Tonight's Agenda

- Welcome & Introductions
- Introduction to Catalyzing Change
- Activities:
  - Addressing a common algebraic problem
  - Connecting linear and exponential
  - Investigating mathematical patterns
- Addressing the recommendations in Catalyzing Change
- Free online resources

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Expected Outcomes:

- Become familiar with the NCTM document Catalyzing Change
- Explore activities highlighting the essential concepts in Catalyzing Change
- Consider how dynamic interactive technology can support the development of those concepts
- Stay in touch with social media and upcoming events
- At the end of the webinar, we will be giving away a free registration to the T^3 International Conference in Dallas March 2020.

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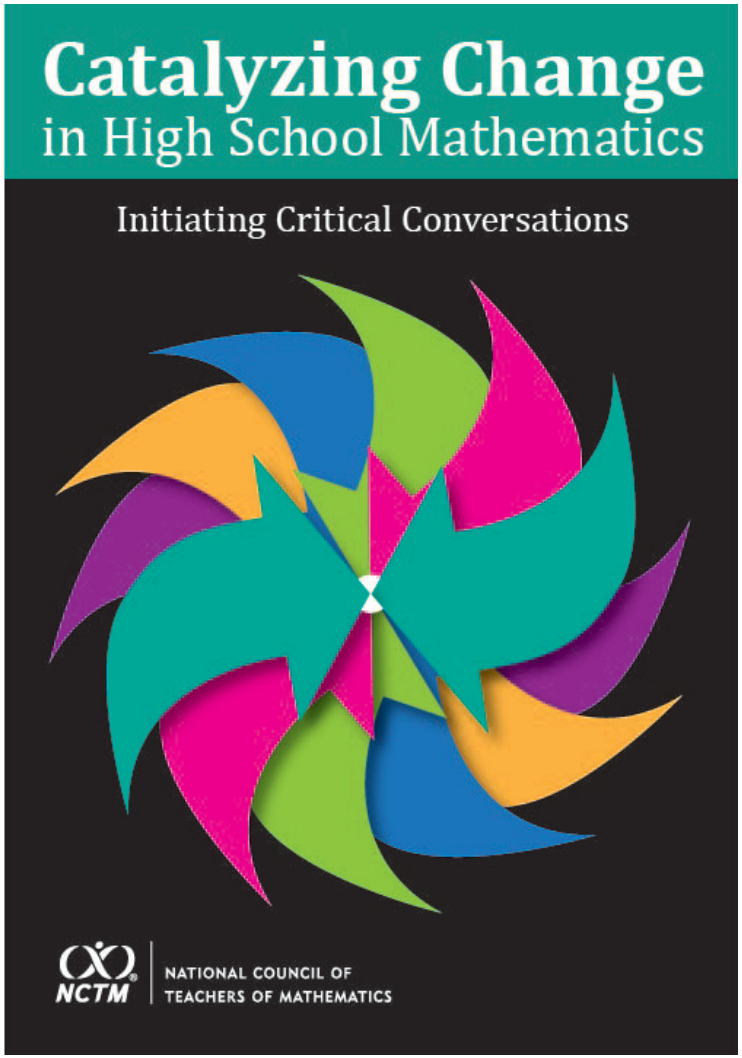

- **Broaden the purposes** for teaching high school mathematics.
- **Equitable structures for learning mathematics**
- **Equitable instruction**
- **Identify Essential Concepts** all students should learn
- **A common Essential Concepts Pathway** for the first 2 1/2 years

National Council of Teachers of Mathematics, 2018

Key Recommendation

Each and every student should learn the Essential Concepts in order to

- expand professional opportunities,
- understand and critique the world, and
- experience the joy, wonder, and beauty of mathematics.

NCTM. (2018). *Catalyzing change in high school mathematics: Initiating critical conversations.* Reston, VA: NCTM.

Essential Concepts

- "… outline a **common shared pathway**- a progression of courses **that all students take**- as part of high school mathematics education."
- "… experience the **foundational mathematics** that [all students] will need for whatever future path they pursue."
- **Domains**: Number, Algebra & Functions, Geometry & Measurement, Statistics & Probability

National Council of Teachers of Mathematics, 2018

Catalyzing Change by a Shift in the Role of Technology

- From learning to perform algebraic **manipulations "by hand"** to learning to recognize which techniques produce a desired outcome, to **interpret** the outcome mathematically, and to **use** the outcome to move forward in analyzing a situation or solving a problem …
- From learning many **individual procedures** for algebraic manipulations to considering multiple **equivalent forms** of expressions and equations, **interpreting** the results of manipulations, and **making strategic choices** about which forms of an expression or equation to use
  - pp.46-47 Focus 1: Algebra

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Does $(a+b)^n = (a)^n + (b)^n$ have a solution for any rational n?

