T3IC 2020

Teachers Teaching with Technology™

International Conference

Using Color Calculators to Improve Retention

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Mount Pleasant/Pittsburg, (NE) Texas
Equidistant from Oklahoma, Arkansas, and Louisiana borders

Welcome!

Though the information discussed in this session can result in improved retention for **anyone**,

<u>it is designed for teachers with students having difficulty retaining mathematical information</u>, *including those receiving Special Education Services for Learning Disabilities*.

Introduction

- Math Educator for 18 years
- Certified in Texas to teach Mathematics 8-12, and Special Education
- 10 years classroom experience, 8 years as an Education Specialist with Region 8 ESC, NE Texas
- New T^3 Regional Instructor (September 2019)
- Mother of 3+, Grandmother of 8 (*and counting*)

50 First Dates

(Columbia Pictures, 2004)

RESEARCH

Memory and Retention

- Transfer of information from short-term memory to long-term memory is a conscious effort (Short-term (working) memory, 2016)
- "Working memory consists of a central executive [function] which controls and coordinates the operation of two subsystems: the phonological loop [*words*] and the visuospatial sketch pad [*pictures*]" (McLeod, 2016)
- Executive function can be built within a student and consists of five major skills: self-control, processing skills, attentional skills, memory capacity, and sequencing skills. (Jensen & Snider, 2013)
- There is a strong correlation between executive function and academic achievement in students aged 5 to 17 (Best, Miller, and Naglieri, 2010)

Memory and Retention

- Academic input comes in two forms: factual and conceptual (Sprenger, 2005)
  - Factual knowledge is best processed as both verbal and as an image (Marzano, Pickering, and Pollock, 2001)
  - Without factual knowledge, you can't build conceptual knowledge (Sprenger, 2005)
- In patients with recall deficits (similar to *50 First Dates*), color association of words improved recall (Diana, Yonelinas, and Ranganath, 2009).
- The brain interprets color as a visual memory, allowing words to be stored as both language and visual.

Memory and Retention

- The use of a strategy that organizes and transforms information improves student performance by an effect size of 0.85 (Hattie, 2012)
- Chunking or Grouping information allows the whole chunk to be stored as a single piece of information.
- Using color as a grouping method assists in storing meaningful information together, as a single piece of information.
- Storage and recall is becoming increasing important as the number of items held in short term memory has transitioned from ≈7 items (1950s) to 3 items (Gen Z). (Sousa and Tomlinson, 2018)

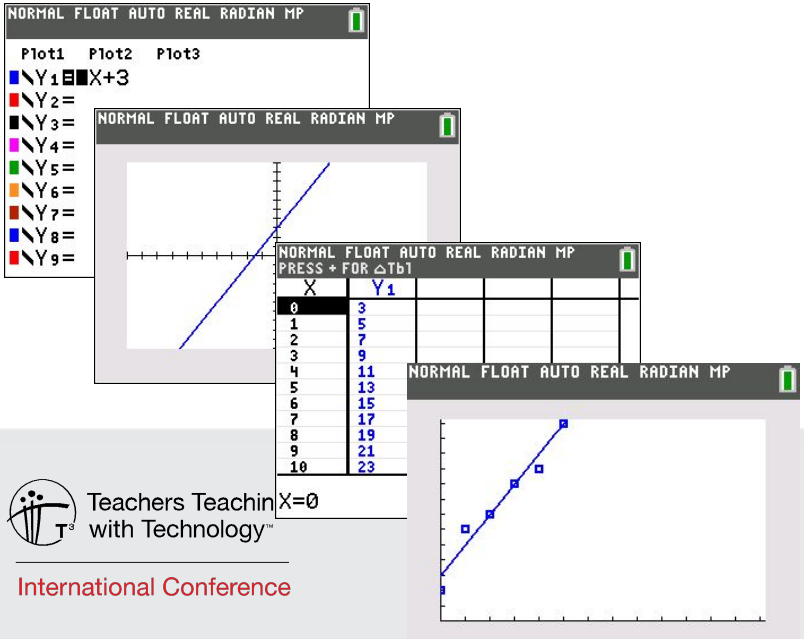
HOW TO USE IT IN INSTRUCTION

Color Association is about “Fact” recall

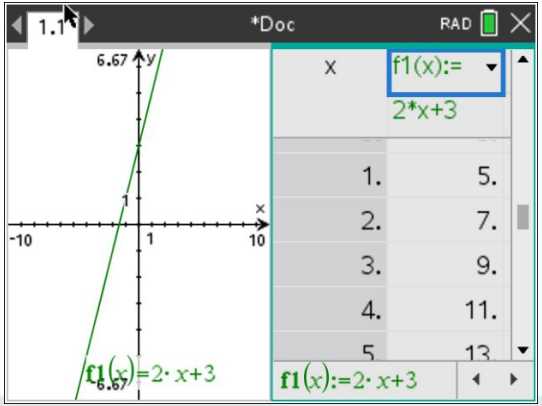
- Facts often need to be recalled as a group or cluster
  - Word(s) with a meaning/definition
  - Word(s) with a picture
  - Word(s) or picture(s) as part of a sequence/order
  - Word(s) with both meaning and picture
- Color used to association (or connect) those different facts into a single group or cluster improves the potential for recall

What TI has already done for you

TI-84 CE - Function on the graph and y values in table are represented in the same color. Stat Plot can be selected to match.



