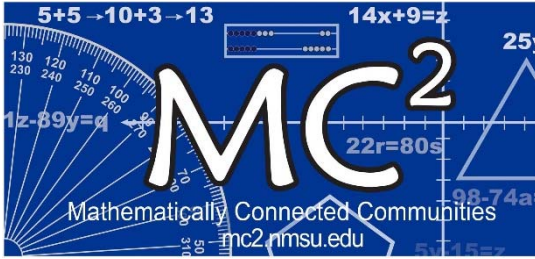


Welcome!

This webinar was pre-recorded on Monday, April 4, 2016. There were no FAQs generated during the live presentation.

Please submit any questions or comments to mc2@nmsu.edu.



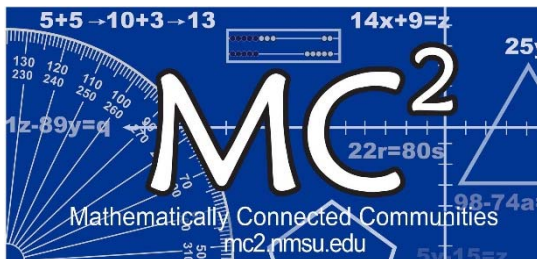
Exponential Functions

Narrators: Colin Nicholls, UNM Taos

Kathe Kanim, MC²

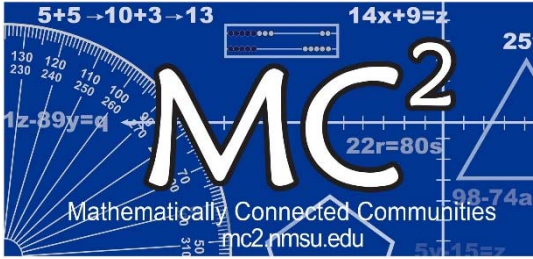
Developers: MC² Team





Webinar Agenda

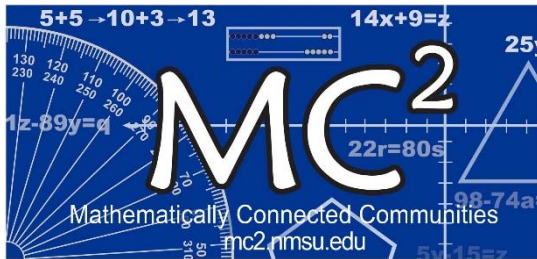
- Exponential Functions (45 minutes)
- Q & A (15 minutes)



Mathematically Connected Communities

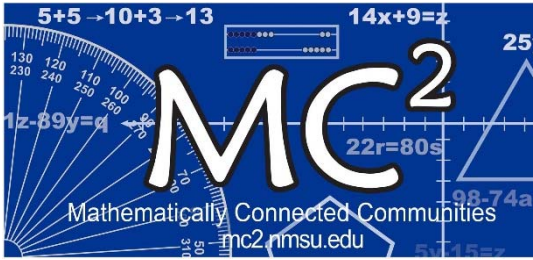
- Math Science Partnership (MSP), National Science Foundation (NSF), research project for implementing CCSS-M
- New Mexico Math Science Bureau
- Partner with teachers to improve teaching and learning mathematics for students
- **MathLab™**





