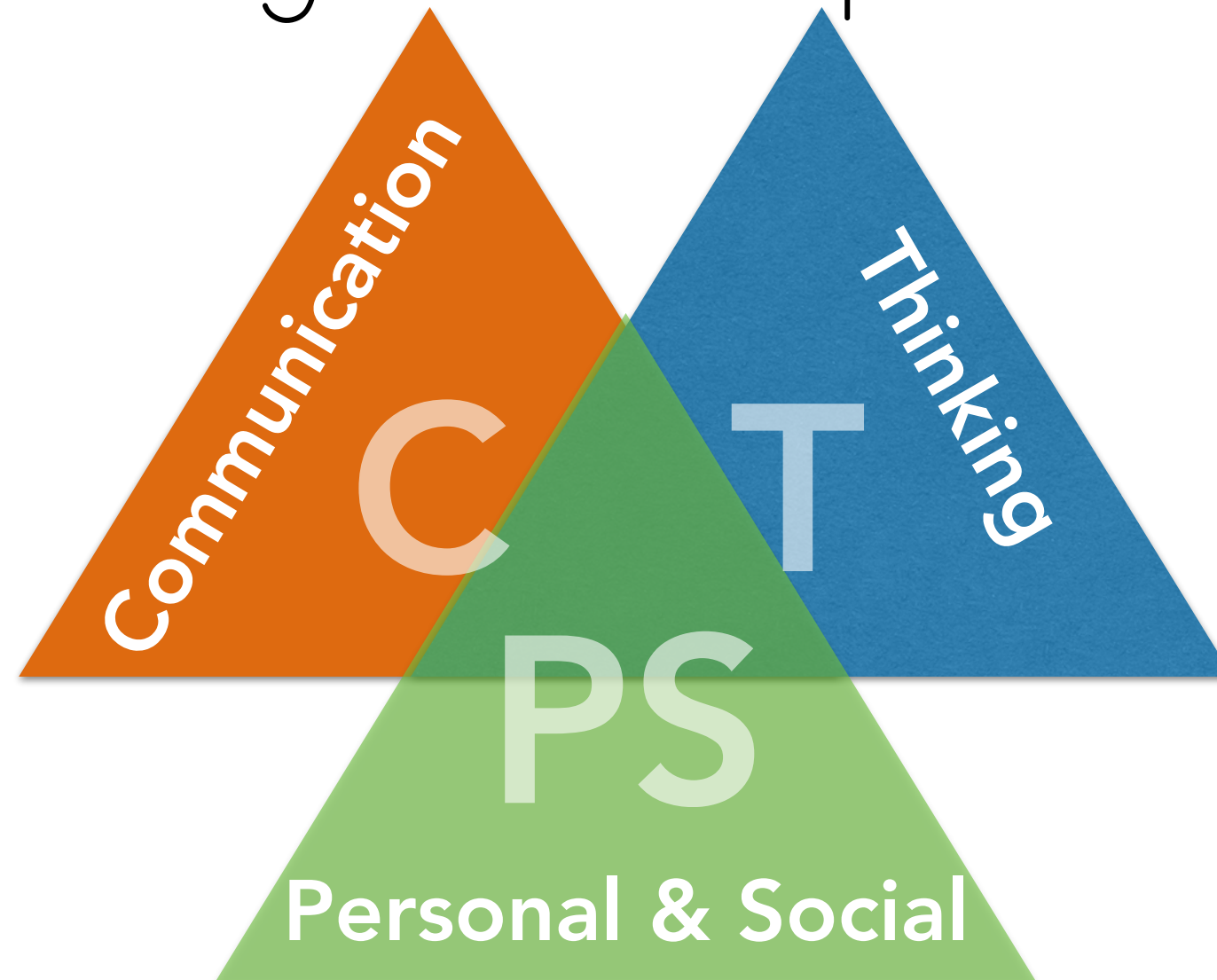


# Engaging in Mathematics Through the Competencies



August 30th, 2018 - Cambridge/Bayridge Elementary Schools

Jen Barker - K to I2 Numeracy Helping Teacher

Twitter: @barkerJBarker

Website: <http://www.meaningfulmathmoments.com/>



# Acknowledgement



Before going any further, it is important that we recognize that we are here today on the unceded, shared territories of the Coast Salish people on which our schools are located. We are so grateful and honoured to be able to live, learn, and create on these beautiful lands.



# Shape of the Day



8:30 a.m. Get To Know Each Other

8:45 a.m. Why the shifts in Mathematics?

9:00 a.m. Exploring the competencies

10 a.m. Morning Break

10:15 a.m. Continue exploring the competencies

11:30 a.m. LUNCH

# Find

# FIVE



- Take some time to get to know your colleagues by moving about and asking them ‘mathematically inspired’ Get To Know You questions either about themselves or from this summer.
- Go to people who are NOT at your table.
- Try to complete five connected squares!
- Blank squares are open for you to create your own challenges!
- **Back at your table, find (or create) a box that is common to everyone at your table.**



# Where can you find the PPT?

[www.meaningfulmathmoments.com](http://www.meaningfulmathmoments.com)

HOME MUSINGS RESOURCES IDEAS CR4YL PRESENTATIONS/PUBLICATIONS



Click the  
Presentations tab  
and look for  
Cambridge/Bayridge  
Summer ProD 2018

## Meaningful Moments in MATHEMATICS



Welcome! Thanks for stopping by my site. I was inspired to write down my Mathematical musings by several other Math educators who have generously shared their stories with me either through workshops, blogs, Twitter, or through publications and have inspired my love of Mathematics and shaped my practice.

I have taught Kindergarten through Grade Five in both Richmond and now the Surrey School District. This year I have two roles. As an Early Numeracy Teacher, I work in an inner-city school with four amazing primary teachers supporting their students in Mathematics. My other position is as the Changing Results for Young Learners Numeracy Advocate. In this role I work with 31 teachers who are participating in a inquiry-based initiative.

### Tweets by @Barkerjbarker

Jennifer Barker Retweeted



ASCD @ASCD

The goal of a class should be for students to walk away with the love of learning  
[bit.ly/2eLtWAR](http://bit.ly/2eLtWAR)



# Learning Intentions

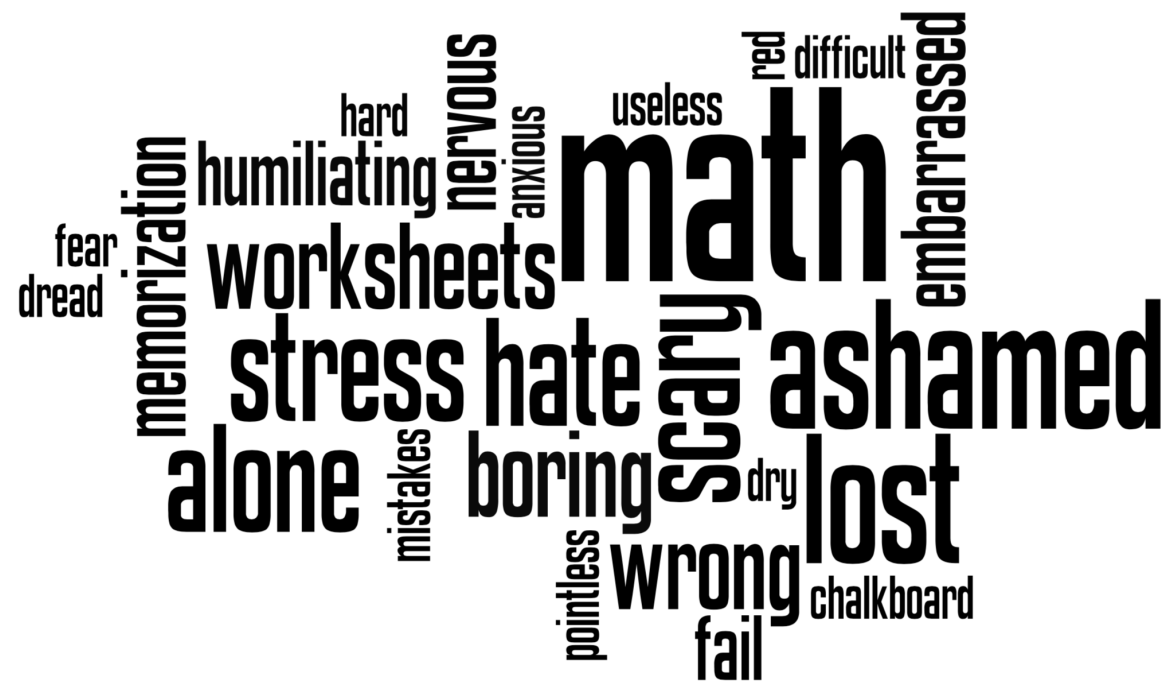
- I have an understanding as to why our curriculum has shifts towards competencies.
- I have a deeper understanding of how the core competencies live within the curricular competencies and how these can be developed and supported in Mathematics. .
- I have a few ideas I want to try.



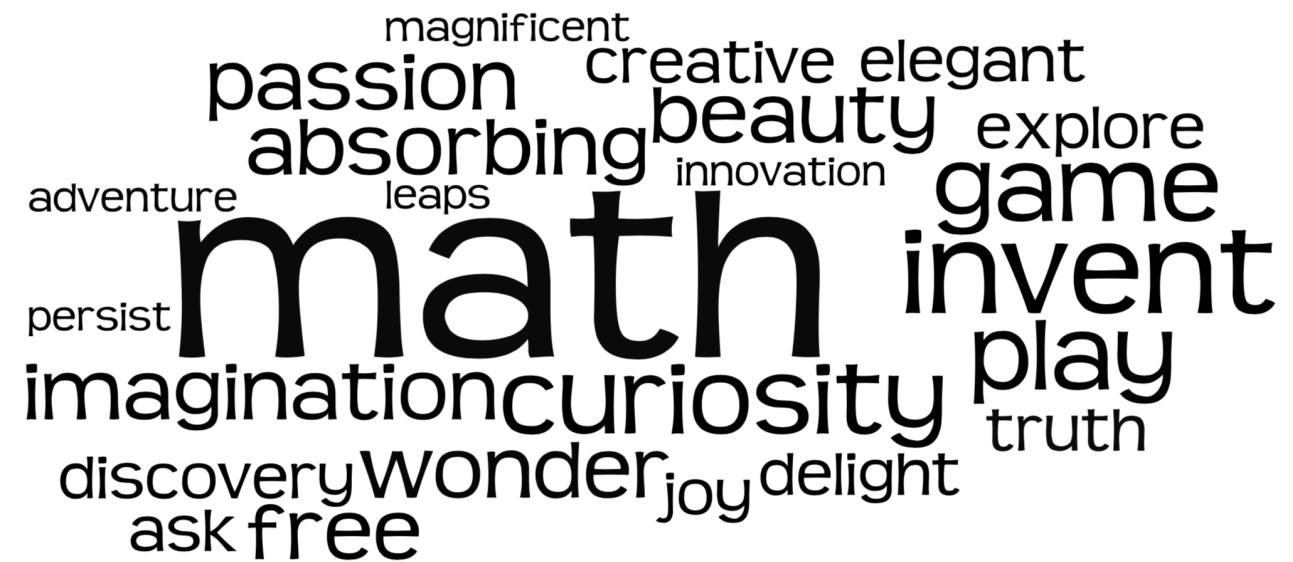
Take 30 seconds and jot down all the words that you would use to describe Mathematics!



Descriptions from  
teachers and students



Descriptions from Real  
Mathematicians



Wordles from Zager (2017), p.g. 5.

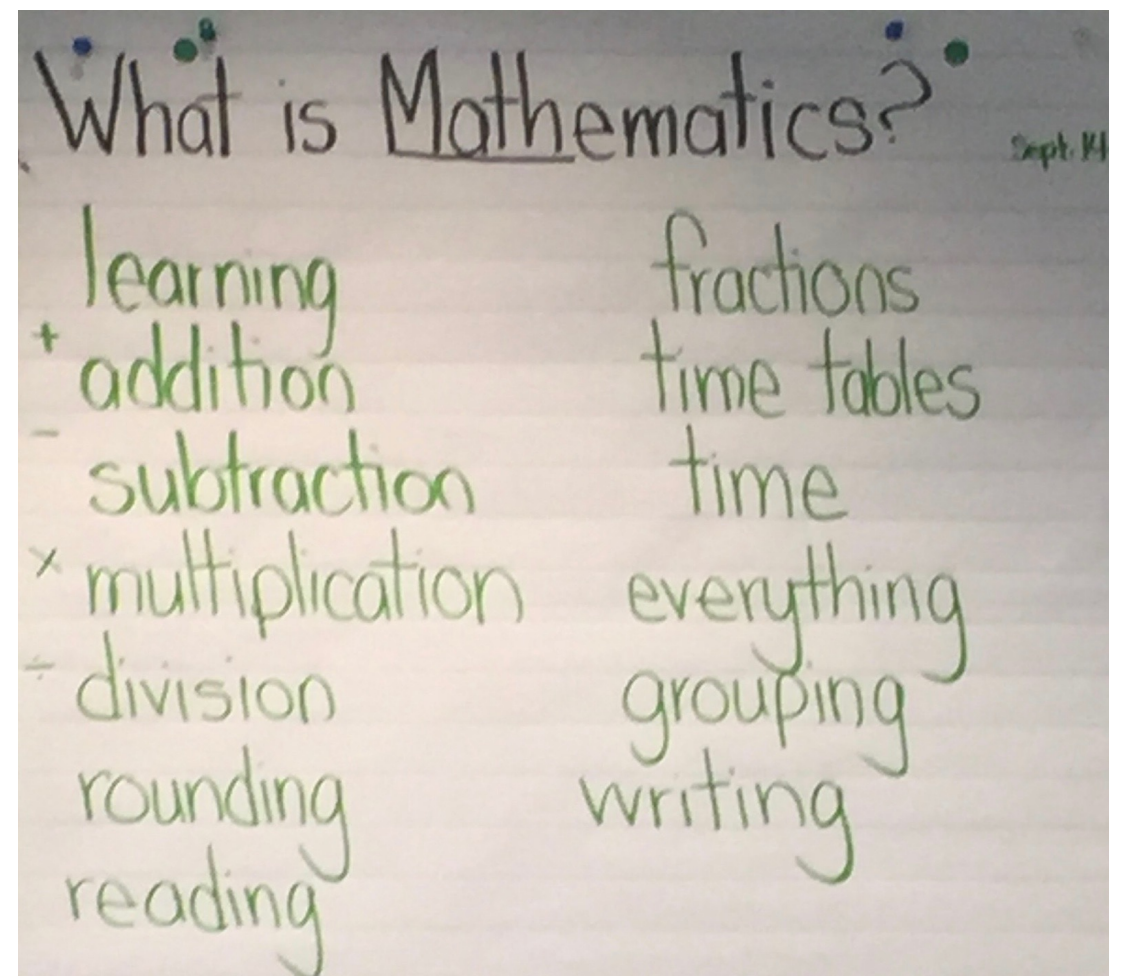
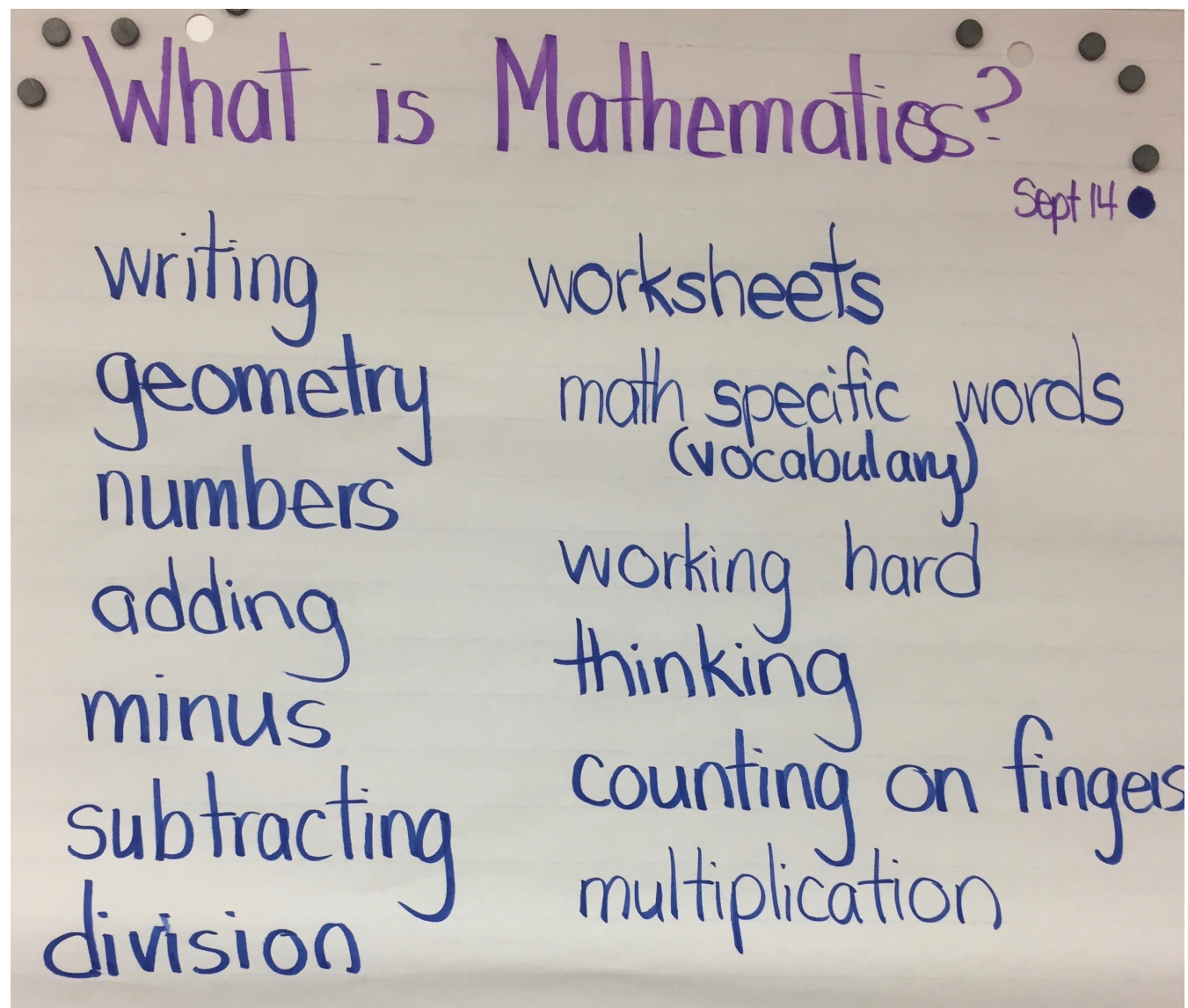
- Which wordle most closely describes your experiences in Math class?
- How would you want your students to describe Math?
- Which word(s) describe something you don't feel is in your classroom currently?





# What does it mean to DO Mathematics?

95% of 60 Elementary Students mentioned only numbers and computation when describing mathematics (Krpan, 2017).



Recorded in a Grades 3/4 and Grades 4/5 class in Surrey, September 2017



## Our Feelings about Maths

I don't like being around  
people I'm not very  
good at it. I don't  
like it. I don't like  
it. I don't like it.  
I don't like it. I don't  
like it. I don't like it.  
I don't like it. I don't  
like it. I don't like it.

Pete

[illegible][illegible]

1. The first step is to identify the problem or question that needs to be answered. This involves understanding the context and the specific requirements of the task.

[illegible]

*[Faint handwritten notes at the bottom of the page]*

1. How is a verb  
verb, subject and object  
of order.

the young man  
for his language. It is  
larger than our old  
one, and it has more  
of a modern look.  
I am very pleased  
with it. I will put  
it up.

math's

negative

1. The first part of the paper is a review of the literature on the topic of the paper. It discusses the various methods that have been used to study the topic and the results that have been obtained. It also discusses the limitations of these methods and the need for further research.

I think that neither is  
for money and not  
for the PS. The party  
of wealth I like is  
when we do something  
valuable, desirable and  
fun for the people I love.  
This is why we do  
education reform. 1999

gates to my heart  
toward earth and  
on at the fall. **IN**  
space. I don't recall  
the great work is  
I come from. But  
much power on my  
of white water  
and much more.

My Son: A 100  
of 1000 is 1000

If I'm really  
being silly with  
myself, I'm  
not a student  
of the school.  
I'm a student  
of the school.  
I'm a student  
of the school.

I like crazy  
cars, but some  
times I get tired  
that I am very  
fast or it

1. The first step is to identify the problem or question that needs to be answered. This involves understanding the context and the specific requirements of the task.

positive

1. The first step is to identify the problem. This involves understanding the symptoms and the context in which they are occurring.





Math Class Needs A Makeover

Dan Meyer

<http://bit.ly/MathClassChange>

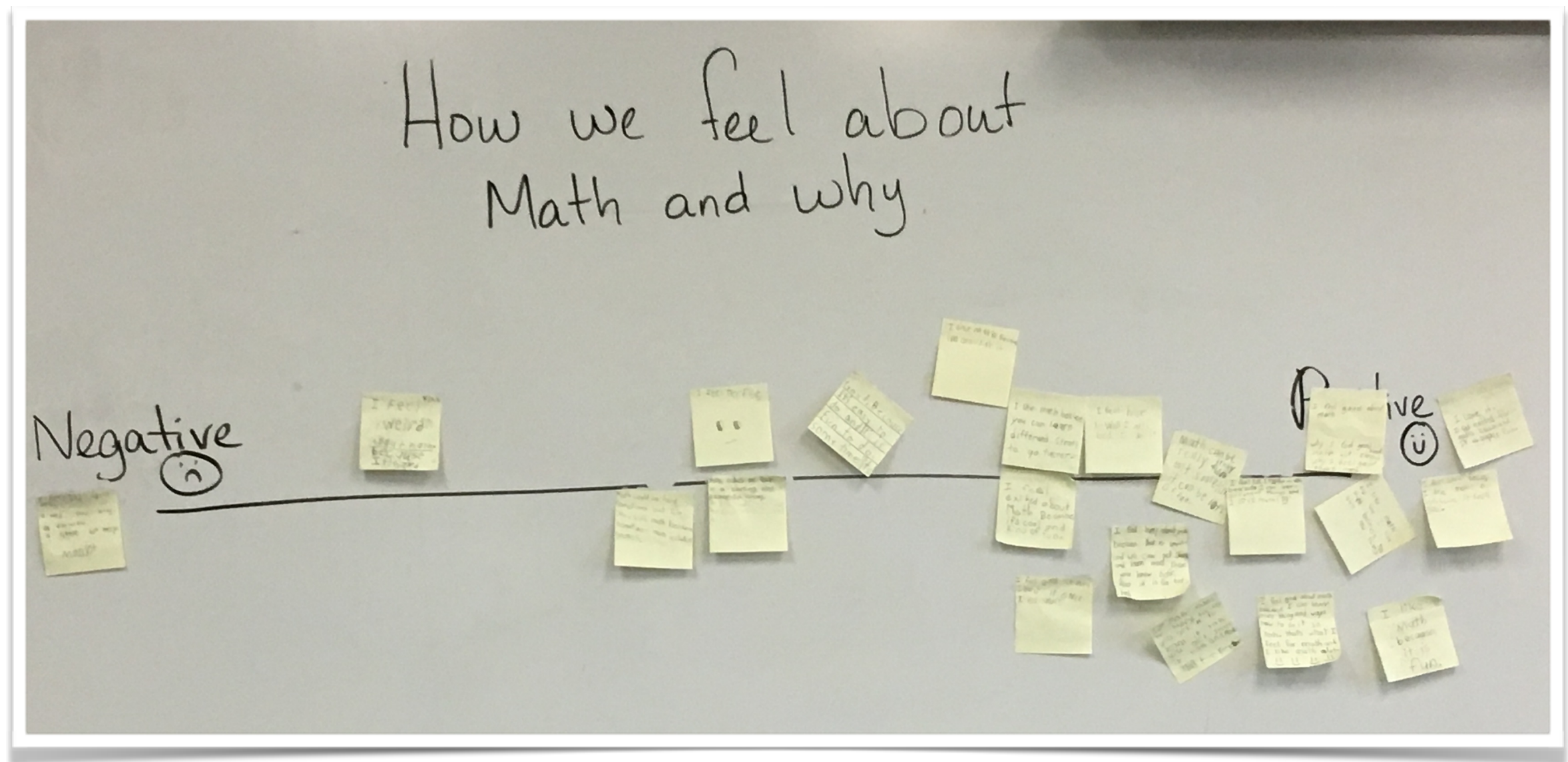
What is Mathematics? Sept. 14

learning	fractions
+ addition	time tables
- subtraction	time
× multiplication	everything
÷ division	grouping
rounding	writing
reading	<b>understanding</b>
wondering	discovering
noticing	questioning
numbers	solving
thinking	dreaming
working with others	ideas
imagined	
problem solving	

Let's change the narrative for our kids and make math class more like what math really is!







The same Grades 4/5 class later in the year after having learning experiences designed to foster the DOING of mathematics!

# Consider exploring your students' experiences in Mathematics

## MATHEMATICS: What is it? What does it mean to do math? Where does it live in the world?

A week of building understanding! Ideas take from Tracy Zager's "Becoming the Math Teacher You Wish You'd Had", Graeme Anshaw, and Jo Boaler's Weeks of Math



### Learning Intentions:

- I believe everyone is a Mathematician.
- I understand that learning is developmental and my identity as a mathematician will grow and change.
- I am developing my understanding of what Mathematics is.

