Overview of *Foundations of Mathematics 10*

The McGraw-Hill Ryerson *Foundations of Mathematics 10* program has five components.

Student Text

The student text introduces topics in real-world contexts. In each numbered section, **Investigate** activities encourage students to develop their own understanding of new concepts. **Examples** present solutions in a clear, step-by-step manner, and then the **Key Concepts** summarize the new principles. **Discuss the Concepts** gives students an opportunity to reflect on the concepts of the numbered section, and helps you assess students' grasp of the new ideas and readiness to proceed with the exercises.

Practise the Concepts questions are single-step knowledge questions and assist students in building their understanding. **Apply the Concepts** questions allow students to use what they have learned to solve problems and make connections among concepts. **Extend the Concepts** questions are more challenging and thought-provoking. Answers to Practise, Apply, and Extend questions are provided at the back of the text. A **Chapter Problem** is introduced in the **Get Ready!** section of each chapter. Students revisit different aspects of the problem in the numbered sections, leading up to the **Chapter Problem Wrap-Up** at the end of the chapter. **Chapter Tasks** are more involved problems that require students to use several concepts from the preceding chapters. Solutions to the Chapter Problem Wrap-Up and Chapter Tasks are provided in the Teacher's Resource.

A **Chapter Review** of skills and concepts is provided at the end of each chapter. Questions are organized by specific numbered sections from the chapter. **Cumulative Reviews** are provided after Chapters 2, 5, 8 and 9 and help prepare students for the Tasks.

The **Skills Appendix** provides examples and additional practise questions for the skills in the Get Ready sections. The **Technology Appendix** provides instructions on the use of *The Geometer's Sketchpad*® and TI-83+/84+/89 graphing calculators.

The text includes a number of items that can be used as assessment tools:

- **Discuss the Concepts** questions assess student understanding of the concepts
- **Achievement Checks** provide opportunities for formative assessment using the four Achievement Chart Categories, Knowledge/Understanding, Thinking, Communication, and Application
- **Practice Tests** contain multiple choice, short response, and extended response questions to help model classroom testing practices
- **Chapter Problem Wrap-Ups** finish each chapter by providing a set of questions that involve all four Achievement Chart Categories
- **Chapter Tasks** are presented after Chapters 2, 5, 8, and 9 and combine concepts from the preceding groups of chapters

Technology is integrated throughout the program and includes the use of scientific calculators, graphing calculators, dynamic geometry programs, and the Internet.

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At the beginning of the **Student Text** you will find two introductory activities:

- Scavenger Hunt: Explore Your Textbook! (BLM INTRO SH)
- Get Started! (BLM INTRO GS)

We have included a Blackline master for each of these activities in the **Teacher's Resource CD-ROM**. Please see references above.

Teacher's Resource

This Teacher's Resource provides the following teaching and assessment suggestions:

- **Teaching Suggestions** for all the sections
- **Literacy Link** and Career Profile
- **Practice** and chapter-specific blackline masters
- Answers to the **Investigate** questions
- Responses for the **Discuss the Concepts** questions
- Response solutions and rubrics for the **Chapter Problem Wrap-Up** and **Chapter Tasks**
- Students' **Common Errors** and suggested remedies
- Solutions and rubrics for the **Achievement Check** questions
- Suggestions for Ongoing Assessment and Summative Assessment
- **Accommodations** for students with different needs

Student Workbook

The program includes a **Student Workbook** which mirrors the chapters and section organization and sequence of the student text and is cross-referenced to pages in the text. Features include the following:

- A **Warm-Up Guide** which offers hints and techniques to help students answer Warm-Up questions in the Student Workbook
- Tips and hints on how to succeed and do well on Chapter Tests, including preparation and study methods
- Each chapter begins with **Get Set**—a review of Key Skills
- Each section begins with a series of topic-related Warm-Up questions, followed by similarly grouped Practice Questions
- Each chapter concludes with a Chapter Review, including Key Terms
- Student Workbook answers are included in the Teacher's Resource CD-ROM

Computerized Assessment Bank CD-ROM

The Computerized Assessment Bank CD-ROM (CAB) contains questions based on the material presented in the student text, and allows you to create and modify tests. Questions are connected to the chapters in the student text. The question types include: True/False, Multiple Choice, Completion, Matching, Short Answer, and Problem. Each question in the CAB is correlated to the corresponding Achievement Chart Category, specific curriculum expectation, and curriculum strand from the Ontario Mathematics MFM2P Curriculum.

Solutions Manual

The Solutions Manual provides worked-through solutions for all questions in the numbered sections of the student text, except for Achievement Check questions, which are in the Teacher's Resource. In addition, the Solutions Manual provides worked-through solutions for questions in the Review, Practice Test, and Cumulative Review features.

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Web site

In addition to our McGraw-Hill Ryerson Web site, teachers can access the password protected site to obtain ready-made files for *The Geometer's Sketchpad*® activities in the text, information about managing TI technology, further support material for differentiated learners, and many other supplemental activities.

To access this site go to:
http://www.mcgrawhill.ca/books/foundations10
username: foundations
password: math10

Structure of the Teacher's Resource

The teaching notes for each chapter have the following structure:

Chapter Opener

The following items are included in the Chapter Opener:
- **Specific Expectations** that apply to the chapter, listed by strand
- **Key Terms** that will be introduced in the chapter, and which are defined in the margin
- Teaching Suggestions include notes on the Chapter Opener, Assessment, Literacy Link, and Career Profile

Planning Chart

This table provides an overview of each chapter at a glance, and specifies:
- **Student Text Pages** references and **Suggested Timing** for numbered sections
- Related blackline masters available on the Teacher's Resource CD-ROM
- Assessment blackline masters for each section of the chapter
- Special tools and/or technology tools that may be needed

Blackline Masters Checklist

- A useful organizer, by Chapter and Section which lists relevant BLMs and their purpose

Get Ready!

The following items are included in the margin:
- **Student Text Pages** references and **Suggested Timing**
- **Tools** and **Technology Tools** needed for the section
- **Related Resources** (Blackline masters) for extra practice or remediation, assessment, or enhancement
- **Common Errors** and remedies to help you anticipate and deal with common errors that may occur
- **Accommodations** for students having difficulties or needing enrichment

The key items in this section include:
- **Teaching Suggestions** for how to use the **Get Ready!** section
- **Assessment** ideas on how to ascertain that students are ready for this chapter
- Introduction to a **Chapter Problem** that includes questions designed to help students move toward the **Chapter Problem Wrap-Up** at the end of the chapter

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Numbered Sections

The following items are listed in the margin:

- **Student Text Pages** references and **Suggested Timing**
- **Tools** and **Technology Tools** needed for the section
- **Related Resources** (Blackline masters) for extra practice or remediation, assessment, or enhancement
- **Common Errors** and remedies give you ideas on how to help students who make typical mistakes
- **Ongoing Assessment** suggestions give a variety of strategies that can be used to assess the students' learning
- **Accommodations** provide ideas for how to provide assistance to students having difficulties or needing enrichment

The notes in each suggestion include the following key elements:

- **Specific Expectations and Strand(s)** that the section covers in whole or in part
- **Link to Get Ready!** refers back to the relevant part of the Get Ready! section (included in some numbered sections)
- **Warm-Up** and **Warm-Up Answers** provide a short check of the prerequisite skills needed for the section and often include a few Mental Math questions
- **Teaching Suggestions** give insights or point out connections on how to present the material from the text
- **Investigate Answers** let you know the expected outcomes of these activities
- Examples and Discuss the Concepts answers help consolidate students' understanding of concepts from the Investigate activity
- Notes for the **Practise the Concepts**, **Apply the Concepts**, and **Extend the Concepts** questions in the text provide: comments on specific questions to anticipate any difficulties; ways to deal with students' questions; and hints on how to help students answer the questions
- **Achievement Check Answers** are included as are Achievement Check rubrics (as Blackline masters)

End of Chapter Items

The **Chapter Reviews** in the text and Teacher's Resource BLM include the following items:

- **Student Text Pages** references and **Suggested Timing**
- **Tools** and **Technology Tools** needed for the section
- **Related Resources** (Blackline masters) for extra practice or remediation, assessment, or enhancement
- Using the **Student Book Review and Teacher's Resource BLM Review** gives insights on how to present the information in the **Chapter Reviews**
- **Ongoing Assessment** suggestions give a variety of strategies you can use to assess the students' learning

The **Practice Tests** in the text and Teacher's Resource BLM has the following key features:

- **Student Text Pages** references and **Suggested Timing**
- **Tools** and **Technology Tools** needed for the section
- **Related Resources** (Blackline masters) for extra practice or remediation, assessment, or enhancement
- **Study Guide** directs students who have difficulty with specific questions to appropriate examples to review
- **Summative Assessment** refers you to the **Chapter Test** to assess student performance
- **Accommodations** provide ideas for how to provide assistance to students having difficulties or needing enrichment

