



Please take some time to  
**PLAY!** Engage with a  
question and the materials.



# Acknowledgement



Before going any further, it is important that we recognize that we are here today to learn on the unceded, shared territories of the Coast Salish people on which our schools are located. We recognize that the Katzie and Semiahmoo First Nations who have signed the Surrey Schools Aboriginal Education Enhancement Agreement.



# Playful Mathematical Inquiry in Grades 3 to 5: Multiplication



May 9th, 2018  
Surrey, BC - REC 206  
Presented by Jen Barker  
Twitter: @barkerJBarker

# Acknowledgements

- Thanks to Karveena Atwal, Adam Fourchalk, Marie Cojocariu, and Natasha Reichhardt for letting me try out some lessons in their classes!
- These ideas have been collected and/or inspired from a number of sources, including a strong inspiration from Janice Novakowski and her amazing work in this area. Please see hand out for links.





# Learning Intentions

- I have an emerging definition of PLAY!
- I understand there are different types of inquiry and what these look like.
- I understand my role as the teacher during playful mathematical inquiry, including designing the learning opportunities, asking nudging questions, and providing formative and summative assessment.
- I have a few ideas about how to design and incorporate playful Mathematical inquiry in my math class with regard to fractions

# Where can you find PPT, learning intentions, and more ideas?

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

HOME MUSINGS RESOURCES IDEAS CR4YL PRESENTATIONS/PUBLICATIONS



Click the  
Presentations tab  
and look for Playful  
Mathematical Inquiry  
Fractions

## 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/2eLlWAR](https://bit.ly/2eLlWAR)





What grade do you teach? Why  
did you sign up for this session?



# PLAY

Diminished consciousness of self

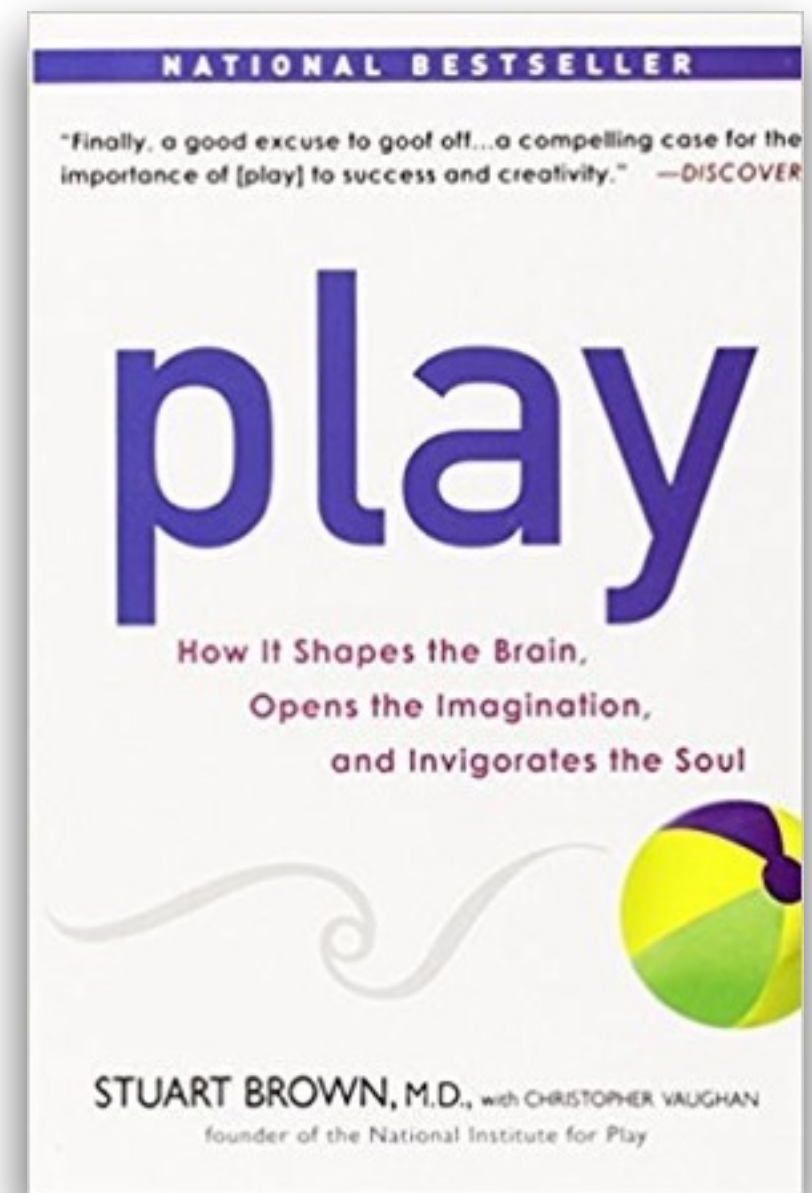
- no good or bad
- willingness to take risks

Improvisational Potential

- its openness
- co-constructing understanding

Continuation Desire

- it hooks! Focused attention
- self motivated





# What is Inquiry-based learning?

- it is a dynamic and emergent process;
- it builds on students' natural curiosity;
- places students' questions and ideas, rather than solely those of the teacher, at the centre of the learning experience.

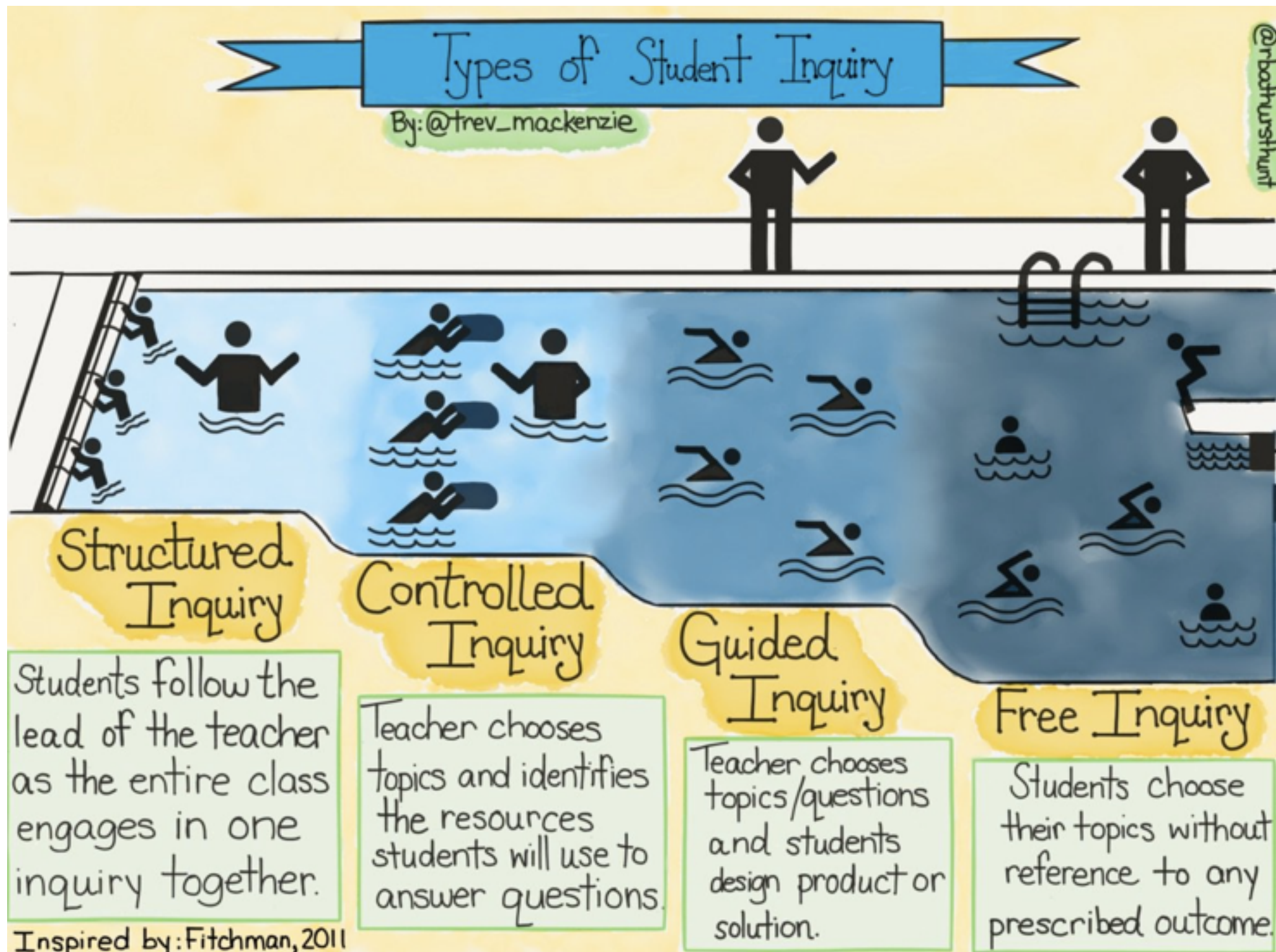


Why use this approach? What affordances come from inquiry?

<b>Traditional learning</b>	<b>Inquiry learning</b>
Have to learn	<b>Want to learn</b>
What to know	<b>How to know</b>
Tell and memorize	<b>Ask and inquire</b>
Only one right answer	<b>Many conclusions</b>
Teacher-directed	<b>Learner-centred</b>
One-size-fits-all	<b>Personalized</b>
Passive learning	<b>Active learning</b>
Assess for marks	<b>Assess for learning</b>

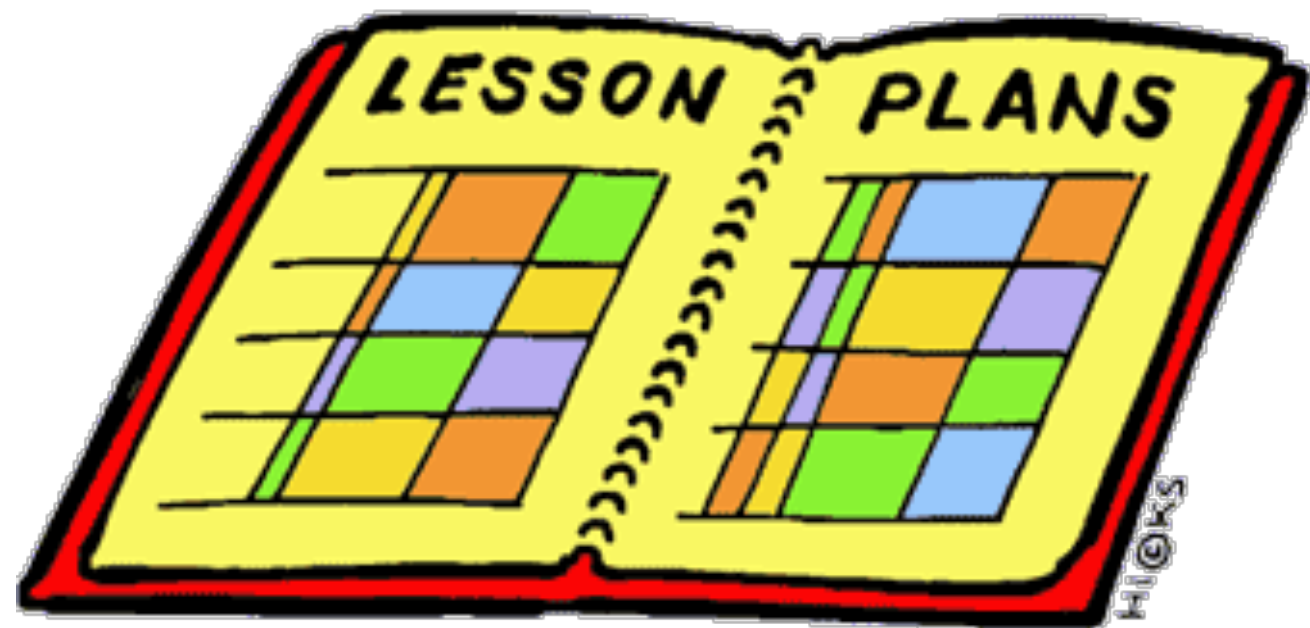


# Types of Inquiry



# Structure of a Whole Class Lesson

1. Introduce the problem - use a book, image, artifact
2. Exploration Time - what materials will you need?
3. Sharing - what strategies did you try?





# Developmental progression of Fractions

Created by Graham Fletch <https://gfletchy.com/2016/12/08/the-progression-of-fractions/>

## **Making Sense Series**

The Progression of Fractions  
Meaning, Equivalence, & Comparison

created by Graham Fletcher



@gfletchy

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

# Developmental progression of Fractions

- Partitioning wholes into equal areas - understanding the language of halves, thirds, fourths and equal shares of a whole do not need to be the same shape
- Recognizing fractions as Numbers - these numbers describe relationships between parts and a whole.
- Recognizing fractions as parts of a whole/area model
- Recognizing fractions as parts of a set/group
- Recognizing fractions as part of linear region
- Comparing fractions
- Recognizing Equivalent Fractions





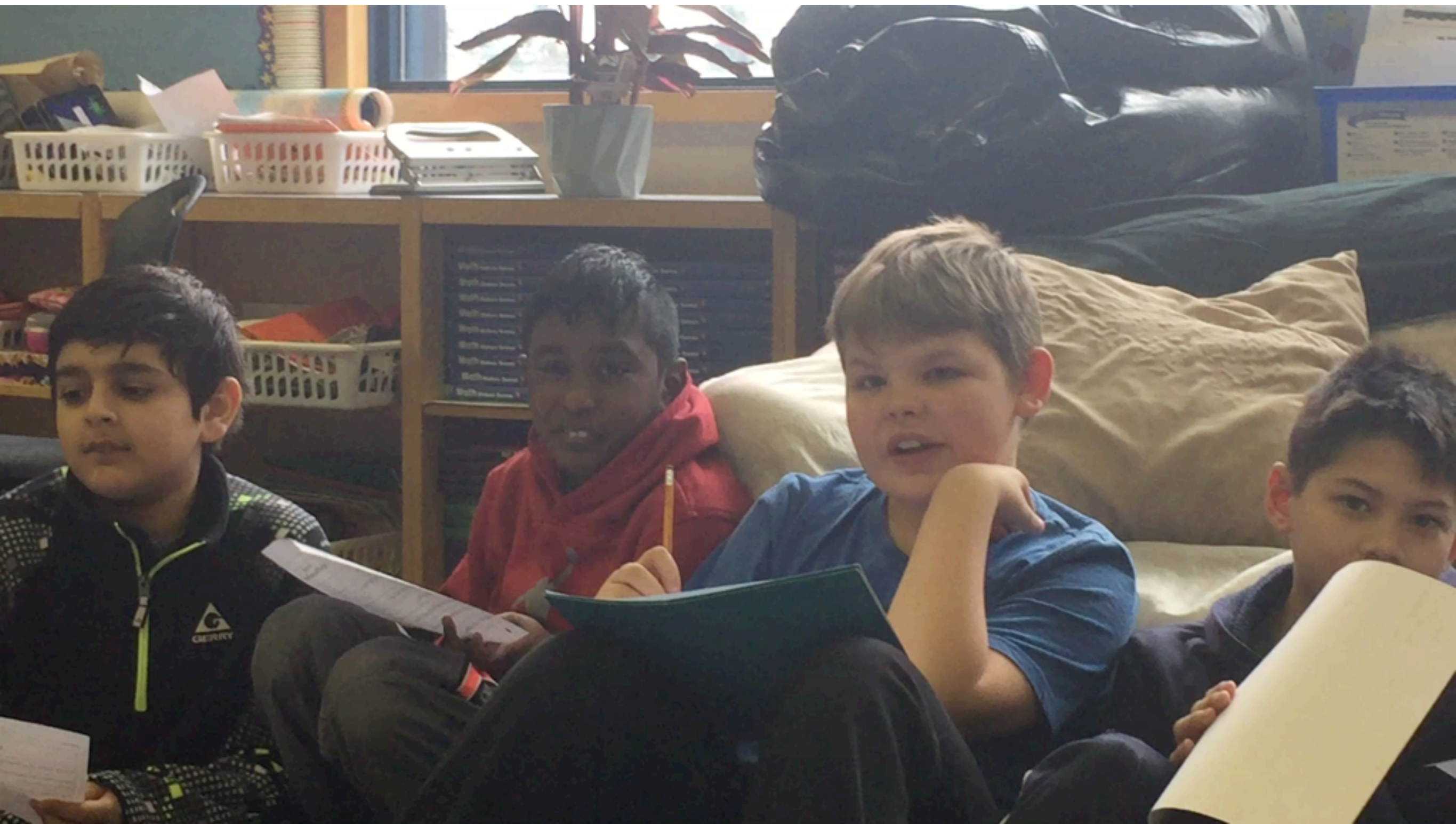
# Finding Out What Students Know

## Activating Prior Knowledge

### Talking Points

Name \_\_\_\_\_ Date Nov 5, 2018

Talking Points	Rounds	
	Agree/Disagree/Unsure 1	Agree/Disagree/Unsure 2
Equal parts of a fraction are all the same shape.	<del>D</del> A 1	D
Fractions can describe equal parts of a linear region (e.g., a string or ribbon).	A	2 A
Equivalent fractions describe the same equal parts.	A	3 D
Fractions are always less than one.	D	4 D
Fractions can be used to describe groups of items.	A	5 A
Fractions cannot be placed on a number line.	D	6 D
$\frac{1}{4}$ is bigger than $\frac{1}{2}$ of a pizza.	<del>A</del> D	7 D







March 5, 2018

The Talking Point I am most sure of is ~~#~~ 5 because... It's groping and I know how to do.

The Talking Point I'd like to explore more is ~~#~~ 6 because it is hard to go on number lines when your doing fraction's.



Mar, 5, 2018

The talking I am most sure about is  $\frac{1}{4}$  is bigger than  $\frac{1}{2}$  of a pizza. I disagree to this because 1 piece of a pizza is smaller than half let's say we have 4 slices of pizza with 4 slices you  $\frac{1}{2}$  because it is one more slice than  $\frac{1}{4}$  of the pizza.

The talking point I'd like to explore the most is fractions is always less than one because I only understand a little bit of the question.

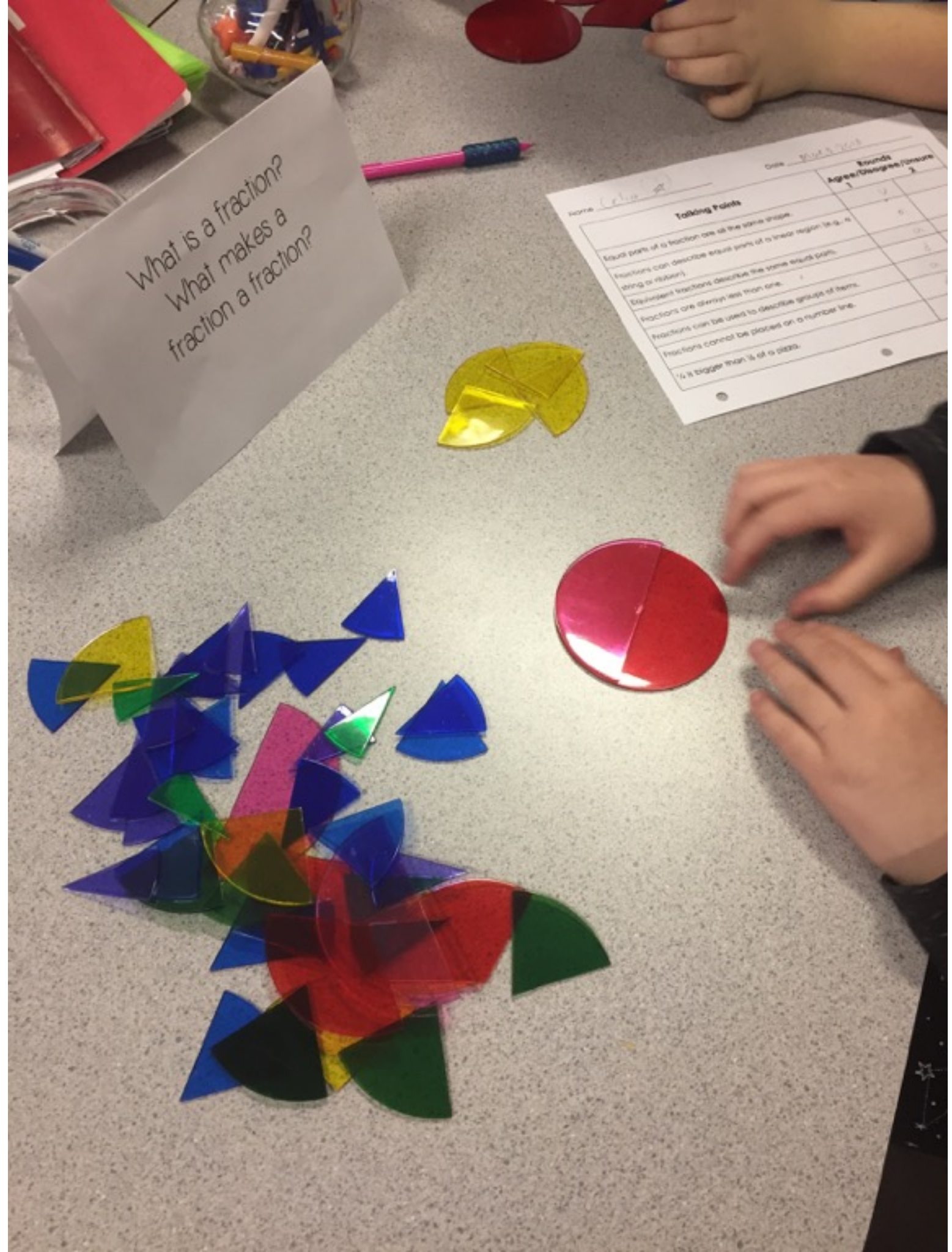


# Exploratory Play

Close observations...

