Cooking with Math

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Task Description
This is an open task with connections to proportional reasoning, measurement and geometry as well as financial literacy. Students will determine the number of muffins or cupcakes that can be made based on an image at an industrial bakery.

They can then continue with this theme to think about costs and revenues for the baker by connecting to linear relations and the intersection of these two relationships.

Students will reflect on Mathematical Process skills that they used to complete this task.

Big Ideas
- Recipes can be scaled using proportional reasoning to accommodate different numbers of people
- The volume of everyday objects can be approximated using formulas for simple shapes and assumptions made
- Businesses need to make financial decisions based on the best information they can gather
- The Mathematical Processes can be used to inform our decision making and problem solving

Duration
2 days (can be split over multiple days)

Recommended Materials
- Diagnostic task recipe either printed or ready to project at the front
- Photo of baker printed or ready to project at the front
- Muffins or cupcakes* (one per group for measuring and one per person for eating when the task is complete)
- Ruler and possibly metre stick
- Vertical whiteboard and dry-erase marker
- Calculators
- Sticky notes
- Device for desmos and/or conversion calculations if needed (Googling is encouraged)
- Math Process labels (preferably pre-cut in envelopes or printed on post-it notes)
    - This jamboard can be used as an electronic alternative

***Caution - in case of allergies or Covid protocols, only an image should be used (not actual food)**
Image options:
Length of a muffin tin
Inside diameter of muffin tin circle
Height of a muffin tin (outer view)
Height of a muffin tin (inner view)
Baking Pan Measurement Guide
Muffin Liner Measurements explained

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Learning Goal(s)

- Students will solve problems involving proportional reasoning
- Students will apply geometric relationships to solve problems
- Students will make financial decisions based on data
- Students will identify which process expectations they used to complete a task

Sample Success Criteria

- I can use proportional reasoning to solve a problem
- I can determine the volume of a 3D shape (ie. cylinder)
- I can identify the relevant measurements and take these measurements in order to solve a problem
- I can connect the mathematical process skills to the math I am doing
- I can explain how using the mathematics process skills can help me solve a problem

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 Sense and operations

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

C3. Application of Relations

represent and compare linear and non-linear relations that model real-life situations, and use these representations to make predictions

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

F1. Financial Decisions

demonstrate the knowledge and skills needed to make informed financial decisions

Social-Emotional Learning (SEL) Skills*

- Recognizing and Identifying Emotions That Support Mathematical Learning
- Recognizing Sources of Stress That Present Challenges to Mathematical Learning
- Identifying Resources and Supports That Aid Perseverance in Mathematical Learning
- Building Healthy Relationships and Communicating Effectively in Mathematics
- Developing a Healthy Mathematical Identity Through Building Self-Awareness
- Developing Critical and Creative Mathematical Thinking

** 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.*

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Mathematical Processes
This task gives an opportunity to focus on the **mathematical processes**.

- **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, use of technology for determining unknown information

Prior Learning and Placement of Task during Semester

Prior learning: Use of volume formulae, proportional reasoning comparisons, and patterning or comparing linear relations.

Placement: This task could be done early in the course or later on, depending on where you wish to go with linear relations. It can be used as a follow up to the Toolbox and Hexagon Task suggested as the first destreaming task developed by OCDSB. The Process skills and consolidation activity can be pulled out and used with other tasks throughout the course to support overall expectation A1, as well as be included in the Portfolio of Process Expectations (Google Slides).

Diagnostic Task & Look fors

Diagnostic Tasks

1. *Ask the students*: What do they or their families commonly cook at home using a recipe? Either ask students to bring in a recipe or google what they share to find something. Example: Pancakes Recipe (ideally go with something that has fractions and mixed numbers and be responsive to your class's cultural background when choosing the recipe to use). Ask students how to alter the recipe to feed 10 people (this may require doubling or tripling depending on the assumption they make for how much each person will eat).

2. *Ask the students*: What does volume mean to you?
    - How would you determine the volume of different shapes?
    - What if it's not a standard shape and you can't use a formula?

Look Fors

- Uses proportional reasoning (multiplicative thinking) to scale the ingredients in the recipe up
- Correctly scales up a fraction
- Use of vocabulary such as ratio, proportionate, scale factor, multiply, numerator and denominator
- Comfort with mixed numbers vs. improper fractions
- Able to identify when an assumption is needed to solve a problem
- Conceptual understanding of *area of the base* x *height* for volume
- Knowledge of volume formulae
- Displacement as a measure of volume

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Teacher note: The two parts of the diagnostic task don't necessarily link together and can be done separately. They are designed to set up for the main task to help you figure out where your students are at. Either do the diagnostic a few days before the task, or do the hook outlined below and then the diagnostic if you plan to do both on the same day. The reason for this is to avoid leading them directly to the context of baking and volume right away.

