Using Open Questions to Enrich Math Learning and Differentiate Instruction Gr 3 – 5

Marian Small

Desert Sands

December 2017

Agenda

- Some open question samples in number
- Strategies for creating open questions
- Let’s write some
- Some open question samples in measurement
- Let’s write some

Let’s look at numbers

- _____ is 4 times as much as _____.
- What could go in the blanks to make this true?

I ask questions like:

- Was the first number bigger or the second one?
- Could they have been equal?
- Could the first number have been 20?
- Could the second one?
- How about 21?

- _____ is 4 times as much as _____.

What are they learning?

- Usually 4 times as much is bigger, but not always.
- If one number is 4 times as much, the reverse is 1/4.
- If a whole number is 4 times as much as another whole, it can only be even.

Let’s look at whole numbers

- _____ is 2/3 of _____.
- What could go in the blanks to make this true?

I might ask

- _____ is 2/3 of _____.
- Did anyone use whole numbers?
- If you did--- was your first number even or odd? How about your second one?

I might ask

- _____ is 2/3 of _____.
- Could your second number have been 8?
- Could your second number have been 9?

What are they learning?

- That to get a whole number, we need to take 2/3 of a multiple of 3.
- We end up with even amounts, since it’s 2 one thirds.
- But it doesn’t have to be whole numbers.

Let’s look at whole numbers

- You multiplied two numbers.
- The answer has the same ones digit as ONE of the numbers you multiplied.
- What could you have multiplied?

What are they learning?

- That if one factor ends in 0, so does the product.
- If one factor is a 1, the other one can be anything.
- What else?

Let’s get just slightly more complex

Let’s look at fractions

- Two fractions are equivalent.
- One has a numerator and denominator that are fairly close together.
- The other has a numerator and denominator that are really far apart.
- What could they be?

Maybe

- 1/2 and 100/200
- 3/5 and 60/100
- 8/10 and 800/1000

Kids are learning

- That the size of a fraction is unrelated to how far apart numerator and denominator are.

- That to make the numerator and denominator really far apart, you have to multiply the original ones by a lot.

Here is a question for you

- Two fractions are equivalent.
- One has a numerator and denominator that are 5 apart.
- How far apart could the other numerator and denominator be?

Likely results

- 5/10 and 1/2(1 apart) or 10/20 (10 apart)
- or 3/6 (3 apart) or 1000/2000 (1000
- apart)

- 3/8 and 6/16 (10 apart) or 30/80 (50 apart)
- or 21/56 (35 apart)….

Likely results

- 1/6 and 2/12 (10 apart) or 5/30 (25 apart) or
- 20/120 (100 apart)

- 20/25 and 4/5 (1 apart), 8/10 (2 apart) or
- 28/35 (7 apart)

Students learn that

- If the initial fraction is in lowest terms, only multiple of 5 differences are possible.

- But if the initial fraction is not in lowest terms, lots of things are possible.

Here is a question for you

- Two fractions are equivalent.
- One has a numerator and denominator that are 5 apart.
- The other has a numerator and denominator that are 20 apart.
- What could they be?

Some possibilities

- 2/7 and 8/28
- 5/10 and 20/40
- 1/6 and 4/24
- 7/12 and 28/48

Some background

- The value of open questions
- Differentiating instruction manageably
- Creating richer math conversations

Let’s consider “place value”

- In a certain number, there are two 5 digits and two 8 digits.
- One of the 5 digits represents a number 10 times the amount of the other.
- One of the 8 digits represents a number 100 times the amount of the other.
- What could the number be?

