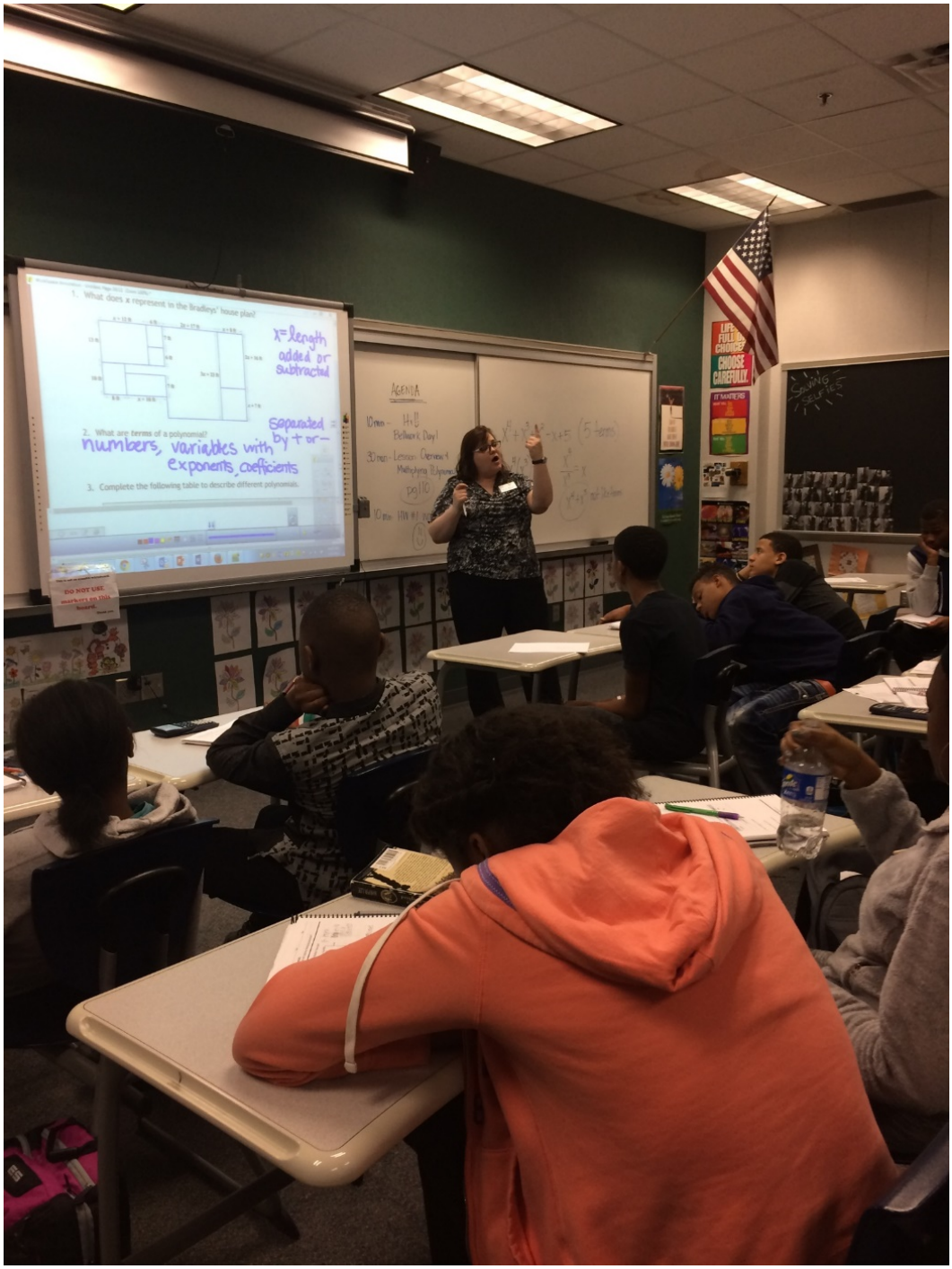
Rachel Wraley



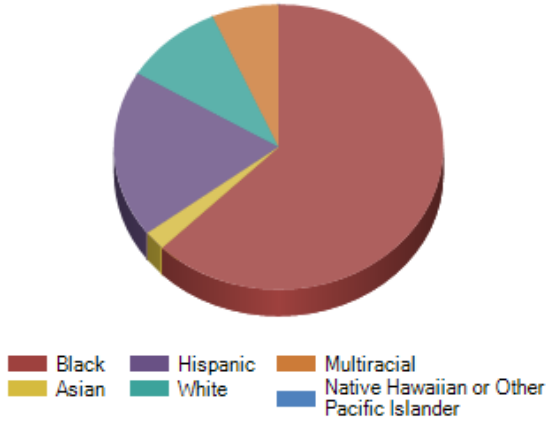
- Pike High School is a highly diverse urban high school located on the northwest side of Marion County in Indianapolis, IN.

- It has a current enrollment of 3,260 students and 175 teachers with a 18:1 student to teacher ratio.

- Pike has a 94% graduation rate.

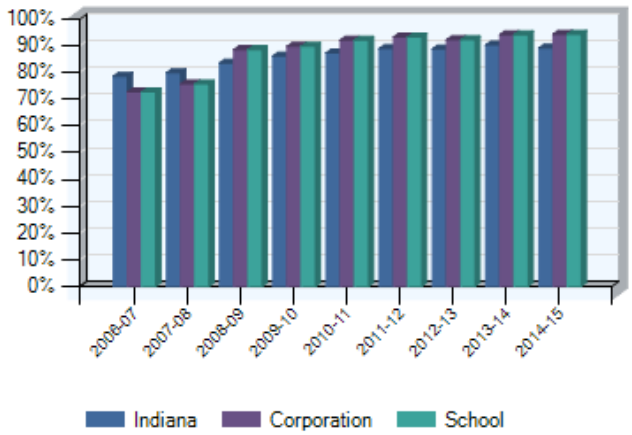
- 50% of the graduating class has earned college credit through dual degree courses offered at Pike.

Enrollment 2015-16 by Ethnicity



Grade	Enrollment
9	873
10	866
11	794
12	727

Four Year Cohort Graduation Rate Trend



- While I was at Pike I was assigned to four 9th Freshman Algebra classes and two 10th-12th Repeat Algebra classes.

- I worked extensively with two periods of the freshman Algebra and with both of the Repeat Algebra classes.

Unit Plan

Long Range Goals

- Distinguish between situations that can be modeled with linear functions and with exponential functions. Understand that linear functions grow by equal differences over equal intervals, and that exponential functions grow by equal factors over equal intervals. Compare linear functions and exponential functions that model real-world situations using tables, graphs, and equations.
- Represent real-world and other mathematical problems that can be modeled with exponential functions using tables, graphs, and equations of the form y = ab^x
- Graph exponential equations in two variables without technology.

Big Ideas

- Exponential Functions
- Graphing Exponential Functions
- Modeling Real-Life Situations with Exponential Functions
- Interpreting Exponential Graphs and Functions

Enduring Understanding

- How graphs and functions can be used to analyze real-life situations/data.
- How we can analyze data to make conclusions about real-life situations.
- How graphs can be important to analyzing real-life situations.

Assessments

Summative

- Modeling Exponential Growth
- Unit Test

Formative

- Class Discussions
- Think, Pair, Share
- Linear or Exponential
- Paper Folding
- Thumbs up/Thumbs down
- Exit slips

Essential Questions

- What can we interpret about real-life situations from functions and their corresponding graphs?
- What situations can be better modeled by graphing? Are there other methods to model situations/data?
- What graphs and functions are more appropriate for modeling different situations?

