# Secondary Math

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# Agenda

Choosing questions to enhance discourse
Making math thinking visible
Lesson consolidation
Assessment for and as learning

# Better questions

Rich questions are rich if they engender both thinking and mathematical conversation;

In doing the latter, they make math thinking visible.

# They can be

Simple or complex
Whole class or pair/small group

# Contrast these questions

What is the slope of the line that joins (2,3) and (5,–1)? TO

A line through (2,3) slants down to the right. Tell as many things about it as you can.

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# Which of these doesn't belong?

$3x - 4 = 2x - 7$

$6/x = -2$

$2x = -8$

$5x + 8 = -7$

# Compare this to

$$3x - 4 = 2x - 7$$

# Or

A line is ALMOST horizontal.
What could the equation be?

# Modelling algebraically

The equation $5f + 2t = 100$ describes a real-life situation.

What might it be?

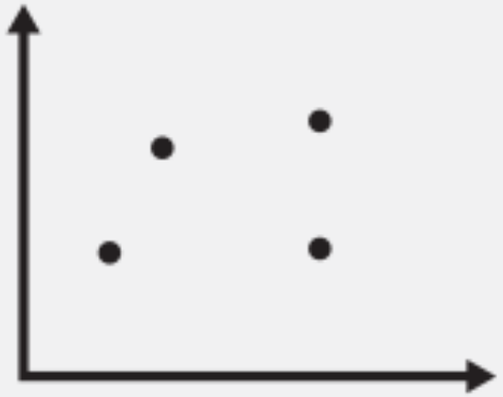
# Maybe

A pile of $5 bills and toonies worth $100
100 people at tables holding either 2 or 5
100 sticks to create pentagons or angles

# Creating equations of lines

A line passes through two of these points:

What could the equation of the line be?



# Graph a line

- Choose values for m and b and graph $y = mx + b$.

# Pythagorean theorem

- A right triangle has two really long sides and a short side. What could the three side lengths be?

# Area

- You need to use the Pythagorean theorem to figure out the area of a shape.
- What could the shape look like?
- Draw three possibilities and show necessary dimensions.

# Proportional reasoning

- You saved $6 on a pair of jeans on sale.
- What could have been the original price and the discount percent?

# Maybe

- 10% on $60
- 20% of $30
- 40% of $15

# Maybe

- 5% of $120
- 50$ of $12

# Proportional reasoning

- 4L of juice that costs $7.27 is a SLIGHTLY better buy than 3L at another price.
- What might that price be? Why?

# Powers

- How could you express 88 as a sum of powers?

# Maybe

- $88 = 2^3 + 2^3 \ldots$ (11 times)
- Or $2^2 + 2^2 \ldots$ (22 times)
- Or $9^2 + 7^1$
- Or $5^2 + 6^2 + 3^3$

# Equations

- The solution to an equation is $x = 4/5$.
- What could the equation be?

# Maybe

- $X = 4/5$
- $5x = 4$
- $5x + 3 = 7$
- $-5x = -4$
- $0.1x = 0.08$

# Volume

- The volumes of a prism, pyramid and cone are all the same.
- Choose a volume and tell what the dimensions of each figure would be.

# Surface area and volume

- A and B are different kinds of shapes.
- A has a greater volume.
- B has a greater surface area.
- Create dimensions to make this possible.

# You can see

- These sorts of questions not only allow for a broader range of students to succeed, but also stretch strong students.

# To create them

- You can begin with straightforward questions and “tweak” them.

# For example

- Instead of: Given a graph that represents the relationship of the Celsius scale and the Fahrenheit scale, determine the Celsius equivalent of –5°F…..

# You could ask

- A Celsius and equivalent Fahrenheit temperature are about 20° apart.
- What could the temperatures be?

# Instead of

- Multiply $2x(x + 4)$.

# I could ask

- You multiply two polynomials and the result can be modelled by 10 algebra tiles. What might you have multiplied?

# Instead of

- Graph $2x+3y = 6$ using the x- and y-intercepts.

# You could ask

- Give the equation of a line you would probably graph:
- Using the x- and y- intercepts
- Using the slope and y-intercept

# Instead of

- The perimeter of a rectangle can be represented as $P = 2l + 2w$. If the perimeter of a rectangle is 59 cm and the width is 12 cm, determine the length.

# You could ask

- The perimeter of a rectangle is almost 5 times the width. What could the width, length and perimeter be?

# A few strategies

- Start with the answer
- Use “flexible” words
- Let students choose their own values

# Let’s try

- To create some open questions for grade 9

# Lesson consolidation

- The purpose of the consolidation is to bring the most important ideas to attention, not to just discuss how the problem was solved.

# For example

- What if my learning goal were:
- Recognize that there are many different ways to decide if a linear relationship is direct or partial variation

# My task might be…

Consider each situation.

- How would you decide whether doubling one variable doubles the other?
- You are looking at the graph of a line.
- You are looking at the table of values of a linear relation.
- You are looking at the equation of a linear relation.

# My consolidation focuses on

- Why does not going through (0,0) mean doubling one variable does not double the other?
- Why does $b \neq 0$ in the equation $y = mx + b$ mean that doubling one variable does not double the other?

# My consolidation focuses on

- Why does a table that being with (0,a) when a $\neq$ 0 mean that doubling one variable does not double the other?

# Or

- What if my learning goal were understanding that we use a line of best fit ONLY to extrapolate far from a graph

# My task

- Might involve carrying out an experiment and determining a line of best fit

# My consolidation

- Does the line help me figure out what is going on in the domain for the data I collected?
- What does it help me with?

# If my learning goal were

- Interpreting the point of intersection of two linear relations in a meaningful way

# My task might be…

- Two catering companies charge a certain amount to rent their hall and a certain amount per meal.
- Each company charges $1100 for 45 people but different amounts for any other number of people.
- What could the charges be?

# My consolidation focus

- What information about the graphs of the lines did you know immediately?
- What did you have to figure out?
- Why did the lines have to have different slopes?
- Why were the slopes positive?
- Could they have been VERY different?

# Notice..

- My learning goals were concepts, not skills.
- We need to move more in that direction with skills woven in- not the focus.

# You try

- Think of what you are teaching now.
- What could the learning goal be?
- What could the consolidation look like?

# Assessment for

- And as learning

# Assessment for…

- This happens ALL the time.
- The issue is how you use the information.

# It’s about…

- Listening for both difficulties and strengths

# As you listen

- The goal is to consider whether and/or how your instructional plans might need to change for particular students based on what they reveal about their thinking.

# It means that…

- You can't be "marking" everything and using those marks.
- It's more about giving feedback, changing plans, etc.

# Assessment as

- Students need many opportunities to self-assess to support their own learning.
- This requires us not to always tell them what we think about what they've done, but, rather, ask them what they think.

# It would be nice

- For you to try out a bit more of this and see where it goes.

# Download

- www.onetwoinfinity.ca
- AMSec1