Possibilities

- 55,808
- 80,855
- 55,828
- 838,155

Or we could look at division

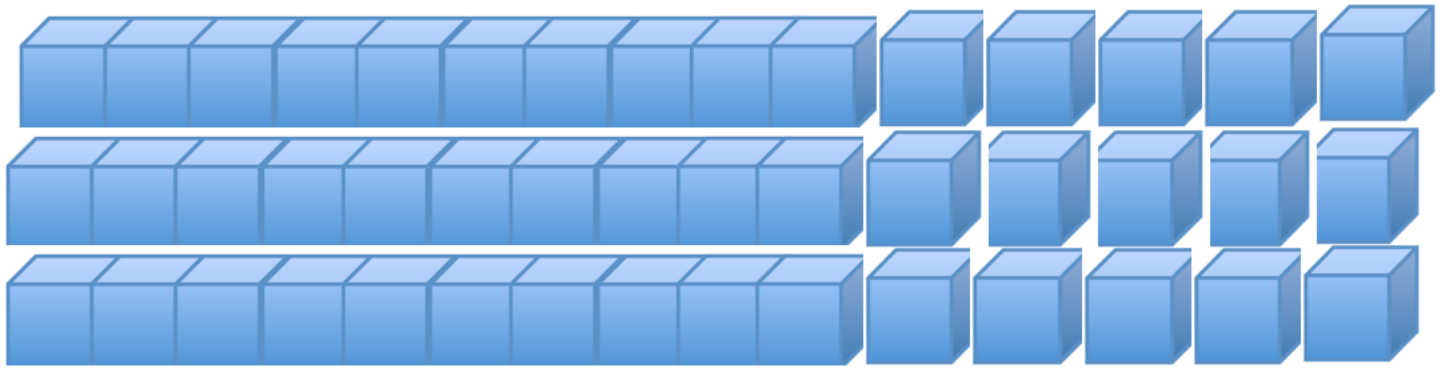
- You divide a 3-digit number by a 2-digit number and the quotient is 42.
- What could you have divided?

It could be

- Simple like 420 ÷ 10 or
- 840 ÷ 20 or
- 966 ÷ 23 or

Here are some others

- You can model 3 x 15 with 18 base ten blocks.



Here are some others

- What other multiplications can you model with 18 base ten blocks?

Here are some others

- Two fractions are both close to 1. But one is closer than the other.
- What might they be?
- Which is closer?

Here are some others

- You choose a fraction.
- Starting at 0, you make jumps of that size on the number line.
- You get past 3 after 10 jumps.
- What might your fraction have been?

Here are some others

- You add two fractions.
- The result is $\frac{[]}{15}$.
- What could the original denominators have been?

Pedagogical decision

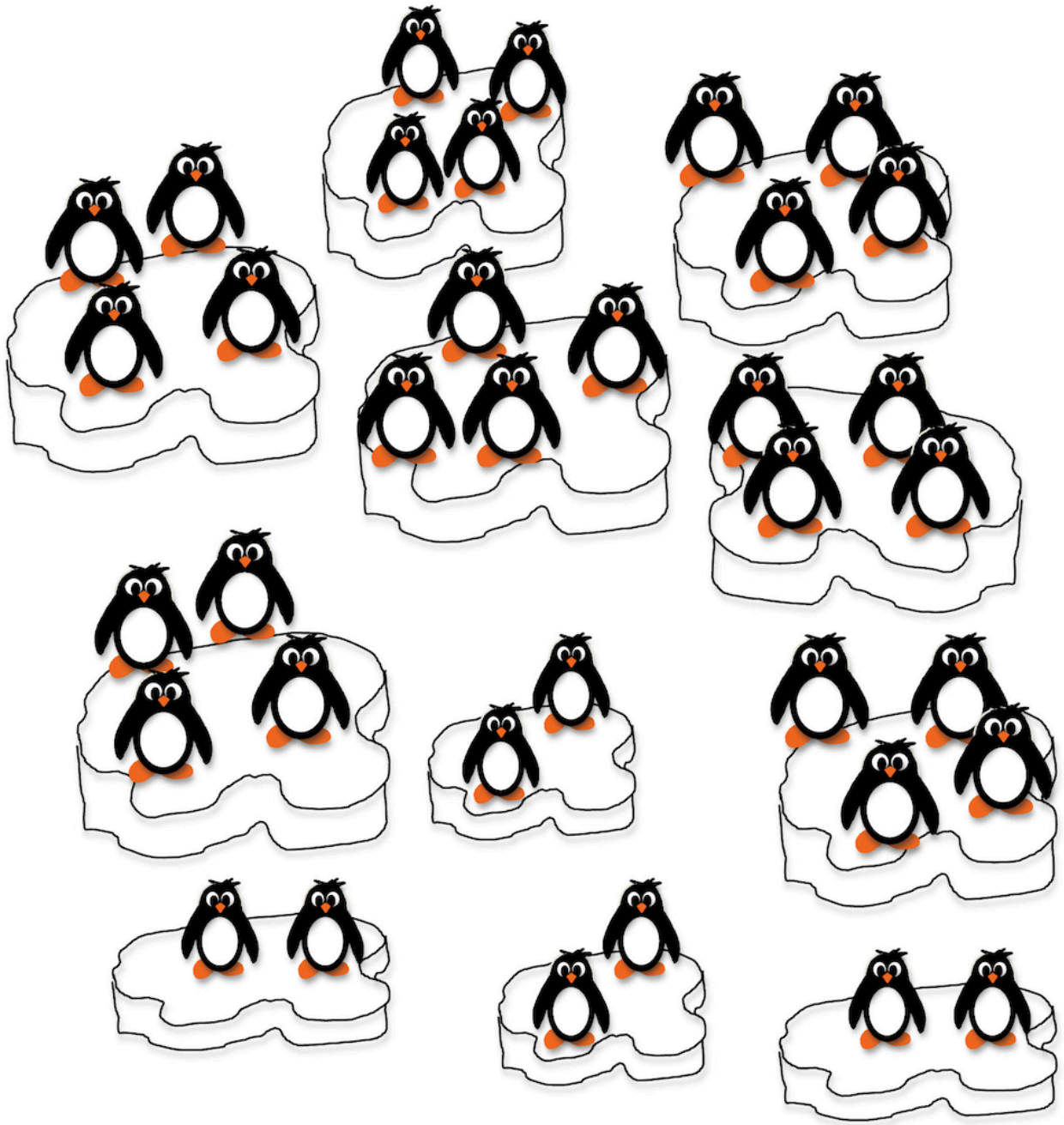
- You could forbid students to use 15, but then you are taking away answers some kids need.

