Infusing Critical Thinking into Mathematics Instruction

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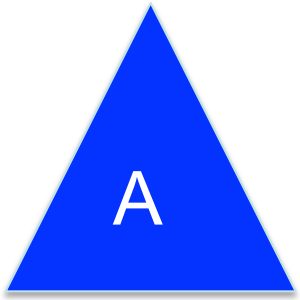
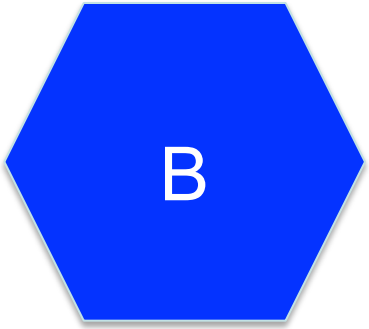
Let's warm up

- A third shape is more like shape A than shape B.
- What might it look like?





Critical thinking

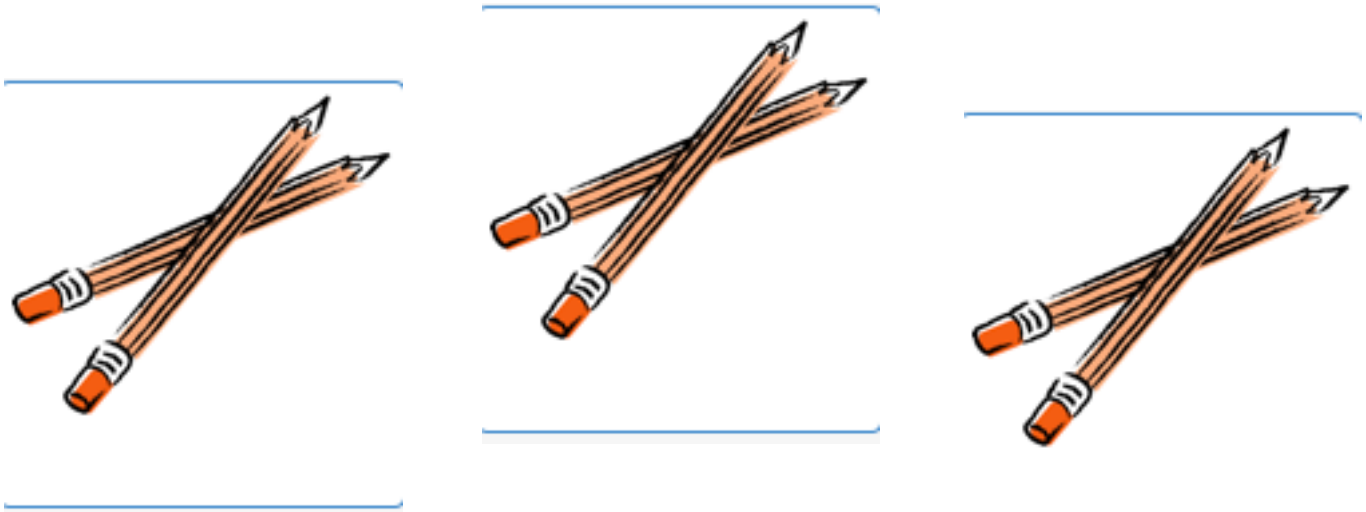
- Goes hand in hand with problem solving and decision making

Critical thinking

- Math is clearly full of problem solving
- There is often decision making in how to proceed on a problem.
- We can, and should, bring in decision making into interpretation too.

For example…

- Kayla had just a few more pencils than Levi.
- Together they had 20 pencils.
- How many do you think each one had?



Or…

A car goes 280 km in 3 hours.

Which would be easiest for you to figure out?

How far it goes in

- 9 hours? 1 hour? 1.5 hours?

Or…

- A shape does not have much area but it has lots of perimeter.
- What might it look like?

Or

- Andy is in grade _____.
- He is _____ cm tall.
- His pencil is ____ cm long.
- His cat has a mass of ____ kg.

Numbers to Use:

4 12

16 125

Critical thinking involves

- Review, analysis and assessment of information from different points of view
- There is always an element of setting criteria in order to do the analysis and assessment.