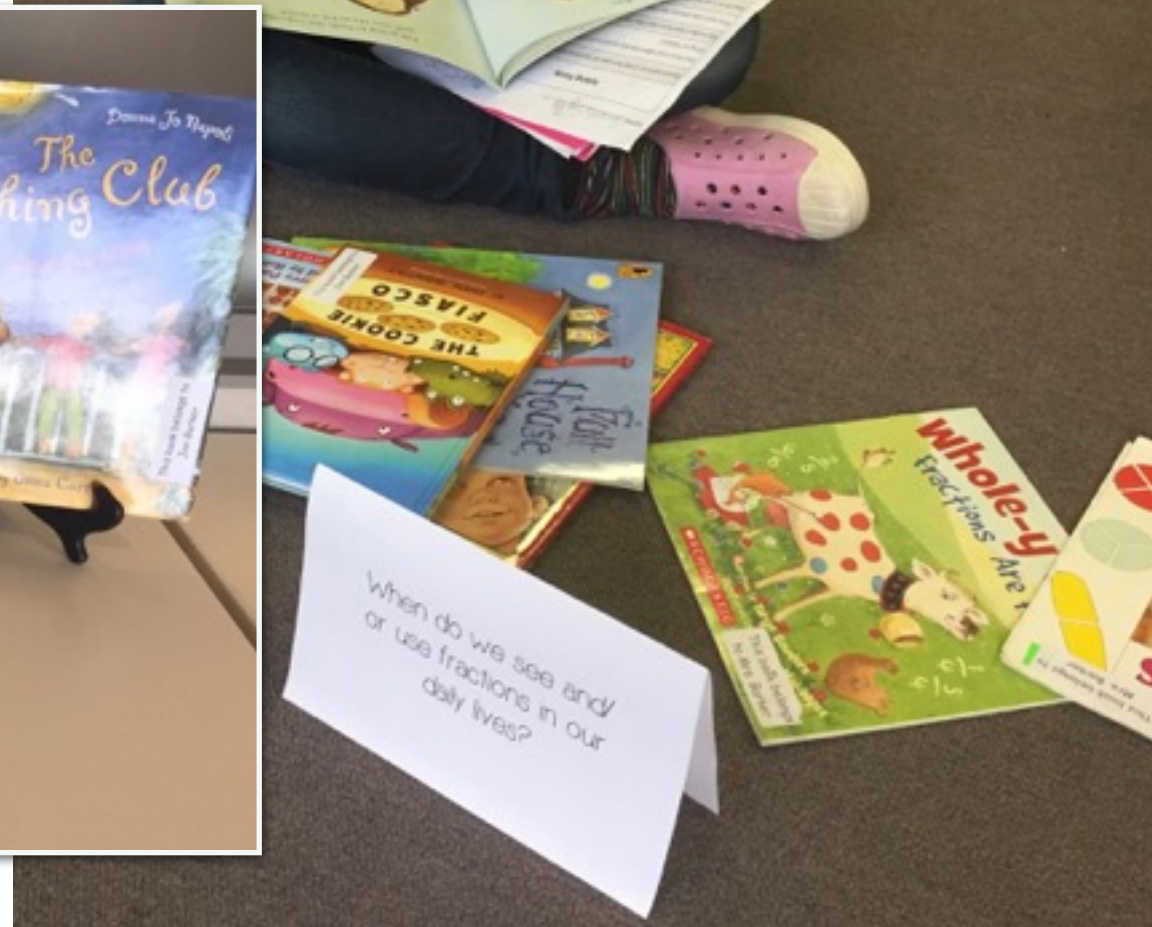
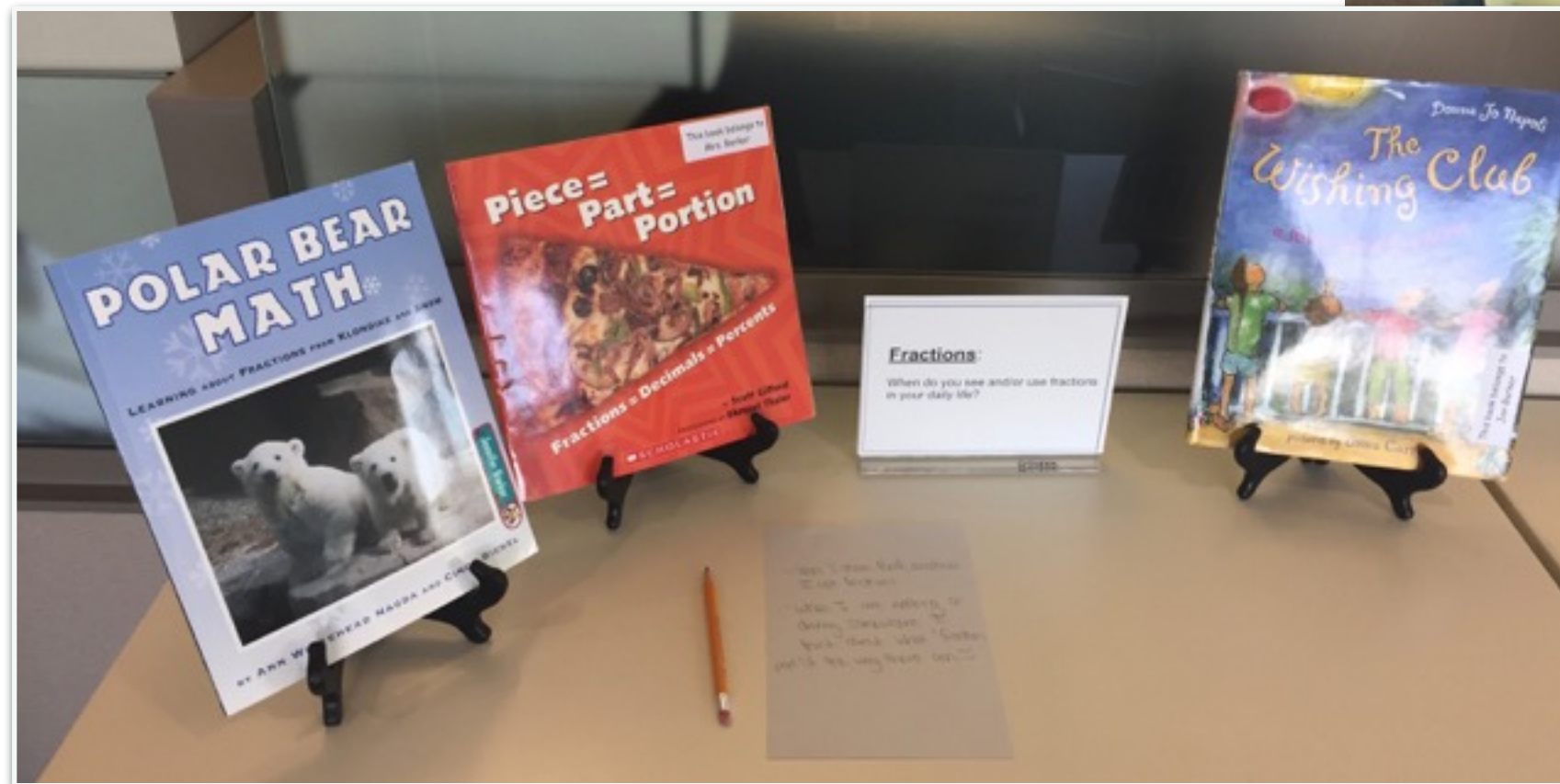
Listening...

Asking questions....





# Children's literature for providing context and connections!



How could teachers use this  
information to inform  
their instruction?





# Designing learning opportunities that are PLAYFUL & ENGAGING?

- Exciting literature
- Inviting Materials
- Connected to students' interests
- Multi-modal - hands on, kinesthetic, visual, auditory
- Opportunities for Collaboration
- Organized



Lessons that provided an entry point  
for all and allow each student  
to work to their potential

Learning Intentions for:

ALL

SOME

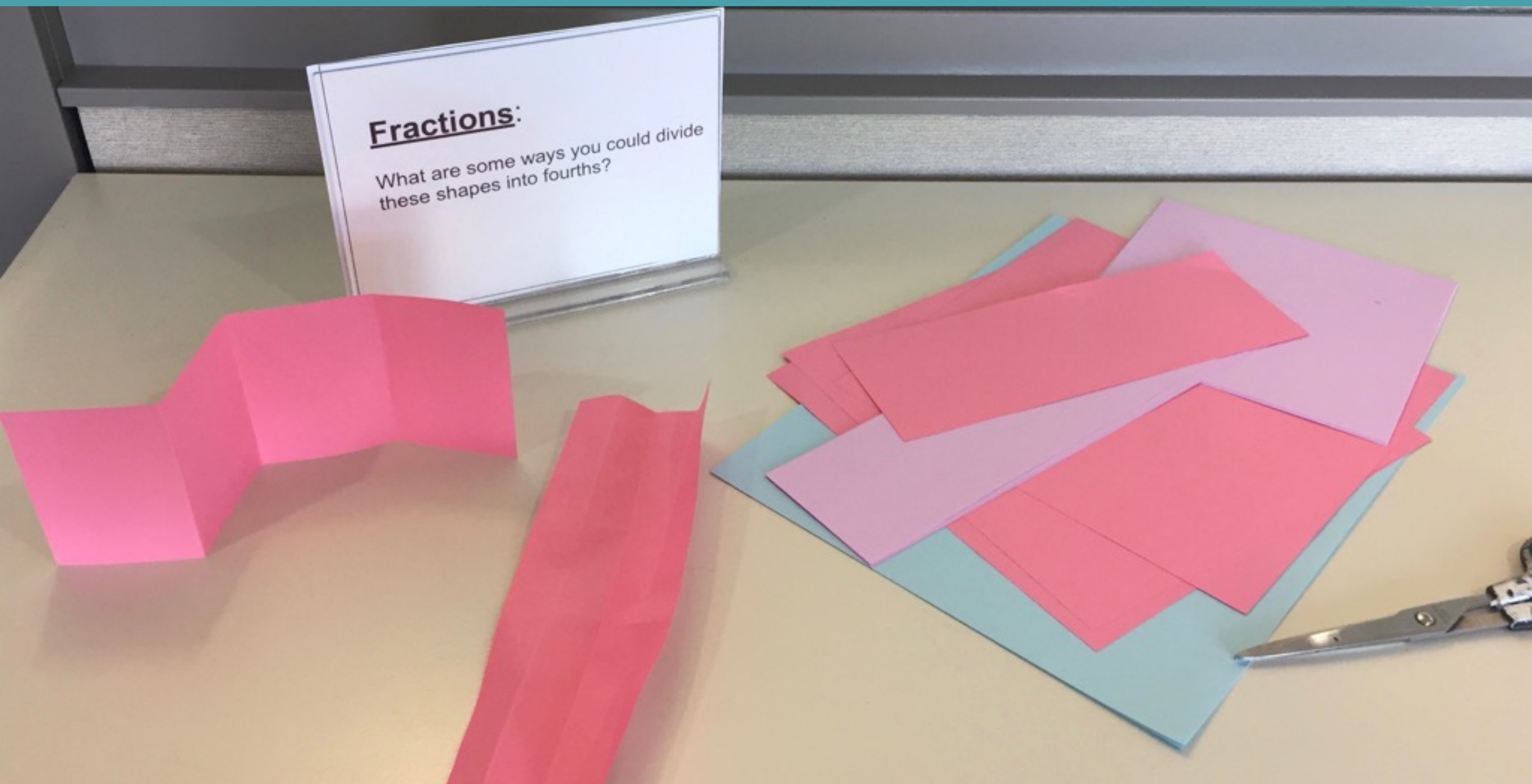
FEW



Thanks to Shelley Moore for her work in this area.

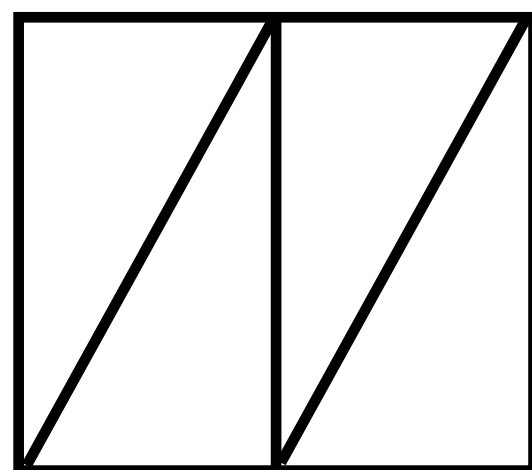
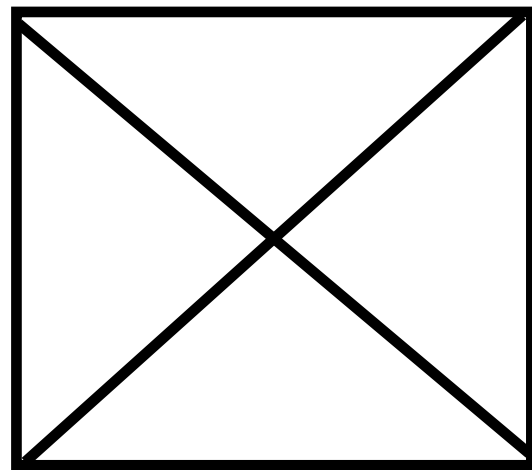
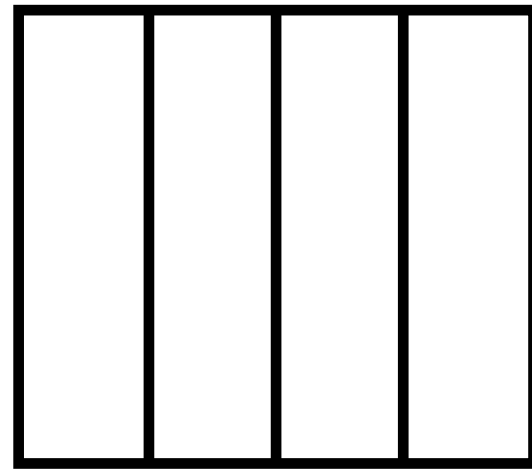
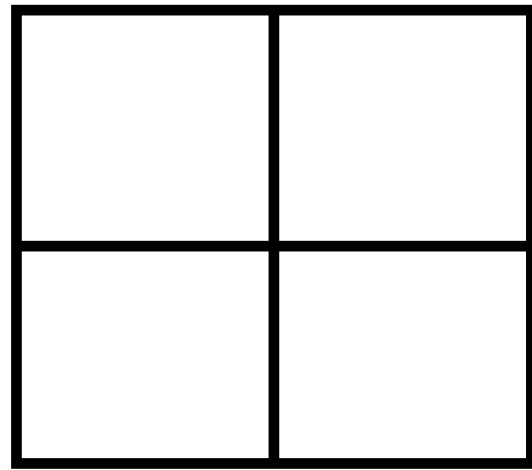


# How might we partition an area into equal groups?





How many ways can we cut the cake into four equal parts?

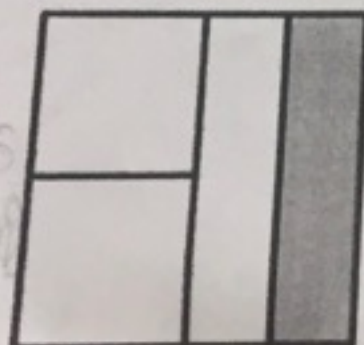
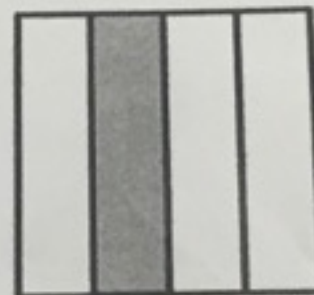
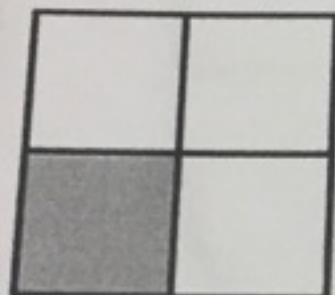


Name: \_\_\_\_\_

Date: March 8/2018

### Which One Doesn't Belong?

Take a few minutes to record what you notice about each of the images.

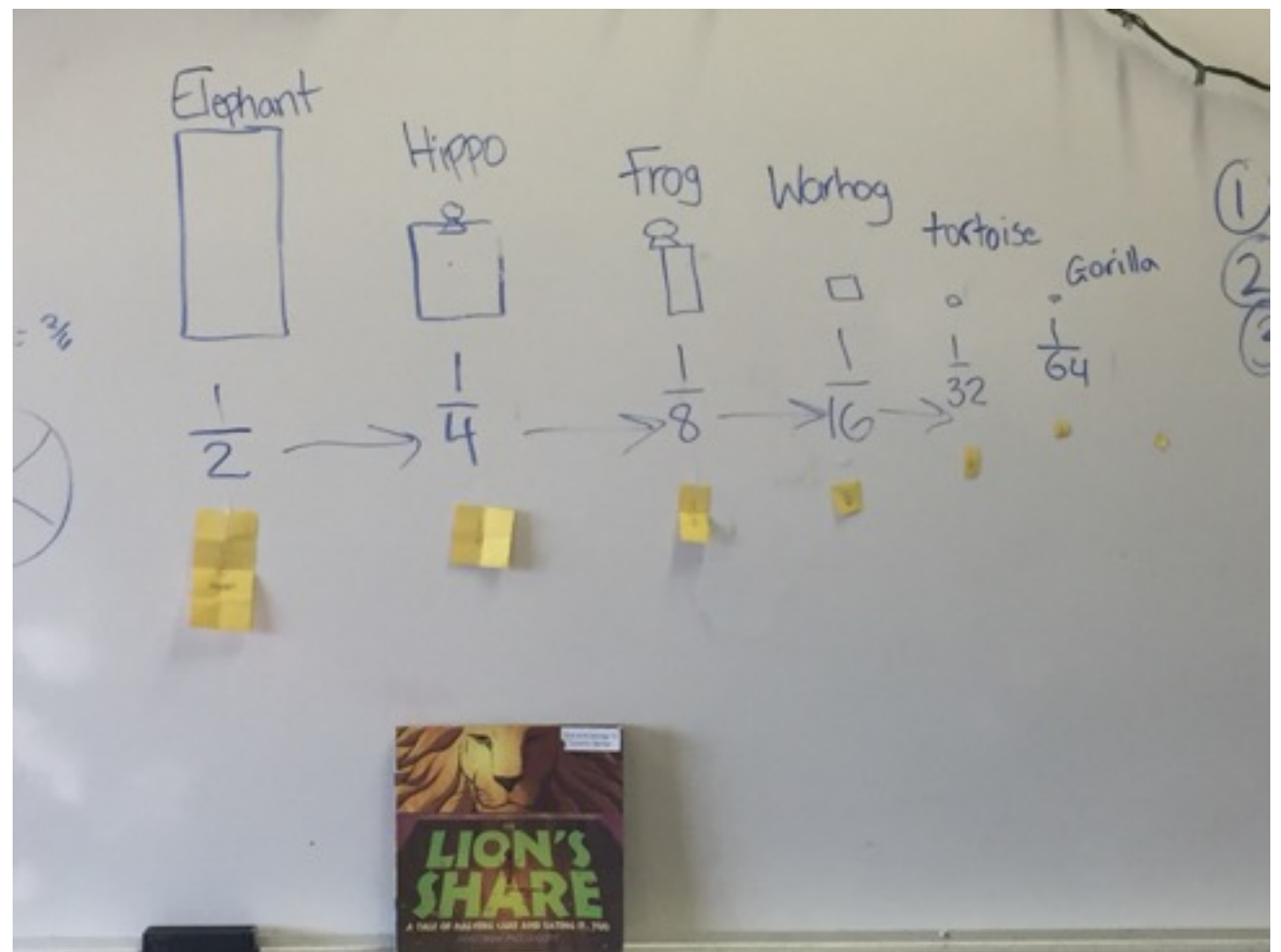
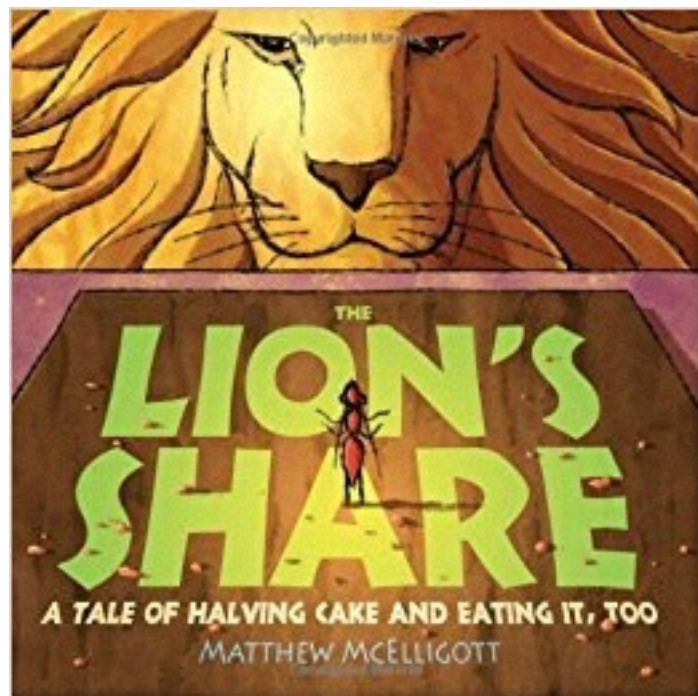


because it not even

This one does not belong

Which one doesn't belong? Explain your reasoning...