- Instead, you might say--- I hope some of you do what we would expect and that some of you surprise us with your choices.

I might ask

- Does this picture show a single multiplication or does it not?

I might a

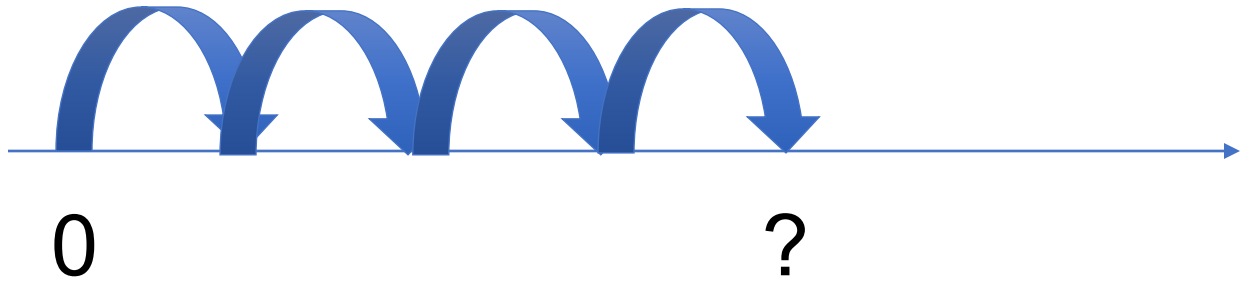


I might ask

- Draw a PICTURE that shows what division means (but don’t just draw the symbol).

I might ask

- What might the value at the ? be if the jumps are whole number lengths?



I might ask

- My number is _____.
- It is _____ groups of _____.
- It is also _____ groups of _____ and _____ groups of _____.

I might ask

- Suppose you know that $20 \div 4 = 5$.
- What other multiplications and divisions does that help you know?

I might ask

- You rounded a number to the nearest 10 and you went down.
- But when you rounded that same number to the nearest 100, you went up.
- What could the number have been?

I might ask

- You subtracted two numbers. The answer was only a little less than the number you subtracted.
- What might the numbers have been?

I might ask

- Fill in the blanks and solve this problem.
- Jennifer had $___. She had ____ times as much money as Angela, but Angela had ____ times as much money as Luis. How much money did Luis have?

I might ask

- To solve a word problem, I needed to add and subtract and multiply. What could the word problem have been?

