

Writing Their Way To Understanding

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Fun Fact

- About [REDACTED] American adults believe chocolate milk comes from brown cows.
- Goldilocks Estimates: Provide estimates that are too small, too large, and just right.
- Helpful Hint: It is between 0-15% of the population.



Fun Fact

- About 16,400,000 American adults believe chocolate milk comes from brown cows.
- https://www.washingtonpost.com/news/wonk/wp/2017/06/15/seven-percent-of-americans-think-chocolate-milk-comes-from-brown-cows-and-thats-not-even-the-scary-part/?noredirect=on&utm_term=.cf4fb65df7b5



Writing Matters

a series about writing's connection
with academic and professional success

Program in Writing and Rhetoric
Stanford University



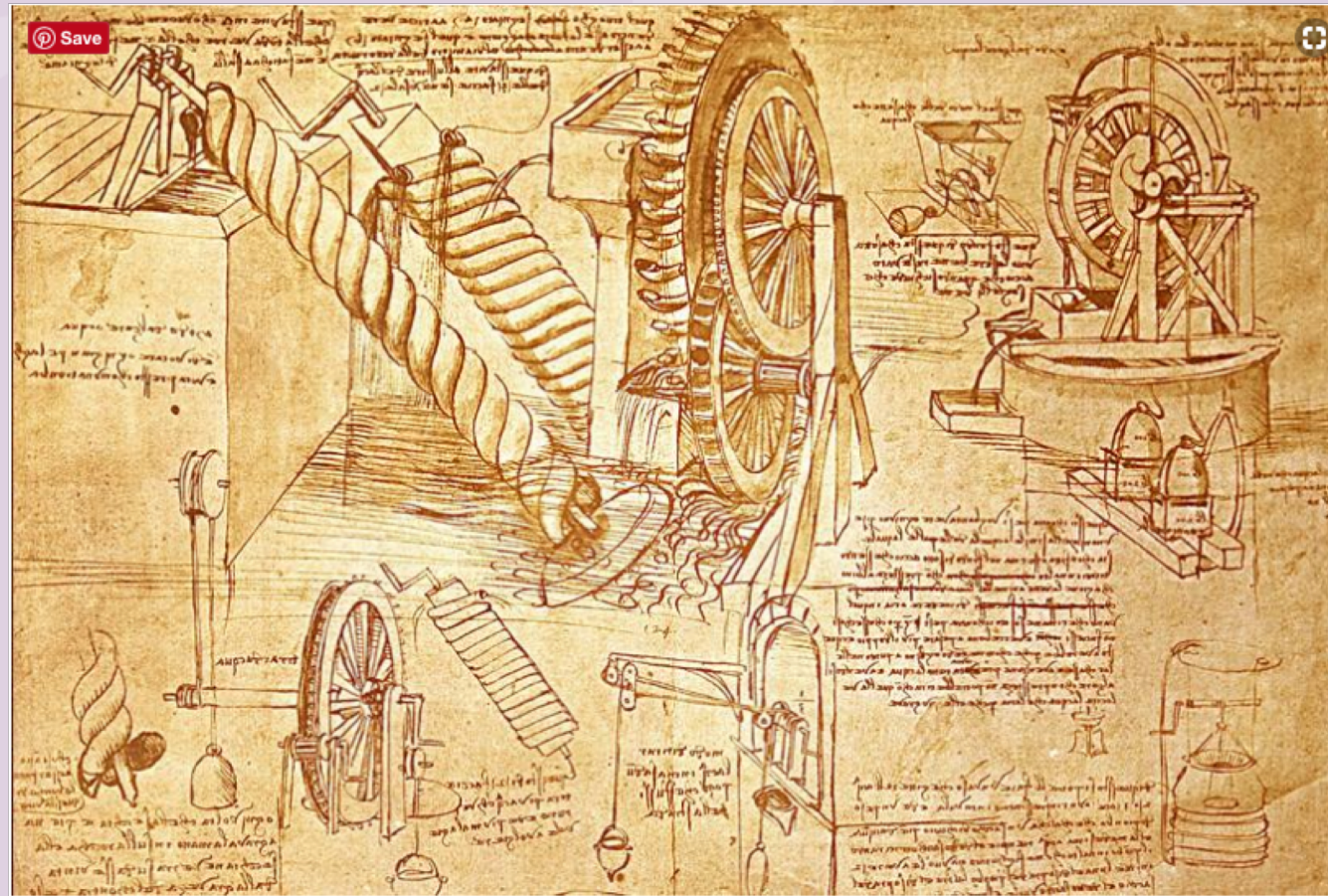
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My Hope, You and Your Students...

