Math Toolkit and a Hexagon

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Task Overview

Description

This task can be used at the beginning of the course to have students identify:

- what math they have previously learned (both in school and outside of school)
- how they access that knowledge (how memory works)
- how they build upon that knowledge
- how they can relate the math they have learned to the grade 9 curriculum.

Students consider their past math experience, then explore where hexagons are used in culture, art and science. This is followed by identifying the math in hexagons. This activity can be extended throughout the course in subsequent spirals to bring in further concepts.

Big Idea

- Math is everywhere.
- There are many different ways to describe things mathematically.
- Everyone brings valuable knowledge, experiences and perspectives to the classroom.

Duration

2-3 lessons depending on delivery.

Recommended Materials: VNPS (white board), paper/graph paper, writing tools, chart paper, sticky notes, coloured stickers/markers, calculators, straight edge/rulers, protractors, compasses, scissors, Mira, technology/Chromebooks, pattern blocks, toothpicks & plasticine

Learning Goal(s)

- Students will think about the math they already know;
- Students will recognize that they have valuable tools and strategies that can be used to explore the world mathematically;
- Students will use tools and strategies to investigate mathematical concepts in a hexagon and describe them in different ways;
- Students will pose and solve mathematical problems.

Sample Success Criteria

- I can identify math problems in the world around me;
- I can select an appropriate math tool to solve problems;
- I can communicate my solution to math problems;
- I can recognize areas of math in which I feel confident.

Overall Expectations

AA1. Social-Emotional Learning Skills

develop and explore a variety of social-emotional learning skills in a context that supports and reflects this learning in connection with the expectations across all other strands

A1. Mathematical Processes

apply the mathematical processes to develop a conceptual understanding of, and procedural fluency with, the mathematics they are learning

A2. Making Connections

make connections between mathematics and various knowledge systems, their lived experiences, and various real-life applications of mathematics, including careers

B3. Number

apply an understanding of rational numbers, ratios, rates, percentages, and proportions, in various mathematical contexts, and to solve problems

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C1. Algebraic Expressions and Equations
demonstrate an understanding of the development and use of algebraic concepts and of their connection to numbers, using various tools and representations
E1. Geometric and Measurement Relationships
demonstrate an understanding of the development and use of geometric and measurement relationships, and apply these relationships to solve problems, including problems involving real-life situations

Social-Emotional Learning (SEL) Skills*

- **Identifying Resources and Supports That Aid Perseverance in Mathematical Learning**
  - Embracing mistakes as a necessary and helpful part of learning
  - Noticing strengths and positive aspects of experiences, appreciating the value of practice
  - Creating a list of supports and resources, including people, that can aid them in persevering
- **Developing a Healthy Mathematical Identity Through Building Self-Awareness**
  - Knowing oneself
  - Caring for oneself
  - Having a sense of mattering and of purpose
  - Identifying personal strengths
  - Having a sense of belonging and community
  - Communicating their thinking and feelings about mathematics

** This overall expectation is to be included in classroom instruction, but not in assessment, evaluation, or reporting. See **further information** about approaches to instruction that support all students as they work to apply mathematical thinking, make connections, and develop a healthy identity as mathematics learners to foster well-being and the ability to learn mathematics.*

Mathematical Processes
There are opportunities for students to engage in the **mathematical processes** throughout this task.
For example:
Problem Solving: critical thinking, math identity, knowledge, collaboration, lived reality, creative thinking, confidence.
Reasoning and Proving: justification, proportional reasoning, algebraic reasoning, spatial reasoning, numbers, operations, geometric properties, measurement.
Reflecting: identify what is working, what isn't working, appropriate strategy, reasonableness of their answer
Connecting: connect different mathematical concepts.
Communicating: share ideas, understandings and solutions, provide feedback, pose questions.
Representing: represent math relationships using pictures, diagrams, numbers and symbols.
Selecting Tools and Strategies: test, revise, confirm reasoning, remembering how they solved a problem.

Prior Learning and Placement of Task during Semester

Recommended to use this task early, ideally within the first week

This task could be done sequentially over 2-3 days, or alternately, the toolkit tasks could be done first and the hexagon task could be done a short time later.

Collect photo evidence of student work for opportunities to revisit and build on this task throughout the semester. Refer to the Extension Tasks for additional ideas.