Task

The suggestion is to do this task using groups of 3 and VNPS (whiteboards) or jamboards.

Hook: What do you notice? What do you wonder?
Hand each group the photo or project at the front and ask "what do you notice, what do you wonder?" or "what do you think might be happening in this photo?".

A handout version is found at this link.

A Jamboard version is found at this link.

Students can discuss in their groups first and then as a whole class or straight to class discussion at the teachers discretion.


http://members.virtualtourist.com/m/p/m/1736fb/#2

If further anchoring is needed you can show this video. Start around 35 seconds in and leave playing for about a minute. It further shows the process of mixing batter on a larger scale.

Part 1: How many can the vat of batter make?

- The person in the photo is a baker working in a commercial bakery
- The vat is a large mixer containing batter
- Figure out how many cupcakes or muffins the baker can make out of that vat of batter.

Each group needs a copy of the photo and a cupcake or muffin (or liner) to measure.
***Caution - in case of allergies or Covid protocols, only an image should be used (not actual food)**
Images are provided in the material section above.

Link here for examples of past work if you want to see the variety of what to expect.

After around 30 minutes get the groups to finish up their work and prepare for the gallery walk in order to give and receive peer feedback. All students rotate around the stations to leave post-it notes with "I like…", "I noticed…", "I wonder..." comments. Consider spending 5 minutes brainstorming what "helpful feedback" looks like vs. "less helpful feedback" if this is the first gallery walk for the class.
(Alternative approach: One member of the group stays with their work to present their ideas; the other two visit other workspaces. Consider setting up a route and having them change location every 30-60 seconds. Also, the person explaining can be switched every 2 or 3 stations visited.)

Students return to their own workspaces and have 5 minutes to, in a different colour, make changes based on the ideas they saw. Stress that there is no one right answer so they shouldn't change their calculations.

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Teachers have the option of having students record their work and the attached template could be used. This may be necessary if branching into multiple lessons and the whiteboards are needed for other classes. A few alternatives of possible write-up templates are provided.

Process Expectations Consolidation for Part 1 (could alternatively be used after Part 2)
This consolidation will allow students to link to and get an understanding of the Process Expectations

Provide each group an envelope of Process skills labels (or the jamboard alternative) and have them read over them and make sure they understand what each phrase means. They can sort them into three piles: things they did in the task, things they could have done, and things they couldn't use/do this time.

Either by taping the labels to their work or writing their boards in a different colour, have them identify where they think they used each label during the task. Point out that some labels may be used more than once or be more general in use, so to find an appropriate spot on the board for them.

Next give the students 5 minutes to take a walk around the other boards and have a look at what steps everyone else used. When they get back to their own groups they can discuss commonalities amongst the group processes.

Suggestions for consolidation/class discussion:

1. Have students group the Process skills labels together in as many groups as they wish and decide on a title for each group. Discuss what they come up with and link their ideas to the Process Expectations.
2. Teacher leads a discussion where they are given the names of the 7 process expectations and together the class puts each label under the expectation they think the label best matches (this can be done in the portfolio which accompanies the tasks).
3. Ask students if they want to add any Process skills (were there any skills missing?)

Optional extra for cross-curricular connections: Teachers could also use the scientific inquiry model to link to the process expectations and discuss the steps of identifying: Known information, Assumptions, Purpose, Method, Sources of Error and Conclusion.

Part 2: Determining a Baking Profit
Ask the students: How many cupcakes (or muffins) does the baker need to sell in a day to make a profit?

1. Turn & talk to generate ideas
2. Class Discussion
   Questions the teacher can ask during the discussion:
   - What information do you need to know?
   - How might you convince someone you are correct?
3. Group work on whiteboards or jamboard

Prompting questions to further support thinking

- How much should the baker charge for each cupcake or muffin?
- How many can the bakery make in a day?
- Can we estimate based on the cost of a box of cupcake or muffin mix at the grocery store?
- Cost of a cupcake or muffin at Loblaws vs. fancy bakery in your community?
- What are the costs associated with running a bakery?

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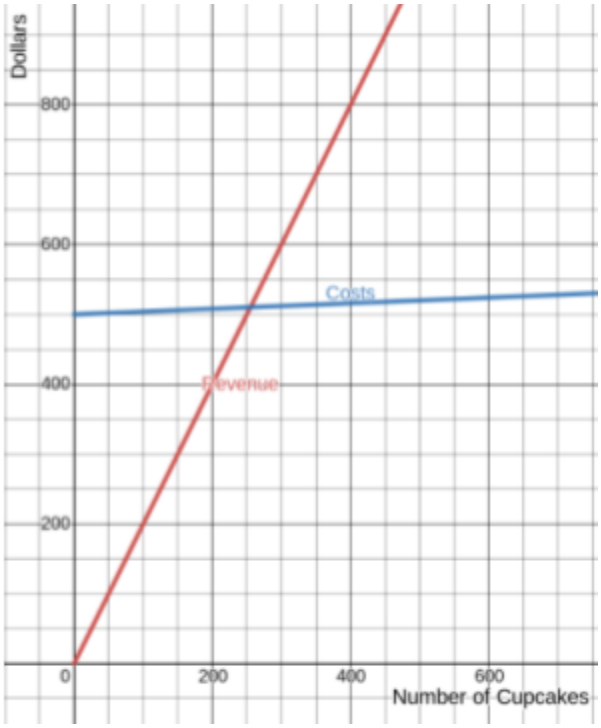
The intention is that students research the appropriate costs and selling prices and use that information to solve this part of the task.