- This is a skill that students struggle to understand - from grade 9 to calculus: from $(x+3)^2 = x^2 + 9$

  to $(g-27)^{2/3} = g^{2/3} - 9$

- The role of technology

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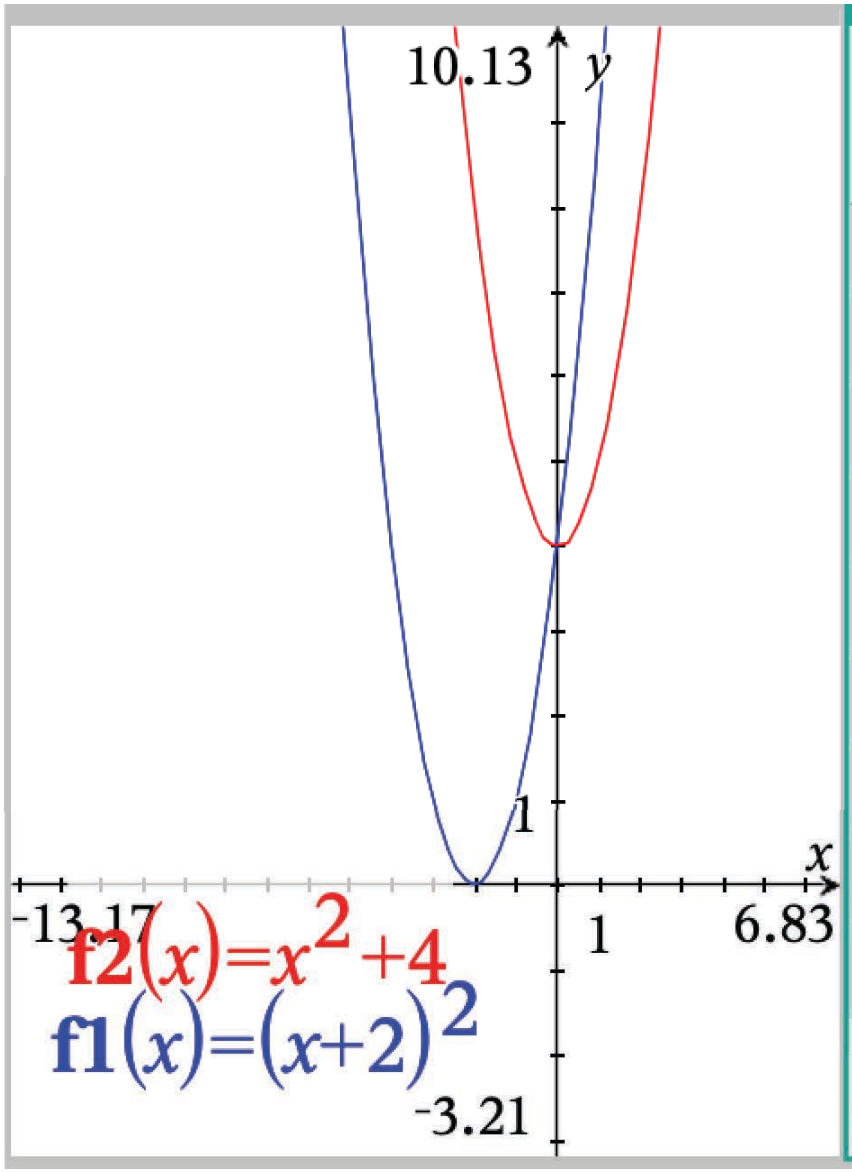
What do you notice in the graph? In the table?

What do you wonder?



x	f1(x):= (x+2)^2	f2(x):= x^2+4
-4	4	20
-3	1	13
-2	0	8
-1	1	5
0	4	4
1	9	5
2	16	8
3	25	13
4	36	20

$f1(x):=(x+2)^2$

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What content in Algebra 1 is important to you?