DAY ONE	DAY TWO	DAY THREE	DAY FOUR	DAY FIVE
<p>Begin with asking the students "How do you feel about Math and why?" Have them write their responses on a sticky note.</p> <p>Then, put up a line spectrum with negative on one end and positive on the other. Each child that wish can share aloud their thoughts and then put the stick where they believe it fits on the line. Idea from Graeme Anshaw. Listen carefully to build your understanding of who your students are and how they see themselves as mathematicians.</p> <p>Ask the students what the graph tells about the community of mathematicians. What generalizations can be made? Ask "Why do we have these feelings about Mathematics?" Teacher should share their own personal stories about their histories with Mathematics.</p> <p>Discuss the goals for the year (e.g., Discover the beauty of Mathematics and where it lives in the world. Develop a positive mindset towards Mathematics. Identify as Mathematicians).</p>	<p>Begin with a class brainstorm to the question "What is Mathematics?". Use a specific coloured marker and date the colour.</p> <p>Read aloud On a Beam of Light: A Story of Albert Einstein by Jennifer Berne (2013)</p> <p>Focus on what Einstein loved to do... Imagine, question, wonder, figure, observe, notice.</p> <p>Split into a couple of groups with a teacher in each group (depending on the class context) and spend some time on a Math Hunt. Let the students know that they are free to wonder, notice, and to ask questions. "Where do they see math in their world?"</p> <p>Have the groups of students share out with the class as a whole by connecting the iPad to a projector. Using a different coloured mark, ask the students if they would like to add any new information to the class anchor chart "What is Mathematics?"</p> <p>Ask students to look at home for an object that represents Mathematics and bring it to tomorrow.</p>	<p>Begin by looking at the chart created yesterday. Share with the students that through looking at the artifacts they brought from home, we hope to broaden our understanding of what Mathematics is.</p> <p>In small groups, have the students share what they brought and discuss the Mathematics in the object. As a teacher, I would bring several items in for those students who forgot.</p> <p>After small group sharing, the students could do a gallery walk and look at all the items or students could bring each of their items to a collaborative circle space. At this point, together as a class, revisit the question "What is Mathematics". Using a different coloured marker add the new suggestions students offer.</p> <p>Next, I would discuss that today our goal is to brainstorm/discuss ways we will work together to build a positive, safe, mathematical community. Follow Jo Boaler's activity "Good Group Work" and co-construct anchor charts for the class. You may also want to ask if there are prickly words that others use that shut them down (e.g., Tracy Zager's six thorny</p>	<p>Begin by asking "Who in Here Believes They Are A Mathematician?"</p> <p>Give short book talks on each of the</p>	<p>Have students share about what they learned Mathematicians do. While students are listening ask if there is anything they would like to add to</p>

## Week of Inspirational Math

**Week 1**  
Grades 3-4  
Grades 5-9+

**Week 2**  
Grades K-2  
Grades 3-5  
Grades 6-8  
Grades 9-12

**Week 3**  
Kindergarten  
Grades 1-2  
Grades 3-5  
Grades 6-8  
Grades 9-12



**Stanford**  
GRADUATE SCHOOL OF  
EDUCATION

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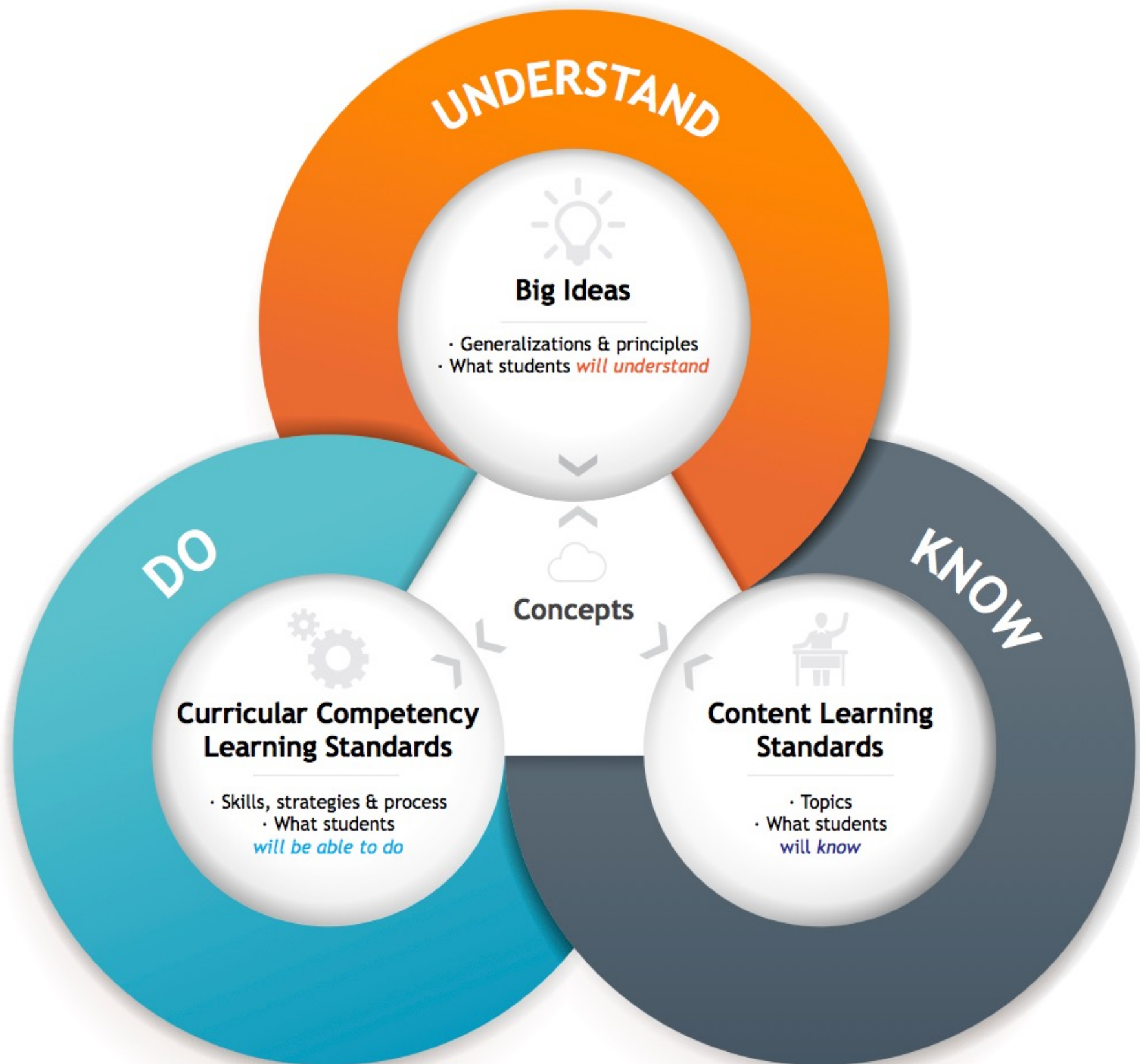


<http://bit.ly/startingtheyear>

<https://www.youcubed.org/week-inspirational-math/>



# BC's Revised Curriculum Framework

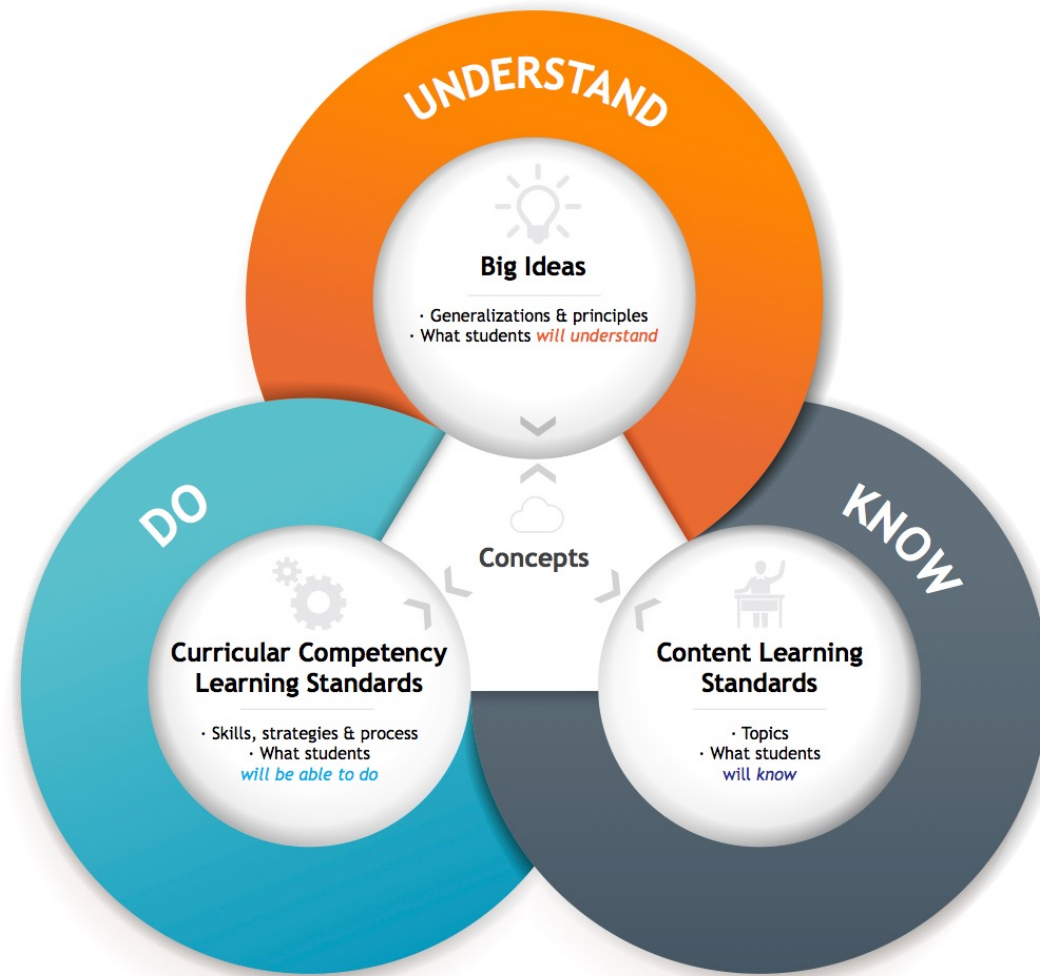


# What does this mean for me?



We must design learning experiences that foster both  
DOING and KNOWING!  
to develop UNDERSTANDING!





Learning standards must including the DOING and KNOWING!

\_\_\_\_\_ is able (is beginning to, needs support) to add and subtract to 1000



Learning standards must including the **DOING** and **KNOWING**!

           is able (is beginning to, needs support) to add and subtract to 1000

           communicates their understanding of addition and subtraction to 1000 in many ways

           applies their understanding of addition and subtraction to 1000 through play, inquiry, and problem solving



**Core Competencies** are the sets of intellectual, personal, and social and emotional proficiencies that all students need to develop to engage in deeper learning and to support lifelong learning.

## Communication

## Thinking

- Critical Thinking
- Creative Thinking

## Personal & Social

- Positive Personal & Cultural Identity
- Personal Awareness & Responsibility
- Social Awareness & Responsibility

# Sort the Curricular Competencies into the Core Headings

Curricular Competencies
<i>Students are expected to do the following:</i>
<b>Reasoning and analyzing</b>
<ul style="list-style-type: none"><li>• Use reasoning to explore and make connections</li><li>• <b>Estimate reasonably</b></li><li>• Develop <b>mental math strategies</b> and abilities to make sense of quantities</li><li>• Use <b>technology</b> to explore mathematics</li><li>• <b>Model</b> mathematics in contextualized experiences</li></ul>
<b>Understanding and solving</b>
<ul style="list-style-type: none"><li>• Develop, demonstrate, and apply mathematical understanding through play, inquiry, and problem solving</li><li>• Visualize to explore mathematical concepts</li><li>• Develop and use <b>multiple strategies</b> to engage in problem solving</li><li>• Engage in problem-solving experiences that are <b>connected</b> to place, story, cultural practices, and perspectives relevant to local First Peoples communities, the local community, and other cultures</li></ul>
<b>Communicating and representing</b>
<ul style="list-style-type: none"><li>• <b>Communicate</b> mathematical thinking in many ways</li><li>• Use mathematical vocabulary and language to contribute to mathematical discussions</li><li>• <b>Explain and justify</b> mathematical ideas and decisions</li><li>• Represent mathematical ideas in <b>concrete, pictorial, and symbolic forms</b></li></ul>
<b>Connecting and reflecting</b>
<ul style="list-style-type: none"><li>• <b>Reflect</b> on mathematical thinking</li><li>• Connect mathematical concepts to each other and to <b>other areas and personal interests</b></li><li>• <b>Incorporate</b> First Peoples worldviews and perspectives to <b>make connections</b> to mathematical concepts</li></ul>

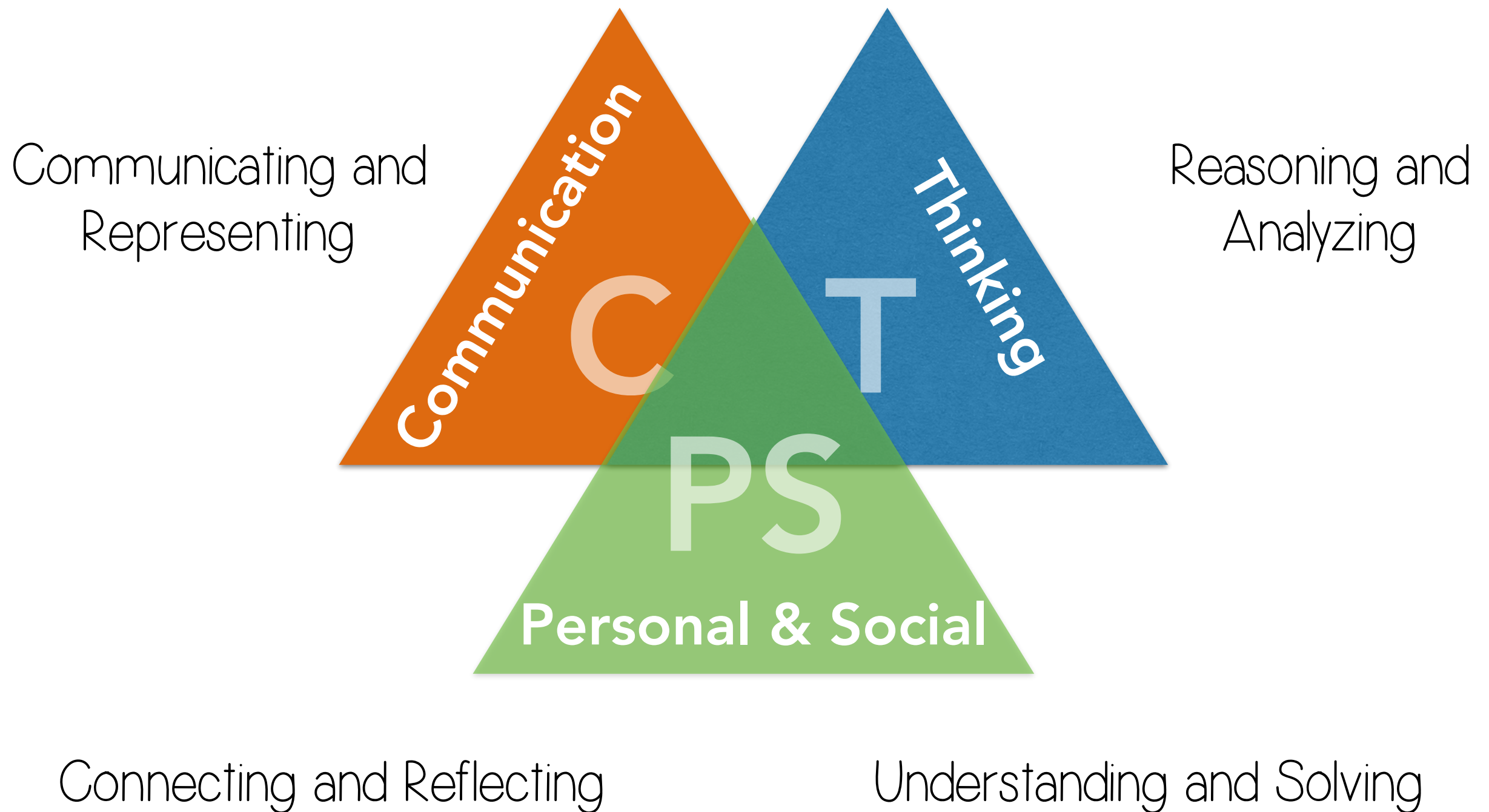


It is hard to categorize...  
Many overlap...  
It is complex!





# What learning experiences will develop and support the competencies?





Many people mistakenly believe that to be successful in mathematics requires only the ability to problem solve and and memorize number facts. Yet, the aptitudes related to understanding one's self and developing positive relationships with others are what enable effective mathematical thinking and communication to take place.

- Teaching With Meaning, Krpan (2018), p.g. 181





- Interacting with others
- Monitoring one's own learning
- Understanding the effects of your actions on others
- Developing a mindset to overcome obstacles
- Collaborating with others
- Listening purposefully
- Self-assessing
- Developing a positive attitude
- Setting personal goals

Evidence of a Weak Classroom Community	Evidence of Strong Classroom Community
Students will not talk to one another; they keep their thinking to themselves	Students talk to one another; they explain and clarify their thinking to each other.
Students see working together as cheating; they work alone.	Students see working together as learning; they collaborate, ask each other questions, and respectfully challenge ideas.
Students believe that they are either good at math or bad at math, and that this really can't change. They exhibit a fixed mindset.	Students believe they are all capable of being successful in math - they exhibit a growth mindset.
Students are reluctant to struggle; instead they wait to be rescued by the teacher or by another student.	Students constructively struggle together and hold all members of the group accountable for learning.
Students are disrespectful of their peers' ideas.	Students respect their peers' ideas and view one another as knowledgeable.
Students hide their work from each other.	Students share their work with each other.
Students feel that their opinions and ideas don't matter - it's not worth the risk.	Students feel their opinions and ideas do matter - it is worth the risk!

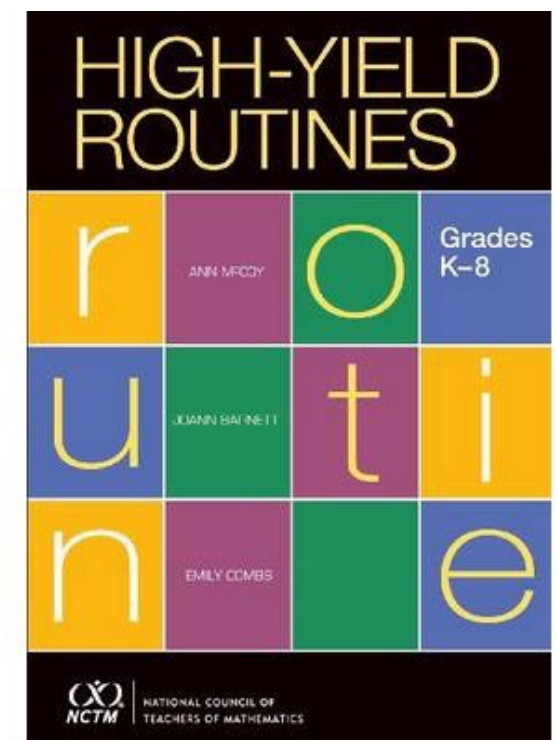
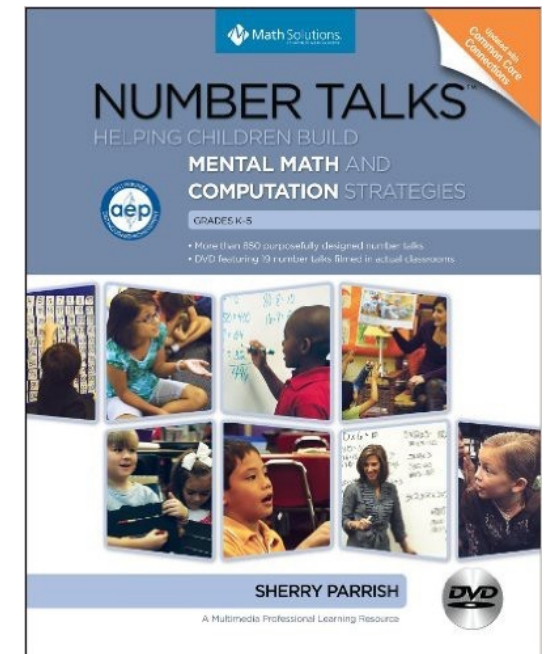
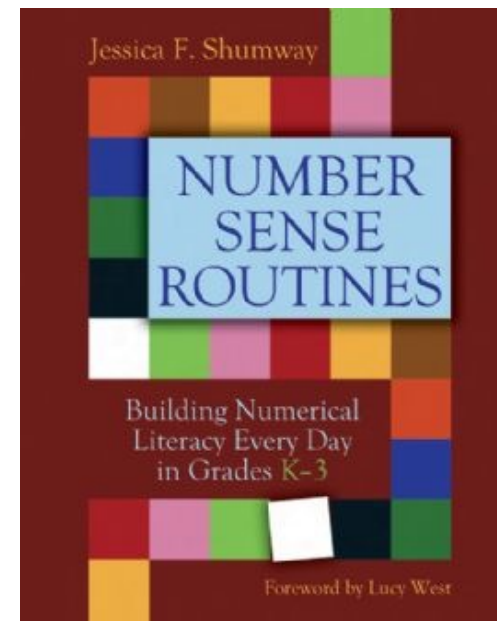


# Why use Number Routines?

- Builds a Math community where students feel safe to take risks and can learn from one and other
- Provides daily number sense experiences where students clarify their thinking, consider and test strategies, and build a repertoire of efficient strategies
- Responsive to students' understandings
- Allows for spiralling through concepts and helps students make connections to the big ideas in mathematics
- Emphasizes the core and curricular competencies in relation to mathematical content.

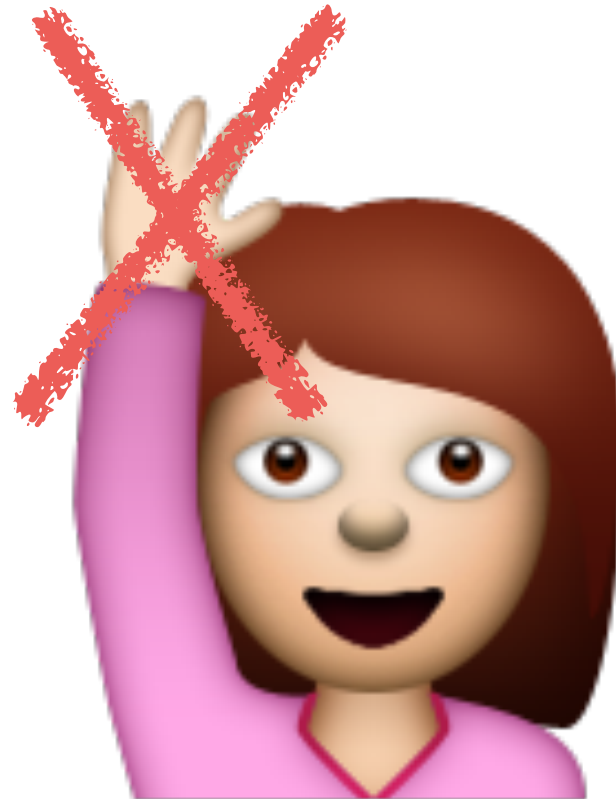
# Let's look at some Mathematical Instructional Routines!

- Collection of quick, low-prep 5 to 10 minute activities.
- They focus on the big ideas in Mathematics.
- They serve to reteach, reinforce, and enrich.
- Can be used as warm ups, mini lesson, with the whole class or in small groups.



# Quick Image Talks

Thinking time  
is needed



**NO HANDS UP**  
**SECRET SIGNALS**

Hold up one thumb if you have one way to  
find the answer.



Hold up another finger if you another way...

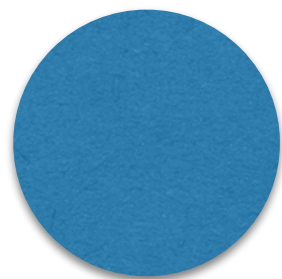






How many?

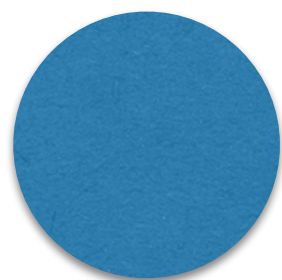
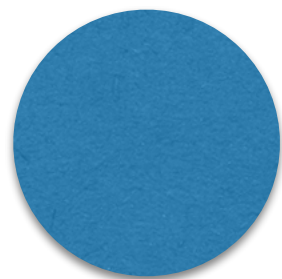
How did you see them?





How many?

How did you see them?

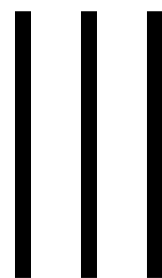
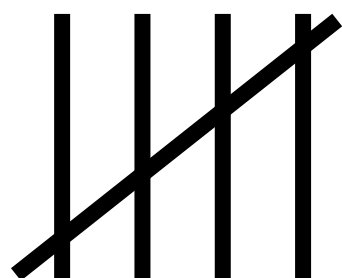
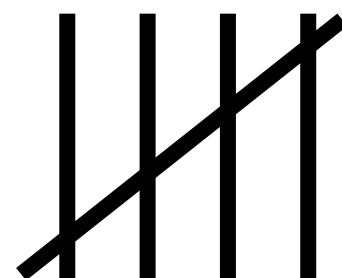
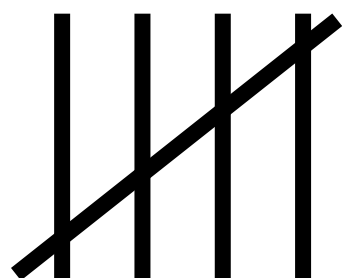
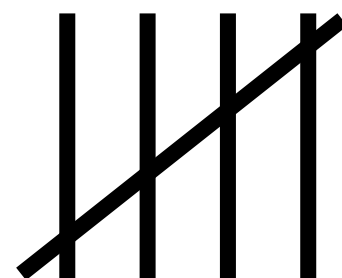
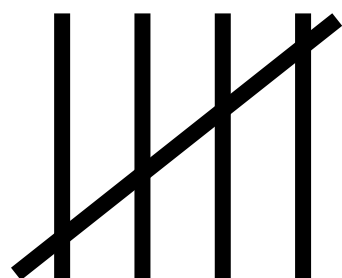


# Subitizing

- Perceptual Subitizing - Instantly seeing how many
- Conceptual Subitizing - involves the ability to see the smaller groups and being able to combine them together to compose the whole/total.

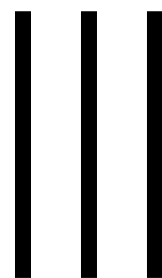
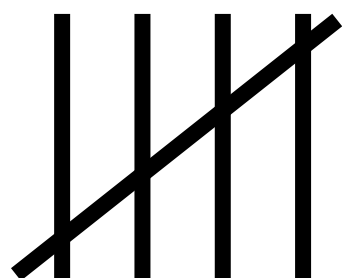
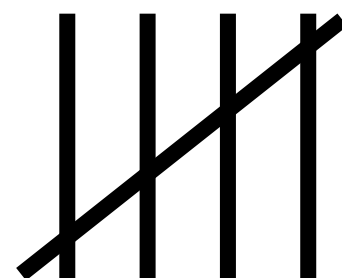
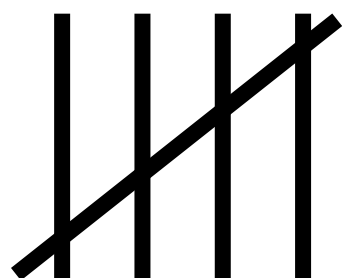
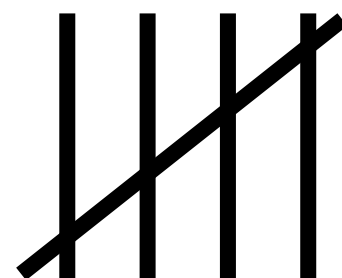
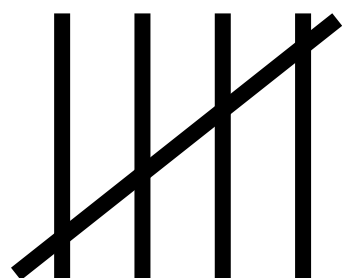
It helps students move from counting by ones, and assists them in seeing how numbers can be taken apart and put back together (decomposing).



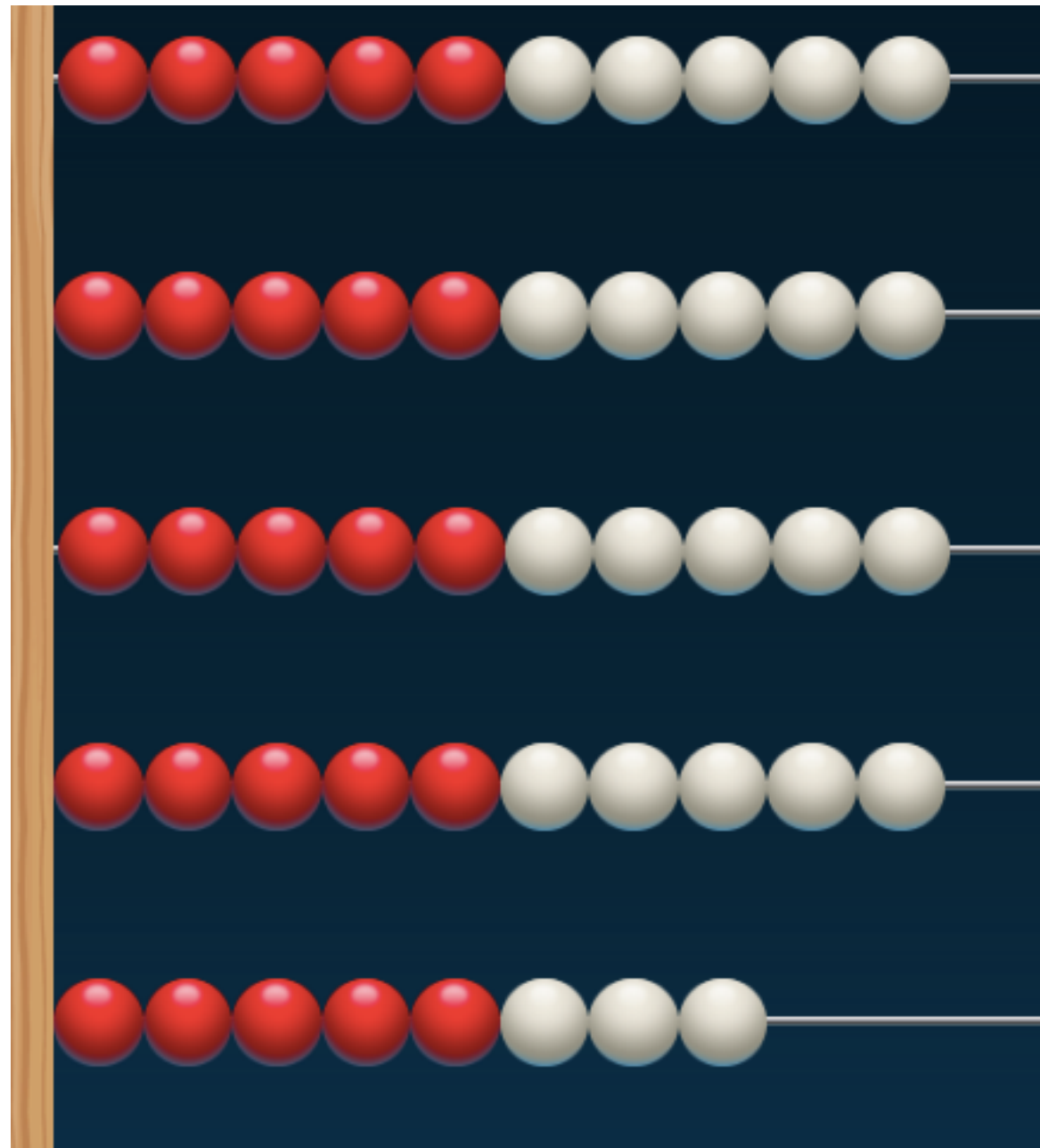


How many?

How did you see them?



