

Differentiating Instruction Meaningfully

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What do you think?

- The answer is 100.
- What might the question have been?

Possibilities

- How old is really old?
- What is the first 3-digit number?
- What is a number with a digit sum of 1?
- What is 10×10 ?
- What comes after 99?
- What is a perfect score on a test?
- What is an easy number to multiply by?

How big? How small?

- A number takes exactly four words to say.
- What might it be?

Possibilities

- 423
- 158
- 3022
- 4100
- 1 000 023
- $1 \frac{3}{10}$
- 2.03

You can see...

An open question like the previous ones

- is accessible to all
- can stretch strong students
- certainly generates lots of math talk

Why we need to..

Even in small classes, kids are not identical and have different academic needs.

We need to make sure that students who normally struggle can grow.

But we also need to stretch our strongest students.

If we...

use "middle of the road" questions, we generally only benefit those "middle of the road" students.

If we...

look at math more broadly through big ideas,
we are much more likely to be able to:

- help students see essential math connections
- include struggling students
- stretch all students

For example

In K, students compare sets with more, fewer or the same number of objects.

In Grade 1, students are asked to compare numbers to 50 and relate numbers to 5 and 10.

In Grade 2, students are asked to compare numbers to 100

It doesn't really matter

In all cases, we want students to compare numbers.

So we might ask:

Maybe

Choose two numbers that are not 1 apart.
Tell me which is more and how you know.

Choose a number. Tell a number just a little more. Tell a number a lot more.

Maybe

Think of a number.

Give a clue about it using this form:

My number is A BIT closer to _____ than to
_____. OR

My number is A LOT closer to _____ than to
_____.

More challenging

- The number _____ is JUST A LITTLE closer to _____ than to _____.
- The number _____ is JUST A LITTLE closer to double _____ than to _____.

It might be

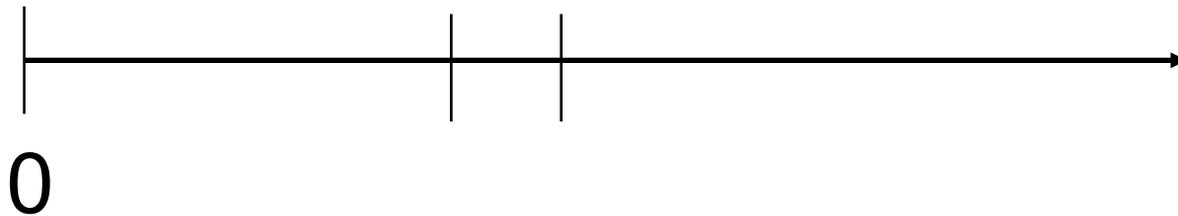
- There are a LOT of people in the office.
How many might that be?
- There are a LOT of people in the gym.
How many might that be?

Or

- I'm thinking of a REALLY BIG number.
- What might it be?
How do you know it's big?

Number Line

- What names might make sense for the two numbers represented by the lines?



What I hope you see

- Each of the previous questions is appropriate for a BROAD range of kids (except the ones I said were to challenge).
- Each focuses on the bigger picture.

What about representing numbers?

- What do we want besides kids just do it?
- I want them to notice that different representations show me different things about a number.

So I might ask

- Choose one of these numbers:

7

25

100

- Show me your number a bunch of ways.
- Which of your ways helps me see how it compares to 10?
- Which helps me see a number it is bigger than?

So I might ask

- Which of your ways helps me see whether it is even or odd?
- Which helps me see a way to add two numbers to get that number?

Or I might want to relate to place value ideas

- I might want kids to see how the place value system affects how we represent numbers.

I might ask:

- A number is made up of LOTS of tens and 3 ones. What could it be?

12 blocks

- A number is represented with exactly 12 base ten blocks.
- What could it be?

12 blocks

- 12 48
- 120 66
- 1200 147
- 111 57
- 30 624
- 102 912

I might ask:

- A number is represented with half as many ten rods as one blocks. What could it be?

Half as many ten rods as ones

- 24
- 36
- 60 (5 rods and 10 ones)
- 72 (6 rods and 12 ones)
- 1200 (100 rods and 200 ones)

How many ways???

- Choose a number.
- Are there more ways to represent that number with
- Base ten blocks?
- Coins?
- Bags of 3 and Bags of 7 counters?
- Bags of 4 and Bags of 2 counters?

