SCHOLASTIC

Math Place

Grade 1
British Columbia

Overview Guide

- Balanced Math and Instructional Approaches
- Spatial Reasoning in Mathematics
- Building Growth Mindsets
- Meeting the Needs of All Students
- First Peoples Perspectives

Contents

Make Your Classroom a Math Place!

Welcome to *Math Place* —a Comprehensive Set of Mathematics Resources

Choose what works best for you. Use all modules for a complete grade resource, or choose individual modules to support and supplement your current math program.

- **Number & Operations**
- **Spatial Sense** (Measurement & Geometry)
- **Patterns & Relations / Data & Probability**

First Peoples Perspectives

Math Place supports the First Peoples Principles of Learning and Aboriginal Worldviews and Perspectives by incorporating opportunities for students to "explore the connections between mathematics and other ways of knowing, including First Peoples knowledge and other worldviews" (British Columbia Ministry of Education, 2016). For more, see First Peoples Perspectives on pages 6–9.

Current Research and Spatial Thinking

Math Place provides teaching support by integrating the best of current research into classroom practices to develop a balance of students' conceptual and procedural understanding, and skills. Many of the lessons and activities are based on recent research that shows how spatial reasoning plays an integral role in learning math concepts across all strands. Providing opportunities for students to build concrete representations of math concepts leads to an ability to form and use mental models to solve math problems. For more, see The Role of Spatial Reasoning in Mathematics on pages 14–15.

Teaching Approaches

Math Place adopts the belief that all students can learn math, although not necessarily in the same way. The instructional approaches are based on the "continued need for balance between conceptual and procedural understanding of foundational skills, including fluency with basic facts" (British Columbia Ministry of Education, 2016). These approaches include guided math lessons, shared and independent problem solving, games and activities that reinforce operational skills, whole-group lessons, and consolidating discussions. Together, they support conceptual learning, meaningful practice, and acquisition of the fundamental math concepts and operational skills. There is an emphasis on actively 'doing' math using a variety of concrete materials and tools, while engaging in problem-solving situations that are relevant to students' daily lives. For more, see Balanced Math and Instructional Approaches on pages 20–27.

Linking Math to Literacy and Science

Math Place includes Read Alouds, as well as big book and little book titles with engaging visuals and supportive text to introduce various math concepts and to prompt student investigations. The texts and visuals also support literacy, science, and other curriculum areas, offering rich and meaningful contexts for learning math. As additional support, teaching plans for the integrated Read Aloud texts identify and incorporate effective literacy strategies. For more, see Cross-Curricular Connections on pages 34–36.

Concrete Materials

Math Place effectively explains how to incorporate concrete materials, which are essential for students of all ages to conceptually understand the math. Research indicates that students learn math more effectively by using and manipulating concrete materials to make their thinking visible. These experiences eventually lead to more abstract ways of thinking. For more, see Learning Materials on pages 15–16.

Support of Differentiated Instruction

Math Place allows for differentiated learning with flexible groupings, and lessons and individual problems that can be tailored to meet the needs of all your students, such as by making the numbers simpler or more complex. This allows students to work on the same math concepts and engage in rich problem-solving tasks while working with numbers they understand. For more, see Meeting the Needs of All Students on pages 30–33.

Assessment to Inform Instruction

Math Place offers ongoing assessment of students' understanding to guide future instruction. Assessment Opportunities within the lessons offer prompts and suggestions on how to assess through observations and conversations. There are also Teacher Look-Fors to further support assessment and to serve as a guide for co-constructing success criteria with your students. For more, see Assessment on pages 28–29.

Growth Mindsets in Mathematics

Math Place provides an introductory lesson (see Instilling a Growth Mindset Lesson on pages 37–39) that lays the foundation for developing positive growth mindsets. This can be continually reinforced throughout the year by using the Building Growth Mindsets prompts that are embedded in many of the lessons. For example, students learn to view mistakes as learning opportunities and to recognize that their efforts will be worthwhile, even if they don't understand a concept YET. For more, see Growth Mindsets in Mathematics on pages 16–17.

Math Talk

Math Place supports the understanding of math concepts through purposeful discussions that are embedded in every lesson. There are also additional Math Talks linked to many of the lessons to reinforce and extend the learning and offer further investigation. For more, see Math Talk on pages 17–19.

Why Math Place?

Early Math Is Important

As educators, our goal is to prepare students for future challenges by equipping them with the relevant knowledge and skills necessary to succeed. Research indicates that mathematics plays an integral role in their education and lives, and that its development in the early years is especially critical for later success, even more so than reading skills (Clements & Sarama, 2009, p. 2).

"... early math concepts are the most powerful predictors of later learning."
(Duncan et al., 2007)

Although mathematical concepts that students attain in the early years are sometimes perceived as being simple, they are actually quite complex and play a significant role in future learning. Greg Duncan carried out an extensive longitudinal study, which revealed that early math concepts are the most powerful predictors of later learning (Duncan et al., 2007, page 1428). This pertains not only to math, but to later success in reading, as well.

Duncan further found that the gains made from kindergarten to the end of grade one were the best predictor of math performance at age 15 (Watts, Duncan, Siegler, & Davis-Kean, 2014, p. 352). These findings highlight the critical need to focus on math in the early grades, and the benefits that can be achieved. They also compel us as educators to reflect upon the effectiveness of our existing programs and to investigate how we can adapt them to best meet students' needs.

It is important to focus on the well-being of the whole child, taking into account their diversity, perspectives, attitudes, and self-efficacy. Young students not only need the math knowledge and skills, but a positive and curious attitude toward the discipline and the self-confidence to solve problems and justify their thinking. Too often, people believe that math achievement is based on aptitude rather than ability, which often leads to the misconception that effort does not play a role in learning (Clements & Sarama, 2009, p. 213). In order to try hard, students need to be motivated, to see relevance in what they are learning, and to believe that they can learn math. Teachers also need to believe that all students can succeed and develop into capable and confident mathematicians.

Math Place is designed to support you by providing rich math lessons and activities that not only meet all of the British Columbia Learning Standards, but also powerfully engage students in the wondrous world of math.

Alignment with the British Columbia Curriculum

The British Columbia curriculum has a number of components. One component is **Core Competencies**. The curriculum focuses on three Core Competencies: Communication Competency, Thinking Competency, and Personal and Social Competency, which are integral to all areas of learning. In mathematics, the Core Competencies emphasize a hands-on problem-solving model and the importance of being able to apply the necessary foundational skills in problem-solving situations.

Another component is **Curriculum Competencies**. *Math Place* strongly supports the Curricular Competencies, which indicate how math concepts progressively build from grade to grade, based on a general developmental continuum. They reflect what students are expected to do and include: Reasoning and analyzing; Understanding and solving; Communicating and representing; Connecting and reflecting. Through the act of doing, students acquire the **Content** that they are expected to know.

For each lesson, the Learning Standards, including the Curricular Competencies and Content, are identified and are supported with related Teacher Look-Fors, which can be used during assessment for learning.

When students are given rich tasks that span the strands, they can make connections between related mathematical concepts and recognize the important role that math plays in their lives.

Cross-Strand Approach

Math Place adopts a cross-strand approach since many of the mathematical big ideas overlap or support each other across the strands. For example, in Data and Probability, as students collect, organize, describe, and compare data using various graphs, they are applying many of the counting principles such as one-to-one correspondence, as well as operational concepts that are prevalent in the Number and Operations strand.

When students are given rich tasks that span the strands, they can make connections between related mathematical concepts and recognize the important role that math plays in their lives. As they problem solve, they are also applying the Learning Standards, which are integral in all of the strands.

First Peoples Perspectives

Since time immemorial, First Peoples have developed skills, understandings, and ways of knowing by interacting with their natural environment. This in turn has enabled First Peoples to thrive in their day-to-day life and survive for thousands of years. "Learning from the land is an essential aspect of First Nations, Inuit, and Métis learning, and entails a significant amount of experiential learning..." (Canadian Council on Learning, 2009). This knowledge base is what is known as First Peoples knowledge. Their understanding of astronomy, physics, chemistry, biology, math, and their environment without the help of textbooks or the Internet, was, and is, extremely sophisticated.

Indigenous Learning

Linking specific Indigenous content to curriculum must be done at a local community level, as Indigenous knowledge and practices for mathematics and learning differs across nations.

Lunney Borden and Wiseman found that the integration of Indigenous perspectives is often less about specific content and is more meaningful when it considers pedagogy and how we are engaging learners "in mind, body, spirit, and heart" (Lunney Borden & Wiseman, 2016). Indigenous pedagogy includes expert-apprentice modelling (Lipka, et al., 2005) and learning in community, and it is holistic and experiential in nature (Battiste, 2013). Linking specific Indigenous content to curriculum must be done at a local community level, as Indigenous knowledge and practices for mathematics and learning differs across nations. Beatty and Blair found that reform-based math practices, such as those found in this text including math talk, guided groups, modelling, gradual release of responsibility, etc., are in line with many aspects of Indigenous teaching (Beatty & Blair, 2015).

Aboriginal Worldviews and Perspectives

Students need to "explore the connections between mathematics and other ways of knowing, including First Peoples knowledge and other worldviews." (British Columbia Ministry of Education, 2016)

- A central goal of the curriculum is to provide personalized learning by offering a variety of opportunities that meet the diverse needs of all students. In order for students to develop a deep understanding of math concepts, they need to learn through realistic contexts and problems that relate to their lives. This includes place-based learning experiences that are adapted to the local community or individual contexts so "all learners have opportunities to understand and respect their own cultural heritage as well as that of others" (British Columbia Ministry of Education, 2016). Students need to "explore the connections between mathematics and other ways of knowing, including First Peoples knowledge and other worldviews" (British Columbia Ministry of Education, 2016). Within the math curriculum there are explicit and implicit references to Aboriginal perspectives and

knowledge in the Learning Standards, specifically in the Curricular Competencies, Content, and Elaborations. The curriculum also includes some possible resources that can be used in the classroom. Checking out the relevance of these resources to your local community is important so the learning experiences are authentic to the cultures, and also to the math.

- Effective planning can occur by using the curriculum in conjunction with the First Peoples Principles of Learning (see pages 8–9) and Aboriginal Worldviews and Perspectives in the Classroom. This document can be found and downloaded from the BC Ministry Website: https://www2.gov.bc.ca/assets/gov/education/administration/kindergarten-to-grade-12/aboriginal-education/awp_moving_forward.pdf. The document succinctly explains the characteristics of worldviews and perspectives and the implications for educational practice.

