

SD 38 K-12 Mathematics & Numeracy

Grade 8 and Grade 9: week three

Rationale: To identify linear relationships, students need non-linear relationships to contrast them with. The visualization activities, designed by Jo Boaler, invite students to interact with patterns to identify characteristics of linear and non-linear relations. These can be used as a jumping off point to develop conceptual understanding of two-variable relations.

Big Idea: Relationships can be represented in many ways, revealed through research, and used to help us make sense of social issues.

Curricular Competencies:

- visualize to explore mathematical concepts
- communicate mathematical thinking in many ways
- explain and justify mathematical ideas and decisions
- connect mathematical concepts to each other, and to other areas and personal interests
- analyze data in real life situations, to determine if the relationship, or pattern, is linear

Curricular Content:

- represent and describe relations in various ways (model, table of values, graph, words, symbols, equation)
- identifying linear relations
- solve problems using linear relations
- describe contexts for linear relations
- graph on a cartesian plane

Essential Questions

- How can we determine if a relation is linear?
- How does recognizing linear relationships in the real world, impact our ability to predict outcomes, and make informed decisions regarding social issues?

Core Competencies Focus:

Communication

Critical Thinking

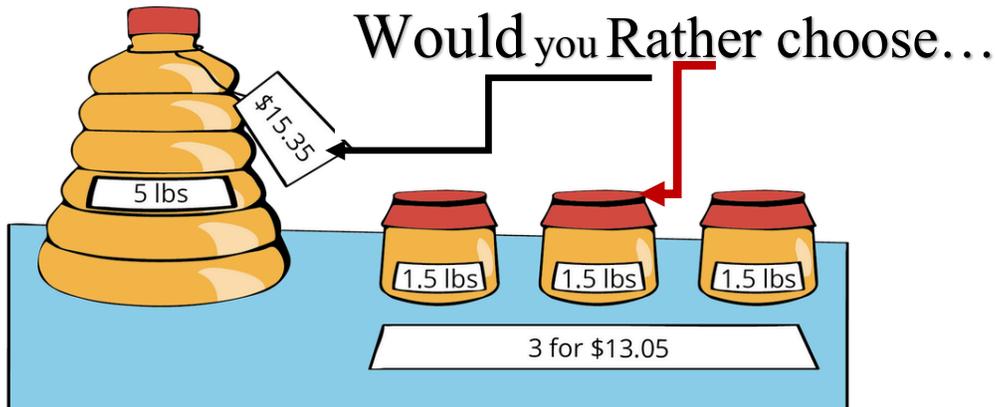
Personal and Social

Key Mathematical Terms:

- | | | |
|-------------------|------------------------|-------------------|
| • input | • plot | • growth |
| • output | • scale | • shrink |
| • ordered pair | • vertical axis | • relation |
| • origin | • horizontal axis | • linear relation |
| • cartesian plane | • independent variable | • constant |
| • quadrant | • dependent variable | • equation |
| • graph | • pattern | |

Consider your students (health, well-being, needs, accessibility to devices, learning personalizations, etc.) when selecting which options and parts of the learning plan you might want to implement.

Math Routine: The, “Would you Rather...,” questions are a good way to start an activity/class for practicing critical thinking because students have to evaluate two different, but seemingly appealing options, while mathematically justifying their selection.



Which would you rather have? Make your choice and justify your reasoning using mathematics. Try to come up with more than one way to support your choice.