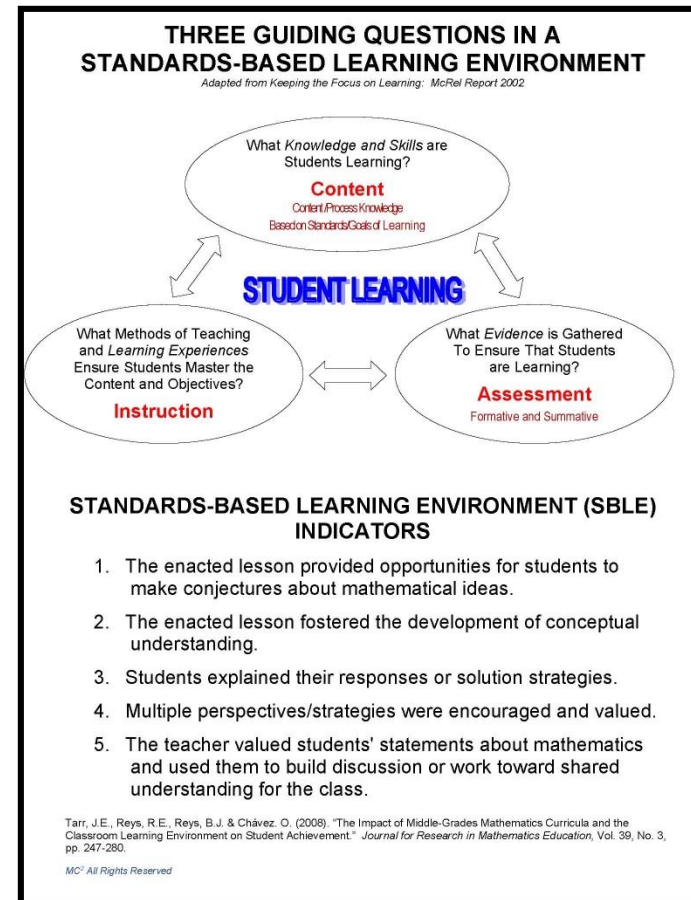
MC² Believes

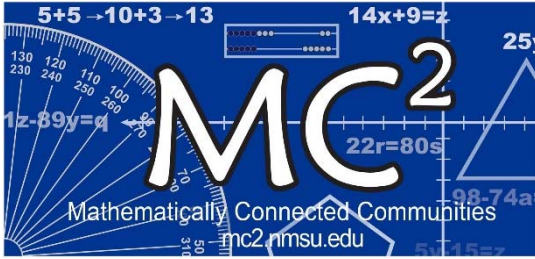
- Students learn by making sense of mathematics
- To do this, teachers must develop a Standards-Based Learning Environment (SBLE)



Standards-Based Learning Environment (SBLE)

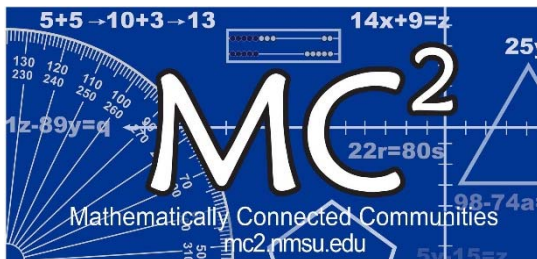
- Teachers determine:
 - Content
 - Instruction
 - Assessment
- Five SBLE indicators





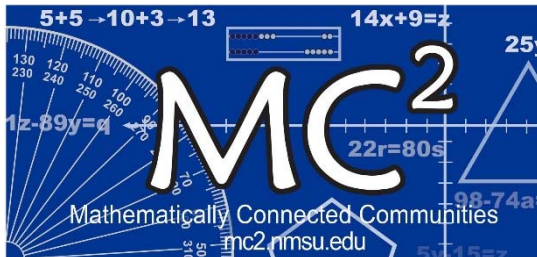
Standards-Based Learning Environment (SBLE)

1. The enacted lesson provided opportunities for students to make conjectures about mathematical ideas.
2. The enacted lesson fostered the development of conceptual understanding.
3. Students explained their responses or solution strategies.
4. Multiple perspectives/strategies were encouraged and valued.
5. The teacher valued students' statements about mathematics and used them to build discussion or work toward shared understanding for the class.