  A good starting point is "Community Engagement" by involving local First Peoples Elders and knowledge keepers to be part of the planning, or inviting them into the classroom to explain local perspectives. Below are some examples of how the documents can spark meaningful questions to ask while planning math lessons in consultation with members of the local First Peoples community.

Curricular Competencies (British Columbia Ministry of Education, 2016)

Understanding and solving:

- Engage in problem-solving experiences that are connected to place, story, cultural practices, and perspectives relevant to local First Peoples communities, the local community, and other cultures

Connecting and reflecting:

- Connect mathematical concepts to each other and to other areas and personal interests (e.g., daily activities, local and traditional practices, the environment, cross-curricular integration, etc.)

  Possible Questions:
  - Ask about significant stories and traditions that can be woven into the lesson that uncover the need for counting and the use of numbers in the local culture, both in the past and in the present.
  - Ask about appropriate contexts for posing problems that reflect how First Peoples apply math in their daily activities, and in local and traditional practices.

Connecting and reflecting:

- Incorporate First Peoples worldviews and perspectives to make connections to mathematical concepts

  Possible Questions:
  - Ask about how math in general is viewed from a First Peoples perspective (e.g., a positive learner-centred approach and experiential learning). Students can learn more about their own identity by reflecting on their feelings toward math and how confident they feel. They can also gain an appreciation for other people's perspectives toward mathematics.

Communicating and representing:

- Represent mathematical ideas in concrete, pictorial, and symbolic forms (use local materials gathered outside for concrete and pictorial representations)

  Possible Questions:
  - Ask about objects and materials that have significance in the culture that can be used for concrete and pictorial representations. Have some of these objects brought into the classroom so students can experience them and understand why they are significant.
  - Ask about the significance of the land and the environment to the First Peoples cultures. Take students for nature walks so they can collect local natural objects that can be used to model their mathematical thinking.

First Peoples Principles of Learning (FPPL)

In order to ensure that First Peoples content, values on learning, and pedagogy are reflected in the learning, the British Columbia Ministry of Education and the First Nations Educations Steering Committee (FNESC) worked in partnership to develop the First Peoples Principles of Learning (FPPL). As Jo-Anne Chrona, FNESC curriculum coordinator, stresses, FPPL must be deeply understood in order to guide educators' choices on what and how to learn since context is critical, cautioning that although "these principles of learning represent an attempt to identify common elements in the varied teaching and learning approaches that prevail within particular First Peoples societies, it must be recognized that they do not capture the full reality of the approach used in any single First Peoples society" (British Columbia Ministry of Education and First Nations Education Steering Committee, 2008, p. 11).

The First Peoples Principles of Learning that are embedded in the British Columbia Curriculum are tied to the Curriculum Competencies. You can be assured that you are already embedding some of these principles in your practice as they are pedagogically sound tenets or beliefs.

First Peoples Principles of Learning

- Learning ultimately supports the well-being of the self, the family, the community, the land, the spirits, and the ancestors.
- Learning is holistic, reflexive, reflective, experiential, and relational (focused on connectedness, on reciprocal relationships, and a sense of place).
- Learning involves recognizing the consequences of one's actions.
- Learning involves generational roles and responsibilities.
- Learning recognizes the role of indigenous knowledge.
- Learning is embedded in memory, history, and story.
- Learning involves patience and time.
- Learning requires exploration of one's identity.
- Learning involves recognizing that some knowledge is sacred and only shared with permission and/or in certain situations.

First Nations Education Steering Committee, 2008 (British Columbia Ministry of Education, 2015, p. 3)

Benefits of Using *Math Place*

For Your Students

The lessons for each topic are engaging, relevant to young students' lives, provoke curiosity about math, and stimulate creative and critical thinking. By working through the activities, students gain strong understanding of the concepts as well as the underlying fundamental skills, including proficiency with math calculations. The accompanying Read Aloud texts for each module instill wonder and excitement about math by engaging students through stories. As students problem solve with others, they develop collaboration skills and learn how to communicate their thinking to others, using mathematical language. Students also engage in independent problem solving and practice to help them internalize and apply recently learned concepts and skills.

The lessons are filled with rich, open problems, allowing students to reason through tasks and represent their thinking with a variety of tools and concrete materials. Most importantly, as students proceed through the activities, they develop a positive attitude toward math, the self-confidence to persevere, and a growth mindset that emanates, "I can do math and be good at it."

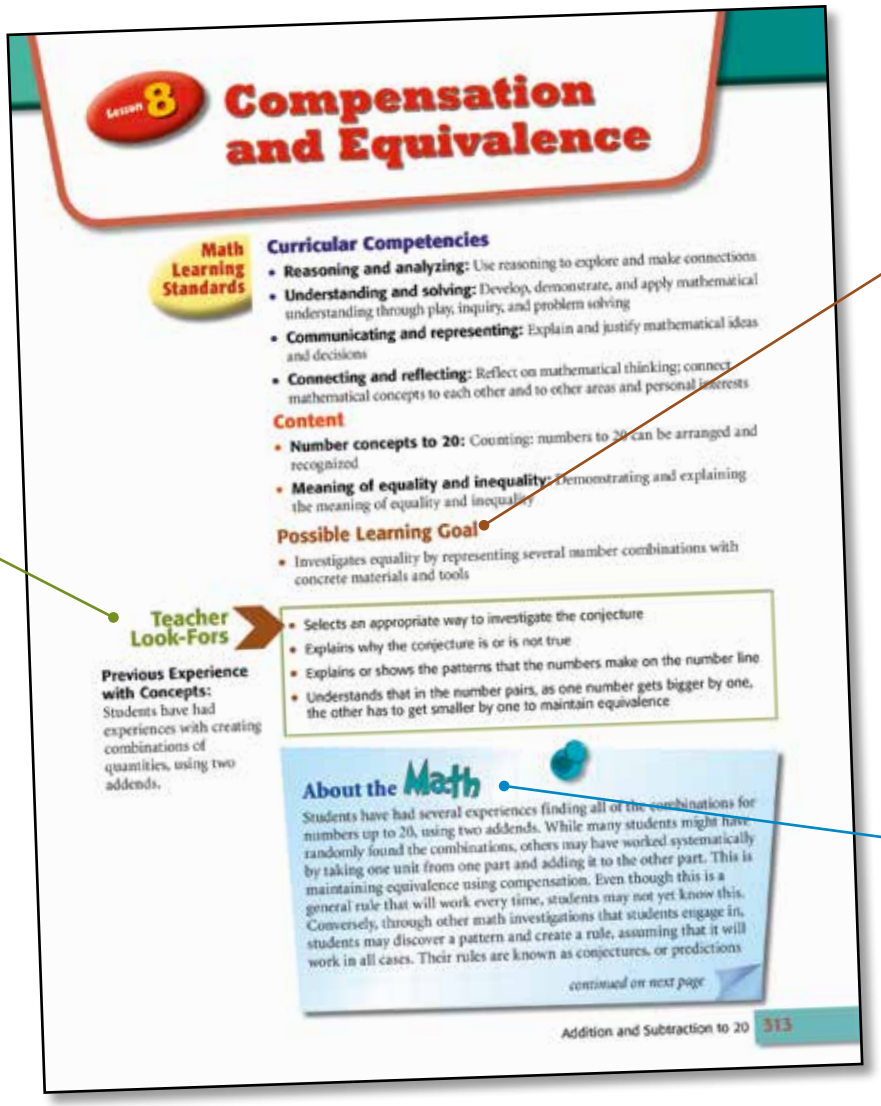
For You, the Teacher

This comprehensive resource can serve as the core of your math program or as a supplement to your existing program. The order of the lessons in each module follows a general developmental path based on research of how students typically acquire concepts, although this can vary from student to student.

The resource is by no means prescriptive, meaning you can pick and choose lessons and the order in which they are presented based on the ability levels of your students, the Curricular Competencies and Content, and your learning goal. Differentiation is critical since all students do not learn in the same way or at the same pace. The lessons and activities can act as starting points and be differentiated or expanded. If a concept is not mastered, lessons can be repeated by changing the numbers and the contexts.

To set up each lesson, there is an About the Math section, which explains the math involved in the lesson, offers some research or suggestions that experts provide, and outlines how concepts develop over time. From this information, a learning goal can be developed based on your major focus for the lesson and the needs of your students. A possible learning goal is provided for each lesson to serve as an example. It can be adapted to suit your goals and be reworded into student-friendly language so it can be shared with your students.

To facilitate assessment for learning, each lesson includes Teacher Look-Fors, which can be used to identify students who have mastered the goals and concepts, and students who require more reinforcement or practice. They can also be used in conjunction with the learning goal to help you co-construct success criteria with your students.



Lesson 8

Compensation and Equivalence

Math Learning Standards

Curricular Competencies

- **Reasoning and analyzing:** Use reasoning to explore and make connections
- **Understanding and solving:** Develop, demonstrate, and apply mathematical understanding through play, inquiry, and problem solving
- **Communicating and representing:** Explain and justify mathematical ideas and decisions
- **Connecting and reflecting:** Reflect on mathematical thinking; connect mathematical concepts to each other and to other areas and personal interests

Content

- **Number concepts to 20:** Counting: numbers to 20 can be arranged and recognized
- **Meaning of equality and inequality:** Demonstrating and explaining the meaning of equality and inequality

Possible Learning Goal

- Investigates equality by representing several number combinations with concrete materials and tools

Teacher Look-Fors

- Selects an appropriate way to investigate the conjecture
- Explains why the conjecture is or is not true
- Explains or shows the patterns that the numbers make on the number line
- Understands that in the number pairs, as one number gets bigger by one, the other has to get smaller by one to maintain equivalence

Previous Experience with Concepts: Students have had experiences with creating combinations of quantities, using two addends.

About the Math

Students have had several experiences finding all of the combinations for numbers up to 20, using two addends. While many students might have randomly found the combinations, others may have worked systematically by taking one unit from one part and adding it to the other part. This is maintaining equivalence using compensation. Even though this is a general rule that will work every time, students may not yet know this. Conversely, through other math investigations that students engage in, students may discover a pattern and create a rule, assuming that it will work in all cases. Their rules are known as conjectures, or predictions

continued on next page

Possible learning goals are provided and can be adapted to suit your goals and to reflect the needs of your students.