This might happen if…

You ask students to argue:

- why when you add any two even numbers the answer is always even.
- why a multiple of 12 is always also a multiple of 3.
- why squares of consecutive whole numbers get farther and farther apart.

We would then listen to the arguments and decide which are most convincing and why.

Involves

It is often said that critical thinking makes use of:

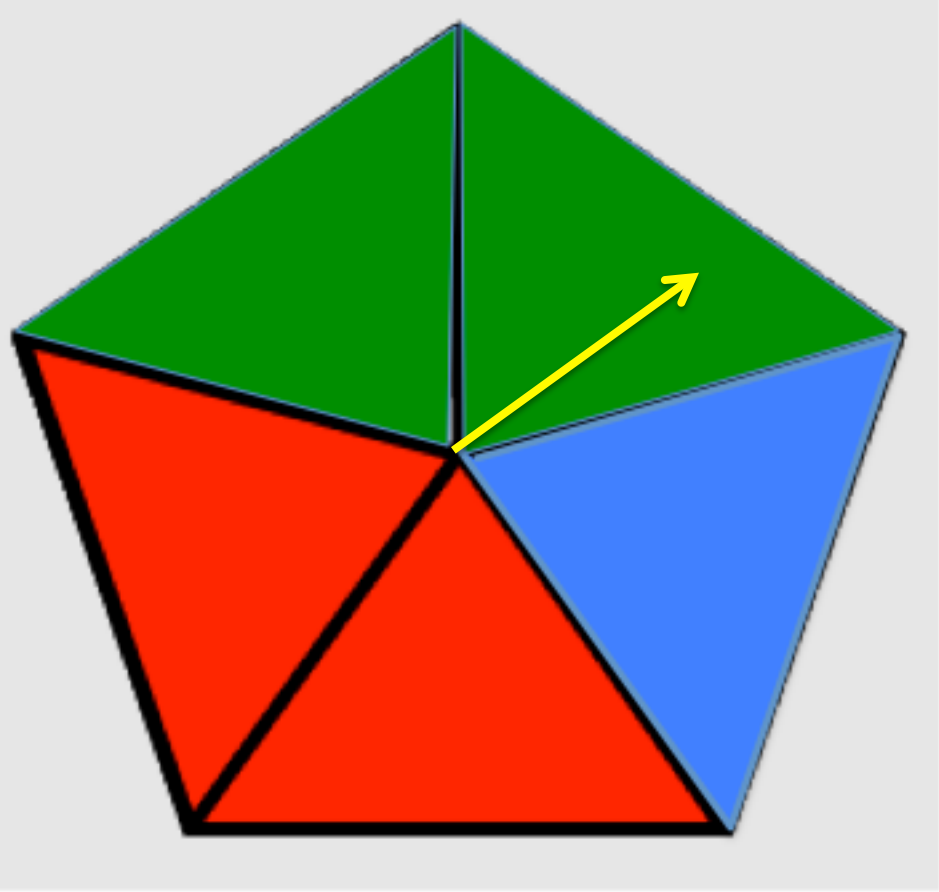
- application,
- analysis,
- evaluation and
- conceptualization,
- including recognition of assumptions

Which did we just use?

So I could have asked…

- You are going to spin a spinner.
- You are twice as likely to get red as blue.
- You are half as likely to get blue as green.
- What could the spinner look like?

Maybe



Critical thinking involves

- Reflection on your own and others' thinking and reasoning
- Confidence as a problem solver
- Flexibility in approaches to solutions

Asking the right questions

- This is the heart of the issue.
- We need to ask questions that encourage or even demand critical thinking behaviours.
- You could make it the “normal” way you teach.