Student Activities

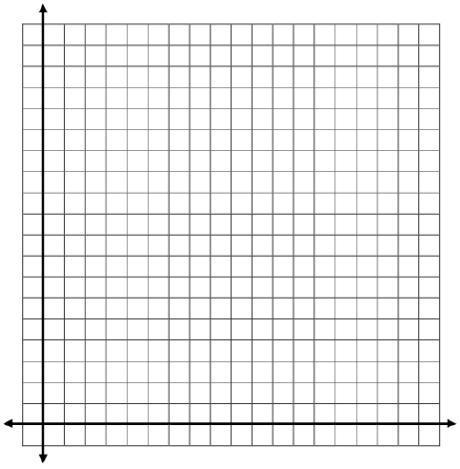
- Bellwork
- Notes
- Linear or Exponential
- Modeling Exponential Growth
- Homework
- Paper Fold
- Notes/Lesson
  - Exponential Rate of Change
  - Comparing Linear and Exponential Functions
  - Exponential Functions
  - Modeling with Exponential Functions

Assessment

Formative	Summative
• Class Discussions • Think Pair Share • Linear or Exponential? • Paper Folding	• Modeling Exponential Growth • Unit Test

1. Zombie Apocalypse

A virus is turning people in Zombies! When the virus started spreading there was only one Zombie and the number of Zombies quadruples every week.



x	y

Question 1. How many Zombies will there be after 15 weeks?

Question 2. When there are 1,000,000 people who have turned into Zombies the World Health Organization (WHO) will call the virus a pandemic. After how many weeks will there be a pandemic?

Linear or Exponential?

1) $y = -x + 8$

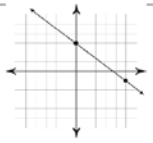
2)

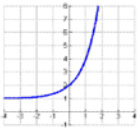
x	y
0	2
1	4
2	8
3	16

3) $y = 6 \cdot 3^x$

4)

x	1	3	7	11
$g(x)$	4	9	19	12

5) 

6) 

7)

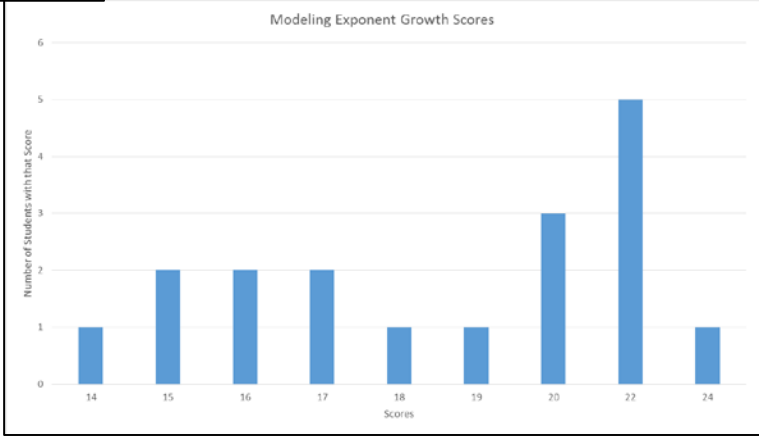
x	y	ratio of y - values
0	4	$\frac{12}{4} = 3$
1	12	$\frac{36}{12} = 3$
2	36	$\frac{108}{36} = 3$
3	108	$\frac{324}{108} = 3$
4	324	

8) $y = -90 \cdot 5^x$

9) Ms. Wraley started with $20 and her money quadruples each day.

10) Ms. Petrin has $1000 and spends $5 each day.

~~Sample from Modeling~~
Exponential Growth Packet



This data represents the scores students received on the Modeling Exponential Growth Assessment, and how many students got what score.

Lesson Plan

Teacher: Rachel Wraley **Lesson # in Unit:** 2 **Lesson Topic:** Exponential Functions

Lesson Objective and Assessment of Objective

By the end of the lesson, students will be able to: Write a function rule for an Exponential Function taking into account whether it is growth or decay.