Teacher Look-Fors support assessment and serve as a guide for co-constructing success criteria with your students.

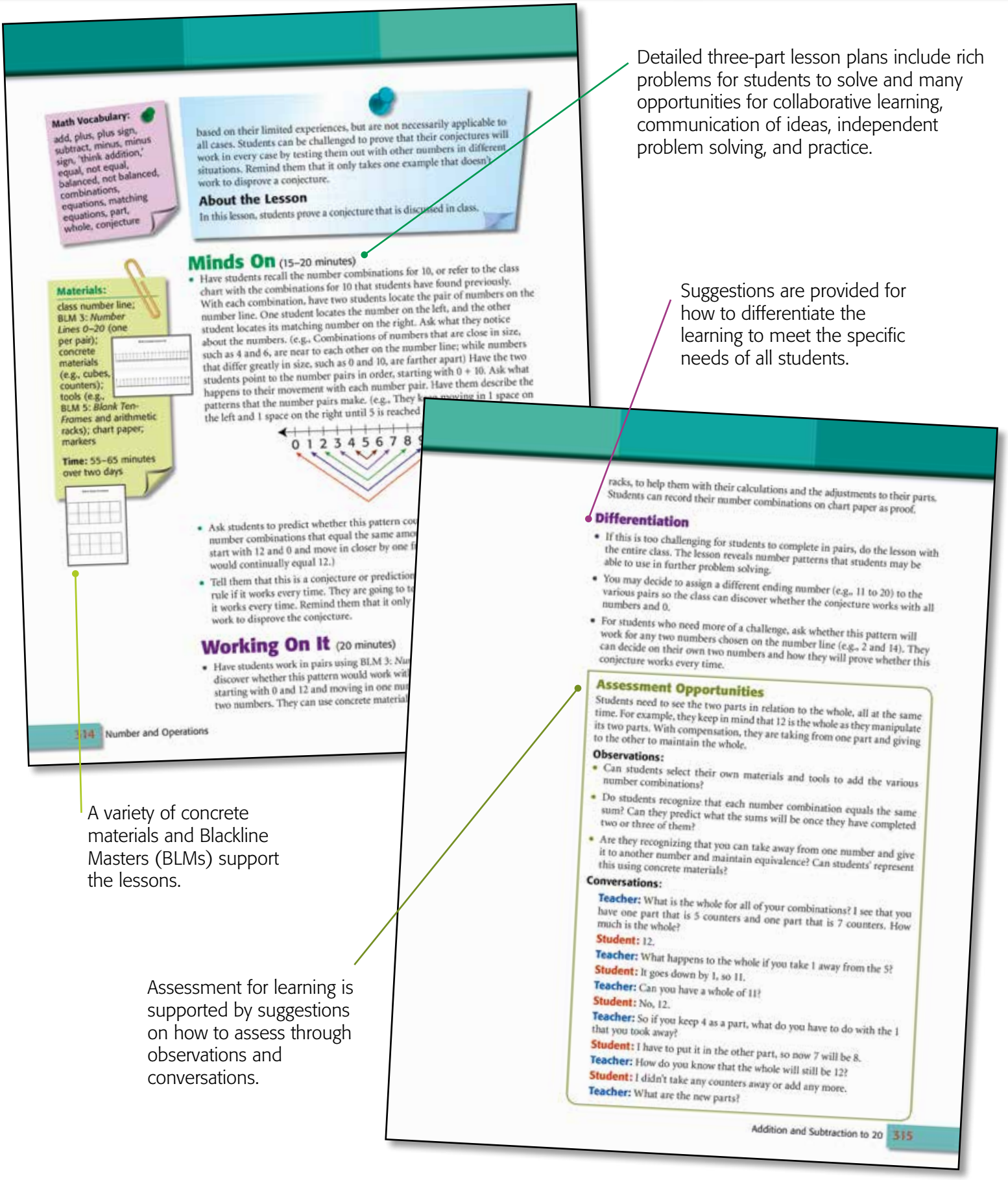
About the Math section incorporates recent research to explain math concepts and why they are so critical to students' current and future learning.

Detailed three-part lesson plans include rich problems for students to solve and many opportunities for collaborative learning, communication of ideas, independent problem solving, and practice.

Suggestions are provided for how to differentiate the learning to meet the specific needs of all students.

A variety of concrete materials and Blackline Masters (BLMs) support the lessons.

Assessment for learning is supported by suggestions on how to assess through observations and conversations.



Math Vocabulary: add, plus, plus sign, subtract, minus, minus sign, 'think addition,' equal, not equal, balanced, not balanced, combinations, equations, matching equations, part, whole, conjecture

based on their limited experiences, but are not necessarily applicable to all cases. Students can be challenged to prove that their conjectures will work in every case by testing them out with other numbers in different situations. Remind them that it only takes one example that doesn't work to disprove a conjecture.

About the Lesson

In this lesson, students prove a conjecture that is discussed in class.

Materials: class number line; BLM 3: *Number Lines 0–20* (one per pair); concrete materials (e.g., cubes, counters); tools (e.g., BLM 5: *Blank Ten-Frames* and arithmetic racks); chart paper; markers

Time: 55–65 minutes over two days

Minds On (15–20 minutes)

- Have students recall the number combinations for 10, or refer to the class chart with the combinations for 10 that students have found previously. With each combination, have two students locate the pair of numbers on the number line. One student locates the number on the left, and the other student locates its matching number on the right. Ask what they notice about the numbers. (e.g., Combinations of numbers that are close in size, such as 4 and 6, are near to each other on the number line; while numbers that differ greatly in size, such as 0 and 10, are farther apart) Have the two students point to the number pairs in order, starting with 0 + 10. Ask what happens to their movement with each number pair. Have them describe the patterns that the number pairs make. (e.g., They k... moving in 1 space on the left and 1 space on the right until 5 is reached

0 1 2 3 4 5 6 7 8

- Ask students to predict whether this pattern co... number combinations that equal the same amo... start with 12 and 0 and move in closer by one f... would continually equal 12.)
- Tell them that this is a conjecture or prediction... rule if it works every time. They are going to t... it works every time. Remind them that it only ... work to disprove the conjecture.

Working On It (20 minutes)

- Have students work in pairs using BLM 3: *Nu...* discover whether this pattern would work wit... starting with 0 and 12 and moving in one nu... two numbers. They can use concrete material...

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racks, to help them with their calculations and the adjustments to their parts. Students can record their number combinations on chart paper as proof.

Differentiation

- If this is too challenging for students to complete in pairs, do the lesson with the entire class. The lesson reveals number patterns that students may be able to use in further problem solving.
- You may decide to assign a different ending number (e.g., 11 to 20) to the various pairs so the class can discover whether the conjecture works with all numbers and 0.
- For students who need more of a challenge, ask whether this pattern will work for any two numbers chosen on the number line (e.g., 2 and 14). They can decide on their own two numbers and how they will prove whether this conjecture works every time.

Assessment Opportunities

Students need to see the two parts in relation to the whole, all at the same time. For example, they keep in mind that 12 is the whole as they manipulate its two parts. With compensation, they are taking from one part and giving to the other to maintain the whole.

Observations:

- Can students select their own materials and tools to add the various number combinations?
- Do students recognize that each number combination equals the same sum? Can they predict what the sums will be once they have completed two or three of them?
- Are they recognizing that you can take away from one number and give it to another number and maintain equivalence? Can students' represent this using concrete materials?

Conversations:

Teacher: What is the whole for all of your combinations? I see that you have one part that is 5 counters and one part that is 7 counters. How much is the whole?
Student: 12.
Teacher: What happens to the whole if you take 1 away from the 5?
Student: It goes down by 1, so 11.
Teacher: Can you have a whole of 11?
Student: No, 12.
Teacher: So if you keep 4 as a part, what do you have to do with the 1 that you took away?
Student: I have to put it in the other part, so now 7 will be 8.
Teacher: How do you know that the whole will still be 12?
Student: I didn't take any counters away or add any more.
Teacher: What are the new parts?

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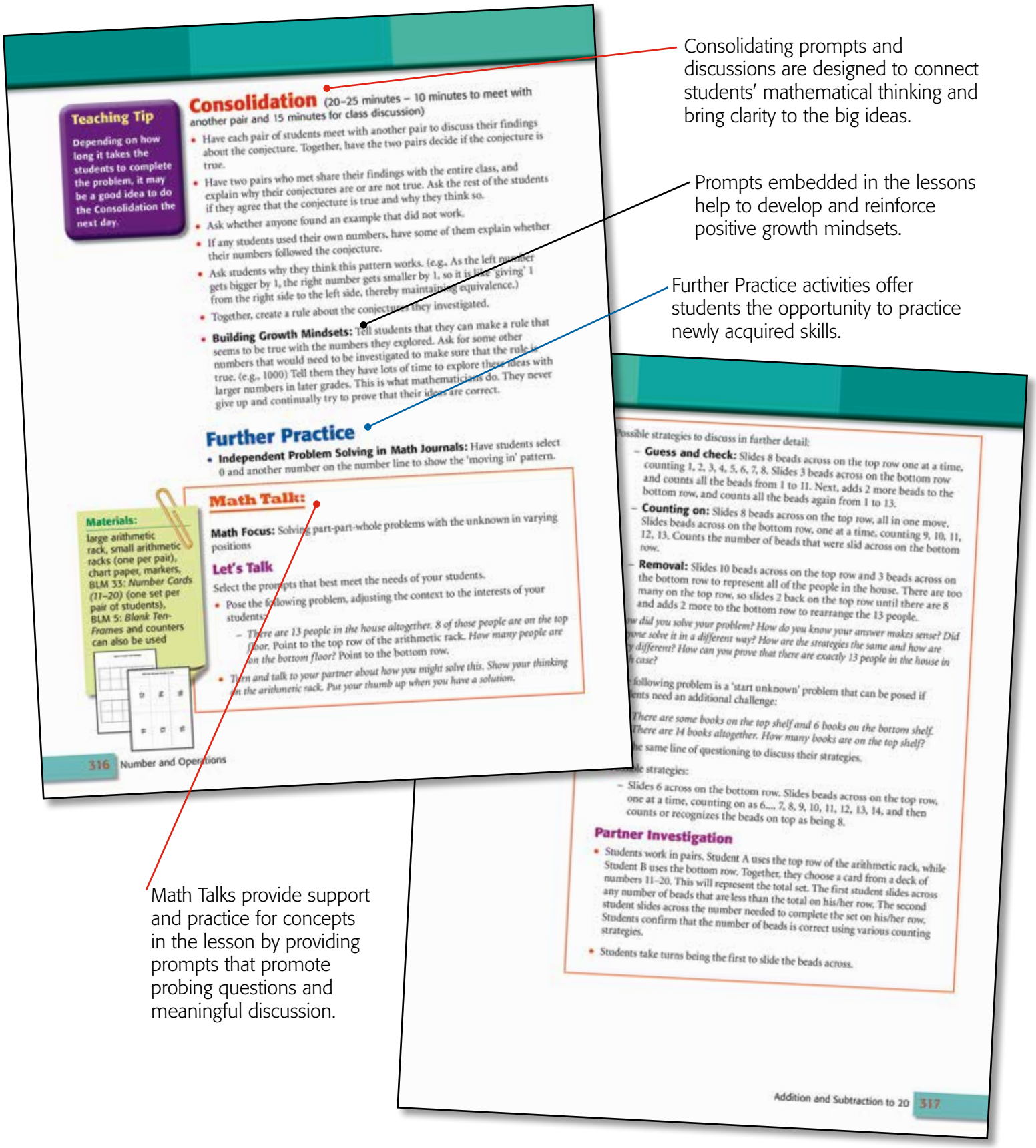