For example, consider 60

- Base ten blocks: 6 rods OR 5 rods 10 ones OR 4 rods 20 ones OR 3 rods 30 ones OR 2 rods 40 ones OR 1 rod 50 ones OR 60 ones (7 ways)

For example, consider 60

- Coins (assuming no pennies):
QQD or QQNN or QDDDN or QDDNNN or
QDNNNN or QNNNNNN or DDDDDD or
DDDDDNN or DDDDNNNN or
DDDNNNNNN or DDNNNNNNNN or
DNNNNNNNNNN or NNNNNNNNNNN (13
ways)

For example, consider 60

- Bags of 3s and 7s

33333333333333333333333333333333

33333333333333333777

33333377777777 (only 3 ways)

For example, consider 60

- Bags of 2s and 4s

4444444444444444

4444444444444422

44444444444442222

444444444444422222 etc.

For the strong kid-

- For which numbers would the answer change?
- Why?

Let's think about subtraction

- What ideas really matter BESIDES getting answers?
- It might be a sense of approximate size of the answer.
- It might be the relationship between addition and subtraction.
- It might be about when we subtract.

Let's think about subtraction

- You can always subtract in parts.
- You can increase both numbers in a subtraction by the same amount and not affect the result.

Each idea

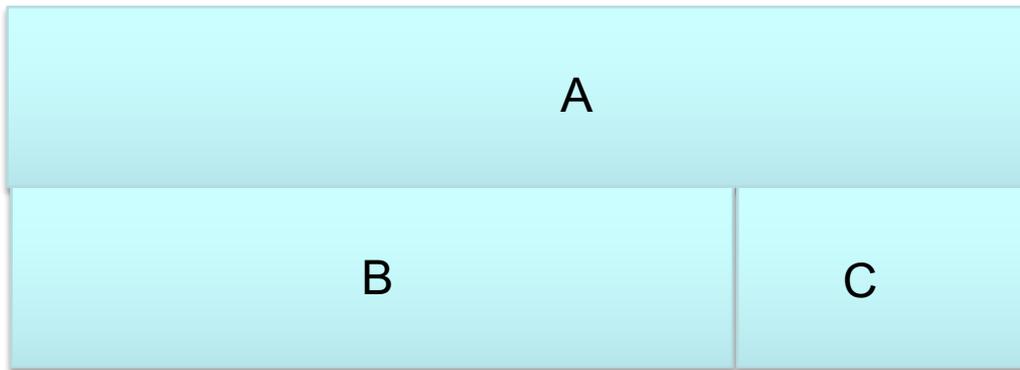
- can help you create an open question

Sense of size of answer

- Choose a number to subtract from.
- What could you subtract so that the answer is A LITTLE LESS than what you subtracted?

Relating + and –

- Choose numbers for box A and box B.
- What number belongs in box C?
- How do you know?

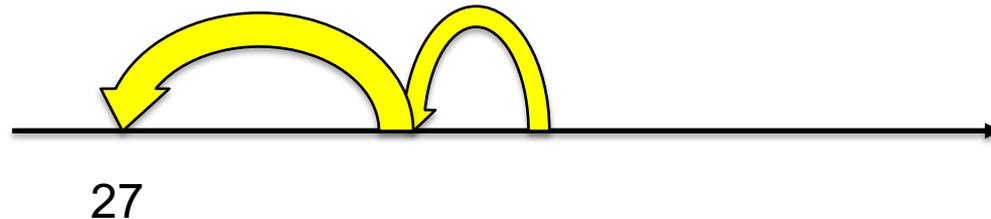


When do we subtract?

- Choose two numbers.
- Write a problem you could solve by subtracting those two numbers.

You can always subtract in parts.

- This is how Jenna figured out a subtraction.
- What subtraction do you think she was doing?



Idea of constant difference

- Is this okay? Why?
- To figure out $45 - 29$, Noah figured out $46 - 30$ instead.
- How might that idea be useful when you are subtracting 48 from a number?

Suppose it was about money

- Instead of being overly specific....

More examples

- You buy 2 items for less than \$5 and 2 items for more than \$5.
- You spend not too much more than \$30.
- What could the items cost?

What about multiplication?