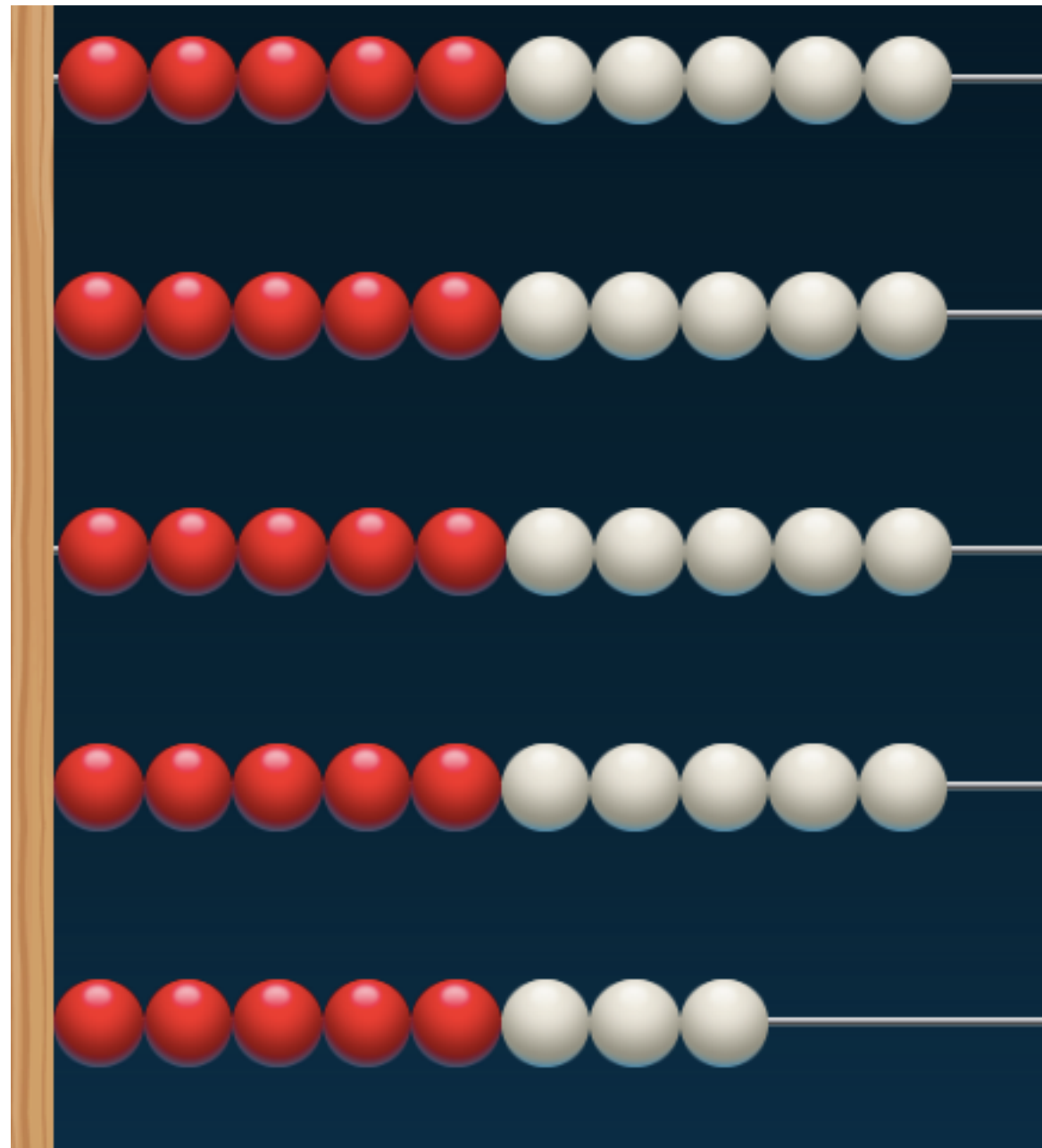




<https://www.mathlearningcenter.org/resources/apps>

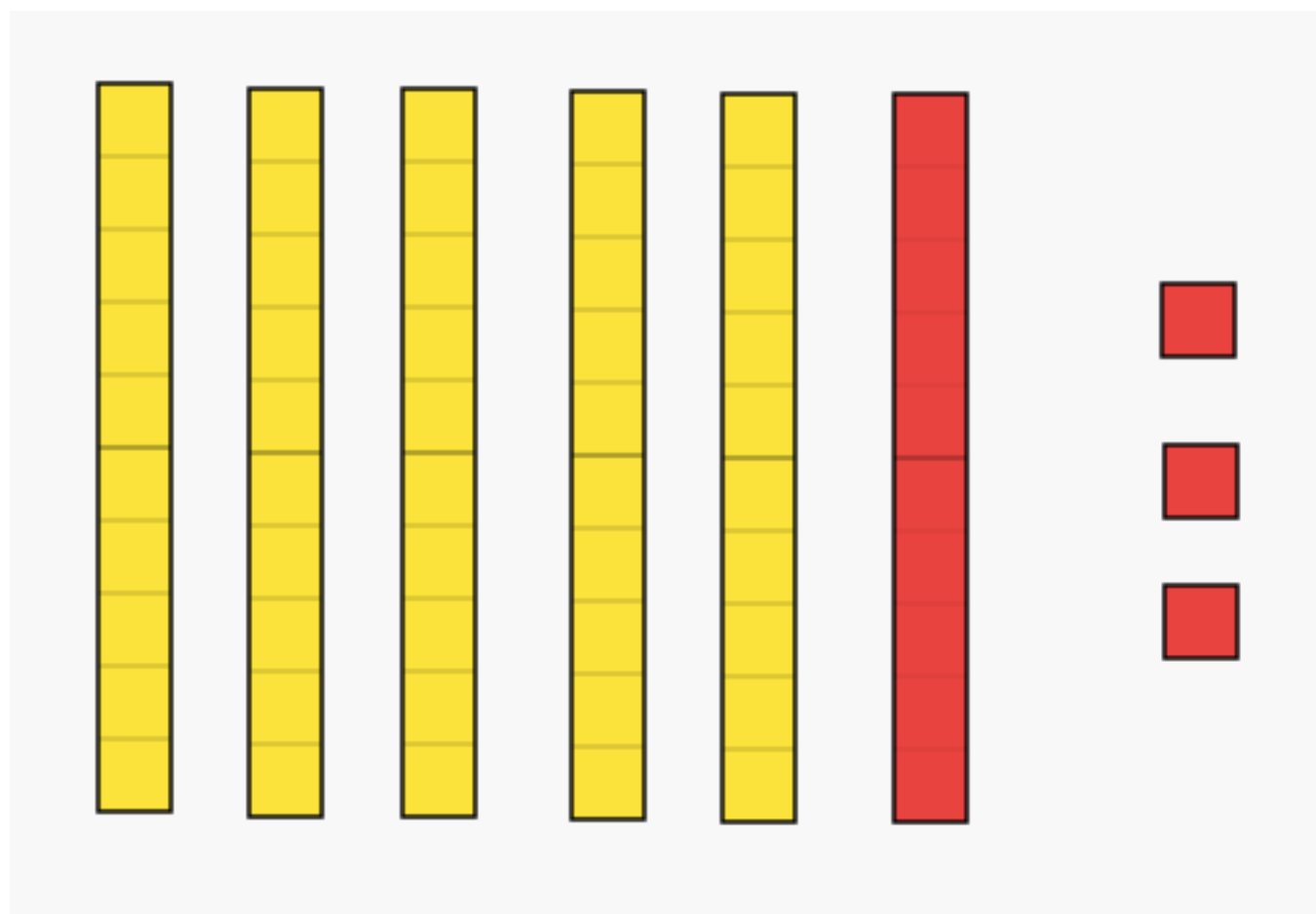
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How did you see them?



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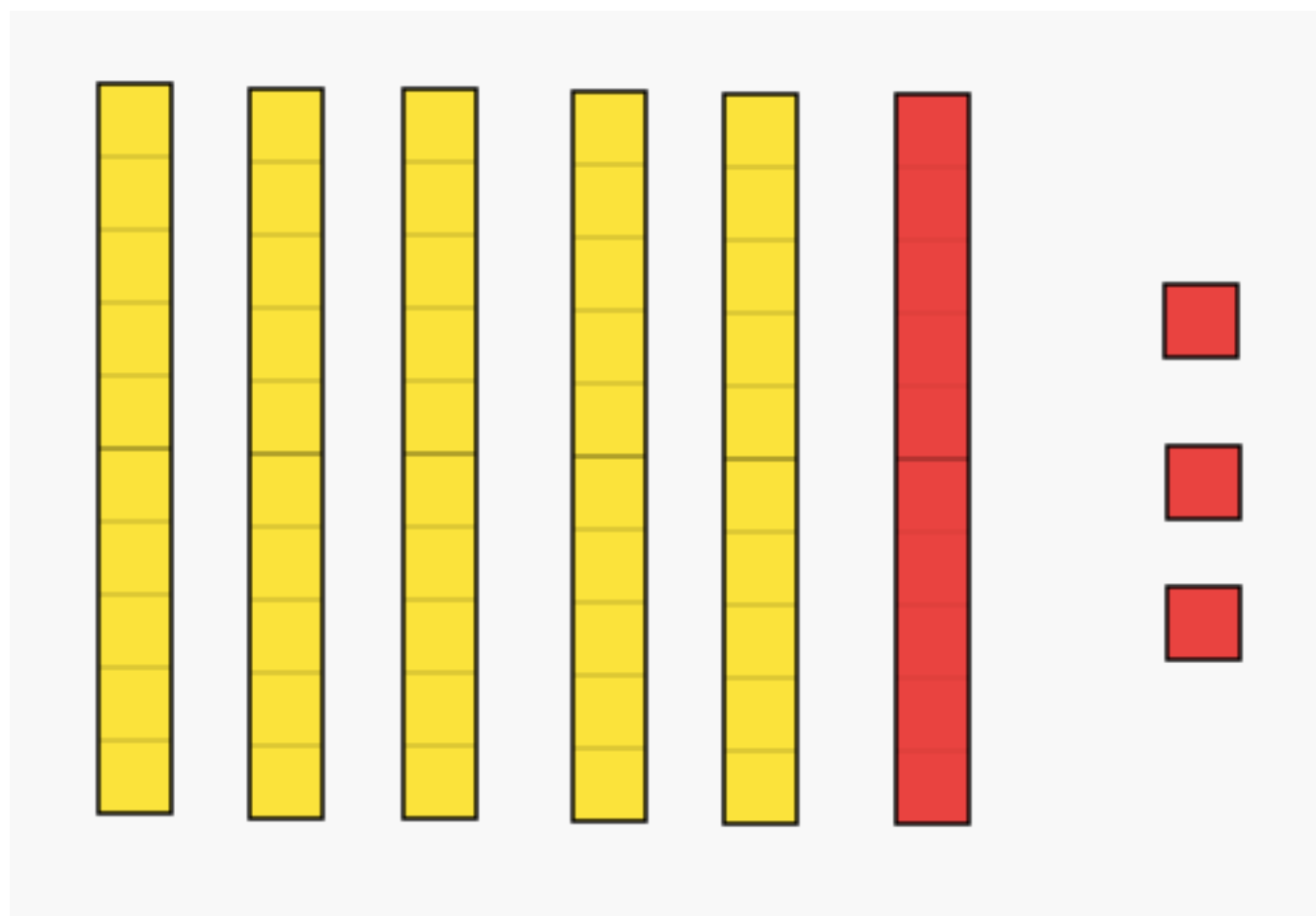




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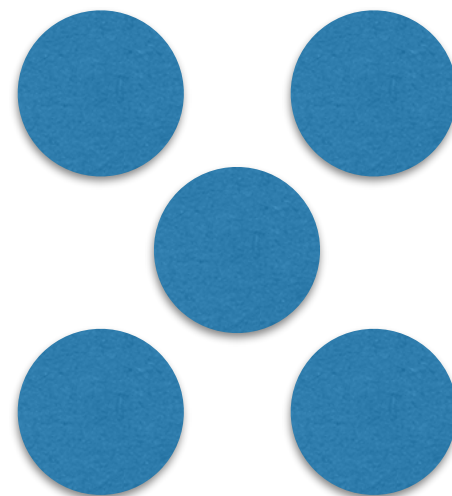
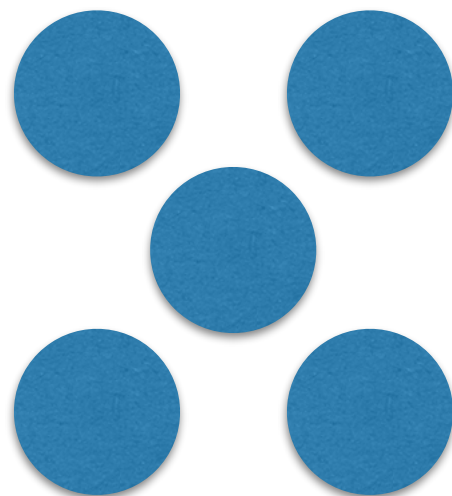
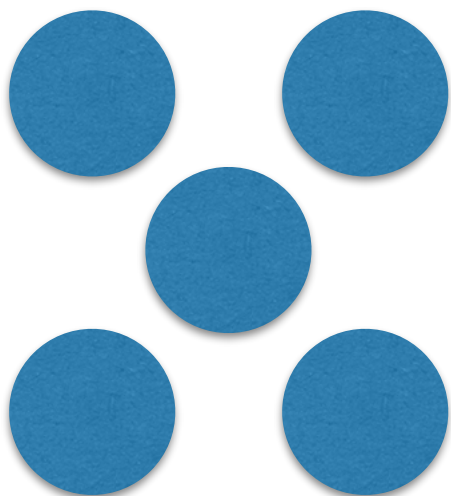
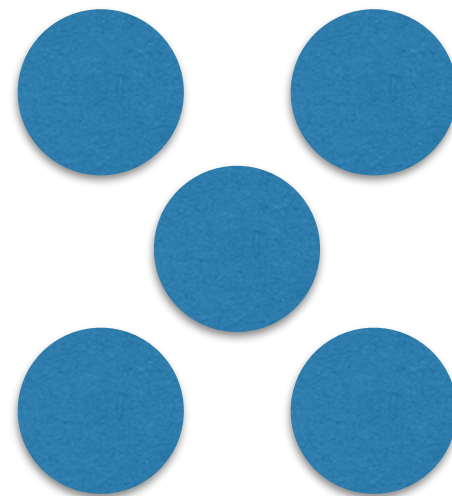
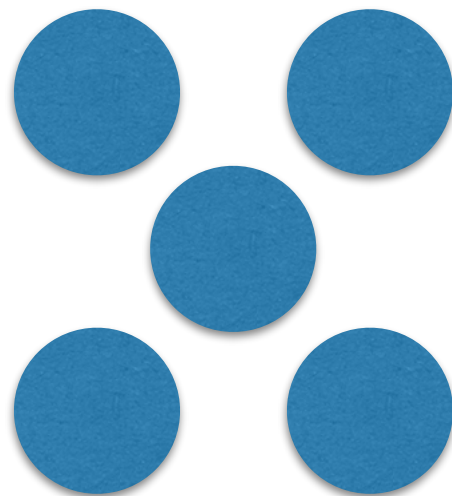
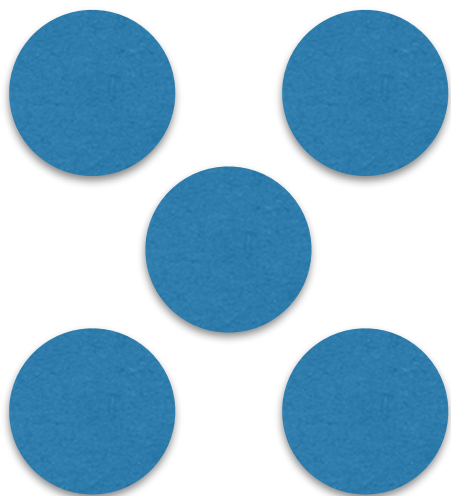
How many?

How did you see them?



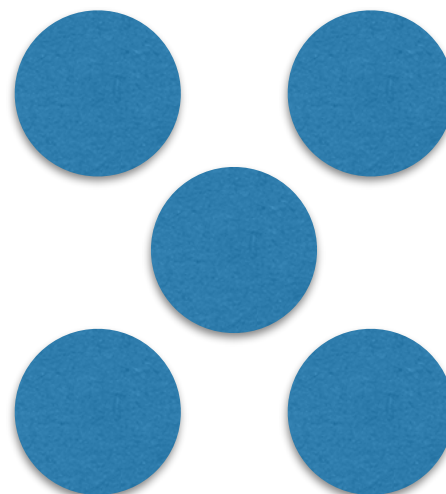
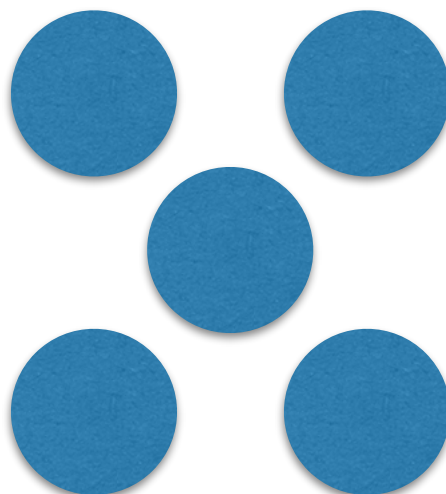
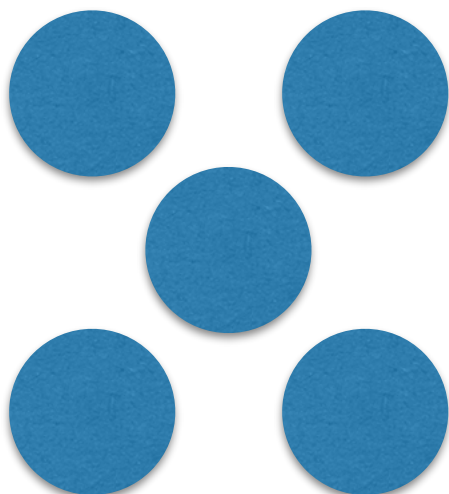
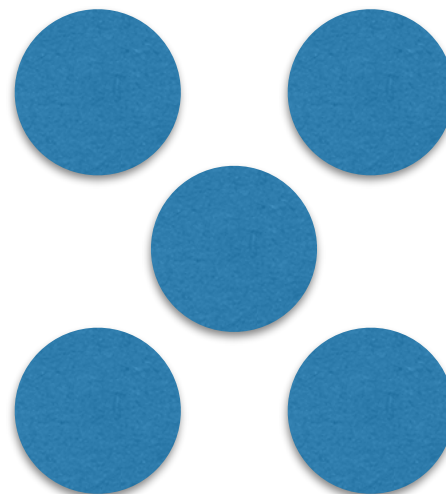
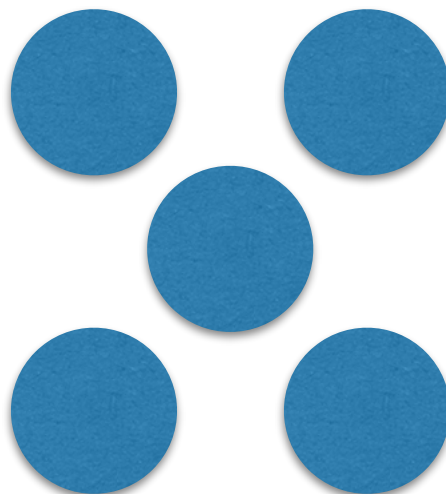
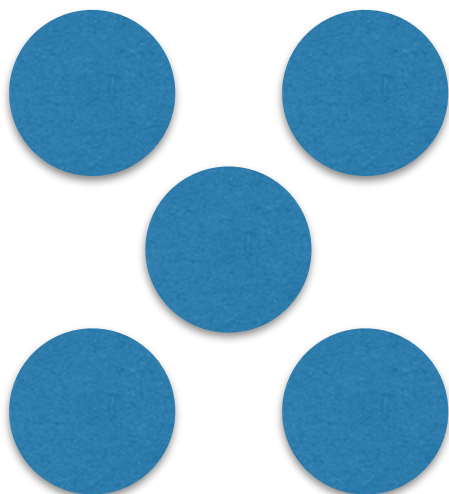
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How many?

How did you see them?



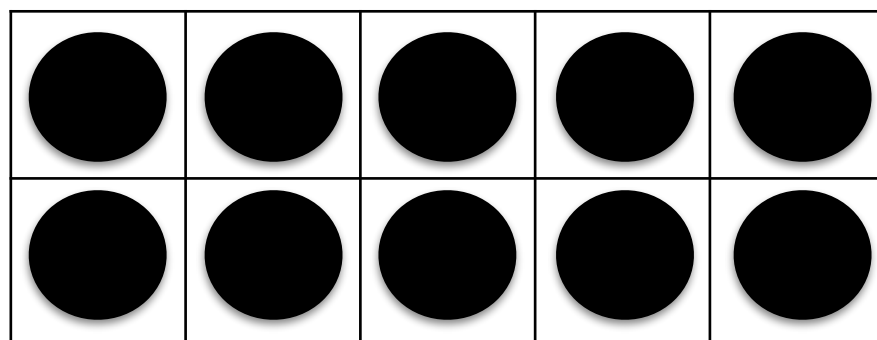
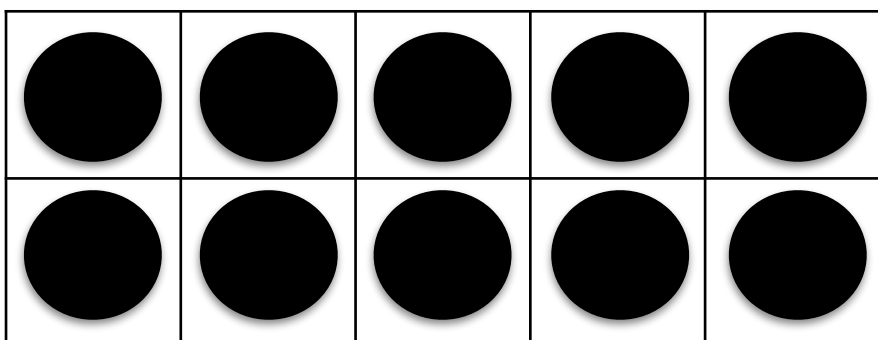
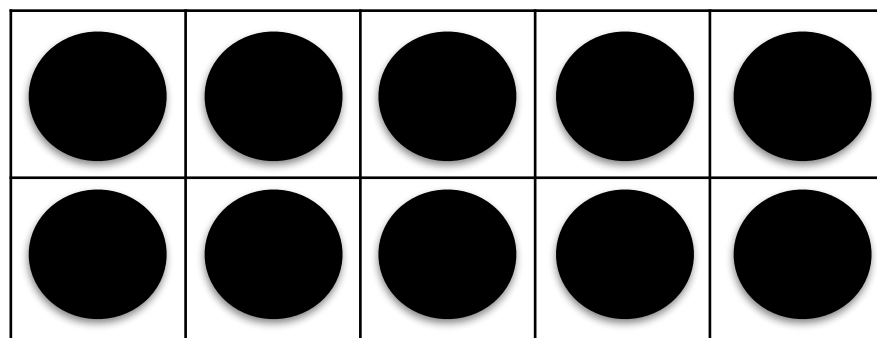
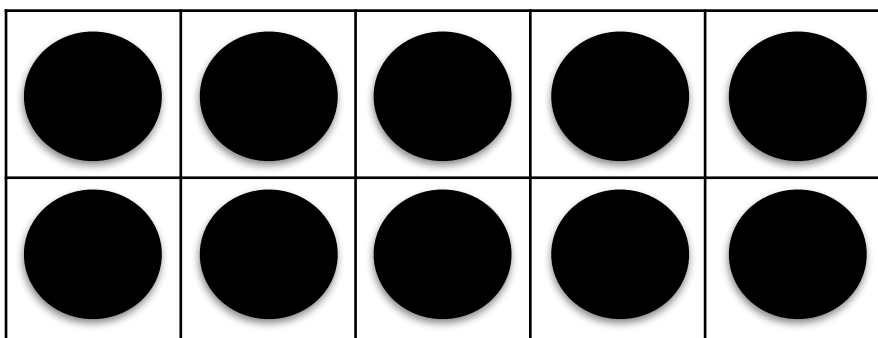
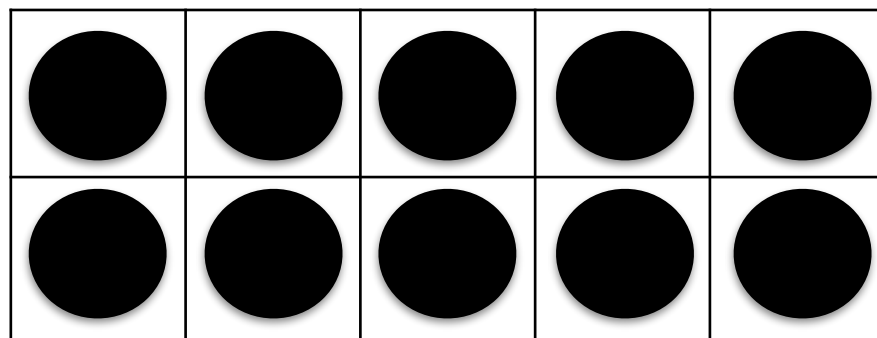
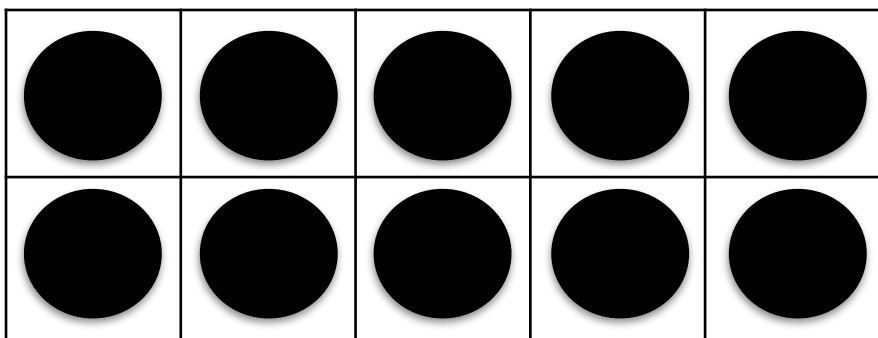
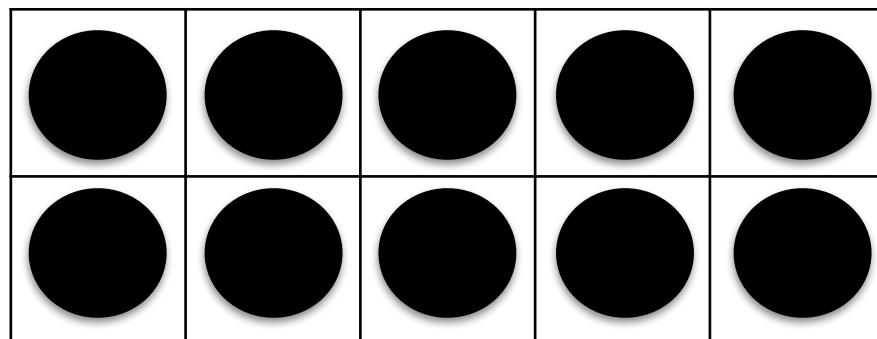
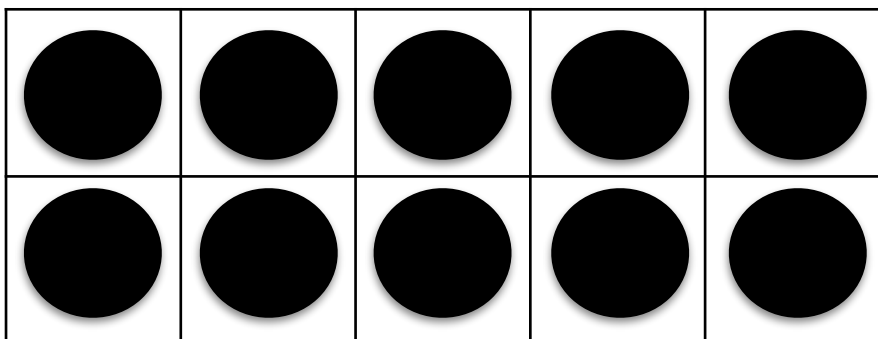




How many?

How did you see them?