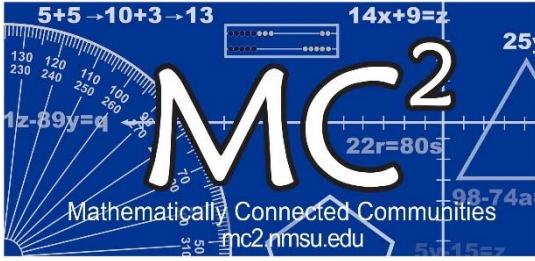
Summary of Things We Frequently Hear

- I agree with all of these.
- I don't have time to develop conceptual understanding. There is too much in the curriculum.
- In my class are many ways for students to explain their reasoning.
- Students regularly show their work at the board.
- Students always have to justify their reasoning on their assignments.
- Students frequently ask questions.
- We use algebra tiles to build conceptual understanding.



MC² Believes

- Students learn by making sense of mathematics
- To do this, teachers must develop a Standards-Based Learning Environment (SBLE)
- Launch, Explore, Summary (LES) Lessons are highly effective

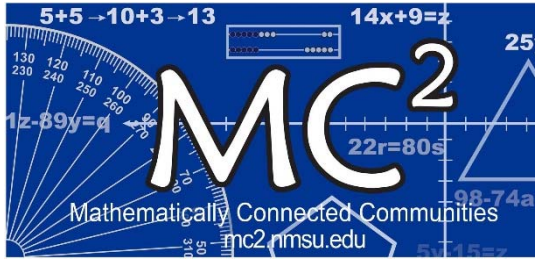


Linear vs. Exponential Functions

What do you know about linear and exponential functions?

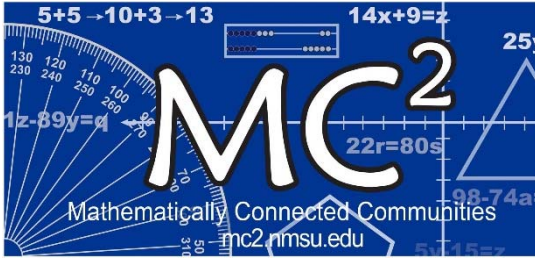
*Metacognition
(High-Yield
Strategy)*

➤ *Launch*



Lesson Outline

- Start lesson with Skittles simulation
- Follow with comparing linear model for growth with doubling and tripling
- Finish with plotting actual Ebola data and watch students present their models



How Does Disease Spread?

Imagine a middle school where there are:

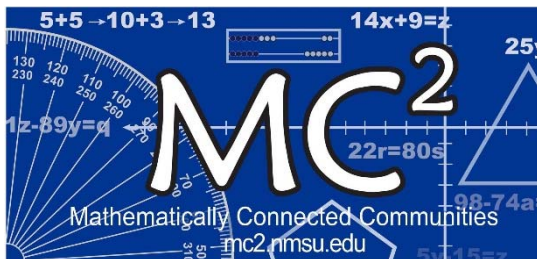
- About 500 students
- Two come to school sick
- In a few days lots and lots of students are sick

<http://www.npr.org/sections/goatsandsoda/2014/09/18/349341606/why-the-math-of-the-ebola-epidemic-is-so-scary>

Fosters development of conceptual understanding

➤ *Launch*





Exploration via Simulation

Skittles Activity Directions

Video Link:

<https://youtu.be/R0KpNJwYpLE>



How Does an Infection Spread?

One day a couple students came to school, coughing and feverish; they had the flu. Then, within a week or so, it seemed like everyone at the school was getting sick.

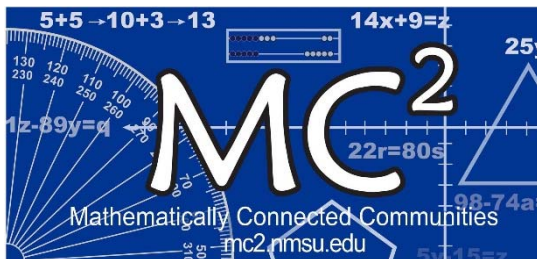
Experiment:

1. Setup:
 - Place 500 Skittles in the pizza box, with only 2 of the Skittles being RED, and the remaining 498 being other colors.
 - Make a table:

Shake Number	Number of RED Skittles	Number of "other color" Skittles
0	2	498
1		
2		
3		
...		

