Making Math Concrete

The title page appears on screen. Upbeat music plays in the background throughout the video.

Text on screen: Ontario Science Centre; An Agency of the Government of Ontario

Animated graphics swipe away the title page and are replaced with small, colourful shapes on a light background. The shapes twist and pulse in place.

Text on screen: Making Math Concrete

Animated graphics sweep away again to reveal Jessica. She is standing in a craft room. There is a whiteboard on an easel beside her. On the whiteboard is a drawing of a plant, showing it both above and below ground, with the sun shining in one corner and a bee flying towards the plant. On a table in front of Jessica is a big box of markers, , coloured craft sticks and a set of flashcards with numbers on them.

Jessica: Hello, I'm Jessica Shearer, Early Childhood Programming Specialist with the Ontario Science Centre.

Text on screen: Jessica (she/her); Early Childhood Programming Specialist, Ontario Science Centre.

The screen splits to show Jessica on one side, and a video of children in an educational setting. An educator blows up a balloon that is attached to an air-powered car.

Jessica: In previous videos in this series, we have focused on the importance of the growth mindset and the scientific inquiry process.

Split screen with Jessica and text appears as she reads it.

Jessica: In this video, we will discuss how to integrate the mathematical processes through play-based experiences as a way to develop foundational mathematics knowledge.

Jessica appears full screen.

Jessica: This knowledge includes number sense and operations, measurement and data literacy, and probability. Let's start with a math question!

Animated graphics sweep away to reveal small, colourful shapes on a light background.

Text on screen: Minds-on / Guiding Questions

Animated graphics sweep away again to reveal a split screen with Jessica and text on a background as she reads it showing 3 yellow dots and 2 red dots.

Overlaid text on screen: A6.5 compose and decompose quantities to 10

Jessica: What do you notice?

A student might say, “I see three yellow counters and two red counters.” That response provides key information.
It reveals how they make meaning of visual representations, what concepts of number they are connecting to the visual and what patterns they observe.
How many are there altogether?
When asked to put it all together, some students may understand the process and what it means mathematically-to add. Other students may not understand what “all together” means. Whatever the answer is, it will help you gauge where that student is on the addition and subtraction continuum.

How do you know? This question is the most powerful of the three. It empowers students to reflect and communicate their reasoning and proof.

Split screen with Jessica and text.

Text on screen: What did you notice?
How many are there altogether?
How do you know?

Jessica: These three questions support the math processes, the ways in which students develop mathematical knowledge and skills.

Jessica appears full screen.

Jessica: Let’s take a moment to reflect on how we can engage the math processes.

The light-coloured page with colourful shapes replaces Jessica full screen. Text appears on screen as she reads it.

Jessica: The Math Processes include:
- Problem solving
- Reasoning and proving
- Reflecting
- Connecting
- Communicating
- Representing
- Selecting tools and strategies

How can you get to know math learners in various learning spaces?
What opportunities are created to develop math fluency and skills through a lesson? In centres?
How can you evaluate and assess mathematics?

Animated graphics sweep away to reveal small, colourful shapes on a light background.

Text on screen: Getting to Know the Math Learner: Math Interview & Observations During Play

Animated graphics sweep away again to reveal Jessica full screen.

Jessica: Begin by getting to know your students.

Split screen with Jessica and text on screen appearing as she reads it.

Jessica: A math interview is a great way to see how learners approach math. Provide the student with a question to problem-solve using the materials and strategies of their choice.

Observe as they represent, make connections and reason. Have them communicate their approach while proving their thinking.

Jessica appears full screen.

Jessica: An interview supports all the math processes which means

Split screen with Jessica and text appearing on screen as she reads it.

Jessica: math interviews can be used as an assessment *for*, an assessment *as* and an assessment *of* learning.

An educator sits with a young child who is counting a stack of building blocks.

Jessica: Math interviews provide qualitative data: You observe strengths, monitor growth and identify next steps.

An educator teaches a child with a colourful abacus.

Jessica: Use addition and subtraction continuums to understand where students are, inform next steps and create math learning groups.

An educator watches over two children pouring sand from various containers into a tray at a sand table.

Jessica Watch students during play to identify interests, too. These interests can be used to engage them in mathematics through play-based learning.

Animated graphics sweep away to reveal small, colourful shapes on a light background.

Text on screen: Invitation to Learning and Parallel Tasks: Math Through Play & Outdoor Learning

Animated graphics sweep away again to reveal Jessica full screen.

Jessica: You can create a dedicated math centre, but math is all around us! Take a survey of the centres in your classroom. How can you integrate math learning in a variety of these places?

A child is sorting differently shaped wooden blocks

Overlaid text on screen: A6.1 explore what numbers are used for

Jessica: For example, at a sensory centre students can dig for objects to match to a magnetic number on a tray.