Teaching Tip

Depending on how long it takes the students to complete the problem, it may be a good idea to do the Consolidation the next day.

Consolidation (20–25 minutes – 10 minutes to meet with another pair and 15 minutes for class discussion)

- Have each pair of students meet with another pair to discuss their findings about the conjecture. Together, have the two pairs decide if the conjecture is true.
- Have two pairs who met share their findings with the entire class, and explain why their conjectures are or are not true. Ask the rest of the students if they agree that the conjecture is true and why they think so.
- Ask whether anyone found an example that did not work.
- If any students used their own numbers, have some of them explain whether their numbers followed the conjecture.
- Ask students why they think this pattern works. (e.g., As the left number gets bigger by 1, the right number gets smaller by 1, so it is like 'giving' 1 from the right side to the left side, thereby maintaining equivalence.)
- Together, create a rule about the conjectures they investigated.
- **Building Growth Mindsets:** Tell students that they can make a rule that seems to be true with the numbers they explored. Ask for some other numbers that would need to be investigated to make sure that the rule is true. (e.g., 1000) Tell them they have lots of time to explore these ideas with larger numbers in later grades. This is what mathematicians do. They never give up and continually try to prove that their ideas are correct.

Further Practice

- **Independent Problem Solving in Math Journals:** Have students select 0 and another number on the number line to show the 'moving in' pattern.

Materials:
large arithmetic rack, small arithmetic racks (one per pair), chart paper, markers, BLM 33: *Number Cards (11–20)* (one set per pair of students), BLM 5: *Blank Ten-Frames* and counters can also be used

Math Talk:

Math Focus: Solving part-part-whole problems with the unknown in varying positions

Let's Talk

Select the prompts that best meet the needs of your students.

- Pose the following problem, adjusting the context to the interests of your students:
  - *There are 13 people in the house altogether. 8 of those people are on the top floor.* Point to the top row of the arithmetic rack. *How many people are on the bottom floor?* Point to the bottom row.
- *Turn and talk to your partner about how you might solve this. Show your thinking on the arithmetic rack. Put your thumb up when you have a solution.*

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Possible strategies to discuss in further detail:

- **Guess and check:** Slides 8 beads across on the top row one at a time, counting 1, 2, 3, 4, 5, 6, 7, 8. Slides 3 beads across on the bottom row and counts all the beads from 1 to 11. Next, adds 2 more beads to the bottom row, and counts all the beads again from 1 to 13.
- **Counting on:** Slides 8 beads across on the top row, all in one move. Slides beads across on the bottom row, one at a time, counting 9, 10, 11, 12, 13. Counts the number of beads that were slid across on the bottom row.
- **Removal:** Slides 10 beads across on the top row and 3 beads across on the bottom row to represent all of the people in the house. There are too many on the top row, so slides 2 back on the top row until there are 8 and adds 2 more to the bottom row to rearrange the 13 people.

w did you solve your problem? How do you know your answer makes sense? Did yone solve it in a different way? How are the strategies the same and how are y different? How can you prove that there are exactly 13 people in the house in h case?

ollowing problem is a 'start unknown' problem that can be posed if ents need an additional challenge:

There are some books on the top shelf and 6 books on the bottom shelf. There are 14 books altogether. How many books are on the top shelf?

he same line of questioning to discuss their strategies.

ble strategies:

- Slides 6 across on the bottom row. Slides beads across on the top row, one at a time, counting on as 6..., 7, 8, 9, 10, 11, 12, 13, 14, and then counts or recognizes the beads on top as being 8.

Partner Investigation

- Students work in pairs. Student A uses the top row of the arithmetic rack, while Student B uses the bottom row. Together, they choose a card from a deck of numbers 11–20. This will represent the total set. The first student slides across any number of beads that are less than the total on his/her row. The second student slides across the number needed to complete the set on his/her row. Students confirm that the number of beads is correct using various counting strategies.
- Students take turns being the first to slide the beads across.

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Consolidating prompts and discussions are designed to connect students' mathematical thinking and bring clarity to the big ideas.

Prompts embedded in the lessons help to develop and reinforce positive growth mindsets.

Further Practice activities offer students the opportunity to practice newly acquired skills.

Math Talks provide support and practice for concepts in the lesson by providing prompts that promote probing questions and meaningful discussion.

About the Math

The Role of Spatial Reasoning in Mathematics

What Is Spatial Reasoning?

Research indicates that spatial reasoning plays a significant role in understanding math concepts and being able to effectively solve problems. It is also a better predictor of later math performance than early math and reading skills (Duncan et al., 2007).

Research indicates that spatial reasoning plays a significant role in understanding math concepts and being able to effectively solve problems.

Researcher Nora Newcombe states that spatial thinking involves "the locations of objects, their shapes, their relations to each other, and the paths they take as they move" (Newcombe, 2010, p. 30). This is not one skill, but is comprised of several abilities that are intertwined and that support each other.

We are immersed in spatial thinking throughout our day, either physically or mentally, as we navigate around our world, pack boxes, or visualize whether our car will fit in a parking space. Early experiences with spatial reasoning can help students maximize their potential in this area. Your attitude and confidence level, as well as those of your students, also play a role. A recent study reveals that teachers' own comfort level with spatial activities is related to their students' growth in spatial abilities throughout the year, and that teachers high in anxiety about spatial reasoning might avoid incorporating spatial activities in the classroom (Gunderson, Ramirez, Beilock, & Levine, 2013). *Math Place* is designed to support you and your students in developing and refining spatial reasoning skills.

The good news is that spatial reasoning is malleable and can be improved.

The good news is that spatial reasoning is malleable and can be improved. Through modelling, you can also instill confidence in your students and challenge them to persevere through spatial tasks.

Spatial Reasoning Focus in *Math Place*

While people often assume that spatial reasoning is only embedded in geometry, it actually plays a significant role in all the strands, and particularly in number sense in the early years. For example, students should create quantities with concrete materials, rather than just interpreting their value in their symbolic, numerical form. This allows them to 'see' the differences in the collections they made, or the effect that various operations have on quantity. While measuring quantities with concrete materials, students can visually estimate the attributes of items and make comparisons. Similarly, when reading concrete graphs, students can effectively use the visual images to interpret and compare data, and make inferences. This helps students create mental images of the concepts, which leads to more effective problem solving.

The lessons in this resource are designed to support and capitalize on the development of spatial reasoning. Embedded in the lessons are visualization activities that are excellent for promoting spatial thinking and acquiring mental strategies to develop proficiency in number facts and calculations.

Learning Materials

Concrete Materials and Tools

Young students need rich, hands-on experiences using a variety of concrete materials and strategies in order to develop spatial thinking and conceptually understand the math. Many lessons and activities in this resource include the use of concrete materials, such as connecting cubes, counters, coloured tiles, pattern blocks, attribute blocks, coin manipulatives, arithmetic racks (rekenreks), and relational rods (Cuisenaire rods). Other materials such as natural objects collected from outdoors can also be effectively used. All materials can be physically manipulated to reflect student thinking. Students initially need exploration time with these materials, and then gradually learn strategic ways to use them while solving problems.

Concrete materials and tools are the most beneficial when they are used as thinking tools and educators help students reflect on the math concepts evident in the representations.

Using concrete materials:

- Supports reasoning, which plays an integral role in learning math. Students internalize visual images of concrete representations, which allows them to develop mental strategies.
- Encourages rich math discussions since students have a concrete model to focus on while explaining their thinking.
- Allows for differentiated instruction since students can choose materials that best support their way of thinking.

Tools, such as hundred charts, ten-frames, number paths, and number lines, also allow students to demonstrate their thinking with visual representations. Using concrete materials and tools helps students to create mental models that can later be retrieved and manipulated. For example, after students represent quantities using ten-frames, they can visualize a new quantity by mentally retrieving an image of a familiar number on a ten-frame, and then manipulating it in their minds by adding, taking away, or rearranging dots. Eventually, students will be able to select the learning materials that best meet their needs, depending on the problem-solving situation.

Technology

Technology can also effectively support math learning, especially when digital environments offer opportunities for investigating math that cannot be achieved with paper and pencil. A variety of virtual manipulatives and digital tools may be found online. Keep in mind that technology isn't always digital and can include the use of common classroom tools such as a pan balance.

"We need to introduce students to creative, beautiful mathematics that allows them to ask questions that have not been asked, and to think of ideas that go against traditional and imaginary boundaries. When we give students mathematical freedom, everything changes for them." (Boaler & Dweck, 2016)

Growth Mindsets in Mathematics

People with fixed mindsets about math believe that you are either born to be good at math or you are not. People with a growth mindset believe that the ability to be successful at math can be developed and improved through instruction, effort, and practice. Carol Dweck emphasizes that mindsets are important since they can predict math achievement over time. The good news is that interventions that change mindsets can actually improve achievement (Dweck, 2008).