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- **Using the Practice Tests** gives you insights on how to present the information in the Practice Tests

The **Chapter Problem** includes the following elements:
- **Student Text Pages** references and **Suggested Timing**
- **Tools** and **Technology Tools** needed for the section
- **Related Resources** (Blackline masters) for extra practice and remediation, assessment, or enhancement
- **Using the Chapter Problem Wrap-Up** includes teaching suggestions specific to the problem
- **Summative Assessment** refers you to the **Chapter Problem Rubric** to assess student achievement
- **Sample Response** provides a typical level 3 answer and distinguishes it from a level 2 and level 4 response

A series of **Chapter Tasks** occur at the end of Chapters 2, 5, 8, and 9 and include:
- **Student Text Pages** references and **Suggested Timing**
- **Tools** and **Technology Tools** needed for the section
- **Related Resources** (Blackline masters) useful for extra practice or remediation, assessment, or enhancement
- **Specific Expectations** covered in the Chapter Tasks
- **Teaching Suggestions** with steps for you to follow
- **Prompts for Getting Started** provides a list of questions you can use to help students begin the Task
- **Hints for Evaluating a Response** provides a list of questions you should consider when assessing students' responses
- **Accommodations** provide ideas for how to provide assistance to students having difficulties or needing enrichment
- **Ongoing Assessment** refers you to the **Chapter Task Rubric** to assess student achievement
- **Level 3 Sample Response** provides a typical level 3 answer and distinguishes it from a level 2 and level 4 answer

Cumulative Reviews are included at the end of chapters 2, 5, 8 and 9. The following information is provided:
- **Student Text Pages** references and **Suggested Timing**
- **Tools** and **Technology Tools** needed
- **Related Resources** (Blackline masters) useful for extra practice or remediation, assessment or enhancement
- **Using the Cumulative Chapter Reviews** includes specific teaching suggestions
- **Ongoing Assessment** suggestions give a variety of strategies you can use to assess student's learning

The **Teacher's Resource CD-ROM** provides various blackline masters in PDF and Word format, including:
- Generic Masters
- Tech Masters
- Practice Masters
- Assessment Masters
- Chapter-specific Masters
- This TR CD also contains all **Student Text** answers that were not included in the text itself, all Student Workbook answers, and the entire TR in PDF format.

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Program Philosophy

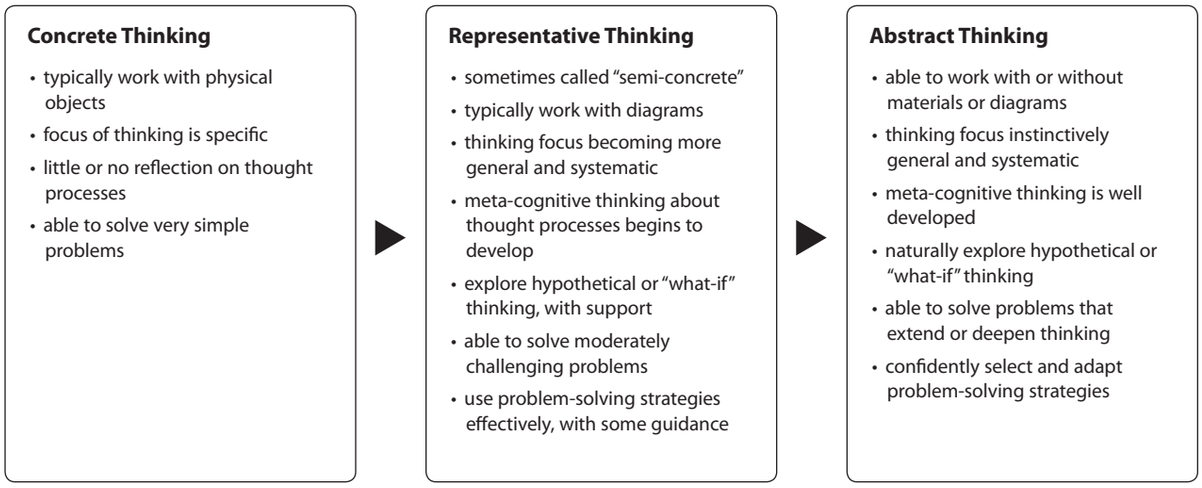
The *Foundations of Mathematics 10* is an exciting new resource for intermediate learners.

The *Foundations of Mathematics 10* program is designed to:

- provide full support in teaching the Ontario MFM2P mathematics curriculum
- enable and guide students' progress from concrete to representational and then to abstract thinking
- offer a diversity of options that collectively deliver student and teacher success

> *Given the changes occurring during adolescence, school administrators and teachers need to consider how best to match instruction to … the developing capabilities and varied needs of intermediate students…*
>
> *The (Foundations of Mathematics 10) program is based on a view that all students can be successful in mathematics… [It] reflects principles of effective practice and research on how early adolescents learn, prerequisites for achieving a balanced approach to mathematics.*
>
> *Creating Pathways: Mathematical Success for Intermediate Learners, Folk, McGraw-Hill Ryerson, 2004*

During grades 7 to 10, most students are ready to progress from solely concrete thinking toward more sophisticated forms of cognition, as shown in the diagram:



In *Foundations of Mathematics 10*, students start with the concrete. Once they have experience with this, they move to the representative. Only when students are comfortable with the concrete and representative do they begin to move toward the abstract. Suggestions for alternative ways to approach some key topics provide students with the opportunity to learn in a manner that may engage them and increase their chances of success.

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Approaches to Teaching Mathematics

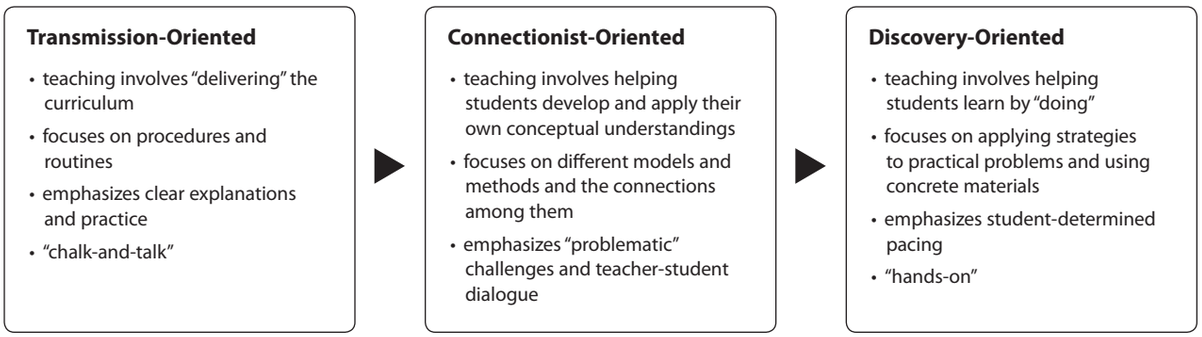
The following assumptions and beliefs form the foundation of the *Foundations of Mathematics 10* program:

1. Students demonstrate a wide range of prior knowledge and experiences, and learn via various styles and different rates.
2. Learning is most effective when students are given opportunities to investigate concepts before being introduced to the abstract mathematics involved.
3. Learning is most likely when familiar, meaningful contexts are used to illustrate ideas and applications of concepts.
4. Students benefit when different learning approaches are used– independent, cooperative, hands-on and teacher guided.

> *Learning is enhanced when students experience a variety of instructional approaches, ranging from direct instruction to inquiry-based learning.*
>
> *Ontario Ministry of Education and Training, 2004*

The concrete and abstract progression is exemplified in the following styles of mathematics teaching.

In grade 10, applied students learn best by using a concrete, discovery-oriented approach to develop concepts. Once these concepts have been developed, a connectionist approach helps students consolidate their learning.



At this level, some transmission-oriented learning is also useful. This variety of approaches can be seen in the *Foundations of Mathematics 10* program design.

Feature	Teaching Style(s) Supported
Chapter Problem	connectionist
Investigate	discovery
Examples	transmission, connectionist
Key Concepts	transmission
Discuss the Concepts	connectionist
Practise the Concepts	transmission
Apply the Concepts	connectionist, transmission
Extend the Concepts	connectionist, transmission
Review	transmission, connectionist
Task	discovery, connectionist

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Instructional Practice

The resources available in today's classroom offer opportunities and challenges. Indeed, the principal challenge—one that many teachers of mathematics are reluctant to confront—is to teach successfully to the opportunities available.

Grouping

> *Instructional practice that incorporates a variety of grouping approaches enhances the richness of learning for students.*
>
> *Creating Pathways: Mathematical Success for Intermediate Learners, Folk, McGraw-Hill Ryerson, 2004*

At one end of the scale, individual work provides an opportunity for students to work on their own, at their own pace. At the other extreme, class discussion of problems and ideas creates a synergistic learning environment. In between, carefully selected groups bring cooperative learning into play.