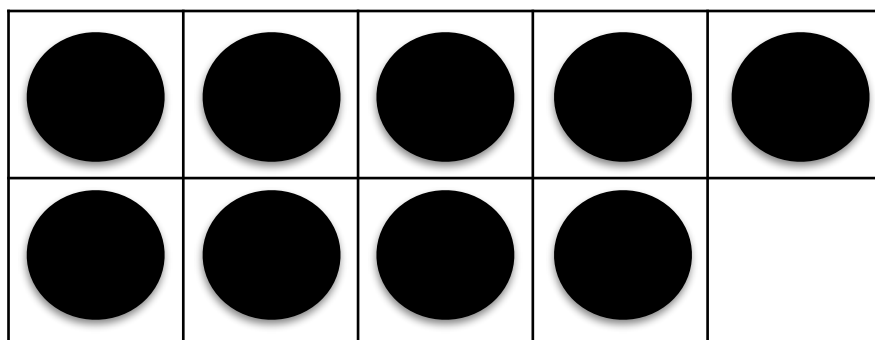
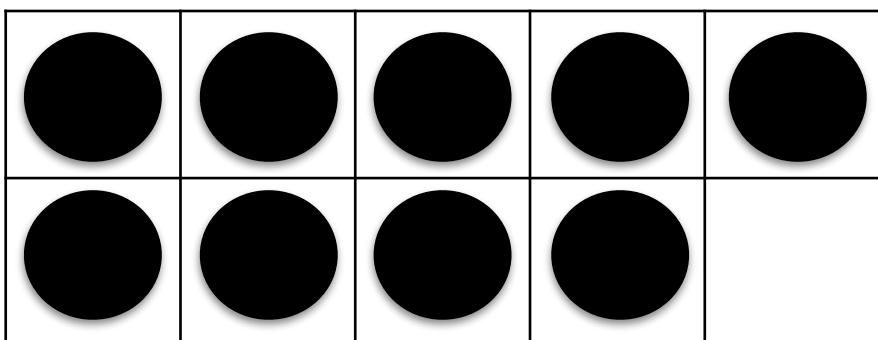
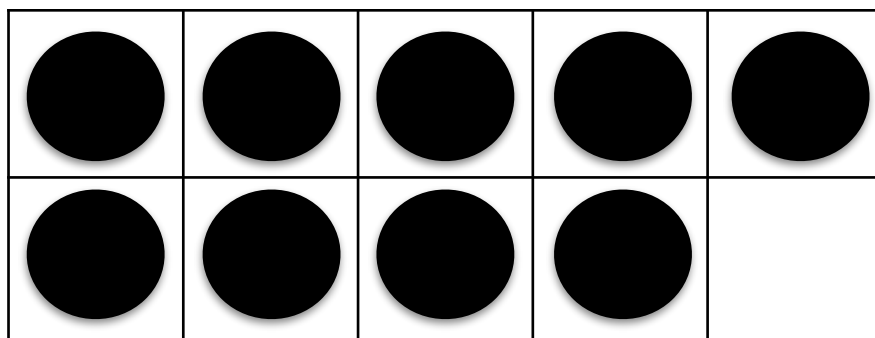
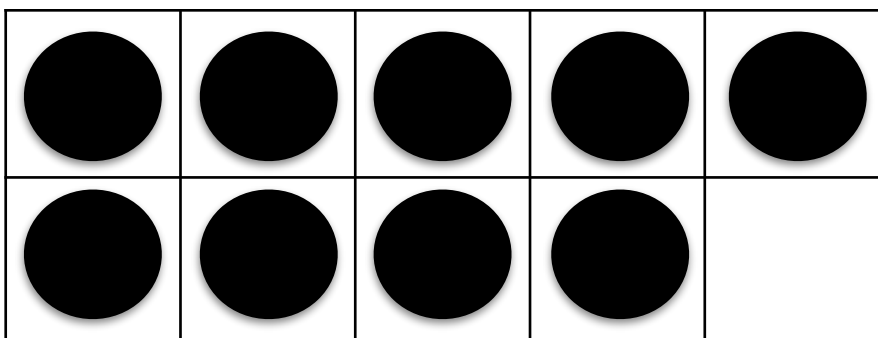
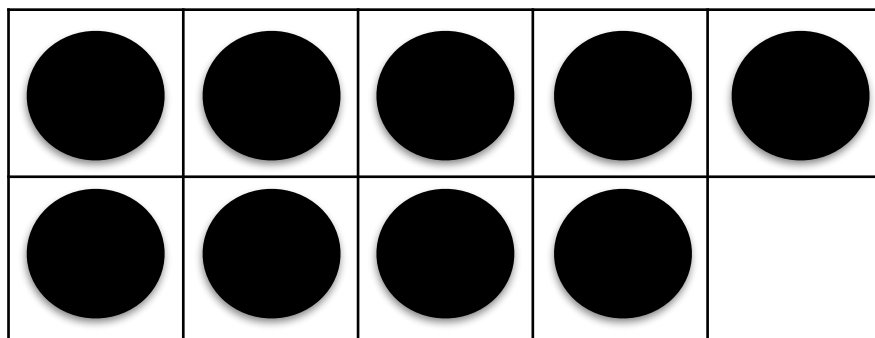
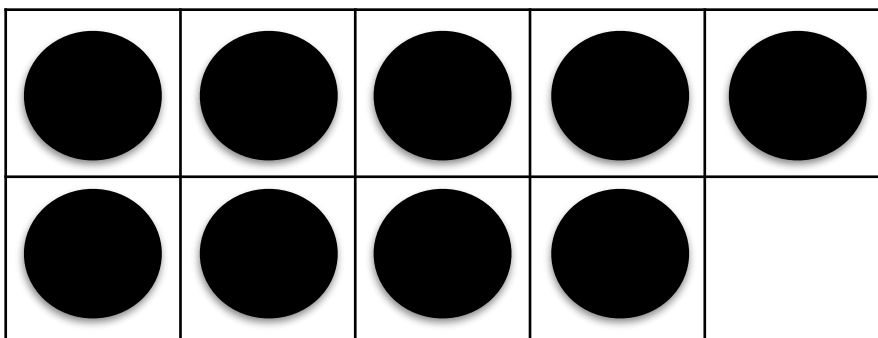
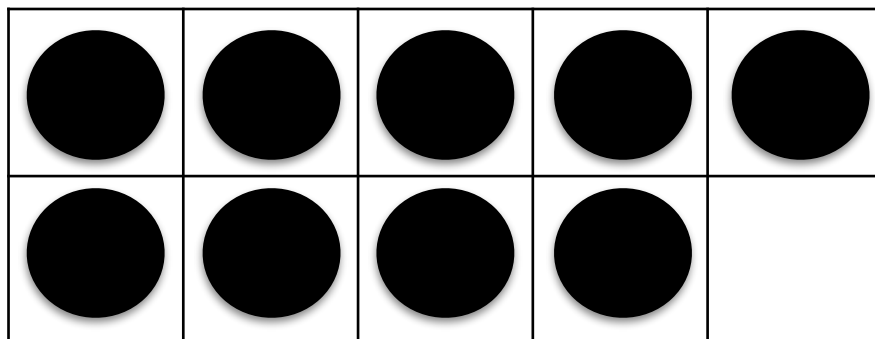
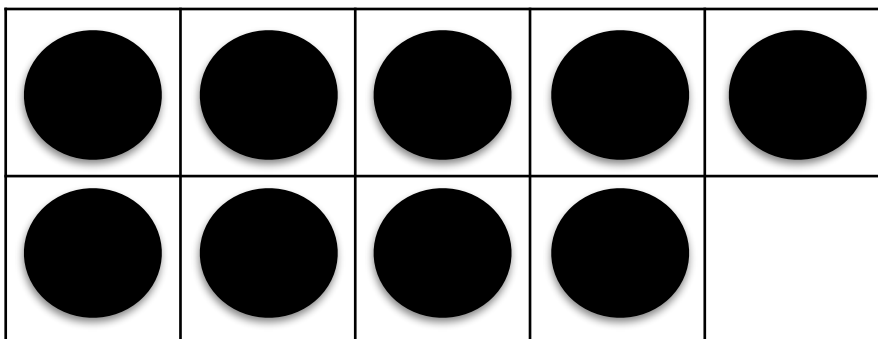




How many?

How did you see them?

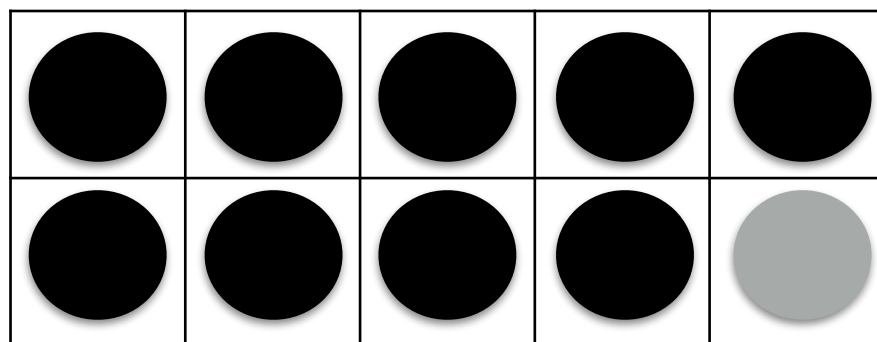
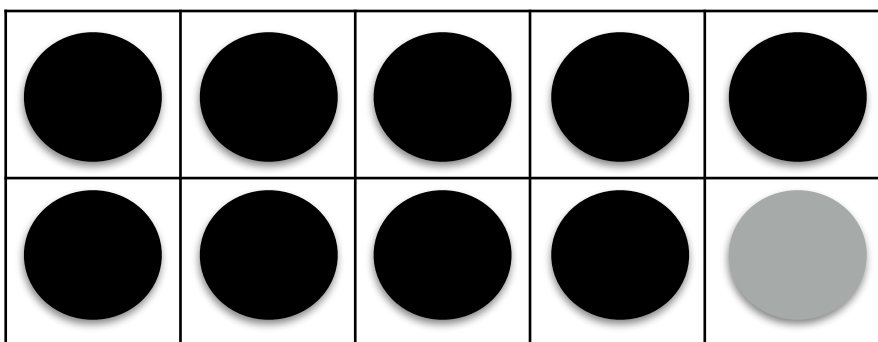
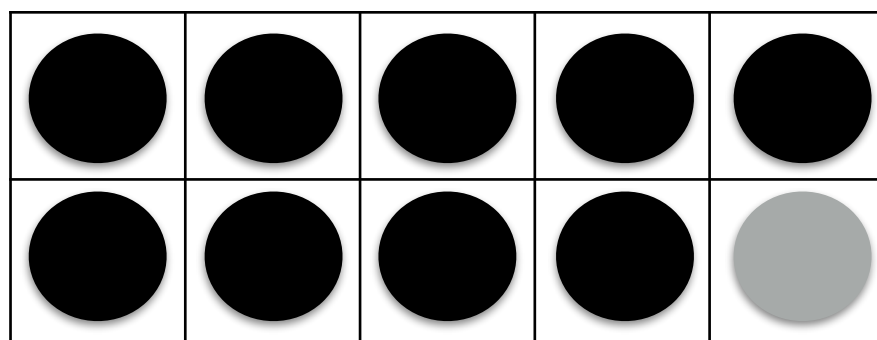
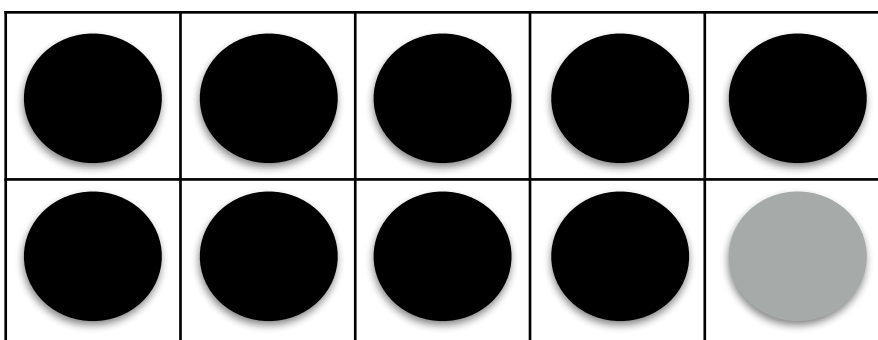
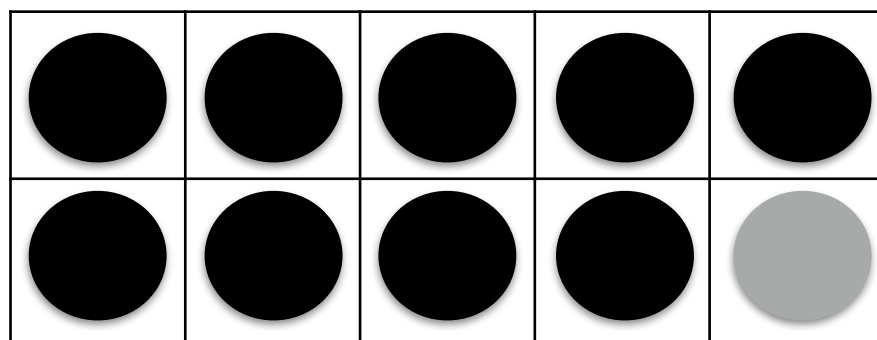
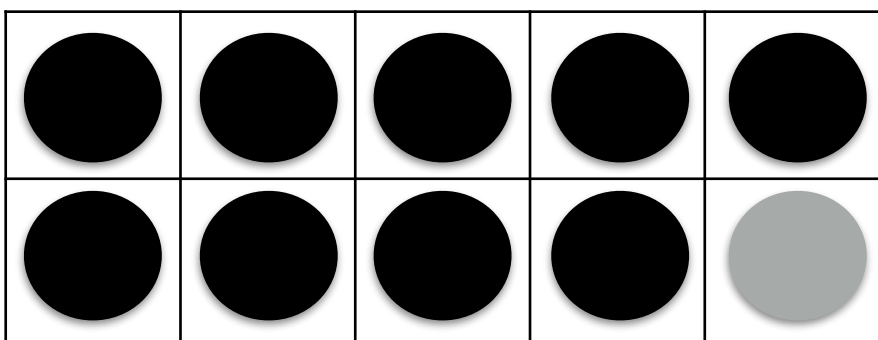
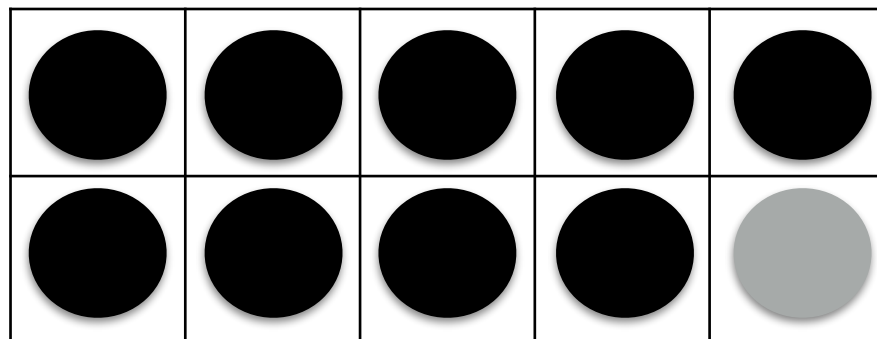
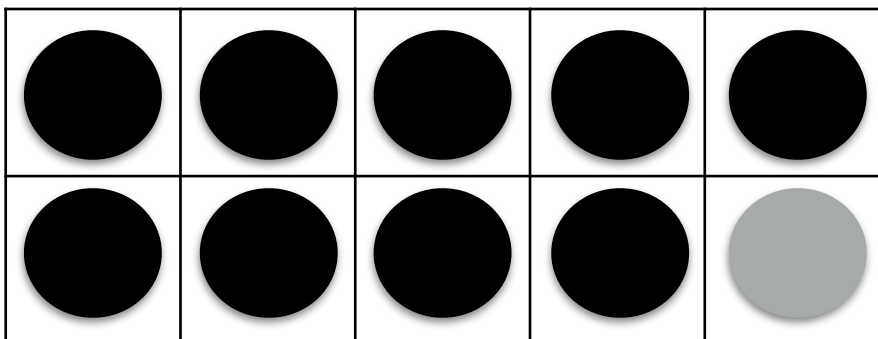


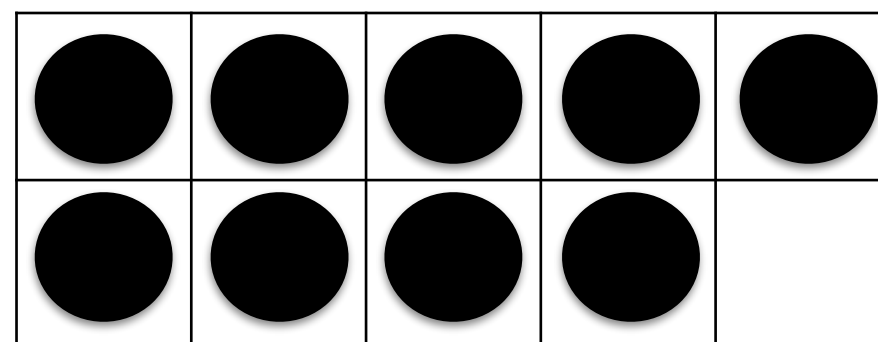
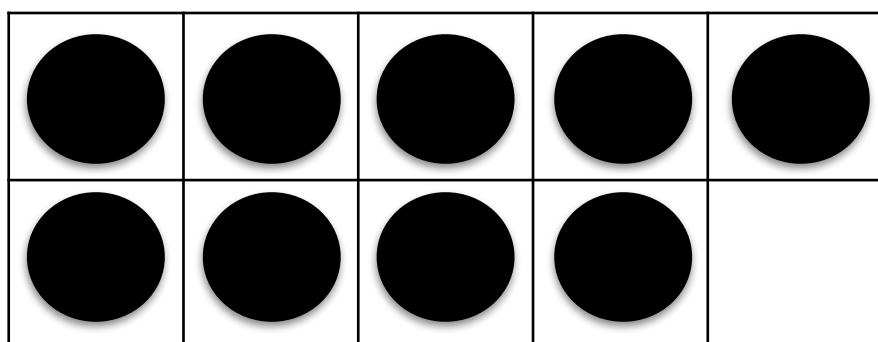
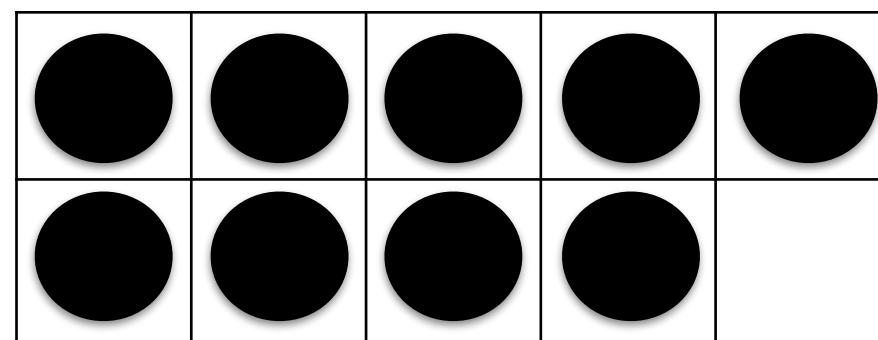
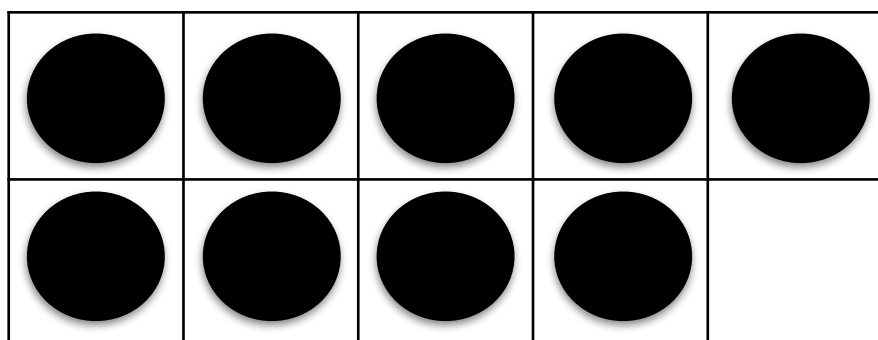
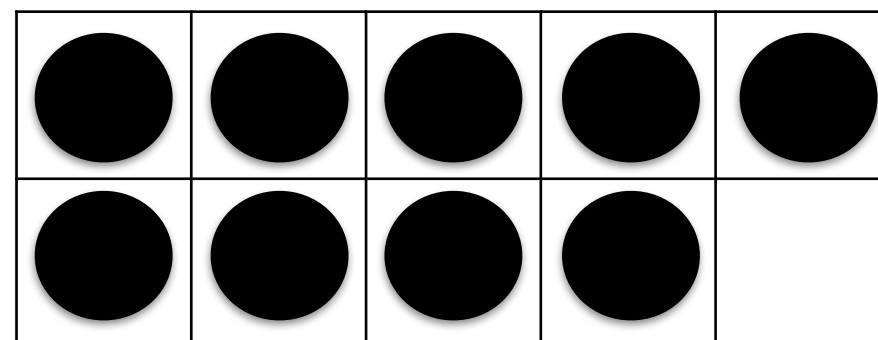
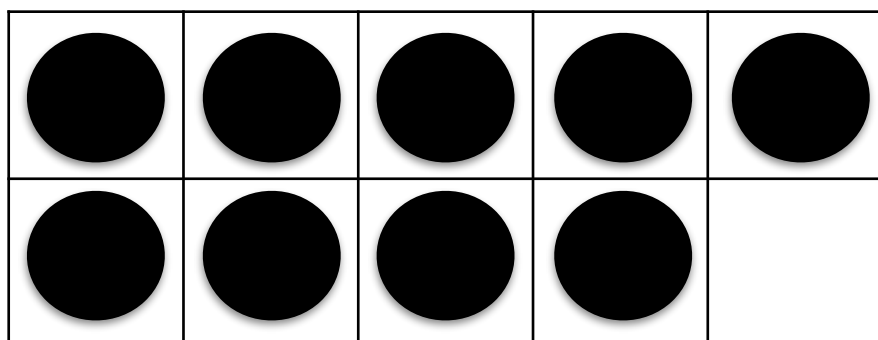
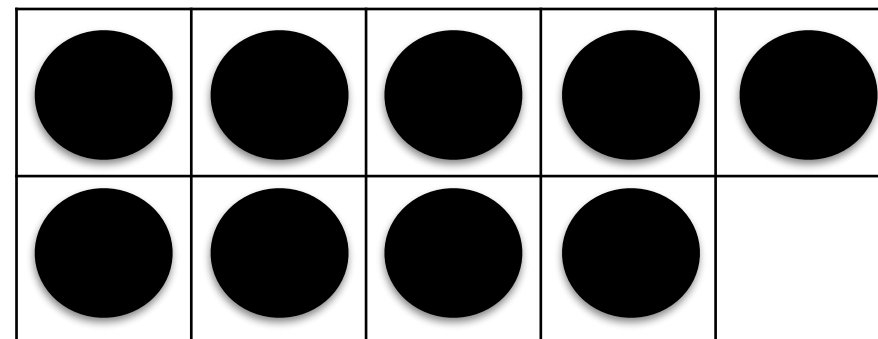
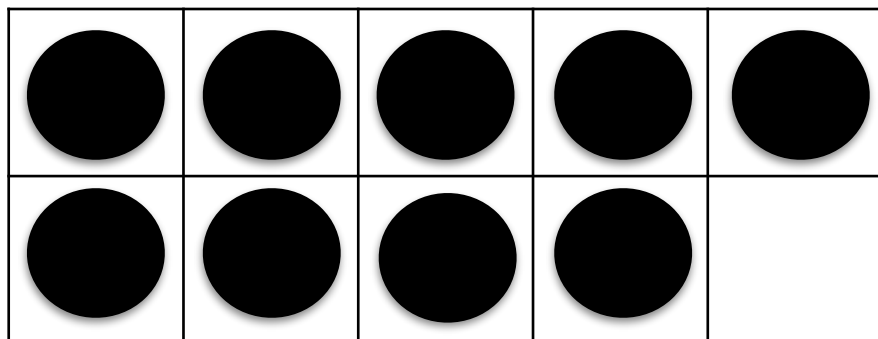


How many?

How did you see them?

How might thinking about the previous  
image help us with this question?





$$(8 \times 10) - 8 = 72$$





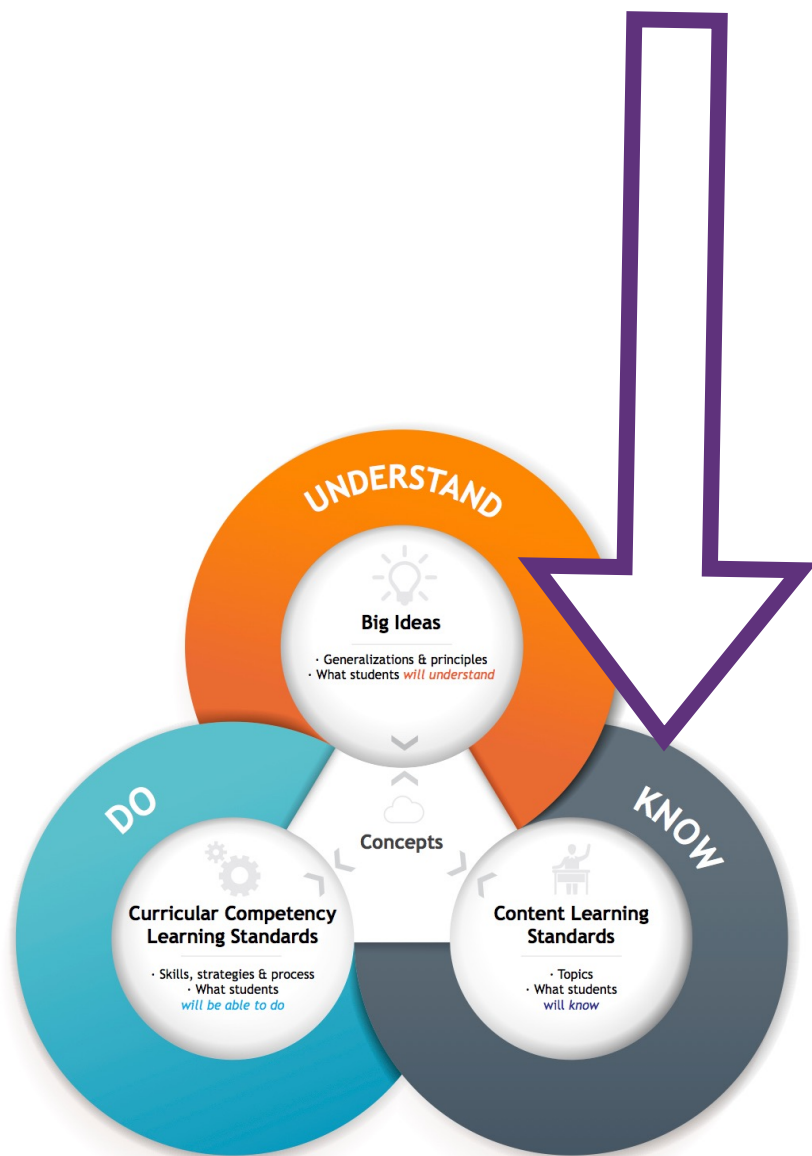
Take a minute and jot down any COMPETENCIES  
you feel are fostered through Quick Image Talks...

**CALL  
OUT...**

**ANY COMPETENCIES  
THAT COME TO MIND**



# What CONTENT might your students explore?



- Subitizing
- Estimation
- Counting - one-to-one correspondence, cardinality, counting sequence, skip counting
- Place Value - Units and groups are the essence of this. Place Value is built upon putting things into groups
- Decomposing and Recomposing
- Additive Thinking
- Multiplicative Thinking

# Understanding Numbers

Students must move fluidly between these 3 understandings:

- Quantity is how many things there are.
- Number language is how we say how many things there are (e.g., one, two, dozen, pair)
- Numeration is how we write how many things there are (e.g., numerals, roman numerals, tally marks)

- Fuson (1997) in Danielson (2017) p.g. 11

# How Many?

## How Many?



A COUNTING BOOK / CHRISTOPHER DANIELSON





Ever since 1 April 1960, when Dr. Martens boots first rolled off the production line and onto the feet of postmen, policemen and everyday workers, our reputation for durability has become footwear folklore. Over 100 million pairs later, our belief in making things to last is as strong as it's ever been.



Turn and talk to a partner about what you see!









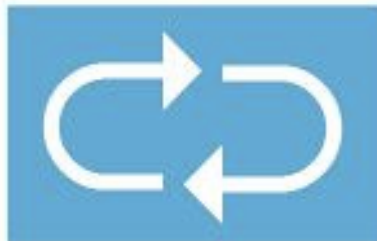


# Math Talk Moves



## Revoicing

"So you're saying that \_\_\_\_\_.  
Do I have that right?"



## Repeating

"Can you restate or rephrase  
what \_\_\_\_\_ just said?"



## Reasoning

"Do you agree or disagree,  
and why?"



## Adding On

"Would someone like to add on?"



## Waiting

"Take your time...we'll wait..."



## Turn & Talk

"Partner turn and talk  
or think-pair-share"

Teachers can  
use and  
encourage  
Talk Moves



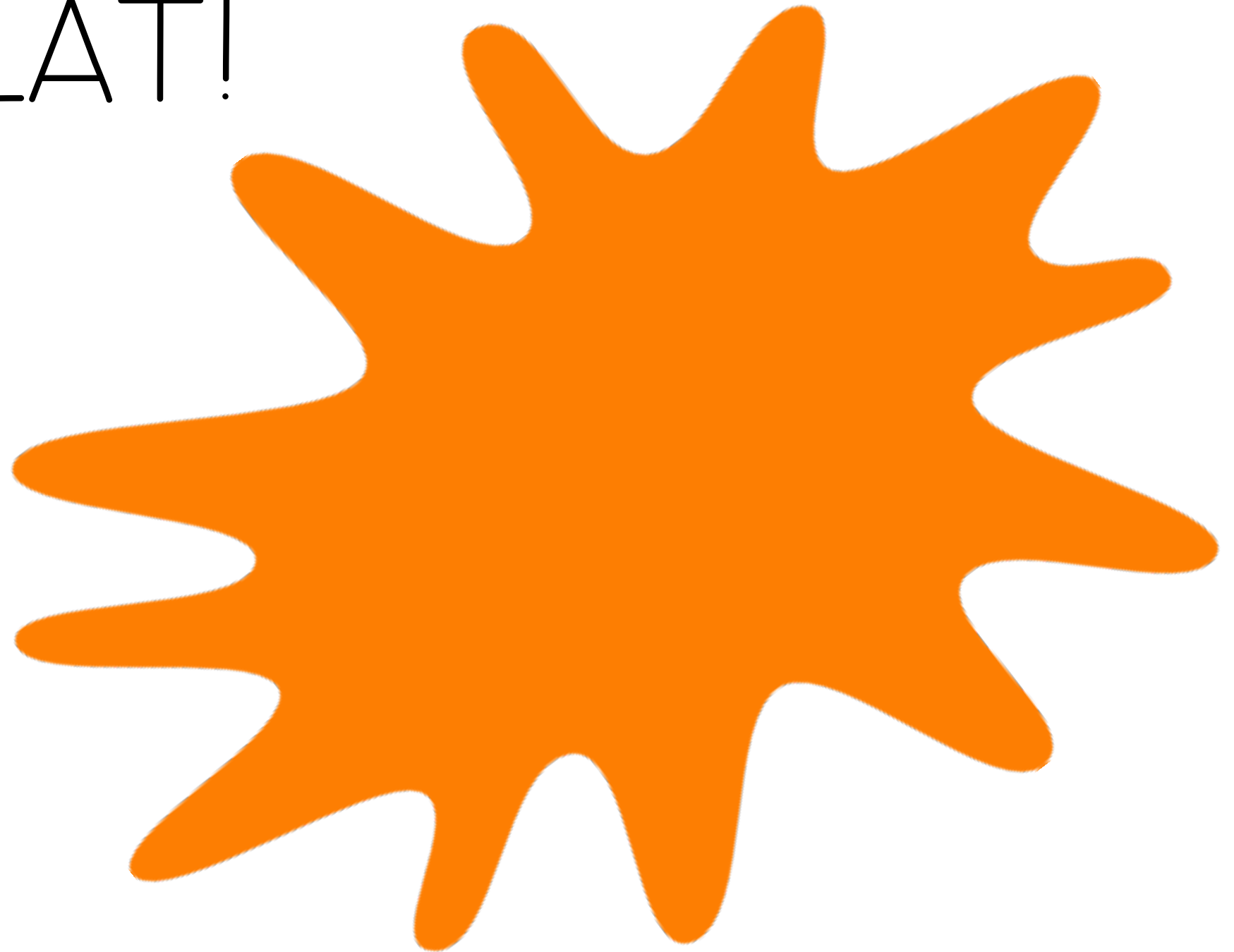
\*Summary Tables of Productive Talk Moves\* from Classroom Discussions in Math: A Teacher's Guide for Using Talk Moves to Support the Common Core and More, Grades K-6 by Suzanne H. Chapin, Catherine O'Connor, and Nancy Canavan Anderson. Copyright © 2013 by Scholastic Inc. All rights reserved. Item # 584882.