I might ask

- The equation 4 x [] = 24 represents very different situations.
  What might two of them be?

I might ask

- _____ had 3 more factors than _____.
- What numbers could go in the blanks?

I might ask

- Every 3rd term in a pattern is a multiple of 12, but not every term is.
- What might the pattern be?
- E.g. 4, 8, 12, 16, 20, 24, …
- 4 , 20 ,36, 52 , 68, 84,..
- 112 , 116 , 120, 124 ,128 , 132

I might ask

- I multiply two 2-digit numbers and the tens digit is 3.
- What could the numbers be?

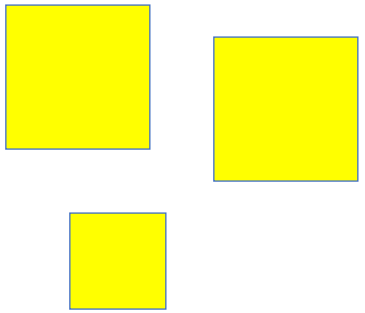
- E.g. 48 x 32
- 57 x 41

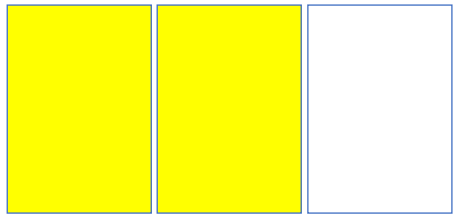
I might ask

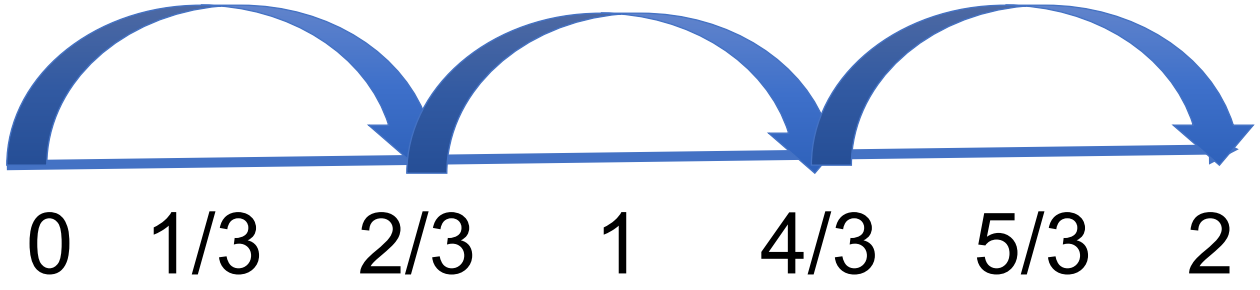
- Draw pictures showing 2/3 so that the pictures are REALLY different.

Maybe

- Draw pictures showing 2/3 so that the pictures are REALLY different.

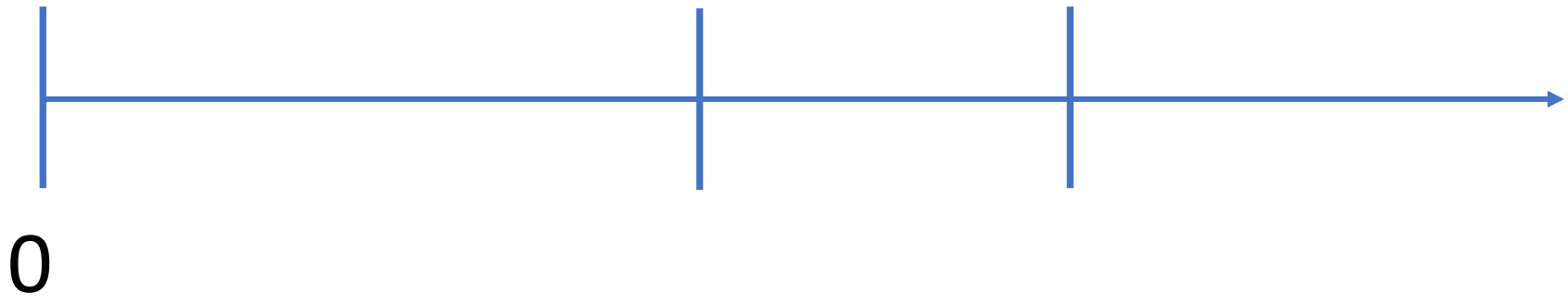






Maybe

- Choose a fractional value for each line that makes sense.