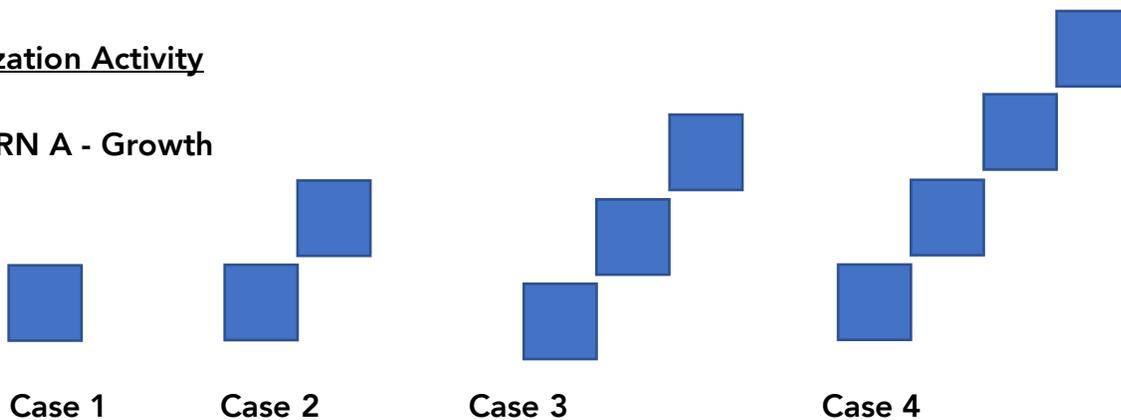
Source: <https://curriculum.illustrativemathematics.org/MS/students/1/6/16/index.html>

Part One: Considering How a Pattern Grows or Shrinks Across Cases

Source: Boaler, J., Munson, J., & Williams, C. (2019). *Mindset mathematics: visualizing and investigating big ideas, grade 7*. San Francisco: Jossey-Bass.

Visualization Activity

PATTERN A - Growth



Cases 1 to 4 represent part of a pattern that can continue either to the right, or to the left. How do you see the pattern growing? Where do you see new squares being added? Use colours, or symbols to mark the squares that have been added.

What does the pattern look like as it extends to the right (cases 4, 5, and beyond)?

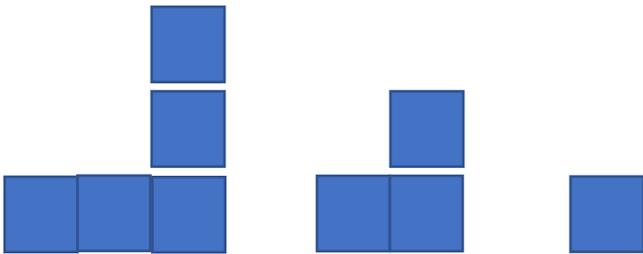
What does the pattern look like as it extends to the left? (cases 0,-1, and beyond)? What happens when the squares are gone? What does it mean?

How could we describe the number of squares in each case?

How could we describe the rule for the pattern's change? Explore different ways you might use words, numbers, symbols, tables, graphs, objects (*Lego*, paper, chips, etc.), or diagrams to describe the rule.

Make predictions. How many squares might it take to build case 100? 500? -100? How do you know?

PATTERN B – What Happens to a Pattern When It Shrinks?



How do you see the pattern shrinking? Where do you see squares being removed? Use colours, or symbols to mark the squares that have been added.

What does the pattern look like as it extends to the right (cases 4, 5, and beyond)? What happens when the squares are gone? What does it mean?

What does the pattern look like as it extends to the left? (cases 0,-1, and beyond)?

How could we describe the number of squares in each case?

How could we describe the rule for the pattern's change? Explore different ways you might use words, numbers, symbols, tables, graphs, objects, or diagrams to describe the rule.

Make predictions. How many squares might it take to build case 100? 500? -100? How do you know?

Discussion

If possible, find ways for students to connect and collaborate to share their thinking and deepen their learning. You might try using an online district-approved discussion platform, such as *Scholantis*, *Zoom* (follow guidelines for setting up your district account), or ask students to determine a method that best suits them. Place students in pairs, or have a class discussion. The *Breakout Rooms* feature, in *Zoom* allows you to divide the participants into discussion groups. Follow the tutorial below, for more direction for this option.