Not only is “What counts as one?” an important question, its answer changes based on your perspective, and so it offers opportunities for ***play***. Children like to play; they need to play. Children find numbers wonderful, delightful, interesting and fun.

**Numbers constitute a playground for children’s minds!**

– Christopher Danielson, How Many?  
Teacher’s Guide (2017) p.g.1

SPLAT!

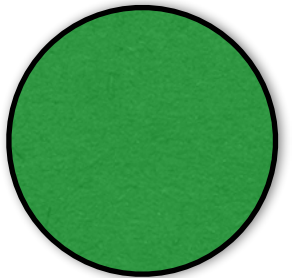
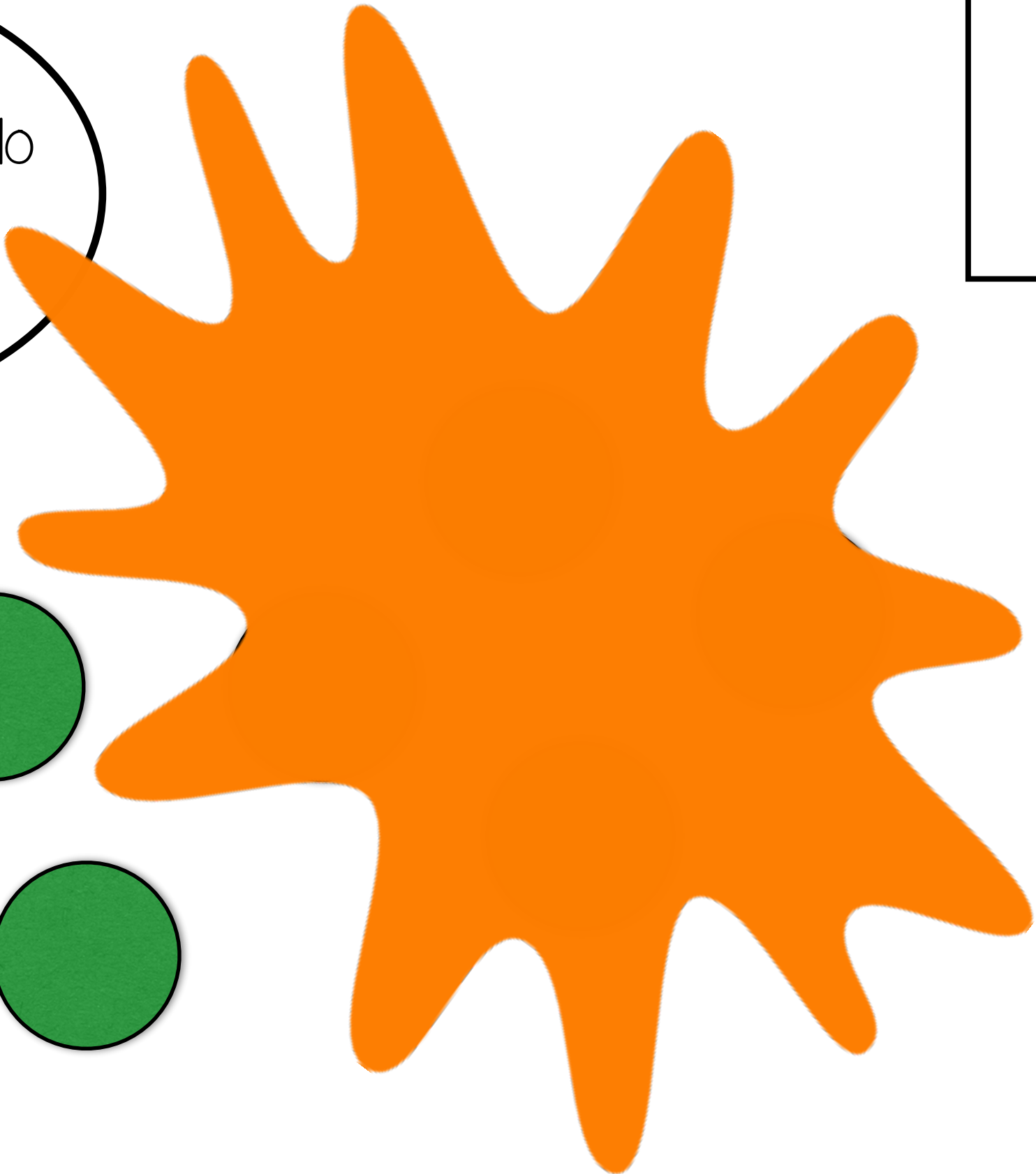
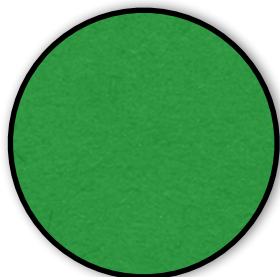
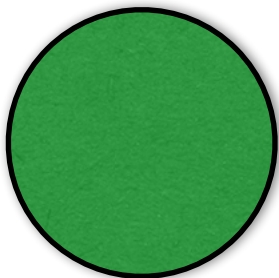
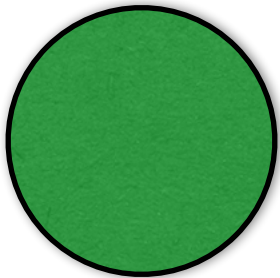
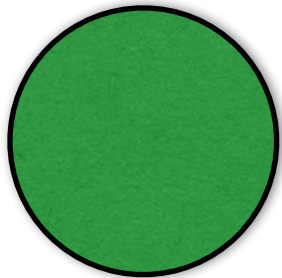


<https://www.stevewyborne.com/>



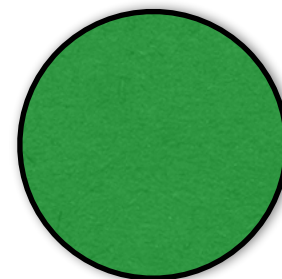
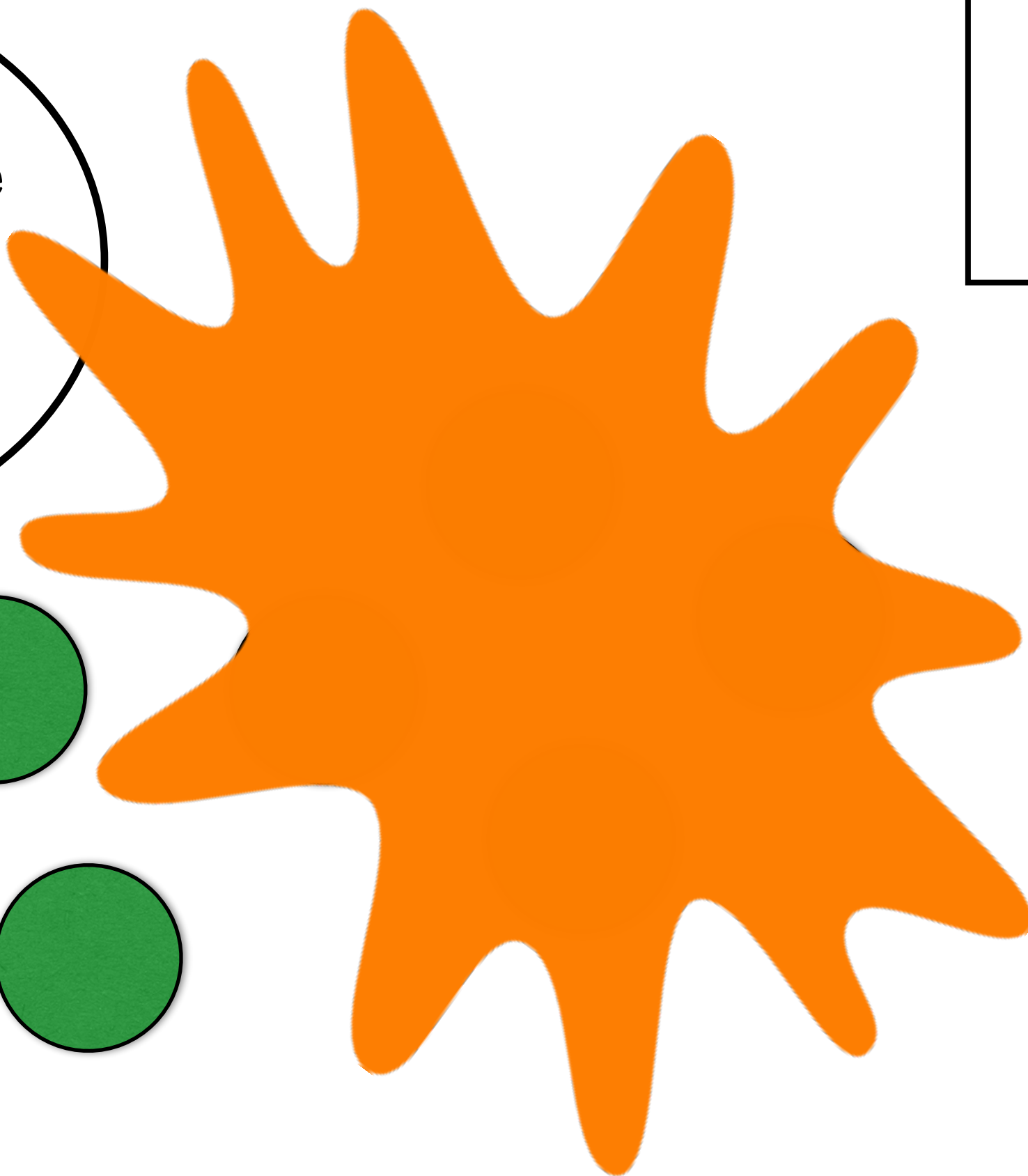
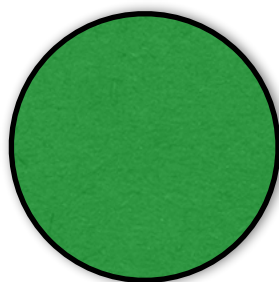
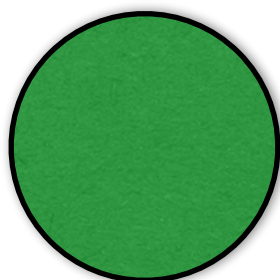
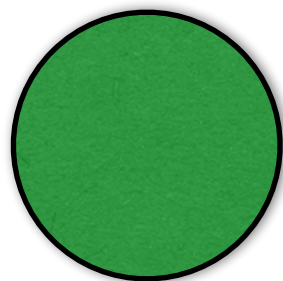
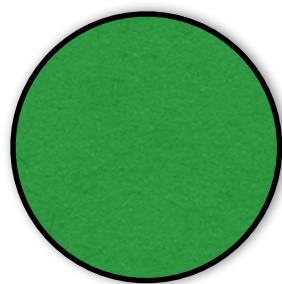
9

How many dots do  
you see?



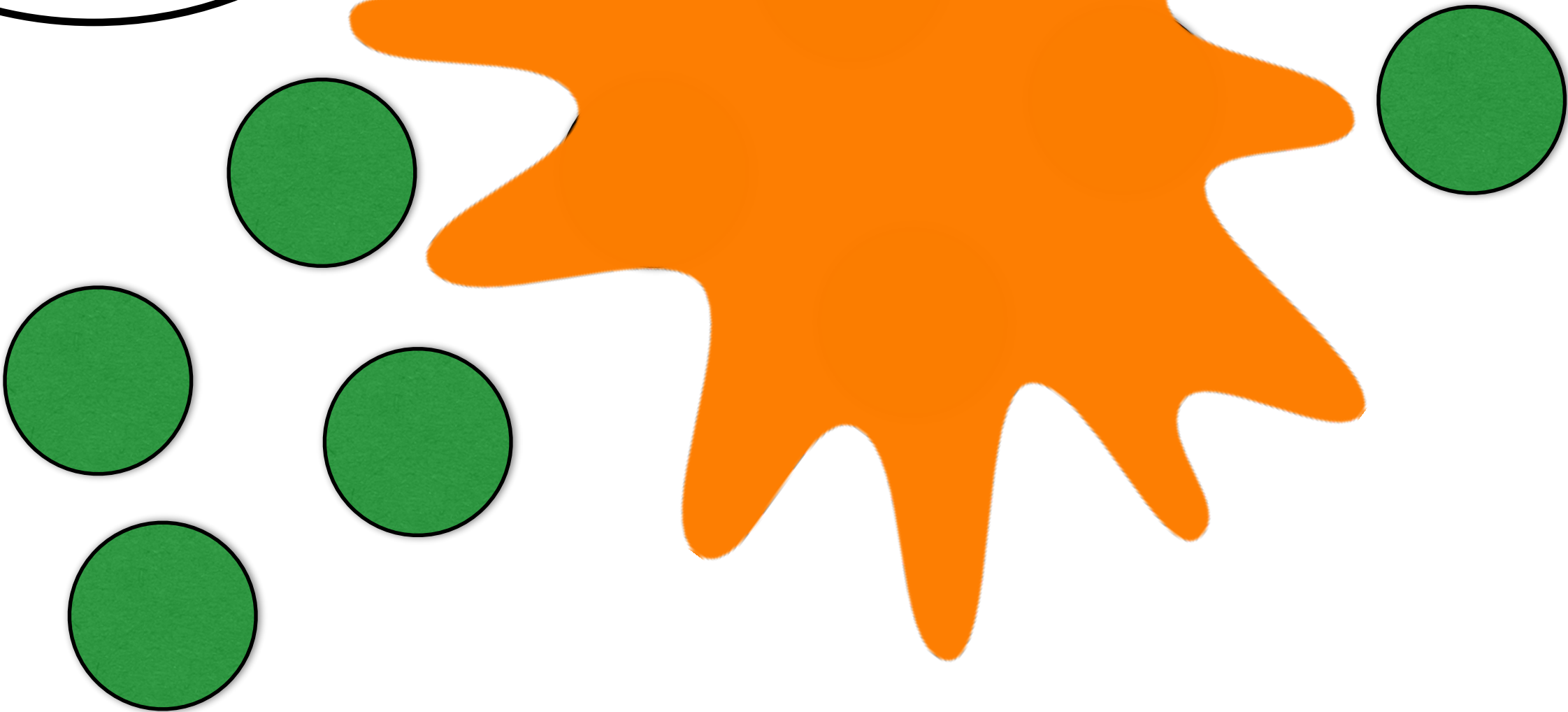
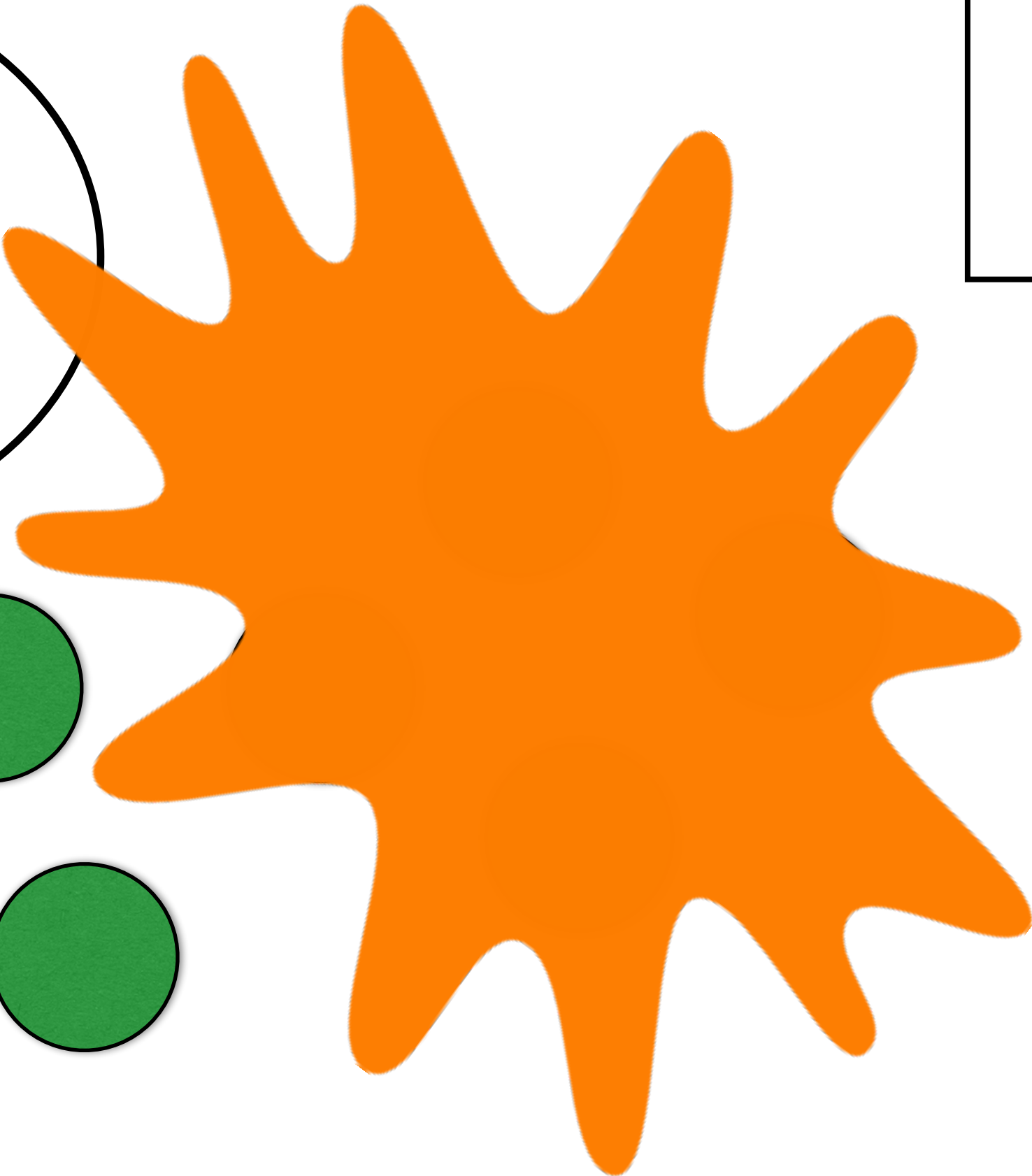
9

SPLAT!  
How many dots are  
hiding behind the  
splat? How do you  
know?



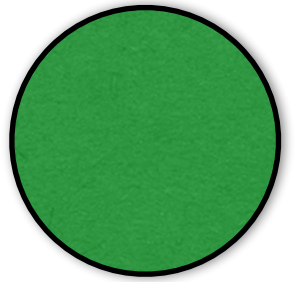
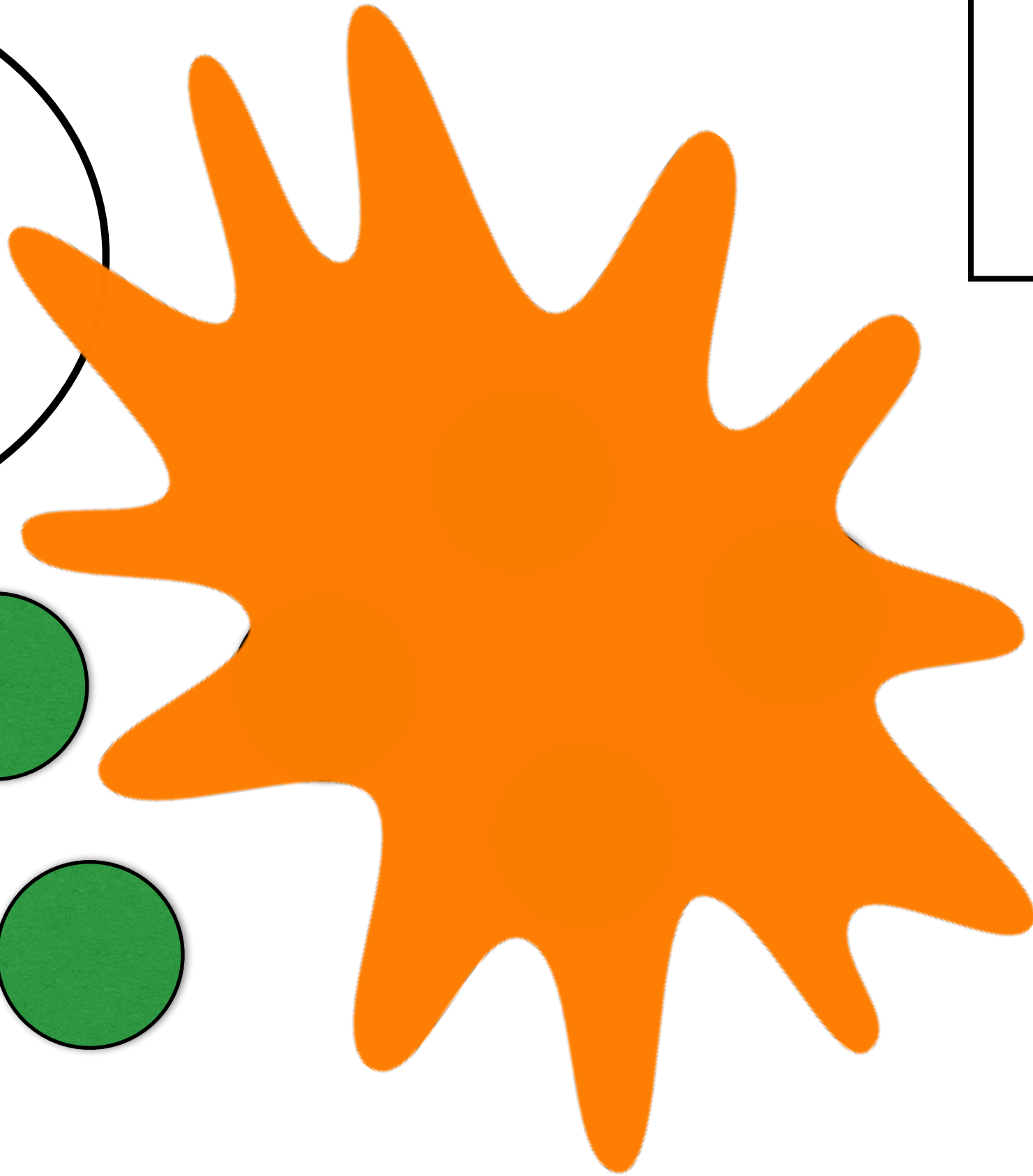
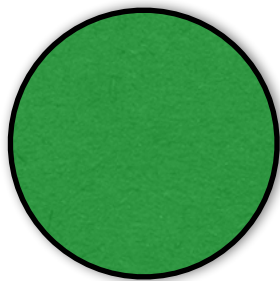
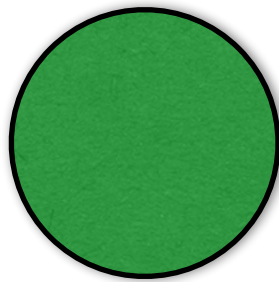
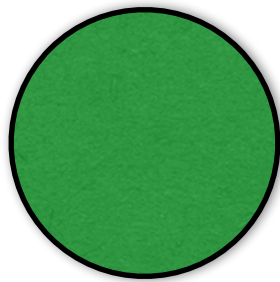
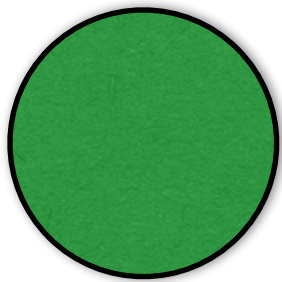
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How else could you  
know?

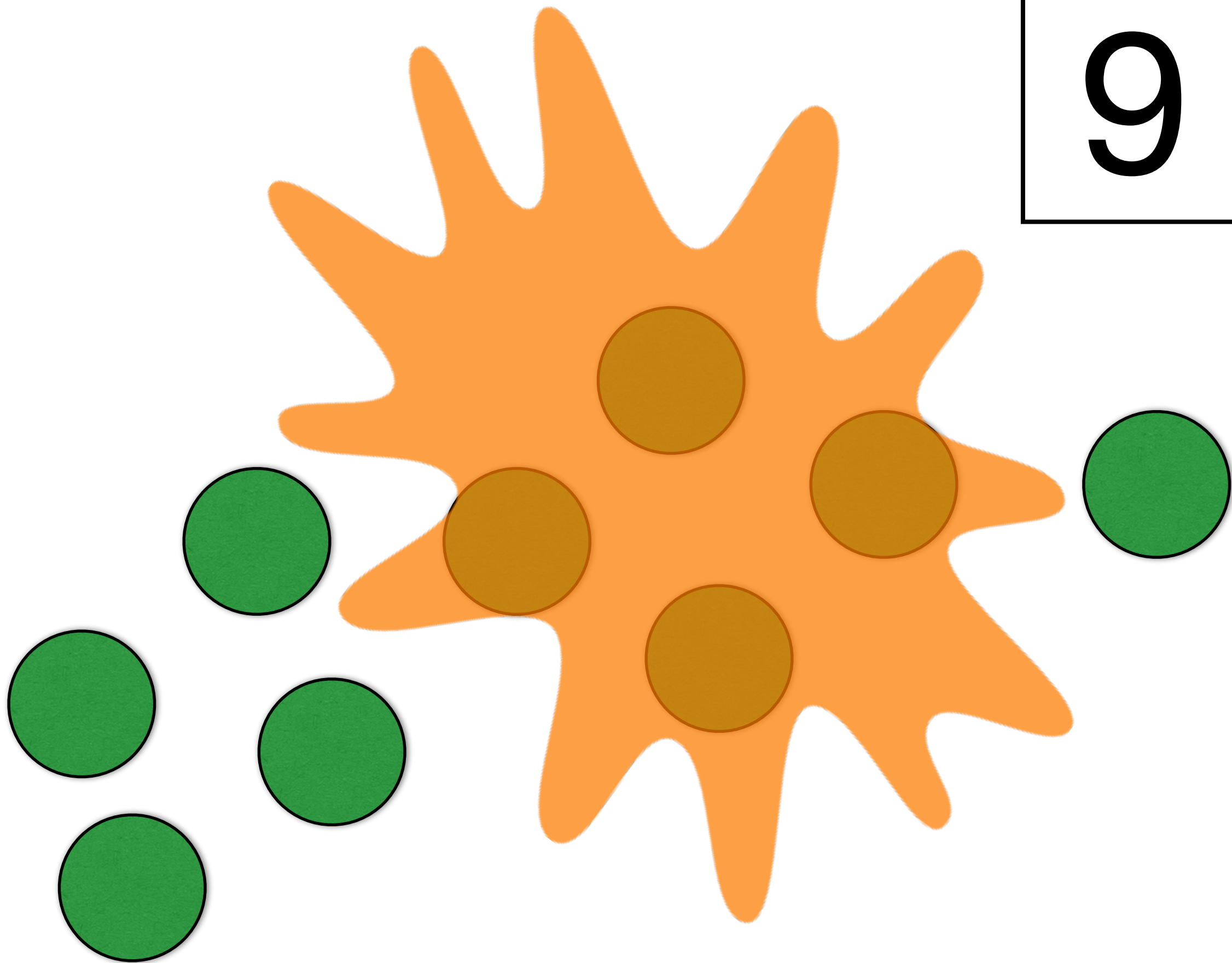


Let's look under  
the Splat to see  
how many dots  
there are!