Content Objectives: Recognize exponential patterns using graphs, tables, and story problems. Recognize the pattern in exponential growth and decay.

Academic Language Objectives: Important vocabulary for the lesson: Linear function, Exponential function, y-intercept, asymptote, constant, rate of change, common difference, and common multiplier

Why does this lesson matter?

Exponential functions are used in several professions/disciplines (mainly scientific) all over the world. It is important to be able to recognize exponential patterns and write exponential functions in order to be successful in those professions/disciplines.

Assessment Statement: How will students show they have met the objective?

Students will be able to correctly label a function rule linear or exponential. Students will be able to read a story problem and write a corresponding exponential function rule.

Specific Standard Indicators Aligned with this Lesson:

- Distinguish between situations that can be modeled with linear functions and with exponential functions. Understand that linear functions grow by equal differences over equal intervals, and that exponential functions grow by equal factors over equal intervals. Compare linear functions and exponential functions that model real-world situations using tables, graphs, and equations. (A1.QE.1)
- Represent real-world and other mathematical problems that can be modeled with exponential functions using tables, graphs, and equations of the form $y = ab^x x$ (for integer values of $x > 1$, rational values of $b > 0$ and $b \neq 1$); translate fluently among these representations and interpret the values of a and b. (A1.QE.2)
- Graph exponential and quadratic equations in two variables with and without technology. (A1.QE.3)

Type of Mathematical Knowledge Objective is seeking to measure

- ☒ Declarative
- ☒ Procedural
- ☒ Conceptual

Standards for Mathematical Practices

- ☒ Make sense of problems and persevere in solving them
- ☒ Reason abstractly and quantitatively.
- ☐ Construct viable arguments and critique the reasoning of others.
- ☐ Model with mathematics.
- ☒ Use appropriate tools strategically.
- ☐ Attend to precision.
- ☐ Look for and make use of structure.
- ☒ Look for and express regularity in repeated reasoning.

Mathematic Conceptual Cates

- ☐ Number and Quantity
- ☒ Algebra
- ☒ Functions
- ☐ Modeling
- ☐ Geometry
- ☐ Statistics and Probability

Supporting Diverse Learners

Students with IEPs receive the following accommodations:

Preferential seating
Extended time on tests/projects

Students with LEPs receive the following accommodations:

Modified tests

List Strategies/Activities:

Mathegories
Notes

Method(s) for Instruction

- ☒ Class/Group Discussion
- ☒ Cooperative Learning
- ☒ Small Group
- ☒ Guided Practice
- ☒ Lecture or Direct Instruction
- ☒ Question/Answer
- ☐ Learning Stations
- ☐ Teacher Modeling/Demo.
- ☐ Journal writing
- ☐ Role Play
- ☒ Hands-on
- ☐ Inquiry Learning
- ☐ Game
- ☐ Simulation/Role Playing
- ☐ Independent Learning
- ☐ Other

Use of Materials:

- ☐ Teacher's Manual pg#
- ☒ Student Text pg# 63-76
- ☐ Picture Books
- ☒ Handouts: HW #3
- ☒ Manipulative: Mathegories
- ☐ Related Equipment:
- ☐ Adapted materials:

Use of Technology

- ☐ Cell Phone
- ☐ PollEverywhere.com
- ☐ CPS Clickers
- ☐ Elmo Document Camera
- ☒ Software: AgileMind
- ☐ Student Computers
- ☐ Teacher Computer
- ☐ Video Clips/DVD
- ☐ Website
- ☐ Web 2.0 tool
- ☒ Other: Smartboard

Lesson Agenda

Warm up: How will you support students in accessing prior knowledge, personal, real world and/or cultural connections?

The bellwork is written so that students do both review problems from previous topics and some problems from the current topic. This gives them a chance to strength their prior knowledge of past topics, and to help reinforce the new topic.