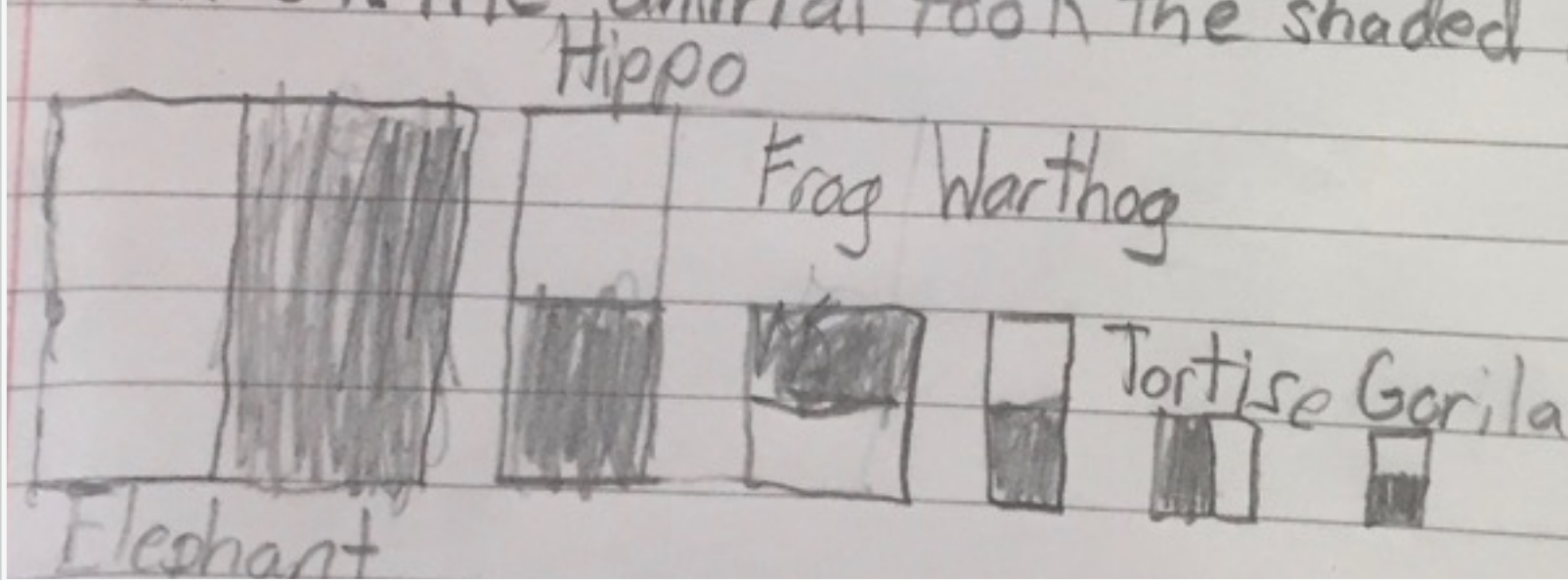
# Understanding fractions as relationships between parts and wholes...





What did you notice happened to the equal pieces of cake? Can you connect this to fractions?

First the elephant took  $\frac{1}{2}$ . Then the Hippo took a  $\frac{1}{4}$  of the cake. After the Frog took  $\frac{1}{8}$  of the cake. Then the Warthog took  $\frac{1}{16}$  of the cake. After that the tortoise took  $\frac{1}{32}$ . After the gorilla took  $\frac{1}{64}$  of the cake. The numerator stayed the same but the denominator doubled each time. It went 2, 4, 8, 16, 32 then 64. The animal took the shaded in part.

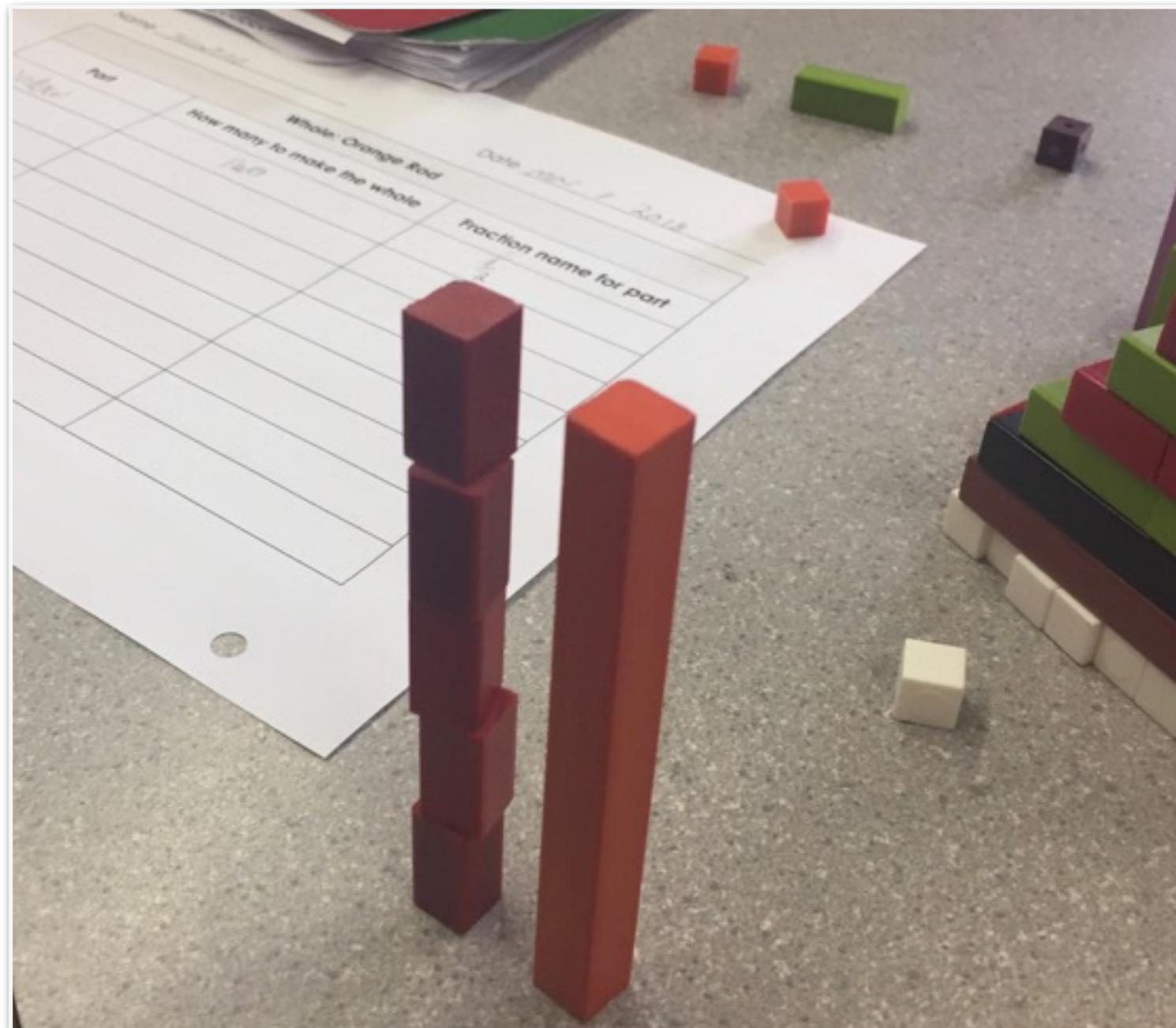


What did you notice happened to the equal pieces of cake? Can you connect this to fractions?

I noticed that the cake was getting smaller and smaller. first it was  $\frac{1}{2}$ . then it was  $\frac{1}{4}$ . then it was  $\frac{1}{8}$  and so on. the denominator was getting multiplied by 2 and the numerator was staying the same. The cake was getting cut in half each time.



If the orange rod is our whole,  
how would you describe the red rod?



Students explored the relationships!

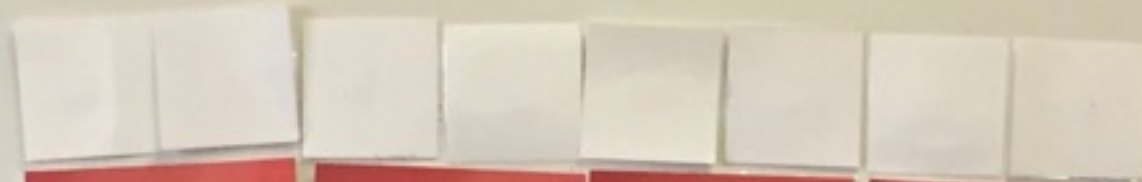


Whole: <u>Brown</u> Rod		
Part	How many to make the whole	Fraction name for part
Purple	2	$\frac{1}{2}$
Red	4	$\frac{1}{4}$
White	8	$\frac{1}{8}$
yellow	doesn't work	- Not equal pieces
green	doesn't work	- Not equal pieces
black	doesn't work	- Not " "
blue	doesn't work	" " "
orange	doesn't work	" " "



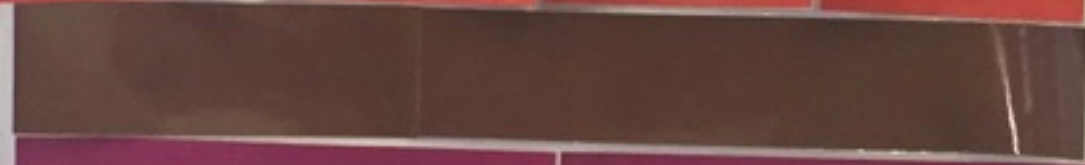
Whole: Brown Rod

One eighth  $\frac{1}{8} \rightarrow$



One fourth

$\frac{1}{4} \rightarrow$



8 whites = 1 brown

4 reds = 1 brown

2 purple = 1 brown

EXIT SLIP

Michael says the RED rod

is always  $\frac{1}{4}$  Do you agree or disagree?


Explain your thinking!

# Formative Assessment

Name \_\_\_\_\_

Date Wednesday March 7<sup>th</sup> 2018

I disagree with Michael because when I was experimenting I recorded that it is  $\frac{1}{5}$  compared to the orange rod and  $\frac{1}{3}$  when compared to the Turquoise rod (it changes on the size of the whole).

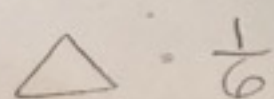


**EXIT SLIP**



## Fractions:

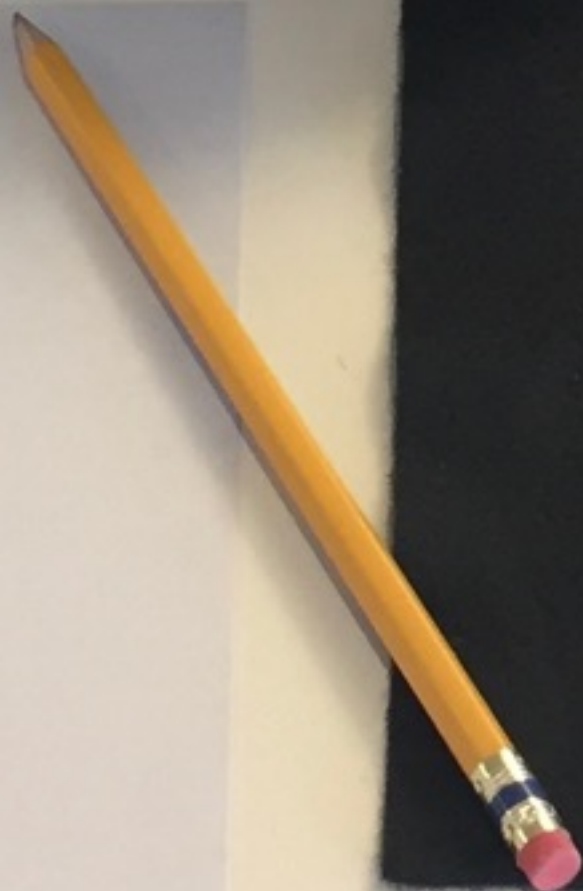
If a hexagon represents a whole,  
do the other pieces represent?



$$\frac{1}{6}$$



$$= \frac{1}{2}$$





## Fractions:

If 2 hexagons represent a whole, what do the other pieces represent?

BONKON  
BONKON



$$= \frac{1}{2}$$



$$= \frac{1}{6}$$







1 one whole



2 wholes



$\frac{1}{2}$



$\frac{1}{6}$



$\frac{1}{3}$



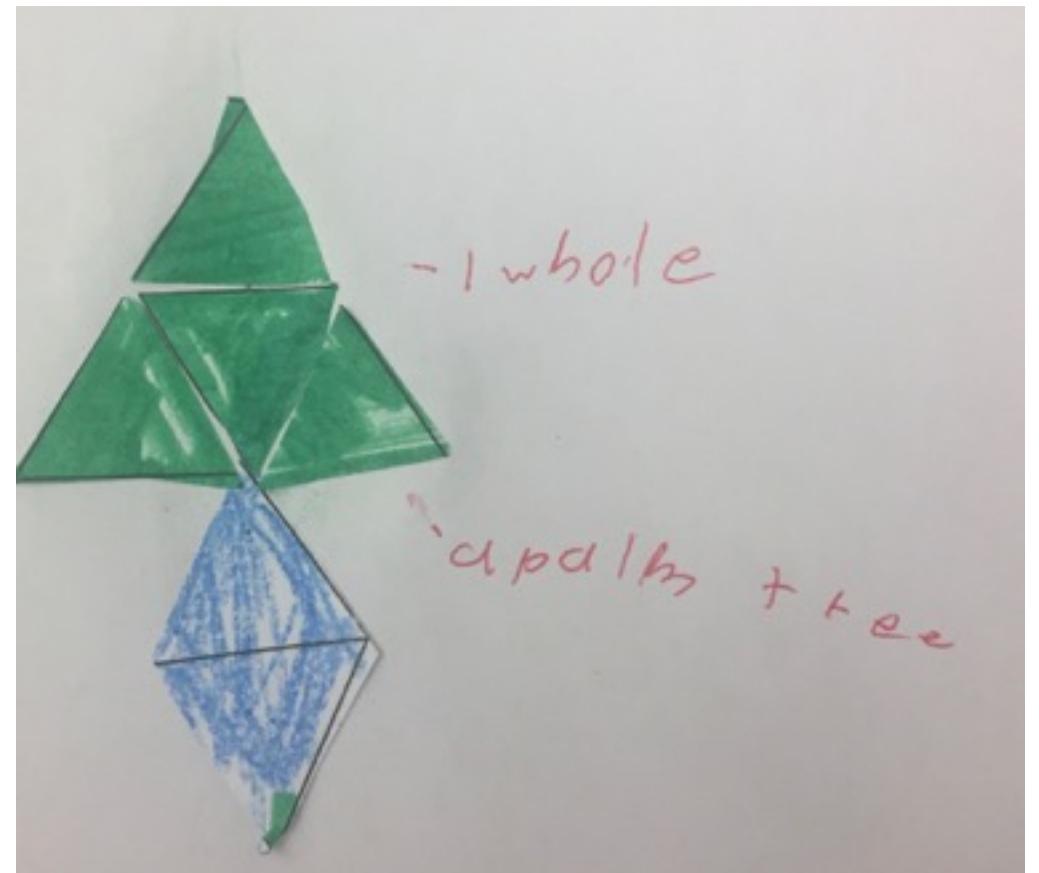
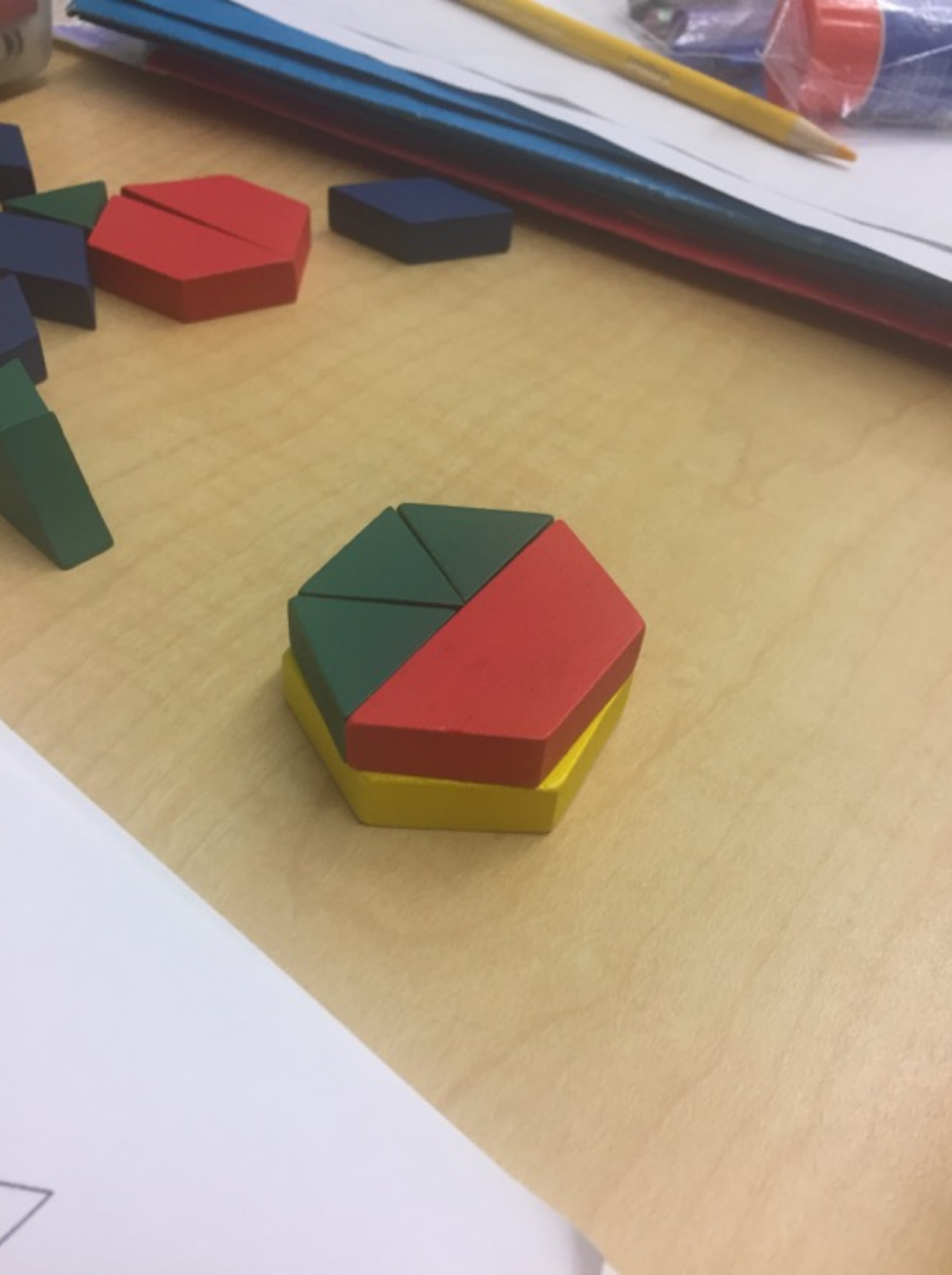
What designs can  
you create that  
equal one whole  
or two wholes?