9



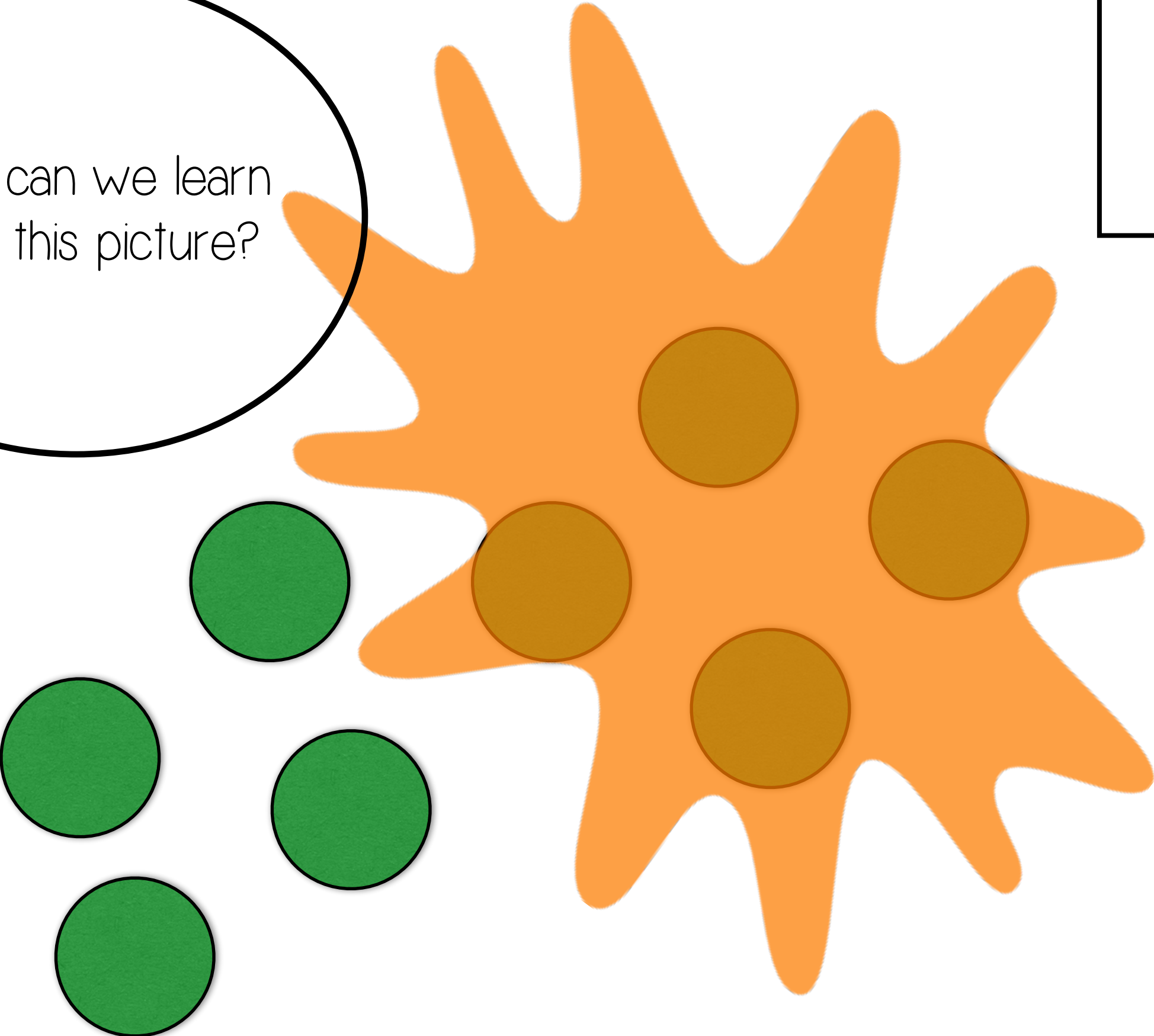
9





9

What can we learn  
from this picture?



The total number

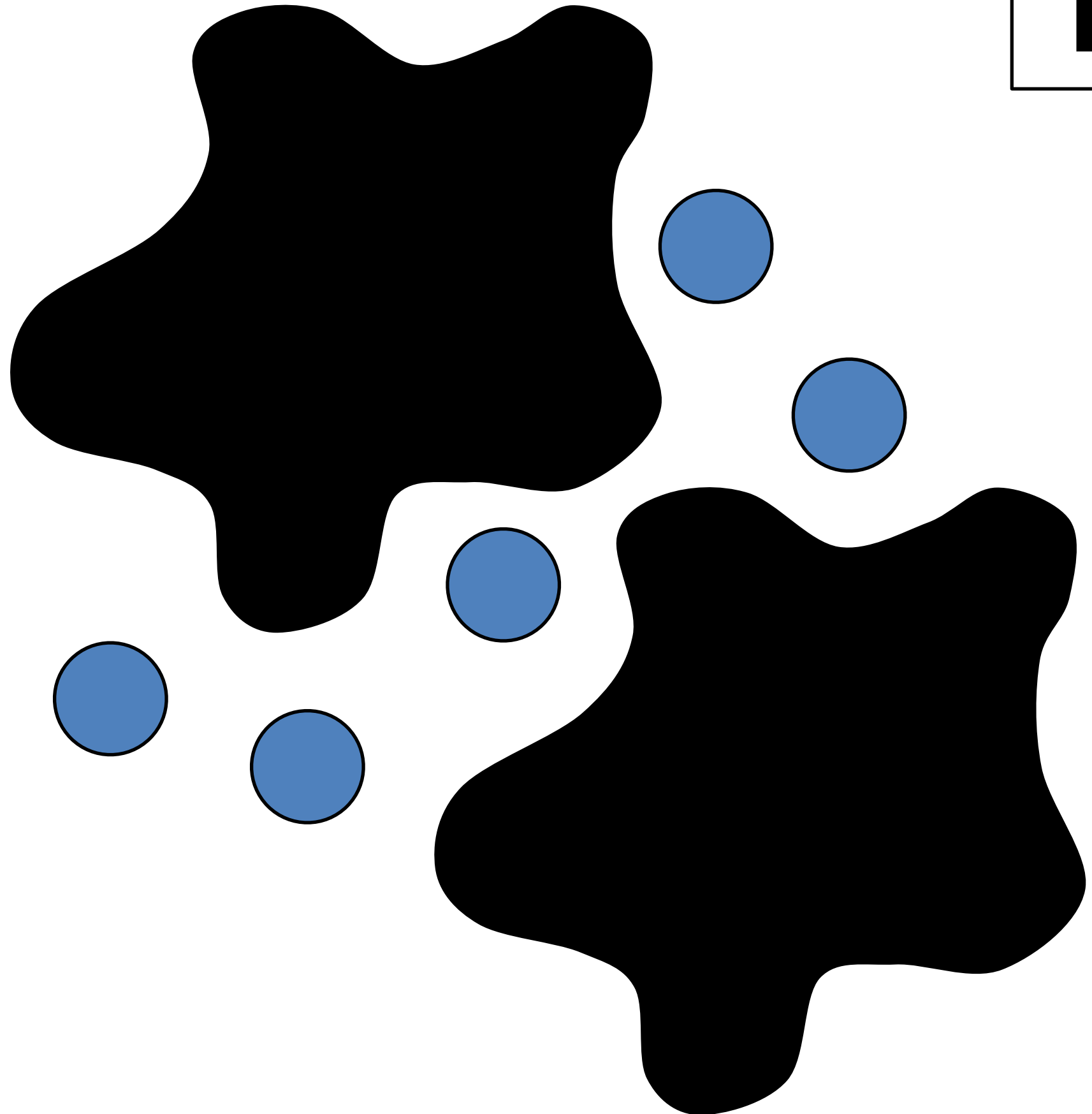
Splat!

How many shapes  
are under each  
splat? How do

How else could  
you know?

Let's look under  
the splats to see  
how many shapes

What can we learn  
from this picture?



# Estimation Clipboard also by Steve Wyborney!



# The Estimation Clipboard

Set 13

Download more free sets [here](#).

Steve Wyborney



How many dice  
are being held  
by the cup?



**The Reveal**





**28 dice**



**The Reveal**



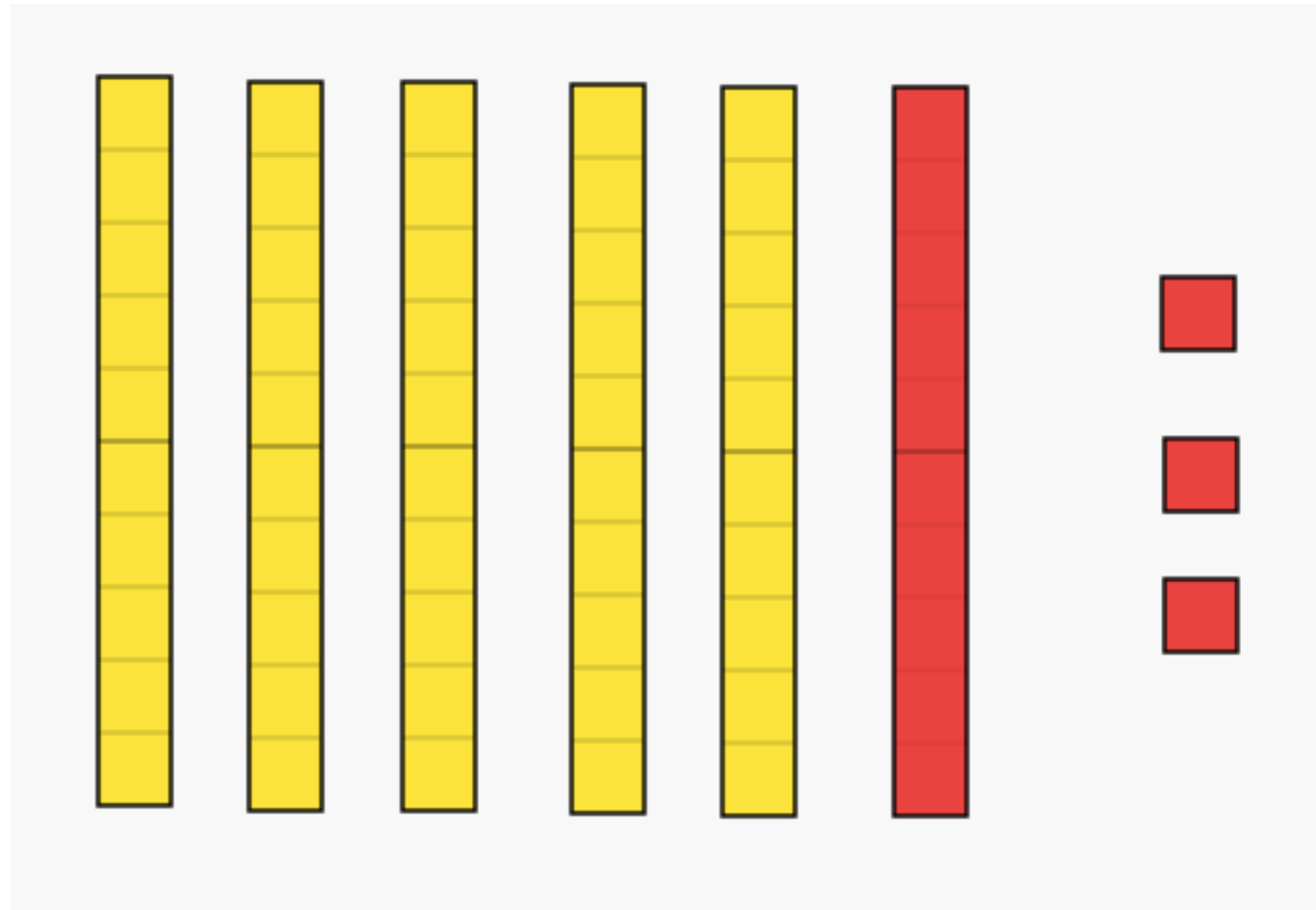
**The Reveal**



**The Reveal**

# MORNING BREAK





<https://www.mathlearningcenter.org/resources/apps>



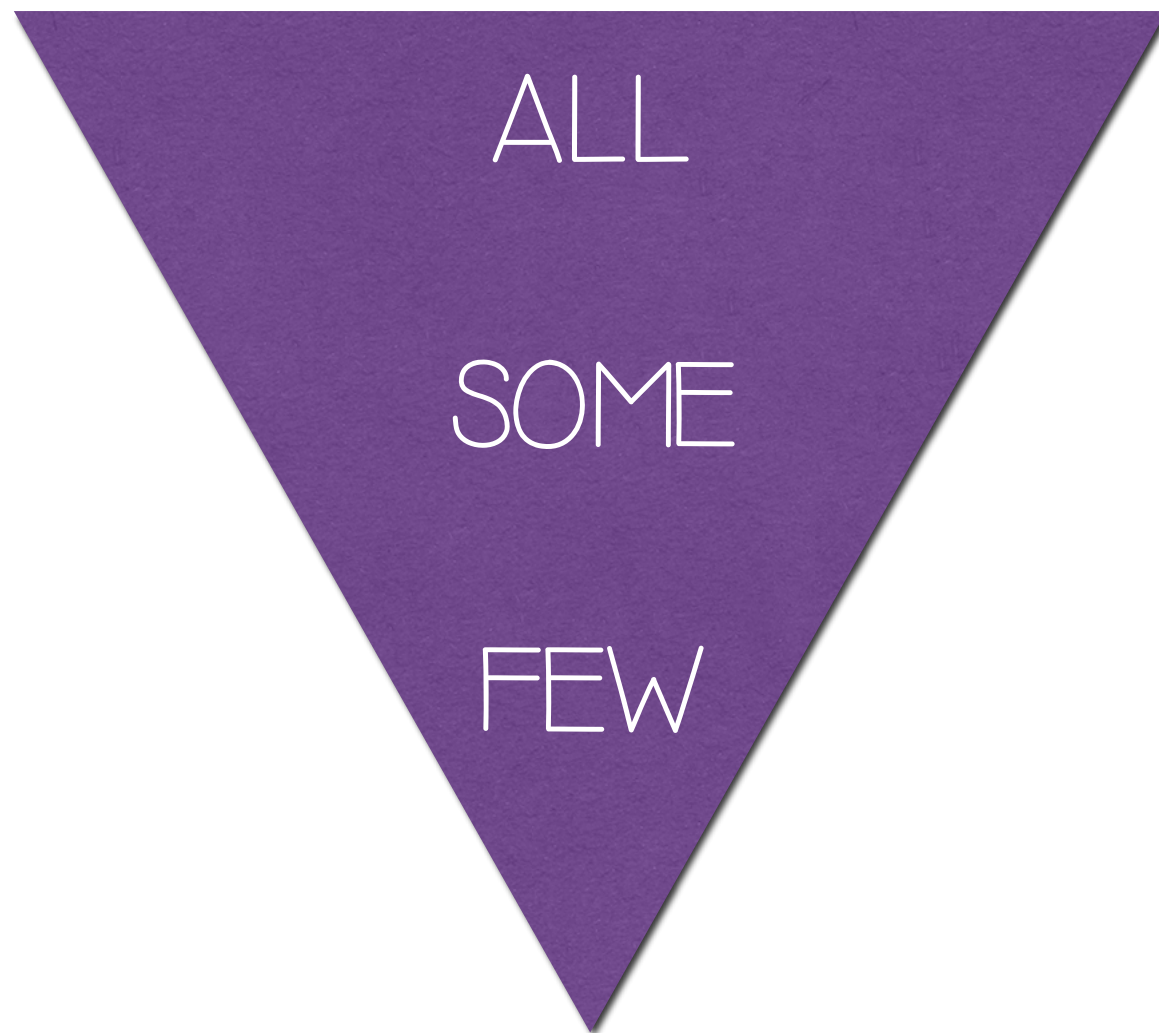
“Student self-efficacy, or a student’s beliefs in perceptions of his or her ability to perform a mathematical task is a strong predictor of student success in mathematics... As teachers of mathematics, we need to plan engaging activities that allow for many entry points, so all students can experience success and feel motivated to learn mathematics.”

– Krpan in Teaching Math With Meaning (2018) p.g., 14



Teachers can design lessons where  
students ALL students have an entry point!

Learning Intentions for:



Thanks to Shelley Moore for her work in this area.

# Open Middle Problems

These questions have a 'closed' beginning and a 'closed' ending but how students approach the question can occur in different ways.



Students must decide:

- which problem solving strategy to try
- what information is important
- which model to use
- which representations to create
- whether to contextualize or decontextualize
- where and how to begin

# OPEN MIDDLE PROBLEM

I need to bake 130 muffins for a bake sale. I am putting them into boxes that hold 15 muffins. How many boxes will I need?



Use the back page of your handout to work on .



# Connecting Representations

Walk around the room and find one or two other “students”. Compare your strategies - How are they the same? How are they different?



“Open mathematical tasks... promote deep mathematical learning while helping students develop creative and critical thinking. Because such tasks support a variety of approaches, they also create an opportunity to share and compare mathematical ideas and explain their mathematical thinking to others... It also empowers students to understand that to do mathematics, we need diverse strategies and different mathematical perspectives.”

– Krpan in Teaching Math With Meaning (2018) p.g, 187



# Open Middle

Challenging math problems worth solving

Home

Kinder ▾

Grade 1 ▾

Grade 2 ▾

Grade 3 ▾

Grade 4 ▾

Grade 5 ▾

Grade 6 ▾

Grade 7 ▾

Grade 8 ▾

High School ▾

About

Submit

## THE TOP 10 MOST VIEWED PROBLEMS OF 2016

1. [Two-Step Equations](#) by Audrey Mendivil, Daniel Lueva
2. [Order of Operations](#) by Robert Kaplinsky with answer
3. [Dot Card Counting](#) by Dan Meyer
4. [Rational and Irrational Numbers](#) by Bryan Anderson
5. [One Solution, No Solutions, Infinite Solutions](#) by Bryan Anderson
6. [Multiplying a Two-Digit Number by a Single-Digit Number](#) by Robert Kaplinsky
7. [Exponents and Order of Operations](#) by Zack Miller
8. [Converting Between Fractions and Decimals](#) by Robert Kaplinsky
9. [Interpreting Percentages](#) by Robert Kaplinsky
10. [Two-Step Equations 3](#) by Erick Lee

Operations & Algebraic Thinking

Number & Operations in Base Ten

Number & Operations—Fractions

Measurement & Data

Geometry

Search



## OPEN MIDDLE WORKSHEET

Download the Open Middle Worksheet (Regular):  
[Version 1.2](#)

Download the Open Middle Worksheet (Large):  
[Version 1.1](#)

## BROWSE BY DEPTH OF KNOWLEDGE LEVEL

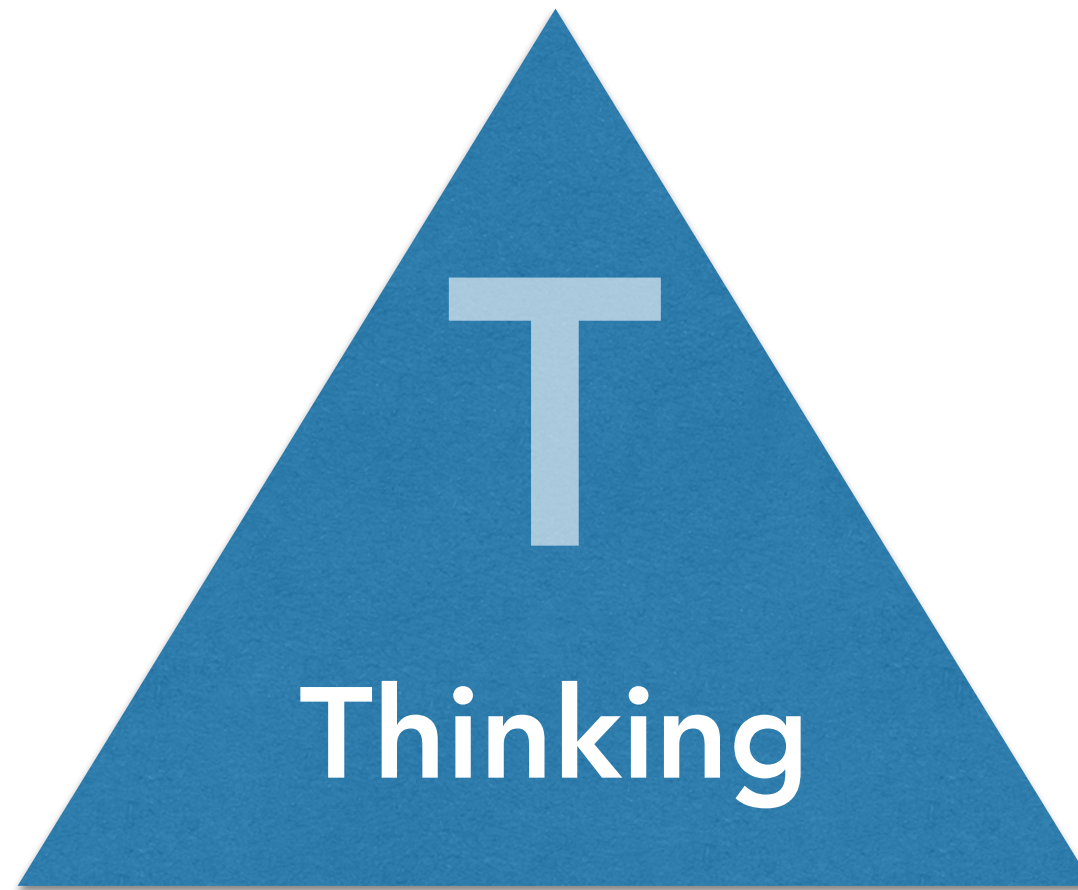
[DOK 2: Skills and Concepts](#)

[DOK 3: Strategic Thinking](#)

## BROWSE BY COMMON CORE STATE STANDARDS

[Kindergarten \(10\)](#)

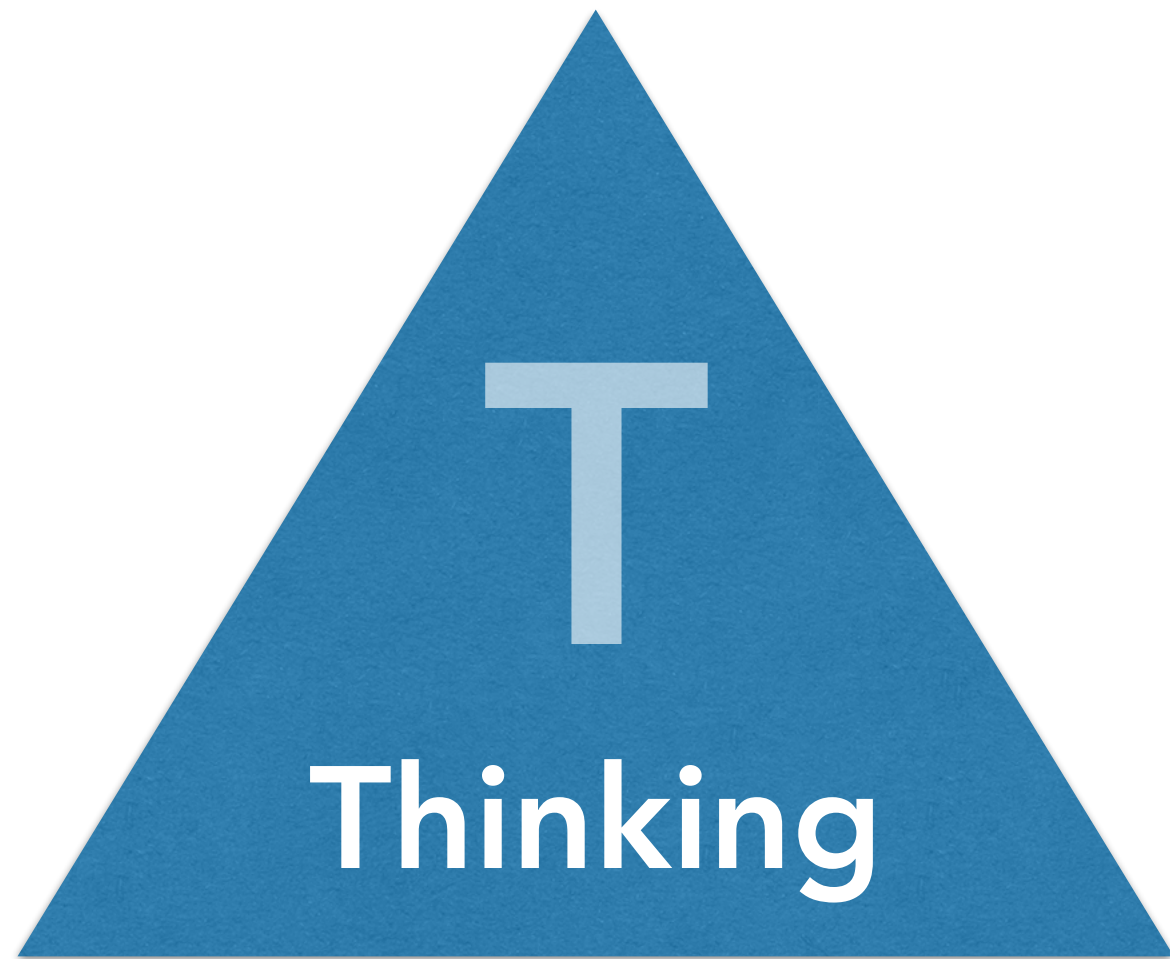
Curated by Robert Kaplinsky, Nanette Johnson, and Bryan Anderson



It isn't enough just to learn - one must learn how to learn, how to learn without classrooms, without teachers, without textbooks. Learn, in short, how to think and analyze and decide and discover and create.

- Bassis (2004) in Krpan in Teaching Math With Meaning (2018) p.g, 124





- Reasoning and Analyzing
- Metacognition
- Critical and Creative thinking
- Memory
- Decision making
- Processing and applying knowledge
- Understanding
- Conjecturing
- Justifying, Proving
- Connecting

It is important teachers go beyond “Show and Tell” lessons where students who have the correct answers each take turns sharing their solution strategies in fragmented and incoherent ways.

Teachers can highlight mathematical ideas, assist students in drawing connections among different strategies, and help students to reflect upon the usefulness, efficiency, and accuracy of their strategies.



# 1. ANTICIPATE

- Do the problem yourself
- What strategies are your students likely to use

# 2. MONITOR

- Circulate, observe, listen
- Identify and keep track of the strategies used
- Ask questions to discover and nudge thinking

# 3. SELECT

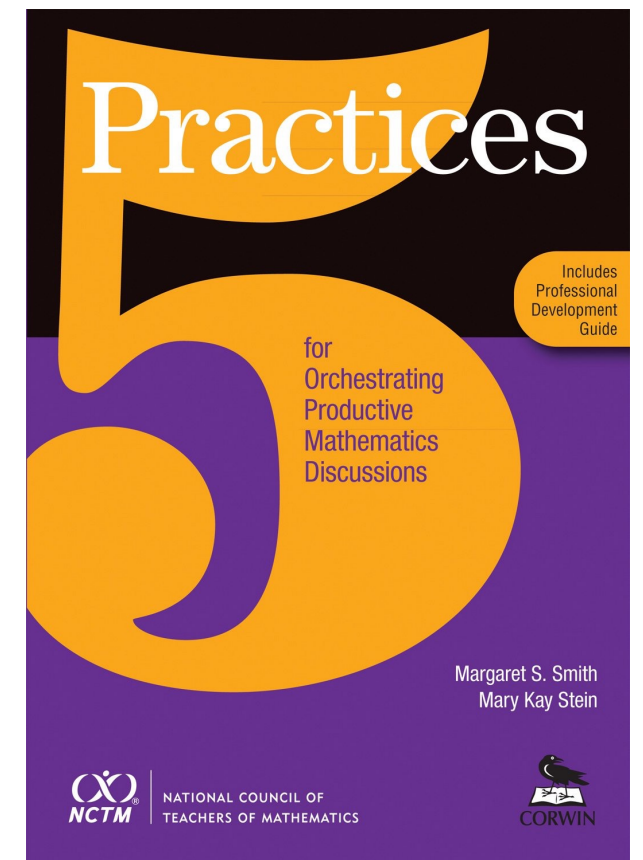
- Crucial Step - what do you want to highlight?
- Purposely select those that will advance mathematical ideas

# 4. SEQUENCE

- In what order do you want to present the student work samples?
- Do you want the most common/accessible? Percent misconceptions first? Build in sophistication? Concrete to abstract?

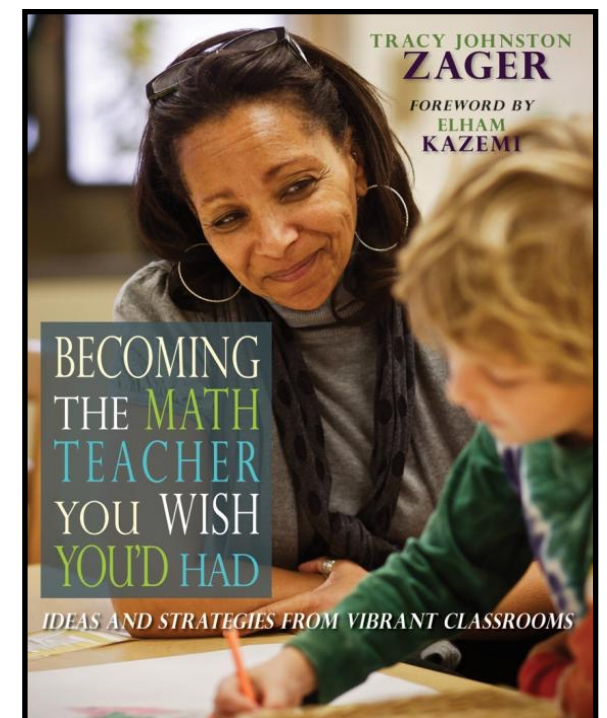
# 5. CONNECT

- Craft questions to make the mathematics visible.
- Compare/contrast 2 or 3 students' work - what are the mathematical relationships?



My point is that, when I sequence, I am doing so for mathematical and cultural goals. I'm trying to share solutions that will reveal the mathematics, will surprise and delight, will enable students to make connections, will spark new questions and conversations that will keep going after we pause our discussion. I'm trying to build a conversation and understanding, not build toward some culminating, "best" solution.