- Type your responses in the text chat

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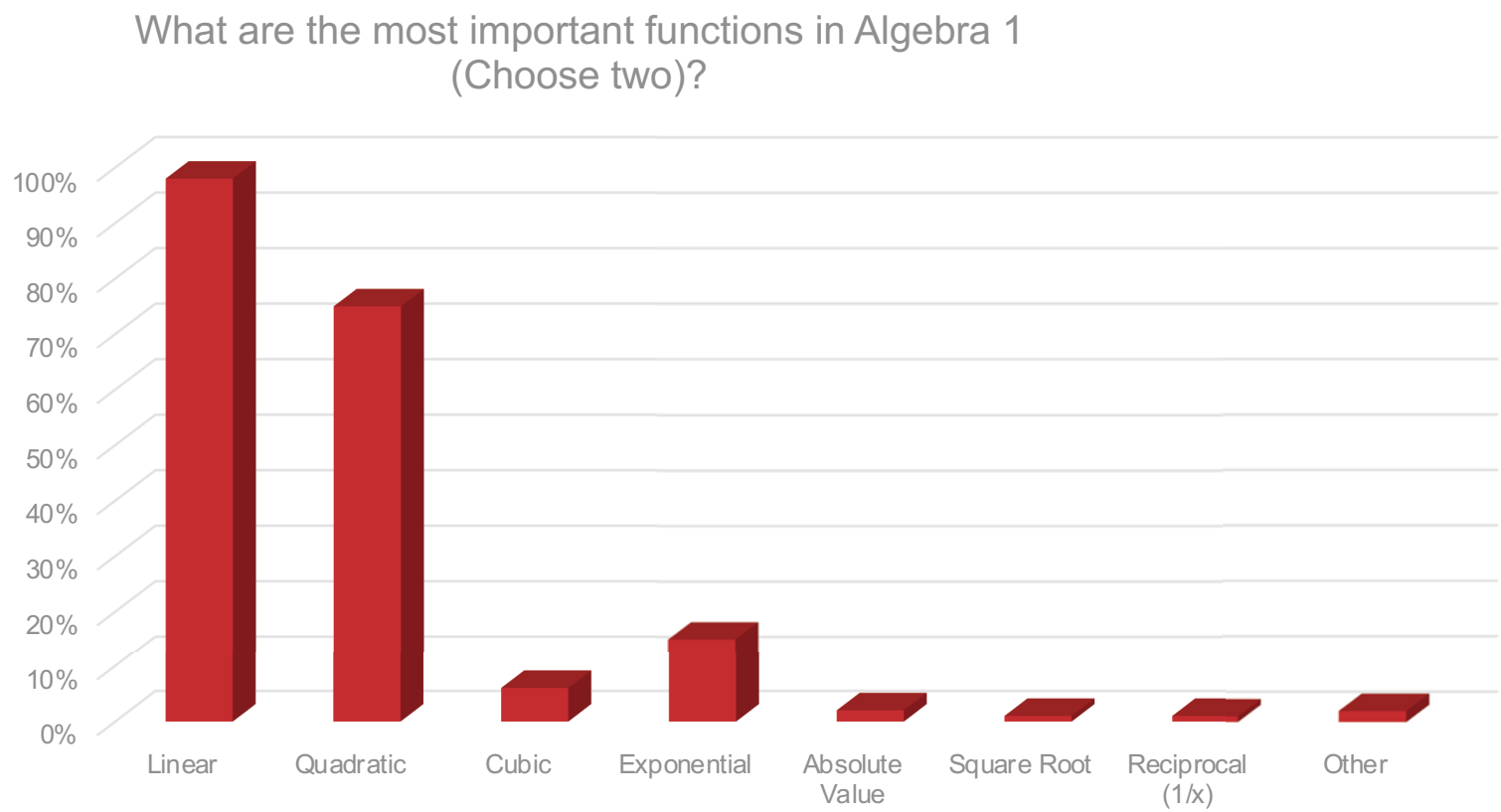
Why so much on Quadratics in Algebra 1?

- Have we considered other forms?
- How can technology help with exponentials?