3 whole

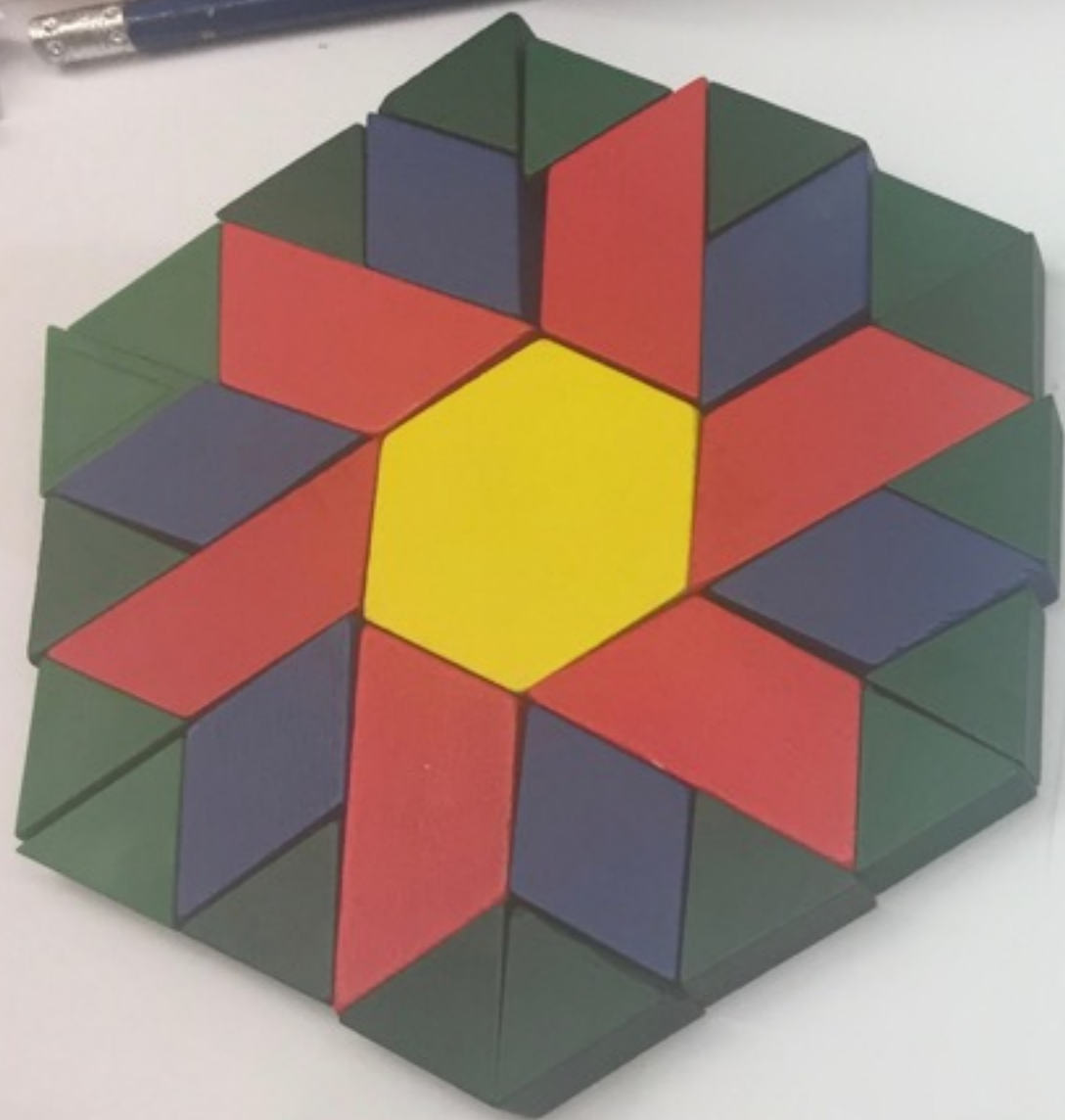


1 whole

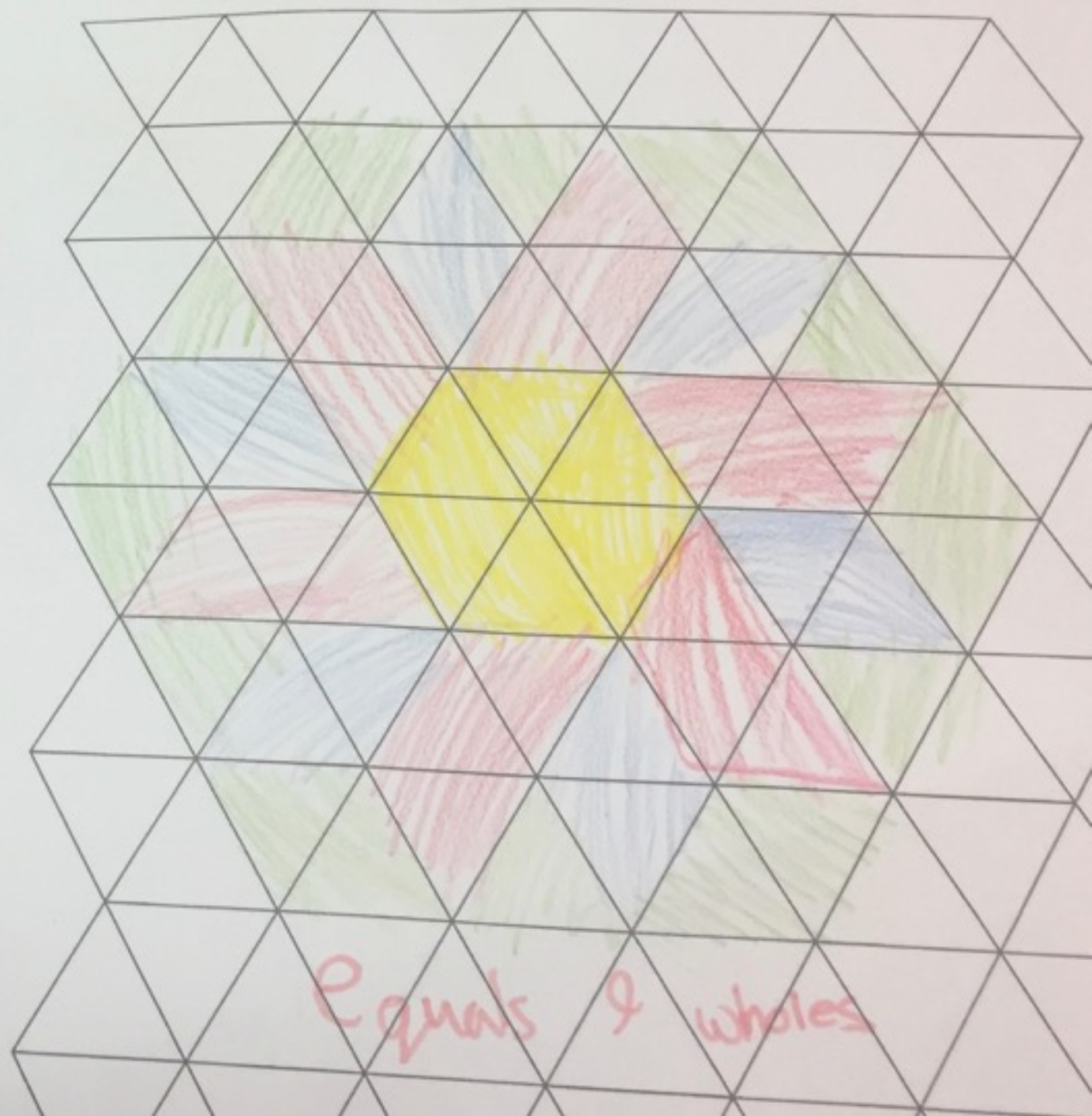


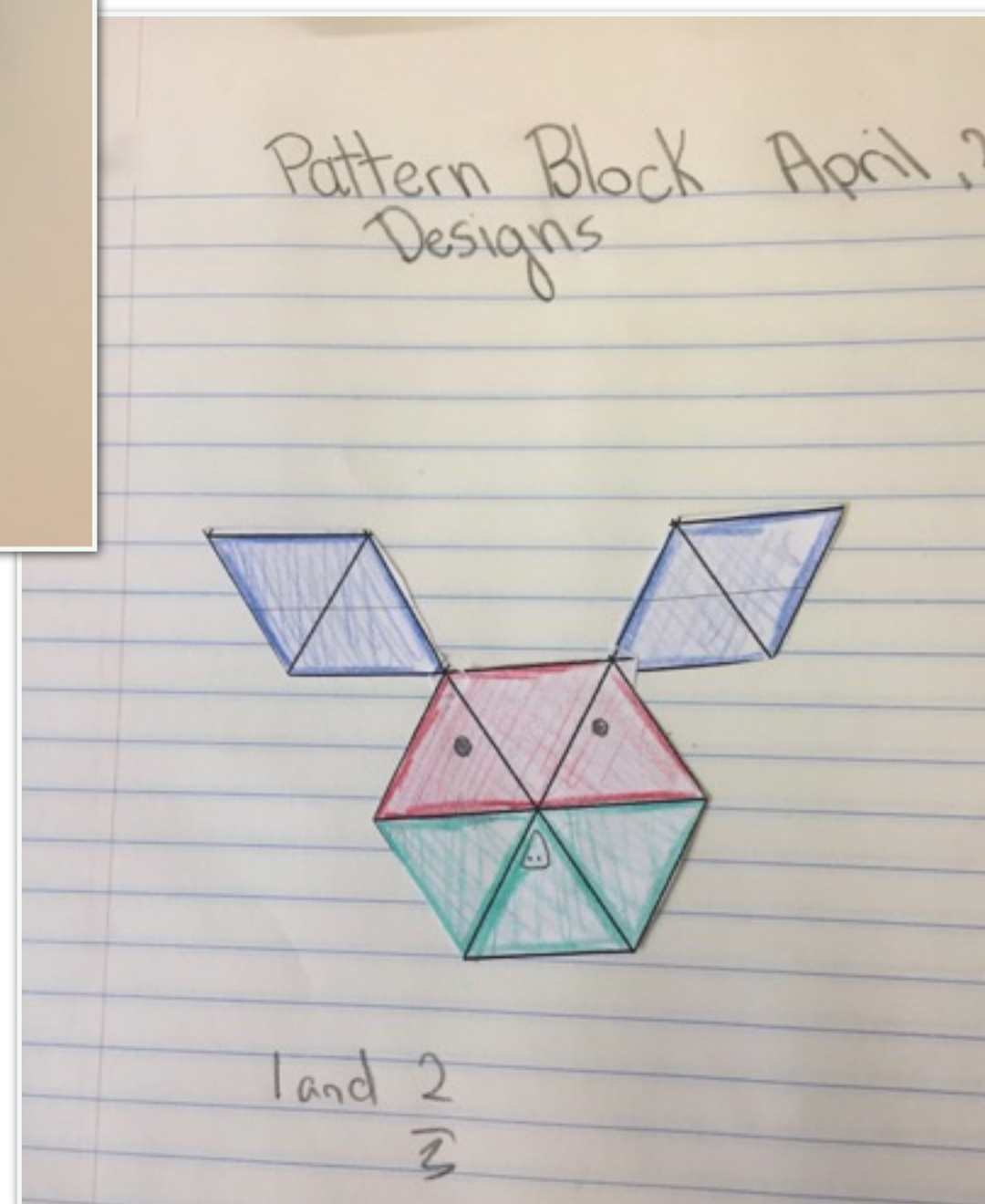
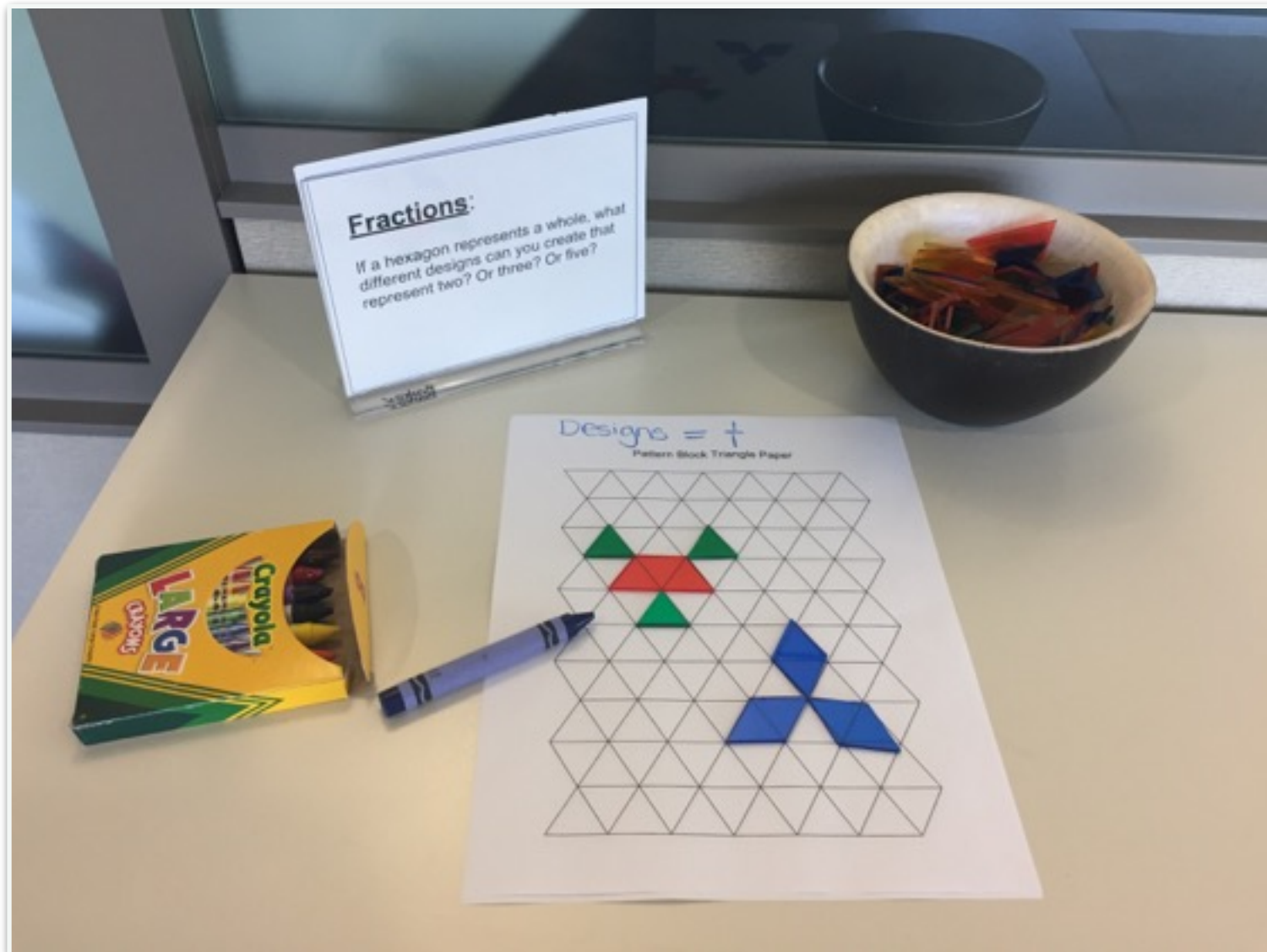






Pattern Block Triangle Paper







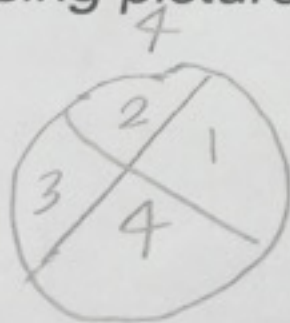
creativity is  
EXPERIMENTING,  
GROWING, TAKING  
RISKS, BREAKING  
RULES, MAKING  
MISTAKES, &  
HAVING FUN.


-Mary Lou Cook

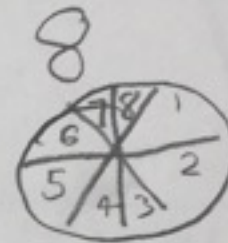
# Formative Assessment


Name \_\_\_\_\_



Would you rather share your favourite pizza with 4 other friends or 8 other friends? Show your thinking using pictures, numbers and words.



Each person gets  
a slice this:  big.

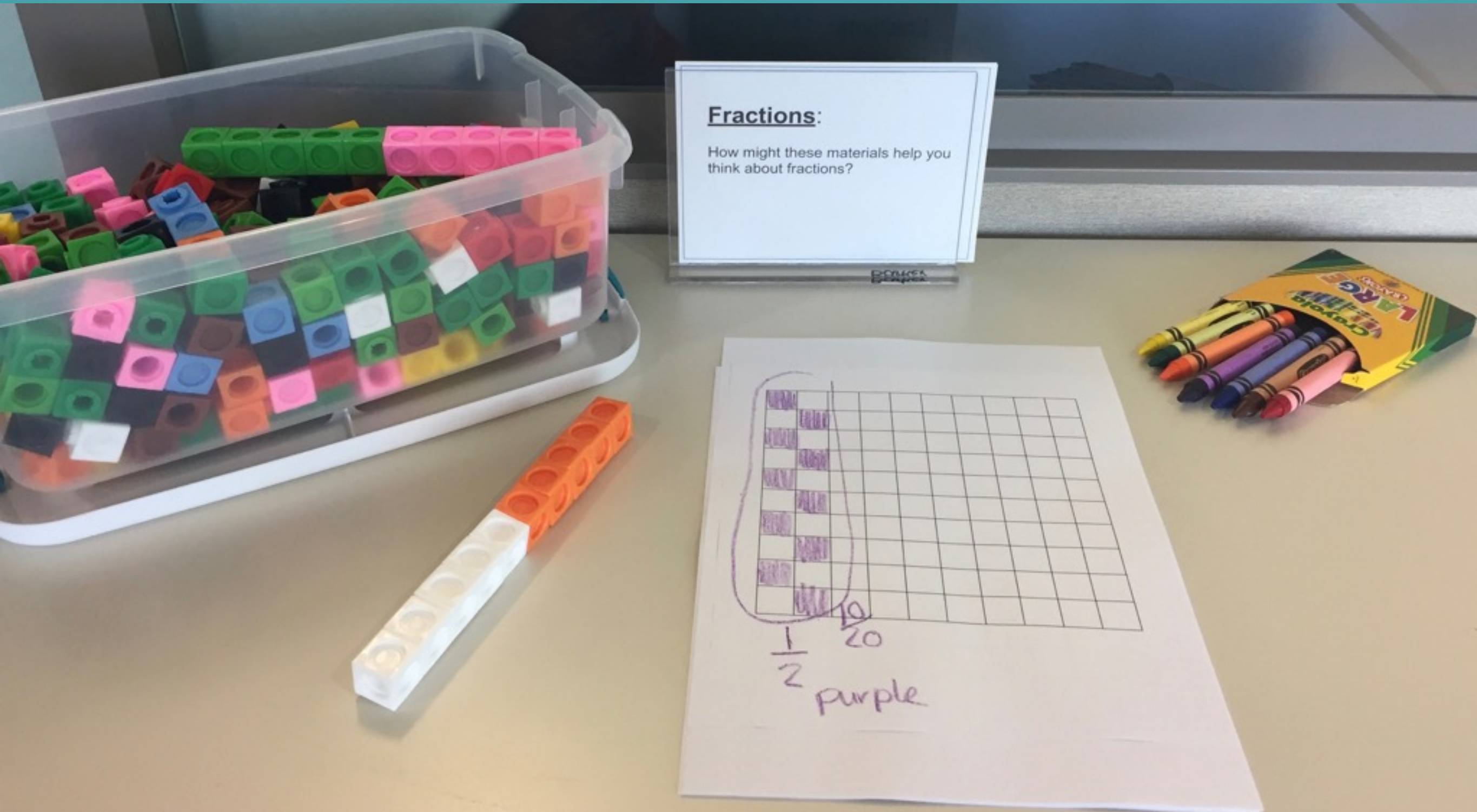


Each person gets a slice this:  big.

This:  is bigger than this:   
So I would share the pizza  
with 4 friends so people get  
bigger slices.



# How can we describe equal parts of a whole/area?



## Fractions:

Create a design using square tiles.  
Can you describe the different  
colours of tiles you used, using  
fractions?

$\frac{1}{2}$  are red

$\frac{1}{2}$  are green

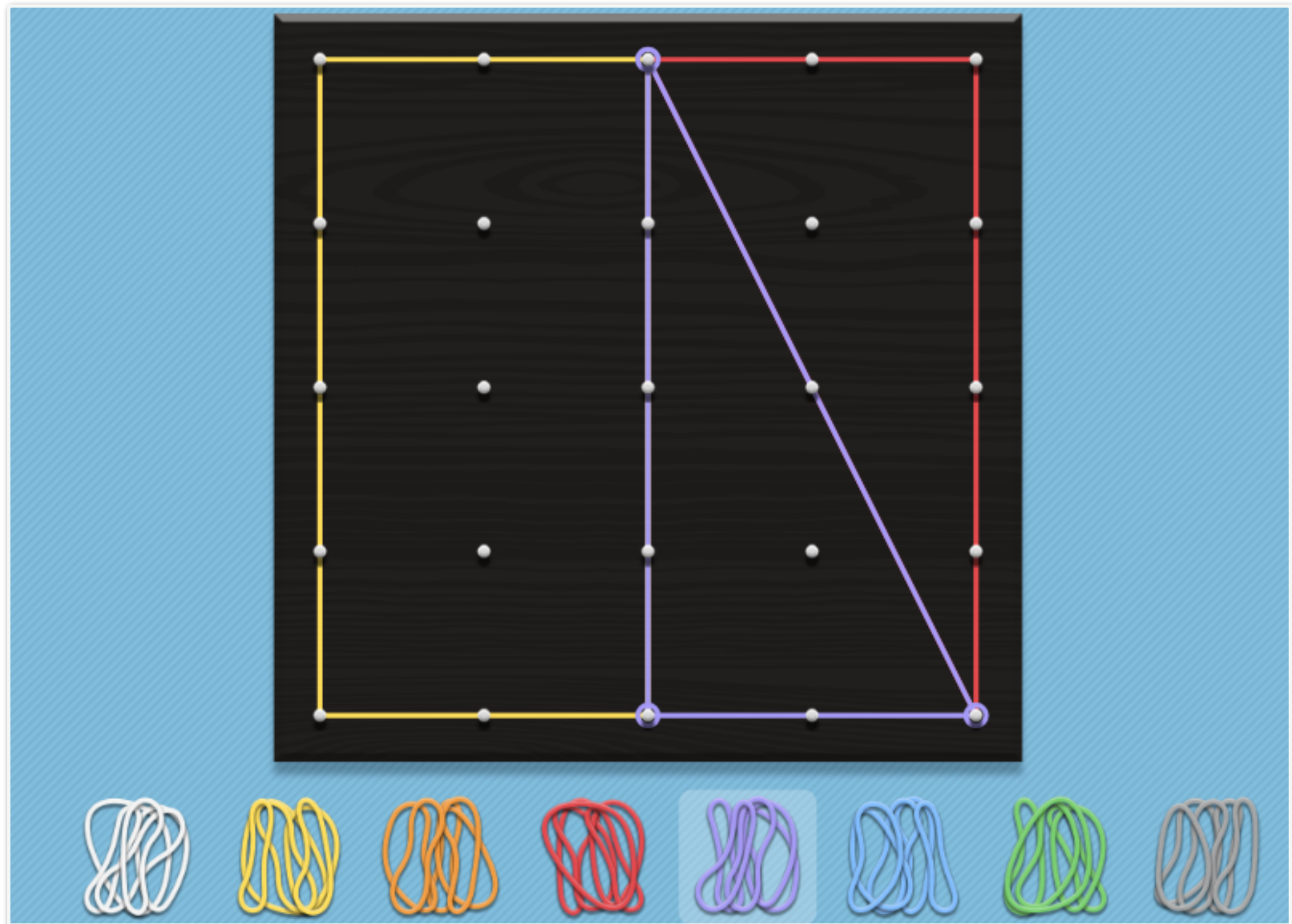
$\frac{6}{12}$  = are red





How might you describe your design using fractions?