<https://support.zoom.us/hc/en-us/articles/206476313-Managing-breakout-rooms>

Discussion Prompts

- Student One - Share how you saw pattern A growing, where you saw new squares being added or disappearing, how you represented the pattern, what happened to the pattern as the cases decreased, what you think it means when the squares disappear, a rule for the change in pattern, and how you made predictions.
- Student Two – Listen and record: how your partner sees the pattern and how it might connect to your thinking (how you saw the pattern).
- Switch Roles for Pattern B.

Core Competencies Self-Reflection

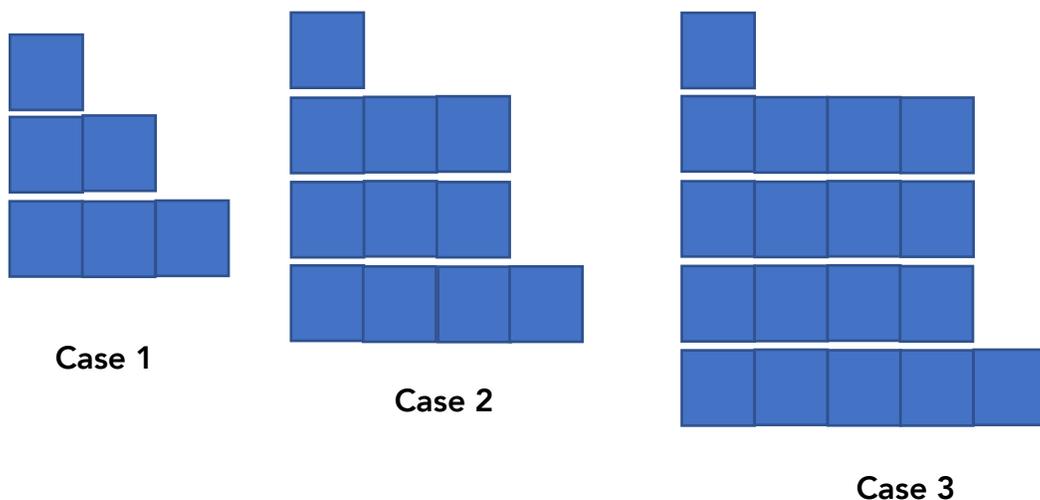
Core Competency Connections	Reflection Question	Respond in words and/or images with labels.
	What were my partner and I trying to do together?	
	How did I connect, listen, and contribute to our discussion?	
	I used to think...now I think...	
	How did you feel about using an electronic device to communicate with others, and to learn?	
	Rate the difficulty of this activity from 1 to 5. The value, 1, means that the task was very easy, and 5 means the task was very difficult. Explain your ranking.	
	Did you get frustrated at any point in the activity? Explain. Consider some challenges you faced.	
How did you work past the challenge(s)?		

Part Two – Identifying Linear Relationships

Option One: Students build visual understanding of the differences between non-linear and linear patterns

Source: Boaler, J., Munson, J., & Williams, C. (2019). *Mindset mathematics: visualizing and investigating big ideas, grade 7*. San Francisco: Jossey-Bass.

Pattern C



Cases 1 to 3 represent part of a pattern that can continue either to the right, or to the left. How do you see the pattern growing? Where do you see new squares being added? Use colours, or symbols to mark the squares that have been added.

What does the pattern look like as it extends to the right (cases 4, 5, and beyond)?

What does the pattern look like as it extends to the left? (cases 0, -1, and beyond)? What happens when the squares are gone? What does it mean?

How could we describe the number of squares in each case?

How could we describe the rule for the pattern's change? Explore different ways you might use words, numbers, symbols, tables, graphs, objects (*Lego*, paper, chips, etc.), or diagrams to describe the rule.

