Criteria Categories and Criteria for Math K-9

Criteria category	Grades K-1	Grades 2-3	Grades 4-5	Grades 6-7	Grade 8-9
Questioning and Investigating	• Ask questions that demonstrate curiosity and wonder • Pose new questions and problems	• Ask questions that demonstrate curiosity and wonder • Pose new questions and problems	• Ask questions that demonstrate curiosity and wonder • Pose new questions and problems	• Ask questions that demonstrate curiosity and wonder • Pose new questions and problems	• Ask questions that demonstrate curiosity and wonder • Pose new questions and problems
Connecting and Reflecting	• Make connections between First Peoples worldviews and mathematical concepts • Connect mathematical concepts: o with other mathematical concepts o with other areas of learning o with personal interests • Reflect on mathematical thinking of self and others	• Make connections between First Peoples worldviews and mathematical concepts • Connect mathematical concepts: o with other mathematical concepts o with other areas of learning o with personal interests • Reflect on mathematical thinking of self and others	• Make connections between First Peoples worldviews and mathematical concepts • Connect mathematical concepts: o with other mathematical concepts o with other areas of learning o with personal interests • Reflect on mathematical thinking of self and others	• Make connections between First Peoples worldviews and mathematical concepts • Connect mathematical concepts: o with other mathematical concepts o with other areas of learning o with personal interests • Reflect on mathematical thinking of self and others • Use mathematical arguments to support decisions	• Make connections between First Peoples worldviews and mathematical concepts • Connect mathematical concepts: o with other mathematical concepts o with other areas of learning o with personal interests • Reflect on mathematical thinking of self and others • Use mathematical arguments to support decisions

Criteria category	Grades K-1	Grades 2-3	Grades 4-5	Grades 6-7	Grade 8-9
Reasoning and Analyzing	• Use reasoning to explore and make connections • Demonstrate flexible thinking about number • Discover and compare patterns and relationships • Measure and compare spatial relationships • Estimate using something familiar • Use mental math strategies to make sense of quantities	• Use reasoning to explore and make connections • Demonstrate fluent and flexible thinking about number • Discover and compare patterns and relationships • Measure and compare spatial relationships • Estimate using something familiar or referents • Use mental math strategies to make sense of quantities	• Use reasoning to explore and make connections • Demonstrate fluent and flexible thinking about number • Discover and compare patterns and relationships • Measure and compare spatial relationships • Estimate using referents • Use mental math strategies to make sense of quantities	• Use logical reasoning to make decisions and reasonable estimates • Demonstrate fluent and flexible thinking about number • Identify and use patterns and relationships • Describe, measure, and compare spatial relationships • Estimate using referents, approximation, and rounding strategies • Apply mental math strategies	• Use logical reasoning to make decisions and reasonable estimates • Demonstrate fluent and flexible thinking about number • Identify and use patterns and relationships • Describe, measure, and compare spatial relationships • Estimate using referents, approximation, and rounding strategies • Apply mental math strategies
Understanding and Solving	• Select and use tools and technology to play with, explore, and apply mathematical ideas • Use multiple strategies to engage in problem solving • See math as pictures and offer different visual representations	• Select and use tools and technology to play with, explore, and apply mathematical ideas • Use multiple strategies to engage in problem solving • Create visual representations of mathematical ideas • Model mathematics in real-life contexts	• Select and use tools and technology to play with, explore, and apply mathematical ideas • Use multiple strategies to engage in problem solving • Create visual representations of mathematical ideas • Model mathematics in real-life contexts	• Use tools or technology to play with, explore, and analyze mathematical ideas • Apply multiple strategies to solve problems in both abstract and real-life contexts • Offer different visual solutions • Model mathematics in real-life contexts	• Use tools or technology to play with, explore, and analyze mathematical ideas • Apply multiple strategies to solve problems in both abstract and real-life contexts • Offer different visual solutions • Model mathematics in real-life contexts

Criteria category	Grades K-1	Grades 2-3	Grades 4-5	Grades 6-7	Grade 8-9
Communicating and Representing	• Communicate thinking using mathematical vocabulary • Share the mathematical thinking of self and others • Represent mathematical ideas in concrete, pictorial, and symbolic forms	• Communicate thinking using mathematical vocabulary • Explain and justify mathematical ideas and decisions of self and others • Represent mathematical ideas in concrete, pictorial, and symbolic forms	• Communicate thinking using mathematical vocabulary • Explain and justify mathematical ideas and decisions of self and others • Represent mathematical ideas in concrete, pictorial, and symbolic forms	• Communicate thinking using mathematical vocabulary • Explain and justify mathematical ideas and decisions of self and others • Represent mathematical ideas in concrete, pictorial, and symbolic forms	• Communicate thinking using mathematical vocabulary • Explain and justify mathematical ideas and decisions of self and others • Represent mathematical ideas in concrete, pictorial, and symbolic forms