- Tracy Zager (2018) August 29th blogpost <http://tjzager.com/2018/08/29/satisfied/>





# What could this look like?



## SELECT

- Crucial Step - what do you want to highlight?
- Purposely select those that will advance mathematical ideas

## SEQUENCE

- In what order do you want to present the student work samples?
- Do you want the most common/accessible? Percent misconceptions first? Build in sophistication? Concrete to abstract? Connect two strategies?

## CONNECT

- Craft questions to make the mathematics visible.
- Compare/contrast 2 or 3 students' work - what are the mathematical relationships?

Learning Goal: _____ Standard: _____ Date: _____		
Strategy (Anticipate)	Who and What (Monitor/Select)	Order (Sequence)

Connecting Questions: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_



Because mathematics is so often conveyed in symbols, oral and written, communication about mathematical ideas is not always recognized as an important part of mathematics education. Students do not necessarily talk about mathematics naturally; teacher need to help them learn how to do so.

- National Council of Teachers of Mathematics, 2000



- Explain thinking
- Using Math Vocabulary
- Using Representations
- Ask questions
- Language Registers
- Listening
- Process information
- Collaborate with others
- Give, receive & act on feedback
- Navigating interactions
- Reading facial cues

# Explore what it means to have a Conversation...

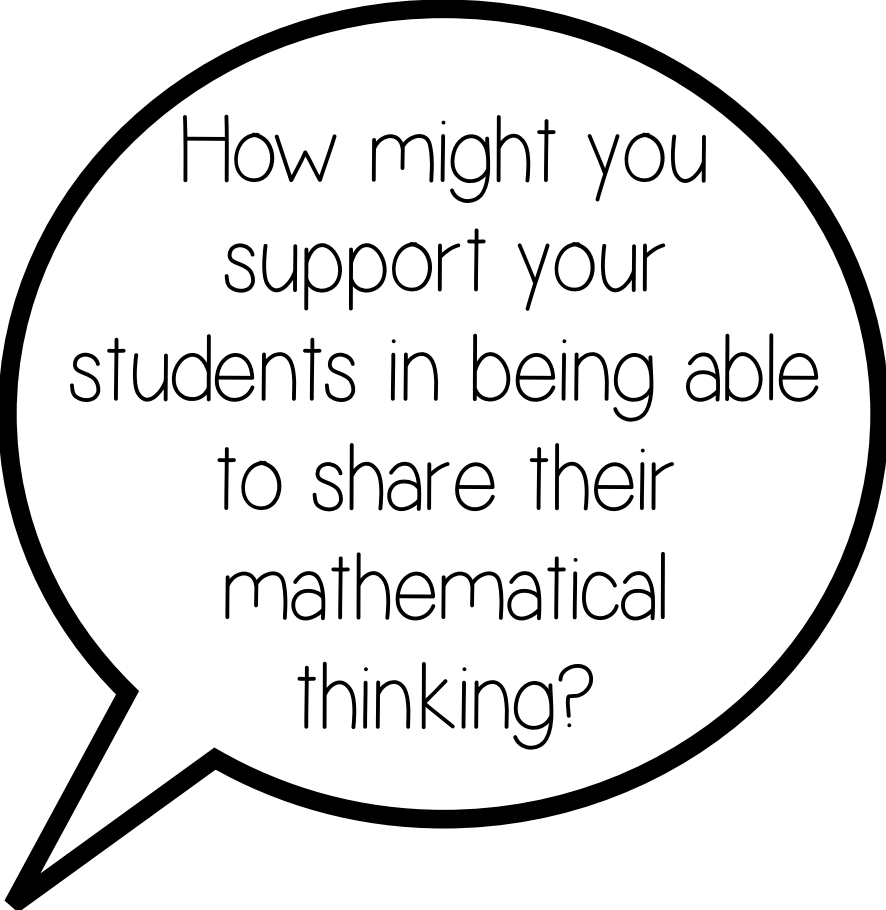
- Let one person at a time talk while the rest listen
- Face the speaker and use eye contact
- Ask questions
- Nod your head when you understand
- Hold your thoughts until the other speaker is finished speaking
- Disagree politely
- Stay on the topic
- Respond to the speaker with comments or questions





# Grade Five example

[http://players.brightcove.net/538749687500/  
experience\\_5a2f108ca13b130010364da8/index.html](http://players.brightcove.net/538749687500/experience_5a2f108ca13b130010364da8/index.html)



How might you  
support your  
students in being able  
to share their  
mathematical  
thinking?

Group discussions can energize children if we are careful about how we teach children to listen to, respond to, and engage with one another's ideas. The time we invest in helping our students learn to participate productively in discussions can result in a huge payoff.

– Intentional Talk by Elham Kazemi and Alison Hintz  
(2014) p.g. 14



# Provide Talking Prompts

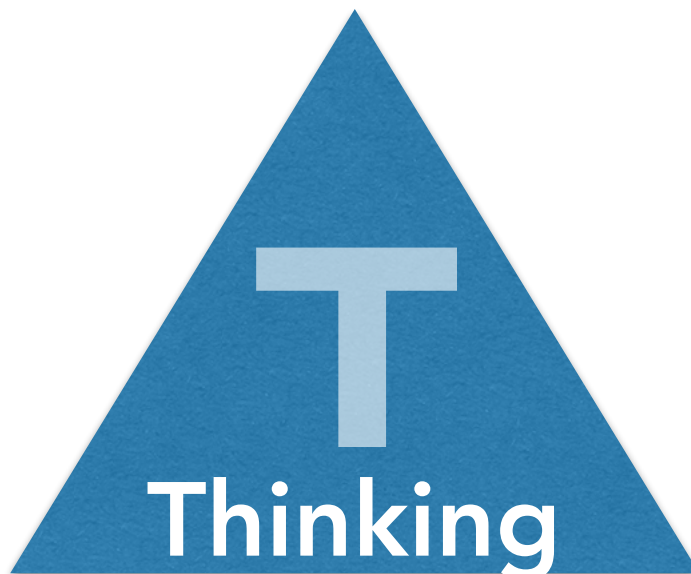
- Will you repeat that?
- I understand \_\_\_\_\_, but I don't understand \_\_\_\_\_
- Where do you see \_\_\_\_\_?
- Do you mean \_\_\_\_\_?
- I agree because \_\_\_\_\_
- Tell me more about....
- I'd like to add on to that....



# Self-Talk/Think Alouds








**Self-talk** refers to the statements or questions we tell or ask ourselves. This internal dialogue plays a role in self-regulated learning. Since self-talk is not voiced, students are often unaware of the role it plays in Mathematics.

A mathematical **think-aloud** is a teaching approach that can be used to show students the thinking journey that takes place in the mind.





## Categories for Classifying Different Types of Self-Talk in Mathematics

	<b>Planning Self-Talk:</b> This self-talk helps us to organize our thinking. It helps us to think about what we need to do and when we need to do it.
	<b>Math Strategy Self-Talk:</b> This self-talk focuses on the mathematics we are using in our thinking.
	<b>Self-Editing/Monitoring Self-Talk:</b> This self-talk checks the strategies we are using. It tells us whether we are on the right track and if things are making sense. It may also tell us to change our ideas and try a different approach.
	<b>Connections Self-Talk:</b> This self-talk helps us to think about other times when we have experienced a similar problem or used a specific strategy, whether in mathematics or in our personal lives. It helps us to link math ideas to other ideas and experiences.
	<b>Struggle Self-Talk:</b> This self-talk is what we express when we feel confused or unable to do a specific task. It alerts us that we need to begin to think positively about our work and figure out what to do to complete the task.
	<b>Focus Self-Talk:</b> This self-talk keeps us on track. It reminds us that we need to concentrate on the task, or the small part of the task, that we are completing and not get distracted.
	<b>Encouragement, or Growth-Mindset, Self-Talk:</b> This self-talk helps us to persevere and keep going when we face challenges. It reminds us that we have good math skills and knowledge, and that we should not give up.

– Krpan in Teaching Math With Meaning (2018) p.g., 132

$$234 - 35 =$$



**Figure 6.8** Non-example and example of a think-aloud script for a mental math question

234 – 35 =	
Non-example	Example
<ul style="list-style-type: none"><li>• I take the number 234 and change it to 235.</li><li>• I subtract the 35 from 235 and the answer is 200.</li><li>• Then, I need to take 1 from 200 to make up for the 1 added to 234.</li><li>• So, the answer is 199.</li></ul>	<ul style="list-style-type: none"><li>• Oh, this looks challenging!</li><li>• I am not sure how to do this.</li><li>• How can I make this question easier to work with?</li><li>• Right now, if I try to subtract, it will be challenging to take 35 from 34 in my head without writing anything down.</li><li>• Think carefully... Don't get discouraged... There is a way to make this easier...</li><li>• Okay...I think I can take 5 from 35 and that will give me 30, which will be an easier number to work with... Wait... I think there might be an even better way...</li><li>• This reminds me of a strategy I used last year.</li><li>• What if I just add 1 to 234? This will make it 235, and I will be able to subtract 35 from 235 easily. Okay. I am going with this idea.</li><li>• So... I add 1 to 234, which makes it 235, and take 35 from 235. Okay, now I have 200. This does not seem correct... Oh,...I know... I have to make up for the fact that I took 35 from 235 and not 234.</li><li>• Hmmm, I am not sure how to do this. Okay... Let me see... I can do this... If I increased 234 by 1, that means that my answer is more than it should be because I took 35 from a larger number than 234. Does this make sense?... Yes, I think it does. So, I need to take away the 1 that I added to 234 from my final answer. So, the answer is <math>200 - 1 = 199</math>.</li></ul>



**Figure 6.9** Thinking strategies demonstrated in the think-aloud script for  $234 - 35 =$

### **Planning Self-Talk**

- *How can I make the numbers in this question easier to work with?*
- *Right now, if I try to subtract, it will be challenging to take 35 from 34 in my head without writing anything down.*

### **Math Strategy Self-Talk**

- *So... I add 1 to 234 which makes it 235, and take 35 from 235. Okay, now I have 200. But I know I need to make up for the fact that I took 35 from 235 and not 234.*
- *If I increased 234 by 1, that means that my answer is more than it should be because I took 35 from a larger number than 234.*
- *So, I need to take away the 1 that I added to 234 from my final answer. So, the answer is  $200 - 1 = 199$ .*

### **Self-Editing/Monitoring Self-Talk**

- *Wait, there might be an even better way...*
- *Does this make sense?... Yes, I think it does.*

### **Connections Self-Talk**

- *This reminds me of a strategy I learned last year.*

### **Struggle Self-Talk**

- *Oh, this looks challenging!*
- *Hmmm, I am not sure how to do this.*

### **Encouragement (Growth Mindset) Self-Talk**

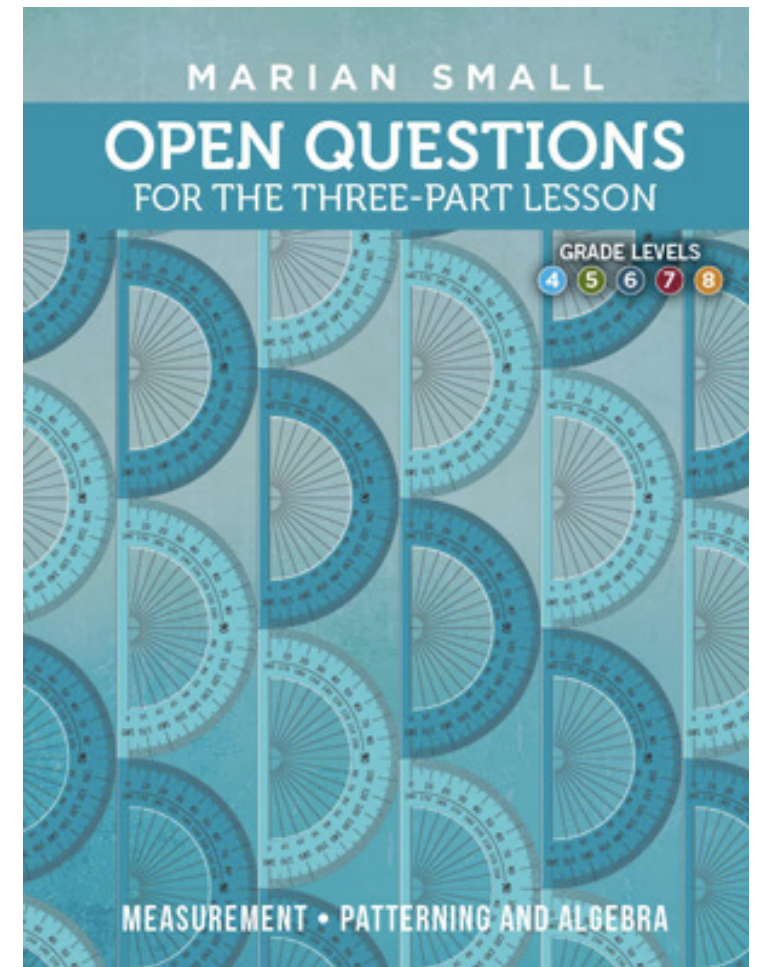
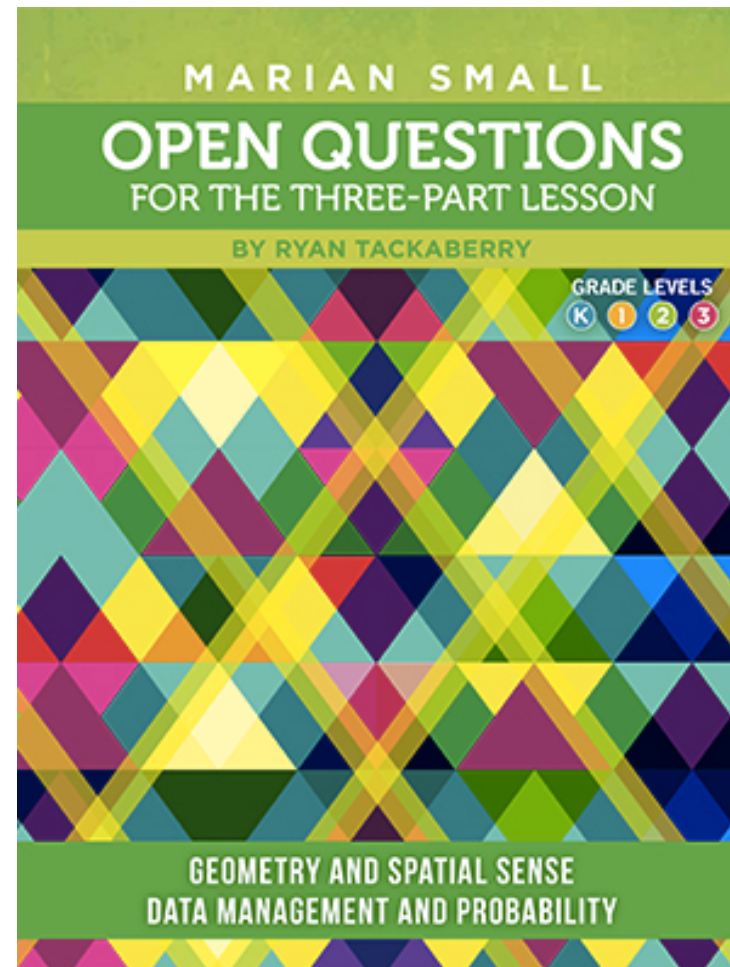
- *Think carefully... Don't get discouraged. There is a way to make this easier...*
- *OK... Let me see... I can do this...*

– Krpan in Teaching Math With Meaning (2018) p.g, 155



# Open Questions

What resources are available?



Each book spans several Grades (e.g., K - 3, 4 - 6, and 7 - 9).  
Currently only the Number Strand is aligned to our BC Curriculum.  
The other strands are coming in Spring 2018.

Rich Tasks: This document can be found at  
<https://sites.google.com/view/bcnumeracynetwork/instruction/how-can-my-instructional-approaches-create-opportunities>

**Websites - Problems/Rich Tasks**

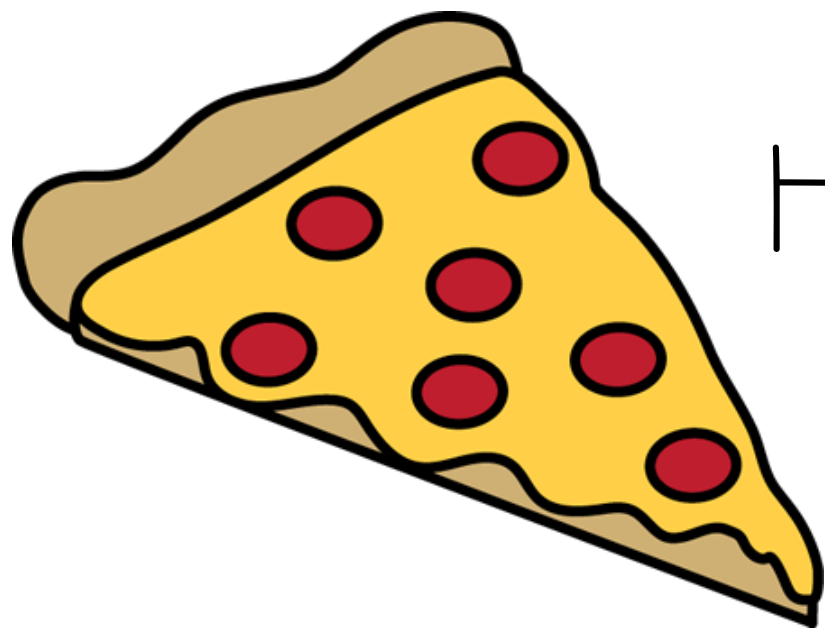
Site	Link	Description
<b>NRICH Math</b>	<a href="https://nrich.maths.org">https://nrich.maths.org</a>	K-12 Problems, Articles and Games
<b>Galileo</b>	<a href="http://galileo.org/classroom-examples/math/math-fair-problems/">http://galileo.org/classroom-examples/math/math-fair-problems/</a>	K-12 Problems for Math Fairs and classroom use
<b>Open Middle</b>	<a href="http://www.openmiddle.com/">http://www.openmiddle.com/</a>	K-12 Challenging math problems, multiple ways to approach and ultimately solve the problem.
<b>Three-Act Math Tasks</b>	<a href="https://tapintoteenminds.com/3act-math/">https://tapintoteenminds.com/3act-math/</a>	K-12 Real World Math Problems
<b>BCAMT</b>	<a href="http://www.bcamt.ca/category/weekly-primary-tasks/">http://www.bcamt.ca/category/weekly-primary-tasks/</a>	<a href="http://www.bcamt.ca/weeklymathtasks/">http://www.bcamt.ca/weeklymathtasks/</a>
<b>NCTM Illuminations</b>	<a href="https://illuminations.nctm.org/">https://illuminations.nctm.org/</a>	K-12 Searchable (by grade/level) & strand. Provides mini-lessons.
<b>Math Pickle</b>	<a href="http://mathpickle.com/organized-by-grade/#">http://mathpickle.com/organized-by-grade/#</a>	K-12 mathematical puzzles, games and problems
<b>Problem of the Day Archive – Waterloo</b>	<a href="http://www.cemc.uwaterloo.ca/resources/potw.php">http://www.cemc.uwaterloo.ca/resources/potw.php</a>	Grades 3-12
<b>NZ Maths</b>	<a href="https://nzmaths.co.nz/problem-solving">https://nzmaths.co.nz/problem-solving</a>	K-12 problem-solving lessons and tasks
<b>Dan Meyer</b>	<a href="http://blog.mrmeyer.com/category/3acts/">http://blog.mrmeyer.com/category/3acts/</a>	Grades 4+ Click on 3-Act Tasks for problems
<b>Peter Liljedahl</b>	<a href="http://www.peterliljedahl.com/teachers/numeracy-tasks">http://www.peterliljedahl.com/teachers/numeracy-tasks</a>	K-12 Collection of numeracy tasks co-constructed with Peter Liljedahl and piloted by B.C. teachers



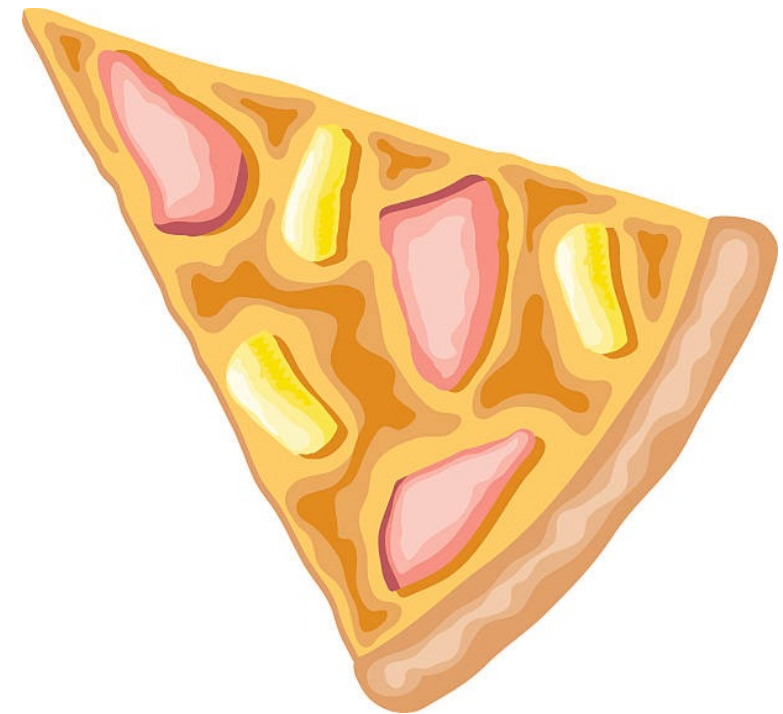
Find your group members and  
your writing surface!



Imagine a pizza order from your school. Students could choose from:



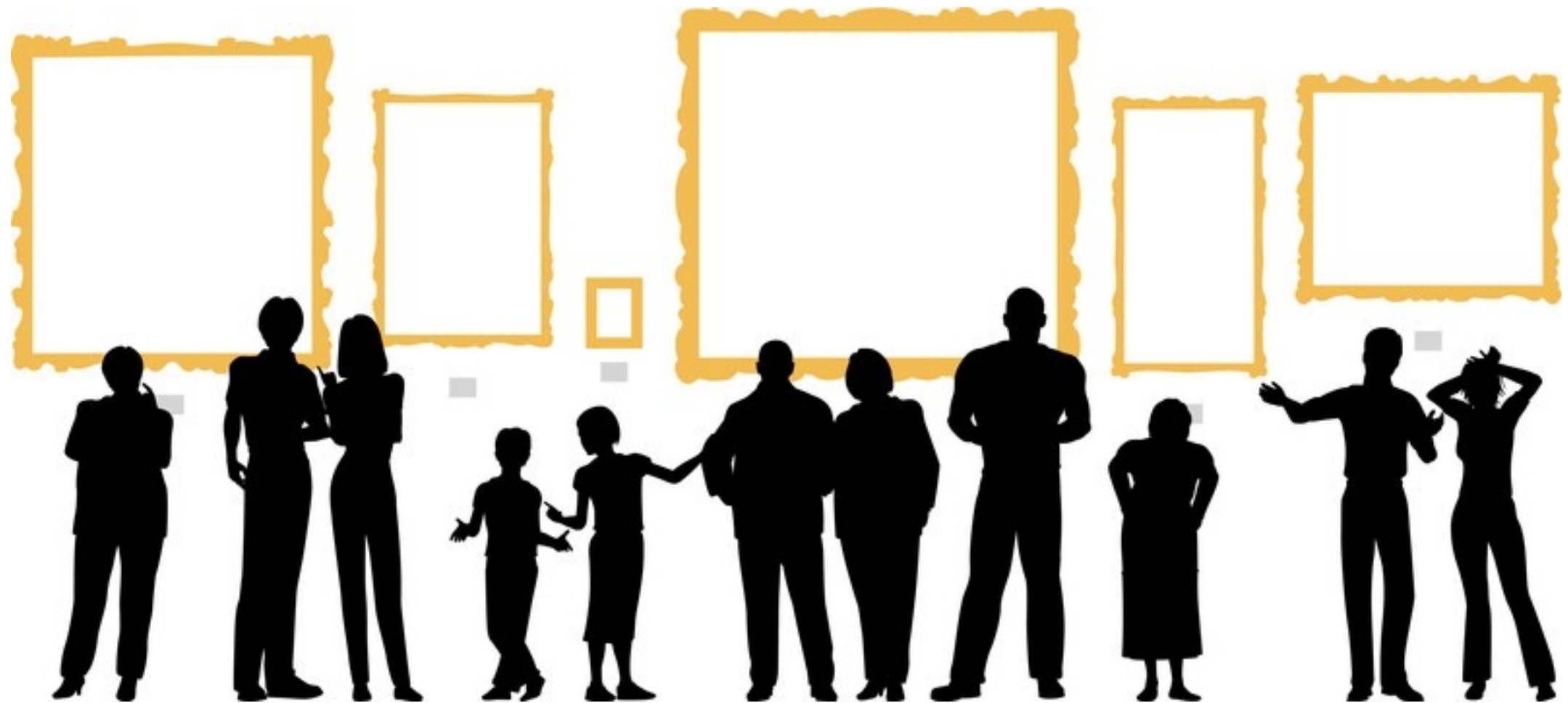
Pepperoni  
Ham and Pineapple  
Cheese  
Vegetarian

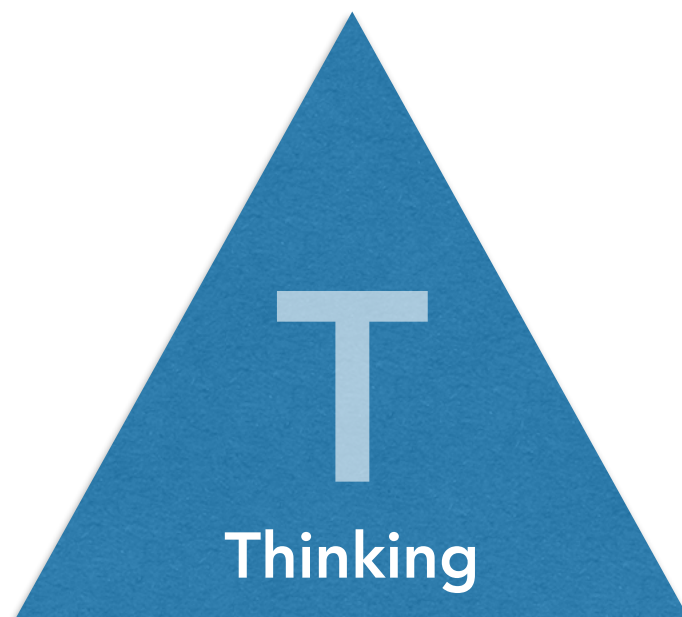


What do you think the bar graph might look like?



# Silent Viewing/ Mid-way Gallery Walk

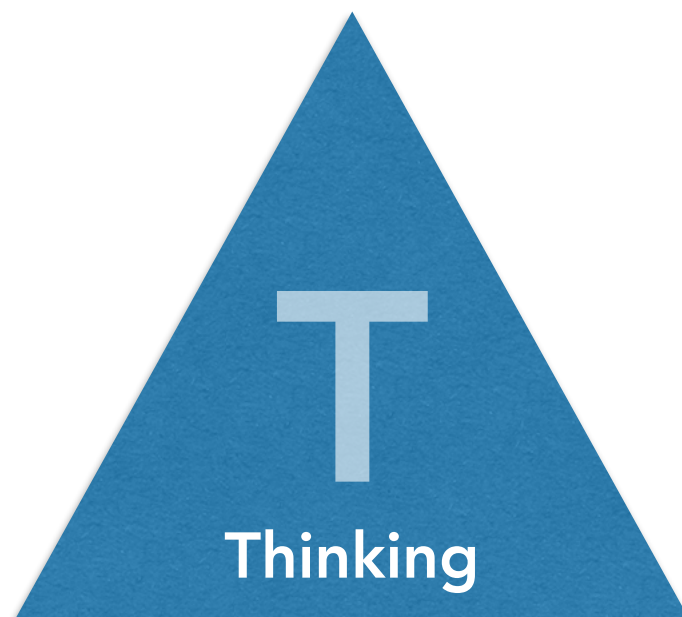




## What could have been my intentions for working in VISIBLE RANDOM GROUPS?

- students become agreeable to work in any group they are placed in
- elimination of social barriers in the classroom
- increased perseverance
- increase in the mobility of knowledge
- increased reliance on constructing knowledge and answers together
- decreased reliance on the teacher for answers
- increase in both enthusiasm for mathematics and engagement in mathematics

- Peter Liljedahl (2016)



## What could have been my intentions for the SILENT VIEWING/GALLERY WALK?

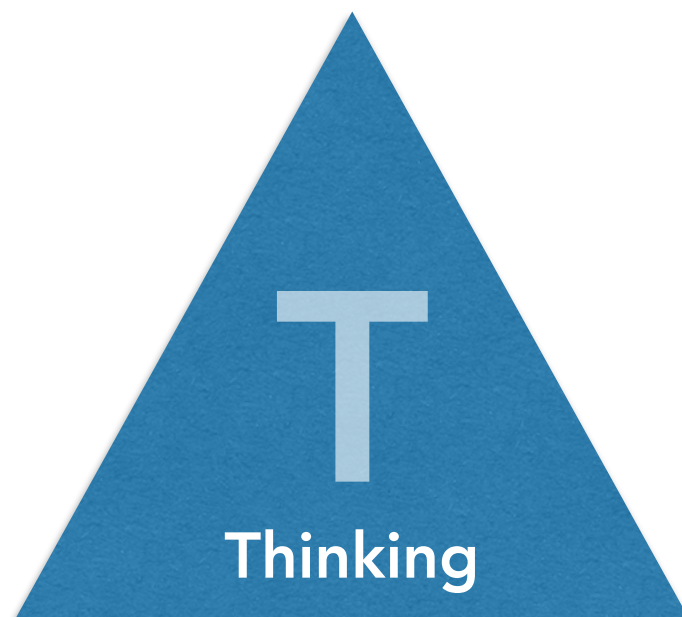
- promotes self monitoring
- students see that they can learn from others
- students can see there are multiple ways - and that all ways are valued
- provides opportunities to gain feedback
- intimate context allows more sharing by students who may be hesitant to share
- provides opportunity for connection and reflection - how is your work similar or different?