2. Procedure:
 - Shake the pizza box with the 500 Skittles.
 - Count the number of RED Skittles that have an S showing.
 - Remove as many "other color" Skittles as the number of RED Skittles with an S showing.
 - Replace them with RED Skittles.
 - Count the new totals for RED Skittles and "other color" Skittles and record in the table (Hints: you never take RED Skittles out and you should always have 500 Skittles).
 - Repeat the experiment ten more times.
3. Prediction:
 - Use a different **color pencil** and make a **prediction** for the next line in your table.
 - Perform one more shake, and also record the actual data. Compare this number with your prediction. Was your prediction accurate? Why or why not?





Look at Data

Make a prediction of the number of red Skittles there will be after the 11th shake.

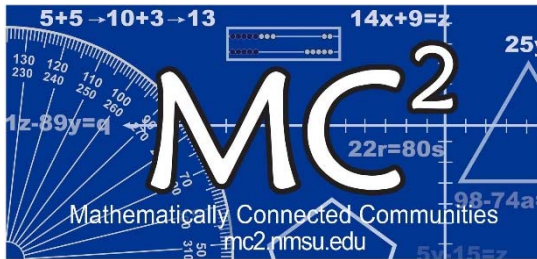
Data

Shake Number	Number of Red Skittles	Number of other colored Skittles
0	2	498
1	4	496
2	5	495
3	8	492
4	10	490
5	16	484
6	23	477
7	34	466
8	48	452
9	69	431
10	99	401

Making predictions helps us assess our current understanding

Metacognition

Marzano's high yield strategies



Use Student Work

Use student work to move learning forward:

- “We chose our number (ending in the digit 3) because that number seemed to keep coming up.”
- “I don’t know why I chose 40 (the actual was 39).”
- “We think the total red Skittles will be a little less than 142 (153ish). This is because 71 doubled is 142. However, we know not all the red Skittles will be showing an “s”.”
- “I got this by getting about half and adding a little bit for my estimate.”

Shake #	Number of Red Skittles	# of others" colors" Skittles
0	272	493
1	471	496
2	571	495
3	875	492
4	1076	490
5	1677	484
6	2377	477
7	34714	466
8	487	452
9	69750	431
10	99	401
11	143	357

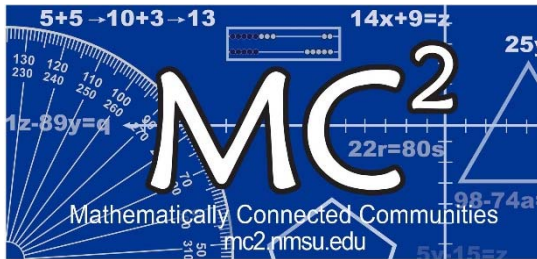
3 Prediction

My Prediction is 144 because if you look at all the numbers the number increases by each shake.

- ① Number of Red Skittles
- ② # of "other color" Skittles
- ③ The red Skittles were the ones that affect people
- ④ The other Skittles would represent the people who were ill.
- ⑤ They are Skittles that are affected and are affecting others.
- ⑥ They were not sick normal.

Multiple strategies were encouraged and valued.

➤ Summary



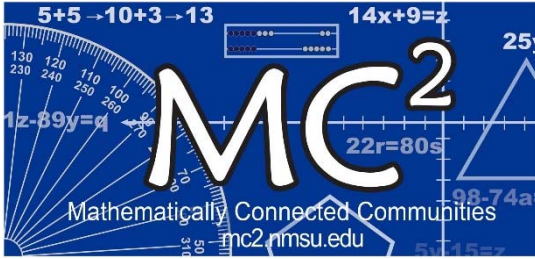
Analyzing The Data

In the context of the spread of infection among the students at the school:

- What do the 2 initial RED Skittles represent?
- What do the 498 other-colored Skittles represent?
- After any shake, what do the RED Skittles represent?
- After any shake, what do the other-colored Skittles represent?
- After any shake, what do the RED Skittles with an **S** represent?
- After any shake, what do the other-colored Skittles with an **S** represent?