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Diagnostic Task & Look fors

Look Fors:

- Students' readiness for the learning in this course
- See "possible look fors" for each part of the task.

The Task - Google Slides with Pear Deck

The Task	Teacher Notes and Suggestions	Possible Look Fors
See: Google Slides 1 What do you see? What do you wonder? What tools would be used to make this?  ***See: Google Slides 2*** Which tools do you recognize? Which are the 'must have' tools and why? 	Independently, students come up with their answers and then Stand & Talk to share their ideas with a partner. Use a random group generator to make pairs/groups or breakout rooms. Additional information student may wonder: *Where was it taken?* W.E. Gowling PS *What time of day?* 7:45 a.m. *What time of year?* Second week of July *Did it rain that day?* In the morning, but then cleared up *Was a filter used?* No, iPhone 11 *What is the brown roofed building in the background?* A church *Why aren't any kids playing on it?* See above for time of day and time of year *Do kids play on the structure?* Yes they do *How long has it been there?* At least 2011 *How many pictures were taken?* Around 10 from different angles **Teacher Considerations:** • Which students dive in vs hesitate? • Students unable to recall or become self-conscious of not knowing the 'correct' math terms can be encouraged to use visuals or descriptions.	☐ Use of vocabulary (ELLs vocabulary) ☐ Communicating ideas

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See:* [Google Slides](#) *3

Think about your experiences in regard to math in your life.

What math have you learned?

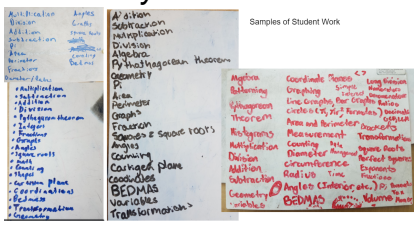
Think about your experiences with math in your life up until now.

What math have you learned?

What connections can you make between your list and the previous image?

What connections can you make between your list and the previous image?

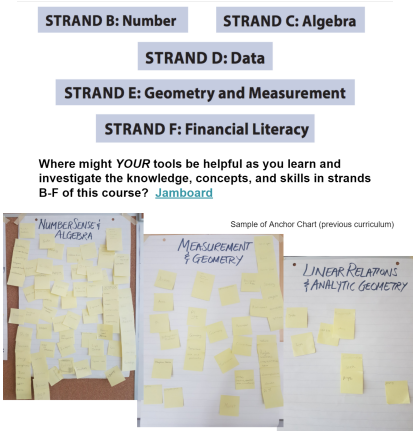
What is in your math toolkit?



Samples of Student Work

See:* [Google Slides](#) *4

Where might YOUR tools be helpful as you learn and investigate the knowledge, concepts, and skills in strands B-F of this course?



Think individually students think about all the math they've learned and create their list (on individual VNPS or paper);
Pair consolidate student lists on individual sticky notes;
Share place sticky notes on MTH1W strand anchor charts (or use [Jamboard](#)).

Teacher Considerations:

- Students may feel ashamed for copying others - discuss different experiences and backgrounds, memory recall and how ideas grow.
- Value formal learning in school and other ways of knowing/learning math.
- Value other forms of learning including technology.
- Only titles of strands are included without explaining the content of the strands.
- Strands A and AA were intentionally left out of this part. The rationale is that a similar task could be done later after some modeling and teaching of SEL/Process skills has been done and students have had some practice reflecting on their processes and strategies.
- Students questioning placements of sticky notes on anchor charts - discuss 'right' and 'wrong' answers.
- Each math tool or concept can be written multiple stickies and placed in multiple strands - elicit justification/examples.
- The chart paper with strands and sticky notes become anchor charts for the semester and more sticky notes can be added to the anchor charts as new tools and concepts are covered. Encourage students to refer to and update them regularly.