Manipulatives and Materials

> *Effective use of manipulatives helps students move from concrete and visual representations to more abstract cognitive levels.*
>
> *Ontario Ministry of Education and Training, 2003*

Although many teachers feel unsure about teaching with manipulatives and other concrete materials, many students find them a powerful way to learn. The *Foundations of Mathematics 10* program supports the use of manipulatives, but also helps teachers adapt to this kind of teaching. The Teaching Suggestions sections in the Teacher's Resource provide suggestions for developing student understanding using semi-concrete materials, such as diagrams and charts.

Technology

Special computer software designed for the classroom and licensed by the Ministry of Education for use in Ontario classrooms, such as *The Geometer's Sketchpad®*, provides a powerful tool for teaching and learning. The *Foundations of Mathematics 10* program supports the use of such software as an enhancement to the classroom experience. In addition, support for Computer Algebra Systems is included. Graphing calculator instructions are provided in the Investigate activities and Technology Appendix. Multiple solutions for worked-through examples in the text allow teachers to enjoy wide flexibility in lesson planning. As a result, you can plan activities using manipulatives, using software, or any combination of the two.

The Internet provides great opportunities for enhancing learning. As with many other sources of information, students must be protected from inappropriate content. The McGraw-Hill web site at *http://www.mcgrawhill.ca/books/Foundations10* (for teachers) has been designed to offer only safe and reliable web site links for students to explore as an integrated part of the *Foundations of Mathematics 10* program. The companion web site for students is http://www.mcgrawhill.ca/links/Foundations10.

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Literacy

Effective mathematics classrooms show students that math is everywhere in their world. For example, students should see that knowledge of probability is useful when learning about the electoral process in Social Studies class. Their work in graphing can be used in Science class. The written work they produce explaining their answers is also a language arts product. When connections such as these are made, students begin to see that math is not an isolated subject, but rather a vital part of everyday life. Contextual examples and problems can be linked to students' everyday experiences outside the classroom, as well.

Literacy Links

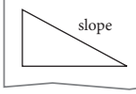
There are **Literacy Links** in every chapter. These features provide students with opportunities to engage in mathematical discourse through various forms of literacy media. The different types of literacy media used in *Foundations of Mathematics 10* include the following:

Word Wall: (CHAPTER 1) used to display the key terms covered in a section. Students make a copy of the list of vocabulary and their definitions in their math journals/notes.

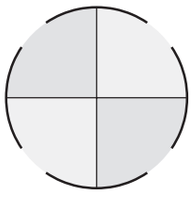
KWL Chart: (CHAPTER 2) used by students to organize what they know about the topic, what they want to know about the topic, and what they have learned about the topic when the chapter is completed.

K What Do I KNOW?	W What Do I WANT to KNOW?	L What Have I LEARNED?

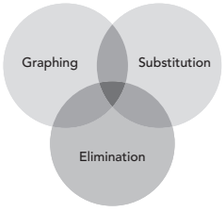
Verbal/Visual T-Chart: (CHAPTER 3) used to model a concept using picture(s) and/or words.

Picture/Word	Description
	

Concept Circle: (CHAPTER 4) used to list properties of a concept or to demonstrate the steps to follow when solving questions with different levels of difficulty.



Venn Diagram: (CHAPTER 5) used to compare characteristics of different concepts.



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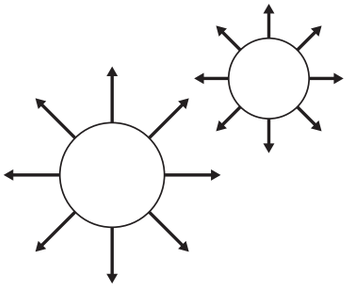
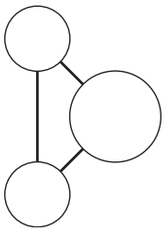
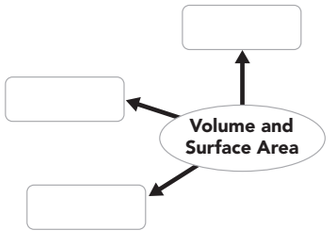
Circle, Wheel and Spoke Diagram: (CHAPTERS 6 and 8) used to activate prior knowledge and for students to reflect on questions they may have about concepts in this chapter.



Web Circles: (CHAPTER 7) used to make connections between mathematical concepts by creating a web. Student write the big ideas in a large circles and the examples and details in smaller circles around it. Then they connect the ideas by drawing lines between the circles.



Discussion Chart: (CHAPTER 9) used to summarize the main ideas of each section. At the end of the chapter, students may be asked to review the main ideas by comparing their version with a partner.



Literacy Connect

There is a **Literacy Connect** question in each numbered section. These questions ask students to explain how they arrived at their answers and/or to communicate their understanding of different ideas or concepts.

Writing and Mathematics

Being able to communicate ideas clearly is an important part of the *Foundations of Mathematics 10* program. Students are asked to write about the mathematics they are learning, and communicate their understanding about what they are learning.

Take time to discuss the importance of being able to communicate understanding. The students' responses are meant to communicate with the teacher and are assessed as part of the mathematics work.

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Cooperative Learning

Students learn effectively when they are actively engaged in the process of learning. Many of the sections in *Foundations of Mathematics 10* include hands-on activities that foster this approach. These activities are best done through cooperative learning during which students work together—either with a partner or in a small group of three or four—to complete the activity and develop generalizations about the topic or process.

Group learning such as this is an important aspect of a constructivist educational approach. It encourages interactions and increases chances for students to communicate and learn from each other (Sternberg & Williams, 2002).

Teacher's Role

In classrooms where students are adept at cooperative learning, the teacher becomes the facilitator, guide, and progress monitor. Until students have reached that level of group cooperation, however, you will need to coach them in how to learn cooperatively. This may include:

- Making sure that the materials are at hand and directions are perfectly clear so that students know what they are doing before starting group work
- Carefully structuring activities so that students can work together
- Providing coaching in how to provide peer feedback in a way that allows the listener to hear and attend
- Constantly monitoring student progress and providing assistance to groups having problems either with group cooperation or the math at hand

Types of Groups

The size of group you choose to use may vary from activity to activity. Small-group settings allow students to take risks that they might not take in a whole class setting (Van de Walle, 2000). Research suggests that small groups are fertile environments for developing mathematical reasoning (Artz & Yaloz-Femia, 1999).

Results of international studies suggest that groups of mixed ability work well in mathematics classrooms (Kilpatrick, Swafford, & Findell, 2001). If the class is new to cooperative learning, you may wish to assign students to groups according to the specific skills of each individual. For example, you might pair a student who is talkative but weak in number sense and numeration with a quiet student who is strong in those areas. You might pair a student who is weak in many parts of mathematics but has excellent spatial sense with a stronger mathematics student who has poor spatial sense. In this way, student strengths and weaknesses complement each other and peers have a better chance of recognizing the value of working together.

Cooperative Learning Skills

When coaching students about cooperative learning, you may want to consider task skills and working relationship skills, as indicated in the table below.

Task Skills	Working Relationship Skills
• Following directions • Communicating information and ideas • Seeking clarification • Ensuring that others understand • Actively listening to others • Staying on task	• Encouraging others to contribute • Acknowledging and responding to the contributions of others • Checking for agreement • Disagreeing in an agreeable way • Mediating disagreements within the group • Sharing • Showing appreciation for the efforts of others

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Class discussions, modelling, peer coaching, role-plays, and drama can be used to provide positive task skills. For example, you might role-play different ways to provide feedback and have a class discussion on which ones students like and why. You might discuss common group roles and how group members can use them. Students also need to understand that the same person can play more than one role.

Role	Math Connection	Sample Comment
Leader	• Makes sure the group is on task and everyone is participating • Pushes group to come to a decision	Let's do this. Can we decide...? This is what I think we should do...
Recorder	• Manages materials • Writes down data collected or measurements made	This is what I wrote down. Is that what you mean?
Presenter	• Presents the group's results and conclusions	We feel that… These are our conclusions… Our group found…
Organizer	• Watches time • Keeps on topic • Encourages getting the job done	Let's get started. Where should we start? So far we've done the following... Are we on topic? What else do we need to do?
Clarifier	• Checks that members understand and agree	Does everyone understand? So, what I hear you saying is... Do you mean that...?

Types of Strategies

A number of different types of cooperative learning strategies can be used in the mathematics classroom, and many are suggested in the Student Success margin items in this Teacher's Resource. The *Foundations of Mathematics 10* program includes selected blackline masters (BLMs) to use with some but not all of these strategies.

Think-Pair-Share

Students individually think about a concept, and then pick a partner to share their ideas. For example, students might work on the Discuss the Concepts questions, and then choose a partner to discuss the concepts with. Working together, the students could expand on what they understood individually. In this way, they learn from each other, learn to respect each other's ideas, and learn to listen.

