Teaching to Big Ideas in Junior Math

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- Our mission today:
- What are **SOME** of the Big Ideas in Junior Math?
- How do we organize teaching around them?

To start

- On a paper nobody else sees, you or you and a partner make a list of two ideas that you think are important in:
- \- number
- \- measurement
- Put it aside.

Let’s consider numeration

- Every whole number can be represented in many ways. Each way highlights something different about that whole number.

So..

- Show 200 in a lot of ways.
- Which of your ways made it easy to see that:

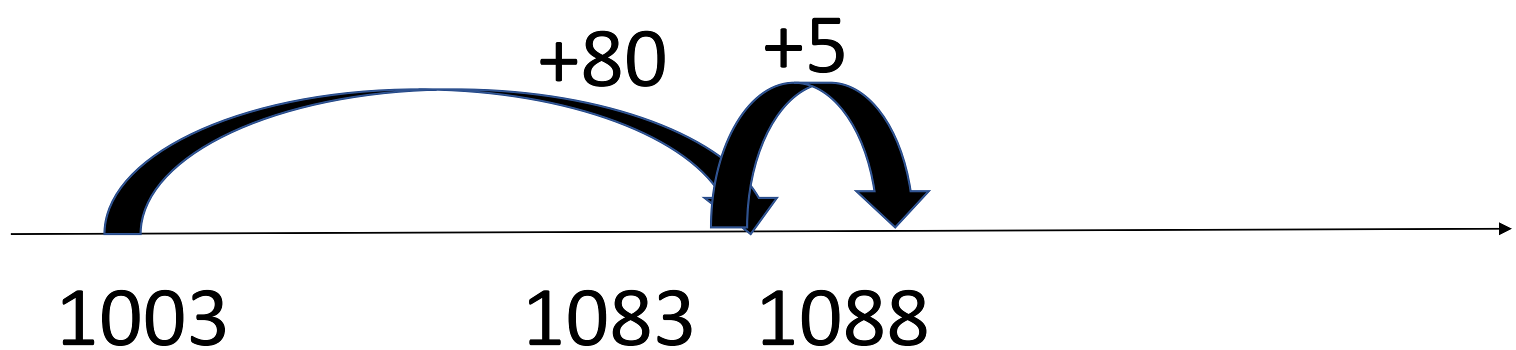
- 200 is eight 25s
- 200 is even
- 200 is more than 150
- is less than 250

It means that..

- Whenever you have kids do a representation in any unit, you ask what they see.

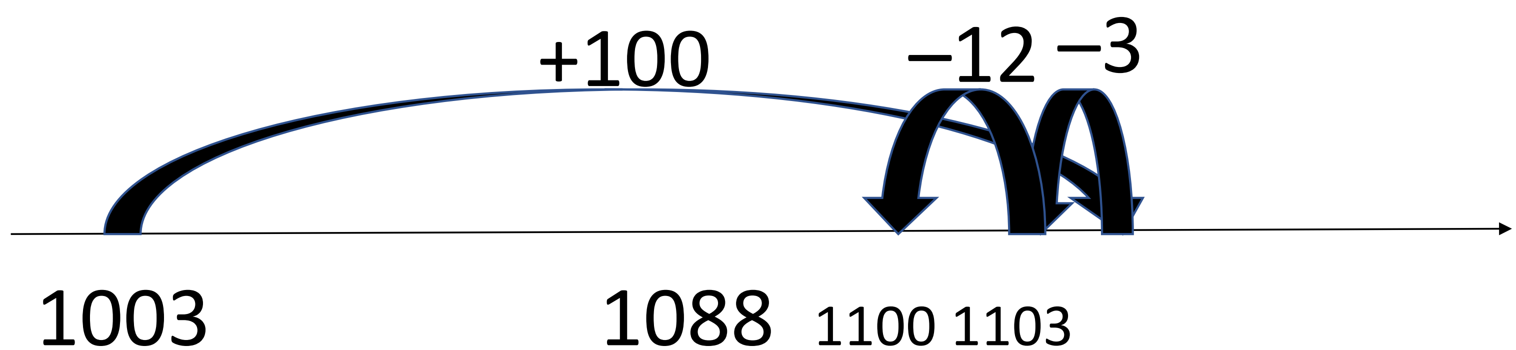
For example…

- They model 1003 + 85 on a number line:



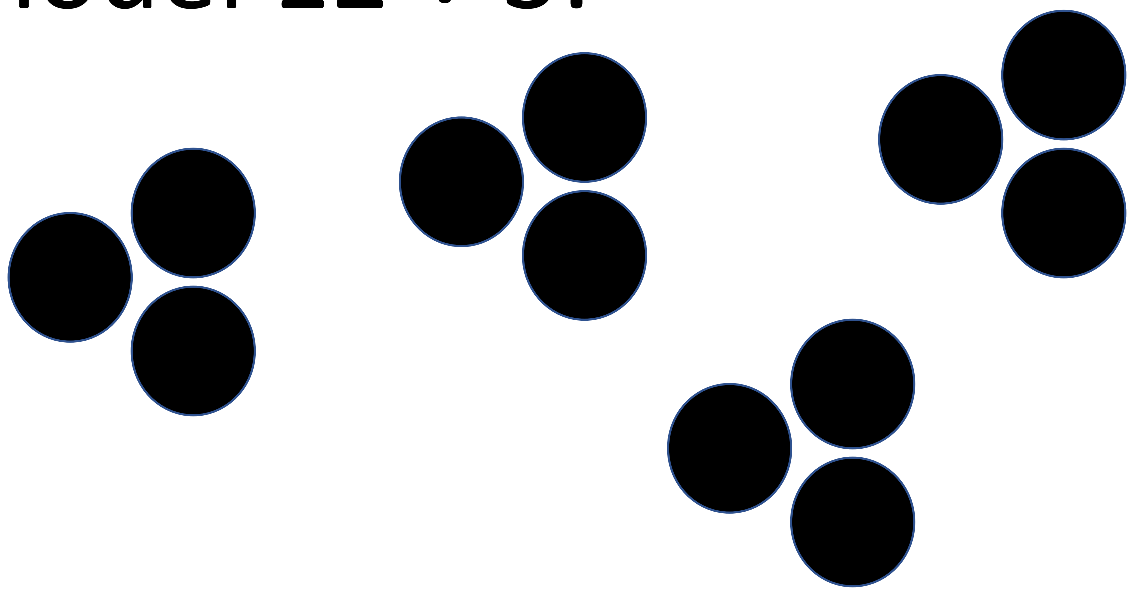
For example…

- They model 1003 + 85 on a number line:



Or

- They model $12 \div 3$:



Let’s consider numeration

- Every number can be decomposed and recomposed in different ways; this often makes it easier to estimate the size of the number or calculate with it.

“Lesson”

- You use 12 base ten blocks to show a number.
- What can it be?

Probably

• 12	66
• 120	57
• 111	390
• 300	417

Or

- You have LOTS of bags of 6 counters.
- You have LOTS of bags of 10 counters.
- What numbers can you show?
- Can't you show?

Cans

- 6, 12, 18, 24, 30,…
- 10, 20, 40, 50,…
- 16, 26, 46, 56, 22, 32, 52,..

can’ts

- 1, 2, 3, 4, 5, 7, 8, 9, 11, 13,…

Or..

- Choose a 2-digit number.
- Take that many counters.
- How can you arrange your counters into equal groups?

Whenever…

- you add or subtract or multiply or divide, you are doing composition or decomposition.
- you use place value ideas, you are doing composition or decomposition.

Whenever…

- you work with money, you are doing composition or decomposition.

Let’s consider numeration

- Benchmark numbers can be used to estimate, compare, and give meaning to numbers.

So.. For example

- I am thinking of a number that is:
- Close to 4000
- About 3500
- Closer to 3500 than to 4000

So.. For example

- I am thinking of a number that is:
- A reasonable number of people in a shopping mall on Saturday afternoon
- A reasonable number of people at an NHL hockey game
- A reasonable number of steps I walk in a week

So.. For example

- How do you know that 4011 > 2889?
- You add two numbers that are about 400 apart and the total is close to 3000. What could they be?