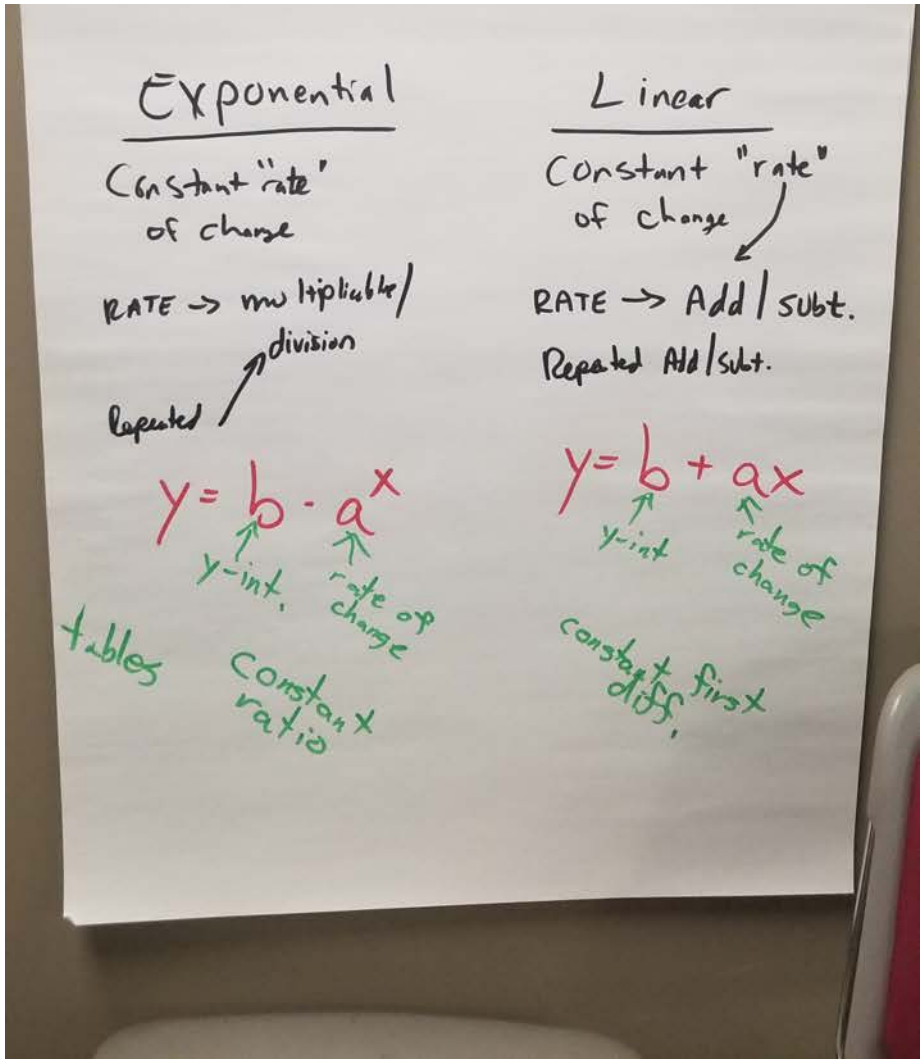


N=234. Source: Online survey in current research project, unpublished

Linear to Exponential

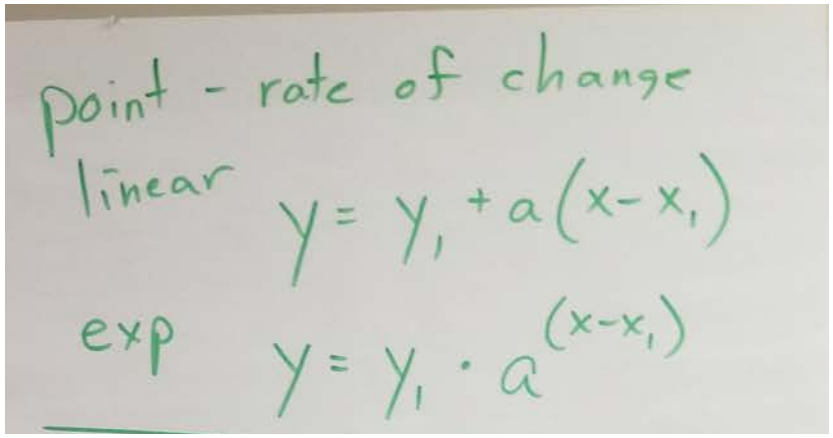
- Where/How does Catalyzing Change impact Algebra 1 (or Math 1)?