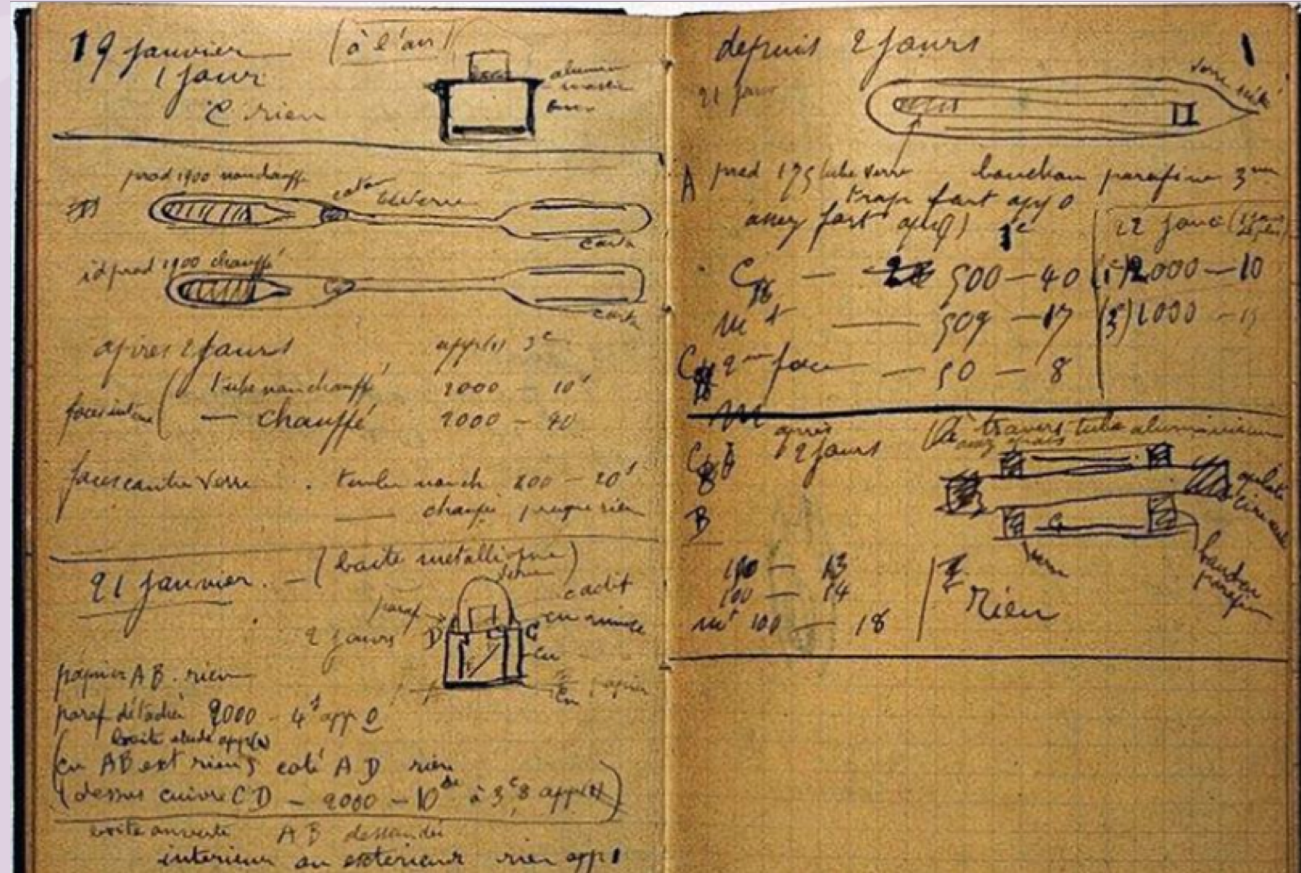
- will embrace math writing and it will become an integral part of your classroom,
- will keep a daily record of their math occurrences, experiences, observations,
- will see the connections in mathematics.
- will see mathematics is an elegant system of interconnected concepts that take time to explore, grapple with, and reason through.

Famous Notebooks---da Vinci



Over 7,000 pages of Leonardo da Vinci's drawings, ideas, and natural inspirations have been preserved. (Photo: The British Library)

Famous Notebooks---Marie Curie



Marie Curie's notebooks are so radioactive that they must be kept in lead-lined boxes. (Photo: Wellcome Trust)

People don't learn from experiences, they learn from processing their experiences.
- Bob Garmston

Looking at the SERP 5x8 card, where do you see writing enhancing the Student Vital Actions?

THE 5x8 CARD



Student Vital Actions	Principles
All students participate (e.g., boys and girls, ELL and special needs students), not just the hand-raisers.	Equity requires participation. A >
Students say a second sentence (spontaneously or prompted by the teacher or another student) to extend and explain their thinking. CCSS-M practices 1 2 3 6	Logic connects sentences. B >
Students talk about each other's thinking (not just their own). CCSS-M practices 1 2 3 6 7 8	Understanding each other's reasoning develops reasoning proficiency. C >
Students revise their thinking , and their written work includes revised explanations and justifications. CCSS-M practices 1 2 3 4	Revising explanations solidifies understanding. D >
Students look for more precise ways of expressing their thinking, encouraging each other to look for and use academic language . CCSS-M practices 3 6	Academic language promotes precise thinking. E >
English learners produce language that communicates ideas and reasoning, even when that language is imperfect. CCSS-M practices 1 2 3 6	ELLs develop language through explanation. F >
Students engage and persevere at points of difficulty, challenge, or error. CCSS-M practice 1	Productive struggle produces growth. G >

Pro Tip

- If students keep a daily record, then a table of contents is a must for them and for you!

How Many Ways?

- Think about the fraction $12/9$.
- How many ways can you write the sum of $12/9$?

LOL

- Draw your LOL.
- When I say go you will:
- Find someone you haven't talked with today.
- Share your representations and explain why you chose those representations. If your partner has any you do not have write those under your LOL.
- At my signal, you will thank your partner and repeat the process.

How Many Ways?

- Think about the fraction $12/9$.
- How many ways can you write the sum of $12/9$?
- Do you think you have all the ways? Why or why not?
- How did you enter the task?

- “Writing in mathematics is considered beneficial for students because, through writing, “they communicate to learn mathematics, and they learn to communicate mathematically.” Having students write about their ideas helps them learn content and develops their problem-solving abilities. The process of writing also allows students to reason immediately and visually about the correctness of their solution.”

- Casa , T. M., Firmender, J. M., Cahill, J., Cardetti, F., Choppin, J. M., Cohen, J., Zawodniak, R.

To Reason and Communicate Mathematically

Exploratory

- To personally make sense of a problem, situation, or one's own ideas

Informative/Explanatory

- To describe
- To explain

Argumentative

- To construct an argument
- To critique an argument

Mathematically Creative

- To document original ideas, problems, and/or solutions
- To convey fluency and flexibility in thinking
- To elaborate on ideas

- “It is important that any symbols and representations used in mathematical writing should support students’ mathematical ideas.”
 - Casa , T. M., Firmender, J. M., Cahill, J., Cardetti, F., Choppin, J. M., Cohen, J., Zawodniak, R.