Children experiment with various objects at a water table.

Jessica: At the water table, compare numbers through inquiry by counting and comparing which objects sink or float.

Children pour water into containers at the water table, while an educator engages with them.

Overlaid text on screen: A8.1 sort objects or data using one attribute

Jessica: Model for students how to line up the objects for comparison, then ask questions to promote reasoning and proving like,

Several brightly coloured objects float in the water table, while a few have sunk to the bottom.

Jessica: “How many more objects floated than sank? How do you know?” You can even build data literacy and probability skills through an inquiry of which materials are least or most likely to float.

Jessica appears full screen.

Jessica: When co-planning with students to create a dramatic play centre, think of ways to reinforce number sense, addition and subtraction.

An educator sets a child-size table for a meal while two children look on.

Overlaid text on screen: A6.9 solve equal-share problems using concrete materials

Jessica: For example, when creating a restaurant, model how to set the table, counting aloud as you place each setting.

This action supports students’ development of one-to-one correspondence when counting and representing numbers, as well as equal-share problems.

Jessica appears full screen.

Jessica: You can also encourage students to follow and make recipes.

Split screen with Jessica and text appearing as she reads it.

Jessica: Students can draw the ingredients and represent the quantity in a variety of ways, such as making tally marks, using counters or writing the number.

Jessica appears full screen.

Jessica: Post the recipes at the centre for other students to try out themselves.

Animated graphics sweep away to reveal a child counting coins. There are also stacks of various coins and a tiny shopping cart on the table top.

Overlaid text on screen: A6.13 identify and explore the value of Canadian coins to 25$ and coins and bills to $10

Jessica: “That’ll be 10 cents, please!” Money reinforces skip counting and early addition skills, too.

Three children count with an abacus.

Jessica: Before introducing the concept of money at the restaurant, have students use counters.

Then, explicitly teach about coin and note values until you can eventually replace the counters with toy money.

Animated graphics sweep away to reveal children of varying ages leaving the school and going outdoors.

Jessica: You can take math learning outdoors, too! On a walk, make estimates of how many steps it’ll take to get to a specific location, then count to verify.

The children and their educator walk on a wide path through the trees.

Overlaid text on screen: A10.1 describe different ways that objects can be measured

Jessica: Discuss why there might be a variety of answers due to foot sizes.
This introduces students to concepts of non-standardized measurement.

Split screen with Jessica and images of pinecones arranged in a grid made up of twigs, and twigs used as counters beneath a math formula: 5 + 4 = 9.

Jessica: You can look for natural materials, like fallen pinecones and leaves, to be counters. Sticks and pine needles make great tally marks and can be used to make a five or ten-frame.

The pinecones arranged in a grid made up of twigs, and twigs used as counters beneath a math formula: 5 + 4 = 9 appear on a sidewalk painted like a rainbow.

Jessica: You can use these natural materials both outdoors and in the classroom.

Animated graphics sweep away to reveal a split screen with Jessica, and text on screen appearing as she reads it.

Invitations to learning are also important, wherever learning happens.

Jessica appears full screen.

Jessica: By providing multiple representations for students to receive information, and by encouraging multiple ways to express mathematical thinking, you support the Universal Design for Learning framework. For example, at a building centre or makerspace, build fluidity in thinking and representation by concurrently developing number sense and measurement skills.

Animated graphics sweep away to reveal a split screen. One side shows a person stacking wooden blocks horizontally, while the other side shows them stacking the blocks vertically. A question mark is overlaid as each question is asked.

Jessica: Stack ten linking cubes or wooden blocks and then line up another set of ten horizontally. Begin an invitation to learning with questions: “How many cubes are standing tall? How do you know?” Repeat the question for the horizontal representation. Finally, invite students to use the same materials to make representations that are taller, longer or shorter than the ones you created.
Provide time for students to reflect and make connections by asking, “How do you know yours is taller, longer, or shorter?”

Animated graphics sweep away to reveal a split screen with Jessica, and text on screen appearing as she reads it.

Jessica: Support learners by using open-ended questions and parallel tasks to give students multiple entry points.

A child’s hands are shown sorting and connecting black and white building blocks together. Brightly coloured blocks that have already been sorted and assembled are seen off to one side.

Jessica: Have the option of 5, 10 or 20 cubes to make this a parallel task.

Overlaid text on screen: A10.1 describe different ways that objects can be measured

Jessica: Extend the learning by using different sized materials to engage in discussions about size and magnitude.

Animated graphics sweep away to reveal text.

Text on screen: Deliberate Practice: Math Groups& Games

Animated graphics sweep away to reveal Jessica.

Jessica: To develop math fluency with representing numbers and beginning to add and subtract, scheduling of deliberate practice is needed.

Children pour small beads through a funnel into a clear plastic cup while an educator engages with them.