TI-Nspire - Function on the graph and the symbolic function in the table are represented in the same color



How to use color for retention

Begin with the end in mind (Covey, 1989)

What is the goal of this activity?

Decompose the goal (Wiggins & McTighe, 1998)

What individual skills/tasks make up this activity?

Determine the connected pieces (chunks)

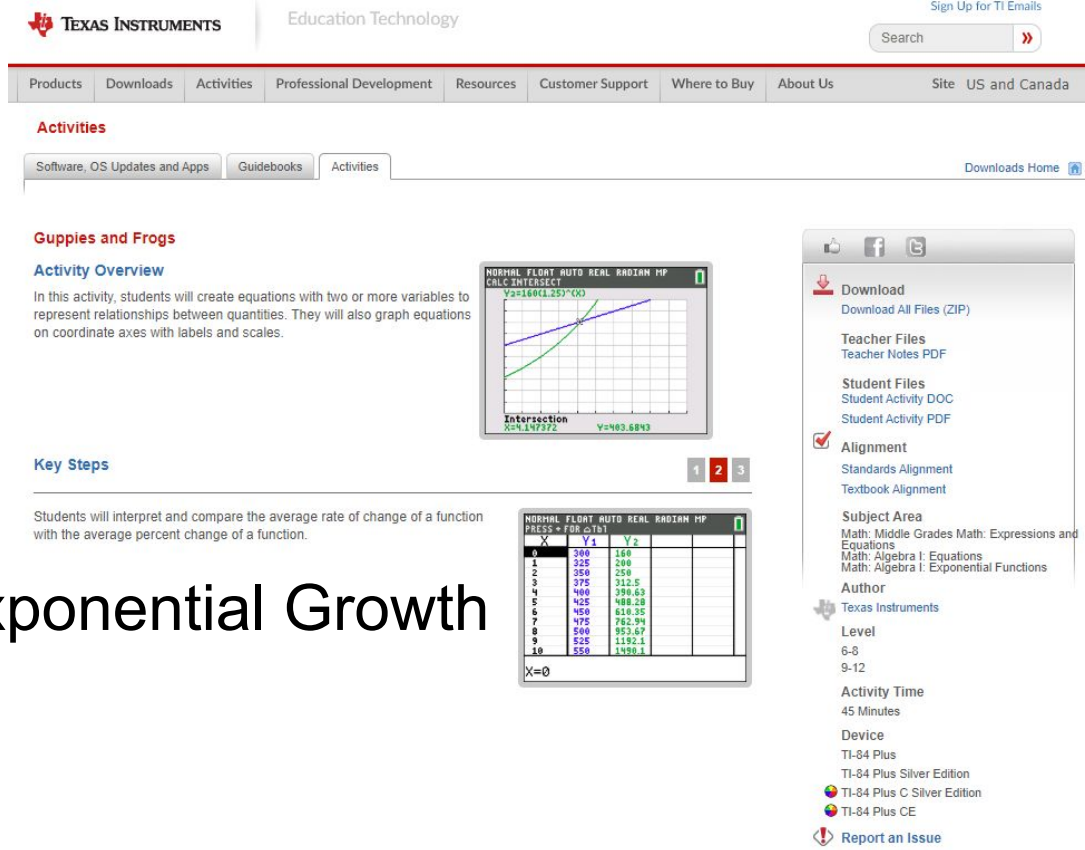
What is written that needs to be connected to what is in the calculator?

Example

From Education.TI.com

Guppies and Frogs

Linear Growth vs. Exponential Growth



How to use color for retention

Begin with the end in mind

What is the goal of this activity?

How to use color for retention

Begin with the end in mind

Compare a function modeling repeated addition to one modeling repeated multiplication to identify similarities and differences.

How to use color for retention

Decompose the goal

What individual skills/tasks make up this activity?

How to use color for retention

Decompose the goal

- *Compare graph shapes*
- *Compare output tables*
- *Compare operations and associated functions, i.e., repeated addition vs. repeated multiplication*

How to use color for retention

Determine the connected pieces (chunks)

What is written that needs to be connected to what is in the calculator?

