variables. We write a function statement.

In the next task students must create a linear graph, a quadratic graph, an exponential graph, and a combination graph. They must give a creative scenario to go along with each. Students must identify the input, the output, the independent variable, the dependents variable, and write a function statement. The function statement is crucial. (There is an example below). Students have not used that terminology before. Writing it in context and using it conversationally makes the wording "f of x" common place rather than an additional challenge later in the curriculum. Now, in our introduction to algebra, students have a very broad but also very valuable awareness of functions. They also are aware that studying them can be fun.



[xvi]

In this graph, height is a function of time.

The height of Lego tower is a function of time. Every 1 minute we have completed another level.

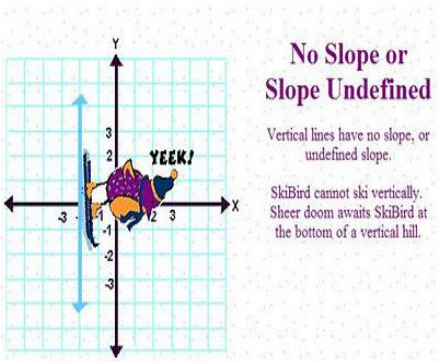
For an extra credit task, and for a great bulletin board, students bring in real-life examples of functions (from newspapers, magazines, or news websites) graph the data, label the input, output, independent and dependent variables and write a function statement. Students realize functions are everywhere. They are happy to do the assignment. I am happy they are reading an article and applying algebra. I am also quite happy about my current events bulletin board.

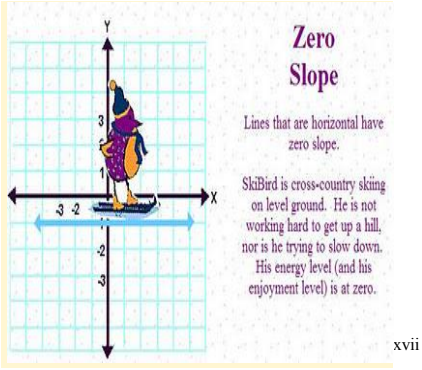
Section 3 out of 5: Linear Functions

In this section of the curriculum, we start to become more involved with the specific math behind the broad ideas (families of functions). Students delve into the equations of lines; slope-intercept form, point-slope form, and standard form. They must also know and apply the formula for slope.

standard form of a line	$Ax + By = C$
slope-intercept form of a line	$y = mx + b$
point-slope form of a line	$y_2 - y_1 = m(x_2 - x_1)$
Slope	$m = (y_2 - y_1) / (x_2 - x_1)$

Students must be able to navigate back and forth between the different types of linear equations. They must see how they are all related. At this point in their education, students do not see anything similar. They simply see 3 more things the have to memorize. Students must be able to find the slope, given the standard form of a line. So they need to be able to manipulate standard form to produce slope-intercept form. Students must also be able to draw graphs from linear equations. They must be able to write linear equations from graphs. They must also write linear equations given 2 points. As students manipulate these equations, they start to become comfortable with identifying linear equations with positive slope and with negative slope. When vertical and horizontal lines are added, this becomes more challenging. Students must be able to write the equation of vertical and horizontal lines. Students must also develop a strong understanding of zero slope and what the graph looks like, as well as no slope.





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This is one of the most difficult concepts for students to remember. There in lies a great deal of the problem. Students have a tendency to try to memorize zero slope means y = 2 and no slope means x = 2. Apply, apply, apply. Using the same strategy as mentioned in section 2 of this unit will prevent the memory work from being an issue. Understanding the concept through engaging examples will do the trick. Of course the tables of values along with the graphs add the extra visual explanation. (2,1), (2,2,), (2,3), (2,4) They see the pattern. Hopefully we are able to work past having to write the tables or relations. Students are a great resource for "cool" examples of zero slope and no slope examples, Zero slope: dragon firing from its mouth; laser guns; Spider man' s webs, if only for a moment (that actually turned into a great conversation and graph). No slope: most of the ones students wanted to write had to do with bad guys being tossed from planes. We

added a spider dropping from its web. We also added Wile E. Coyote falling from a cliff, while in pursuit of Road Runner. An elevator isn't exactly the hook I was looking for.

Of course I would like them to take the great math and connect it to many different slopes. My professor, Dr. Tim Chartier suggested a font task.[xviii] This is a great task. It can be a small task, like a single letter (perhaps an initial). It can be a larger task like a full name or a word or even a phrase. Essentially, students will write their initial or name using line segments only. In essence, they will have created a font. Students will then need to create a Cartesian coordinate system in the background for a frame of reference. Then students need to find the equations of the lines. Students can double the size and discover how that changes the equations. Students can consider what it would take to make their font one that could be colored in. What would it take to color it in? How could they add some curves?