Cooperative Task Group

Task groups of two to four students work on activities in the Investigate section. As a group, students share their understanding of what is happening during the activity and how that relates to the mathematics topic, at the same time as they develop group cooperation skills.

Jigsaw

Individual group members are responsible for researching and understanding a specific part of the information for a project. Individual students then share what they have learned so that the entire group gets information about all areas being studied. For example, during data management, this type of group might have "experts" in making various types of graphs using technology. Group members could then coach each other in making each kind of graph.

Another way of using the Jigsaw method is to assign "home" and "expert" groups during a large project. For example, students researching the shapes of various sports' surfaces might have a home group of four in

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which each member is responsible for researching one of soccer, baseball, hockey, or basketball. Individual members then move to expert groups. Expert groups include all of the students responsible for researching one of the sports. Each of the expert groups researches their particular sport. Once the information has been gathered and prepared for presentation, individual members of the expert group return to their home group and teach other members about their sport.

Placemat

In groups of four, students individually complete their section of a placemat. The group then pools their responses and completes the centre portion of the placemat with group responses. This method can be used for pre-assessment (diagnostic), review, or to summarize a topic.

Concept Attainment

Based on a list of examples and non-examples of a concept, students identify and define the concept. Then, they determine the critical attributes of the concepts and apply their defined concept to generate their own examples and non-examples.

Think Aloud

Work through a problem in front of the class, verbalizing your thinking throughout. This method can help develop process thinking in students.

Decision Tree

Students use a graphic organizer flow chart to identify key decisions and consequences.

Carousel

Students at different stations display and explain topics or concepts to other classmates who rotate through the stations, usually in order.

Timed Retell

Students sit in pairs facing each other. After some preparation time, Student A has 30 s to tell what she or he knows about the topic to Student B. Student B then retells the talk for about 30 s and adds additional information. Both students then write a summary of the talk.

Frayer Model

Students complete four quadrants for a specified topic: definition, facts/characteristics, examples, and non-examples. Variation: Give students a completed model and ask them to identify the topic/concept.

Word Wall

Individually or in groups, students complete cards for words or symbols, and then post the cards to use during future studies. One side of the card has the word or symbol, while the other side has four quadrants: the word, definition, picture or diagram, and an example or application.

Blast Off

This strategy can be used to start a class in an energized way. Students are asked to record: **3** important things they learned last class; **2** questions they have about last class; **1** reflection on what they learned last class; Blast Off!.

Inside/Outside Circle

Students face each other in pairs, forming two concentric circles. Students take turns giving information to their partner, then the outside circle rotates one person to the right while the inside circle remains still. Students then share information with their new partners. The process continues until the students in the outside circle have rotated back to their starting point.

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Three-Step Interview

In triads, label students A, B, and C. Have students individually compose interview questions. Assign roles to the three groups: A = Interviewer; B = Interviewee; C = Recorder. Student A interviews Student B, while Student C records the information. Then the students rotate roles. After all the interviews are complete, students share the recorded information in a Round Robin format.

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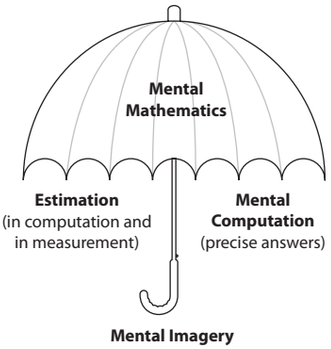
Mental Mathematics

A major goal of mathematics instruction for the twenty-first century is for students to make sense of the mathematics in their lives. The development of all areas of mental mathematics is a major contributor to this comfort and understanding.



The diagram above shows the various components under the umbrella of Mental Mathematics. All three are considered mental activities and interact with each other to make the connections required for mathematics understanding.

Computational Estimation

Computational estimation refers to the approximate answers for calculations, a very practical skill in today's world. The development of estimation skills helps refine mental computation skills, enhances number sense, and fosters confidence in math abilities, all key in problem solving. Over 80% of out-of-school problem-solving situations involve mental computation and estimation (Reys & Reys, 1986).

Computational estimation does not mean guessing at answers. Rather, it involves a host of computational strategies that are selected to suit the numbers involved. The goal is to refine these strategies over time with regular practice, so that estimates become more precise. The ultimate goal is for students to estimate automatically and quickly when faced with a calculation. These estimations are a check for reasonableness and provide learners with a strategy for checking their actual calculations.

Measurement Estimation

This skill relies on awareness of the measurement attributes (e.g., metre, kilometre, litre, kilogram, hour). Just as computational estimation enhances number sense, practice in measurement estimation enhances measurement sense.

A *referent* is a personal mental tool that students can develop for use in thinking about measurement situations. Tools could include the distance from home to school, a 100-km trip, the capacity of a can of juice, the duration of 30 min, and the area of the math textbook cover. These referents develop with measurement practice, and specifically with practice that encourages students to form these frames of reference. Students can compare other measurements to these referents. By doing so, they can gain a better understanding of what may be happening in a problem-solving situation.

You can help students develop referents by doing activities such as asking students to use their fingers or hands to show such measurements as: 6 cm, 260 mm, 0.4 m, a 60° angle, or 2000 cm^3.

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Mental Imagery

Mental imagery in mathematics refers to the images in the mind when one is doing mathematics. It is these mental representations, or conceptual knowledge, that need to be developed in all areas of mathematics. Capable math students "see" the math and are able to perform mental manoeuvres in order to make connections and solve problems. These images are formed when students manipulate objects, explore numbers and their meanings, and talk about their learning. Students must be encouraged to look into their mind's eye and "think about their thinking."

Asking, *What do you see in your mind's eye* when asked to visualize, as in the exercises below, for example, encourages students to think about the images they are using to help them solve problems. Students are often surprised when fellow students share their personal images; the discussion generated is very worthwhile.

Try these Mental Imaging Activities with your students.

Example 1:
Draw the mental image you have for each of the following:

- $\frac{2}{3}$
- 243 100 in relation to a million
- 75% of the questions on the page
- a 175° angle
- 0.56 m
- 36 cm
- 280 mm
- a 6 m by 10 m garden
- a 6.3-kg fish
- a 6-g fish

Example 2:
Use mental imagery to answer the following:

1. How many edges does a cube have?
2. If I am facing east, what direction is to my left?
3. What is the perimeter of a 90 cm by 30 cm shelf?
4. How many sides does a hexagonal pyramid have?
5. Imagine a 5-cm cube. What is its volume?
6. You cut off one vertex on a cube. What shape is exposed?
7. You cut the top off a square pyramid. What shape is exposed?

Mental Computation

Mental computation refers to an operation used to obtain the precise answer for a calculation. Unlike traditional algorithms, which involve one method of calculation for each operation, mental computations include a number of strategies—often in combination with others—for finding the exact answer. These mental calculations are often referred to as Mental Math.

As with computational estimation, strategies for mental computation develop in quantity and quality over time. Students need regular practice in these strategies.

Some Points Regarding Mental Mathematics

- Students must have knowledge of the basic facts (addition and multiplication) in order to estimate and calculate mentally. They learn the many strategies for fact learning in elementary school. With practice, they eventually commit these facts to memory. Without knowing the basic facts, it is unlikely that students will ever attempt to employ any estimation or mental math strategies, as these will be too tedious.
- The various estimation and mental calculation strategies must be taught; opportunities must be provided for regular practice of these strategies. Having students share their various strategies is vital, as it provides possible options for classmates to add to their repertoire.
- Unlike the traditional paper and pencil algorithms, there are many mental algorithms to learn. With the learning, however, comes a greater

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facility with numbers. Key to the development of skills in mental math is the understanding of place value and the number operations. This understanding is enhanced when students make mental math a focus when calculating.

- Mental math strategies are flexible; you need to select one that is appropriate for the numbers in the computation. Students should practise the strategy itself, select appropriate strategies for a variety of computation examples, and use the strategies in problem-solving situations.
- Although students should not be pressured with time constraints when first learning a mental math strategy, it is beneficial to provide timed tests once they have some facility at mental computation. If too much time is provided, many students will resort to the traditional algorithm, and will not use mental strategy.
- Mental math algorithms are used with whole numbers, fractions, and decimal numbers.
- Sometimes mental math strategies are used in conjunction with pencil and paper tasks. The questions are rewritten to make the calculation easier.
- The ultimate goal of mental mathematics is for students to estimate for reasonableness, and to look for opportunities to calculate mentally.
- Encourage students to refer to the strategies by their name (for example, front-end strategy). Once the strategies have been taught, post them around the room for the students. Have students write problems in which a mental strategy would be the appropriate computation. Share these problems with the class.