How to use color for retention

Determine the connected pieces (chunks)

- *Connect linear graph, table, and operation (function)*
- *Connect exponential graph, table, and operation (function)*

How to use color for retention (cont'd)

Choose your color scheme, but **don't** create a rainbow of distraction (I prefer colored pencils to highlighters)

Be as aware as possible of students' negative reactions to colors or inability to see certain colors

Recall the "pieces" in sets of information (connecting vocabulary and concept)

Color Selection

Guppies

Frogs

There is no magic formula. Keep it Simple!!!

Example

Guppies and Frogs
Student Activity

Name _____
Class _____

A large pond contains 300 guppies and 160 frogs.

Suppose the guppy population increases by 25 guppies per year.

Suppose the frog population increases by 25% per year.

1. What does the future hold for this pond? Make a prediction.

2. What factors might impact the growth of the guppy and frog populations?

3. Use the words NOW and NEXT to write a rule showing how the guppy population changes each year. On the home screen of your calculator, simulate 6 years of guppy growth.

   Next = Now + 25

4. Let the function G represent the guppy population at year t. Complete the table.

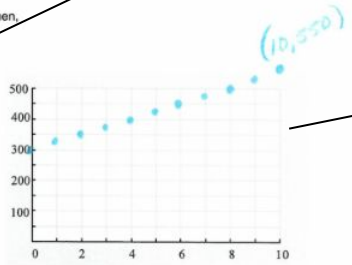
Year, t	Guppies, G
0	300
1	325
2	350
3	375
4	400
5	425
6	450

5. How does the guppy population change every 2 years?

6. Graph the data (t, G) on the set of axes provided. Then, connect the data points.

7. Write a formula to model the population growth.

   $G(t) = 300 + 25t$



8. Use your formula to predict the population at year $t = 10$.

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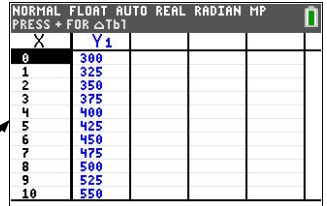
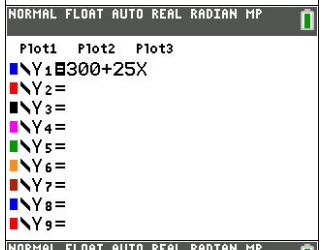
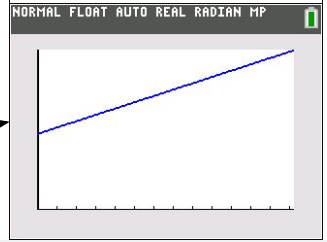


X=0



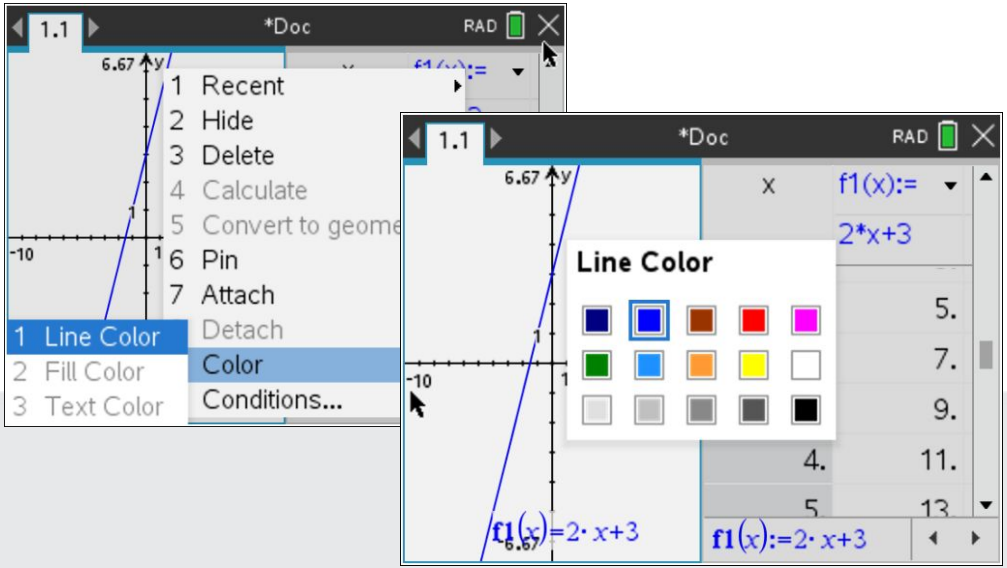


To change the color

TI-84CE

TI-Nspire

While hovering over the function (*grabby hand is visible*), press Ctrl Menu



Example

Guppies and Frogs

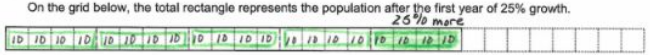
Student Activity

Name _____

Class _____

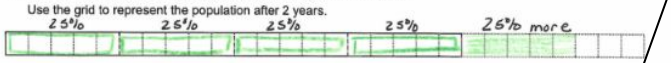
9. The initial population of 160 frogs grows by 25% each year.
Suppose the rectangle below represents a population of 160 frogs.