Since research shows that educators play an integral role in shaping students' mindsets, teachers have the opportunity to make a positive difference in the classroom. It is important to reflect on what is valued in a math learner. Jo Boaler identifies how society tends to value a learner who can memorize and calculate quickly, rather than one who may have the same potential but takes more time, and reflection to understand the concepts (Boaler & Dweck, 2016, p. 30). Boaler explains, "We need to introduce students to creative, beautiful mathematics that allows them to ask questions that have not been asked, and to think of ideas that go against traditional and imaginary boundaries. When we give students mathematical freedom, everything changes for them" (Boaler & Dweck, 2016, p. 208).

Math Place offers many opportunities to build and reinforce growth mindsets. In an introductory lesson (see Instilling a Growth Mindset Lesson, pages 37–39) students discover what constitutes a growth mindset by investigating what mathematicians do, such as asking questions, not giving up after making mistakes, and trying new strategies. An anchor chart can be co-created with phrases that support the development of a growth mindset. Embedded in the lessons are suggestions for reinforcing this way of thinking about math, with regular references

to the messages in the anchor chart. For example, when students do make a mistake, there can be a focus around the phrases, "Mistakes help me to learn," and "I can try a new strategy." By explicitly drawing on their learning experiences and efforts, students can develop not only a growth mindset, but also self-confidence in their abilities as mathematicians. See page 40 for *Interview Prompts and Questions: Building Growth Mindsets and Positive Attitudes*. Hold individual conferences, selecting the prompts and questions that are most suitable for your students. A modifiable BLM version of this page is available on the Teacher's Website.


Interview Prompts and Questions:
Building Growth Mindsets and
Positive Attitudes

Prompts:

I like math because _____

What I like the best about math is _____

When I get stuck on a problem, I _____

A mistake I made was _____. It helped me to learn _____

When I make a mistake, I _____

I don't know about _____ YET, but I can _____ to learn more.

I think and work like a mathematician when I _____

I am a mathematician when I _____

When I feel like I am going to give up, it helps me to _____

Questions:

What did you do today in math to make you think hard?

What is a mistake that you made that taught you something? What did you learn?

What made you keep going when this problem got hard?

What did you do to challenge yourself today?

What do you wonder about other what we have learned in math?

How can the math we are learning help you in your life?

How does math help you in your life? In your family's life?

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Math talk is more than just presenting to one another.

Math Talk

Talk plays a critical role in learning mathematics. It involves discussion and discourse so students can reflect on each other's thinking, clarify their own ideas and add to others' ideas, pose questions, respectfully agree or disagree, and offer evidence to support their claims. Math discussions also help us, as educators, identify learning gaps or misconceptions and assess which students may need further reinforcement.

Math talk is more than just presenting to one another. It involves active listening and a clear focus on mathematical content. While sharing various strategies is beneficial, deeper conceptual understanding emerges through discussions about the mathematical thinking underlying those strategies and how they connect to the big ideas. As Chapin and colleagues explain, our goal should be to "increase the amount of high-quality talk in our classrooms – the mathematically productive talk" (Chapin, O'Connor, & Anderson, 2009, p. 6). Chapin recommends strategically integrating the following 'math talk moves' into all discussion to maximize student participation and active listening.

Math Talk Moves

Talk Move	Description	Example
Wait Time	Teacher waits after posing a question before calling on a student, so all students can think.	- Wait at least 10 seconds after posing a question. - If a student has trouble expressing themselves, say "Take your time."
Repeating	Teacher asks students to repeat or restate what another student has said, so more people hear the idea. It encourages active listening.	"Who can say what _____ said in their own words?"
Revoicing	Teacher restates a student's idea to clarify and emphasize, and then asks if the restatement is correct. This can be especially helpful for any students who may need support with the language.	"So you are saying…. Is that what you were saying?"
Adding On	Teacher encourages students to expand upon a proposed idea. It encourages students to listen to peers.	"Can someone add on to what _____ just said?"
Reasoning	Teacher asks students to respond to other students' comments by contributing and justifying their own ideas.	"Who agrees? Who disagrees?" "You agree/disagree because _____." (sentence starter)

For these rich discussions to happen, we as educators need to have a strong understanding of the math content. In this resource, the lessons have an About the Math section that describes the mathematical concepts to bring to the forefront during discussions. Each lesson incorporates several opportunities to discuss the math before, during, and after the learning activities, either as a whole class, in a small group, or with a partner. Possible prompts and questions are also provided.

While students may have budding understanding of various concepts, they need support with the math language that will allow them to express their ideas and discuss them with others. A variety of Math Talks have been included with many of the lessons and can be flexibly used in a variety of ways to help students further develop their mathematical thinking through verbal language and discussion. They are excellent for reinforcing and extending new ideas introduced in the lesson and to assess where students may need further instruction. The Math Talks are 5–15 minutes in length, and support learning of concepts in all math

Math Talks may be used at the beginning or end of a lesson, or whenever there are 5–15 free minutes during the day.

strands by stimulating rich dialogue and discussions with the whole class or small groups. Sample dialogue is provided for each Math Talk to show how to have the key mathematical ideas emerge in the discussions. To maximize effectiveness, it is important to integrate the math talk moves.

Math Talks can be used at the end of a lesson to offer further consolidation on a specific concept that still seems rather shaky or not fully developed. They can also be used at the beginning of the next day's lesson to refresh what was investigated the day before and clear up any misconceptions. You may decide to use a Math Talk part way through a lesson if students are struggling with the problem solving and need some clarification of a skill or idea before they can move on. Math Talks can also be used throughout the day when there are 5–15 free minutes between planned tasks, since they require little time and preparation. The more students talk about math, the more they will understand and retain.

The Math Talks can be repeated or altered, for example, by changing the numbers, visuals, or tools used. Pick and choose from the prompts provided to ensure they meet your learning goals and the needs and abilities of your students.

The (optional) Partner Investigations should last about 5–10 minutes and can extend the Math Talks. The (optional) Follow-Up Talks are used to briefly summarize students' findings from the investigations and clarify their thinking.

It is also important to establish a supportive 'talk' environment, with interaction that extends beyond 'teacher-student' dialogue to include student-to-student discourse. This takes time and practice. Have students model situations that allow them to role-play discussions with one another. You can facilitate by posing comments and questions that promote interactive talk. For example, you can ask students to state in their own words what another student has just said, ask if they have anything to add, or whether they agree and why. Through such talk experiences, students value learning from each other and can gain self-confidence in their own abilities.

Balanced Math and Instructional Approaches

The instructional approaches are based on the "continued need for balance between conceptual and procedural understanding of foundational skills, including fluency with basic facts" (British Columbia Ministry of Education, 2016).

Math Place is based on the belief that all students can learn math, although not necessarily in the same way. The instructional approaches are based on the "continued need for balance between conceptual and procedural understanding of foundational skills, including fluency with basic facts" (British Columbia Ministry of Education, 2016). Lessons and activities reflect a focus on problem solving, which is evident in the Curricular Competencies that use a problem-solving model, as well as the importance of the foundational skills indicated in the Content section. A balanced instructional approach is used, which includes:

- Building understanding through problem solving and the use of the curricular competencies
- Consolidating understanding through related discussions and application of concepts and skills to new situations
- Practising newly acquired concepts and skills in meaningful ways
- Acquiring computational fluency of facts and operational skills

Some components of a balanced math program offered in *Math Place* are:

- **Shared Math**

  Students collaboratively problem solve with a partner or in small groups, allowing them to communicate and build upon each other's thinking and to represent the math in various ways, using concrete materials, drawings, and words. While problem solving, students share and refine their mathematical thinking, which they can later contribute to the Consolidation discussion.

- **Guided Math**

  These lessons allow you to tailor instruction to a small group of students with similar needs or strengths. For more on Guided Math, see pages 25–27.

- **Independent Math**

  Students independently solve problems relating to concepts they have learned and investigated. This offers an excellent opportunity to demonstrate their learning without the assistance of group members. Suggestions for independent problem solving are located in the Further Practice section.

- **Consolidation Through Related Discussions**

  Whole-group or small-group discussions are critical since they bring students' thinking to the forefront and allow students to communicate their ideas and representations. You, as teacher, make the connections between students' solutions explicit and clarify how they reveal the big ideas in mathematics.

- **Reinforcement Activities**

  Students engage in meaningful activities and games that reinforce recent concepts and proficiency with calculations. The games and activities encourage interaction and communication, and support the development of self-confidence and positive attitudes toward math.

- **Math Journals**

  Math journals foster communication as students respond to prompts that encourage them to reflect on their learning, attitudes, and feelings. Journals also serve as an ongoing record and assessment tool of how student thinking evolves over time.

  An appropriate time to use math journals naturally emerges after the Consolidation discussion, when interesting ideas, misconceptions, or feelings arise that are worthy of further exploration. Students can reflect on what was discussed in relation to their own thinking. Examples of prompts for math journals are found in the Further Practice section.

  Since grade one students are still learning to read and write, they are encouraged to record their ideas in a variety of ways. For example, they can draw pictures, print simple words and sentences, record their verbal explanations using technology, or take photos of their representations. You can also scribe students' explanations or annotate their work.

Three-Part Problem-Solving Lessons

Problem-solving lessons incorporate a balanced approach and are organized into three parts, including Minds On, Working On It, and Consolidation.

Minds On

The Minds On session is intended to activate prior knowledge, create a context for the problem, and introduce conventions or concrete materials that may be used in the problem-solving part of the lesson. Various experiences, such as how to choose or use materials, and activities can be modelled with the students before asking them to do it independently.

Ideally, the whole class is involved and the focus is on having students engage in rich conversations about the math.

Students may initially turn and talk with a partner to suggest and refine ideas, which can later be shared with the whole class. While class discussions may be challenging for grade one students at the beginning of the year, prompts from the teacher can spark conversations. Important questions to ask may include:

- Where might we start?
- How is your idea like Jack's thinking?
- How can you add on to Jack's ideas?
- Do you agree with what Jack said? Why?
- Can you solve it in a different way than Jack did?
- How can you prove your thinking?

Students who may lack the vocabulary to explain their ideas can use concrete materials to show what they are trying to convey. The discussions during Minds On activities also serve as formative assessment opportunities, since they uncover students' understanding of the math and their misconceptions. They can also reveal when it is time to step back and explore ideas further before continuing on with the lesson.

This is a time for you to observe the students in action, assessing and documenting students' strategies, and how they may change or adapt their approach throughout the problem solving.