Sample Application for Grade 1 Mathematics

Observation and Conversation

Criteria category	Criteria

Connecting and Reflecting	• Connect mathematical concepts:
	  ○ with other mathematical concepts
	  ○ with other areas of learning
	  ○ with personal interests

Communicating and Representing	• Communicate thinking using mathematical vocabulary • Share the mathematical thinking of self and others • Represent mathematical ideas in concrete and pictorial forms

Learning activities in Mathematics		
Lego	**Sidewalk chalk outdoors**	**Unifix Cubes**
During whole-class discussions and individual conversations: • Ask students: "How can you use Lego to do Math?" • Clarify: "What do I mean by Math?" • Student responses include: "Numbers," "counting," "showing how many," etc. Note: When using something we typically use for a different purpose, students need to clearly understand that they're being asked to represent Mathematics in some way. What I expected: Students comparing the sizes of Lego blocks (maybe making patterns or sticking the blocks together to make varying quantities…) What I observed: Students using Lego blocks to represent numerals, forming shapes, stacking quantities, grouping/sorting like blocks	During whole-class discussions and individual conversations: • Ask students: "How can you use sidewalk chalk to show Math?" • Clarify: "What do I mean by Math?" • Student responses include: "Numbers," "counting," "but no drawing," etc. • Model drawing 5 smiley faces and writing the numeral 5 • Ask students: "If you're doing a drawing to show how many, is that Math?" • Student response: "Yes" Observations: • students making collections (e.g., collecting three things and drawing the number) • a student collecting items and then trying to add them up (e.g., 2+3) • students trying to write big numbers (e.g., 15, 23) • students trying to create and communicate number stories	During whole-class discussions and individual conversations: • Ask students: "Can you make a pattern using just one colour of Unifix Cubes?" • First student response: "No" Observations: • one child showed an up-down, up-down pattern (a pattern of height: e.g., one-two, one-two) • another child showed a standing cube/lying-down cube, standing cube/lying-down cube pattern… • another child rotated the cube showing a square-rhombus-square-rhombus pattern

"Listening to students' discussions as they work together on tasks can provide you with insight into their thought processes and working relationships that might not be evident in their finished work."

(Cathy Marks Krpan, 2018, *Teaching Math with Meaning*, p. 26)

Observe and converse with a purpose to:

- Consider misconceptions and strengths in mathematical thinking. *What kind of vocabulary are children using to describe the mathematical ideas? Do their models make sense? Are they able to try out different solutions? Do they plan strategies or randomly try out solutions?*
- Note how students relate different math ideas to each other. *What ideas are they connecting? Not connecting? What additional supports might be possible to extend and develop learning?*
- Formulate questions that can target specific mathematical concepts during the learning process.
- Carefully observe student interactions. *How are mistakes viewed? Are students allowing and respecting all voices? Does one voice seem to dominate? Are students building on other's ideas or sharing without regard to other's thoughts?*

Questions that you might ask during intentional observation and conversation in a Grade 1 Math learning environment:

- When encouraging students to be metacognitive about their learning:
  - *Please describe your math picture.*
  - *You've shown your thinking one way. How can you show your thinking another way using tools or pictures?*
  - *What questions did you ask yourself or others as you worked on this problem? What questions do you have now?*
  - *When you used pictures and math tools to show your thinking were you able to capture all your ideas? Do you have other ideas to share?*
  - ***I noticed ____ and connected it to ____ because ____.***
- When fostering opportunities for students to learn from one another:
  - *Will you now pair up with Myra to notice and share ideas about your solutions?*
  - *Can you explain Myra's thinking in your own words? Will you describe her picture and mathematical thinking?*
  - *How are your ideas connected (same)? How are they different?*
- When developing connections with other mathematical concepts, other areas of learning, and personal interests:
  - *Why did you include ____ in your solution?*
  - *Have you done another investigation or task, which helped your thinking?*
  - ***We knew ____ so we connected ____ to ____.***

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Sample Application for Grade 5 Mathematics

Three-Act Task – Student Reflection

During a three-act task, students are engaged in an investigation and working with peers during the learning experience. After the task, students reflect on their learning by answering the questions below, recording their thinking on a non-permanent surface in a random trio of peers. Student reflections provide information and evidence of student thinking for teachers to gather, interpret, and act on.