I might ask

- Fill in the blanks to make these true.
- []/11 is MUCH less than []/[].

- 12/[] is MUCH less than []/[].

I might ask

- You multiply a whole number by a fraction and the answer is just a little more than 3.

- What could you have multiplied?

I might ask

- Choose numbers for the blanks and then evaluate the expression.

- ___ x (____ + _____) - _____

I might ask

- You add 4 fractions and the result is 3/[].

- What could you have added?

I might ask

- Choose numbers for the blanks.
- The first number has to be greater than the second.
- Solve the problem.
- _____ families shared _____ cakes. How much cake did each get?

I might ask

- You multiply two fractions and the result is a LITTLE more than one of them and a LITTLE less than the other.
- What fractions might you have multiplied?

Each time

- Each time I created one of the questions you just saw, I read a standard and thought about what I could do with it.

To make open questions, you might…

- **Give the answer and ask for the question.**
- For example, the quotient of two numbers is 12 with a remainder of 2.
- What could I have divided?

To make open questions, you might…

- **Let students choose the numbers.**
- Choose a fraction.
- Create a fraction a little more than it and another a little less.

To make open questions, you might…

- **Use words with wiggle room, e.g.**
- a little more
- A little less
- Close
- Almost….

To make open questions, you might…

- **Draw a picture that shows….**
- E.g. a fraction subtraction
- E.g. that some number is a multiple of another

Often you can start with a standard question

- And then change it a little to open it up.

- For example, if you start with:
- Solve: 8 x [] = 48, it could become:

Often you can start with a standard question

- You write a multiplication equation with an unknown. The solution is 6. What could the equation be?

Often you can start with a standard question

- It could become:
- [] x ?? = 48.
- Choose a number for [] and figure out ??

Often you can start with a standard question

- Choose different even numbers for A and B and solve for [].
- A x [] = B

Now it’s your turn

- Choose 3 number standards at your grade level and create open questions.

- Try to create different kinds.

Let’s switch to measurement

- The same ideas work with any strand, so we are trying one more strand- measurement.

Let’s switch to measurement

- An activity took 1 hour 28 minutes to complete.
- Choose a starting time that is not an o’clock time.
- What would the ending time be?

Let’s switch to measurement

- You did 3 activities in less than an hour.
- You started at []:30.
- There were 5 minute breaks between them.
- Activity 2 went twice as long as Activity 1.
- Activity 3 went twice as long as Activity 2.
- When could each have started and ended?

Let’s switch to measurement

- Fill in the blank with different numbers and for each number, describe the object.
- An object usually weighs around ____ kg.

Let’s switch to measurement

- Use your grid paper.
- Create a shape with an area of 12 square units that has lots of sides.

Let’s switch to measurement

- The perimeter of a shape is a little more than three times the length of one side of it.
- Sketch your shape and show the dimensions.

Let’s switch to measurement

- A rectangle has a length four times the width.
- Choose whole number values and get the area.
- Is the area value odd or even?

Let’s switch to measurement

- The perimeter of a rectangle is three times its length.

- What might the length and width be?

Let’s switch to measurement

- 6 ___ = 6000 ____.

- What units can go in the blanks?

Let’s switch to measurement

- An angle fits into a right angle a BUNCH of times.
- Draw what the angle might look like.

Let’s switch to measurement

- Choose a volume for a prism.
- Build a tall prism with that volume.

Let’s switch to measurement

- Draw an unusual shape whose area you could figure out by breaking it up into rectangles.

Let’s switch to measurement

- You put together two rectangles to make a shape. The area of the combined shape is 100 square inches. What might be the side lengths of the two rectangles?

Let’s switch to measurement

- Two shapes have almost the same volume, but not quite.
- One is much wider than the other.
- Build possible shapes.

Your turn again

- Now try to create more open questions but this time in measurement.
- Address at least two or three different standards.

Download

- You can download this presentation at
- www.onetwoinfinity.ca
- Recent Presentations
- PalmSprings