Let’s consider numeration

- When you use fractions to compare two amounts, you need to be clear about the attribute you care about.

I might ask

- Use pattern blocks to make a design that is 2/3 yellow.
- Why might someone use a different fraction to describe the yellow?

Perhaps

- You are careful about talking about what attribute to consider when using fractions.

Let’s consider numeration

- The size of a fraction can be thought about in terms of the ratio of the numerator to the denominator.

You might ask

- Why are you sure without doing much of anything that $1/10 < 5/7$?
- Why is $2/3 = 20/30$?
- Suppose the numerator of a fraction is $2/5$ of the denominator. What could the fraciton be?

Let’s consider numeration

- Addition and subtraction are related. They always involve parts and wholes.

So I might ask…

- Describe a situation where you might subtract 4.3 from 12.2.
- What addition also describes that situation? Why?

So I might ask…

- Fill in one of the boxes with the number 12.4. Then fill in the other boxes so the total lengths are the same.

So maybe

- You teach addition and subtraction together.
- You repeatedly ask for what addition is related to a subtraction situation kids are dealing with or the reverse.

Let’s consider numeration

- Multiplication and division are related to each other and to addition and subtraction.

So I might ask…

- Draw a picture or build a model that shows multiplication.
- What divisions do you see in your picture or model?
- What additions?
- What subtractions?

So I might ask…

- Solve 815 ÷ 5 using only subtraction.
- Solve 3 x 422 using only addition.

Perhaps…

- Frequently when students are doing a computation involving one operation, you ask how a different operation could have been used.

Let’s consider numeration

- The multiplicative comparison of two numbers can always be thought of in two ways– how many b’s make an a OR how much of an a is a b?

For example

- Fill in the blanks to make each true in lots of ways.
- _____ is 3 times as much as _____.
- _____ is 1/3 as much as _____.

Later

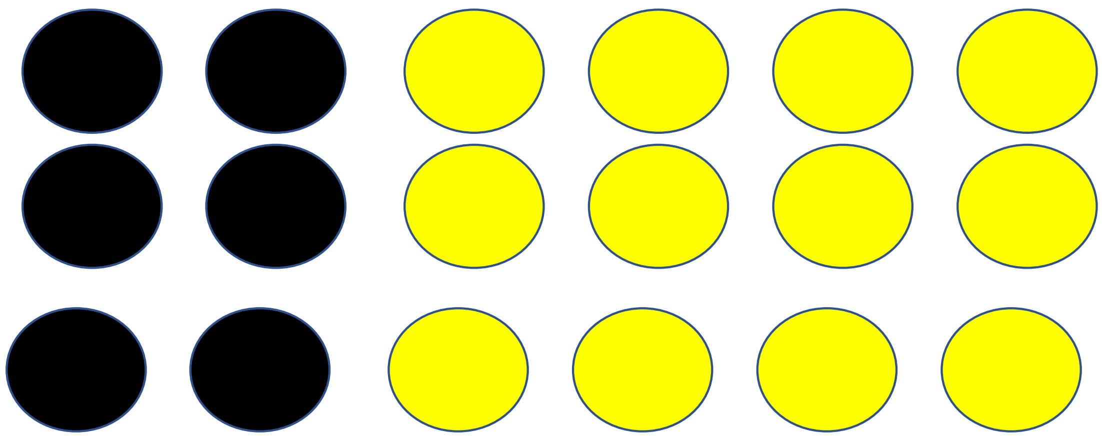
- Fill in the blanks to make each true in lots of ways.
- _____ is 5/2 times as much as _____.
- _____ is 2/5 as much as _____.

Let’s consider numeration

- Whenever you see one ratio, you actually see a lot of ratios and a lot of fractions.

For example

- What ratios and fractions do you see here?