[www.mathlearningcenter.org](http://www.mathlearningcenter.org)





# Grandfather Tang's Story

A TALE TOLD WITH TANGRAMS

Ann Tompert

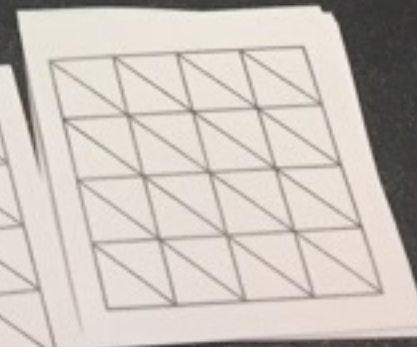
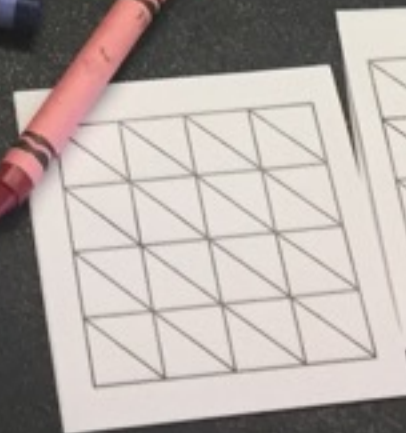
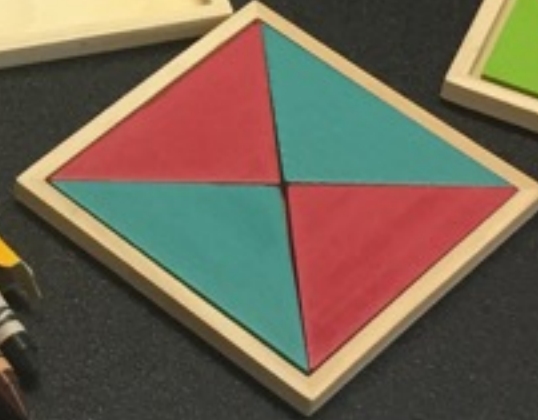
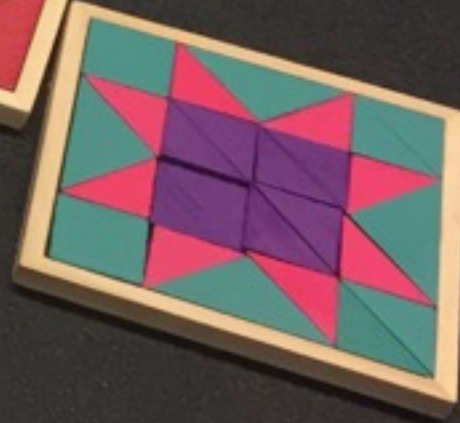


Illustrated by  
Robert Andrew Parker

SCHOLASTIC

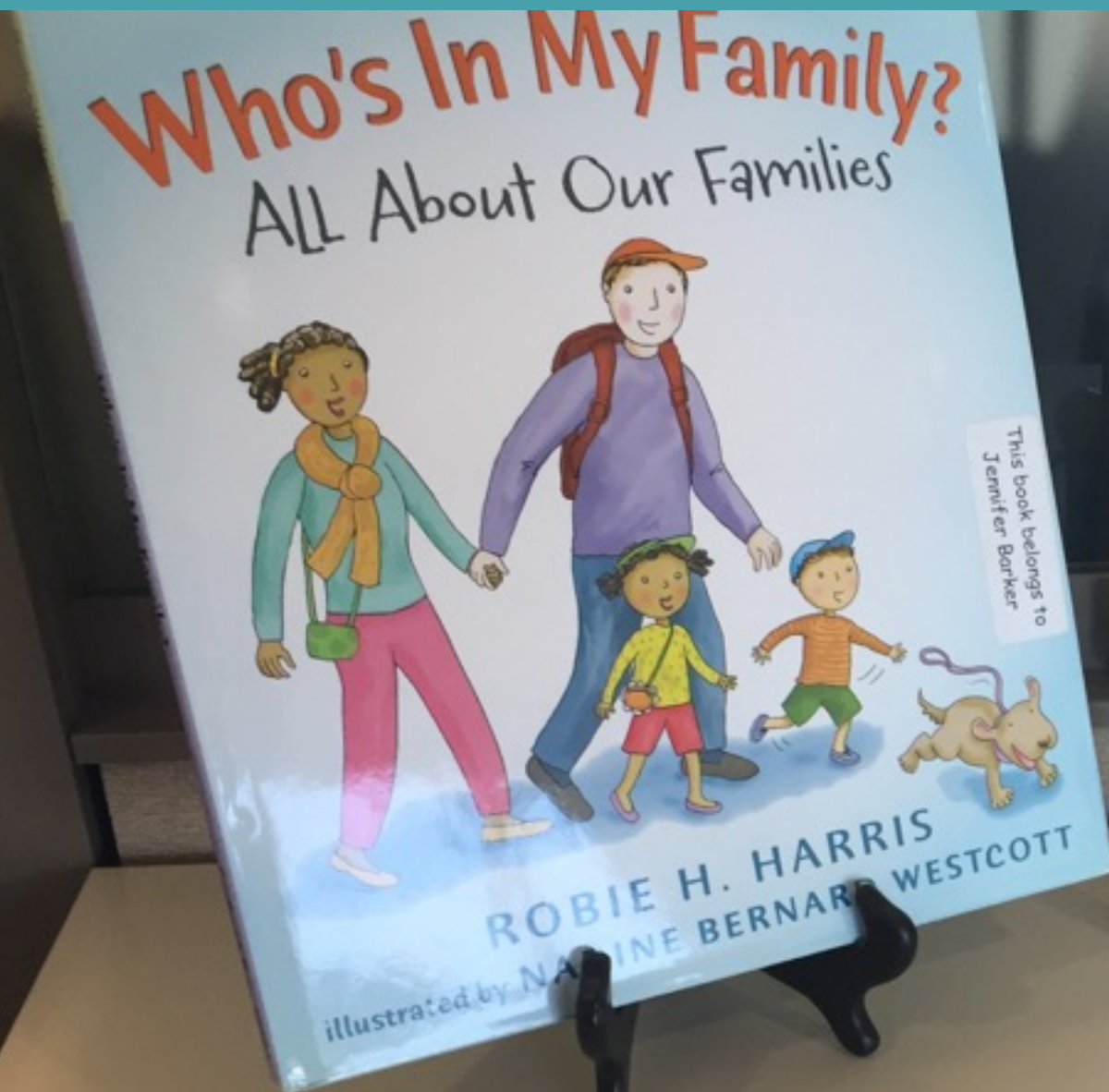
## Fractions:

How might these materials help you think about fractions?





# How can we describe equal parts of a group/set?



## Fractions:

How might these materials help you think about fractions?



$\frac{4}{8}$  have ponytails or buns





## The Barker Bunch

1. What fraction is boys?
2. What fraction is girls?
3. What fraction has a headband?
4. What fraction has brown hair?
5. What fraction is wearing a red scarf?





### The Whitecaps

1. What fraction of the group are adults?
2. What fraction are wearing white shirts?
3. What fraction are holding a ball?
4. What fraction are sitting in the front?
5. What fraction has a mustache?

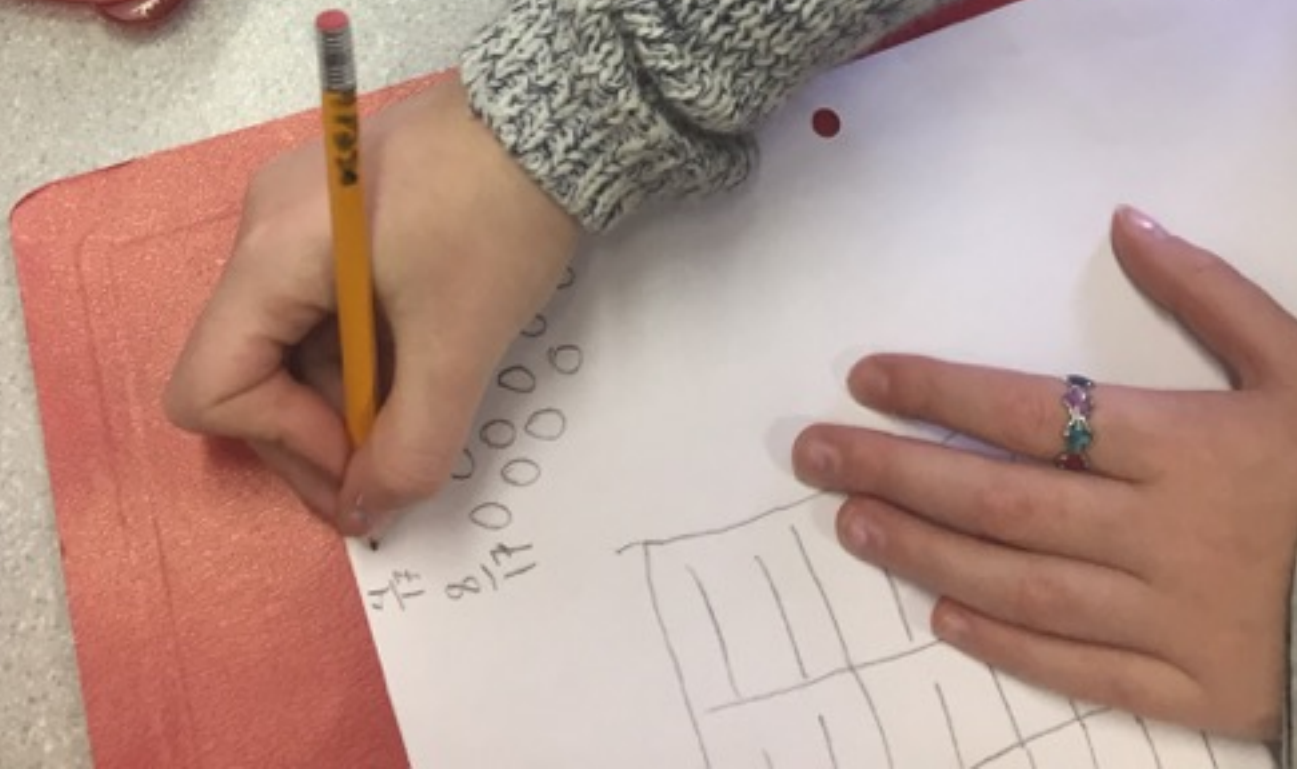
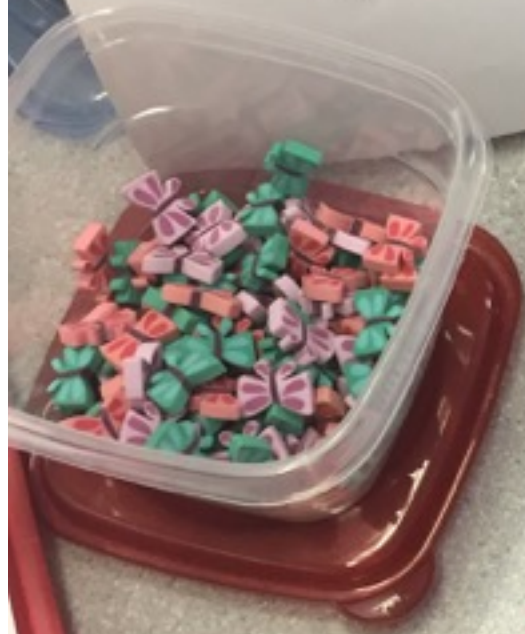
Name Matthew

### Answers

1.  $\frac{2}{10}$
2.  $\frac{9}{10}$
3.  $\frac{1}{10}$
4.  $\frac{5}{10}$
5.  $\frac{1}{10}$



How might these  
materials help you think  
about fractions?







**Fractions:**  
How might these materials help you  
think about fractions?

*Polk  
Rock*



## Fractions:

How might these materials help you think about fractions?



2

5



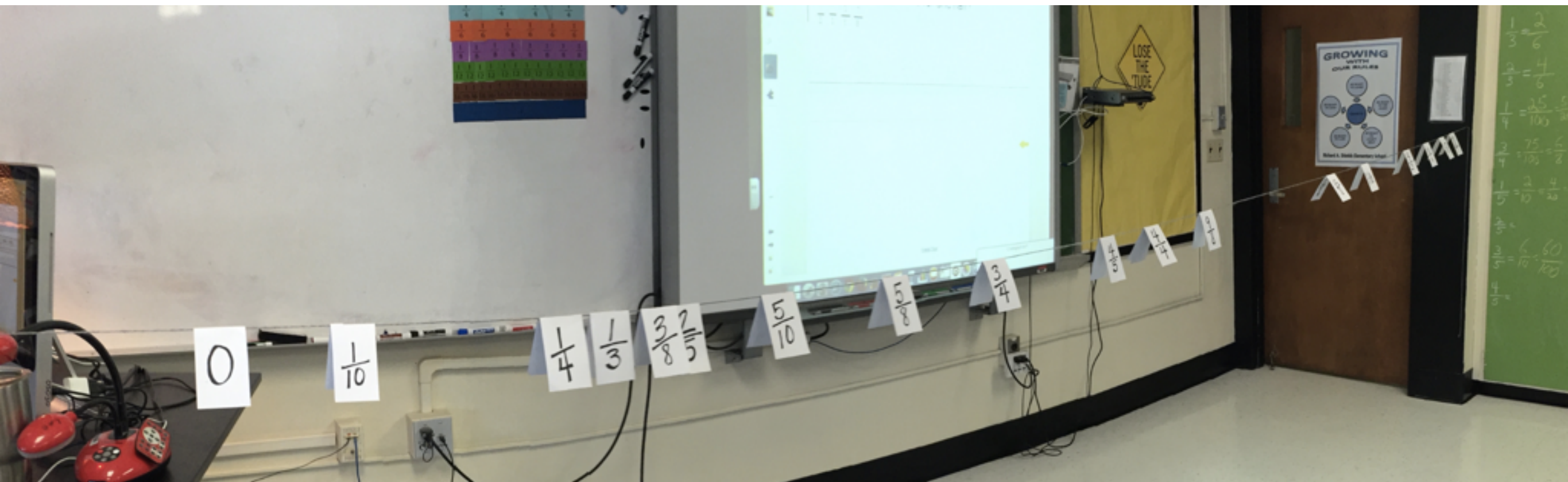
1

2

3

6

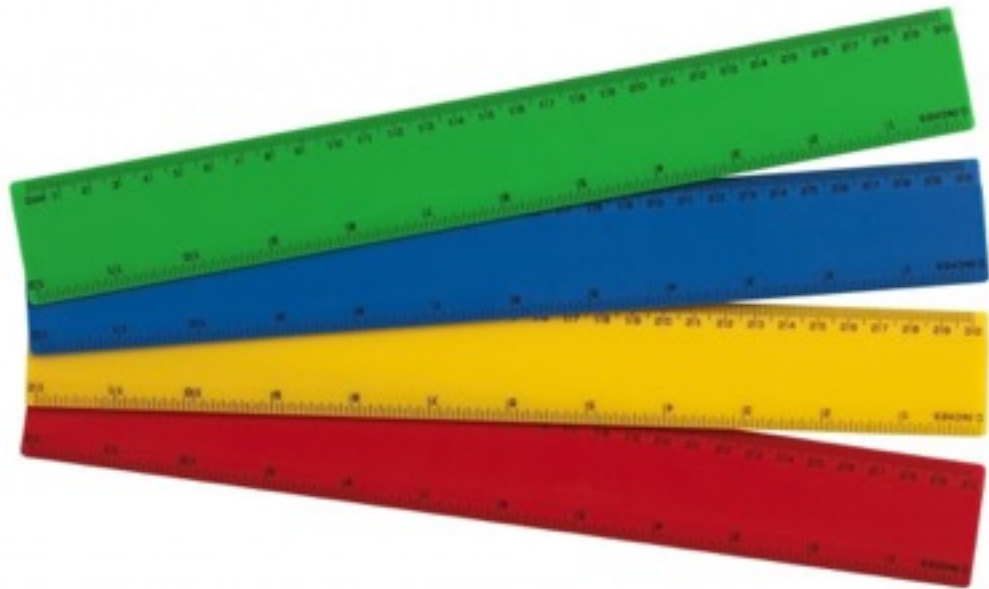




# Number lines:

- Build them
- Fix them
- Find the mystery number

# How do we describe equal parts of a linear region?

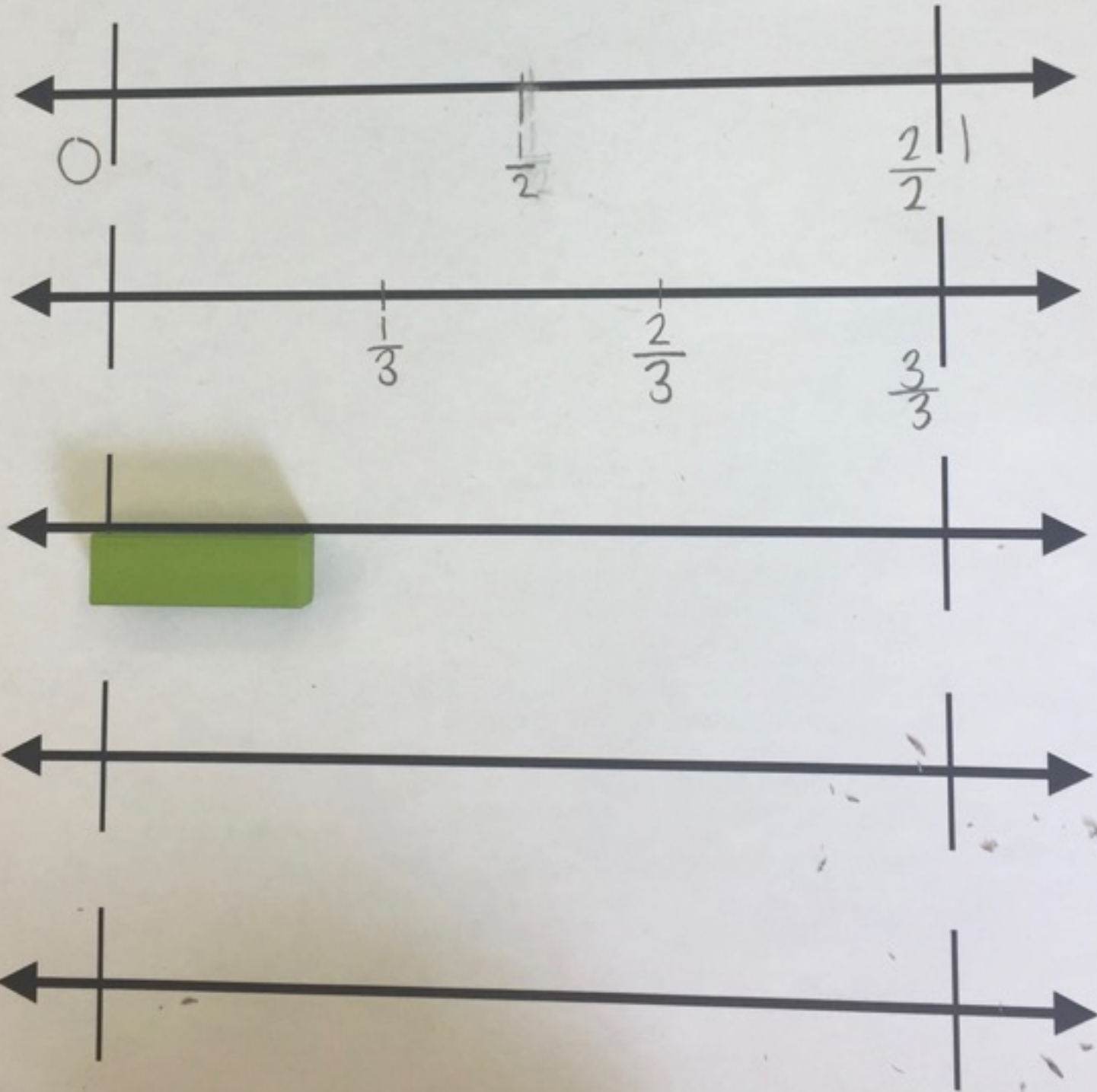


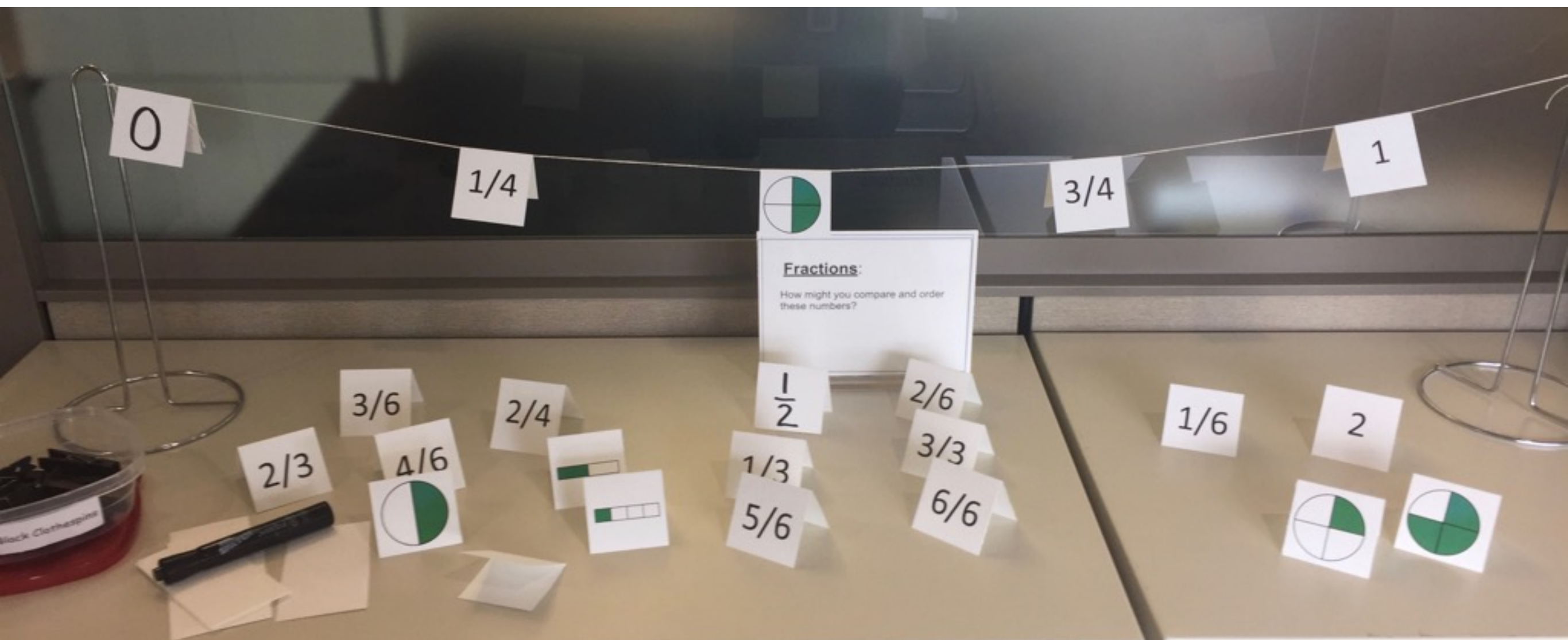
How do these materials help you think about fractions?