Asking the right questions

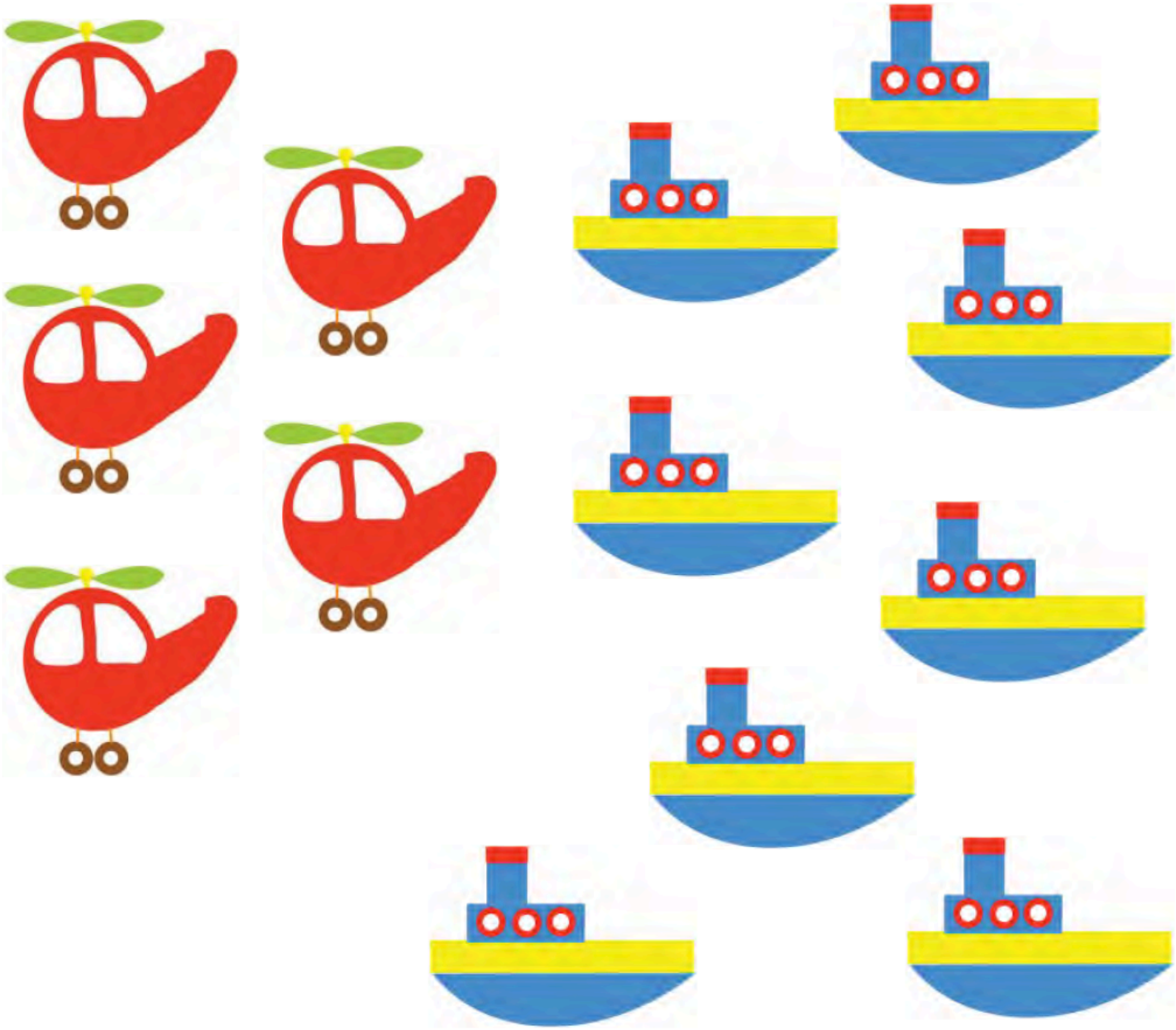
- It is often useful to ask “provocative” questions. e.g.

Asking the right questions

- Is it more useful to know how to multiply or how to add?
- What would be the criteria for “useful”?

Or…

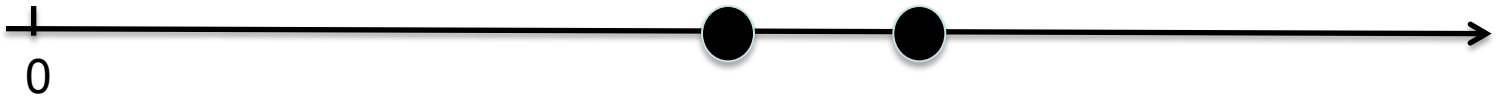
- Do you think people should exclusively use a 24 hour clock or a 12 hour clock or do you think a mixture is good?