Comparing and Contrasting

- Refer to Pattern A and Pattern C. How are the two patterns similar? How are the two patterns different? Find as many different ways to describe the similarities and differences as you can. (Think about the number of squares in each case, and how the patterns grow.)
- Organize your thinking by using a model, table of values, or graph(s).
- What are characteristics of linear relations? What are characteristics of non-linear relations?
- If possible, share your thinking with a partner and add/refine the characteristics you used to define linear relations and non-linear relations.

Option Two:

<p>Collecting data and using a graph to interpret and analyze the relationship.</p> <p>Identify if the relationship is linear/ non-linear.</p> <p>Explore if the data represented should be discrete, or continuous.</p>	<p>Problem: You are planning to participate in a walkathon to help raise money for charity. The distance to be walked is 10 kilometers. You are wondering how long it might take them to walk this distance.</p> <p>Design an experiment to determine the walking rates of three people (person A, person B, and Person C). They can be people in your home, or your classmates. Your experiment must include: the collection of data and a graph that represents your participants' data. Use a legend to identify how the reader will be able to tell the difference between each person's data. Your graph must be able to be used to predict how long it might take for each person to walk 10 kilometers.</p> <p>Consider: walking rate is a measure of speed; the relationship between distance and time.</p> <p><u>Interpreting the Data</u></p> <p>Describe the procedures you used to determine the distance walked and time travelled. What is the independent variable on our graph? What is the dependent variable on your graph? Why?</p> <p>What is the relationship between the two variables? Does the pattern represent a linear, or non-linear relationship? How do you know?</p> <p>Is the data discrete, or continuous? Why?</p> <p>What quadrant of the cartesian plane is your data located in? Why?</p> <p>What is each person's walking rate? Show your thinking and justify your response.</p>
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	<p>Consider your data and graph, how long will it likely take each person to walk 10 kilometers, if he/she continues at the same walking rate? Show your thinking and justify your response. What might be another approach to determining a solution to this question? What assumptions are you making?</p> <p>What equation can you use to predict the time it would take for Person A to walk 10 km? Show your thinking with labels, where necessary.</p> <p>Where does the graph begin? What does that point (ordered pair) represent?</p> <p>Compare your results (walking rates, how long it will take for each person to walk 10 km, equations) with someone in your class. What is the same? What differs? Why might this be?</p>
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Part 2: Interdisciplinary Task

Linear Equations and Scale

Overview: Through this time of living in a global pandemic, we might have become consciously aware of our interconnectedness locally and globally.

Remote learning provides an opportunity for students to connect their learning to real-world experiences. Everyone around the world is experiencing the same thing during this time; we are all faced with a different way to live and to stay safe. It may be a time for students to reacquaint themselves with their current community through this initiative, while sharing their learning with a wider audience.

First Peoples Principles of Learning

- Learning ultimately supports the well-being of the self, the community, the land, the spirits, and the ancestors.
- Learning is reflexive, reflective, experiential and relational (focused on connectedness, on reciprocal relationships, and a sense of place).

Materials Required

Print Sources (attached)

City of Richmond

<https://www.richmond.ca/newsevents/city/richmondhasheart.htm>

<https://www.richmond.ca/safety/COVID-19/heart.htm>

Richmond News

<https://www.richmond-news.com/community/richmond-launches-spirit-campaign-during-covid-19-1.24118465>

Cartesian Plane Graph Paper

Areas of Learning

- Mathematics 8/9
- Arts Education 8/9
- Social Studies 8/9
- English Language Art 8/9

Big Ideas

Mathematics 8	Social Studies 8	Arts Education 8	English Language Arts 8
Relationships can be represented in many ways, revealed through research, and used to help us make sense of social issues.	Human and environmental factors share changes in population and living standards.	Individual and collective expression can be achieved through the arts.	Exploring texts helps us understand ourselves, and make connection to others and to the world.
Mathematics 9	Social Studies 9	Arts Education 9	English Language Arts 9
Continuous linear relationships can be represented in art.	Emerging ideas profoundly influence societies and events.	People connect to others and share ideas through the arts.	Exploring texts helps us understand ourselves, and make connection to others and to the world.