Perhaps

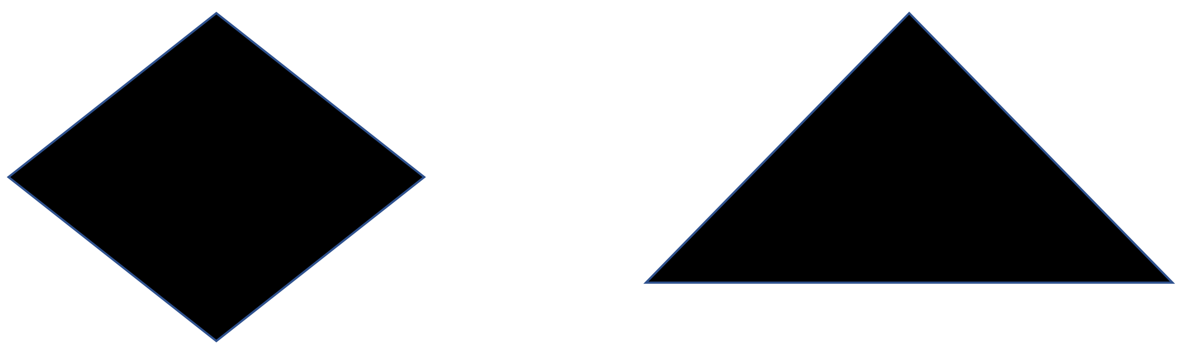
- Whenever kids are working with ratios, you bring up fractions they also see, and vice versa.

Consider measurement

- Using units when describing a measurement makes it easier to describe and compare measurements.

I might ask

- You want to know which shape has more area. What could help you figure that out?



Perhaps

- You present lots of situations where two objects are being compared that are not able to be “brought together”. You keep asking how knowing how many units “big” they are can be useful.

Consider measurement

- There is always a choice of unit when measuring an object; that choice is affected by many factors.

For example

- You want to know how much a box will hold.
- What units could you use to measure it?
- Why might you choose one of those units rather than another?

Perhaps

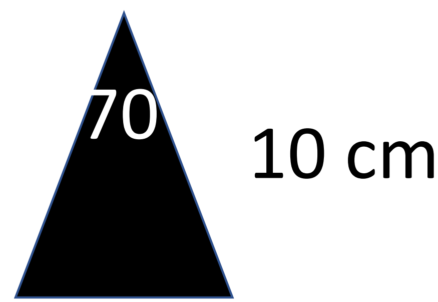
- Many times when students choose units, you ask them to justify their choice, but also think of a reason they might make a different choice.

Consider measurement

- Some measurements of an object are independent of other measurements, but some are not.

So I might ask

- You know this triangle is isosceles.
- What other measurements of it do you know now? Which not?



Perhaps

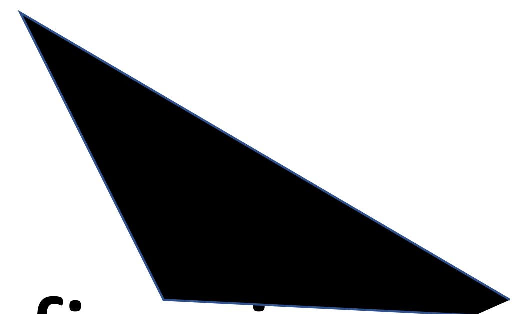
- You frequently bring up situations where knowing one measurement of an object tells you another one and talk about how they know. You also bring up situations where measurements are independent and discuss those.

Consider measurement

- Formulas are useful since you can figure out measurements that are hard to take from ones that are easy.

You might ask

- Sarah doesn’t know the formula for the area of a triangle.
- Rick does.
- Who will have an easier time figuring out this area? Why?



Consider pattern

- Every pattern involves repetition.

You might ask

- Why might you think this is a pattern?
- 4, 7, 11, 15,…?

Perhaps

- Frequently when patterns are being addressed, you go back to why they are patterns--- focus on predictability because of repetition.