Working On It

The Working On It session involves students solving problems, either independently, in pairs, or in small groups. This is a time for you to observe the students in action, assessing and documenting students' strategies, and how they may change or adapt their approach throughout the problem solving. You can pay attention to how students communicate their ideas, through verbal expression, written words, drawings, and/or symbols, or through their actions with concrete materials.

It is important to give students time to reflect and to devise their own problem-solving plan, rather than steering them toward methods that we perceive as valuable. If students are truly 'stuck,' asking a few prompting questions rather than rescuing them can help them move forward. For example, you can ask students:

- What do you think you are supposed to find?
- What do you know about the problem?
- How might you begin?
- Is there a tool that can help you?
- What if the number was 5? How might you solve it then?

Consolidation

During Consolidation, the class or small groups convene to discuss the problem-solving strategies, the mathematical thinking, and the math concepts that emerge throughout the process. This is a critical component of the lesson and is more than just sharing students' strategies and solutions. It is not necessary or practical to have all students explain their solutions. To focus the discussions, strategically select two or three pieces of student work that align with your learning goal and show the progression of thinking in the class.

The critical aspect of all consolidations is the dialogue that clarifies, connects, and summarizes the mathematical thinking and concepts.

Asking students why they took a certain approach or why they think their solution is reasonable promotes reflection and class discussion. You play a significant role by actively listening to what students are saying, rather than listening for what you want to hear. It is also important to encourage students to listen to each other and to ask questions so they are involved in reflection, as well as in justifying their thinking.

As the mathematical concepts emerge, you can ask questions that clarify students' ideas. You can also make connections between students' representations, and ensure that the main learning goal of the lesson is brought to the forefront. Prompts to promote discussion may include:

- How do you know that your solution is reasonable?
- Could there be another solution? How do you know?
- How is your thinking like Jack's thinking?
- Can you tell me in your own words what Jack just said?
- What is the same about these two solutions?
- Where do you see this solution in this other solution?
- What strategy did Jack use?
- How are these two strategies different?
- Do you have a question for Jack?
- After what we did today, what do you wonder about?
- What is the most important math that we learned today?

To help students to consolidate the problem-solving strategies, mathematical thinking, and math concepts, you need to understand the math and how it develops in young students. This information is in the About the Math section for each lesson (or set of lessons) to support you in the consolidation phase, so you can ask questions to move students' thinking and learning forward.

You can alter the delivery of the consolidation by offering a variety of formats, such as gallery walks. The critical aspect of all consolidations is the dialogue that clarifies, connects, and summarizes the mathematical thinking and concepts. This is the area of focus in the lesson consolidations.

Flexibility is key, and if a wonderful math moment arises, it is best to embrace it, further investigate it, and then celebrate the learning.

Flexibility in the Lessons

Any of the three parts of the lessons and timing can be altered according to students' needs and scheduling. For example, a Minds On activity may be extended to be the problem of the day, or the Consolidation may become the main activity for the next day. Flexibility is key, and if a wonderful math moment arises, it is best to embrace it, further investigate it, and then celebrate the learning.

Balanced Problem Solving

During the Working On It sessions of the three-part lessons, it is important to be flexible about whether students engage in guided, shared, or independent problem solving, even if the lessons recommend a certain approach. If the concept is relatively new and students are still investigating it, shared problem solving allows students to work together to try out several different approaches, offering each other mutual support. You may decide to have them work in pairs or small groups, depending on your students' collaborative skills.

If a concept has been previously explored in groups, you may decide to have some or all students solve a similar problem independently to assess individual understanding. This is important since students who may solve a problem in a group may not have internalized the concept well enough to find a solution on their own.

It is also important to be flexible throughout the lesson, based on your observations. For example, if students are struggling independently, you may decide to team them up with others who are also having difficulty or with those who are on the verge of a solution. If you want to offer some instruction that is tailored to a specific group, you may decide to sit with those students and offer a guided math lesson as they solve the assigned problem. Ongoing observations before and during the problem-solving process help to make these decisions.

Whole-Group Lessons

In a three-part lesson, students often meet as a whole group in the Minds On and Consolidation sessions, while working in small groups at the actual problem solving. Sometimes, the entire lesson is done with the whole group, or with a smaller group. The flow of a whole-group lesson follows the three-part lesson structure, offering an activity to activate prior knowledge, a problem to solve, and a consolidation to discuss the

learning. It is important to integrate the math talk moves (see page 18) throughout all parts of the whole-group lessons to maximize student participation and active listening.

These whole-class lessons are beneficial since they create a community of mathematicians who feel they can safely work together in a risk-free environment to make sense of the math.

Guided Math Lessons

Guided math lessons are intended to offer instruction and support to small groups of students on any concept, process, or skill that you deem necessary. For example, while the rest of the class solves problems with partners in a Working On It session, or is engaged in centre activities, you can provide personalized and differentiated support to a small group by addressing the students' needs.

You join the group as a coach rather than a leader, listening carefully and being responsive to what students are saying and doing. Rather than 'rescuing' students by offering them solutions, you can ask probing questions to uncover and clear up any misconceptions, and move the learning forward by proposing various ideas. For example, you may ask how the problem would change if a new element were added, or whether their thinking could work with other numbers.

During the session, you can continually assess what students understand, offering 'in-the-moment' remediation and devising steps to address areas that require further instruction or practice.

Managing Guided Math Lessons

A fundamental concern is what to do with the other students while you are working with a small group. There are several options.

- During the Working On It section of a three-part lesson, students are engaged in problem solving, either in partners or in small groups. You can join one of these small groups and either offer a guided math lesson using the same problem, or use another activity that focuses on a more specific concept that the group finds difficult to understand.

- In some cases, you may wish to meet with all students in small groups on the same concept, but differentiate the instruction according to the needs of each group. Math centres that reinforce related concepts can be set up, and the students can rotate through them, including the guided math lesson. Alternatively, students can practise skills through games and online activities, or further explore various concrete materials.

Sample of Rotation Schedule

Activity/Day	Group A	Group B	Group C	Group D
Session 1	Guided math lesson with teacher	Centre 5	Centre 4	Centre 3
Session 2	Centre 2	Guided math lesson with teacher	Centre 5	Centre 4
Session 3	Centre 3	Centre 2	Guided math lesson with teacher	Centre 5
Session 4	Centre 4	Centre 3	Centre 2	Guided math lesson with teacher
Session 5	Centre 5	Centre 4	Centre 3	Centre 2

- The key is to get your students to be able to work for 15 minutes independently, without relying on your guidance. This can be achieved by practising routines early in the year.

  Make a chart of things that students can do if they get 'stuck,' rather than asking you. The way in which the activities are initially introduced is critical to this process so students are clear on the expectations and questions can be addressed. It can be beneficial to have some students model the process of the activities or games in front of the class, while you explain the task.

Guided Math Lessons Using Math Little Books

In the resource, there are two guided math lessons per module that use a fiction or non-fiction book to uncover the math. The purposes of guided math lessons in relation to the little books are to:

- offer context for the math
- help students see the relevance of math in their lives and recognize the value of becoming proficient at solving problems

- use the text to help students develop math strategies for solving the problems
- monitor and assess students' mathematical understanding of concepts and abilities to apply skills in new situations
- monitor and assess students' problem-solving abilities in terms of the mathematical processes, such as reflecting and connecting

Further Practice

At the end of many lessons, there are activities that offer additional reinforcement and practice of skills and concepts, often in a different context, so students can apply what they have learned to new situations. These activities can be completed by the whole class, small groups, partners, or individuals.

Students need individual time to practise since they may be successful solving problems with others, but have more difficulty when tackling a problem on their own. Examples of problems for students to solve independently and prompts for math journals are also offered in this section. All activities, including journal tasks, can contribute to ongoing assessment for learning as they are excellent indicators of students' understanding.

Reinforcement Activities

At the end of some units are reinforcement activities that can be used anytime throughout the unit, either as whole- or small-group activities, or as centres. They offer further practice of skills and concepts. While problem-solving lessons may introduce or even extend understanding of a concept, students still require practice time to clearly consolidate their thinking and become more proficient at applying skills in different situations.

Assessment

'Assessment for Learning' to guide future instruction is critical to determine whether students have mastered a concept, which students need more reinforcement, and what the next steps might be. It is important to assess during the problem-solving process through observations and conversations. Assessment Opportunities, which are embedded throughout the lessons, offer suggestions about possible observations and conversations that can take place to bring to the forefront students' mathematical thinking related to the learning goals.

It is important to listen to what students are saying and not question or 'rescue' them right away.

Observational Assessment

Making observations while students are problem solving can be very revealing. It is important to listen to what students are saying and not question or 'rescue' them right away. Watch what students are doing with the tools and what strategies they are trying. Is it trial and error, or are they adopting a strategy that they saw in a previous consolidation?

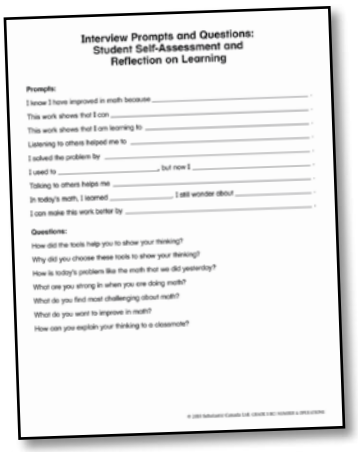
Conversational Assessment

If students appear 'stuck,' you can offer assistance by providing a prompt rather than by telling them what to do. Prompts might include:

- What might you do to start?
- What have you done so far?
- What do you find challenging or confusing?
- Can you explain to me what you think the problem is about?
- Tell me in your own words what you think you need to do.
- Could another tool help you?
- What do you visualize when you think about this problem?

Listen carefully to what students are actually saying, rather than paying attention to what you hope to hear. Much can be learned from students' explanations for their actions, but it is often difficult for young students to express their ideas in words. To encourage students to explain their thinking, try using prompts to get them started. Prompts might include:

- How did you solve this problem?
- Tell me what you did here.
- Why did you move those blocks over here?
- Does your solution seem reasonable?
- Explain or show me how you organized your ideas.
- Will your solution/strategy work every time? How do you know?
- How else could you show your thinking?