- Building from 8th grade, can lead to exponentials



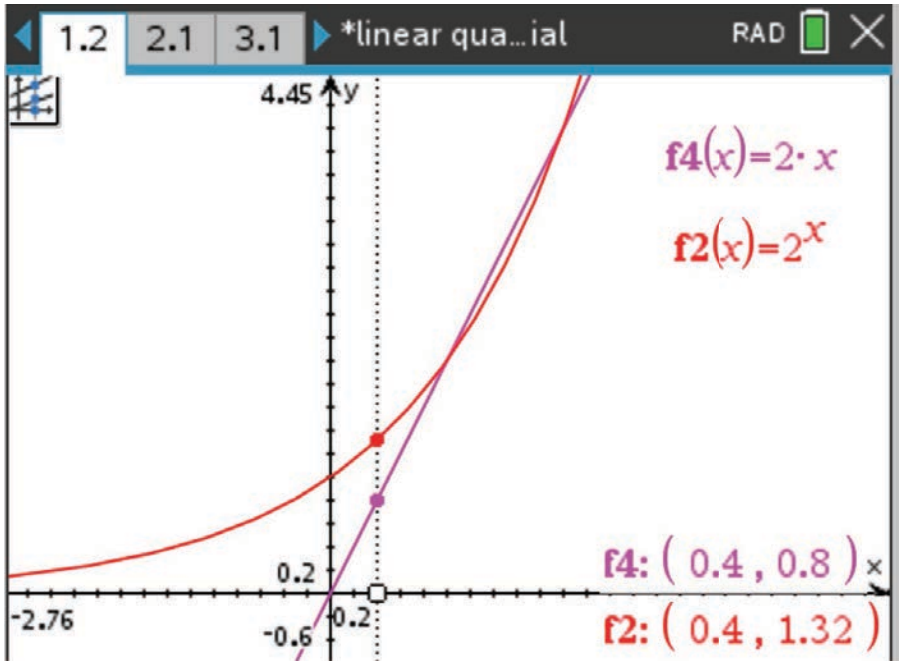
Linear to Exponential

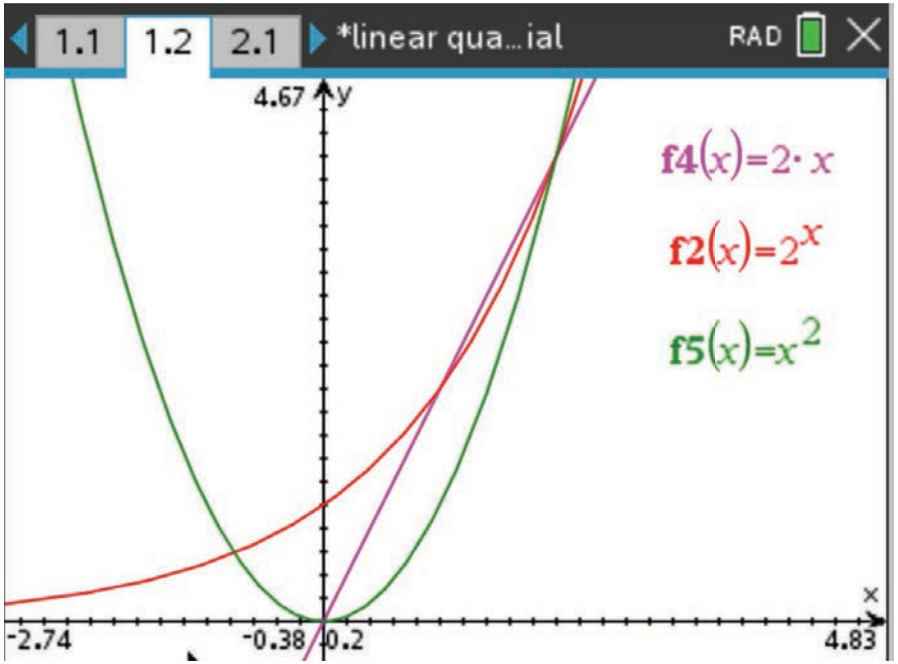
- "Algebra and functions constitute the language of generalization, useful for describing general patterns of relationships by means of a formula and answering all questions of a particular type at once rather than solving many questions individually" (Usiskin, 1995 via NCTM, 2018, p.45)
- Purposefully, using the "point-rate" phrase provides a focus on "rate of change" ideas within both functions.
- Connections
  - Algebra to functions