Time	Teacher Will Be:	Students Will Be:	Rationale:
5 minutes Welcome/ Starting Bellwork	Welcoming the class, giving any necessary beginning announcements, and putting the students on task (bellwork).	Starting/attempting their bellwork.	The bellwork is written so that students do both review problems from previous topics and some problems from the current topic. This gives them a chance to strength their prior knowledge of past topics, and to help reinforce the new topic. This also starts the class's highly structured routine.
5 minutes Wrapping Up Bellwork	Mrs. Petrin and I will ask for volunteers to put up their work for a specific Bellwork problem. After students have put up their work, Mrs. Petrin or I will lead the students in a discussion about their peer's work, and correct any mistakes or miscalculations.	Select students will put up their work for a specific Bellwork problem. Students will correct their Bellwork if needed.	This format for going over the bellwork, allows for a more constructive conversation about mathematics. It also enforces the structure of the classroom, and the Bellwork.
10 minutes HW Check/Questions	Mrs. Petrin or I will ask for the students to put up their Bellwork and get out their homework from the previous night. Then we will project/talk about the answers and go over any problems the students need (provided there is sufficient time).	Students will get out their homework and begin checking their answers either from the projected answers on the smartboard, or from the answers we provide them. They will ask about any questions they need answered.	This is gives the students a chance to ask questions about homework problems/concepts that confused them. It is also a chance for them to learn that asking questions to not only ok, but encouraged, and something we, as teachers, want.

Lesson Plan

15 minutes Lesson # 3 Exponential Growth and Decay	Mrs. Petrin and I will ask the students to put away their homework, get out their AgileMind textbook, and turn to page 63. Mrs. Petrin or I will then lead the students through the lesson using the textbook and AgileMind software.	Opening their AgileMind textbook to page 63. Students will take notes in their AgileMind textbook and actively participate in the lesson.	One of the great advantages of AgileMind is its focus on active engagement from the students. The lesson is structure in such a way that students make conjectures about different mathematical computation, and then as a class we solve to see if we had a true or false conjecture. This helps ensure that students are more actively engaged in a lesson that relies on Direct Instruction.
5 minutes Linear or Exponential?	After handing out an envelope to each group of students, we will be wandering around the classroom answering questions and/or checking work as we are asked.	Categorizing different functions, tables of values, graphs, and story problems as either linear or exponential.	This is an informal assessment I will use to check how well students are meeting the unit objectives. Are they able to discern whether a graph, table of values, story problem or function is linear or exponential?
10 minutes Work/Study Time/Exit Slip	We will wrap up the lesson in order to give the students a chance to work/ask questions about tonight's homework.	After finishing the lesson the students have work time to ask questions related to tonight's homework.	This is another opportunity to ask questions if they are having trouble with the topic. It also is a teaching moment to tell students it is alright if you have a question.

This activity allowed for more social learning, and better differentiation.

Transition to Wrap up/Closing: How will you engage students in self-assessment and/or reflection on key concepts?

Daily Assessment *How do you know your students met your lesson objective(s)?*

- ☒ knowledge
- ☒ comprehension
- ☒ application
- ☐ analysis
- ☐ synthesis
- ☐ evaluation

Formative:

- ☒ Class discussion
- ☐ CPS clickers
- ☐ Email teacher
- ☒ Entrance/Exit slip
- ☒ Teacher Observe
- ☐ Thumbs up, neutral, or down
- ☒ Homework check
- ☐ Listened to conversations
- ☐ Math Journal
- ☐ Quiz
- ☐ Video quiz
- ☐ Voting
- ☐ Whiteboard Check
- ☐ Other

Summative:

- ☐ Test
- ☐ Project
- ☐ Report
- ☐ Presentation
- ☐ Final Exam
- ☐ Other

Additional Teacher Preparation:

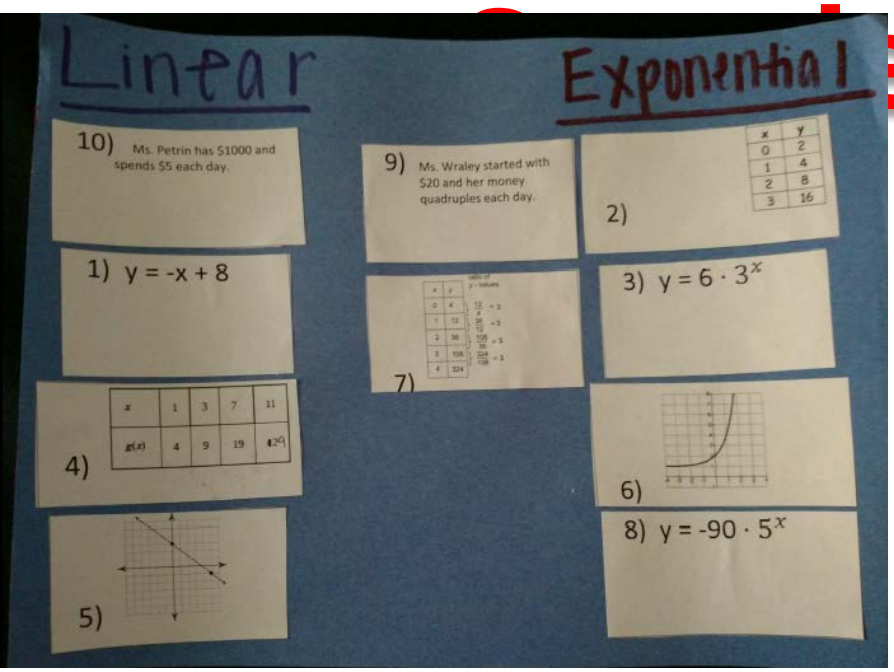
Materials: HW #3

Technology: Smartboard, AgileMind

Copy:

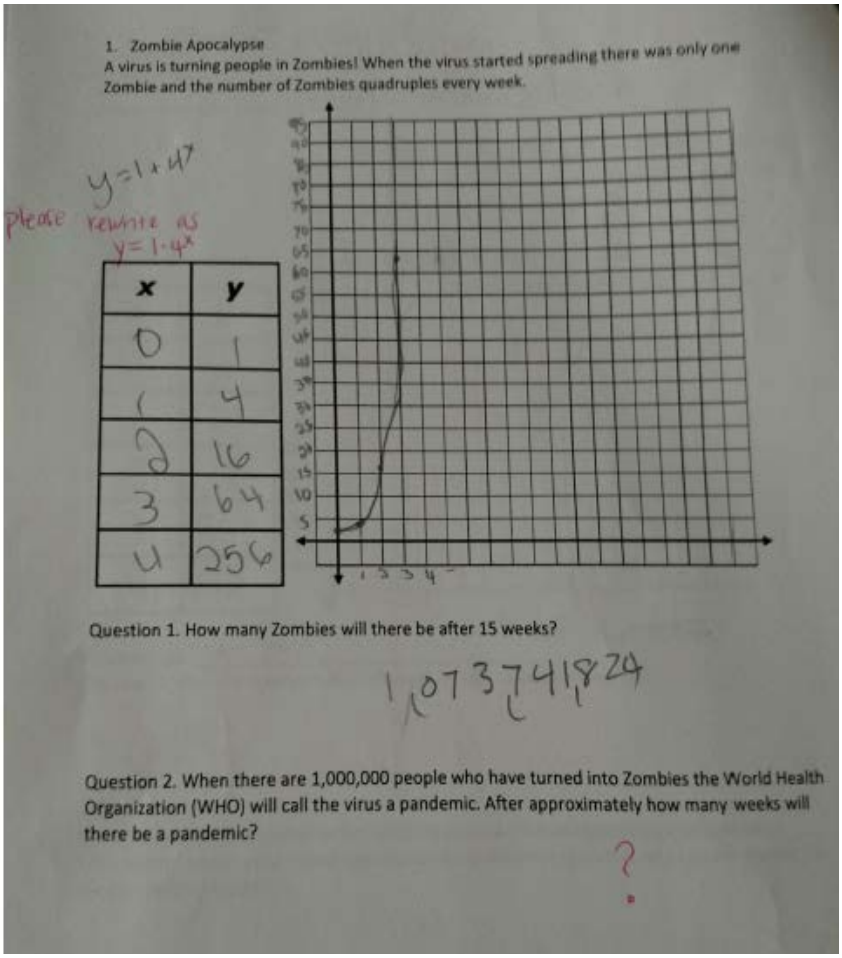
Locate:

Student Work



Student work for Linear or Exponential.

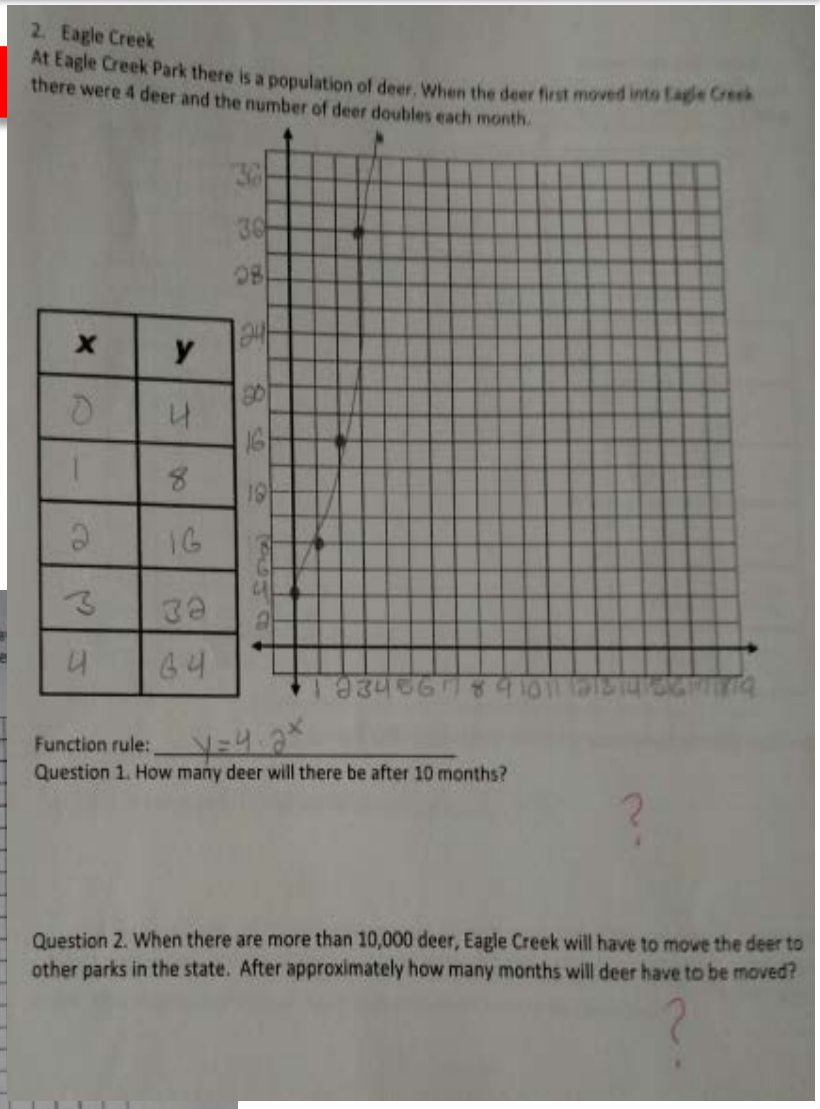
Student work for the Modeling Exponential Growth activity.