We spend a lot of time with parallel and perpendicular lines and talking about how they are related graphically, in equations, and in applications. This is very difficult for students in algebra 1. Graphically, they do well. Equations and applications are frequent struggles. One activity that can help students get in some extra practice with these equations without feeling like it is work is "Mystery Sketch". I developed this one day on a whim, just trying to get students to keep practicing. Essentially a student draws a figure that has 5 lines (otherwise I would only get squares and rectangles). Parallel and perpendicular lines must be represented. The student writes the equations for these lines. He/she then trades equations with a partner to see if the partner can duplicate the original figure. Understanding the *opposite reciprocal* takes a lot of repetition. Giving the students another adrenaline boost here is just what they need to carry them through that grind.

Section 4 out of 5: Quadratic Equations

Quadratics are a lot of fun to teach. Did I just type that? I think they are fun if the students have the broad understanding of what they represent. Most of my examples have to do with the path of an object (rocket, ball, firework) going through the air. Roots are the starting and landing points, typically. The height is the MAX. This is all fairly basic to algebra I. Of course we can embellish the stories that go with the graphs. Angry Birds will be a big help this year.


[xix]

Students are already familiar with the game. Furthermore, with the help of a diagram camera (Elmo), I can project my IPad screen to the class. The game is loaded on my IPad so I will be able to show students the game and emphasize the path of flight. My professor, Dr. Tim Chartier, wrote a great PowerPoint presentation that illustrates that firing from different initial angles produces different trajectories. His Power Point presentation will also allow my Algebra I students will see that firing from 30 degrees vs. 60 degrees creates different parabolas.[xx] Students will also look at the quadratic equations that go with each and try to determine how and why the graphs change.

To help students visualize contextual examples of quadratic examples with a MIN, I will use projections and a coordinate grid. I will project the image of the Golden Gate Bridge onto my dry-erase board. I will draw a coordinate grid over the image. Students will students consider the MIN and the roots (the x-intercepts). Another graphic that will work for freshmen is a graphic of a half pipe, or the like, as seen in the XGames. Students are very fascinated with extreme skating and biking. Students will be able to complete this task at their desk or at home. They simply need a printout of the image. Students can draw the coordinate grid over the image, as I did on the board. I am also considering printing a coordinate grid onto tracing paper and passing it out to the class. Students will simple overlay the tracing paper onto the image and carry out the same tasks. With coordinate grid printed for them, their findings will be more accurate.

Certainly any factoring application is always helpful. Students start with small factoring support models by making math mobiles. Students are given cardstock with a 2-digit number. Students must then take small square pieces of card stock and write one factor of that number on each square. Then we hang these math mobiles in the room with the large number at the top and its factor pairs hanging below. It is great support for students who need to find factors of 12 that add to 7. Then in the next problem find factors of -12 that add to -1. The room is filled with visuals of factor tables. Students use these to help them with basic factoring of trinomials.

Section 5 out of 5: Exponential Equations – Growth and Decay

The introduction with the hydra and with the Roman general was tremendous. Continuing with the Roman general and getting students to predict how that might translate today and graph their data will be a great lab. There is a similar story involving a Chinese emperor that will turn into a great hands-on activity.

> …a wise man does a favor for the emperor, and the emperor asks what he can do in return. The wise man asks for 1 grain of rice to be placed on the first square of a chess board on the first day, 2 grains to be placed on the second square on the second day, 4 grains to placed on the third square on the third day, and so on, doubling the number of grains each day. The emperor agrees, and after a couple of weeks, all of the rice in the empire belongs to the wise man![xxi]

Another task that students will complete in this section is to consider whether they would rather receive $1,000,000 today or $.01 today and let me double their money for 30 days. They NEVER pick the penny. It is great example of exponential growth. They create a table of values, graph their data, and determine what day the penny becomes a better choice.

Activities

Within each broad section of my unit, I have given an overview of activities and tasks. In this section will focus on the culminating activity for each section. These activities have a great impact on the students. They are powerful not only because they bring many math concepts to together, but also because they are very adaptable for the teacher. A teacher can easily tweak them to make them longer more researched based or shorter and make them mini-labs or mini-projects. Some of the activities can even be used over again with new objectives.