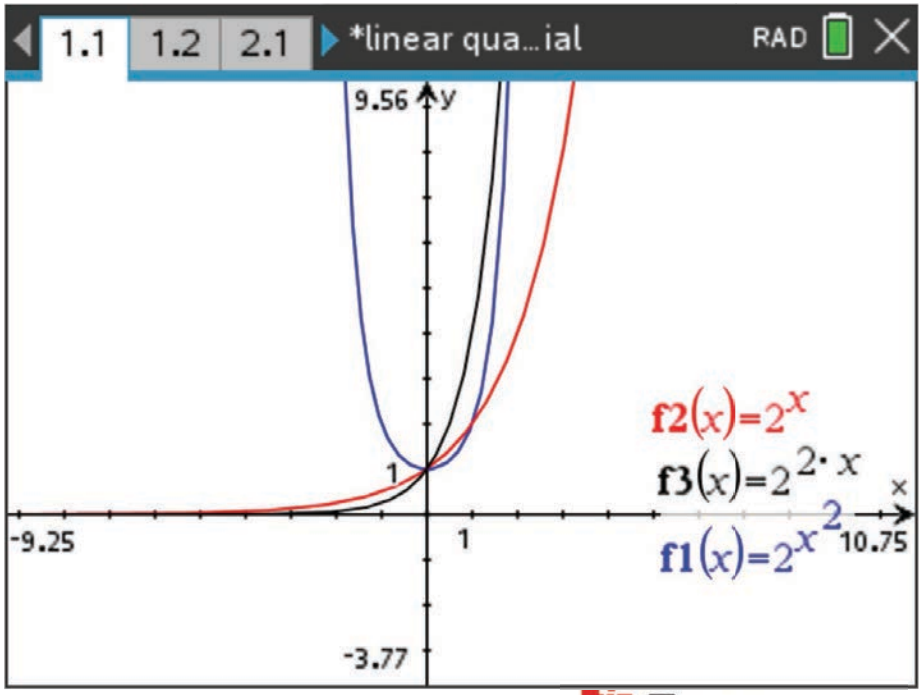


Nspire Lessons

» Leveraging the technology for compare/contrast quality tasks







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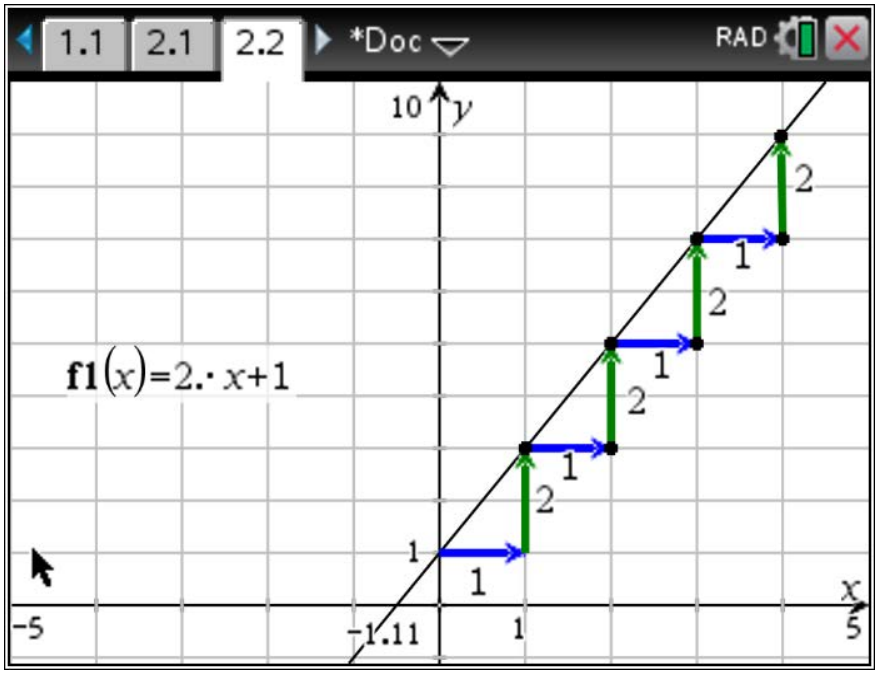
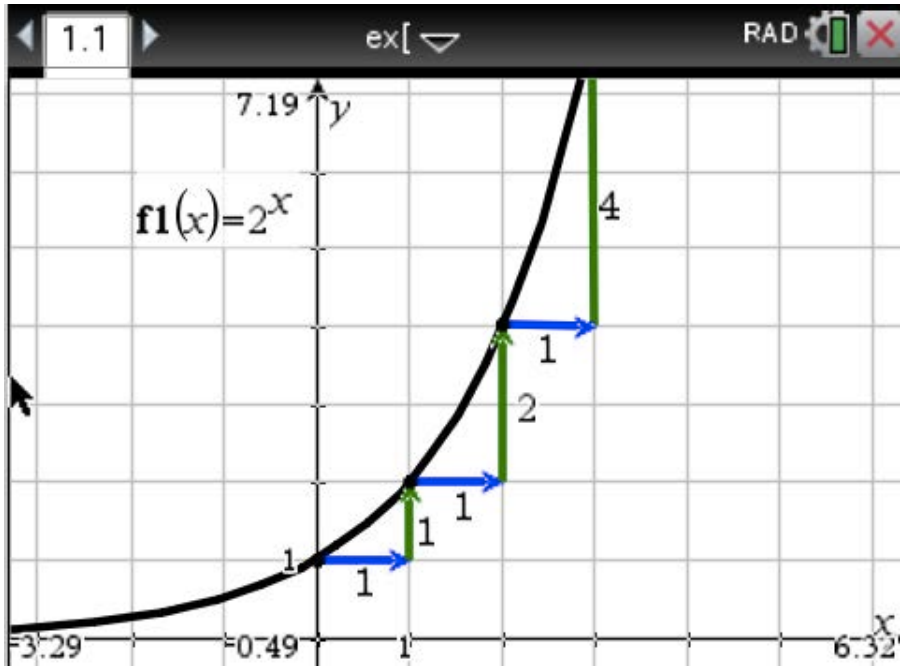
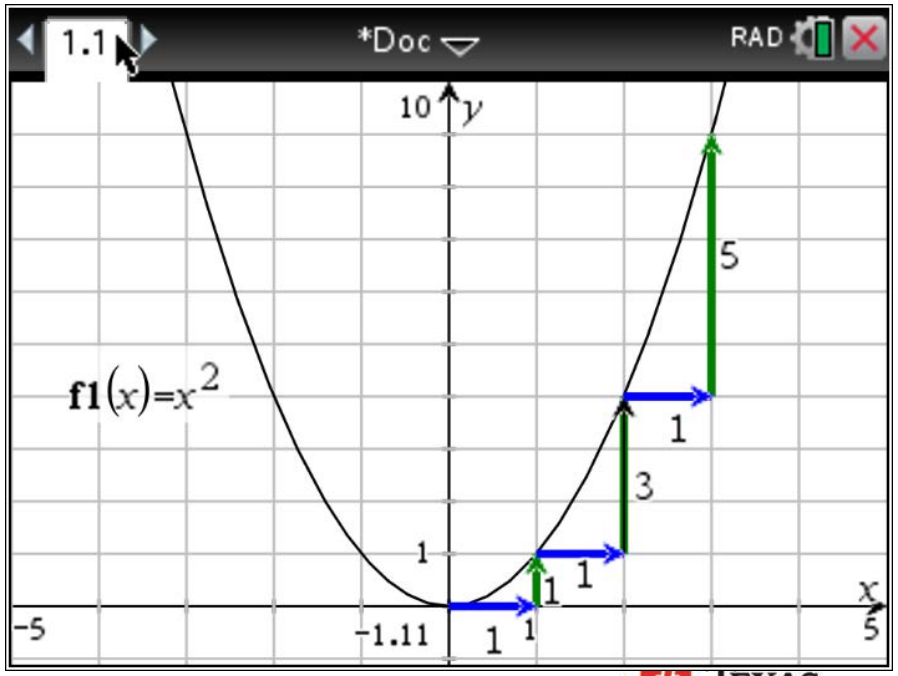


Structure: linear, quadratic and exponential rate of change





Notice and Wonder

- Choose two whole numbers a and b (not too large)

Compute

$a^2 + b^2 =$

$a^2 - b^2 =$

$2ab =$

Type your *a*, *b*, and *c* in the text chat

What do you observe?