Keep in Mind

Classroom practice has traditionally been in the form of asking students to write the answers to questions presented orally. This is particularly challenging for students who are primarily visual learners. Although we are sometimes faced with computations of numbers we cannot see, most often the numbers are written down. This makes it easier to select a strategy. In daily life, we see the numbers when solving written problems (e.g., when checking calculations on a bill or invoice, when determining what to leave for tips, when calculating discounted prices from a price tag). Provide students with mental math practice that is sometimes oral and sometimes visual.

Capable students of mathematics are comfortable with numbers. This comfort means that the students see patterns in numbers and intuitively know how they relate to each other and how they will behave in computational situations. Due to their comfort with numbers, these students have developed strong skills in estimation and mental math. Because of this, their understanding of numbers is further strengthened. We say they have "number sense." This sense of numbers develops gradually and varies as a result of exploring numbers, visualizing them in a variety of contexts, and relating them in ways that are not limited by traditional algorithms.

The position of the National Council of Teachers of Mathematics (NCTM) on how to proceed when faced with a problem that requires a calculation is best explained with this chart.

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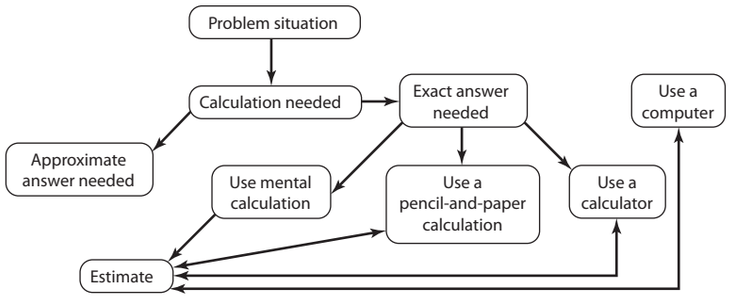

The chart tells us that, given a problem requiring calculation, students should ask themselves the following questions:

- Is an approximate answer adequate or do I need the precise answer?
- If an estimate is sufficient, what estimation strategy best suits the numbers provided?
- If an exact answer is needed, can I use a mental strategy to solve it?
- If the numbers don't lend themselves to a mental strategy, can I do the calculation using a paper-and-pencil method?
- If the calculation is too complex, I will use a calculator. What is a good estimate for the answer?

NCTM's Number and Operations Standard states that, "Instructional programs from kindergarten through grade 12 should enable all students to compute fluently and make reasonable estimates" (Principles and Standards for School Mathematics, 2000). Whether the students select an estimation strategy, a mental strategy, a paper-and-pencil method, or use the calculator, they must use their estimation skills to judge the reasonableness of any answer.

Mental Math Strategies

In *Foundations of Mathematics 10*, mental math strategies are explicitly practised in some of the Warm-Up questions that are presented in this Teacher's Resource for each section within individual chapters. In addition, even though not always explicitly mentioned, students use mental math strategies throughout many parts of the text.

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Problem Solving

Solving problems is not only a goal of learning mathematics but also a major means of doing so. Students should have frequent opportunities to formulate, grapple with, and solve complex problems that require a significant amount of effort and should then be encouraged to reflect on their thinking.

National Council of Teachers of Mathematics, 2000

Problem solving is an integral part of mathematics learning. The National Council of Teachers of Mathematics recommends that problem solving be the focus of all aspects of mathematics teaching because it encompasses skills and functions, which are an important part of everyday life.

NCTM Problem-Solving Standard
Instructional programs should enable all students to—
- Build new mathematical knowledge through problem solving
- Solve problems that arise in mathematics and in other contexts
- Apply and adapt a variety of appropriate strategies to solve problems
- Monitor and reflect on the process of mathematical problem solving

Problem solving is, however, more than a vehicle for teaching and reinforcing mathematical knowledge and helping to meet everyday challenges. It is also a skill that can enhance logical reasoning. It requires students to make logical deductions, connections, and to apply their mathematical understanding to situations outside the classroom. For these reasons problem solving can be developed as a valuable skill in itself, a way of thinking, rather than just the means to an end of finding the correct answer.

McGraw-Hill Ryerson has made the problem-based learning approach the focus of its program. In *Foundations of Mathematics 10*, a variety of problem-solving opportunities are provided for students:

- The textbook's opening pages include a section devoted to introducing **Problem-Solving Strategies**. In *Foundations of Mathematics 10*, students are presented with practical applications and problem-solving situations. The problem-solving model presented in the student textbook involves four steps:
  1. understand–indentify what the problem is asking
  2. plan–choose which strategy or combination of strategies to use
  3. solve–carry out the plan
  4. look back–determine if the answer is reasonable
  When faced with a new problem, students are encourage to try different methods to solve it. Common problem-solving strategies include the following: draw a diagram; make an organized list; look for a pattern; make a model; work backward; make a table or chart; act it out; use systematic trial; make an assumption; find needed information; choose a formula; solve a simpler problem.
- Each chapter includes the investigation of a specific real-life problem. The **Chapter Problem** is then revisited throughout the chapter through **Chapter Problem** questions, and ends with the **Chapter Problem Wrap-Up**.
- Questions that involve the **Mathematical Process Expectations** are embedded throughout the chapters.

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- At the end of chapters 2, 5, 8, and 9, students are presented with **Chapter Tasks** where the solution path is not readily apparent and where solving the problem requires more than just applying a familiar procedure. These cross-curricular tasks require students to apply what they have learned in the current chapter and the previous chapters to solve real-life, broad-based problems.

Mathematical Processes

The seven expectations presented at the start of the mathematics curriculum in Ontario describe the mathematical processes that students need to learn and apply as they investigate mathematical concepts, solve problems, and communicate their understanding. Although the seven processes are categorized, they are interconnected and are integrated into student learning in all areas of the *Foundations of Mathematics 10* program.

Problem Solving MPS.01

Problem solving is the basis of the *Foundations of Mathematics 10* program. Students can achieve the expectations by using this essential process, and it is an integral part of the mathematics curriculum in Ontario. Useful problem-solving strategies include: making a model, picture, or diagram; looking for a pattern; guessing and checking; making assumptions; making an organized list; making a table or chart; making a simpler problem; working backwards; using logical reasoning.

Reasoning and Proving MPS.02

Critical thinking is an essential part of mathematics. As the students investigate mathematical concepts in *Foundations of Mathematics 10*, they learn to: employ inductive reasoning; make generalizations based on specific findings; use counter-examples to disprove conjectures; use deductive reasoning.

Reflecting MSP.03

Students are given opportunities to regularly and consciously reflect on their thought processes as they work through the problems in *Foundations of Mathematics 10*. As they reflect, they learn to: recognize when the technique they are using is not helpful; make a conscious decision to switch to a different strategy; rethink the problem; search for related knowledge; determine the reasonableness of an answer.

Selecting Tools and Computational Strategies MPS.04

Students are given many opportunities to use a variety of manipulatives, electronic tools, and computational strategies in the *Foundations of Mathematics 10* program. The student text provides examples of and ways to use various types of technology, such as calculators, computers, and communications technology, to perform particular mathematical tasks, investigate mathematical ideas, and solve problems. These important problem-solving tools can be used to: investigate number and graphing patterns, geometric relationships, and different representations; simulate situations; collect, organize, and sort data; extend problem solving.

Connecting MPS.05

Foundations of Mathematics 10 is designed to give students many opportunities to make connections between concepts, skills, mathematical strands, and subject areas. These connections help them see that mathematics is much more than a series of isolated skills and concepts. Connecting mathematics to their everyday lives also helps students see that mathematics is useful and relevant outside the classroom.

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Representing MPS.06
Throughout the *Foundations of Mathematics 10* program, students represent mathematical ideas in various forms: numeric, geometric, graphical, algebraic, pictorial, and concrete representations, as well as representation using dynamic software. Students are encouraged to use more than one representation for a single problem, seeing the connections between them.

Communicating MPS.07
Students use many different ways of communicating mathematical ideas in the *Foundations of Mathematics 10* program, including: oral, visual, writing, numbers, symbols, pictures, graphs, diagrams, and words. The process of communication helps students reflect on and clarify ideas, relationships, and mathematical arguments.

Using Mathematical Processes

You can encourage students to use the mathematical processes in their work by prompting them with questions such as the following:

- *How can you tell whether your answer is correct/reasonable?* This promotes reasoning and reflection.
- *Why did you choose this method?* This promotes reflection, reasoning, selecting tools and computational strategies, and communication.
- *Could you have solved the problem another way?* This promotes reasoning, reflection, selecting tools and computational strategies, representing, and communication.
- *In what context have you solved a problem like this before?* This promotes connecting.

You can also encourage students to use a Think-Pair-Share approach to problem solving (see the **Cooperative Learning** section in this Program Overview). They will benefit greatly from brainstorming ideas and comparing methods of approach. A useful life skill is willingness to try different methods of solving a problem, learning from methods that perhaps do not reach the final goal, and being able to change their approach to reach the solution.