- ☐ Math Vocabulary
- ☐ Communicating math ideas
- ☐ Types of mathematical tools/concepts
- ☐ Placement of sticky notes with respect to strands (connecting tools/concepts to multiple strands)
- ☐ SEL: Knowing oneself
- ☐ SEL: Noticing Strengths

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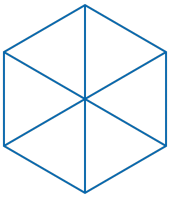
See: Google Slides 7 *What does your toolkit look like?*    	**Discuss** the different toolkits. Some are less organized, some are organized in a different way, some have support to ensure that tools go in the correct spot. **Question**: "What does your toolkit look like?" **Discuss**: • Organization of the toolkit: different strategies to organize - no one strategy is better than the other. The idea is that you know the tools are in the toolbox; they just need to be accessed. • Locating the correct tool: may be easily identified, some may need help finding it, some may need to borrow one, some may need a refresher on how to use the tool, some may need to be shown how to use the tool, some may need support to ensure tools go back in the correct spot. • Community: potentially bring in working as a group to solve a problem. We can work together and support each other in building the play structure. • Final Product: You can still achieve the final product as long as you have the tools in your toolkit, and sometimes you might not have the right tool, but can still make due with the ones you already have. However knowing where or who to go to if you don't have a tool or need help using or sharpening a tool, will be a focus of the class - the class is full of tool experts! **Teacher Considerations**: some students will be reluctant to share as they might not yet have the confidence.	☐ SEL: Knowing oneself ☐ SEL: Noticing Strengths ☐ SEL: Community ☐ SEL: Communicating mathematically ☐ SEL: Accessing supports/resources
See: Google Slides 8  Introduce Hexagon - Do you recognize this image? - What do you know about it?	**Discussion**: Allow students to share their connection (non-curricular) to the hexagon before moving to slide 9 to 11.	

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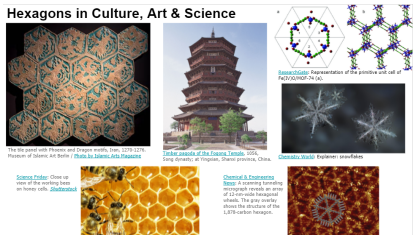
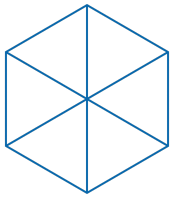
See: Google Slides 9 & 10  	**Teacher Considerations**: Students might have some personal, cultural and religious connections/sensitivities related to the hexagon. Watch a 6:15 minute video "Why Nature Loves Hexagons" courtesy of PBS.	
See: Google Slides 11 What math can you show using this hexagon? 	Sample student responses: ● Area of the hexagon; Area of each part ● Perimeter of the hexagon ● Triangle or hexagon as a part of the whole (expressed as a fraction or percent) ● Types of triangles ● Regular polygons ● Number of triangles ● Angles, vertices, side lengths ● Intersecting and Parallel lines ● Congruency ● 3D cube volume and surface area ● Pieces of a 3D equilateral bipyramid net ● Rotational Symmetry ● Reflective Symmetry ● Paper folding ● Decompose the hexagon into other shapes	☐ Math Vocabulary ☐ Posing problems ☐ Communicating math ideas ☐ Types of mathematical tools/concepts ☐ Connecting to prior learning
	In class or as homework: Students pick one "concept" and show the math. Depending on timing this can be done in class (individual or in groups) on VNPS/jamboard (virtual) or at home completed on paper/jamboard (virtual). If possible, try to have the students working on similar concepts sorted and displayed close together. **Discussion**: ● What tools do you need to solve your problem?	☐ Problem Solving ☐ Reasoning and Proving ☐ Reflecting ☐ Connecting ☐ Communicating ☐ Representing ☐ Selecting Tools and Strategies ☐ SEL: Embracing mistakes ☐ SEL: Knowing oneself ☐ SEL: Identifying strengths

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	Teacher Considerations: ● 'Tools' don't just have to be actual physical resources such as rulers, protractors, etc, but also math knowledge/concepts.	☐ SEL: Accessing supports and resources ☐ SEL: Sense of community
	Gallery walk: Students' Math of the hexagon are grouped and displayed by concept. Students then use coloured dots or sticky notes to identify: - Is the student's work familiar to you? (red dot). - Does it look like something you did or would have done? (blue dot). **Discussion:** ● Look at student work with a lot of red dots… why is this strategy familiar to you? Where have you seen it before? ● Look at the blue dots. Some of you would have used this approach and some of you might use another approach. What other ways could we solve the problem? There are multiple strategies to solve the same problem. What makes them different? Why would you pick one strategy over another? (ie. tools; what we are comfortable using and/or considering efficiency). **Teacher Considerations**: ● Correctness of solutions is not considered, however photos of student work can be taken to support future discussions and connections.	
See: Google Slides 12 Which hammer is in your toolkit?  	**Discussion:** Variety of solutions to the same problem. Analogy of hammers (from their toolkit): There are many different types of hammers and they all can generally do the same thing. Is it important to have all these hammers in your toolkit? Which ones would you be comfortable and confident using? What determines your comfortableness or confidence?	☐ SEL: Embracing mistakes ☐ SEL: Knowing oneself ☐ SEL: Identifying strengths ☐ SEL: Accessing supports and resources ☐ SEL: Sense of community