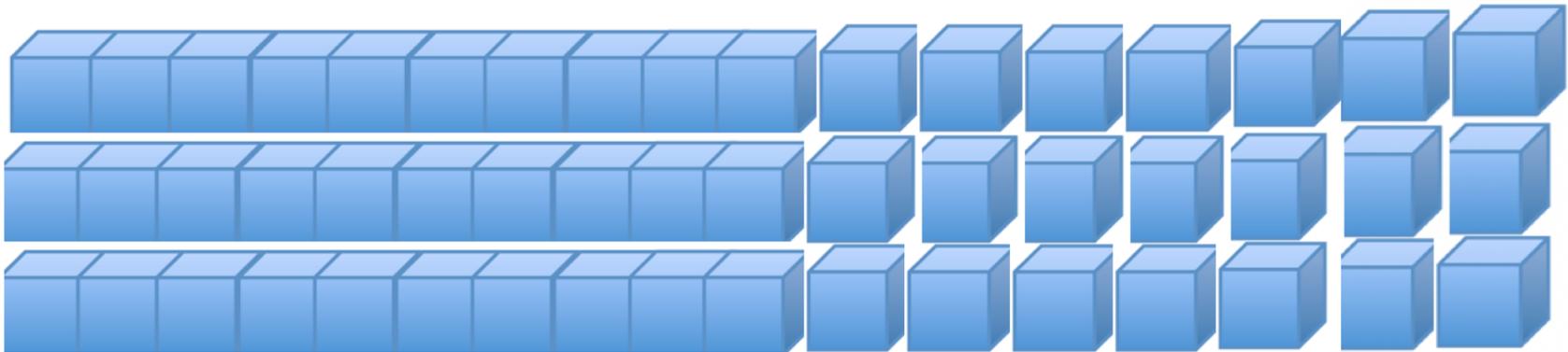
- You might want students to realize that different numbers of equal sets (even if what's in the set is complicated) is a way to think about multiplication.

What about multiplication?

- You create identical sets using 24 base ten blocks.
- How many sets and what might be in each set?

More examples

- 3 sets of 17



Maybe

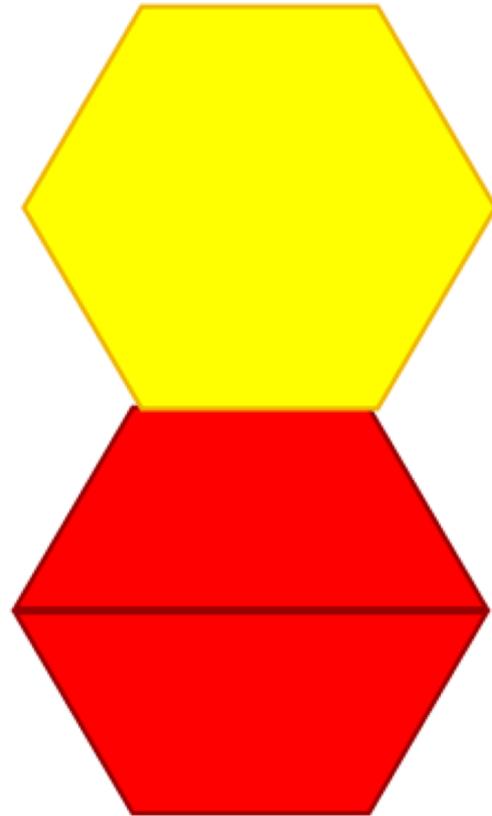
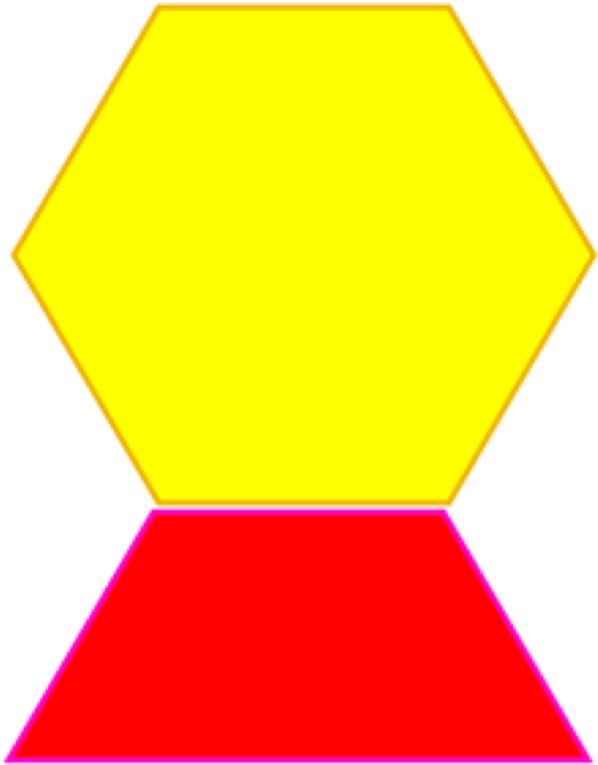
- 3 sets of 2 tens and 6 ones
- 3 sets of 4 tens and 4 ones
- 2 sets of 1 hundred, 5 tens and 6 ones
- 2 sets of 12 ones
- 2 sets of 6 tens and 6 ones
- Etc.