Inigo

# Numberlines with Cuisenaire Rods



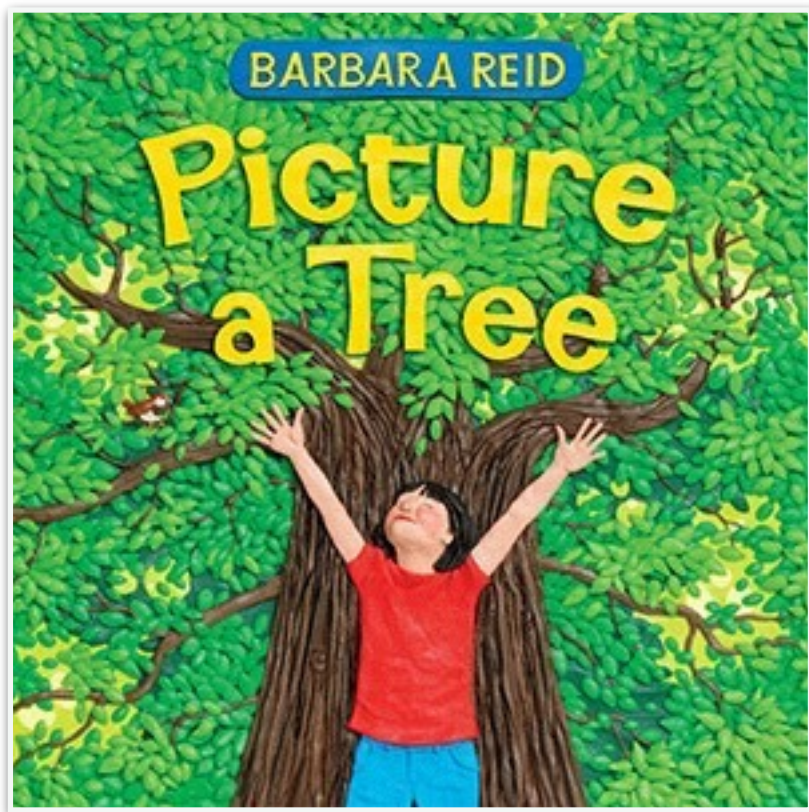




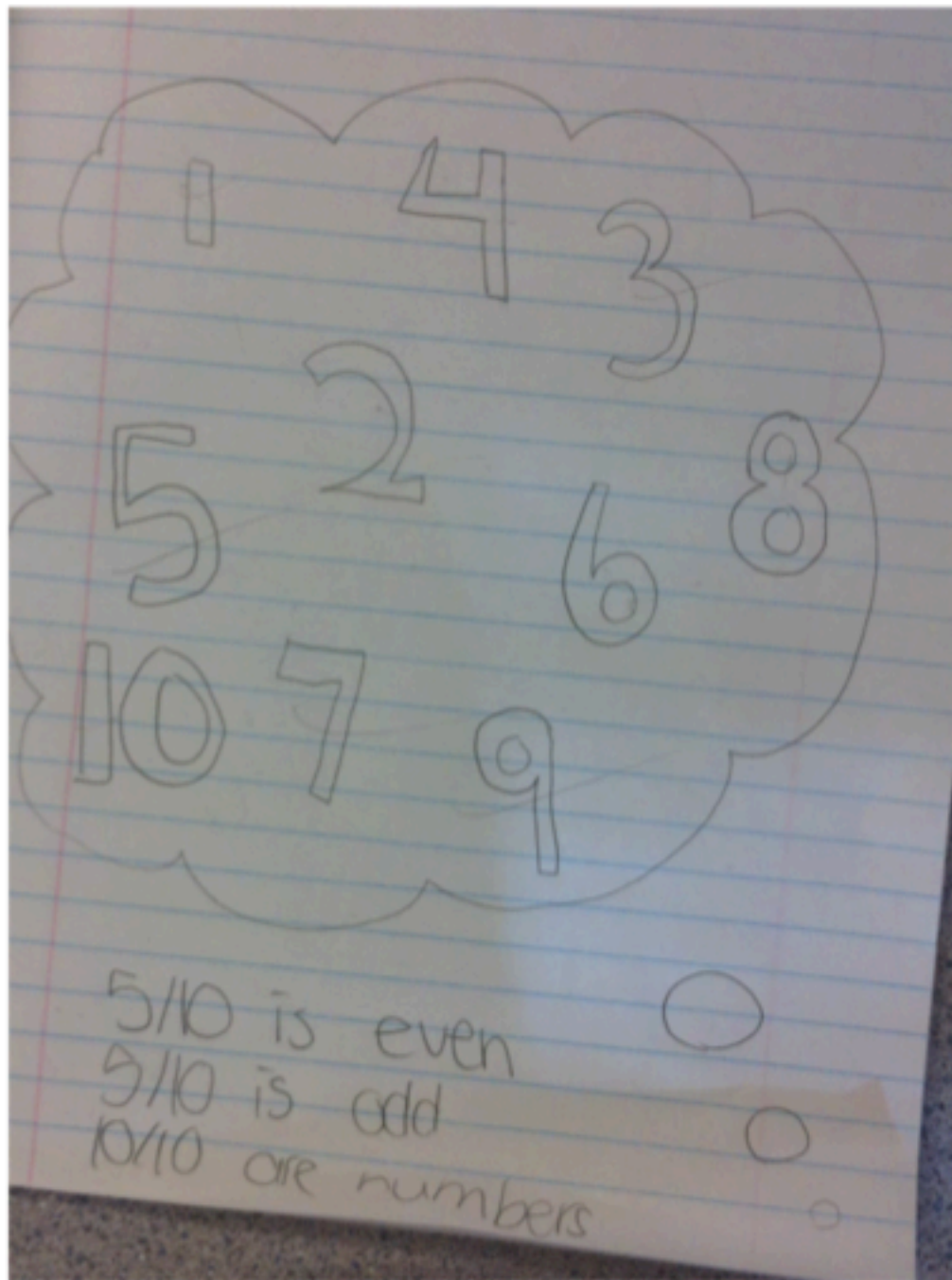
If we ran around the school  
leaving from our classroom door,  
how far would be half way?



When you picture a fraction, what  
do you see?









3/8 of the planets have rings



5/8 of the planets do not have rings

Jason "I picture planets when I think about the planets in our solar system. Only some have rings". (Gr. 4)





$\frac{2}{3}$  of the cookies are whole



$\frac{1}{3}$  of the cookies is cut in half

Sharon "I picture fractions when I think of sharing cookies". (Gr. 3)



1/3 of the snowballs is a face

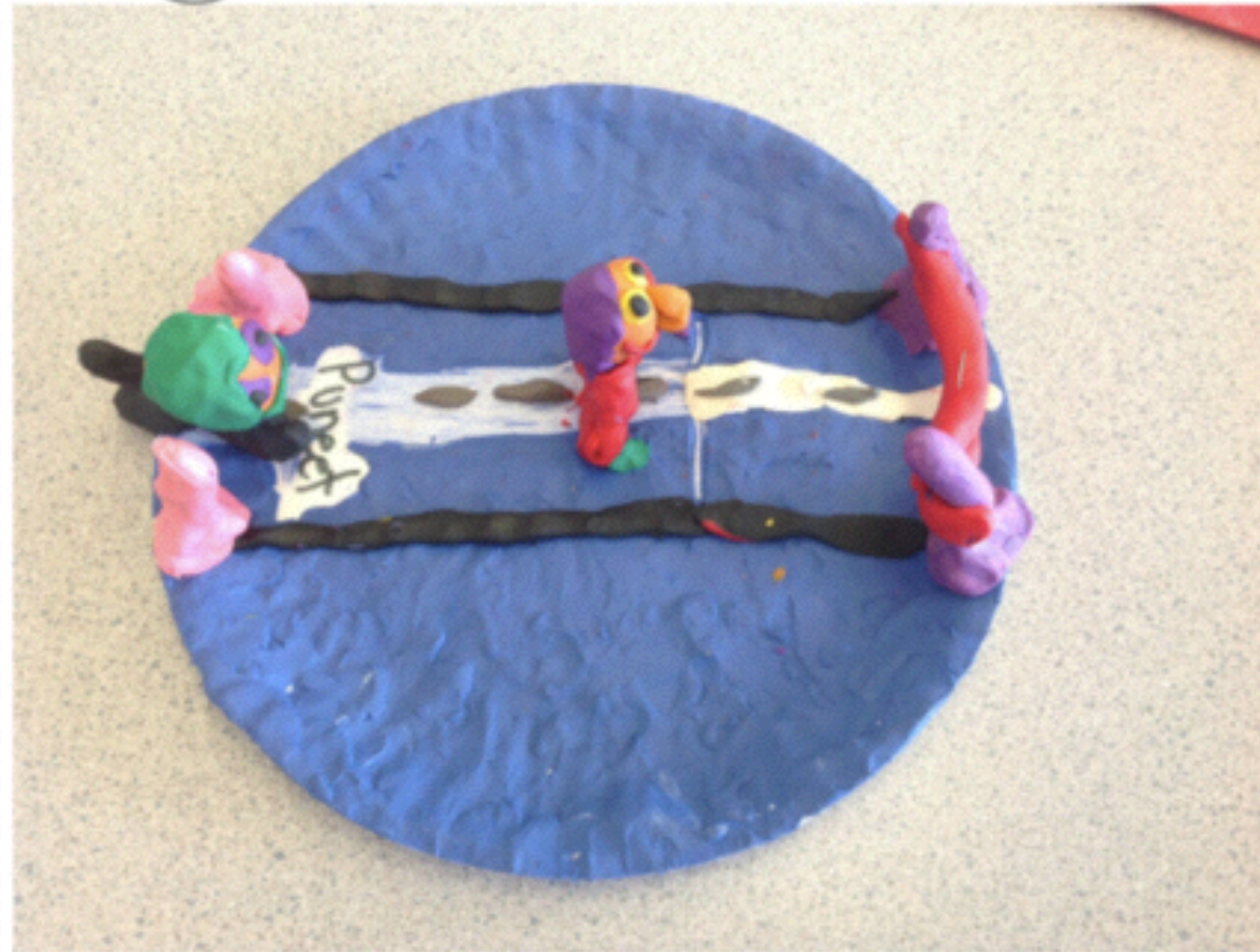


2/3 of the snowballs make the body of the snowman

Kristina "I picture fractions when I make snowmen because I make three balls". (Gr. 3)



The person with purple hair is  $\frac{1}{2}$  way finished the race



Puneet "I picture fractions when I remember running a race and being half way done". (Gr. 4)



The girl with black hair is  $\frac{3}{4}$  the height of the other girl.



Johnathan "I picture fractions when I see short and tall people and compared them". (Gr. 4)



**I HAVE NO SPECIAL  
TALENTS. I AM ONLY  
PASSIONATELY  
CURIOUS.**

**-ALBERT EINSTEIN**

# How do we compare fractions?

VIDEO: <https://mathsolutions.wistia.com/medias/cyd3uupovn>



What are some ways we could compare fractions without common denominators?



Marc and Chris each bought the same chocolate bar. Marc ate  $\frac{1}{8}$  of his bar and Chris ate  $\frac{1}{10}$  of his bar. Who has more of their chocolate bar left? How do you know?



Sarah and Jenny are racing their bicycles.  
Sarah is  $\frac{3}{7}$  of the way to the finish line, and  
Jenny is  $\frac{2}{3}$  of the way to the finish line. Who  
is closer to the finish line? How do you know?





# Comparing Fractions using...

- Visual models
- Benchmarks (e.g., zero, half, whole)

Focus on reasoning rather than...



$$\frac{3}{5} > \frac{4}{8}$$

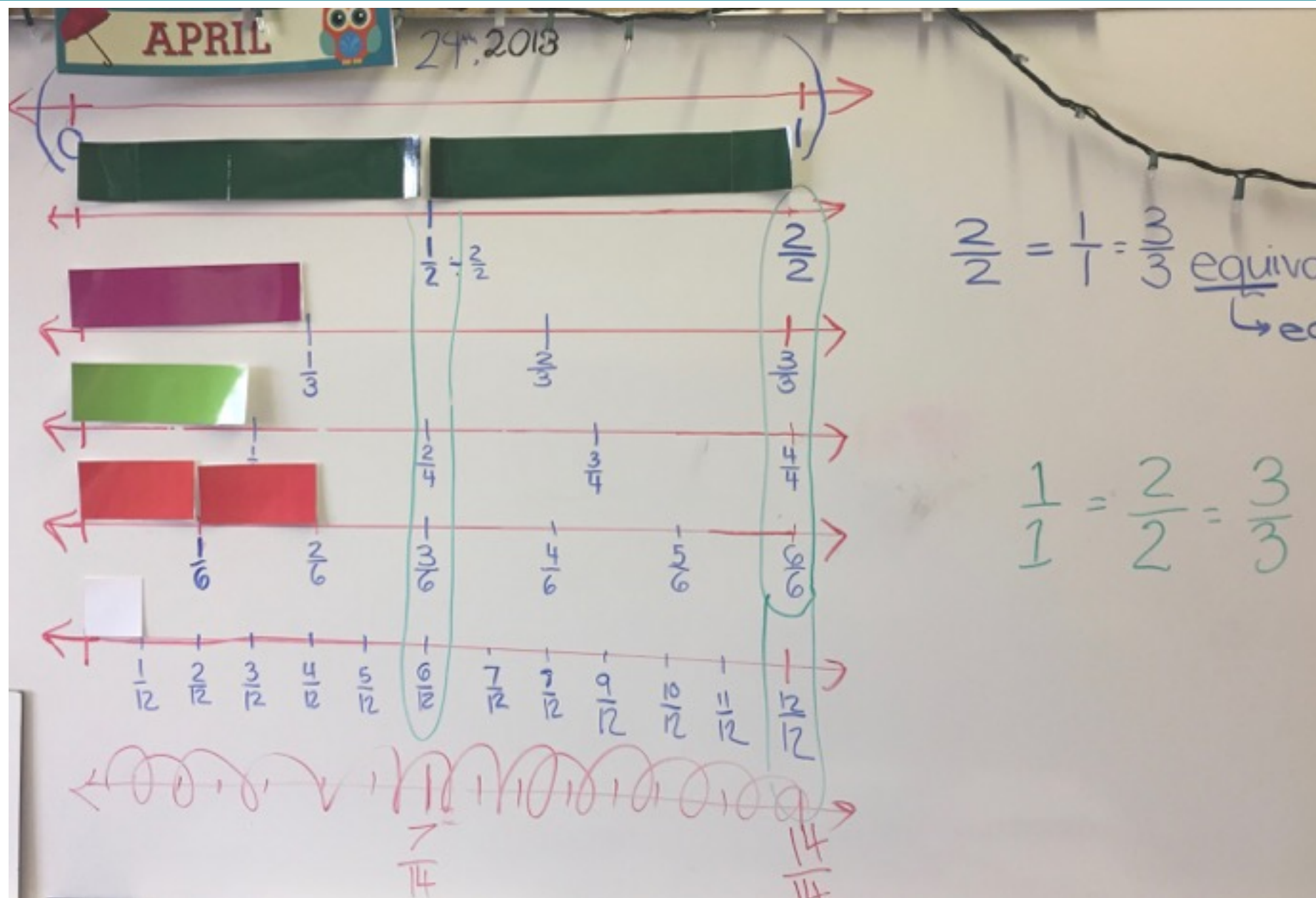
The image shows a handwritten comparison of the fractions  $\frac{3}{5}$  and  $\frac{4}{8}$ . Above the fraction  $\frac{3}{5}$ , the number 24 is written in red. Above the fraction  $\frac{4}{8}$ , the number 20 is written in blue. A green greater-than sign (>) is placed between the two fractions. A red loop is drawn around the 3 and 5, and a blue loop is drawn around the 4 and 8. A green circle is drawn around the greater-than sign.

Create fractions with you friend.  
Can you compare and order your fractions?