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	Idea: You may begin using a small one until you build skill and confidence using a larger one. It isn't about brute force it is about skill level, you need more skill and confidence to move on to using a 'bigger' hammer. Could also use a hand saw/electric saw as an analogy.	

Assessment

Individual Reflection
Here are some example reflective questions you may want your students to complete individually. Depending on your SEL/Process focus, you may want to add or change these questions.

- What tools and strategies did you use? How did they help you? What tools needed sharpening? What tools were missing?
- How did you decide which math concept to show? Why didn't you choose another one?
- Did you change tasks? If so, why?
- What other tools or strategies did you use? Include tools or strategies that aren't specifically math. For example: if you weren't sure what to do? if your plan didn't go as you expected?

A Google Form is available that you can copy and modify for your needs.

This task can be used to introduce the **Student Portfolio of Process Expectations** (Google Slides).

Additional Resources

EQAO Formula Sheet (not updated for MTH1W)
Online Geometry Manipulatives Mathigon Polypad

Extension Tasks

Angle Geometry (Regular Polygons - now in grade 8 curriculum)**:**
Skip counting on a 360 circular number line (regular polygons)
Desmos Reviewing Angle Geometry and *(Notes from OCV 2020-21)*
Desmos Polygon Angle Geometry and *(Notes from OCV 2020-21)*

Measurement (Nets & Pyramids)**:**
Sum of Squares Desmos Activity
2D & 3D Shapes Notes *(from OCV 2020-21)*
Volume Google Slides with PearDeck *(Notes from OCV 2020-21)*

Analytic Geometry:
Lines on a Grid ('Friendly' Lattice Points, Parallel Lines & Transformations - Similar vs Congruent)
Linear Art with Desmos Task *(from OCDSB Summer 2021)*

Coding:

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Angles in Polygons Task *(from OCDSB Summer 2021)*
Code.org Express Course (2021) Sequencing 4. Creating Art with Code
HPEDSB Coding Challenge and Scratch - Drawing Polygons (Shapes)

Culturally Responsive Math
***NOTE*: A community partner needs to be invited to explore the cultural connection.**
Dream catcher designs can be based on the hexagon because the number of sides is decided by the person who is creating it. Contact the Indigenous education team to find out more.

Isamlic Geometry's connection to the hexagon and transformations/tessellations can be explored as an extension through students' cultural knowledge and involving a community partner. Explore Islamic Geometry courtesy of Artful Maths www.artfulmaths.com to appreciate the beauty and evident mathematical thinking that goes into creating art.

Origami is the art of paperfolding and connections can be to the hexagon. Explore students' cultural knowledge and involving a community partner, as well as MyModernMet.com and Origami Hexagon Tutorial to extend students' learning.

Culturally Responsive Math Webinar Series (scroll down to find the links to the 9 sessions)
"Nelson's Culturally Responsive Math webinar series brings together many educational and community leaders in Indigenous Education and provides you with the opportunity to discover Western mathematics in the heart of Indigenous culture. Webinars are hosted by Dr. Ruth Beatty, Associate Professor, Faculty of Education at Lakehead University and Danielle Blair. These webinars help participants understand that "ensuring math instruction is culturally responsive requires communication, cultural and mathematical content, and learning from Indigenous pedagogy. All of this is founded upon the building of strong relationships." (Dr. Ruth Beatty)"

Getting to Know Turtle Island

For Fun:
Cross Curricular activity with art Vi Hart's How To Make a Hexaflexagon: The Definitive Guide and Hexaflexagon Safety Guide, or hexagon Flower Pop-Up Card (History and Cultural connection to Paper Engineering: Fold, Pull, Pop & Turn)