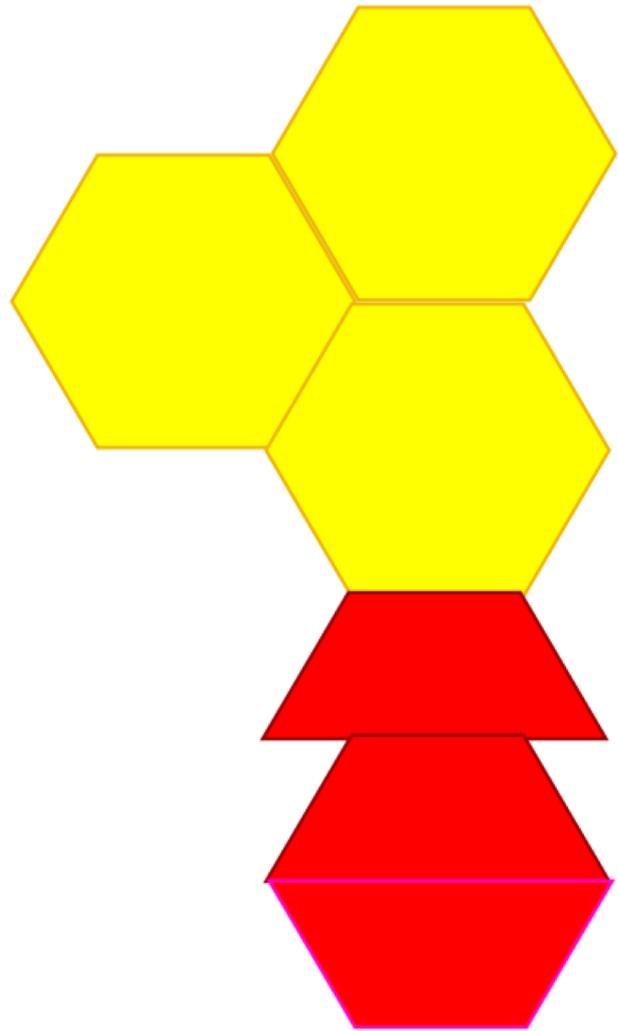
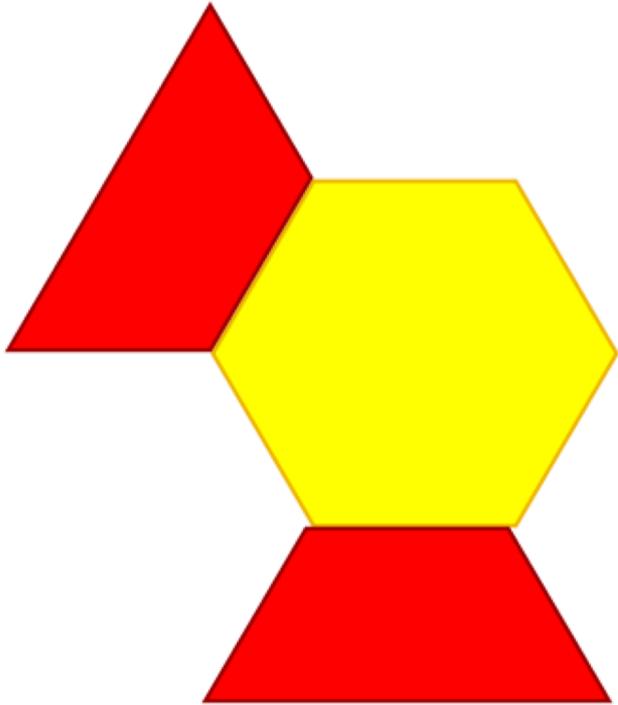
I might want to introduce fractions

- What do I care about?
- I'll show you with my task.