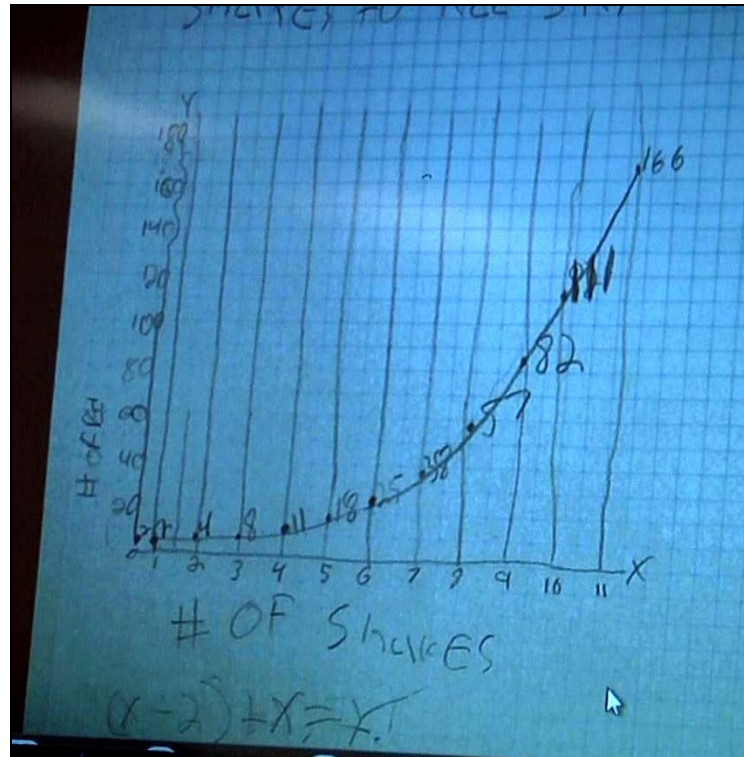


CCSSM – MP #2
*Contextualize/
Decontextualize*



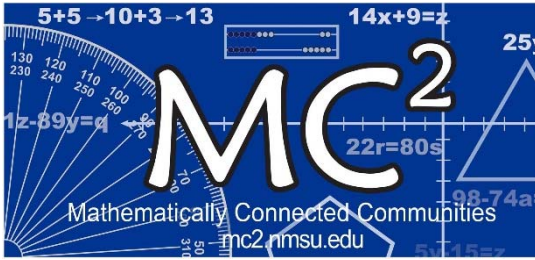
Model the Relationship

Graph the data and write an equation to model the relationship.