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Technology

The use of technology in instruction should further alter both the teaching and the learning of mathematics. Computer software can be used effectively for class demonstrations and independently by students to explore additional examples, perform independent investigations, generate and summarize data as part of a project, or complete assignments. Calculators and computers with appropriate software transform the mathematics classroom into a laboratory much like the environment in many science classes, where students use technology to investigate, conjecture, and verify their findings.

In this setting, the teacher encourages experimentation and provides opportunities for students to summarize ideas and establish connections with previously studied topics.

Curriculum and Evaluation Standards for School Mathematics, NCTM, 1989

Foundations of Mathematics 10 taps the full power of today's interactive technologies to engage students in math inquiry, research, and problem solving. Technology is a major focus in several of the chapters, providing students with hands-on experience in creating graphs, and constructing and manipulating geometric figures. If at all possible, a classroom environment should be in place in which students are encouraged to reach for and apply technology whenever they feel the situation calls for it. In such an environment, the ongoing use of technology becomes another tool in the student's problem-solving tool kit, rather than a discrete event.

The *Foundations of Mathematics 10* program includes opportunities for students to do research in the library or on the Internet. Consider having a class discussion on Internet web sites and appropriate sources. Remind students that anyone can create a web site on any topic on the Internet. Ask students to raise their hands if they have a personal web site or keep an Internet journal (a *blog*). Explain that web sites like these contain personal opinions and information contained on them should be looked at critically. This also may provide an opportunity to remind students that personal information should never be revealed over e-mail, in an on-line journal, or a chat-room, and that anything that makes them uncomfortable should be reported immediately to their parent or guardian.

Types of Programs

The principal software program used in *Foundations of Mathematics 10* is *The Geometer's SketchPad®*.

Technology BLMs are also available, providing students with step-by-step directions on how to use technology, such as software and Computer Algebra System calculators, to explore the mathematical concepts of the lesson. These BLMs include:

- BLM T1 *The Geometer's Sketchpad®* 4
- BLM T2 CAS (The Computer Algebra System) TI-89
- BLM T5 Cabri Jr

Spreadsheets Programs

- BLM T3 Corel® Quattro Pro® 12
- BLM T4 Microsoft® Excel

The **Technology Appendix**, on pages 444–466, of the student text provides clear step-by-step instruction in the basic functions of the TI-83 Plus Basics, TI-84 Plus Basics and TI-89 TITANIUM Basics graphing calculator and the basic features of *The Geometer's Sketchpad®*.

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Assessment

The main purpose of assessment is to improve student learning. Assessment data helps you determine the instructional needs of your students during the learning process. Some assessment data is used to evaluate students for the purpose of reporting.

Assessment must be purposeful and inclusive for all students. It should be varied to reflect learning styles of students and be clearly communicated with students and parents. Assessment can be used diagnostically to determine prior knowledge, formatively to inform instructional planning, and in a summative manner to determine how well the students have achieved the expectations at the end of a learning cycle.

Diagnostic Assessment

Assessment for diagnostic purposes can determine where individual students will need support and will help to determine how the classroom time needs to be spent. *Foundations of Mathematics 10* provides you with diagnostic support at the start of the text and the beginning of every chapter.

- The **Get Ready!** section at the beginning of each chapter provides coaching on essential concepts and skills needed for the upcoming chapter. **Get Ready Self-Assessment** blackline masters are also provided for each chapter.
- For students needing support beyond the Get Ready, the Skills Appendix in the student textbook and **Practice Masters** provided in this Teacher's Resource help to develop conceptual understanding and improve procedural efficiency.

Diagnostic support is also provided at the start of every section.

- Each section begins with an introduction to facilitate open discussion in the classroom.
- Each activity starts with a question that stimulates prior knowledge and allows you to monitor students' readiness.

Formative Assessment

Formative assessment tools are provided throughout the text and Teacher's Resource. Formative assessment allows you to determine students' strengths and weaknesses and guide your class towards improvement. *Foundations of Mathematics 10* provides blackline masters for student use that complement the text in areas where formative assessment indicates that students need support.

The **Chapter Opener**, visual, and the introduction to the **Chapter Problem** at the beginning of each chapter in the student book provide opportunities for you to do a rough formative assessment of student awareness of the chapter content.

Within each lesson:

- **Key Concepts** can be used as a focus for classroom discussion to determine the students' readiness to continue.
- **Discuss the Concepts** questions allow you to determine if the student has developed the conceptual understanding and/or skills that were the goal of the section.
- **Apply the Concepts** offers you an opportunity to determine students' understanding of concepts through conversations and written work. It also allows you to monitor students' procedural skills, their application of procedures, their ability to communicate their understanding of concepts, and their ability to solve problems related to the section's Key Concepts.

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- **Achievement Check** questions allow students to demonstrate their knowledge and understanding and their ability to apply, think of, and communicate what they have learned.
- **Chapter Problem** questions provide opportunities to verify that students are developing the skills and understanding they need to complete the **Chapter Problem Wrap-Up** questions.
- **Extend the Concepts** questions are more challenging and thought-provoking, and are aimed at Level 3 and 4 performance.
- **Chapter Reviews** and **Cumulative Reviews** provide an opportunity to assess Knowledge/Understanding, Thinking, Communication, and Application.

Summative Assessment

Summative data is used for both planning and evaluation.

- A **Practice Test** (Text and BLM) and a **Chapter Test** (BLM only) in each chapter assess students' achievement of the expectations in the areas of Knowledge/Understanding, Thinking, Communication, and Application.
- The **Chapter Problem** provides a problem-solving opportunity using an open-ended question format that is revisited in the **Chapter Problem Wrap-Up** questions. The **Chapter Problem** can be used to evaluate students' understanding of the expectations under the categories of Knowledge/ Understanding, Thinking, Communication, and Application.
- **Chapter Tasks** are open-ended investigations with rubrics provided. They are presented at the end of Chapters 2, 5, 8, and 9. The Tasks require students to use and make connections among several concepts from the preceding chapters.
- BLMs of rubrics for Chapter Problems and Tasks are provided in the Teacher's Resource CD-ROM

Portfolio Assessment

Student-selected portfolios provide a powerful platform for assessing students' mathematical thinking. Portfolios:

- Help teachers assess students' growth and mathematical understanding
- Provide insight into students' self-awareness about their own progress
- Help parents understand their child's growth

Foundations of Mathematics 10 has many components that provide ideal portfolio items. Inclusion of all or any of these chapter items provides insight into students' progress in a non-threatening, formative manner. These items include:

- Students' responses to the **Chapter Opener**
- Students' responses to the **Chapter Problem Wrap-Up** assignments
- Responses to **Discuss the Concepts** questions, which allow students to explore their initial understanding of concepts
- Answers to **Achievement Check** questions, which are designed to show students' mastery of specific expectations
- **Chapter Task** assignments, which show students' understanding across several chapters

Assessment Masters

Foundations of Mathematics 10 provides a variety of assessment tools with the chapter-specific blackline masters, such as Chapter Tests, Chapter Problem Wrap-Up rubrics, and Task rubrics. In addition, the program offers a wide variety of generic assessment blackline masters. These BLMs will help you to effectively monitor student progress and evaluate instructional needs.

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Generic Assessment BLM	Type	Purpose
BLM A1 Knowledge/Understanding General Scoring Rubric	Rubric	Evaluate students' understanding of expectations under the Knowledge/ Understanding category
BLM A2 Thinking General Scoring Rubric	Rubric	Evaluate students' understanding of expectations under the Thinking category
BLM A3 Communication General Scoring Rubric	Rubric	Evaluate students' understanding of expectations under the Communication category
BLM A4 Application General Scoring Rubric	Rubric	Evaluate students' understanding of expectations under the Application category
BLM A5 Observation General Scoring Rubric	Rubric	Assess students' understanding of the expectations under all four categories
BLM A6 Group Work General Scoring Rubric	Rubric	Assess students' group-related work
BLM A7 Portfolio Checklist	Checklist	Assess students' portfolios
BLM A8 News Report Checklist	Checklist	Assess students' work on a news report
BLM A9 Self-Assessment Recording Sheet	Worksheet	Students self-assess their understanding of chapter material
BLM A10 Group Work Recording Sheet	Worksheet	Record comments as students work on group tasks
BLM A11 Presentation Checklist	Checklist	Assess students' oral and written presentations
BLM A12 Attitutes Recording Sheet	Chart	Organize comments for assessment of student observations, portfolios, and presentations
BLM A13 Attitudes Assessment Checklist	Checklist	Assess students' attitude as they work on a task
BLM A14 Problem Solving Checklist	Checklist	Assess students' problem-solving skills
BLM A15 How I Work	Worksheet	Students self-assess independent and group work
BLM A16 Self-Assessment Checklist	Checklist	Students self-assess their understanding of chapter material
BLM A17 My Progress as a Mathematician	Checklist	Students self-assess their understanding of mathematics, in general
BLM A18 Teamwork Self Assessment	Worksheet	Students evaluate their work as part of a team
BLM A19 My Progress as a Problem Solver	Checklist	Students self-assess their ability at solving problems
BLM A20 Assessing Work in Progress	Worksheet	Student groups assess their progress as they work to complete a task
BLM A21 Learning Skills Checklist	Checklist	Assess students' work habits and learning skills
BLM A22 Opinion Piece Checklist	Checklist	Assess students' work on an opinion piece
BLM A23 Earning Money Report Checklist	Checklist	Assess students' work on a report

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Intervention

Foundations of Mathematics 10 accommodates a broad range of needs and learning styles, including those students requiring accommodations, and students with limited proficiency in English. This Teacher's Resource provides support in addressing multiple intelligences and learning styles through a variety of strategies.