Does this picture show addition or subtraction or both?

More examples

- What numbers might belong at the dots marked on the number line?
- What numbers are bad choices?

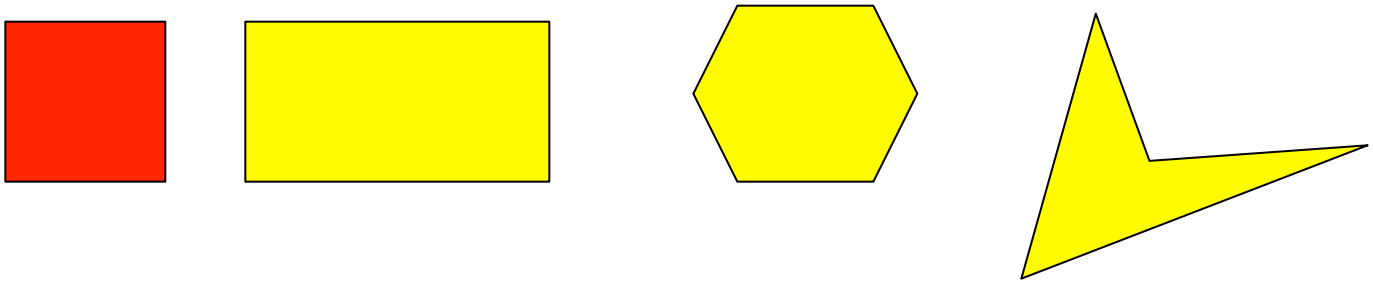


More examples

- Is it easier to solve $4x + 16 = 28x + 16$ by dividing first or subtracting first?

More examples

- Which shape doesn't belong? Why?



More examples

- Which number doesn't belong? Why?

2 5 12 20

More examples

- How would you arrange 8 counters to make it easy to tell it is 8?

More examples

- What shapes are a lot like rectangles, but not quite rectangles?

More examples

- A number is represented with some hundred flats, one more ten rod and two fewer ones than rods.
- What could the number be?

More examples

- What numbers take exactly four words to say?

More examples

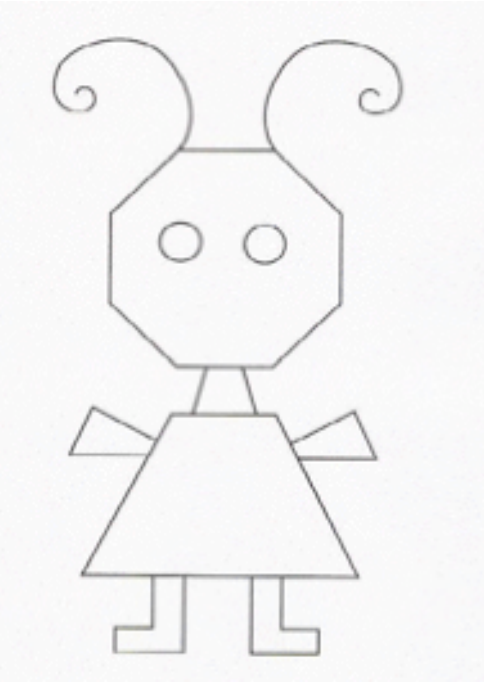
- An angle's measure is really easy to estimate. What might it look like?

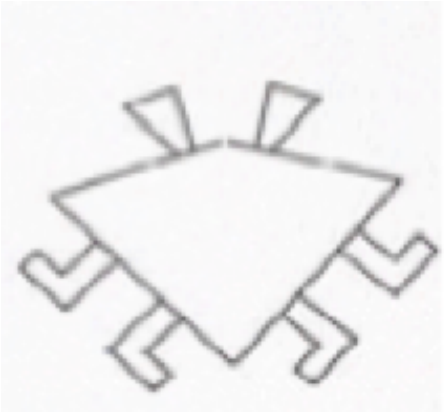
More examples

- Is 10% a lot or not?

More examples

You could ask: Where would you put the mirror on Molly to see the design on the right.





More examples

- You found an equivalent fraction to 2/5 but the numerator and denominator were 36 apart.
- What could that fraction have been?
- Why does your answer make sense?