Valued students' statements...used them to build discussion

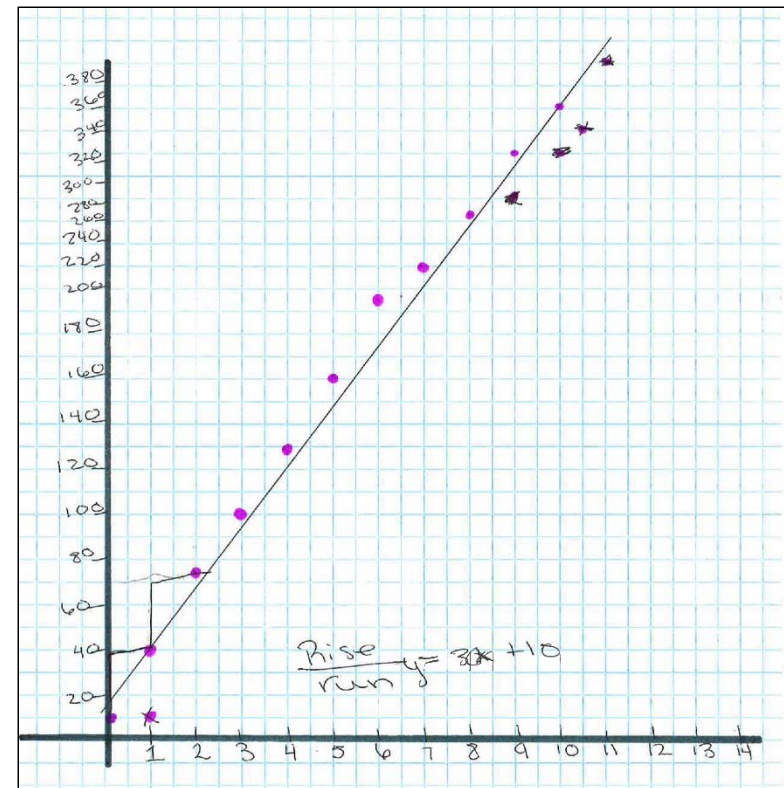
➤ *Explore & Summary*



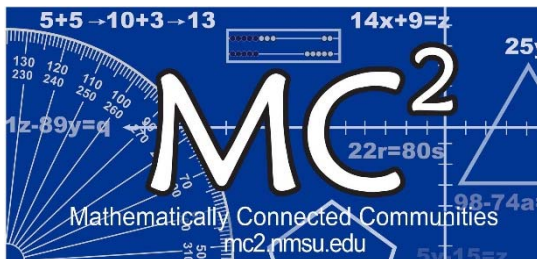
Doubling/Tripling

Explore linear vs. exponential models:

- Suppose there are initially 10 cases of Ebola and the number of cases increases by 30 each month
- Suppose there are initially 10 cases of Ebola and each month the number of cases doubles/triples



➤ **Launch**

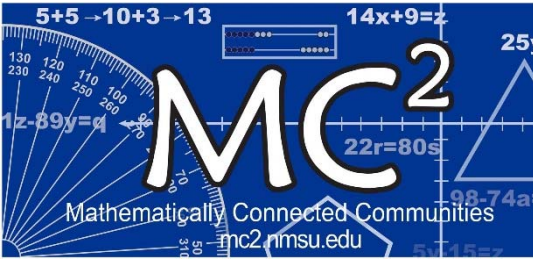


On your own

- We will pause for a few minutes to allow you to graph the data and write equations for this situation (choose either handout #6 or #7)
- When you're finished, which CCSSM Math Practice(s) did you engage in?

CCSSM MP#
(which ones did you use?)