Interview Prompts and Questions:
Student Self-Assessment and
Reflection on Learning

Prompts:

I know I have improved in math because _____

This work shows that I can _____

This work shows that I am learning to _____

Listening to others helped me to _____

I solved the problem by _____

I used to _____, but now I _____

Talking to others helps me _____

In today's math, I learned _____. I still wonder about _____

I can make this work better by _____

Questions:

How did the tools help you to show your thinking?

Why did you choose these tools to show your thinking?

How is today's problem like the math that we did yesterday?

What are you strong in when you are doing math?

What do you find most challenging about math?

What do you want to improve in math?

How can you explain your thinking to a classmate?

You can also hold individual conferences with students to help them reflect on their learning. See page 41 for *Interview Prompts and Questions: Student Self-Assessment and Reflection on Learning*. Select the prompts and questions that are most suitable for your students. A modifiable BLM version of this page is available on the Teacher's Website.

Possible Learning Goals and Teacher Look-Fors

Since students frequently work in groups or partners as they problem solve, it can be challenging to know whether all students understand the math, or which ones need more reinforcement. Students can often collaboratively work through a problem, but struggle when they work individually. A similar problem may be given for students to solve independently after the Consolidation to assess which students fully grasped the concept, have partial understanding, or have misconceptions.

Included in the lessons are examples of possible learning goals that can be reworded with the class so they are in meaningful student language. Also included are examples of Teacher Look-Fors that can be used to discern whether students have mastered a concept, and which students need more reinforcement. The suggestions will help you focus your observations as students solve problems so you can recognize gaps in their understanding and application of concepts. The Teacher Look-Fors can be used as a guide for co-creating success criteria with your students. Additionally, modifiable *Observational Assessment Tracking Sheets* based on the Teacher Look-Fors can be found on the Teacher's Website.

Meeting the Needs of All Students

Student Recording of Thinking

Grade one students are in the early stages of writing and may find it difficult to record their thinking while problem solving. It is therefore important that students have several ways to express their ideas. For example, they can verbally state an idea and a teacher can scribe by writing, or record it using technology.

Students should use concrete materials to represent their ideas, which can serve as a focal point for getting students to verbally explain what they did. Paying attention to their actions with the tools, asking what their model represents or why they moved some parts can be very revealing. It is valuable to take photos of students' models so they can be discussed during the consolidation.

Students should also express their thinking through drawings, symbols, and/or written words. In some of the earlier lessons, Blackline Masters (BLMs) are suggested to help students organize and express their ideas in writing. Later in the year, students are given more flexibility in how they wish to express their thinking. For example, you might provide them with a blank piece of chart paper to record their ideas (chart paper cut into halves or fourths is good since the work is big enough to be seen by all in whole-group discussions). Students can use markers to record their ideas, and if they switch their thinking, to 'x' out the part they are no longer using, rather than trying to erase or completely cover it up. In this way, you can better follow the students' thinking processes when examining their work. It also reinforces the idea that mistakes are valuable learning opportunities. It is important to pay more attention to the thinking that students are expressing, rather than the actual written product, since the work may not be reflective of what they actually know. Questioning allows students to expand upon their work with verbal explanations.

Flexibility in Grouping Students

Students need opportunities to work on their own and to collaborate with others. They also need practice time to consolidate or 'mathematize' what they have learned and to apply it in various ways to new situations within meaningful contexts.

In many of the lessons, although it is suggested that the Minds On and Consolidation activities take place with the entire class, these activities can also be carried out with small groups. Throughout these sessions, students can 'turn and talk' with a partner to discuss an idea before presenting it to the rest of the group. Students also learn to listen to each other and to respond to their peers' ideas.

Throughout the lessons, it is often recommended that students engage in the Working On It problem solving in partners. This is often better than groups of four or five, since all students may not interact or express their ideas in larger groups.

With partners, students also need to learn how to collaborate. At first, they may just sit side by side and solve the problem individually. A few prompts from you can encourage interaction. For example, you may ask a question and have both students answer parts of it, or you may encourage one student to explain to the other what he/she is thinking or doing. Over time, students will become more proficient at working together and creating a collaborative solution.

It is helpful if students work with many different partners throughout the year so they can benefit from different ideas, strategies, and points of view. Although partners are recommended, there may be times when you decide to have students work individually or in small groups, depending on the circumstances in your class.

Differentiation

Lessons and problems can be differentiated to meet the specific needs of students.

Lessons and problems can be differentiated to meet the specific needs of students. For example, by making the numbers simpler or more complex, depending on individual needs, students can work on the same math concept and engage in rich problem-solving tasks, yet work with numbers they understand.

After consolidating a lesson, it may become evident that all or only some students require more experience to master a concept. This can be accomplished by changing the numbers or context to offer a variation of the completed lesson to students who need more reinforcement. Students can also be encouraged to solve the varied problem in another way or use different materials to show their thinking.

It is also beneficial to meet with students in guided math lessons (see description, pages 25–27) as they problem solve, so they can express their ideas and any misconceptions can be identified and clarified. Throughout the lessons and activities, there are suggestions for how to differentiate specific tasks.

English Language Learners

All students need to discuss math and learn the appropriate terms to describe their thinking, but it is a greater challenge for students who have a different first language and are just learning English.

It is sometimes assumed that, since English Language Learners (ELLs) cannot express all of their ideas in English, they require easier math tasks. ELLs actually benefit from collaboratively participating in the same activities as other students. Although they may not share their ideas within the group, they can work with concrete materials and listen to the conversations of others, thereby acquiring mathematical language. They also develop self-confidence as they manipulate the concrete materials and participate within a group.

While ELLs may go through a silent period, they are still learning and processing the math. Since all grade one students need to learn the correct mathematical terms, it is valuable to offer the vocabulary as it arises during the Minds On and Consolidation class discussions. Displaying these terms on the Math Word Wall, and drawing attention to them by playing games on a daily basis, will also help to encourage the use of math vocabulary in all students. In addition, ELLs benefit greatly from having visuals paired with instructions or problems. This can also assist all students who are in the early stages of learning to read.

Teaching Tip

When conversing with beginning ELLs, you may use first language buddies so students can think in their first language. As well, asking questions for which students can answer by pointing, matching, or choosing between two choices are helpful strategies.

Students with Learning Disabilities

Students with learning disabilities are usually not identified until the later grades. If you have students who have been identified as having a learning disability, it is important to realize that they are average to above average in overall cognitive abilities and should be able to attain the math concepts and skills outlined in the grade-appropriate curriculum by being given accommodations.

Taking an asset-based look at all students is best, identifying their strengths and areas of need. Accommodations can be designed to use their strengths to leverage their needs. For example, a student with a strength in perceptual reasoning and a need in working memory can benefit from having visuals, such as pictures and charts, so they do not have to hold all the information in their minds when solving a problem. These accommodations can be offered to any students who may benefit from the additional support.

Students with learning disabilities benefit from working with their peers in group situations, since the collaborative interaction gives them support, rather than the feeling of isolation that can be created when working alone.

Building a Math Word Wall with students is more meaningful than putting up premade words all at once.

Math Vocabulary and the Math Word Wall

Each lesson highlights the math vocabulary that pertains to the lesson, including terms that were previously learned but are important to current understanding, or new vocabulary. Rather than introducing vocabulary before the lesson, it is more meaningful to highlight or introduce the words as the related concept arises within the lesson. This provides students with an immediate example of a term that is relevant to what they are doing. If students describe a math concept in common language or through their physical model, offer the formal mathematical term and clearly link it to its meaning and an example. At this point, add the word to the Math Word Wall.

Building a Math Word Wall with students is more meaningful than putting up premade words all at once. As vocabulary arises in class, print the words on cards so they are visible from any point in the room. They can also be accompanied by a visual, which conveys word meaning, and arranged by strand so related words are together.

Every couple of days, take two or three minutes to ask questions about the Math Word Wall. For example, you can ask, "I am thinking of a word that means 'the same as'," or "What do you know about a dime?" This can also be done incidentally, for example, while students are waiting in line. It is important to draw attention to words that were used previously so students remember their meanings over time.

During a lesson, if a student describes a concept without using the mathematical term, it is an excellent opportunity to offer or ask for the vocabulary and have students locate it on the Math Word Wall. These activities do not take a great deal of time or effort to create or reinforce, but the benefits are substantial as students naturally integrate the vocabulary into their oral dialogue and written responses.

Cross-Curricular Connections

Language Arts/Literacy

Read Alouds

Read Aloud sessions are also intended to instill a love of math and an appreciation of its importance in students' everyday lives.

Read Aloud sessions, which involve the teacher reading a text to students, are intended to instill a love of reading. They offer opportunities for students to experience various text types and the reading strategies that unlock meaning in the story.

In mathematics, Read Aloud sessions are also intended to instill a love of math and an appreciation of its importance in students' everyday lives. Stories set the context and meaning for math, and provide opportunities to apply the curricular competencies and fundamental big ideas that are integral to problem solving. They set the stage for students to be powerful mathematicians engaged in solving problems that relate to their lives.

The Read Aloud lesson plans describe a first and second focus for the text. The first reading segment allows students to enjoy the story, and acquire understanding of the key ideas through application of comprehension strategies. This sets a meaningful context for the math that is embedded in the text, and the follow-up math lessons and investigations.

During the second reading segment, the focus is on the math. Students apply the curricular competencies to understand the concepts, unlock ideas, and ask questions that emerge from the math presented in the story.

The following Literacy and Mathematics Links chart highlights how the reading behaviours and strategies, and the curricular competencies and big ideas are linked. Both support each other as students gain greater comprehension of literacy and math in their lives.

While not exhaustive, these links reveal how the strategies and curricular competencies are not distinct entities, but interplay throughout the thinking process as students make sense of their world.