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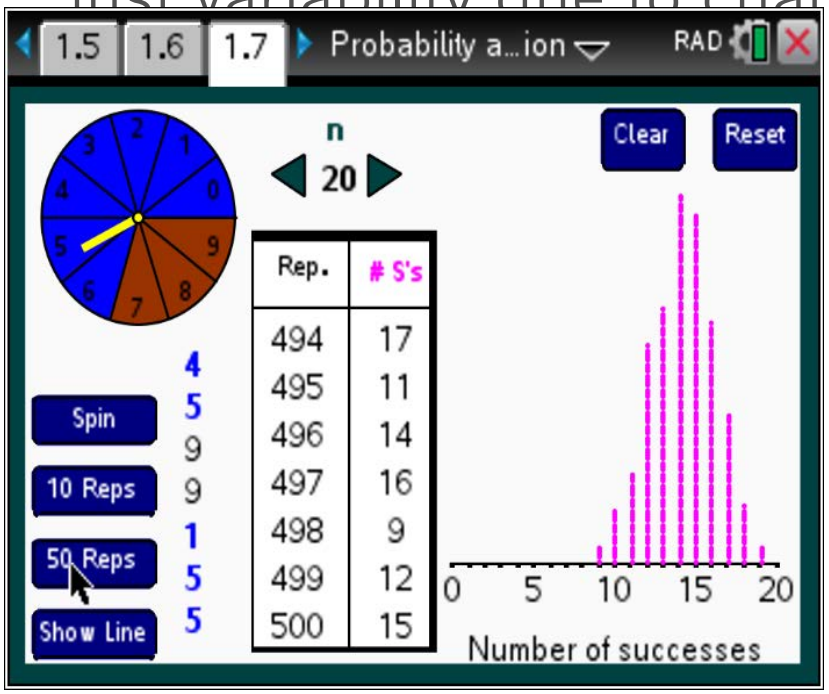
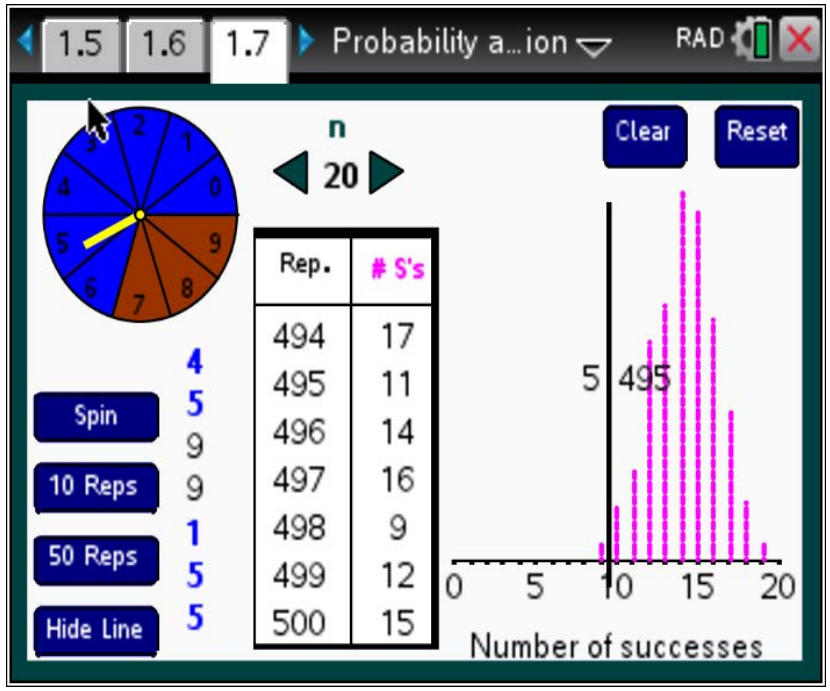
- Stephen Curry typically makes about 60% of his field goal attempts. In 2017 he went into a slump and was making only about 9 shots in every 20 attempts. Was he really in a slump?
- Outcomes vary by chance as well as for other reasons. Is making only 9 shots in 20 attempts **surprising** – or is it just variability due to chance?





Building Concepts: Statistics and Probability, Probability and Simulation

Gottfried Wilhelm Liebniz

"It is unworthy of excellent men to lose hours like slaves in the labour of calculation which could safely be relegated to anyone else if machines were used."

(Describing, in 1685, the value to astronomers of the hand-cranked calculating machine he had invented in 1673.)

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Some Promising Programs to Learn from…

- NCTM's Catalyzing Change Webpage
  - https://www.nctm.org/catalyzing/
  - Four case studies
    - Colorado Use of Essential Concepts
    - Escondido Union High School District (CA)
    - Louisiana's Intensive Algebra 1 Pilot
    - San Francisco Unified School District

What are States Doing?