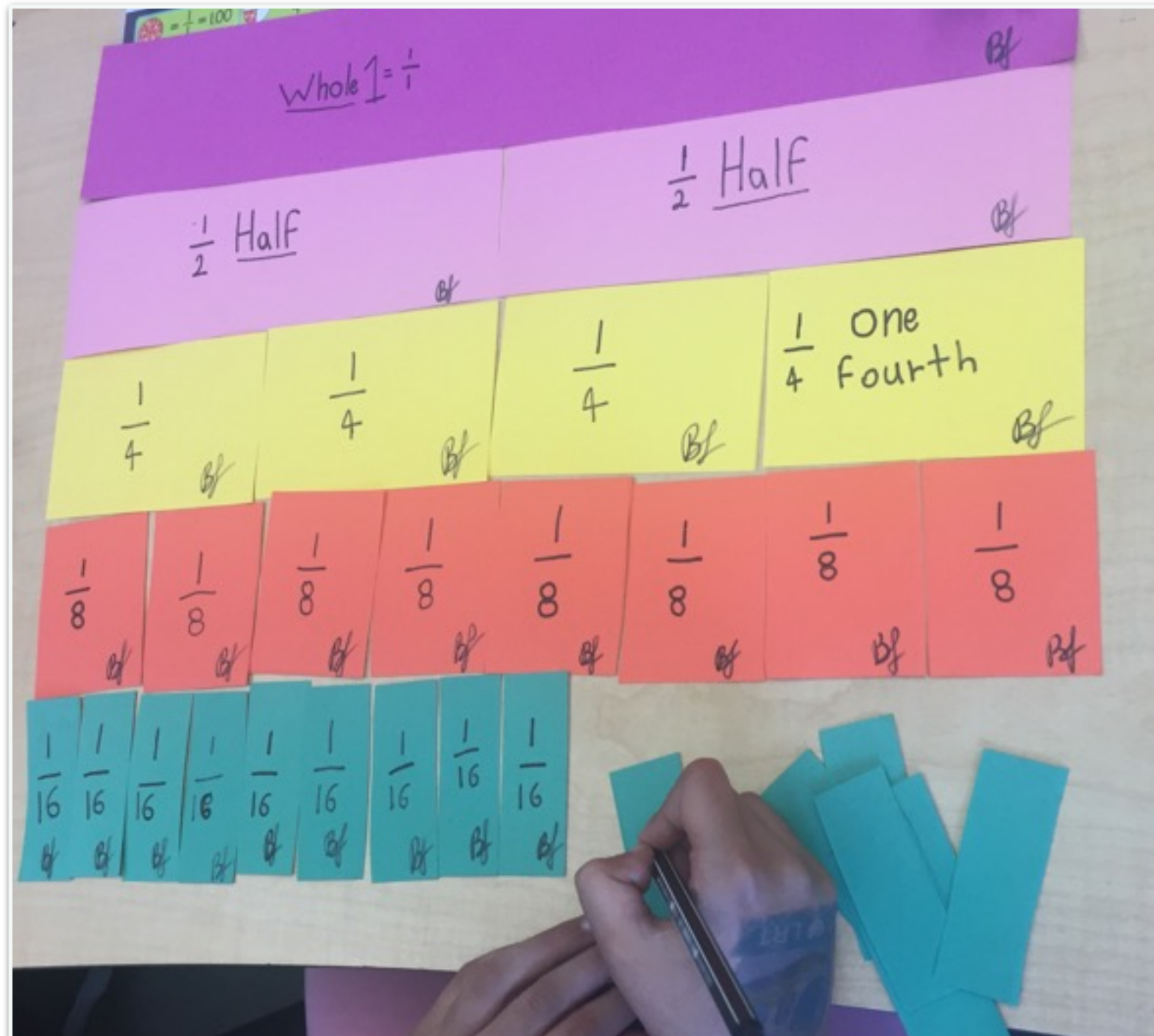




# What are equivalent fractions?



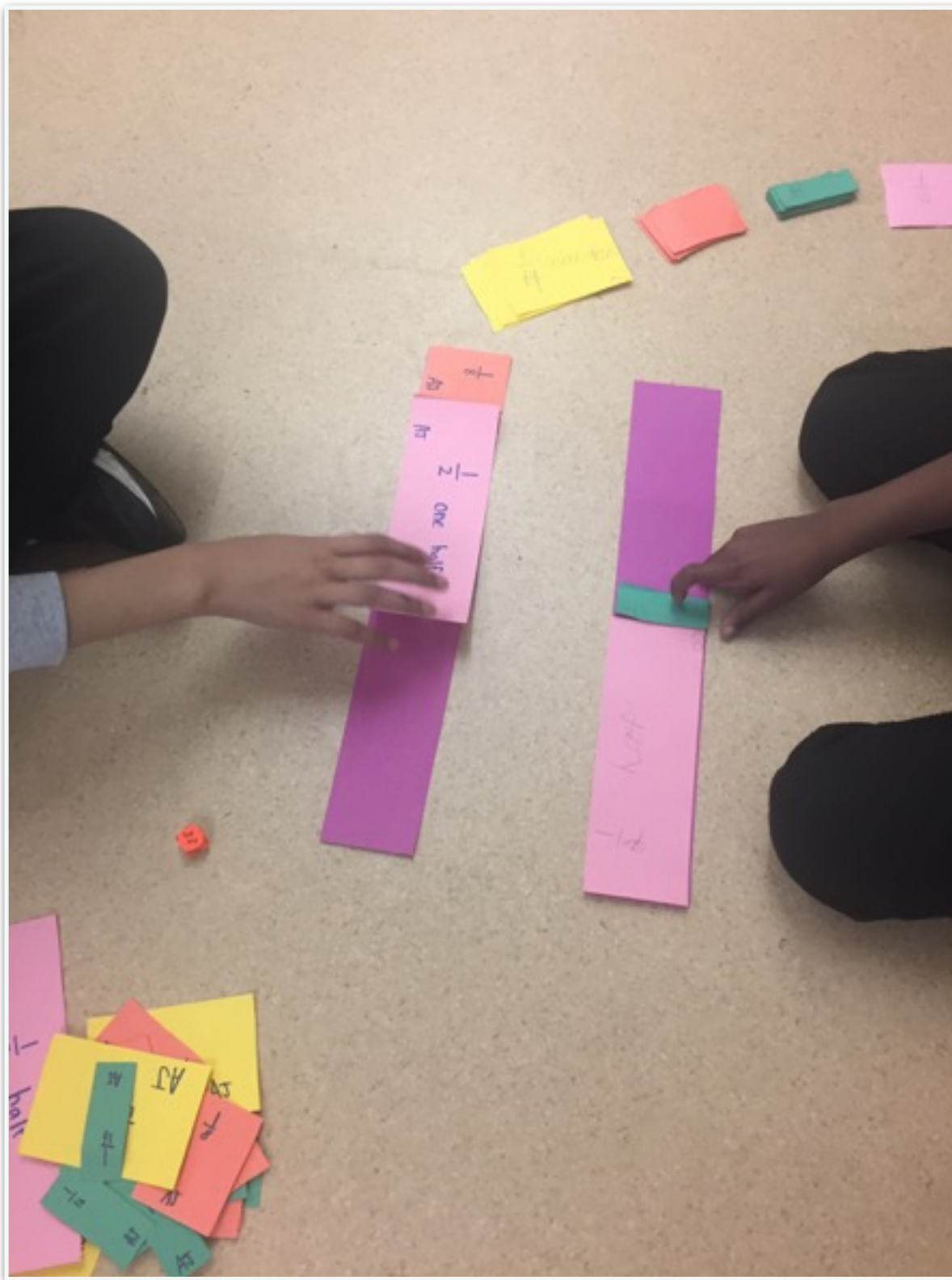
# Build a Fraction Kit





## Fraction Kit Games:

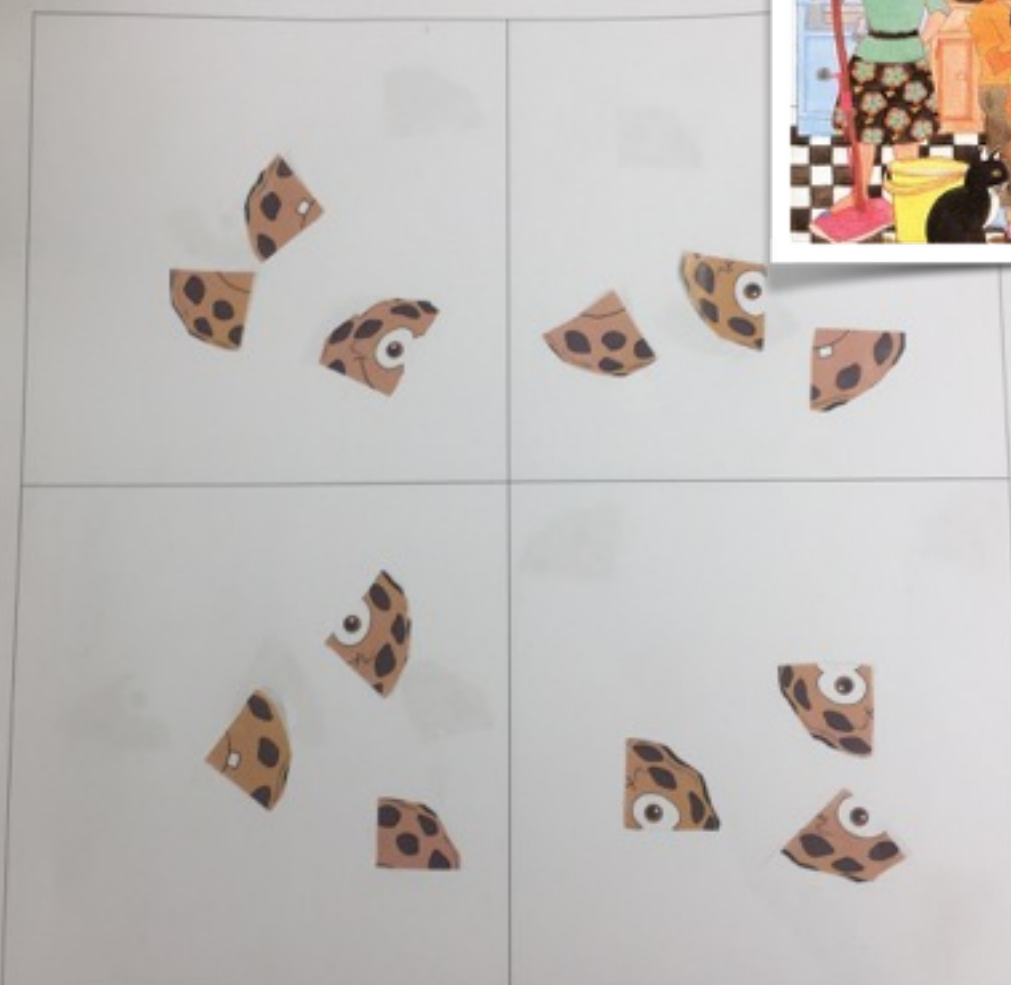
- Cover the whole
- Race to zero



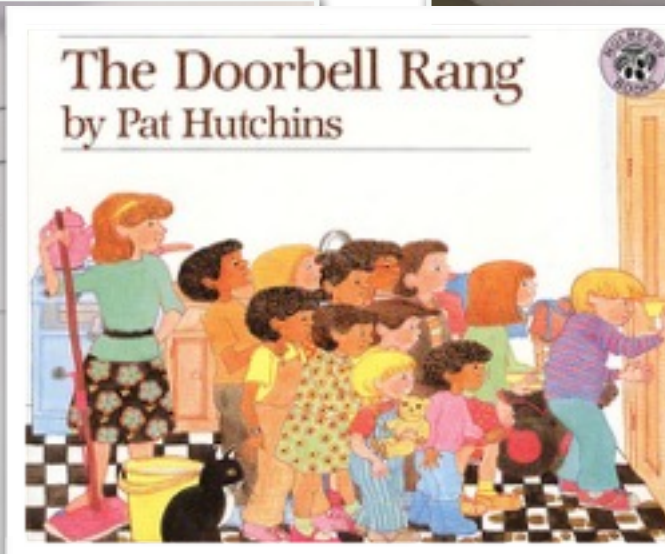
# How can we share \_\_\_\_\_ cookies equally?

Names of Group Members  
Arya  
Sukhman  
Diya  
Esther

Share 3 cookies among your group.  
 Glue each person's share in a box.




Describe how much each person received?  
 Each person gets three quarters of a cookie  
 $3 \frac{1}{4}$



Names of Group Members  
Katir  
Ishan

Share 3 cookies among your group.  
 Glue each person's share in a box.



Describe how much each person received?  
 everyone got  $\frac{1}{4}$  and a  $\frac{1}{2}$

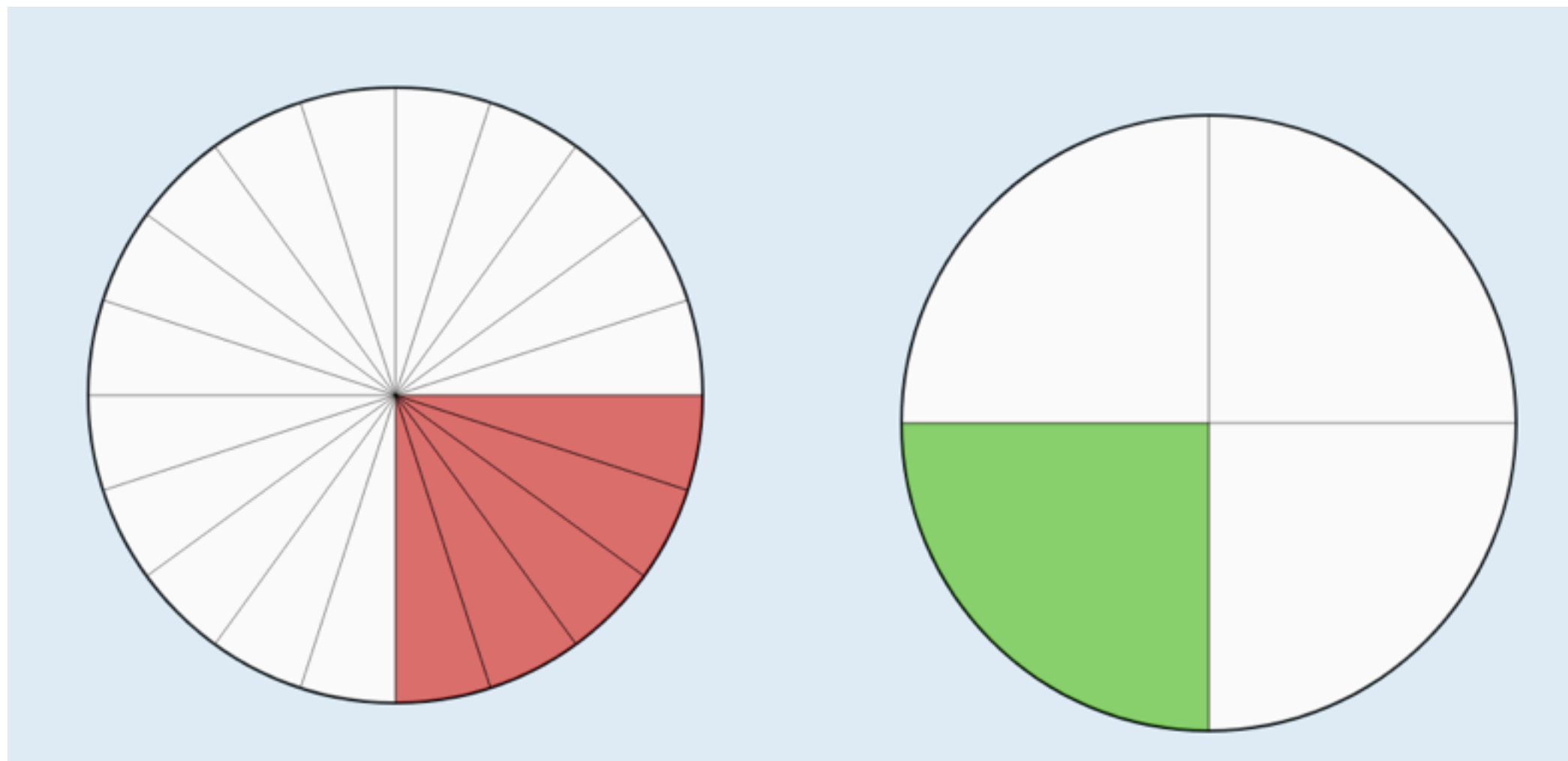


# Count Around the Circle



What number do you estimate \_\_\_\_\_ will say?  
What numbers won't we say? How do you know?  
What did you notice about the thirds and fourths?

How can you use this app to show your understanding of equivalent fractions?



[www.mathlearningcenter.org](http://www.mathlearningcenter.org)



## Fractions:

Make models that shows fractions with a denominator of 4. What is the same about them? What is different?

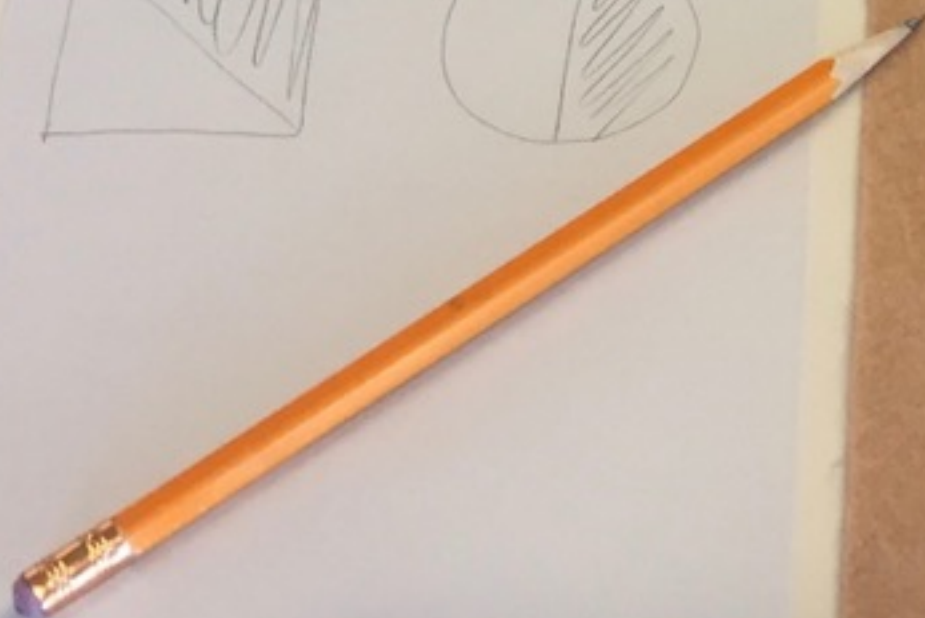
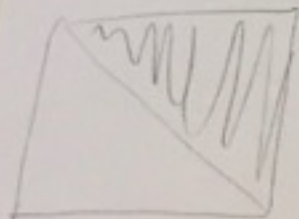
Polydron  
Duker





## Fractions:

How many ways can you represent  
the fraction  $\frac{1}{2}$ ?



$$\frac{2}{4}$$

$$\frac{8}{16}$$





Children have real understanding only of that which they invent themselves, and each time that we try to teach them too quickly we keep them from reinventing it themselves.

- Piaget





THE BEST

Teachers

ARE THOSE WHO SHOW YOU WHERE TO

Look

BUT DON'T TELL YOU WHAT TO

see.



# What is our role in playful inquiry?

- talk less and listen more
- be open to the children's questions
- ask open questions - design inviting, playful learning opportunities
- notice and name the curricular competencies
- ask questions to nudge learning
- use mathematical vocabulary
- build in time to reflect and connect
- know and honour student's interests
- establish a culture that supports wondering and playfulness



# Formative Assessment



We circulate and observe. Based on what we see, we ask questions to clarify our understanding and nudge learning forward.

We document the learning we see using anecdotal notes, photos, videos, checklists, collection of student work samples.



# Performance Based Assessment

Oct. 11/17

Patterns

Grade 3 / Div. 12

2017-18

	Increasing Patterns	Decreasing Patterns	Repeating			
A.	✓					
ad A.	pic X					
t B.						
B.	✓	✓	✓			
B.	✓ can't explain					
y B.	✓ can't explain		✓			
D.	X	X	✓			
D.	✓	✓	✓			
D.	# + colour →	✓				
I.			✓			
h K.	1/2					
a K.			✓			
K.			✓ colour.			
A.	✓ ✓		✓ colour.			
N.	✓ inc by 1	✓ colour				
R.	✓ ✓					
S. ab.						
S.	✓	✓	↗ ↘			
S.	✓ inc. ✓	✓	↗ ↘			
S.						
Y.			✓ colour.			

# Journal Prompts

- Fractions can be represented using
- I created...
- I'm proud of...
- I know...
- I'm thinking now...
- This reminds me of...
- Today I learned...
- A connection I have...
- I noticed...





# 2017/18 School Calendar

Calendar*pedia*  
Your source for calendars

Su	Mo	Tu	We	Th	Fr	Sa
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31		

Su	Mo	Tu	We	Th	Fr	Sa
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30

Su	Mo	Tu	We	Th	Fr	Sa
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31				

Su	Mo	Tu	We	Th	Fr	Sa
		1	2	3	4	
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30		

Su	Mo	Tu	We	Th	Fr	Sa
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
31						

Su	Mo	Tu	We	Th	Fr	Sa
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	31			

Su	Mo	Tu	We	Th	Fr	Sa
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28			

Su	Mo	Tu	We	Th	Fr	Sa
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31

Su	Mo	Tu	We	Th	Fr	Sa
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30					

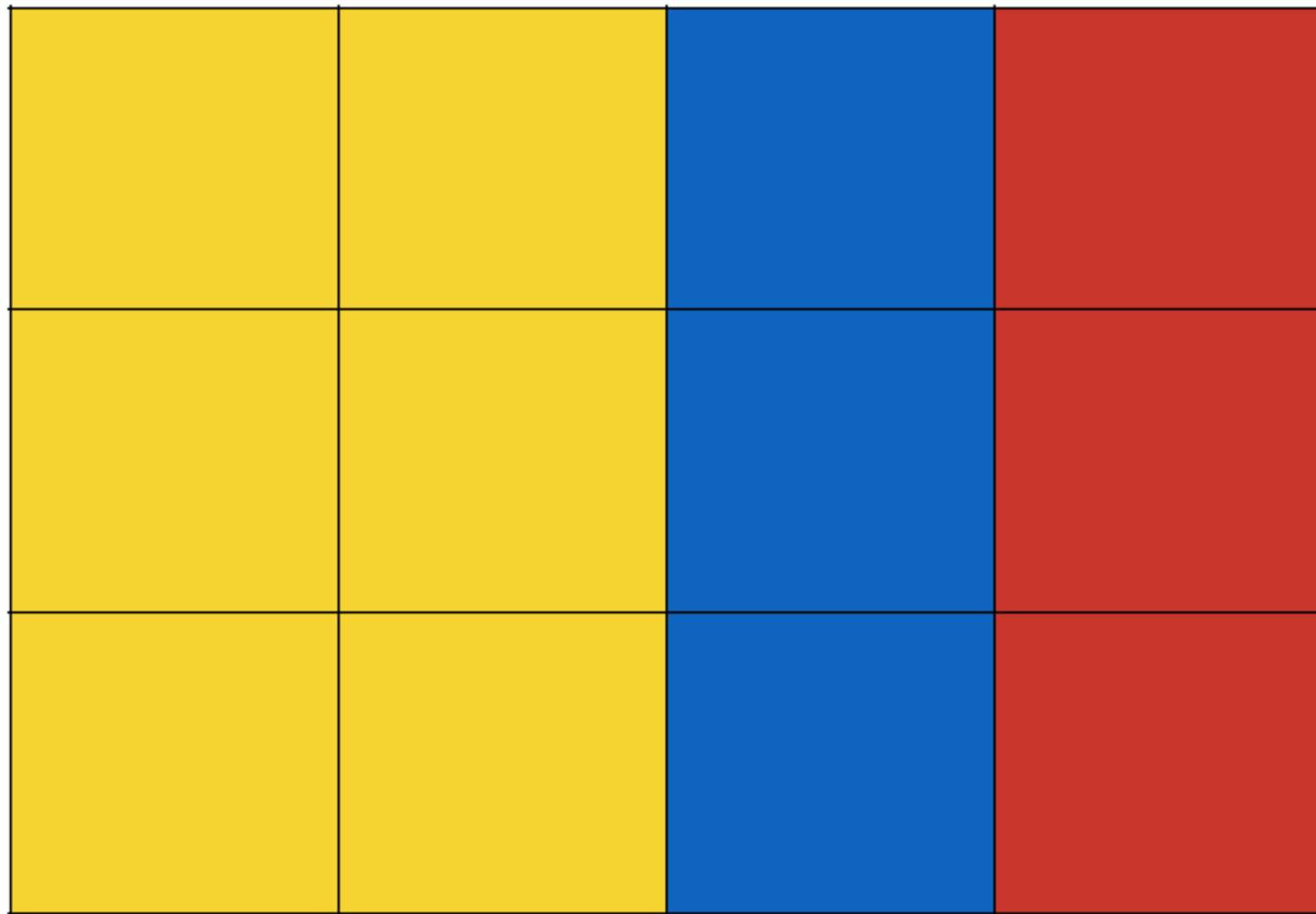
Su	Mo	Tu	We	Th	Fr	Sa
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31		

Su	Mo	Tu	We	Th	Fr	Sa
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30

Su	Mo	Tu	We	Th	Fr	Sa
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31				

# Number Talks: Fractions

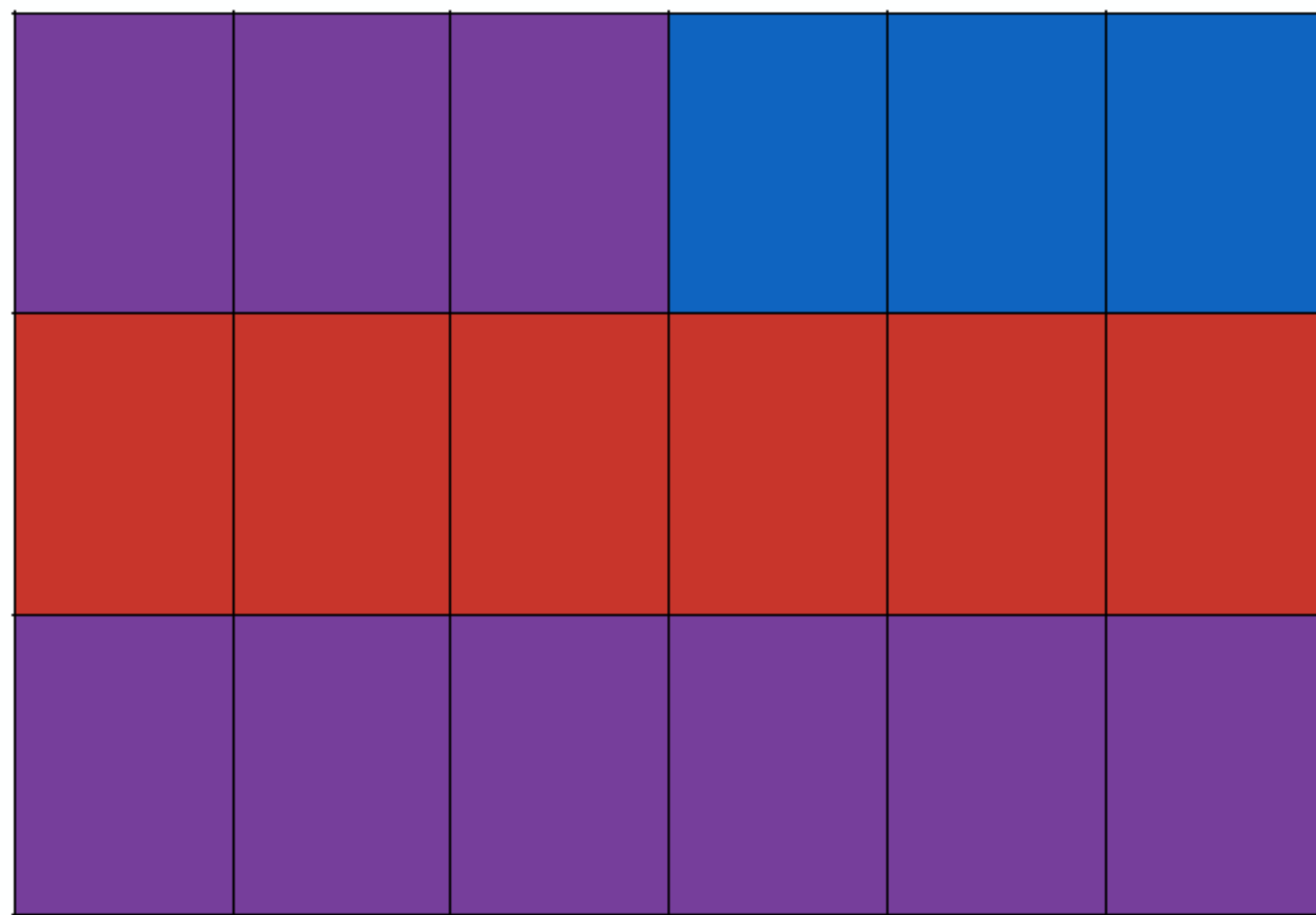
## Using Images





How many?