Making S'Mores



- Add your LOL
- On my signal:
- Find someone you haven't spoken with today.
- Compare your representations of part c.
- How are they alike and how are they different. (Write this under your LOL)
- Ask questions such as, Tell me more about that, Can you say that in a different way?, How does that connect to my answer?

1a. Responding to Students (From 5 Practices)

- Critical to think about the questions you will ask about the work being produced to advance students towards the goal.
- Assessing Questions are intended to make a student's current thinking visible.
- Advancing questions are intended to move students beyond where they currently are, towards the goal of the lesson.

1a. Responding to students (From 5 Practices)

Assessing Questions

- Are based closely on the work that the student has produced.
- Clarify what the student has done and what the student understands about what he or she has done.
- Give the teacher information about what the student understands.
- Teacher **stays** to hear the answer to the question.

Advancing Questions

- Use what students have produced as a basis for making progress toward the target goal of the lesson.
- Move students beyond their current thinking by pressing students to extend what they know to a new situation.
- Press students to think about something they are not currently thinking about.
- Teacher **walks Away**, leaving students to figure out how to proceed.

“revision is where the real mathematics happens”

•Dr. Ravi Vakil, 2012



Ma and Pa Kettle



Write a Letter

- Write a letter to Ma & Pa explaining the reason why $25/5 = 5$

Stronger and Clearer Each Time

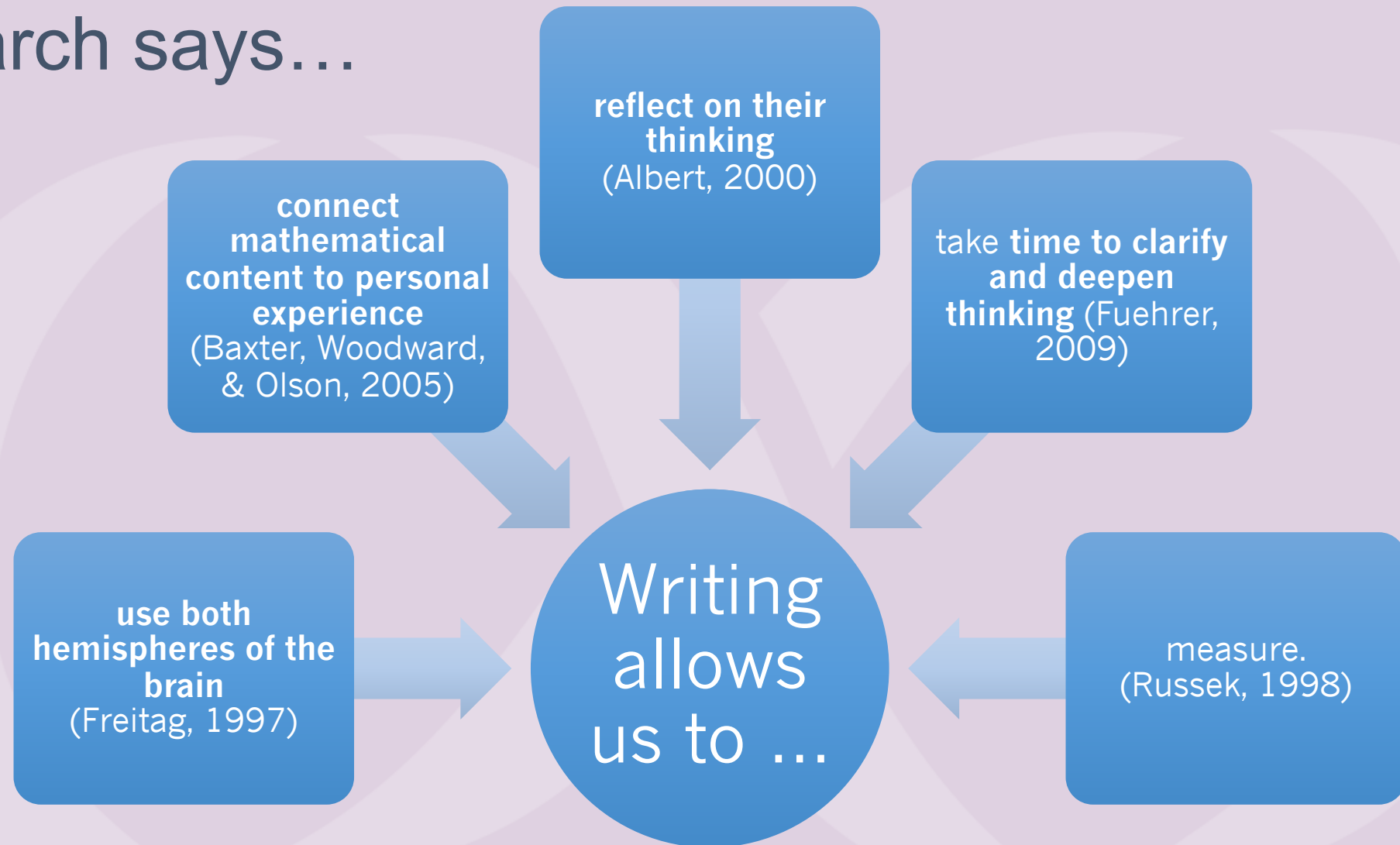
Purpose: To provide a structured and interactive opportunity for students to revise and refine both their ideas and their verbal and written output.

This routine provides a purpose for student conversation as well as fortifies output. The main idea is to have students think or write individually about a response, use a structured pairing strategy to have multiple opportunities to refine and clarify the response through conversation, and then finally revise their original written response. Throughout this process, students should be pressed for details, and encouraged to press each other for details.

Stronger and Clearer Each Time

- Pre-Write: Individually write down their idea/reasoning for solving the problem, any thoughts or questions about it, in complete sentences if possible.
- Think-Time: Give a minute for students to think about what they will say to the first partner to explain what they are doing or did to solve the problem. (They can't look at their writing while talking.)
- In Pairs: Your goal today is to clearly explain it to other as a mathematician would. One partner listens, the other talks. The listening partner can ask clarifying questions, especially relating to justifying. Press your partner for details. Switch roles.
- Post-Write: Revise your writing based on your conversations. The revised writing should include evidence of new ideas, refinement in precision, communication, or academic vocabulary.