Jessica: With deliberate practice, students develop mathematical skills and the mathematical processes of representing, problem-solving and communicating. They also reinforce the connections between these skills and processes.
Encourage students to reflect as it will expand their metacognition skills.

Several children stack large building blocks of various shapes and colours together.

Jessica: Math games are one engaging, collaborative way for students to practice.

Remember that math interview data?

An educator sits on a low chair and engages with children seated on the floor in a semi-circle in front of him.

Jessica: Use that information to create math learning groups for small group instruction and practice.

An educator shows children a colourful picture of a robot she made from construction paper. There are glue sticks, child's scissors, and more construction paper on the table in front of the children.

Jessica: These groups should be flexible. As students acquire skills, or if they need additional support, they can move groups.

An educator sits on a low chair and points to drawings of animals in a picture book to the children seated on the floor in a semi-circle in front of her.

Jessica: While you provide direct instruction to one group,

A group of children count with tally marks on pages with coloured dots down one side of a grid. Each child has its own clipboard, markers, and page.

Jessica: other groups are playing math games to develop their own counting, number sense, addition and subtraction skills.

Jessica appears full screen.

Jessica: Here are a few examples of games to try during small group instruction or for students to play together.

Overlaid text on screen: A6.8 count to 20 by 1s, starting from any number

Split screen: Jessica on one side; a person with a number cube and five counters that are then covered over and hidden by an index card.

Jessica: To learn the counting-on strategy, play hide and seek with counters. Have students roll a number cube, spin a spinner or flip a number card.

A person shakes the number cube in their hand. Cards numbered 1 to 5 are also on the tabletop. The person rolls a 5, then arranges five counters in a row on the table.

Jessica: If they got a five, for instance, they then use counters to represent five.

The person hides the five counters with an index card and rolls the number cube again and gets a 3.

Jessica: Before they roll again, cover the 5 counters and remind them to keep five in mind.

The person places 3 more counters and removes index card covering the first five and counts them all together.

Jessica: Once they represent the second number, students will count-on from FIVE to the cardinal number, using the counters.
So, if three is rolled, the student would tag or touch as they count aloud: “6, 7, 8.”

A person shows a card with four dots on it. Off to the side is a score grid with 10 squares on it.

Overlaid text on screen: A6.4 subitize quantities to 5

Jessica: To solidify number representation, students can have a subitizing race to five. One student shows the dot pattern to their partner (with the number on the back). If the partner gets it correct, they get to put a counter in their ten-frame.

The person flips over the card to show the number 4.

Jessica: First student to five wins. The dot patterns that were challenging can be kept aside for a bonus review round.

Counters are placed on the score grid in a row of 5.

Jessica: Differentiate by selecting which sets of numbers students should focus on, like one to five or six to ten.

A person shakes 4 yellow and 6 red counters in a clear plastic cup and drops them onto the tabletop.

Overlaid text on screen: A6.5 compose and decompose quantities to 10

Jessica: Reinforce the benchmarks of five and ten while composing and decomposing. Play “Shake and Spill” with two-colour counters.

The counters are sorted by colour and are placed in two rows onto a sheet of white paper. The person writes 4 beside the yellow counters, and 6 beside the red ones.

Jessica: Place either five or ten counters in a cup. Next, have the student identify the total counters in each colour. Students can write their findings in a chart on a laminated sheet or a whiteboard to see the number relationships.

Animated graphics sweep away to reveal Jessica.

Jessica: You can review the Kindergarten curriculum for more educator support examples, too.

Animated graphics sweep away to reveal text.

Text on screen: Educator Considerations and Consolidation

Animated graphics sweep away to reveal Jessica.

Jessica: Throughout this video, we've explored how to integrate number sense and operations into play and inquiry. Here are some educator considerations for planning instruction and student learning experiences:

Split screen: Jessica, and text on screen appearing as she reads it.

Jessica: Get to know the math learners in the room and document interviews with notes, digital recordings or photos.

Review centres for places where math can be integrated.

Take math outside (and bring it indoors)!

Use games to practice skills and the math processes.

Employ parallel tasks and open-ended invitations to make learning accessible for all.

Be intentional and purposeful when creating play and inquiry opportunities.

Jessica appears full screen.

Jessica: The math processes help students develop their foundational mathematical knowledge and skills. Starting with representing numbers and counting then moving through addition, subtraction, number sense and operations, the foundations of mathematics can be child's play.

Animated graphics sweep away to reveal text.

Text on screen: We hope you enjoyed this video, which is part of a series developed to support Ontario's kindergarten teachers in STEM education.

Be sure to check out other videos in this series along with additional classroom-ready resources and professional learning resources at OntarioScienceCentre.ca.

Animated graphics sweep away to reveal text.
Text on screen: Ontario Science Centre; An Agency of the Government of Ontario