Consider pattern

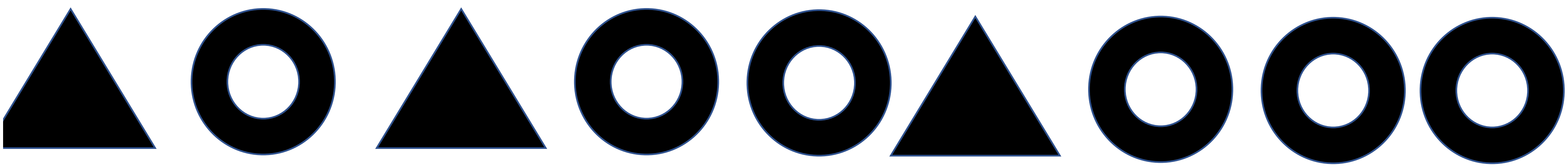
- There is no way to be certain how a pattern continues without a pattern rule.

So I might ask

- Continue this to form a pattern in three different ways:
- 5, 10,…

Perhaps

- You are careful to not say: What is the tenth shape in this pattern?
- Instead, you ask what MIGHT be the tenth shape.



Consider algebra

- Equality is an expression of balance.

You might ask

- Put in numbers to make this true. What do you notice about the numbers?
- [] + 48 = {} + 50
- 3 x [] = 9 x {}

You might ask

- Line up two different Cuisenaire rods.
- Now use different combinations of rods to make the same total length.
- Write the equations.

Perhaps

- When you read 4 x 3 = 12, you say either “4 x 3” balances”12” or you say “4 x 3” is another name for 12.

Consider algebra

- An equation describes many situations.

You might ask

- Describe different situations that are described by this number sentence: $24 \div 3 = 8$

Consider algebra

- There are many things that are true about “all” numbers or all of a particular set of numbers.

You might ask

- I add two numbers.
- I subtract the same two numbers.
- The “add” answer is 10 more than the “subtract” answer.
- What numbers could they be?

You might ask

- Choose a number.
- Multiply it by the number that is 2 greater.
- Now multiply the number between them by itself.
- What do you notice?

For example

- When you talk about ideas like multiplying numbers in any order, you ask kids for other mathematical things that are “always true” .

Consider data

- Often an organized visual display makes it easier to “see” data.

You might ..

- provide a table with some data and the same data in a simple bar graph and ask a question about the data; discuss which organization they find most helpful and why.

Consider probability

- Probabilities are always predictions that are rarely certain.

You might ask

- I flipped a coin and got H, T, T.
- What will happen next?

Or

- I chose 10 cubes and got 2 red, 8 blue.
- What will happen next time I choose 10 cubes?

What does planning look like?

- I probably use the expectations in conjunction with these big ideas to create learning goals.

What does planning look like?

- I build lessons with the commitment to address some essential understandings (as well as expectations) each time.

For example

- I choose an expectation
  - describe multiplicative relationships between quantities by using simple fractions and decimals (e.g., "If you have 4 plums and I have 6 plums, I can say that I have $1\frac{1}{2}$ or 1.5 times as many plums as you have.");

I decide

- To connect this to the idea that whenever there is one relationship, there is a reverse one as well; to the notion that there are many ways to represent numbers, I create some activities like these:

- Jane read more than 5 books. Her sister read 2 ½ times as many.
- Give some possible numbers of books each has read.

But then ask questions like these

- Which number is bigger– Jane's or her sister's? Why?
- If this picture showed how many Jane read, what picture would show how many her sister read?

But then ask questions like these

- Did Jane read more or less than half the number of books as her sister? Why does that make sense?
- What fraction of the number of books that her sister read did Jane read?

- AND/OR

- I look at the big ideas.
- I figure out which expectations they might marry with.
- I build lessons around that big idea that cover those expectations.

So

- Let’s try it.
- You either start with an expectation, marry it to a big idea and build a lesson. OR
- Start with the big idea, find related expectations, and build a lesson.

Now

- Take out your old paper about your ideas of big ideas.
- Have they changed?
- Do you feel there are important ones we missed?

- Questions?

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