On the grid below, the total rectangle represents the population after the first year of 25% growth.



What is the population of frogs at year $t = 1$? 200

10. On the grid below, the model represents the population after 1 year.
Use the grid to represent the population after 2 years.



What is the population of frogs at year $t = 2$? 250

Does the population increase by the same number of frogs each year? Explain your answer.
The % stays the same, but the number of frogs is different

11. Use the words NOW and NEXT to write a rule showing how the frog population changes each year. On the home screen of your calculator, simulate 6 years of frog growth.
Next = Now(1+.25) = Now•1.25

12. Interpret the meaning of the population at year $t = 3$ in terms of the context of the situation.

13. Let the function F represent the frog population at year t. $F(t) = 160(1.25)^t$
Write a formula that models the population growth of frogs.

t	$F(t)$
0	160
1	200
2	250
3	312.5
4	390.625
5	488.28

14. Use the table feature of your calculator to validate your formula.
Draw the graph of the frog population on the set of axes on the previous page.

15. In what year does the population of frogs overtake the population of guppies?

16. List any limitations of these models for population growth.

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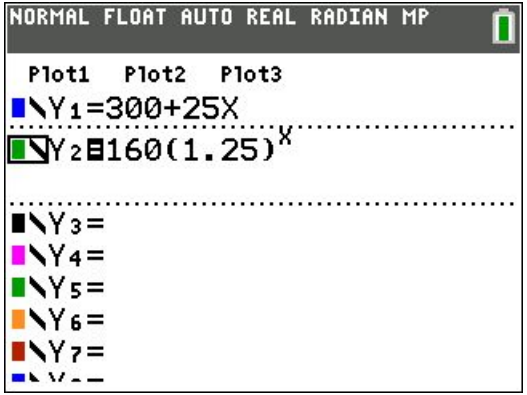

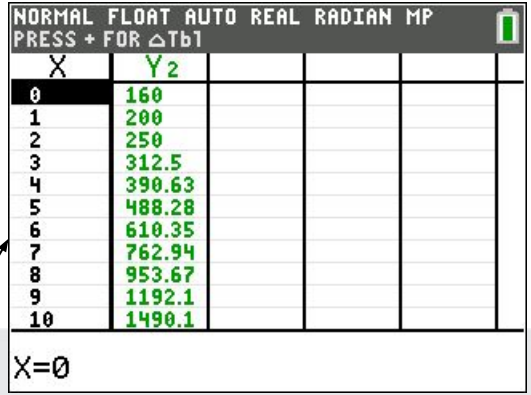

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7. Write a formula to model the population growth.

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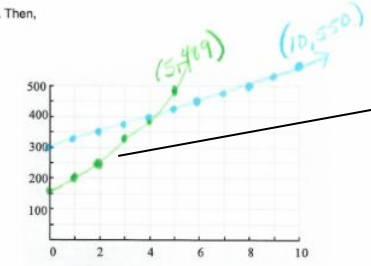

8. Use your formula to predict the population at year $t = 10$.

   $G(10) = 550$

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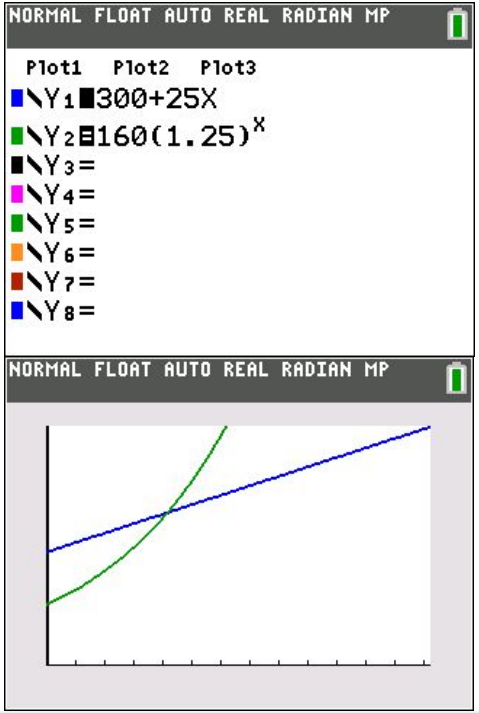

Implementation Notes

- The strategy must be taught.
- There is a learning curve for both teacher and students.
- Effectiveness is greatest when used voluntarily by the student.
- Recall improvement will be least in students who already have an internal recall system.

Contact Information

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