There are multiple ways students could complete this task. The following possible solutions assumes a small local bakery where each cupcake or muffin will sell for $2 and costs about 4 cents for the consumable ingredients to create (based on a cake or muffin mix from a grocery store costing $1 that makes 24 cupcakes or muffins) as well as a daily operating cost of $500.

Number of cupcakes	Cost to make ($)	Revenue ($)
0	500	0
50	502	100
100	504	200
150	506	300
200	508	400



Although students may reason it out logically through patterning and perhaps lay out their solution in a table, they could be encouraged to make connections to linear relations and display the information graphically using Desmos. In this case, the graph was obtained by entering the equations $R=2n$ where R is revenue in dollars and n is number of cupcakes sold and $C=0.04n+500$ where C is costs in dollars and n is number of cupcakes made.

Process Expectations Consolidation, if not completed in Part 1, could be used at the end of Part 2.

Assessment

Observations during the lesson focusing on the process expectations and success criteria

- I can connect the mathematical process skills to the math I am doing
- I can explain how using the mathematics process skills can help me solve a problem

A1. Mathematical Processes

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

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Exit Card Questions

Which 3 Process skills do you feel you are good at? How do you know?
Which 3 Process skills do you feel you need to work on the most? How do you know?
What steps will you take next time in order to apply these skills to complete the task?

This task can be included in the **Student Portfolio of Process Expectations** (Google Slides)

Additional Resources

***Caution - in case of allergies or Covid protocols, only an image should be used (not actual food)**

Image options:

Length of a muffin tin
Inside diameter of muffin tin circle
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Diagnostic - Example Recipe

allrecipes

Good Old Fashioned Pancakes

★★★★★

This is a great recipe that I found in my Grandma's recipe book. Judging from the weathered look of this recipe card, this was a family favorite.

By dakota kelly

Prep: 5 mins
Cook: 15 mins
Total: 20 mins
Servings: 8
Yield: 8 servings

Ingredients

1 ½ cups all-purpose flour

3 ½ teaspoons baking powder

1 teaspoon salt

1 tablespoon white sugar

1 ¼ cups milk

1 egg

3 tablespoons butter, melted

Directions

Step 1
In a large bowl, sift together the flour, baking powder, salt and sugar. Make a well in the center and pour in the milk, egg and melted butter; mix until smooth.

Step 2
Heat a lightly oiled griddle or frying pan over medium-high heat. Pour or scoop the batter onto the griddle, using approximately 1/4 cup for each pancake. Brown on both sides and serve hot.

Nutrition Facts

Per Serving: 158 calories; protein 4.5g; carbohydrates 21.7g; fat 5.9g; cholesterol 37.7mg; sodium 503.6mg.

Recipe source: https://www.allrecipes.com/recipe/21014/good-old-fashioned-pancakes/

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What is happening in this photo?

http://members.virtualtourist.com/m/p/m/1736fb/#2

What do you notice?

What do you wonder?

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Process Skills Labels

I made estimations	I recognized relationships
I offered an opinion with a reason	I made a judgement
I thought creatively	I collaborated on ideas
I shared ideas	I listened
I gave meaningful descriptive feedback to group members	I chose a strategy to solve a problem with justification
I thought about what worked and didn't work	I thought about if my method worked to solve the problem
I thought about my partner's way of thinking	I thought about something I learned before
I used a skill I knew already	I highlighted key terms
I asked key questions to clarify the situation	I used what I already know and understand
I reflected on whether the answer made sense	I identified the question to be answered
I reworded the problem	I stated assumptions
I justified the assumptions made	I collected information
I made a hypothesis	I listed knowns & unknowns
I used different ways (pictures, diagrams, graphs, tables, numbers, words, and symbols) to show thinking	I selected appropriate learning tools (pieces of knowledge, method, formula, equipment,...)
I selected formulas and did calculations	I justified my thinking / I explained my reasoning
I wrote clear & concise explanations	I had a clear layout
I used appropriate mathematical structure (layout)	I used math terms instead of everyday language
I connected the math to the real-world concept	I connected the steps of the problem together
	I connected different math topics (Strands) together