- Excellent visuals and multiple representations of concepts and instructions support visual learners, ESL students, and struggling readers
- Relevant contexts, including multicultural examples, engage students and provide a purpose for the mathematics being learned
- **Extend the Concepts** questions provide additional challenge
- **Accommodations** in the margin provide suggestions for students having difficulties or needing enrichment

Reaching all Students

Students may experience difficulty meeting provincial standards for a variety of reasons. General cognitive delays, social-emotional issues, behavioural difficulties, health-related factors, and extended or sporadic absences from instruction underlie the math difficulties experienced by some students. These factors do not explain the challenges other students encounter, however. For these students, math difficulties are usually related to three key areas: language, visual/perceptual/spatial/motor, or memory.

Language

Students with language learning difficulties demonstrate difficulty reading and understanding math vocabulary and math story problems, and determining saliency (e.g., picking out the most important details from irrelevant information). Processing information that is presented using oral or written language is often difficult for these students, who may be more efficient learners when information is presented in a non-verbal, visual format. Diagrams and pictorial representations of math concepts are usually more meaningful to these students than lengthy verbal or written descriptions.

Visual/Perceptual/Spatial/Motor

Some students demonstrate difficulties understanding and processing information that is presented visually and in a non-verbal format. Language support to supplement and make sense of visually presented information is often beneficial (e.g., verbal explanation of a visual chart). Visual, perceptual, spatial, and motor difficulties may be evident in students' written output, as well as in their ability to process visually inputted information. Difficulties with near and far point copying, accurately aligning numbers in columns, properly sequencing numbers, and illegible handwriting are examples of output difficulties in this area.

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Memory (Short-Term, Working, and Long-Term Memory)

Students with short-term memory difficulties find it hard to remember what they have just heard or seen (e.g., auditory short-term memory, visual short-term memory). A weak working or active memory makes it difficult for students to hold information in their short-term memory and manipulate it (e.g., hold what they have just heard and then perform a mathematical operation with that information). For others, the retrieval of information from long-term memory (e.g., remembering number facts and previously taught formulae) is difficult. Students with long-term memory difficulties may also have difficulty storing information in their long-term memory, as well as retrieving it.

Modifications, Individual Education Plans (IEP), and Accommodations

A modification changes what is being taught by reaching well below or well above grade level, or by reducing the number of curriculum expectations. Students with a modified math program have an Individual Education Plan (IEP) describing how their program differs from classmates in their grade. An IEP also describes strategies, resources, and how the student will be evaluated. Modifying a student's program is a well-defined process involving the principal, teachers, parents, and student. Addressing a student's need for program modification falls outside the scope of this Teacher's Resource.

Accommodations

Accommodations do not change what is being taught. Rather, an accommodation to a student's program alters the "how," "when," or "where" the student is taught or assessed without changing curriculum expectations. This Teacher's Resource provides suggested accommodations based on the student's identified area of difficulty. Three types of accommodations are provided.

- Instructional accommodations refer to changes in teaching strategies that allow the student to access the curriculum.
- Environmental accommodations refer to changes that are required to the classroom and/or school environment.
- Assessment accommodations refer to changes that are required in order for the student to demonstrate learning.

The following three charts provide accommodations for the three key areas underlying math difficulties. Accommodations have been grouped under the headings of instructional, environmental, and assessment.

Chart I: Accommodations for Students with Language Difficulties

Instructional	Environmental	Assessment
• Pre-teach vocabulary • Give concise, step-by-step directions • Teach students to look for cue words, highlight these words • Use visual models • Use visual representations to accompany word problems • Encourage students to look for common patterns in word problems	• Provide reference charts with operations and formulae stated simply • Post reference charts with math vocabulary • Reinforce learning with visual aids and manipulatives • Using a visual format, post strategies for problem solving • Use a peer tutor or buddy system	• Read instructions/word problems to students on tests • Extend time lines

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Chart II: Accommodations for Students with Visual/Perceptual/Spatial/Motor Difficulties

Instructional	Environmental	Assessment
• Reduce copying • Provide worksheets • Provide graph paper • Provide concrete examples • Allow use of a number line • Provide a math journal • Encourage and teach self-talk strategies • Chunk learning and tasks	• visual bombardment • a work carrel or work area that is not visually distracting • rest periods and breaks	• Provide graph paper for tests • Extend time lines • Provide consumable tests • Reduce the number of questions required to indicate competency • Provide a scribe when lengthy written answers are required

Chart III: Accommodations for Students with Memory Difficulties

Instructional	Environmental	Assessment
• Regularly review concepts • Activate prior knowledge • Teach mnemonic strategies (e.g., BEDMAS) • Teach visualization strategies • Allow use of multiplication tables • Colour-code steps in sequence • Teach functional math concepts related to daily living	• Provide reference charts with commonly used facts, formulae, and steps for problem-solving • Allow use of a calculator • Use games and computer programs for drill and repetition	• Allow use of multiplications charts • Allow use of other reference charts as appropriate • Allow use of calculators • Extend time lines • Present one concept-type of question at a time

Accommodations for ESL Students

For ESL students, language issues are pervasive throughout all subject areas, including math. Non-math words are often more problematic for ESL students because understanding the meaning of these words is often taken for granted. Everyday language is laden with vocabulary, comparative forms, figurative speech, and complex language structures that are not explained. By contrast, key words in math are usually highlighted in the text and carefully explained by the teacher. Accommodations to the programs of ESL students do not change the curriculum expectations.

Accommodations for ESL Students

Instructional	Environmental	Assessment
• Pre-teach vocabulary • Explain colloquial expressions and figurative speech • Review comparative forms of adjectives	• Display reference charts with mathematical terms and language • Encourage personal math dictionaries with math terms and formulae	• Allow access to personal math dictionaries • Read instructions to students and clarify terms • Allow additional time

Accommodations for Learning-Disabled Students

A student with a learning disability usually suffers from an inability to think, listen, speak, write, spell, or calculate that is not obviously caused by any mental or physical disability. There seems to be a lag in the developmental process and/or a delay in the maturation of the central nervous system. Providing simplified presentations, repetitions, more specific examples, or breaking content blocks into simpler sections may help in minor cases of learning disability.

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Accommodations for At-Risk Students

Students learn in different ways. For all students to have the opportunity to succeed, we need to have alternative ways of delivering program. For example, a student whose dominant learning modality is kinesthetic/tactile needs active, hands-on investigations. A student with strong social/emotional intelligence benefits more from interpersonal interactions and needs instructional strategies like Jigsaw or Think-Pair-Share to optimize their chances of acquiring the skills and knowledge in the curriculum (see the **Cooperative Learning** section in this Teacher's Resource). These students underachieve and become at-risk not because they have acquired concepts imperfectly (and need remediation), but because they have not become engaged in their own learning, and often have failed to acquire concepts at all. At-risk students are in danger of completing their schooling without adequate skills development to function effectively in society. Risk factors include low achievement and retention, behaviour problems, poor attendance, and low socio-economic status.

By addressing topics in a new or different way, teachers can provide at-risk students with the opportunity to learn in a manner that may engage them and increase their chances of success.

Neither failing such students nor putting them in pullout programs has produced much gain in achievement, but there are certain approaches that do help.

- Allow students to proceed at their own pace through a well-defined series of instructional objectives.
- Place students in small, mixed-ability learning groups to master the material first presented by the teacher. Reward teams based on the individual learning of all team members.
- Have students serve as peer tutors, as well as being tutored. This helps raise their self-esteem and makes them feel they have something to contribute.
- Involve students in learning about something that is relevant to them, such as money management or wise shopping.
- Get parents involved in their child's learning as much as possible.