Families of Functions

In the strategies section I discussed that every graph tells a story and every story has a graph. Students were given various graphs and had to match or even create scenarios that could match. They also had to go the other way. If they were given scenarios, they had to create a graph that would match. For the culminating activity, students will create a function cube. They will actually make an origami cube. As they are folding the paper to create the cube, they have to answer some short questions about the lines formed by the creases. Are there intersecting lines? How many points do any two lines share? Are there parallel lines? Do they share points? Why or why not? Etc. This portion is great preview for systems of equations, which comes later. Once the origami cube is together, students must cover all six sides. On one side, students create a graph and label the

independent variable, dependent variable, input, output, x, and f(x). The other five sides are used to write five different scenarios. I encourage them to really use different topics. We brainstorm ideas together on their rubric. Options include, but are not limited to, superheroes, mythology, sports, parables, the path of famous characters in books or movies, weather (they usually choose things like tornadoes, hurricanes, tsunamis, etc), money and economics, environment, ecosystems, health and social issues, adrenaline junkie data, fashion merchandising, etc. The title of each scenario should also be an appropriate title of the graph.

There is a lot of flexibility for the teacher. This year I did not have the school supplies I normally have. As I have had to reserve as much as possible, I only gave each student 3 pieces of paper, rather than 6. Students had to cut each pieces of paper in half to get the 6 pieces needed for the cube. The final products were small. To fit all of the five different scenarios and a quality graph, we ended up folding the stories and gluing them on. It created a pop-up version of what I originally had in mind. They turned out great. In fact, I think I may even use this next year as the initial idea, rather than the back-up plan. As far as time and grading go, there are many ways to edit the function cube. For example, if the teacher is really short on time the six sides can be the graph, one story, a function statement, domain and range, independent and dependent variables, and the input and output. This activity can be revised to fit almost any math objective. Students love to do origami. In fact I often have to ask students to put the origami aside as we move on.

Linear Functions

When students are wrapping up the section of curriculum that covers linear functions, we are getting ready to start midterm exams. They are usually nervous about exams and very tired of doing practice problems. It is the perfect time to introduce their project. Students choose between three options; an art product, a current event, or a creative writing piece. All three options have similar rubrics. The rubrics contain the creative piece, the math content, a reflection (guided), and an article to back their point of view in the reflection.

If students choose the art product, they draw a picture and highlight 5 lines within the picture. They then draw a coordinate system over the drawing in a black magic marker (or whatever color will stand out). They extend the highlighted lines over the y-axis. They determine the slope, and y-intercept of each line. They then use this information to determine the equation of each line. In the example I showed the class I project a drawing of Iron Man on by dry erase board. I took a florescent marker and literally drew over 5 lines with different slopes (all part of the armor). Then I took a black marker and drew a coordinate system right through the middles of the projection. I extended the highlighted lines. We determined the slope and y-intercept, and wrote the equation of each line. It is important that students who choose this option have some artistic ability. If they are not proud of their product, they will not enjoy the assignment. For the non-artistic people in the room, like the teacher, I recommend a perspective drawing. Youtube has great step-by-step instructions that take very little time. Students must write a short reflection about how computer programmers and/or graphic designers use a similar process. They must find an article to back their reflection. It only means so

much for the math teacher to say math exists in the real world. Discovering it on their own has a much greater impact.

If students choose the current event, they must choose an event that they find interesting. Current, in this instance, means within the last 10 years. Students must find a short article (about 2 pages) and highlight the key points, showing an impact over time. Students must write a reflection about this impact: Was it positive? Why? Will it continue? How? Why? What can we learn from it? etc. They must produce a graph to illustrate this impact over time. The graph must have a title, the appropriate intervals (This requires more guidance than you might originally think), and each axis labeled. Students must write an official function statement. For example, "The negative health effects on the body, are a function of the time one is using steroids." Students must identify domain and range, as well as the independent and dependent variables. A student working on this topic (steroid use and health in professional athletes) ended up creating two graphs. One illustrated the change in performance with steroid use, the other illustrated the change in health with steroid use.

It is important that students choose a topic they are really interested in. This can be challenging. For instance, I discourage them from choosing an article about the recession, unless they can really show me they are interested in economics and/or politics. Students can find these articles easily. They don't usually understand a recession; however, they do know that is associated with loss of money. Some believe they can print the article and draw a graph that is decreasing over time and be done. Some students will look for the quick completion, and need to be encouraged in another direction. With a few minutes conversation about their interests, they can be easily guided to topics they will enjoy. That means that they will remember a meaningful learning experience associated with math.