Note: Students are familiar with open-ended reflections: *What went well in the investigation? What was difficult? What would you do differently next time?*

Criteria category	Criteria	Students reflect on both their participation in the class discussion and the work of solving the mathematics investigation
Questioning and Investigating	• Ask questions that demonstrate curiosity and wonder • Pose new questions and problems	**J:** In Act One I shared my thoughts about what I noticed from the video clip and what I was wondering mathematically. **B:** I made a suggestion to help us go from estimating to solving our investigation. **L:** I came up with the number line as a visual model for our thinking and helped others when they were trying to draw their thinking.
Connecting and Reflecting	• Reflect on mathematical thinking of self and others	**All:** We posted our think board for everyone to see and we looked at other people's and that helped us think of solutions.
Reasoning and Analyzing	• Measure and compare spatial relationships • Estimate using referents	**All:** We had to solve using grams. The referent was the large bottle filled with 397 g and the small bottles were each 64 g. **J:** I estimated that the large bottle would fill 10 small jars.
Understanding and Solving	• Use mental math strategies to make sense of quantities • Create visual representations of mathematical ideas Model mathematics in real-life contexts	**L:** My math strategy was first to figure out that 64 g x 10 = 640 g. I knew my first estimate was too big. **All:** We modelled our thinking with an open number line and we skip-counted: 64, 128, 192, 256, 320, 384 plus one more partly filled jar. **B:** We showed our thinking with drawings of the 10 small ketchup bottles with between 6 and 7 jars filled.
Communicating and Representing	• Explain and justify mathematical ideas and decisions • Represent mathematical ideas in concrete, pictorial, and symbolic forms	**L:** I chose the number line representation so that we could show jumps of 2 as the bottles capacity doubled (64 + 64 = 128, 128 + 128 = 356). Then I knew we were close to the whole bottle amount. **J:** I was the one that drew the bottles and wrote down large and small bottle so it was clear.

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Sample Application for Grade 6 Mathematics

Peer interview

Grade 6 students have collated evidence of their learning in Math into portfolios and will share these with their parents in three-way interviews. Two students interview one another, discussing how their portfolios demonstrate their learning in mathematics, in preparation for parent-teacher-student interviews later in the week. Prior to the peer interviews, the teacher and students reviewed the criteria categories, brainstormed, and co-created interview questions.

Criteria category: Questioning and Investigating
Criteria • Ask questions that demonstrate curiosity and wonder • Pose new questions and problems

Interviewer: What have you been most excited about learning in Math this year and why? What do you wonder about or want to learn more about?

Interviewee: I really liked it when we learned about areas for triangles and other different shapes because I learned about how finding an area of a triangle was like half of a rectangle. Here on this page you can see where I was trying to work out the area for trapezoids and that was really hard at first because you have to think of it as a rectangle and two triangles. But once I understood that, I thought about how if you know the basics for the areas of shapes, then you can really figure out all kinds of weird shapes. It's kind of like breaking the shape into puzzle pieces. So I want to learn more area formulas because it's fun.

Criteria category: Connecting and Reflecting

Criteria

- Make connections between First Peoples worldviews and mathematical concepts
- Connect mathematical concepts:
  - with other mathematical concepts
  - with other areas of learning
  - with personal interests
- Reflect on mathematical thinking of self and others
- Use mathematical arguments to support decisions

Interviewer: What's one activity or project that connected with your personal interests and why?

Interviewee: When we had to figure out the area of our classroom and we even had to take away the spot where the door comes in right there, because it's not a perfect square. That was cool, and here is a picture of me in my backyard because I was measuring how long the fence was to figure out the area of the backyard. And after that I wanted to see how much bigger my brother's bedroom was than mine and I found out that it is 20 square metres bigger. So it's not really fair that I get a smaller bedroom.

Criteria category: Reasoning and Analyzing

Criteria

- Use logical reasoning to make decisions and reasonable estimates
- Demonstrate fluent and flexible thinking about number
- Identify and use patterns and relationships
- Describe, measure, and compare spatial relationships
- Estimate using referents, approximation, and rounding strategies

Interviewer: What is one thing you can show me that demonstrates how you used logic to analyze a math problem this term?

Interviewee: Well when Ms. B asked us to estimate how many people in our school had brothers or sisters, or pets, or how many were in French Immersion and all that, I had to figure out with my group how we could measure that and find approximate numbers. So we asked everyone in our class those questions and because we have 18 classes in our school we figured out how to multiply our class total by 18. And then we had to estimate how many would be too many and how many would be too few and explain our thinking to the class.