Essential Understanding

Exploring Artworks helps us understand ourselves, and provides a means for connecting to others (family, local, and global).

Learning Activity

Challenge yourself to design a piece of artwork for the City of Richmond's new initiative, titled, the 'Spirit Campaign,' that strives to: show support for front-line and essential workers, to connect communities through empathy and compassion, and to find joy in the create and share process.

Share your design with your local community, by enlarging your piece from a drawing on a paper, to a window, sidewalk, fence, etc. Hashtag your creation #RichmondHasHeart.

Your final piece should include the following:

- At least 12 lines inclusive of: horizontal, vertical, positive slope, and negative slope lines
 - Label the lines: a through l, on the cartesian plane graph paper
 - Determine the equation for each line (show your thinking), and record them on a separate piece of paper.
- Graph of a non-linear relation (s)
 - Identify the graph of the non-linear relations on your cartesian plane, by labelling them with numbers
- Linear relations should be represented in all four quadrants
- An inspirational message of hope, calm, comfort and care.
- Colour

You may decide to enlarge your design, so that it can be placed in a visible spot (window, sidewalk, fence, etc.). Your teacher may request that you show the calculations for the enlargement.

Examples of this socially-conscious art are in the photos below. You may choose to create something more unique, that meets the requirements of the task. Ensure you communicate your ideas with your teacher.



Discussion Questions

Read the articles provided and discuss how an initiative like this, might provide us with an opportunity to learn more about our neighbours (think about what you might notice and see in your local community).

Describe potential short-term and long-term consequences of engaging in a community project, like #RichmondHasHeart.

What might the relationship be between art and a sense of belonging, in this project?

Peer Assessment

Your teacher will provide options for you to be able to connect with someone else in your class. You will be shown that student's artwork (draft). Determine the equation of five lines. Show your thinking. Provide feedback about the design, clarity of the lines/non-linear relations, and message by using the assessment tool your teacher provides you. Comment on one of your partner's responses to the discussion questions. State if you agree/disagree, why, and share similarities and differences to your response to that same question.

Possible response prompts:

- I learned...
- I discovered...
- Now I know...
- It was interesting to discover that...
- I am confused about...
- I am wondering...
- I have changed my mind about...

Related Numeracy Task

Source: Peter Liljedahl's Numeracy Tasks

<http://www.peterliljedahl.com/teachers/numeracy-tasks>

TERRY FOX FUNDRAISER

Last month your principal announced the annual Terry Fox Run and promised to provide a pizza lunch to the most deserving class. There were two ways to raise money for this event:

- **Pledges** – This form of fundraising required students to go door to door and get written promises (called pledges) from neighbours to donate a certain amount of money per kilometre that the student will run (for example: \$1.00 per kilometre). After the run the student needed to go back to these neighbours to collect the money.
- **Parent Donations** – If students did not want to go to the trouble of seeking pledges they could simply have asked their parents for a donation. These donations had nothing to do with the Run in that they were not based on how far the students ran.

The Run was last week, the pledges and donations were collected, and the results were just announced AND for the first time in school history there is a tie ... AND not only is it a tie, but it is a three-way tie.

- Class A has 24 students and they collected \$290 in donations and \$20 in pledges.
- Class B has 28 students and they collected \$150 in donations and \$160 in pledges.
- Class C has 30 students and collected \$35 in donations and \$275 in pledges.

The principal can only afford to give pizza lunch to one class.

WHICH TEAM SHOULD GET THE PIZZA LUNCH AND WHY?

The principal is an ex-math teacher and is best convinced with mathematical arguments, so explain your decision by giving specific details about how you determined which class is most deserving.

[richmond.ca](https://www.richmond.ca)

City of Richmond BC - COVID-19

2 minutes

COVID-19 Pandemic



Now more than ever we know that Richmond has heart.