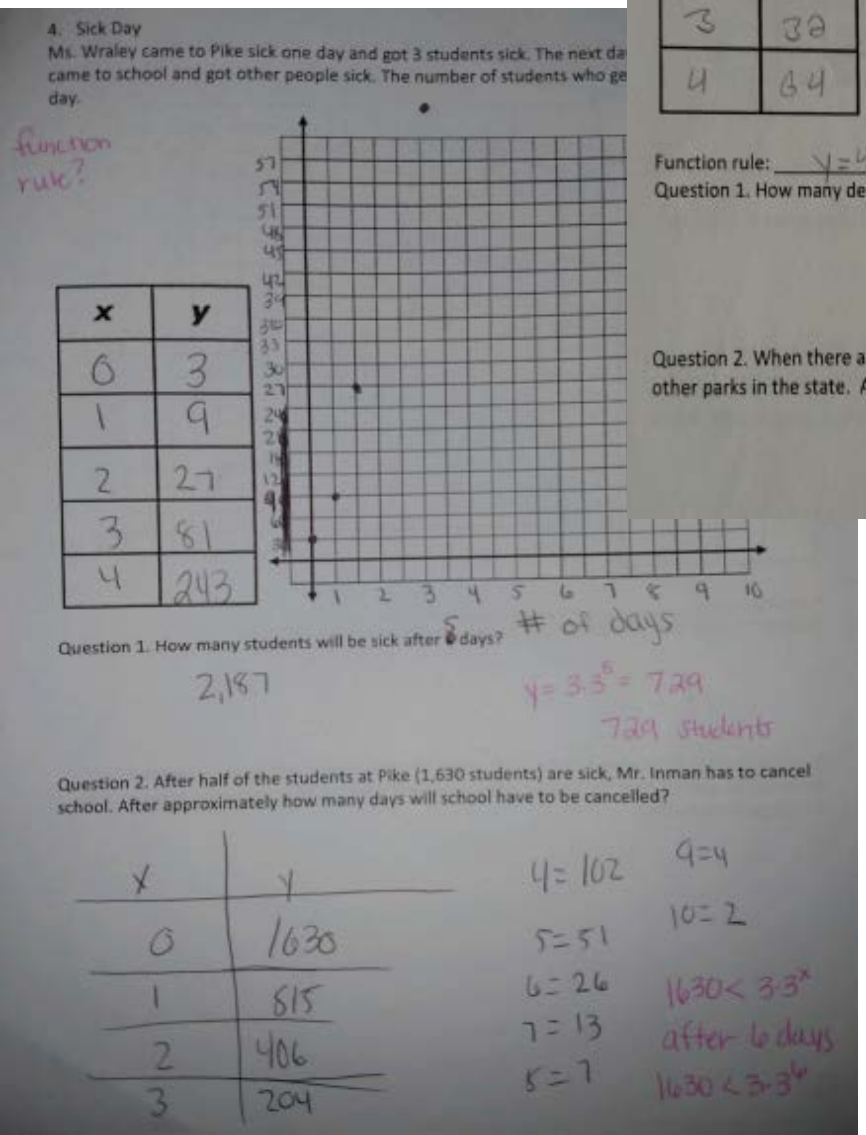


Student Work

Sa

Student work for the Modeling Exponential Growth activity.





Analysis and Reflection

Analysis:

The students gained in not only factual knowledge about exponential functions, but the ability to create an exponential function to model a story problem. Though they gained the knowledge to create the functions, they still struggled to use the function to solve real-life problems associated with the function. They were able to create the function, but not use it to solve problems.

Reflection:

Throughout the lesson I learned that I need to include even more opportunities for the students to manipulate complex mathematical concepts. The students benefited immensely from activities like Linear or Exponential? and Modeling Exponential Growth where they got to work with the material in an authentic manner. When teaching the unit again, I want to include more such learning opportunities in the unit. I will also focus on more instruction time on using exponential functions to solve real-life problems.