More examples

- I added some positive and negative integers using two-colour counters.
- There were five times as many negative counters as positive ones.
- What sums could I end up with?
- What sums could I not end up with?

More examples

- An algebraic expression is worth 20 more when $x = 4$ than when $x = 2$. What could it be?
- An algebraic expression is worth 30 less when $x = 4$ than when $x = 2$. What could it be?

More examples

- We write 24 ÷ 4 to ask for the size of a group when 24 is divided into 4 equal groups.
- We also write 24 ÷ 4 to ask for how many groups we can make if 24 is divided into groups of 4.
- Do you think we should use a different symbol in the two situations?

More examples

- Compare and contrast the strategies you would use to compare

  2/3 to 7/3

  2/3 to 2/5

  2/3 to 1/10

  2/3 to 4/5

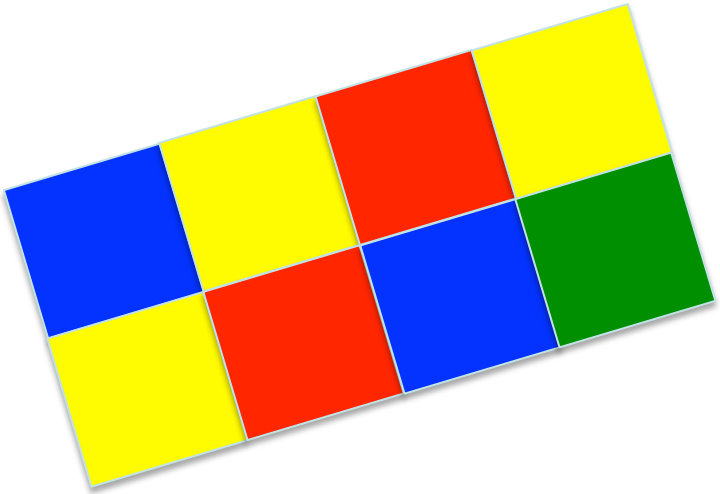
More examples

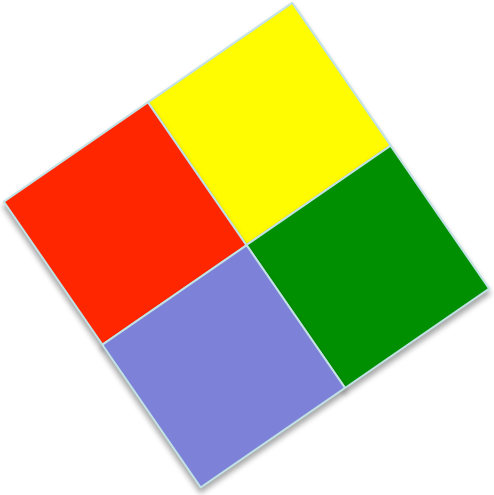
- Is it true that a/b is usually more than c/d if a and b are closer together than c and d?

  (e.g. 2/3 is more than 1/9 since 3 -2 < 9 – 1)

More examples

- One rectangle has half the area of another.
- Would the perimeter also be half?
- Is it ever? Usually? Often?





More examples

- If you know 20% of an amount, what other percents of it do you also know?
- Which don't you know?

More examples

Which is easiest to construct?

- An equilateral triangle
- An isosceles triangle with one angle of 40°
- A scalene triangle with side lengths of 4 cm, 5 cm and 6 cm
- A right triangle with a 35° angle

More examples

- Which pattern gets beyond 1000 first? How do you know?

- 15, 25, 35, 45, 55, 65,…
- 500, 502, 504, 506, 508,…

More examples

- Sometimes we write $P = 2l + 2w$ and sometimes we write $P = 2(l + w)$ to determine the perimeter of a rectangle.
- Why do these really say the same thing?
- Which is more useful when?

Your work

- I would like you to work with at least one partner at your grade level or in your division.
- Choose 3 curriculum focuses.
- Create tasks related to those concepts that foster critical thinking.
- We will share thinking.

Let's discuss some big issues

- Do you see this as possible a bit of the time or lots of time?
- Do you recognize its value for even students who are not the high fliers?

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- www.onetwoinfinity.ca
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