➤ *Explore*



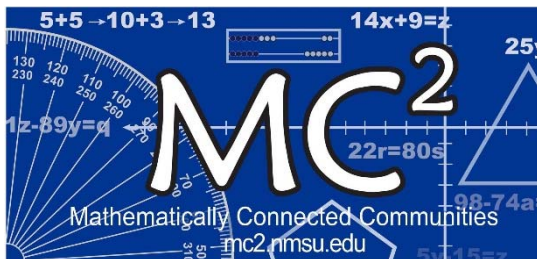
On Your Own

Gallery Walk

Video Link: <https://youtu.be/grKROkzbgrA>

Students explained their responses or solution strategies

➤ *Summary*

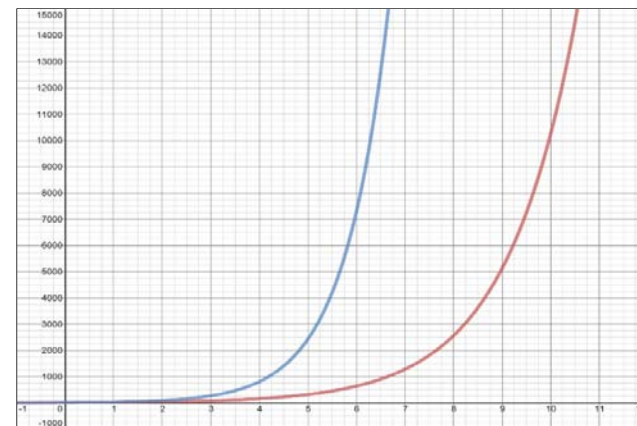


Actual Data

Actual Ebola Data Table taken from Time Magazine

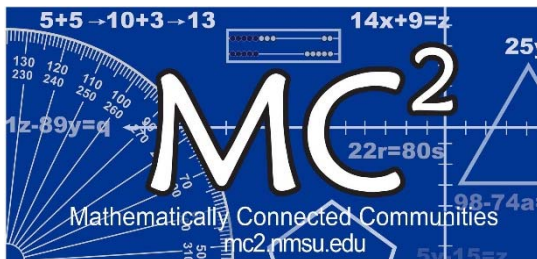
1. *Time* magazine (10 November 2014) gives the following data for the Number of Ebola cases and the number of deaths from Ebola.

Month (2014)	Number of Ebola cases	Number of Ebola deaths
January	10	10
February	39	34
March	130	82
April	238	158
May	420	224
June	759	467
July	1440	826
August	3417	1818
September	7492	3439
October	13703	4922



Conjectures

➤ Launch



Student Share-Out

Two groups share-out their model for actual data.

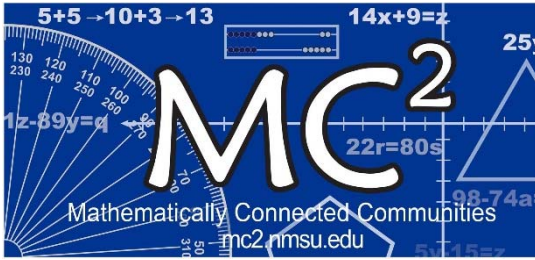
Time magazine (10 November 2014) gives the following data for the Number of Ebola cases

Month (2014)	(difference) Number of Ebola cases
January	29 < 10 > 3.9
February	91 < 39 > 3.33
March	168 < 130 > 1.830
April	182 < 238 > 1.764
May	539 < 420 > 1.807
June	681 < 759 > 1.897
July	1977 < 1440 > 2.372
August	4075 < 3417 > 2.192
September	6211 < 7492 > 1.829
October	13703

average = 2.4

Video Link: <https://youtu.be/xakQOn3GU-8>

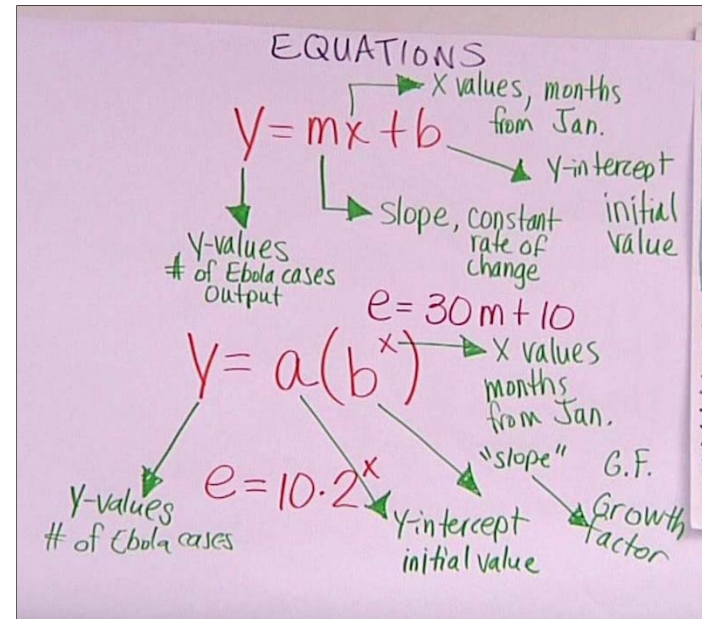
➤ Summary

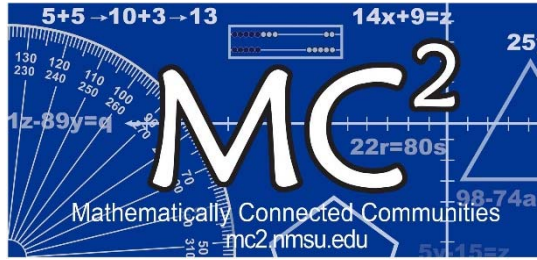


Expansion of Earlier Thinking

- Add to your earlier thoughts on exponential functions
- What are the similarities and differences between linear and exponential functions when expressed
 - as Tables
 - as Graphs
 - as Equations