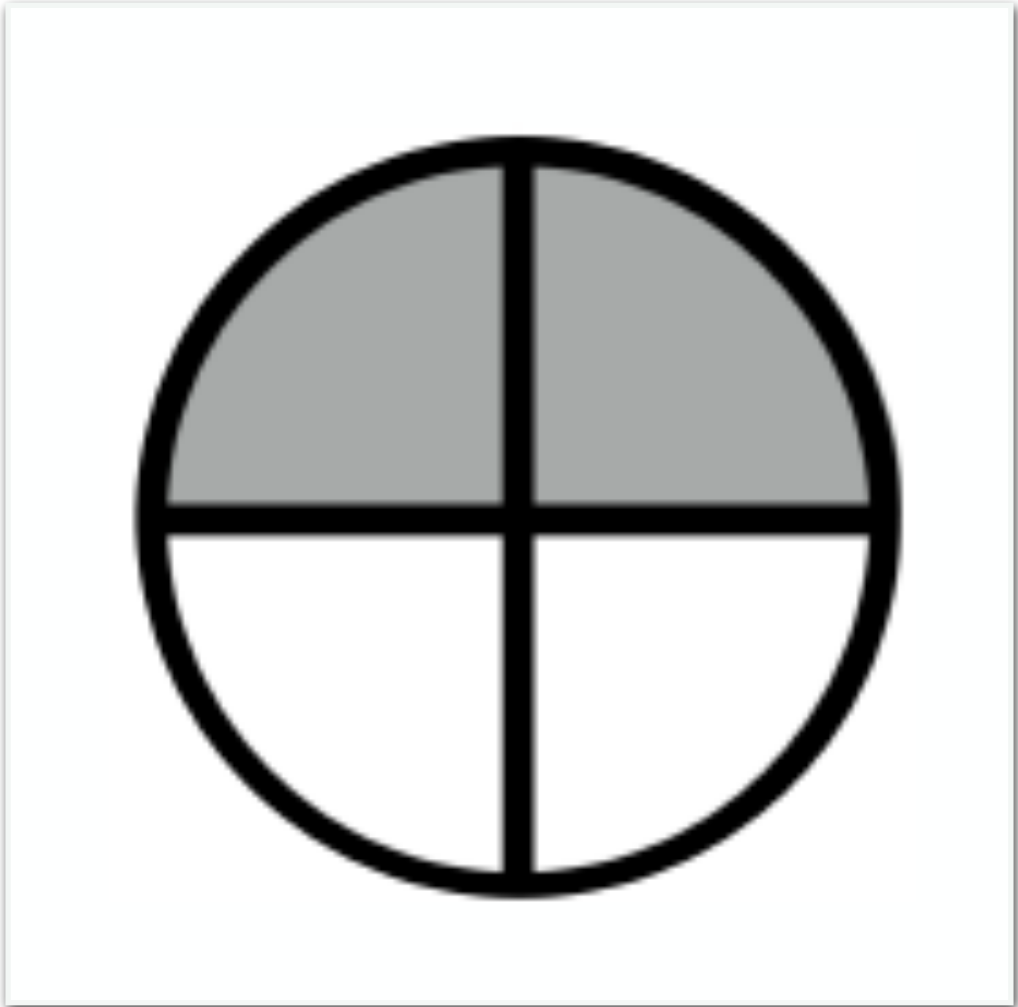
How did you see them?





How many?

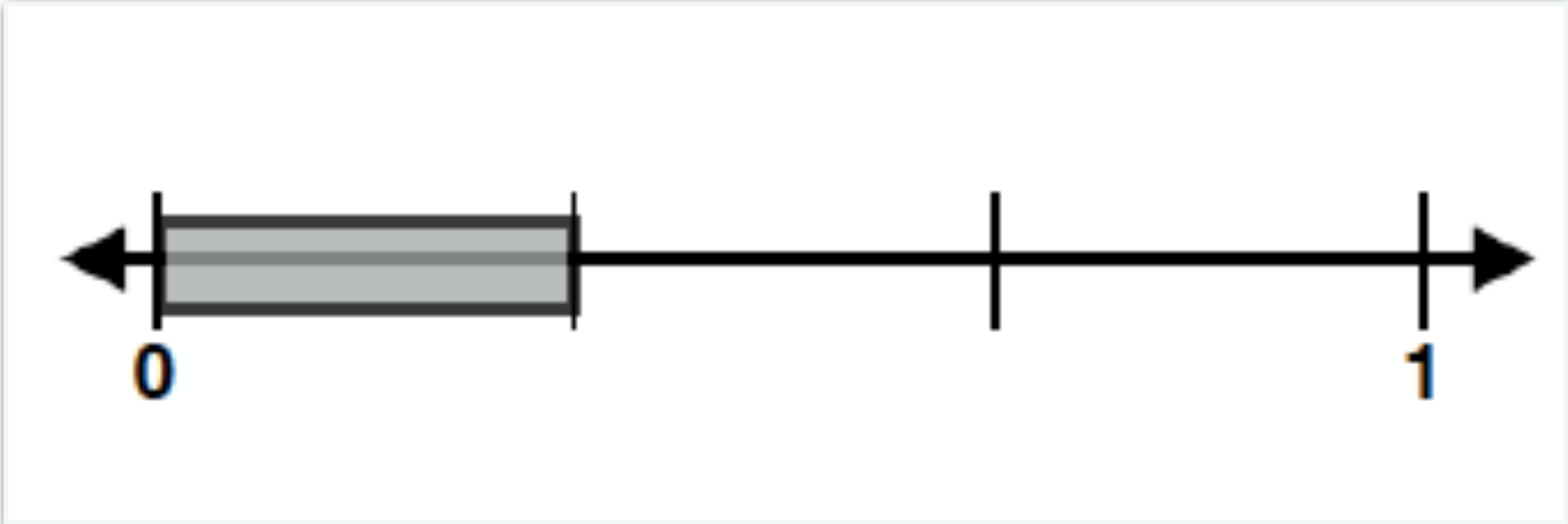
How did you see them?





How many?

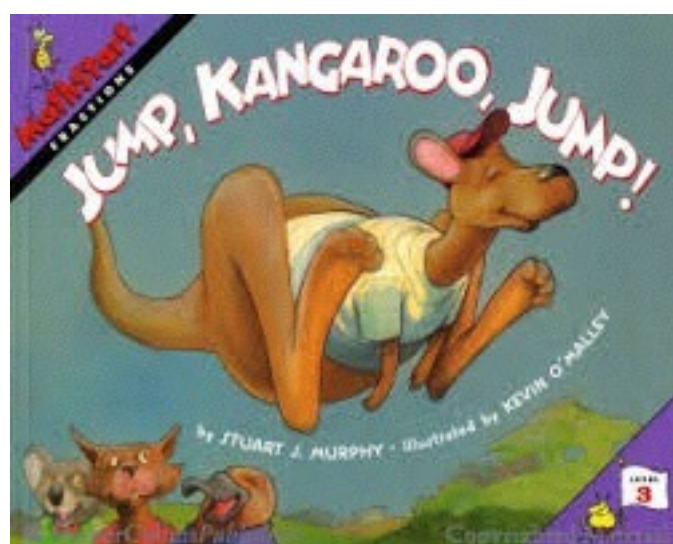
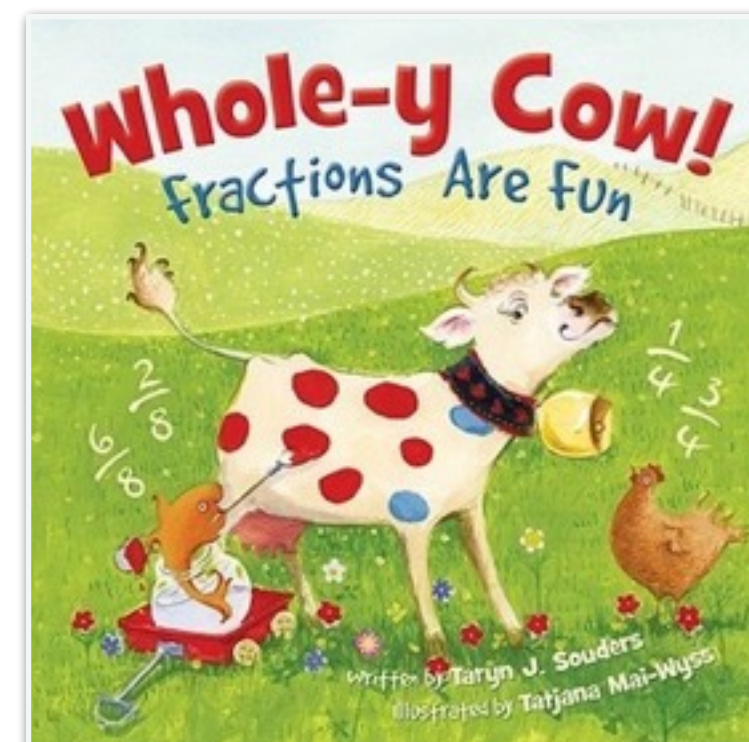
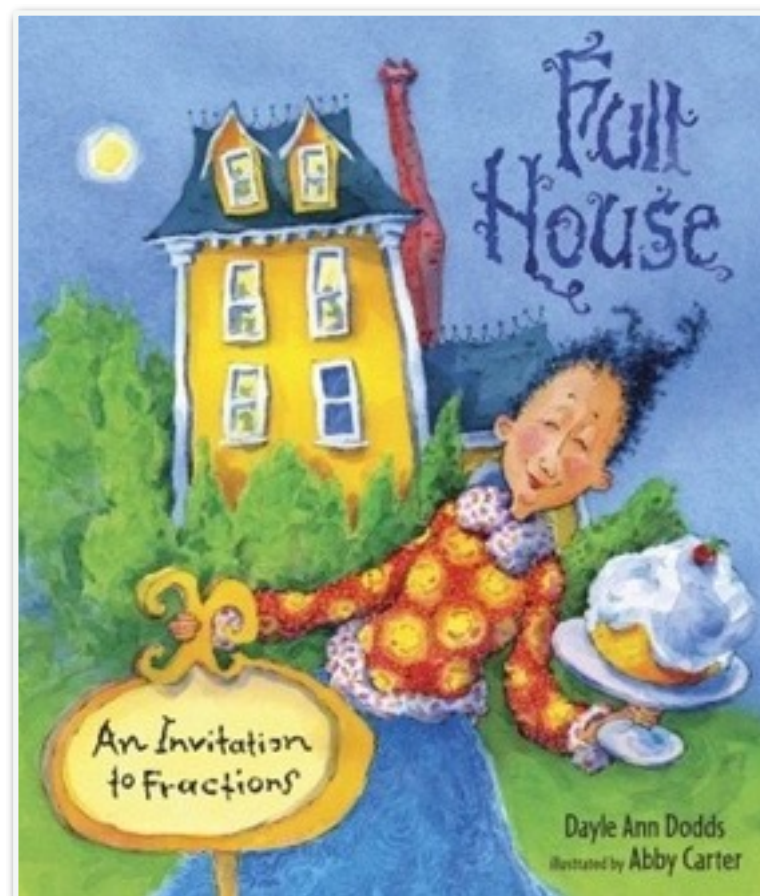
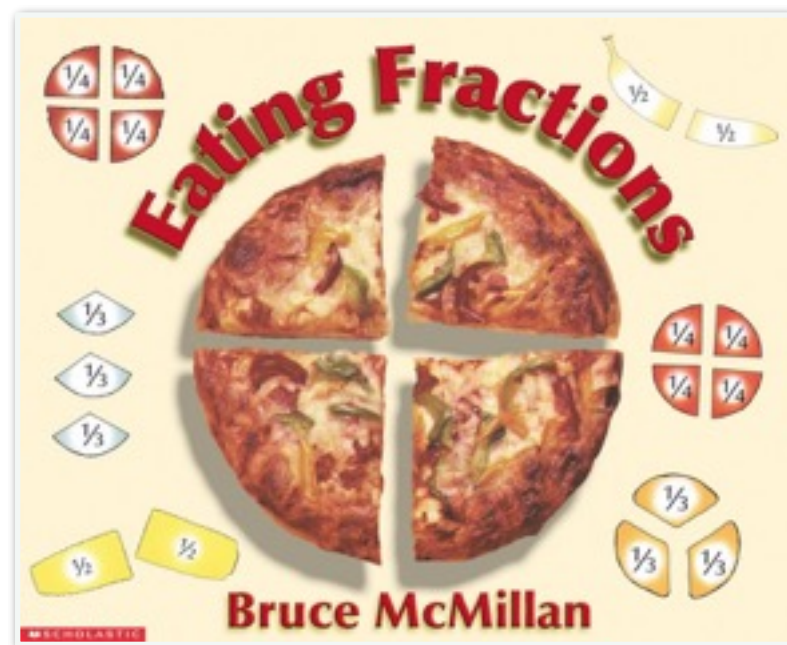
How did you see them?





How many?

How did you see them?



Look at a page from the story.  
What questions could you ask that  
fractions could help you solve?  
Try it out!



How could we describe this page using fractions?

What fraction have black spots? Brown spots?

What fraction are calves?



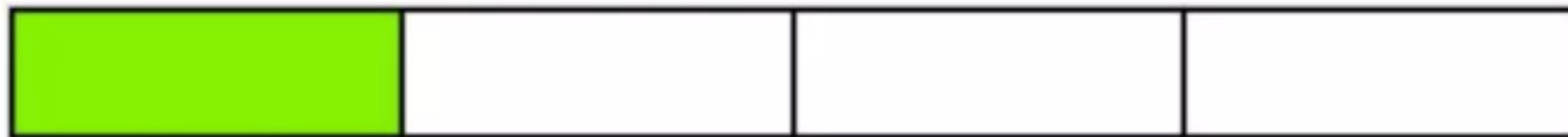
How many?

How did you see them?



# Same and Different

What is the same? What is different?



Created by Brian Bushart



# SAME OR DIFFERENT?

*supporting mathematical argument in the elementary grades*

HOME

VIDEOS

CONTRIBUTORS

ABOUT



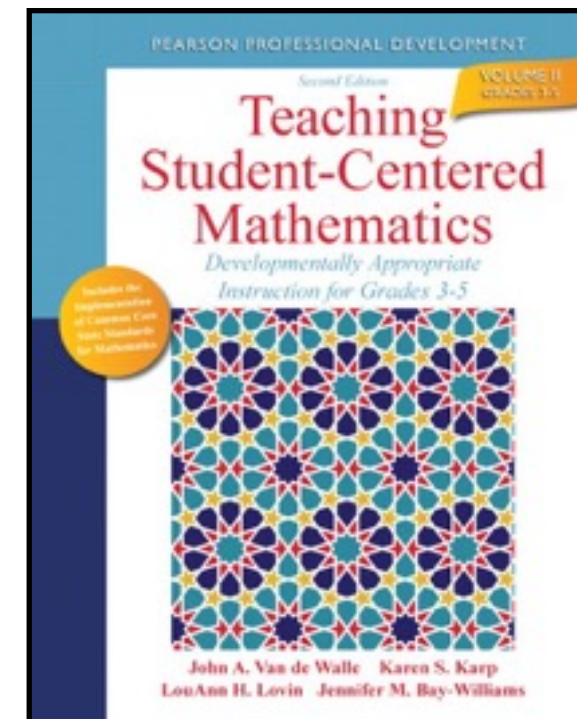
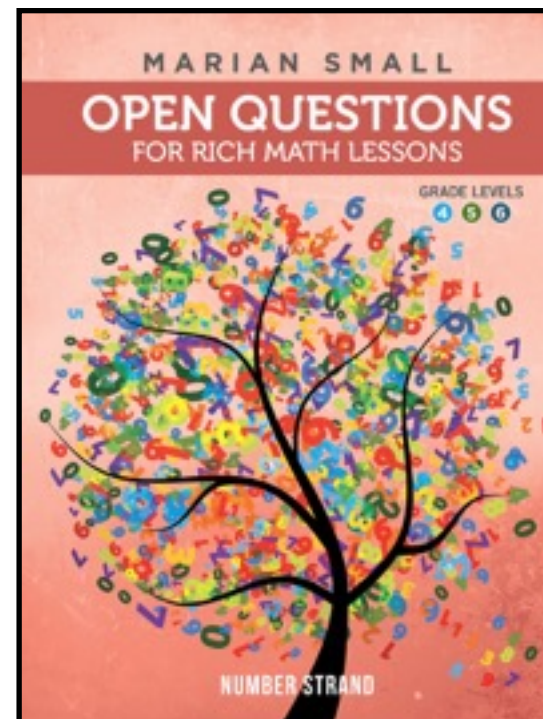
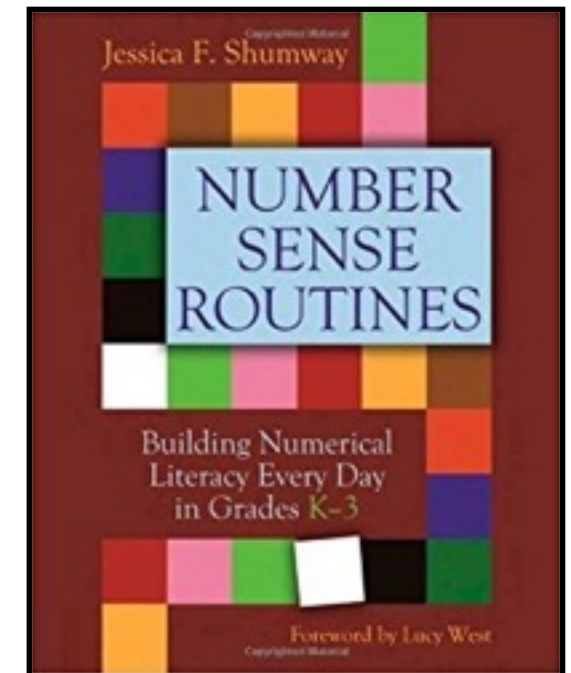
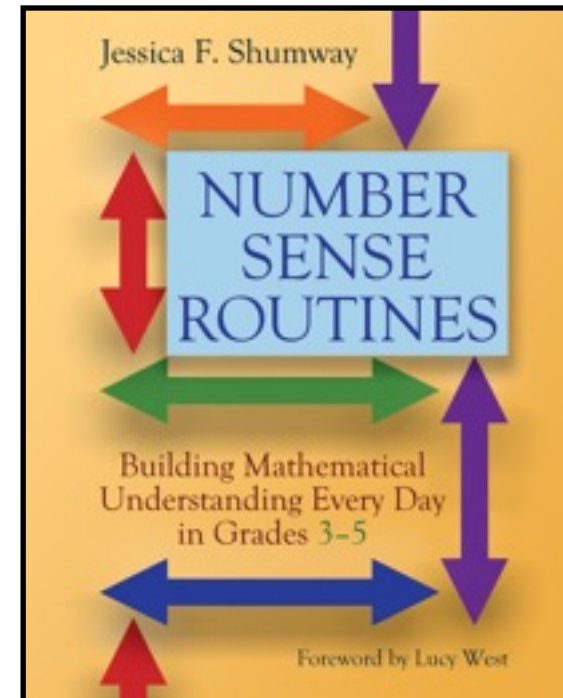
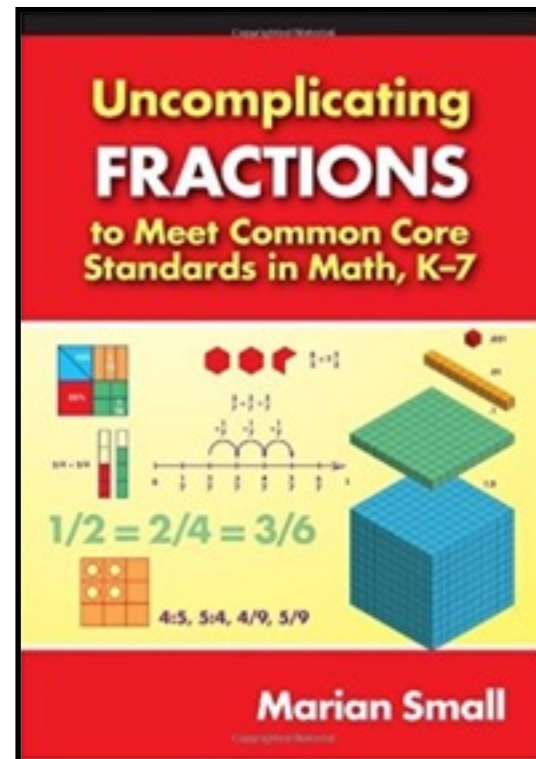
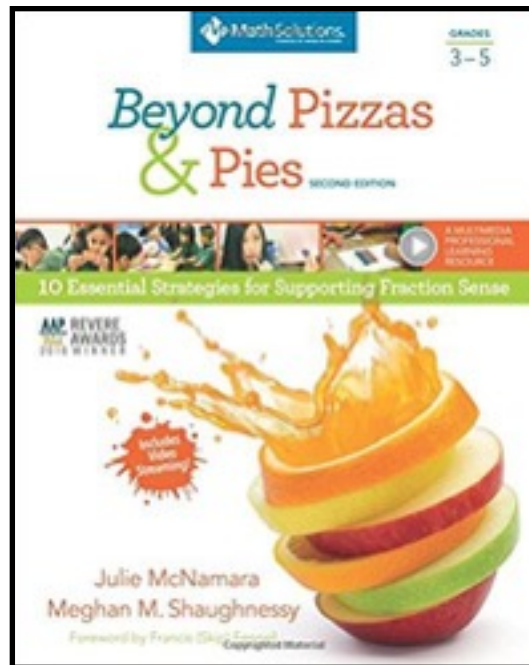
<https://samedifferentimages.wordpress.com/>

Website curated by Brian Bushart et al.

#samedifferent



# Recommended Resources:





TEACHERS  
who LOVE  
teaching,  
.....teach  
children  
TO love LEARNING.