# What could have been my intentions for working on VERTICAL NON-PERMANENT SURFACES?



- increased student engagement
- increased mathematical discourse
- increased perseverance
- decreased time to write first notation on work surface
- students took risks sooner
- increased sharing and interactions between groups
- everyone gains a 360-degree view of all the thinking occurring



- Peter Liljedahl (2016)

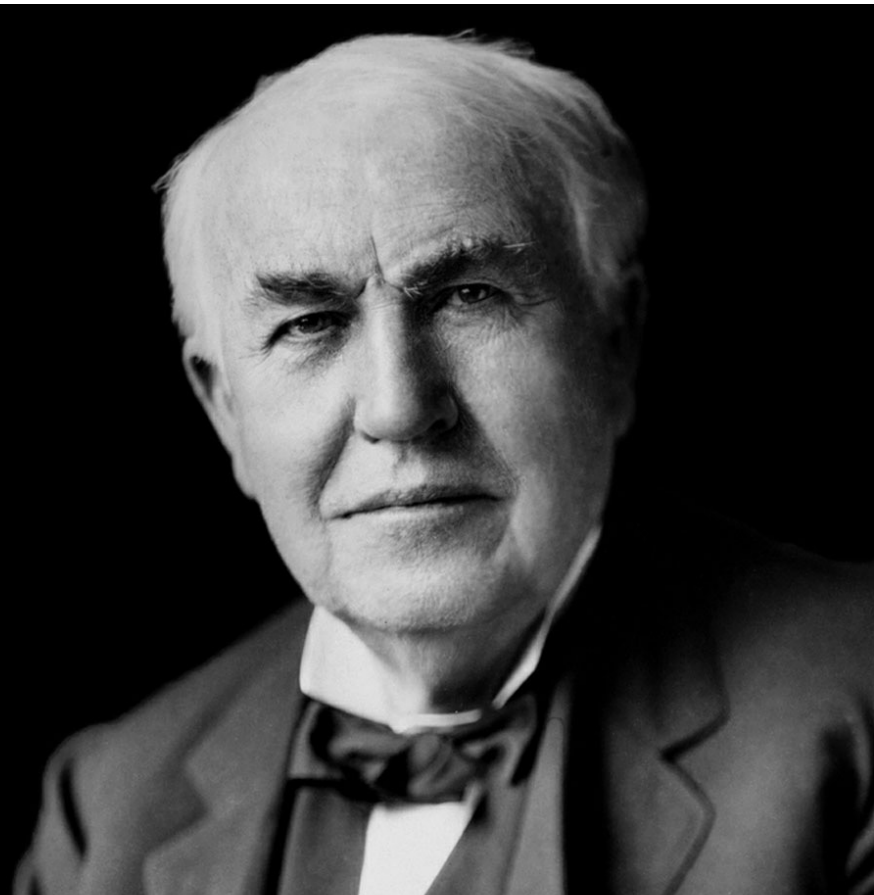


# Teacher can encourage mistakes as learning opportunities!

Remind yourself to have students explain their thinking both when their answer is correct and incorrect. Sometimes when explaining their thinking process, the student will catch their mistake and see exactly where the misconception is taking place.

I have not failed. I've just  
found 10,000 ways that  
won't work.

*Thomas Edison*



# My Favourite NO

<https://www.teachingchannel.org/video/class-warm-up-routine>



Talk your notebook or a neighbour  
regarding one of the questions below...



- What COMPETENCIES are fostered through talking about mistakes in this way?
- Why does the teacher have the class start with things that are working well in the favourite no?
- What are the benefits of having the students correct the mistake, instead of the teacher doing it herself?



NAME: \_\_\_\_\_

### \*MY FAVORITE NO\*

Directions: Take a minute to analyze this student's work. Then, write everything he/she did well. Next, write about the mistake(s).

$$\boxed{7 \times 4 = 28}$$

$$\begin{array}{r} 280 \\ + 70 \\ \hline 350 \end{array}$$

$$\boxed{350 \div 7 = 57 \text{ r } 2}$$

$$7 \times 40 = 280$$

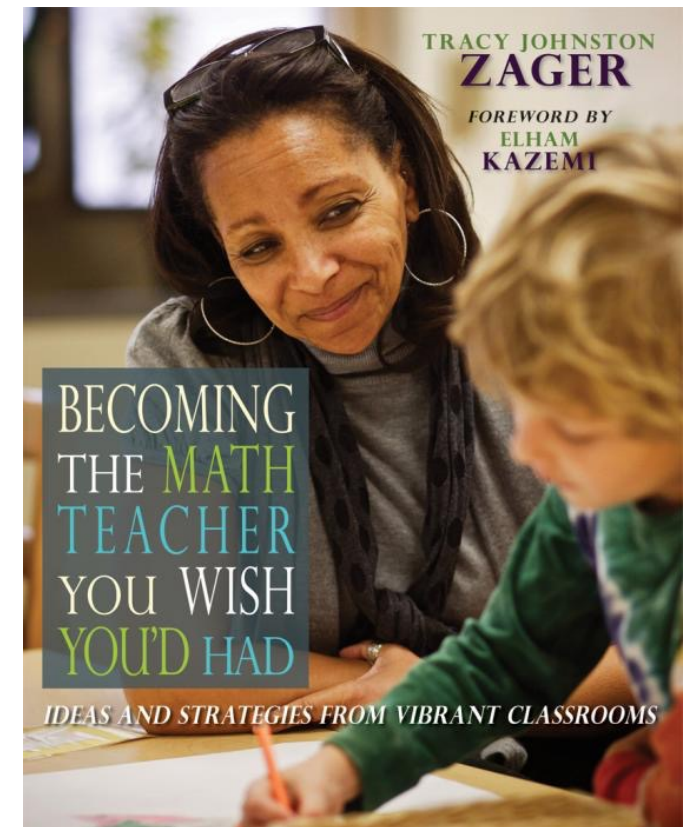
$$7 \times 10 = 70$$

$$350 + 7 = 357$$

$$40 + 40 + 7 = 57 \text{ r } 2$$

Wow! This is a very thorough and clear response! 😊

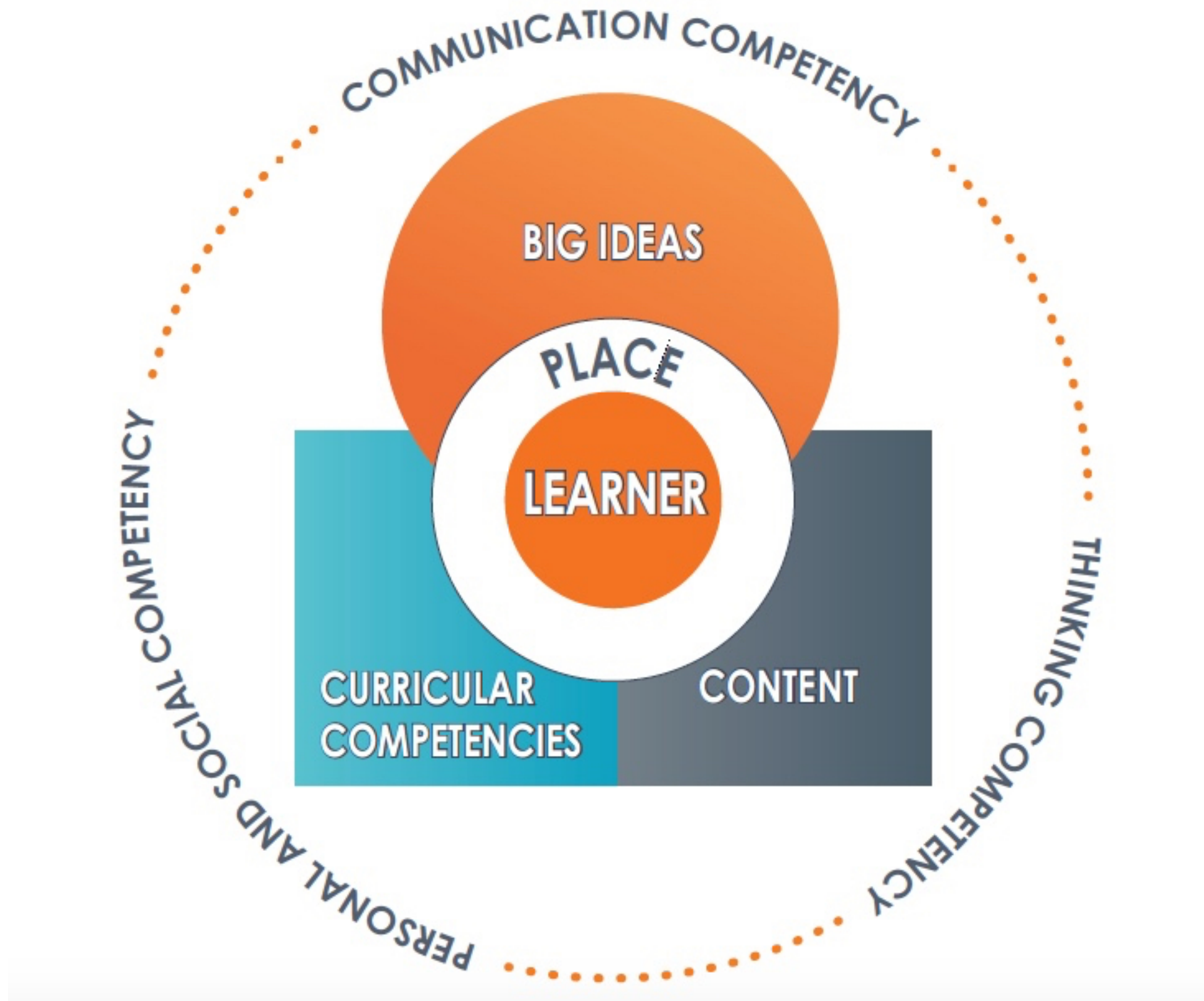
I appreciate how this student used a good landmark number like 280 to start the problem. I like how they took advantage of using their knowledge of  $7 \times 4$  to resolve  $7 \times 40$ . I see that they were able to use the inverse relationship of multiplication and division to help solve this problem. I like how this person found out how many more groups he/she needed to get to the dividend. I see that they tripped up when they added 7 instead of 1 because seven is one more group.



- Zager (2017) p.g. 100

Figure 5.8 A student's written analysis of another student's mistake







# Notice - Name - Nurture

## Connections between Core and Curricular Competencies K-5 Mathematics

Core Competencies	Curricular Competencies
<b>Communication</b> <ul style="list-style-type: none"> <li>connect and engage with others (to share and develop ideas)</li> <li>acquire, interpret, and present information (includes inquiries)</li> <li>collaborate to plan, carry out, and review constructions and activities</li> <li>explain/recount and reflect on experiences and accomplishments</li> </ul>	<b>Communicating and Representing</b> <ul style="list-style-type: none"> <li>Communicate mathematical thinking in many ways</li> <li>Use mathematical vocabulary and language to contribute to mathematical discussions</li> <li>Explain and justify mathematical ideas and decisions</li> <li>Represent mathematical ideas in concrete, pictorial, and symbolic forms</li> </ul>
<b>Thinking</b> <p><b>Creative Thinking</b></p> <ul style="list-style-type: none"> <li>novelty and value</li> <li>generating ideas</li> <li>developing ideas</li> </ul> <p><b>Critical Thinking</b></p> <ul style="list-style-type: none"> <li>analyze and critique</li> <li>question and investigate</li> <li>develop and design</li> </ul>	<b>Understanding and Solving</b> <ul style="list-style-type: none"> <li>Develop, demonstrate, and apply mathematical understanding through play, inquiry, and problem solving</li> <li>Visualize to explore mathematical concepts</li> <li>Develop and use multiple strategies to engage in problem solving</li> </ul> <p><b>Reasoning and Analyzing</b></p> <ul style="list-style-type: none"> <li>Use reasoning to explore and make connections</li> <li>Estimate reasonably</li> <li>Develop mental math strategies and abilities to make sense of quantities</li> <li>Use technology to explore mathematics</li> <li>Model mathematics in contextualized experiences</li> </ul>
<b>Personal and Social</b> <p><b>Positive Personal &amp; Cultural Identity</b></p> <ul style="list-style-type: none"> <li>relationships and cultural contexts</li> <li>personal values and choices</li> <li>personal strengths and abilities</li> </ul> <p><b>Personal Awareness &amp; Responsibility</b></p> <ul style="list-style-type: none"> <li>self-determination</li> <li>self-regulation</li> <li>well-being</li> </ul> <p><b>Social Responsibility</b></p> <ul style="list-style-type: none"> <li>contributing to community and caring for the environment</li> <li>solving problems in peaceful ways</li> <li>valuing diversity</li> <li>building relationships</li> </ul>	<b>Understanding and Solving</b> <ul style="list-style-type: none"> <li>Engage in problem-solving experiences that are connected to place, story, cultural practices, and perspectives relevant to local First Peoples communities, the local community, and other cultures</li> </ul> <p><b>Connecting and Reflecting</b></p> <ul style="list-style-type: none"> <li>Reflect on mathematical thinking</li> <li>Connect mathematical concepts to each other and to other areas and personal interests</li> <li>Incorporate First Peoples worldviews and perspectives to make connections to mathematical concepts</li> </ul>

**Note:** Many of the curricular competencies are connected to more than one core competency and this table is just meant as a guide to support teachers in planning and assessment and to support students' connection-making as they learn to self-assess their development of the core competencies. This table may also be useful in supporting the development of a competency-based IEP.

compiled jn/updated January 2017

Created by Janice Novakowski  
Richmond's Math Teacher  
Consultant - [bit.ly/  
jnovakowskicompetencies](https://bit.ly/jnovakowskicompetencies)

# In Reflection some questions to ponder...

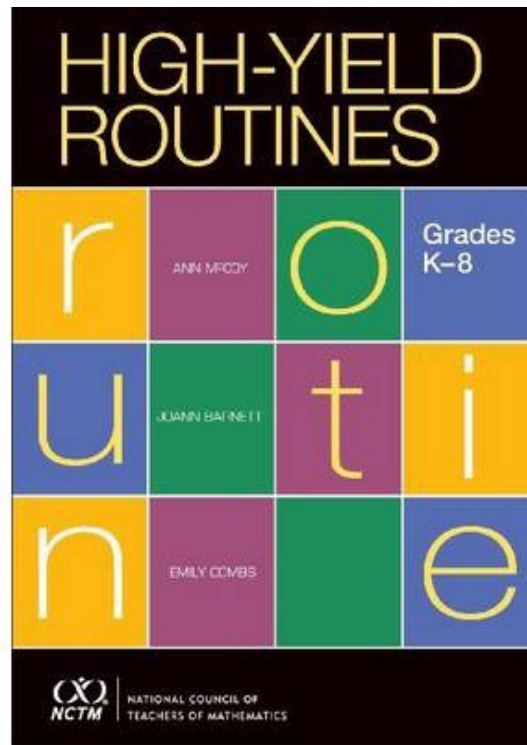
Note: These questions come from an excellent blogpost by Janice Novakowski

"How do the core competencies connect with mathematics?"

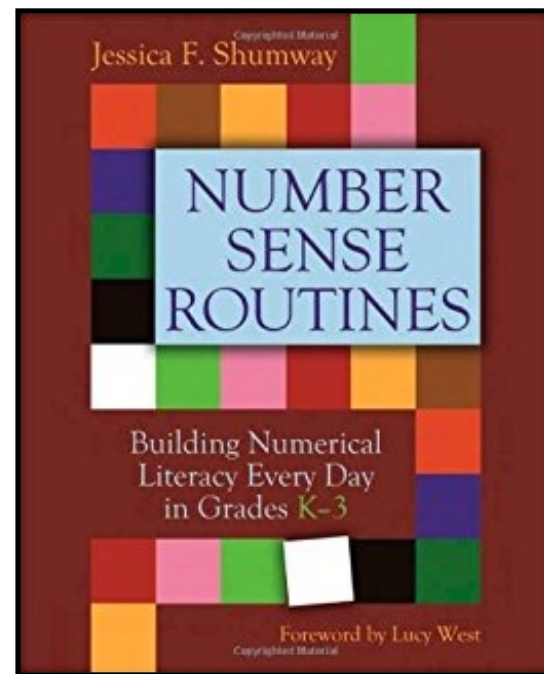
<http://bit.ly/jnovakowskicompetencies>

- What opportunities will you have students to experience and develop the core competencies in their mathematics learning?
- What opportunities over the school year will your students have to name and reflect on the core and curricular competencies in mathematics?
- How will you make the core competencies and curricular competencies in mathematics visible in your classrooms and schools?
- How will you embed the core and curricular competencies language and ideas in the mathematical community and discourse in our classrooms and schools?
- What different ways will your students be able to share, reflect on and self-assess their mathematical thinking and learning?

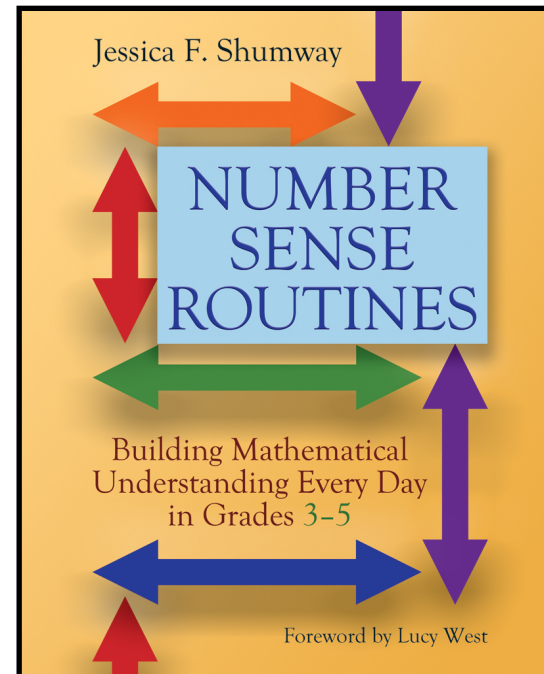
# Recommended Resources:



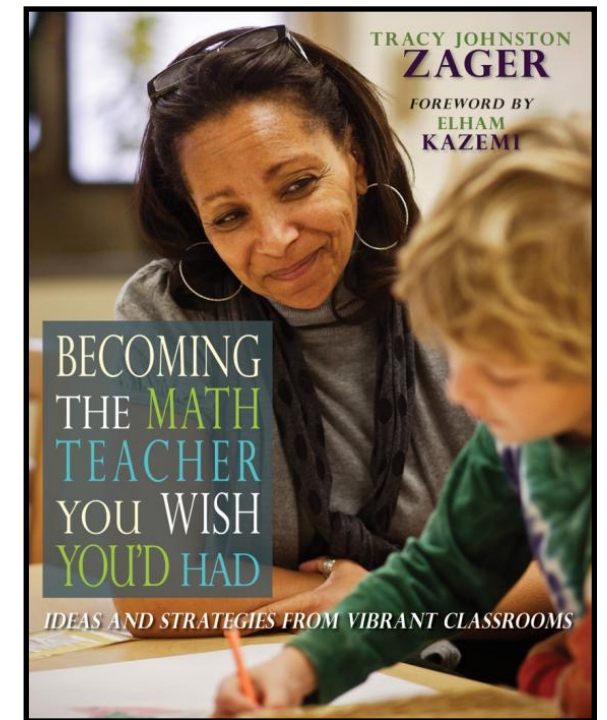
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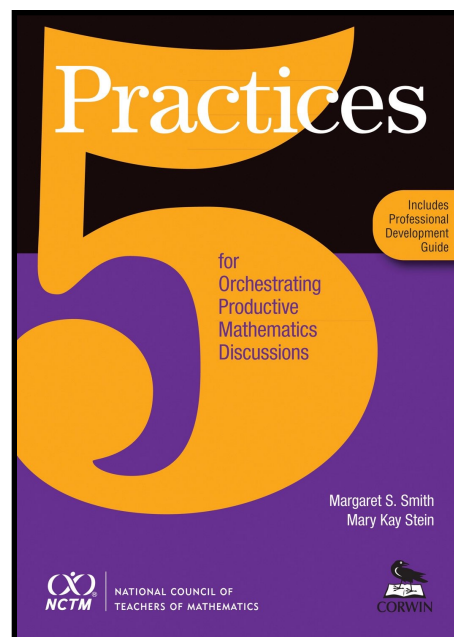
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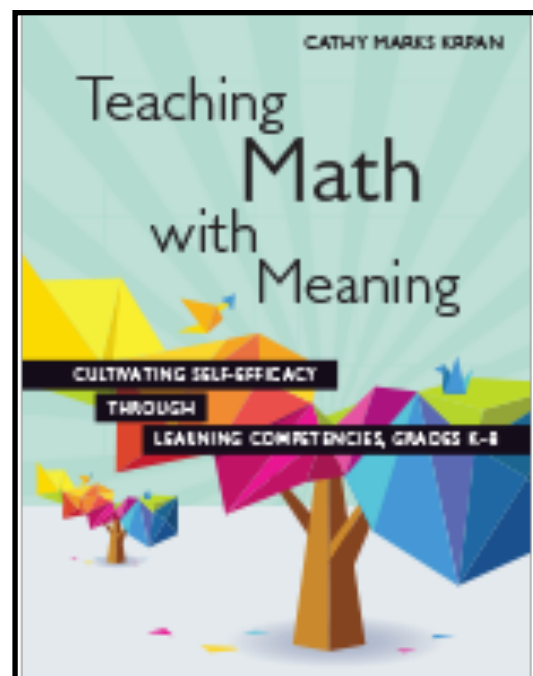
Coming Soon



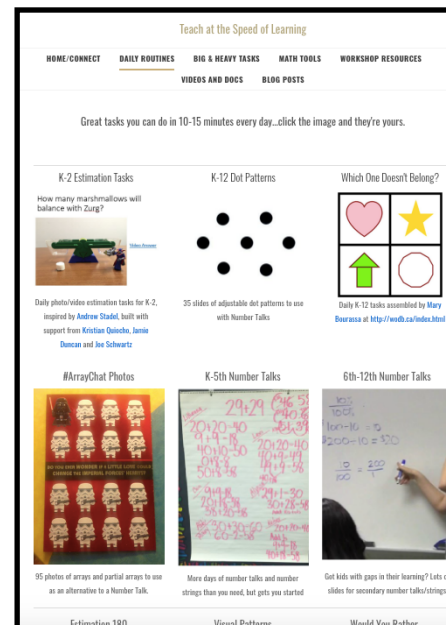
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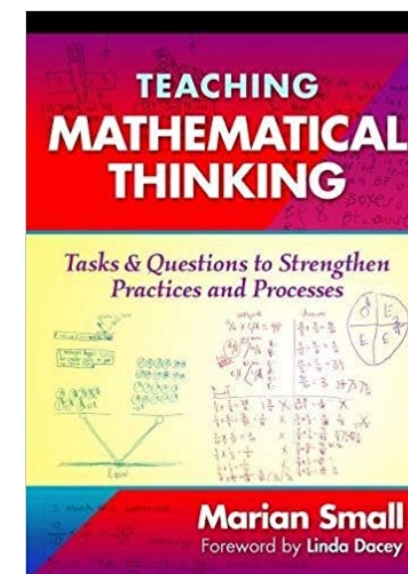
Coming Soon



LRS #179563

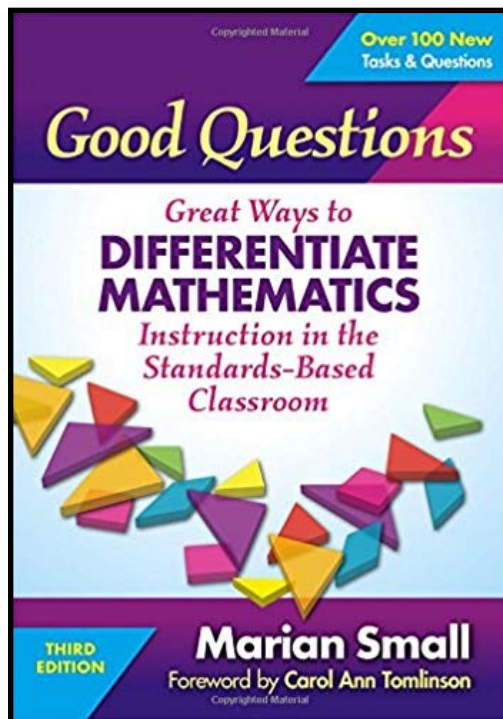


<https://visiblethinking.weebly.com/daily-routines.html>

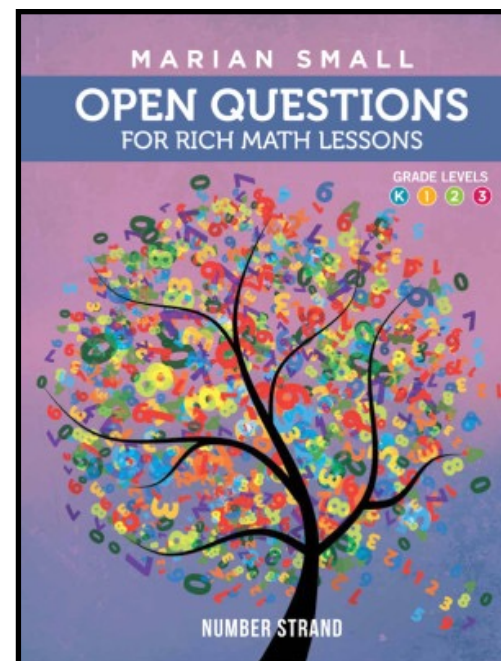


Coming Soon

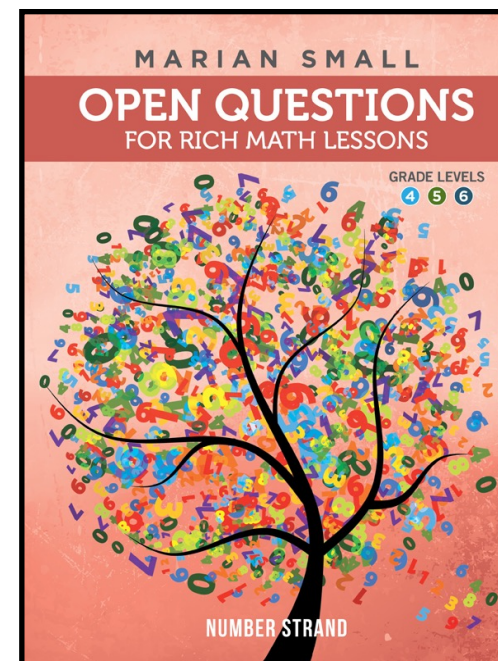




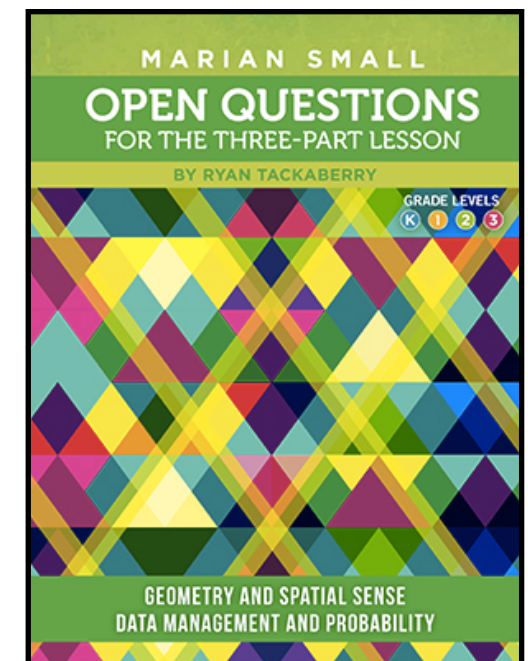
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LRS #173627

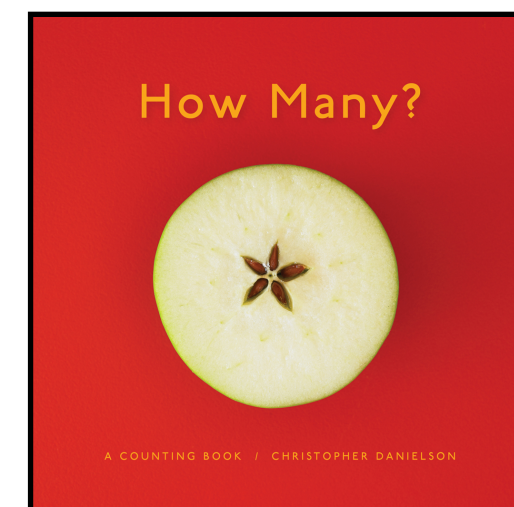


LRS #173628



Coming Soon

Consider registering for the Open Questions Series - check Weekly Memo  
After School 3:30 p.m. - 5:00 p.m. on  
October 11th  
January 16th  
February 5th



LRS #179551



Enjoy your LUNCH !!!



SPLAT!



Estimation Clipboard



Quick Image Number Talk



Choose ONE of the following  
Number Routines  
and try planning one for your class.  
See page 5 on the handout.