Criteria category: Understanding and Solving

Criteria

- Use tools or technology to play with, explore, and analyze mathematical ideas
- Apply multiple strategies to solve problems in both abstract and real-life contexts
- Offer different visual solutions
- Model mathematics in real-life contexts

Interviewer: Tell me about a time when you had to use math strategies or tools to explore and solve a problem.

Interviewee: When we did that bucket activity with all the different bottles full of water. We had to figure out how many litres the bucket was and then figure out how many bottles of water it would take to fill the bucket. But it was kind of hard because all the bottles were different sizes. So my team chose the 500 ml bottle because we know how many millilitres are in a pop bottle and kept filling it up and dumping it in the bucket. We drew a line on the bucket every time so we could see how much was half a litre and how much was a litre and it went all the way up to six litres. Then we could figure out the capacity for other bigger and weird-shaped containers easier.

Criteria category: Communicating and Representing

Criteria

- Communicate thinking using mathematical vocabulary
- Explain and justify mathematical ideas and decisions of:
  - self
  - others
- Represent mathematical ideas in concrete, pictorial, and symbolic forms

Interviewer: Tell me about when you had to make a decision using math, and how and why you made it.

Interviewee: When we had our sweet sale in class and everyone brought stuff to sell and everyone had four (pretend) dollars to spend. We had to decide what to buy. I really wanted a Nanaimo bar and they were $1.75 and then I had $2.25 left. The small rice krispie squares were only 50 cents but the big ones were $1.00. I decided to get the bigger one because it was way bigger than two of the little ones put together. Then I had $1.25 left so I bought a chocolate chip cookie and I only had 25 cents left and didn't have enough money to buy anything else. I should have figured out what to buy ahead of time because I wasted 25 cents.

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Sample Application for Grade 8 Mathematics

Financial Literacy Project: Students have been involved in a whole-class project where they have grown food in their school garden, selling their produce at a local farmers' market. The students have been working in groups to create budgets for this project, with projections based on actual evidence, and have been asked to make decisions as issues have arisen. The teacher has been recording observations during group work; students have been asked regularly for their assessment of their progress (either as a group or as individuals, depending on the focus of the assessment). Here are examples of prompts used throughout the project.

Criteria categories and relevant criteria	Examples of teacher observation prompts	Examples of reflection and conversation prompts
Questioning and Investigating • Ask questions that demonstrate curiosity and wonder • Pose new questions and problems	• What questions are students asking that demonstrate their curiosity and wonder? • How are students extending their mathematical understanding by posing new questions and problems?	• What thoughts and questions do you have? • What would you like to learn more about and why?

Connecting and Reflecting
• Make connections between First Peoples worldviews and mathematical concepts
• Connect mathematical concepts:
  ○ with other mathematical concepts
  ○ with other areas of learning
  ○ with personal interests
• Reflect on mathematical thinking of self and others
• Use mathematical arguments to support decisions
	• Are students connecting math concepts with each other, with other worldviews/areas of learning, and/or with personal interests?
	• Can students use mathematical arguments to support personal choices?
		• What connections can you make? How/why is this connection important/ significant?
		• How have you learned from others?
		• Tell me about how you used math to come to this decision/conclusion.

Criteria categories and relevant criteria	Examples of teacher observation prompts	Examples of reflection and conversation prompts
Reasoning and Analyzing • Use logical reasoning to make decisions and reasonable estimates • Demonstrate fluent and flexible thinking about number • Identify and use patterns and relationships • Describe, measure, and compare spatial relationships • Estimate using referents, approximation, and rounding strategies • Apply mental math strategies	• Are students persistent in finding answers to problems, using reasoning and demonstrating flexible thinking? • Are students discovering, measuring, and comparing the yield per plant/plot, number of sales at various price points, and so on?	• Given that you have only enough space for ___ plants, how many ways could you organize your vegetable plot? • Estimate how much money you could earn from selling ___ or pricing ___ at $X?
Understanding and Solving • Use tools or technology to play, explore, and analyze mathematical ideas • Apply multiple strategies to solve problems in both abstract and real-life contexts • Offer different visual solutions • Model mathematics in real-life contexts	• How are students using the tools at hand to explore and extend their understanding? • What strategies are students using to solve problems?	• What tools/technologies were most useful when designing your garden plot? • What strategies (e.g., drawing, creating lists, estimating, working backwards) did you use when figuring out what vegetables to plant?
Communicating and Representing • Communicate thinking using mathematical vocabulary • Explain and justify mathematical ideas and decisions of self and others • Represent mathematical ideas in concrete, pictorial, and symbolic forms	• What mathematical vocabulary do students use when sharing their thinking?	• If you were to create a children's book describing the math work required of your garden project, what images and vocabulary would you include?

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