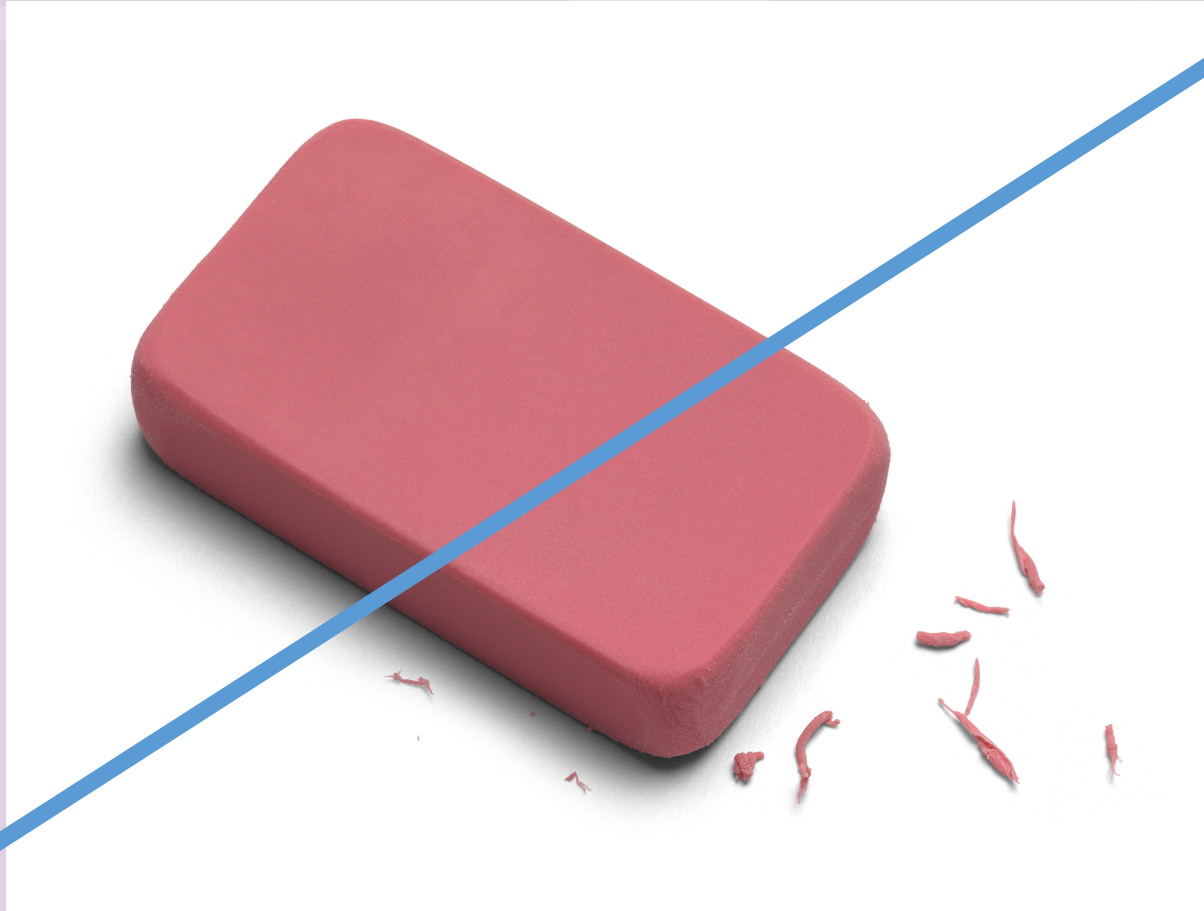
Research says...



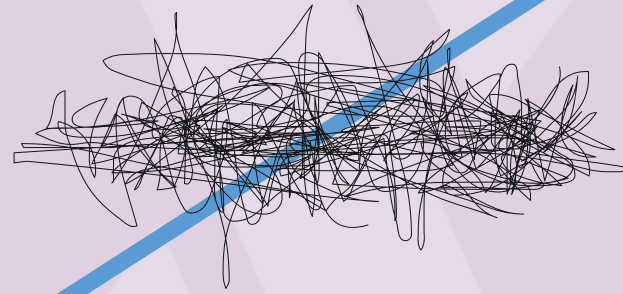
Jon and Charlie's Run



Pro Tip:
Just Say No!



Pro Tip:
Just Say No!