Can you..

- Use your pattern blocks to make a design that is half yellow.



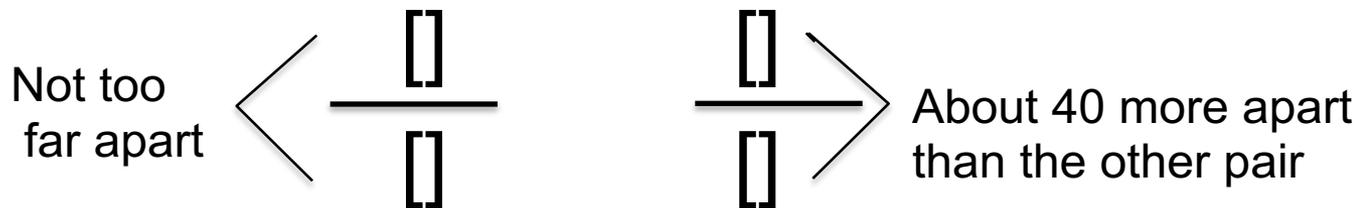


Maybe it's about comparing fractions

- A fraction is just a LITTLE more than $\frac{1}{2}$.
- What could it be?

Maybe it's about equivalence

- Two fractions are equivalent.



- What could the fractions be?

More examples

- Which one doesn't belong?

$3/5$

$2/3$

$3/8$

$4/5$

Here are some more

- Just to give you a better feel for how they can look.
- In our smaller sessions, we'll talk more about how to create them and what ideas to bring out with them.

More examples

- Which one doesn't belong?