Literacy and Mathematics Links	
Language Arts/Literacy	**Mathematics**
Curricular Competencies: What students do **Comprehend and Connect:** Prior Knowledge/ Reading, Listening, and Viewing Strategies to Make Meaning; Metacognitive Strategies	**Curricular Competencies:** What students do **Reasoning and Analyzing** **Understanding and Solving** **Communicating and Representing** **Connecting and Reflecting**
Making Connections/Using Prior Knowledge: Associating ideas in the text to previous knowledge and their own lives	**Connecting and Reflecting:** Making connections among mathematical concepts and relating the math to situations in their lives, and to First Peoples worldviews and perspectives
Predicting: Exploring text and illustrations to anticipate what will happen next	**Reasoning and Analyzing:** Exploring math and making connections, developing mental math strategies, estimating reasonably to make predictions so decisions can be made
Inferring: Using previous knowledge and ideas from the text to 'read between the lines' and make meaning of what is not explicitly written	**Understanding and Solving:** Applying mathematical understanding and multiple strategies to problem solve, using different perspectives
Metacognitive Strategies (reflecting and self-evaluation)**:** Intentionally monitoring thinking throughout the reading process so they can adjust their thinking and select comprehension strategies that will allow for better understanding	**Reflecting and Analyzing:** Intentionally reflecting on thinking throughout the problem-solving process so they can adjust strategies and judge the reasonableness of a solution
Visualizing: Creating pictures in the mind while reading text	**Understanding and Solving:** Visualizing to explore math through spatial thinking (e.g., create a mental picture that represents a quantity) and to problem solve from various perspectives
Analyzing: Finding information that is on the page in various forms including illustrations, diagrams, and text	**Understanding and Solving:** Developing mathematical understanding through inquiry and problem solving **Communicating and Representing:** Representing mathematical thinking using concrete materials, graphs, and diagrams
Evaluating: Forming opinions and modifying or confirming them while reading	**Reasoning and Analyzing:** Forming conjectures while problem solving and then proving or disproving them through investigations
Synthesizing: Filtering through details, linking to underlying key concepts, and formulating new understanding	**Communicating and Representing:** Sharing, analyzing, and justifying solutions; representing math concepts in a variety of ways **Connecting and Reflecting:** Reflecting on thinking and connecting math concepts to each other and to other areas and personal interests

The reading is intended to create context, but should not interfere with the problem solving or students' abilities to uncover the math.

Math Big Book and Little Books

Several fiction and non-fiction math texts are included in *Math Place*. A big book (also provided in eight little book versions and as a digital text), along with eight copies each of one fiction and one non-fiction little book are included for each module. These books present math in a relevant and meaningful way, and connect the math to students' lives. The intent of including these books is to view math within a relevant context that helps students understand the problems to be solved.

These texts are not intended for independent reading but can be read to, or with, students. The reading is intended to create context, but should not interfere with the problem solving or students' abilities to uncover the math.

Science and Other Curriculum Areas

Students gain a better appreciation for how math is used in their world when it is connected to other subject areas. For example, in Number and Operations, some grade one science topics are integrated into the lessons to provide meaningful context for the math so students can make connections to their lives and across subjects. They can also apply what they have learned in science to better understand the math. For example, as students learn about the characteristics of living things, they are sorting and categorizing plants and animals by their features and needs. One of the Big Ideas in science that is addressed in this resource is, "living things have features and behaviours that help them survive in their environment" (British Columbia Ministry of Education, 2016).

Instilling a Growth Mindset Lesson

About the Lesson

In this lesson, as students collaboratively work through the problem-solving process, they engage in the thinking that mathematicians exhibit, thereby discovering what constitutes a growth mindset. Together with students, you can co-create an anchor chart of these characteristics including what they look and sound like. Throughout the year, regularly refer to and reinforce the messages in the chart by recognizing students' efforts as they persist through various math challenges. The chart can also inspire the celebration of students' accomplishments as they arise. Embedded within many of the lessons in the Teacher's Guides are suggestions on how to further build and reinforce a growth mindset based on the activities that students have just completed.

Whole-Group Lesson:

Minds On (15 minutes)

Materials:
class hundred chart, chart paper

Time: 25 minutes

- *I am thinking of a secret number. It could be any number on this hundred chart, so it could be from 1 to 100. Turn and talk to your partner about what you think my number might be.* (Build up excitement about finding out your secret number.)
- Ask only one pair of students what they think the number is. *No, that isn't my number. Too bad. Let's go on to something else.* (Most likely, other students will still want to guess and you can let that excitement build.)
- *Why would you want to guess again? You didn't get it right the first time.* Discuss some of their reasons. *So, you still want to play the guessing game?*
- *I will give you a clue. My number is larger than 5 and less than 95. Turn and talk to your partner, and put your thumb up when you have chosen a number.*
- Select only one pair of students to guess your number. *No, that is not my number. I let you guess two times, and you didn't get it. So the game is over now.*

- *Oh, you still want to play some more? What questions would you like to ask me? You can't guess what number it is. You have to ask questions about the number like the clue I gave you. Turn and talk to your partner and decide on a question.*
- Take some questions and answer them. They may ask, "Is it bigger than 10? Is it less than 50?" Offer an example of a question if they run out of ideas, such as "Is there a 4 in the number?" Then let them guess the number until they are correct.

Working On It (5 minutes)

- *I am so proud of your efforts for finding out my secret number. You are true mathematicians—people who love math and work hard to solve problems. Let's talk about how you are mathematicians.* Pose some of the following prompts and, based on students' responses, record the key messages about growth mindsets on an anchor chart.
  - *How did you feel when I asked you to guess my secret number?* (e.g., curious, puzzled, not sure, excited) **Mathematicians are curious about math and want to learn more.**
  - *What did you think of the problem at first?* (e.g., it seemed hard; too many numbers to choose from, etc.) *Did you still want to try it?* **Mathematicians like challenges, even if they seem hard at first.**
  - *How did you feel when I only let you have one guess? Did you want to stop?* (e.g., disappointed; sad; I wanted more turns) **Mathematicians don't give up.**
  - *What did you do for your second guess?* (e.g., We thought about your clue to pick a different number.) **Mathematicians try different strategies if they don't find the solution the first time.**
  - *How did talking to your partner help?* (e.g., We thought of new questions together; we talked about your clue.) **Mathematicians talk to and work with others to get ideas.**
  - *What helped you figure out my secret number?* (e.g., asking questions; looking at the hundred chart) **Mathematicians ask questions and use tools to help them.**
  - *Many of your guesses were mistakes. Did they help you in any way?* (e.g., We knew that those numbers were not the right ones, so we tried other numbers. It helped us ask new questions.) **Mathematicians learn from their mistakes. Mistakes help us do things better.**

– *How did you feel partway through guessing my secret number?* (e.g., We were getting closer, but we needed more time to think of new ways and to keep trying.) **Mathematicians may not know the answer YET, but will find out with more time and effort.**

– *How did you feel when you finally found my secret number?* (e.g., proud; excited; happy, etc.) **Mathematicians believe that they can do math, and are proud that they solve problems.**

– *Do you think you could answer a riddle like this again? What might you do differently?* (e.g., We would ask different questions; We would cover numbers on the hundred chart that weren't correct so we could keep track.) **Mathematicians keep finding new tools and strategies to help them learn more about math.**

Consolidation (5 minutes)

- *We have discovered what mathematicians do. We are mathematicians and we have the whole year and the rest of our lives to learn more about math and be better mathematicians. It is going to be an exciting journey for us this year. We are going to keep this chart up in the room to remind us how we can become good mathematicians. It starts with having a growth mindset. That means we can help our minds to grow if we believe in ourselves and keep on trying.*

Sample Growth Mindset Statements:

- I will keep trying and not give up.
- What can I try instead? What materials and tools can I use to help me?
- Mistakes help me do things better. They help my brain grow.
- My hard work and practice will help me learn.
- I may not know YET, but I will find out with more time and hard work.
- I believe that I can do math if I try.

Interview Prompts and Questions: Building Growth Mindsets and Positive Attitudes

NOTE:
See the Teacher's Website for a modifiable version of these prompts and questions.

Prompts:

I like math because _____.

What I like the best about math is _____.

When I get stuck on a problem, I _____.

A mistake I made was _____. It helped me to learn _____.

When I make a mistake, I _____.

I don't know about _____ YET, but I can _____ to learn more.

I think and work like a mathematician when I _____.

I am a mathematician when I _____.

When I feel like I am going to give up, it helps me to _____.

Questions:

What did you do today in math to make you think hard?

What is a mistake that you made that taught you something? What did you learn?

What made you keep going when this problem got hard?

What did you do to challenge yourself today?

What do you wonder about after what we have learned in math?

How can the math we are learning help you in your life?

How does math help you in your life? In your family's life?

Interview Prompts and Questions: Student Self-Assessment and Reflection on Learning

NOTE:
See the Teacher's Website for a modifiable version of these prompts and questions.

Prompts:

I know I have improved in math because _____.

This work shows that I can _____.

This work shows that I am learning to _____.

Listening to others helped me to _____.

I solved the problem by _____.

I used to _____, but now I _____.

Talking to others helps me _____.

In today's math, I learned _____. I still wonder about _____.

I can make this work better by _____.

Questions:

How did the tools help you to show your thinking?

Why did you choose these tools to show your thinking?

How is today's problem like the math we did yesterday?

What are you strong in when you are doing math?

What do you find most challenging about math?

What do you want to improve in math?

How can you explain your thinking to a classmate?

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Lead Author: Diane Stang, National Math Consultant for Scholastic Education

Math Reviewers:
Tamara DeFord, Prince George School District #57
Tawnie Hildebrandt, Abbotsford School District #34
Katie McCormack, Kamloops/Thompson School District #73
Debbie Nelson, Comox Valley School District #71
Kenneth Wandeler, Vernon School District #22

Indigenous Consultant: Diane Jubinville, Delta School District #37

Additional Indigenous Content: Anika Guthrie

Director of Publishing: Molly Falconer
Project Manager: Jenny Armstrong
Photo Researchers: Sundus Butt, Mary Rose MacLachlan
Copy Editor: Wendy Scavuzzo
Proofreaders: Sundus Butt, Danielle Arbuckle
Art Director: Kimberly Kimpton
Designer: Noel Upfield
Production Specialist: Pauline Galkowski-Zileff

175 Hillmount Road, Markham, Ontario, Canada, L6C 1Z7

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British Columbia

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Lead Author for *Math Place* and National Math Consultant

Diane Stang

Diane Stang has been an educator for over 40 years, working in various roles in the public and private sector. She began her career as a classroom and special education teacher in Ontario and British Columbia, and later, as a systems resource coach. Next, she became a student achievement officer for the Ontario Ministry of Education, supporting educators in all subject areas, especially in mathematics. She also developed several math video resources to assist teachers in adopting effective instructional pedagogy and increased math content knowledge. Diane has always advocated for equitable education and has devoted considerable time to supporting students with learning disabilities in math. Diane is now working as National Math Consultant for Scholastic Education.

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