Metacognition



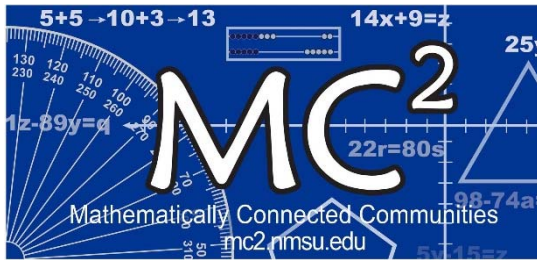


Reflecting on the SBLE Indicators

How did both the **SBLE indicators** and the **Launch Explore Summary** structure contribute to your learning?

1. The enacted lesson provided opportunities for students to make conjectures about mathematical ideas.
2. The enacted lesson fostered the development of conceptual understanding.
3. Students explained their responses or solution strategies.
4. Multiple perspectives/strategies were encouraged and valued.
5. The teacher valued students' statements about mathematics and used them to build discussion or work toward shared understanding for the class.





Reflecting on the Common Core Standards

Here are a few that we think came out in the webinar:

- **F-LE 1.a**

Prove that linear functions grow by equal differences over equal intervals, and that exponential functions grow by equal factors over equal intervals.

- **F-LE 2.**

Construct linear and exponential functions ...given a graph, a description of a relationship, or two input-output pairs (include reading these from a table).

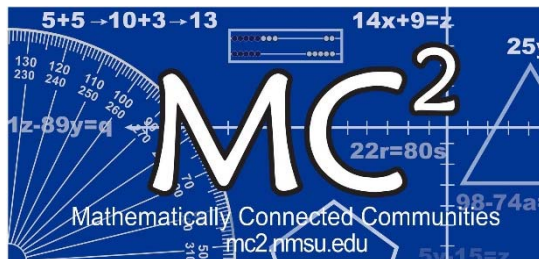
- **F-LE 5.**

Interpret the parameters in a linear or exponential function in terms of a context.

- **S-ID 6.a**

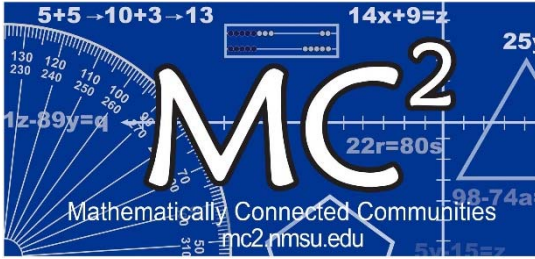
Fit a function to the data; use functions fitted to data to solve problems in the context of the data. *Use given functions or choose a function suggested by the context. Emphasize linear, quadratic, and exponential models.*





Funding Sources

- Math Science Partnership (MSP), National Science Foundation (NSF), research project for implementing CCSS-M
- NM Math and Science Bureau



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MC² Website www.mc2.nmsu.edu



YouTube Channel

<https://www.youtube.com/channel/UC0mTSTKPJhozuJ3lxdqvMdw>

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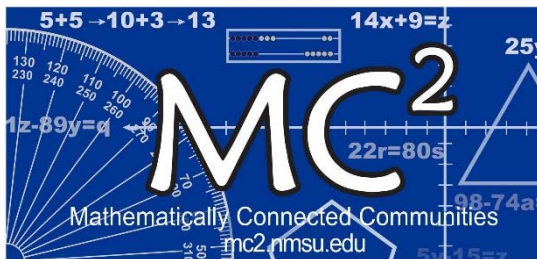
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Thank you!

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Please submit any questions or comments to mc2@nmsu.edu.

Thank you for your input!

MC² is always striving to improve the learning experience.