Students also need a fair amount of guidance in finding an appropriate article. We spend time discussing that the odds of finding good fit in the first few options from a Google search are very low. Students should print articles they are interested in reading and that they are able to easily understand. Most of my students are not ready for the Wall Street Journal or even the New York Times. Science journals are not usually a good choice. In many instances I suggest sites like USA Today, CNN/HLN (Headline news), MSN, US News and World Report, Sports Illustrated, and even People Magazine. Youth science websites can help too.

If students choose the creative writing option they may write a short story and illustrate it with a piece of art, as described above (only highlight 3 lines instead of 5), or produce a graph comparing 2 things in the story. My professor, Dr. Tim Chartier, gave the great suggestion of a system of lines with one line depicting the girl's feelings for the boy and the other depicting the boy's feelings for the girl. I use it as an example. The students love it. The final option in the creative writing piece is to actually incorporate the math language into the story. I use the book, The Phantom Tollbooth by Norton Juster, as an example. This is a children's book with great math and English lessons and references. However, it is a classic for its life lessons for all ages. One math example I

particularly like when the mathemagician explains that there is never a largest number. There is always another number higher. Here is a example of the author comparing math and life.

..for one of the nicest things about mathematics, or anything else you might care to learn, is that many of the things which can never be, often are. You see it's very much like your trying to reach Infinity. You know that it's there, but you just don't know where-but just because you can never reach it doesn't mean that it's not worth looking for.[xxii]

Students choosing the creative writing piece must also find an article. I write in the rubric that students must find an article connecting the creative process to increased learning. We discuss right brain and left brain and what it means to exercise both. Students are willing to do this; however, they may need help in finding a reasonable article. Youth science magazine sites help here. Students can also use the information in their graph (if they chose a graph to go with their story) in connection with the article. For example, if a student wrote a love story in which the couple did not see eye to eye, the student may reflect on the basic differences in men and women. It would not be difficult to find a short article to accompany that reflection.

Quadratic Functions

Quadratic functions are not studied in the depth that linear functions are studied. Students are exposed to trajectory and are able to discern information from the path of flight; height, time of travel etc. For the culminating activity in this section, students will take contextual examples of 2 parabolas. Students can use different versions of the examples we have discussed; Angry Birds, half pipe (XGames), flight of a rocket, flight of bird, etc. Students will print the examples and draw a coordinate system over the image. Students will label the vertex (MAX or MIN) and the intercepts. Students will give the equation of each. Finally students will reflect on how the coefficients change the parabola and the impact this has for making conjectures.

Exponential Functions

For the culminating activity in exponential functions, students will complete a lab activity illustrating exponential growth. I have 3 great stories for the students to revisit. We have the hydra, when one head is cut off two more grow back. Student have completed and activity on the board and on paper. At this time (right before final exams) it would be great to have one go down the hall. Could we really get farther than on the board? Why or why not? I will also offer the opportunity for students to create a 3-d hydra with Styrofoam peanuts and toothpicks.

Students also have the story of the general who was rewarded with a single coin. He can go back and double his money until he cannot carry it. I would love to illustrate this with pennies, but do not think I have the resources. Golf balls may have to substitute. They will symbolize pieces of gold. Students will quickly see that it will not take long to fill a duffle bag (or 2).

Probably the best lab illustration I have seen follows the story of the wise man earning all of the rice in the kingdom.

1+2+4+8+16+32+64+128+256 = 511 objects

(The largest objects are dried beans; then it's rice grains; then it's anise seeds.)
Just as in the experience of making"A Few Iron Posts of Obseration", I found it instructive to "think with my hands" for a while. I sat peacefully on my kitchen floor, pushing the pieces around, planning the next stage, and repairing damage from the occasional errant finger or too-vigorous exhaling of breath. With my hands busy, my mind was free to roam. I reflected on the way my ever-shrinking materials - beans, rice, seeds - resembled the ever-shrinking computer chips that carry out our society's calculations. If I needed to take that next step to an outer tier of 512 objects, how would I fit them into the structure? What objects could I use? Salt grains? How then would I manipulate such tiny objects and put them in the proper places? How would I better control my breathing and other destructive effects?[xxiii]

Following along with idea of the author above, students will create a similar model. Students will be asked at the beginning of the activity how many iterations they believe will have to take place to make it to 511 objects. Then students will create the model.

Closure

In summary, I would like pop culture to weave throughout my Algebra I course; perhaps in short examples; perhaps in projects, labs, and models. I would like students to be immersed in math. I would like them to live it rather than be force-fed. As my professor, Timothy Chartier, so aptly put it, " Experience math". Students will develop a greater depth of understanding. They will have more fun with the material. I will have more fun with the material. In the end, I hope the enthusiasm over our topics will naturally translate into a greater enthusiasm for learning.

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