- Catalyzing Change, 2018 release
- Oregon
  - Essential Concepts
  - 2+1 pathway model
- Alabama
  - Essential Concepts
  - All 9th graders take geometry

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Connect with Gail & Jeremy

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» http://sema.ua.edu

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References

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- *Catalyzing Change in High School Mathematics: Initiating Critical Conversations.* (2018). Reston, VA: NCTM.
- NAEP Data Explorer. https://www.nationsreportcard.gov/ndecore/landing

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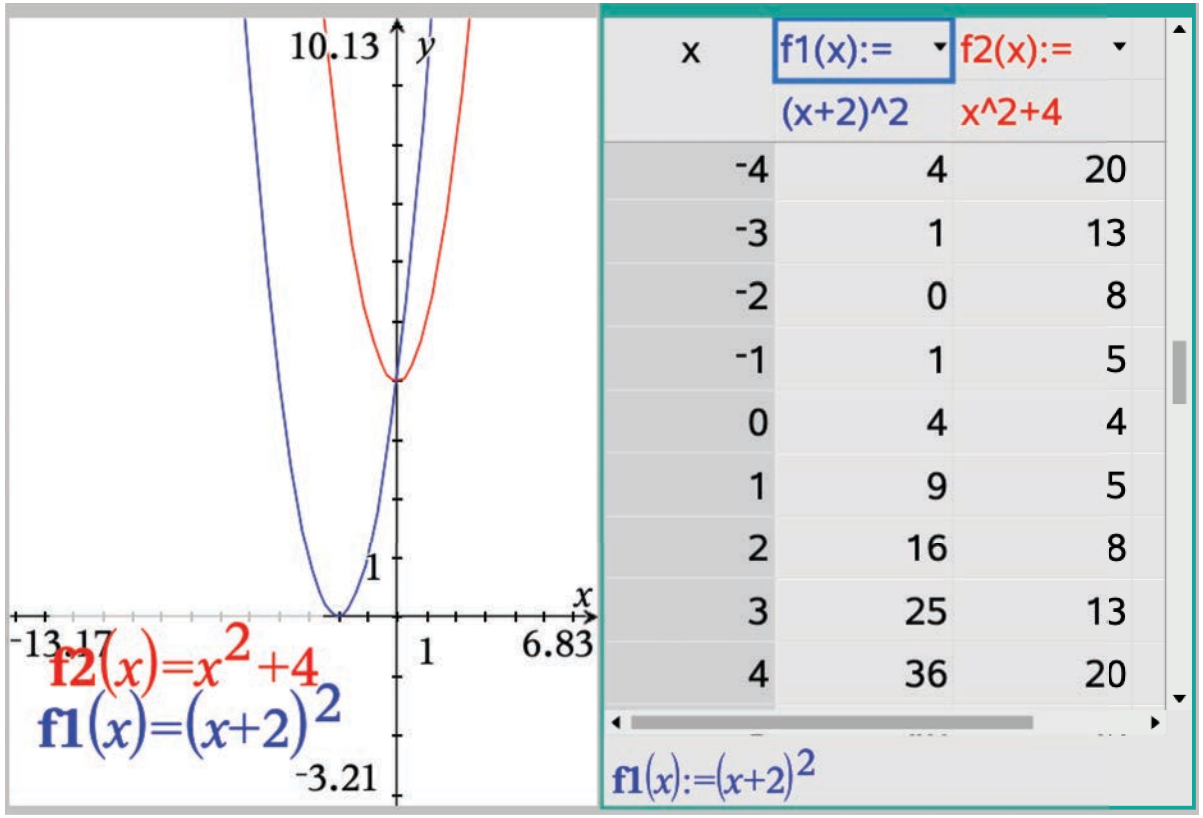
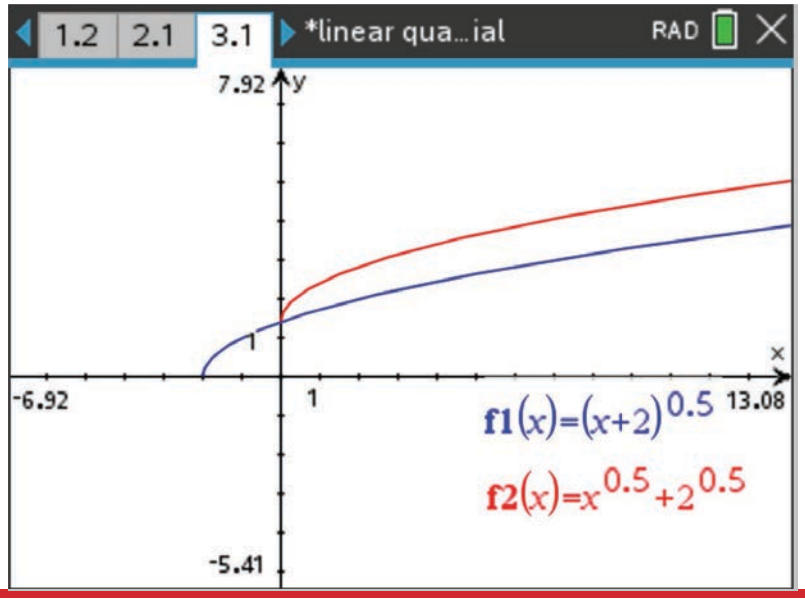
Squares and sums





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