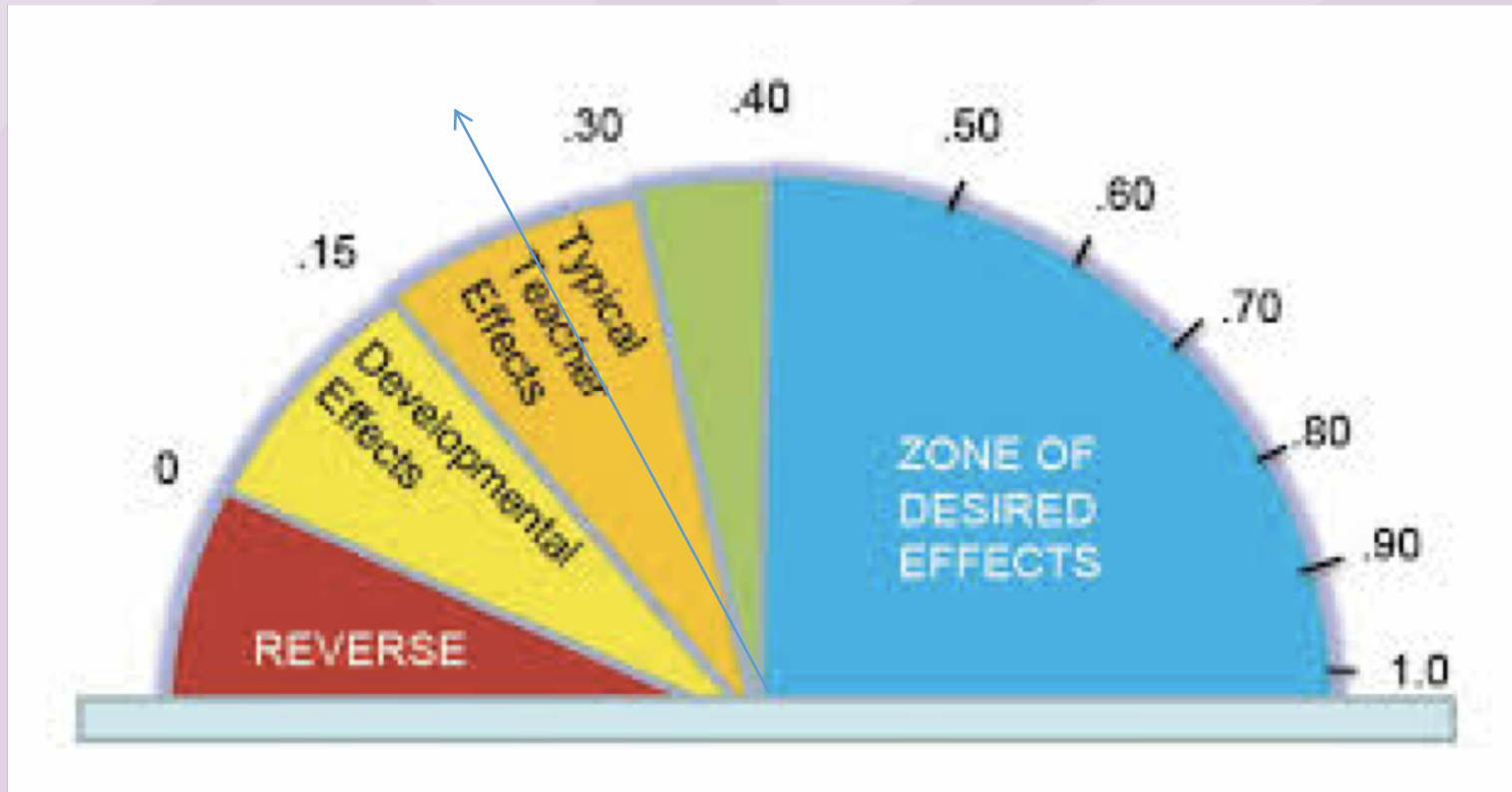


Make sure your math writing includes:

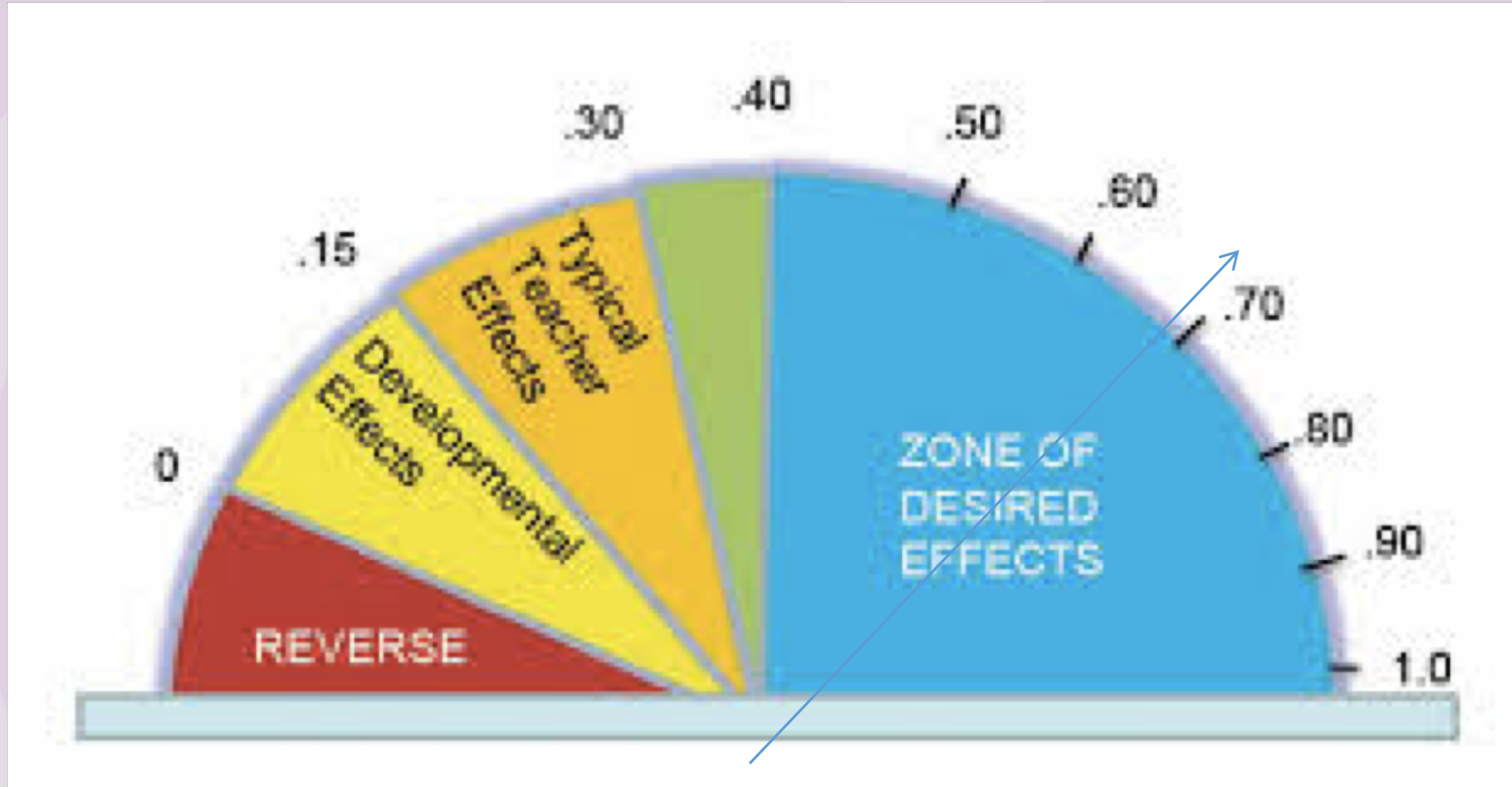
- ♦ Complete response with mathematical notations.
- ♦ Clear, coherent explanation.
- ♦ Clear and labeled diagrams when used.
- ♦ Shows understanding of the question
- ♦ Identifies the elements of the question.
- ♦ Includes examples and/or counter examples.
- ♦ Combines words with symbols.
- ♦ Uses correct mathematical notation
- ♦ Provide details.