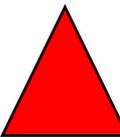
$$6 + 8$$

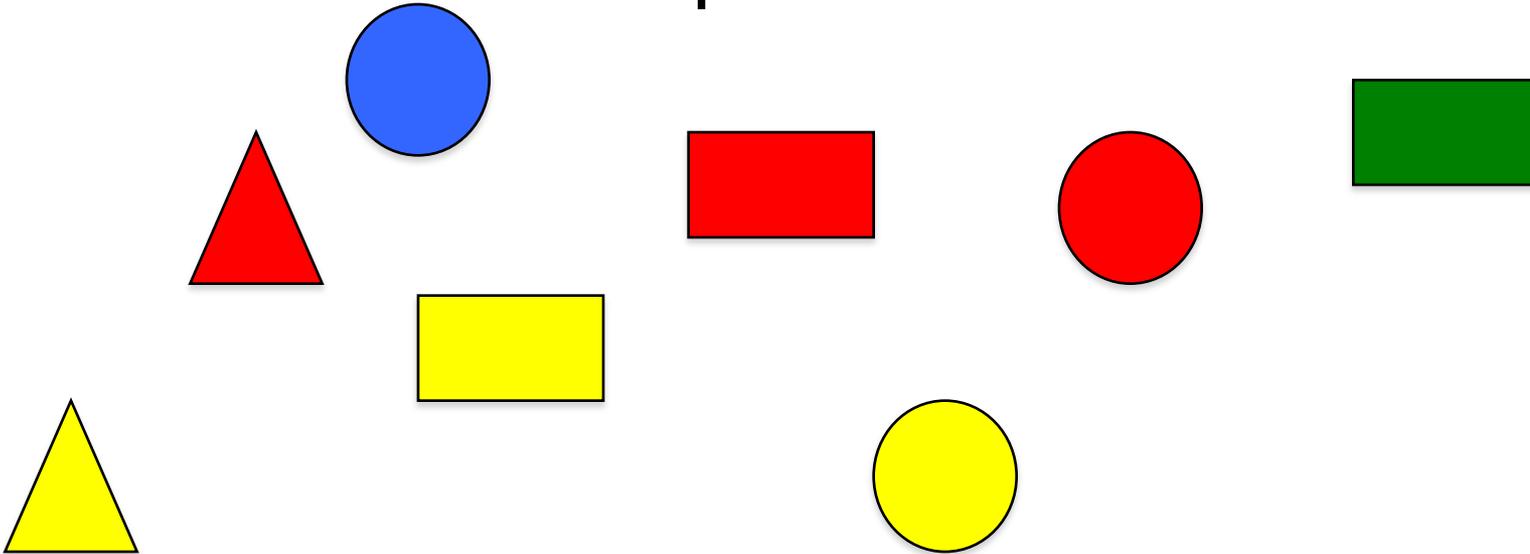
$$10 + 4$$

$$5 + 9$$

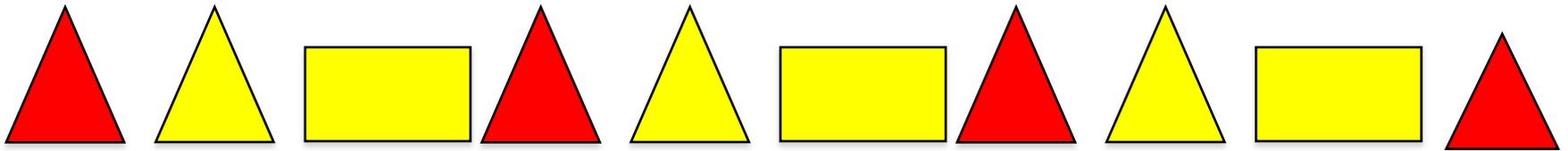
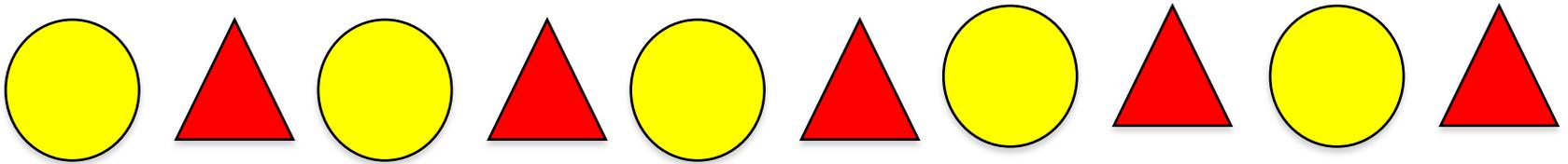
$$8 + 2$$

More examples

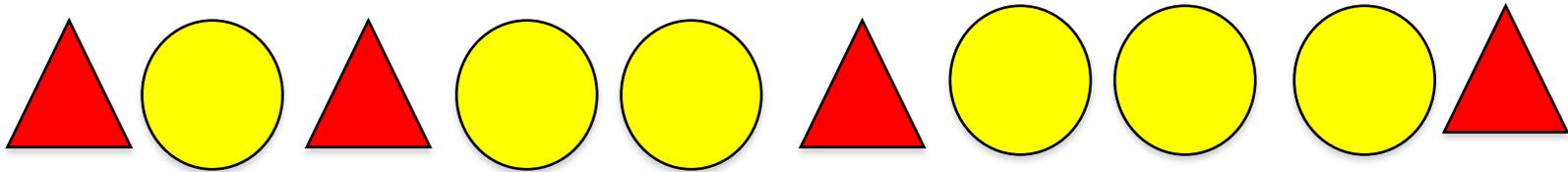
- The 10th shape in a pattern is 
- What could the pattern be?