The City of Richmond has unveiled a campaign aimed at bringing the community, residents and businesses together to show their support for those working to fight the COVID-19 pandemic.

We're asking the residents of Richmond to share uplifting news, cheer on our front line and essential workers and show support for your community and gather the good news using the hashtag #RichmondHasHeart.

We'll be sharing stories, videos, artwork and photos on our social media channels in the coming days and weeks ahead.

Follow [funRichmond](#)

How you can show that #RichmondHasHeart

- Bang pots and pans, make some noise and cheer on front line and essential workers from the safety of your window, balcony or front step every night at 7pm
- Post a message or heart in your window as a sign of encouragement for your neighbours, front line workers and community
- Share a message of appreciation for frontline workers on your social media
- If you see something shareable in your neighbourhood, snap a photo and share
- DIY, we'd love to see your creative mind at work and how you show that #RichmondHasHeart

How you can share #RichmondHasHeart

- Use the hashtag #RichmondHasHeart
- Tag @funRichmond on Facebook, Instagram and Twitter

How you can get started

Here are some downloadable graphics to get you started! Print, colour and share!

 [#RichmondHasHeart Colouring Sheet](#)

 [#RichmondHasHeart Full Colour](#)

[richmond.ca](https://www.richmond.ca)

City of Richmond BC - News

2 minutes

City News

15 April 2020

The City of Richmond has unveiled a campaign aimed at bringing residents, businesses and stakeholders together to show their support for those working to fight the COVID-19 pandemic.

#RichmondHasHeart encourages the community to share their thoughts, ideas and images through social media posts, physical-distance appropriate appreciation activities and creative displays at home, at their business or in the community.

"One of the elements of being a safe and resilient community is people coming together during difficult and challenging times to support each other and focus on the positive outcomes," said Mayor Malcolm Brodie. "With the #RichmondHasHeart campaign, we want to support and promote the wide range of initiatives many people are already taking across the city that are connecting and engaging residents, as well as showing support for our front line, essential services and health care workers and first responders."

Elements of the campaign will include:

- A social media campaign using the hashtag #RichmondHasHeart for Richmond residents and others to share messages
- Decorating City Hall windows in the shape of a heart
- Lighting the prominent Together public art sculpture outside the Minoru Centre for Active Living in blue in keeping with the campaign colour theme
- A call to local artists to present ideas for community-engaged projects that explore new and meaningful ways for residents to find connection while maintaining physical distancing protocols.

Branded materials with the #RichmondHasHeart messaging will be available for download at [Richmond.ca](https://www.richmond.ca), along with ideas for people who would like to create short videos and other messages to be posted to social media sites.

[richmond-news.com](https://www.richmond-news.com)

Richmond launches 'spirit campaign' during COVID-19

Valerie Leung

2-3 minutes

Colourful artworks have taken over Richmond's sidewalks and windows in support of frontline workers during COVID-19 and the city is stepping up to help community members broadcast their creativity.

The City of Richmond announced a new campaign, #RichmondHasHeart, is being launched to encourage everyone to share their thoughts, ideas and images through social media posts in support of those working to fight the pandemic.

"One of the elements of being a safe and resilient community is people coming together during difficult and challenging times to support each other and focus on the positive outcomes," said Richmond Mayor Malcolm Brodie.

"With the #RichmondHasHeart campaign, we want to support and promote the wide range of initiatives many people are already taking across the city that are connecting and engaging residents, as well as showing support for our front line, essential services and health care workers and first responders."

During the campaign, the Together public art sculpture outside

the Minoru Centre for Active Living will be lit up in blue – the colour theme of the campaign – and the Richmond City Hall's windows will be decorated in the shape of a heart.

Community members are also encouraged to use the hashtag #RichmondHasHeart for their social media posts.

Branded materials with the campaign hashtag and ideas for video creators will also be available at [Richmond.ca](https://www.richmond.ca)



You Might Be Interested In