(AVID 2008, Lee 2010, Crannell 2008)

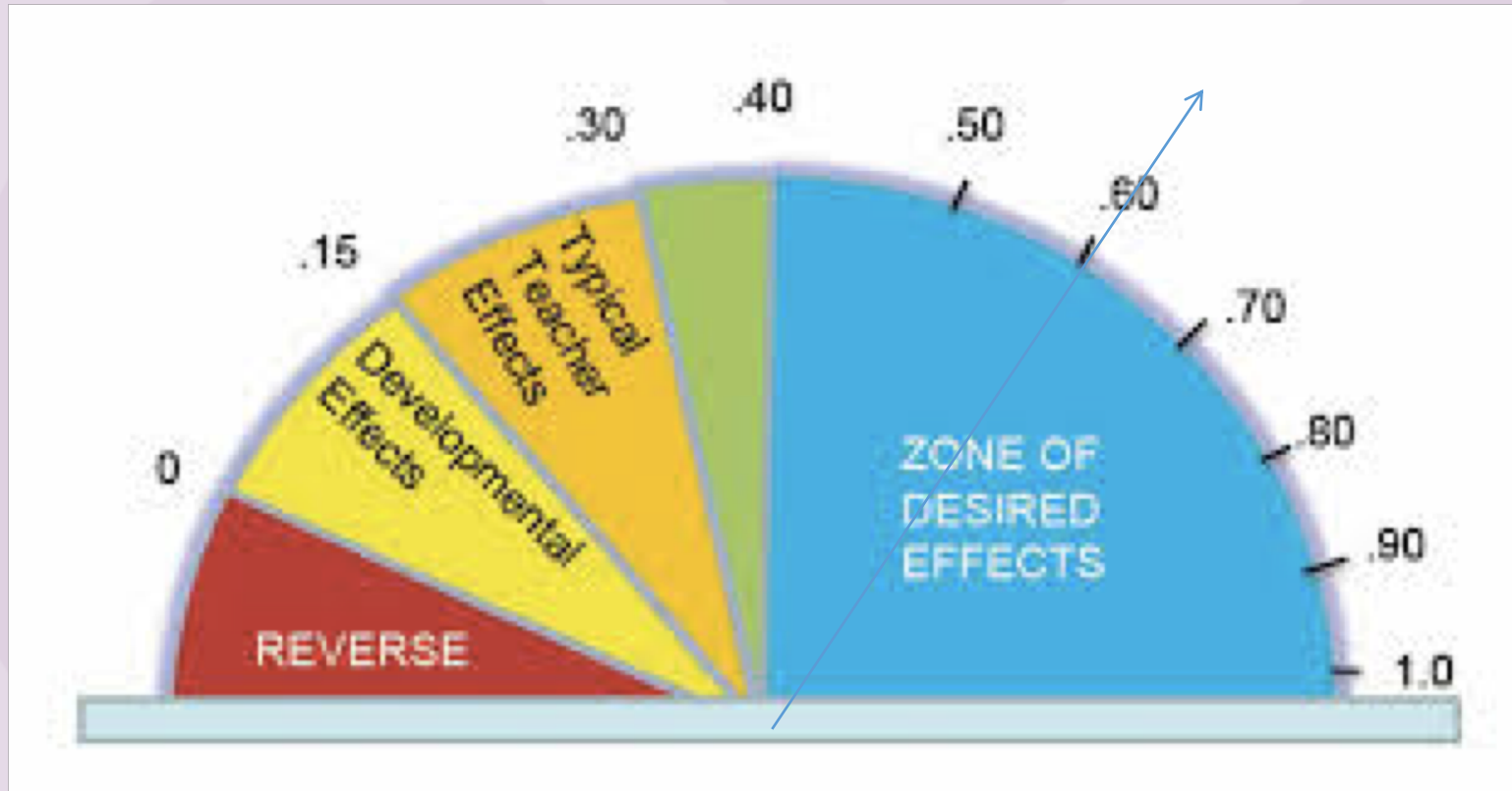
Teaching Test Taking = .22



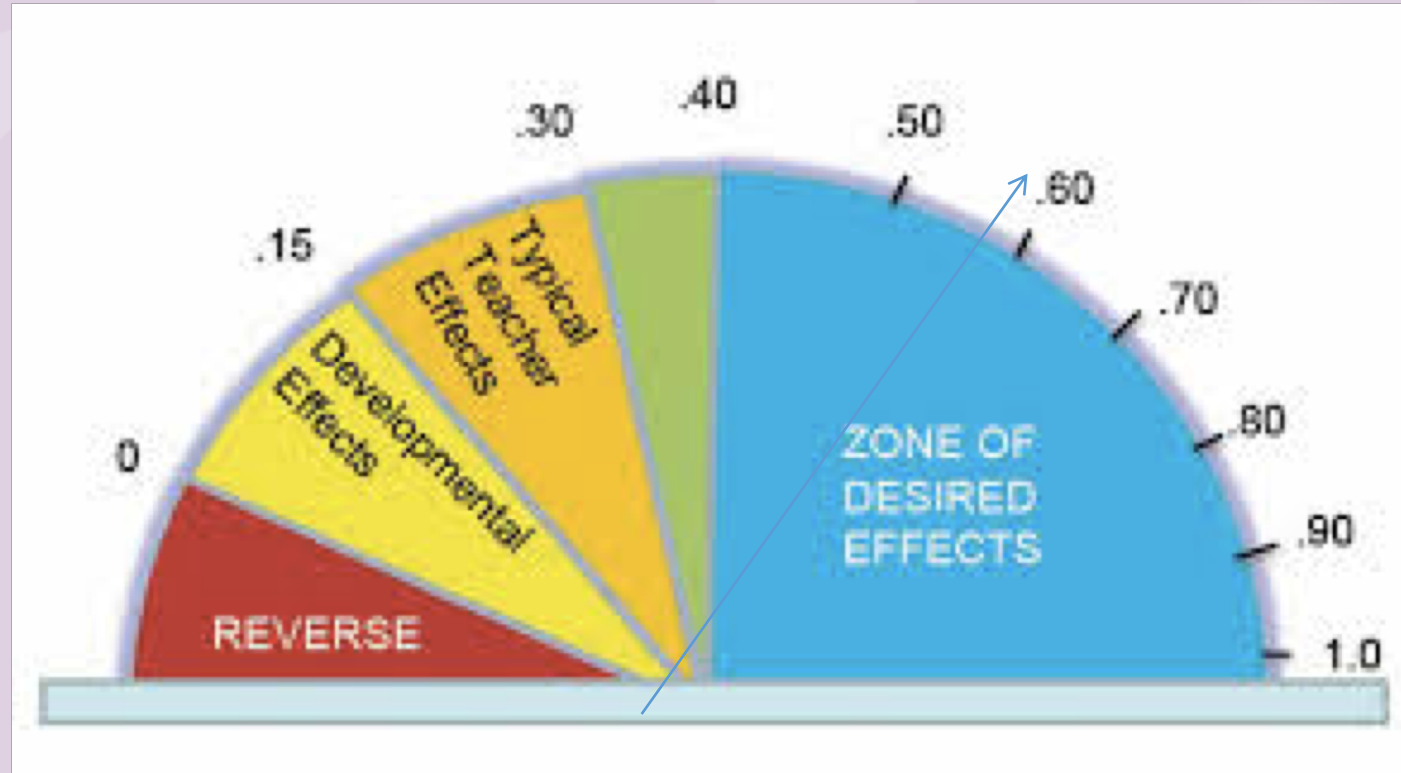
Meta-Cognition Strategies = .69



Peer Teaching = .60



Concept Maps = .57



Concept Mapping

- More Effective with Deep learning than surface learning.
- Similarities and differences.
- Helps students see connections instead of seeing math as a series of discrete items

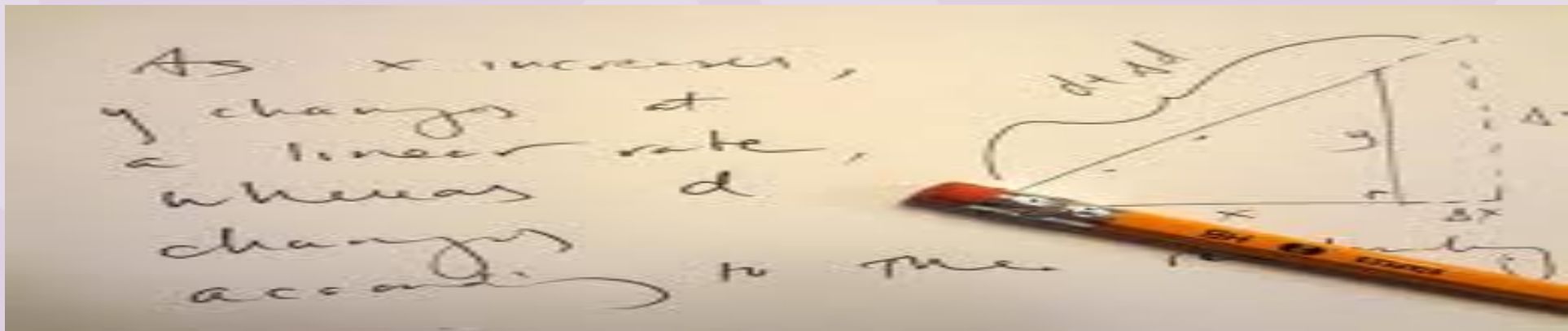
Halves, Thirds, and Sixths



Please Remember that...

“Teachers incorporate writing in math class to help students **reflect** on their learning, **deepen** their understanding of important concepts by **explaining** and providing examples of those concepts, and make important connections to real-life applications of the math they are learning.”

(Mathwire.com, 2013)



This Process...

- Can be challenging
- Takes a bit of patience
- Requires modeling, modeling, modeling
- Must consistently be reinforced
- Takes time to learn both for the teacher and for the students to develop their own style

Citations

- Casa , T. M., Firmender, J. M., Cahill, J., Cardetti, F., Choppin, J. M., Cohen, J., Zawodniak, R. (2016). Types of and purposes for elementary mathematical writing: Task force recommendations. Retrieved from <http://mathwriting.education.uconn.edu>.
- Hattie, J. (2009). Hattie Ranking: Teacher Effects. Retrieved September 19, 2018, from <https://visible-learning.org/hattie-ranking-influences-effect-sizes-learning-achievement/hattie-ranking-teacher-effects/>
- Smith, M. S., & Stein, M. K. (2018). *5 practices for orchestrating productive mathematical discussions*. Reston, VA: The National Council of Teachers of Mathematics.

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How Many Ways

Think about the fraction $\frac{12}{9}$.