Maybe



Maybe



More examples

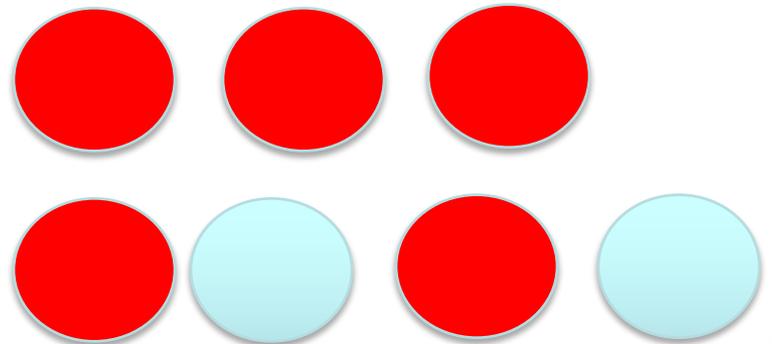
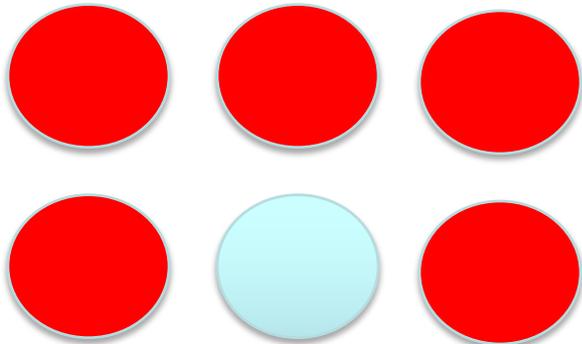
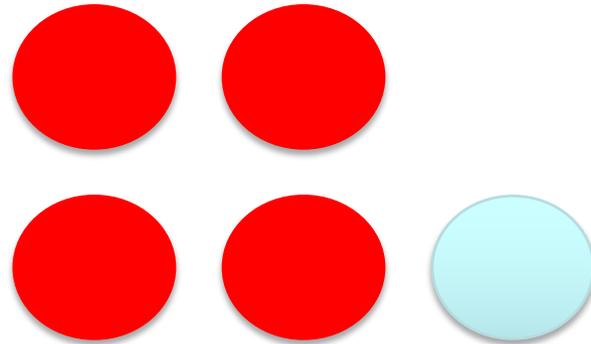
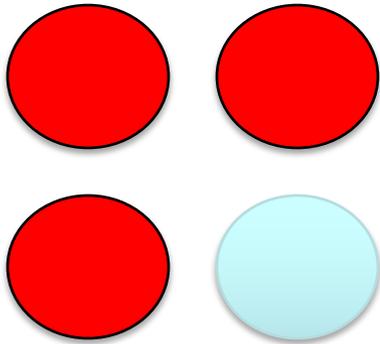
- The 20th term in a growing pattern is 41.
- What are possibilities for the pattern?

Maybe

- 22, 23, 24, 25, 26,...
- 3, 5, 7, 9, 11,.....
- -16, -13, -10, -7, -4, -1,.....

More examples

- Which group is reddest?



More examples

- If all the fruit were blueberries, how many would there be?



More examples

- One line is about 5 cm shorter than another.
- Draw what they might look like.

More examples

- The area of one shape is **WAY** less than the area of another, but its perimeter is **WAY** more.
- What could the two shapes look like?

More examples

- The volume of one prism is exactly 100 cubic units more than the volume of another. What might the dimensions of each be?

Maybe

- What might this graph be describing? (It should make sense.)