1. How many ways can you write the sum of $\frac{12}{9}$?
2. How do you know you have all the ways?
3. How did you enter the task?

5.NF Making S'Mores

Task

Nick and Tasha are buying supplies for a camping trip. They need to buy chocolate bars to make s'mores, their favorite campfire dessert. Each of them has a different recipe for their perfect s'more. Nick likes to use $\frac{1}{2}$ of a chocolate bar to make a s'more. Tasha will only eat a s'more that is made with exactly $\frac{2}{5}$ of a chocolate bar.

- What fraction of a chocolate bar will Nick and Tasha use in total if they each eat one s'more?
- Nick wants to cut one chocolate bar into pieces of equal size so that he and Tasha can make their s'mores. How many pieces should he cut the chocolate bar into so that each person will get the right amount of chocolate to make their perfect s'more?
- After Nick cuts the chocolate bar into pieces of equal size, how many pieces of the chocolate bar should he get? How many pieces of the chocolate bar should he give to Tasha?



5.NF Making S'Mores
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3.NF Jon and Charlie's Run

Task

Jon and Charlie plan to run together. They are arguing about how far to run. Charlie says,

I run $\frac{3}{6}$ of a mile each day.

Jon says,

I can only run $\frac{1}{2}$ of a mile.

If Charlie runs $\frac{3}{6}$ of a mile and Jon runs $\frac{1}{2}$ of a mile, explain why it is silly for them to argue. Draw a picture or a number line to support your reasoning.

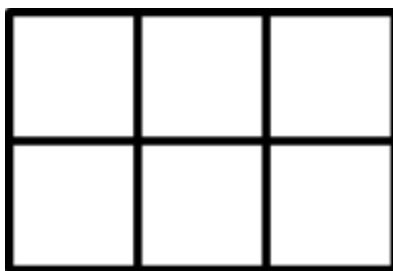


3.NF Jon and Charlie's Run
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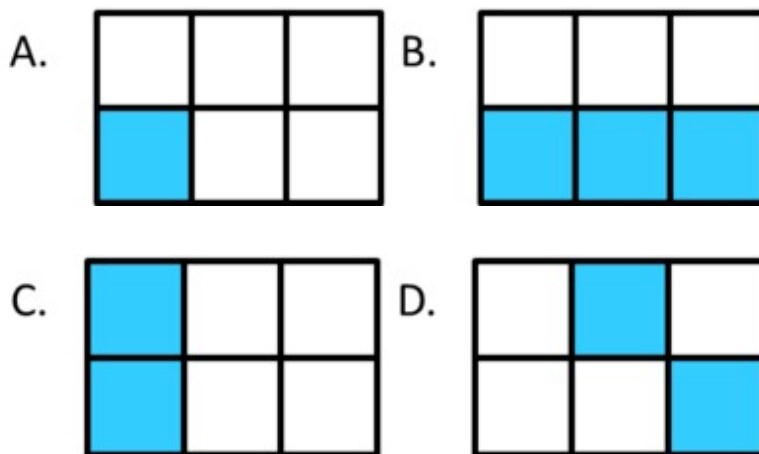
3.MD, 3.G, 3.NF Halves, thirds, and sixths

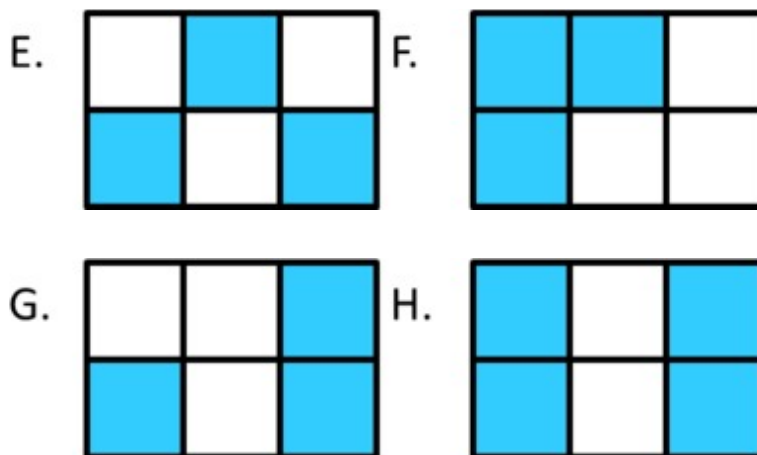
Task

a. A small square is a square unit. What is the area of this rectangle? Explain.

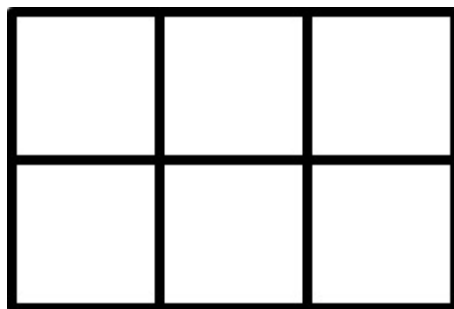


b. What fraction of the area of each rectangle is shaded blue? Name the fraction in as many ways as you can. Explain your answers.

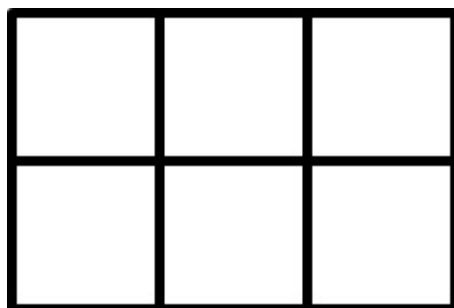




c. Shade $\frac{1}{2}$ of the area of rectangle in a way that is different from the rectangles above.



d. Shade $\frac{2}{3}$ of the area of the rectangle in a way that is different from the rectangles above.



Links:

<https://math.serpmedia.org/5x8card/>

https://www.youtube.com/watch?v=UN-nRM_ZCGs

<https://www.youtube.com/watch?v=Bfq5kju627c>