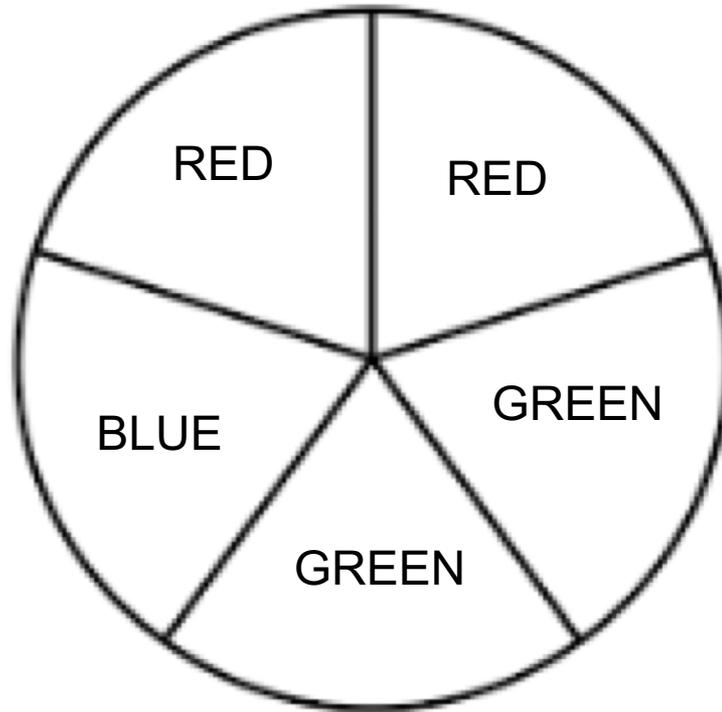


More examples

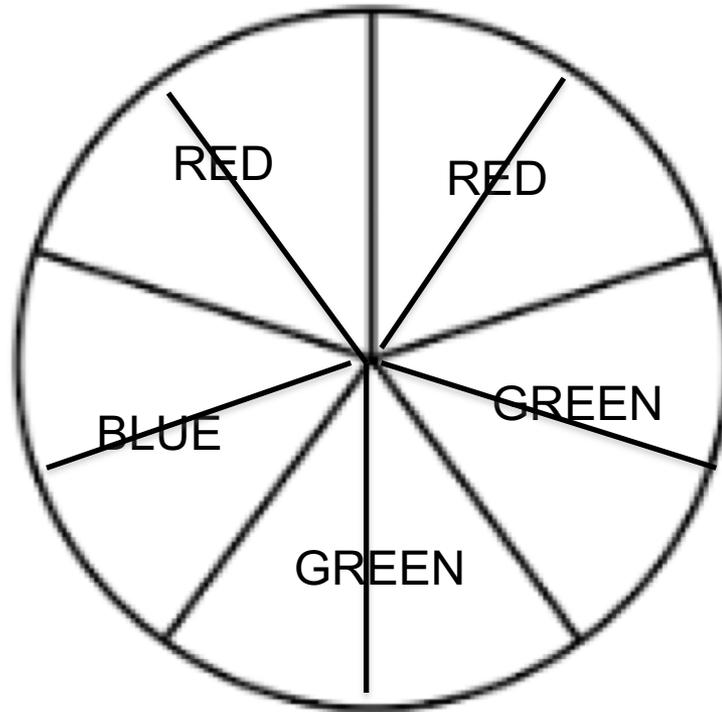
You create a spinner where :

- The red section is twice as big as the blue one.
- The blue section is half as big as the green one.
- Create such a spinner.

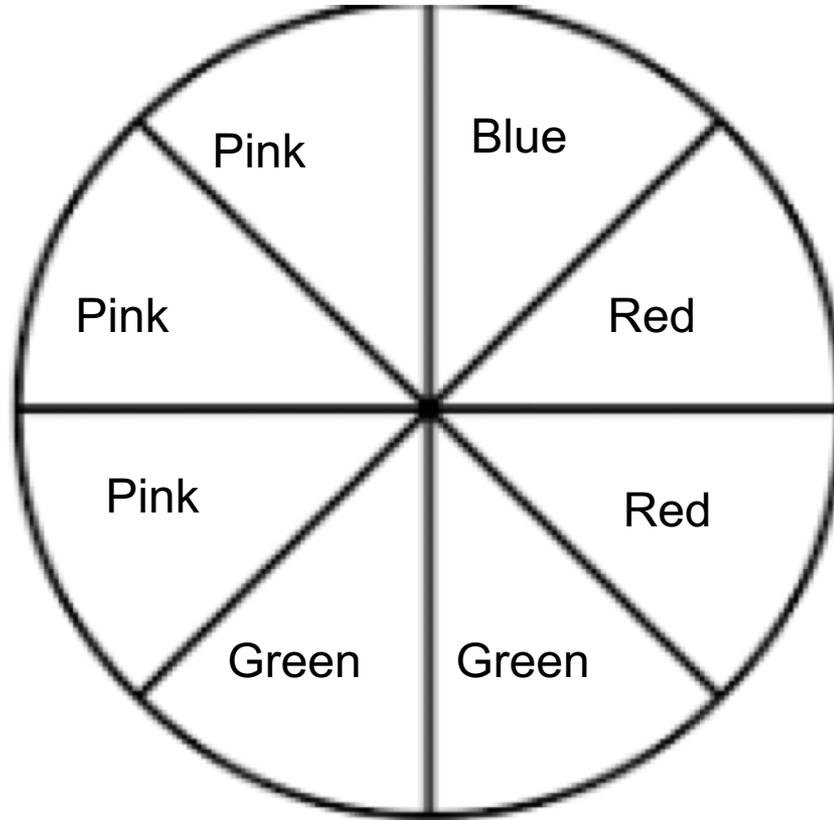
Maybe



Maybe



OR



Strategies to create them

- Here is the answer. What is the question?
- The answer could be the word *square*.
- the number 12
- the calculation 4×2
- a particular graph

Strategies to create them

- How are these alike or different?
- numbers with 3 factors and numbers with 5 factors
- bar graphs and pictographs
- adding numbers under 10 and adding numbers over 10

Strategies to create them

- Let students choose values.
- Choose 3 numbers to add so that the tens digit in the answer is 4.
- Choose a regular shape and its side length. Determine the perimeter and area.

Strategies to create them

- Use flexible words.
- The sum of two numbers is **almost** triple the difference. What could the numbers be?
- You multiply two numbers and the answer is **WAY MORE** than one of them, but not the other one. What might you have multiplied?

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