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Curriculum Correlations between McGraw-Hill Ryerson *Foundations of Mathematics 10* and The Ontario Curriculum (MFM 2P)

This course enables students to consolidate their understanding of linear relations and extend their problem-solving and algebraic skills through investigation, the effective use of technology, and hands-on activities. Students will develop and graph equations in analytic geometry; solve and apply linear systems, using real-life examples; and explore and interpret graphs of quadratic relations. Student will investigate similar triangles, the trigonometry of right triangles, and the measurement of three-dimensional figures. Students will consolidate their mathematical skills as they solve problems and communicate their thinking.

Foundations of Mathematics 10: Mathematical Process Expectations Correlation

Mathematical Process Expectations

The mathematical processes are to be integrated into student learning in all areas of this course. Throughout this course, students will:

Mathematical Process Expectations	Chapter/Section	Pages
Problem Solving MPS.01 develop, select, apply, and compare a variety of problem-solving strategies as they pose and solve problems and conduct investigations, to help deepen their mathematical understanding;	**General References** Problem-Solving Strategies All Chapters/Sections **Specific References** **5.2** Solve Linear Systems by Substitution **6.1** Explore Non-Linear Relations **9.1** Volume of Prisms and Pyramids **9.2** Surface Area of Prisms and Pyramids **9.4** Volume of Cones and Spheres	**General References** X to XV Throughout **Specific References** 210 243 370, 371 379 395
Reasoning and Proving MPS. 02 develop and apply reasoning skills (e.g., recognition of relationships, generalization through inductive reasoning, use of counter-examples) to make mathematical conjectures, assess conjectures, and justify conclusions, and plan and construct organized mathematical arguments;	**Specific References** **1.1** Imperial Measure **1.2** Conversions Between Metric and Imperial Systems **5.4** Solve Problems Involving Linear Systems **6.3** Key Features of Quadratic Relations	**Specific References** 10 17, 18 223 263
Reflecting MPS.03 demonstrate that they are reflecting on and monitoring their thinking to help clarify their understanding as they complete an investigation or solve a problem (e.g., by assessing the effectiveness of strategies and processes used, by proposing alternative approaches, by judging the reasonableness of results, by verifying solutions);	**Specific References** **1.2** Conversions Between Metric and Imperial Systems **2.1** The Pythagorean Theorem **2.3** The Sine and Cosine Ratios **2.4** The Tangent Ratio **5.1** Solve Linear Systems by Graphing **5.4** Solve Problems Involving Linear Systems **6.2** Model Quadratic Relations **9.1** Volume of Prisms and Pyramids **9.2** Surface Area of Prisms and Pyramids	**Specific References** 17 50, 51, 52 72 81 202 224 252 370 378

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Mathematical Process Expectations	Chapter/Section	Pages
Selecting Tools and Computational Strategies MPS.04 select and use a variety of concrete, visual, and electronic learning tools and appropriate computational strategies to investigate mathematical ideas and to solve problems;	**General References** All Chapters/Sections (Tools) Technology Appendix **Specific References** **1.3** Similar Triangles **5.4** Solve Problems Involving Linear Systems	**General References** Throughout 444 to 466 **Specific References** 28 224
Connecting MPS.05 make connections among mathematical concepts and procedures, and relate mathematical ideas to situations or phenomena drawn from other contexts (e.g., other curriculum areas, daily life, current events, art and culture, sports);	**General References** MathConnect Margin Feature **Specific References** **1.4** Solve Problems Using Similar Triangles **4.1** Solve One- and Two-Step Linear Equations **5.2** Solve Linear Systems by Substitution **6.1** Explore Non-Linear Relations **6.2** Model Quadratic Relations **6.4** Rates of Change in Quadratic Relations **9.3** Surface Area and Volume of Cylinders **9.5** Solve Problems Involving Surface Area and Volume	**General References** Throughout **Specific References** 35 160 210 242 252 270 388 403
Representing MPS.06 create a variety of representations of mathematical ideas (e.g., numeric, geometric, algebraic, graphical, pictorial representations; onscreen dynamic representations), connect and compare them, and select and apply the appropriate representation to solve problems;	**Specific References** **1.4** Solve Problems Using Similar Triangles **4.1** Solve One- and Two-Step Linear Equations **4.3** Model With Formulas **5.1** Solve Linear Systems by Graphing **5.3** Solve Linear Systems by Elimination **5.4** Solve Problems Involving Linear Systems **9.1** Volume of Prisms and Pyramids **9.2** Surface Area of Prisms and Pyramids	**Specific References** 36 161 180 202 218 224 370 377
Communicating MPS.07 communicate mathematical thinking orally, visually, and in writing, using mathematical vocabulary and a variety of appropriate representations, and observing mathematical conventions.	**General References** Literacy Links Literacy Connect Questions **Specific References** **1.1** Imperial Measure **1.2** Conversions Between Metric and Imperial Systems **1.3** Similar Triangles **2.1** The Pythagorean Theorem	**General References** One in each Chapter opening spread (supported in the Teacher's Resource) One in each section (included in the Practice Questions) **Specific References** 10 18 27 51

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Mathematical Process Expectations	Chapter/Section	Pages
Communicating MPS.07 communicate mathematical thinking orally, visually, and in writing, using mathematical vocabulary and a variety of appropriate representations, and observing mathematical conventions.	**2.2** Explore Ratio and Proportion in Right Triangles **2.4** The Tangent Ratio **2.5** Solve Problems Using Right Triangles **4.1** Solve One- and Two-Step Linear Equations **4.3** Model With Formulas **5.3** Solve Linear Systems by Elimination **6.3** Key Features of Quadratic Relations **7.1** Multiply Two Binomials **9.1** Volume of Prisms and Pyramids **9.2** Surface Area of Prisms and Pyramids	61 81 87 161 182 218 263 288 370, 371 378

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Foundations of Mathematics 10: Correlation to Overall and Specific Expectations by Chapter and Section

Measurement and Trigonometry

Overall Expectations

MTV.01 use their knowledge of ratio and proportion to investigate similar triangles and solve problems related to similarity

MTV.02 solve problems involving right triangles, using the primary trigonometric ratios and the Pythagorean theorem

MTV.03 solve problems involving the surface area and volumes of three-dimensional figures, and use the imperial and metric systems of measurement

Specific Expectations

	Chapter/Section	Pages
Solving Problems Involving Similar Triangles		
MT1.01 verify, through investigation (e.g., using dynamic geometry software, concrete materials), properties of similar triangles (e.g., given similar triangles, verify the equality of corresponding angles and the proportionality of corresponding sides)	**1.3** Similar Triangles	19–29
MT1.02 determine the lengths of sides of similar triangles, using proportional reasoning	**1.3** Similar Triangles **Task:** Fix Up a Neighbourhood Park	19–29 92–93
MT1.03 solve problems involving similar triangles in realistic situations (e.g., shadows, reflections, scale models, surveying)	**1.4** Solve Problems Involving Similar Triangles **Task:** Fix Up a Neighbourhood Park	30–37 92–93
Solving Problems Involving the Trigonometry of Right Triangles		
MT2.01 determine, through investigation (e.g., using dynamic geometry software, concrete materials), the relationship between the ratio of two sides in a right triangle and the ratio of the two corresponding sides in a similar right triangle, and define the sine, cosine, and tangent ratios $\left(\text{e.g., } \sin A = \frac{\text{opposite}}{\text{hypotenuse}}\right)$	**2.1** The Pythagorean Theorem **2.2** Explore Ratio and Proportion in Right Triangles	46–53 54–62
MT2.02 determine the measures of the sides and angles in right triangles, using the primary trigonometric ratios and the Pythagorean theorem	**2.2** Explore Ratio and Proportion in Right Triangles **2.3** The Sine and Cosine Ratios **2.4** The Tangent Ratio **Task:** Fix Up a Neighbourhood Park	54–62 63–73 74–82 92–93
MT2.03 solve problems involving the measures of sides and angles in right triangles in real-life applications (e.g., in surveying, in navigation, in determining the height of an inaccessible object around the school), using the primary trigonometric ratios and the Pythagorean theorem	**2.4** The Tangent Ratio **2.5** Solve Problems Using Right Triangles **Task:** Fix Up a Neighbourhood Park	74–82 83–87 92–93
MT2.04 describe, through participation in an activity, the application of trigonometry in an occupation (e.g., research and report on how trigonometry is applied in astronomy; attend a career fair that includes a surveyor, and describe how a surveyor applies trigonometry to calculate distances; job shadow a carpenter for a few hours, and describe how a carpenter uses trigonometry)	**2.5** Solve Problems Using Right Triangles	83–87

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	Chapter/Section	Pages
Solving Problems Involving Surface Area and Volume, Using the Imperial and Metric Systems of Measurement		
MT3.01 use the imperial system when solving measurement problems (e.g., problems involving dimensions of lumber, areas of carpets, and volumes of soil or concrete)	**1.1** Imperial Measure **1.2** Conversions Between Metric and Imperial Systems **9.1** Volume of Prisms and Pyramids **9.2** Surface Area of Prisms and Pyramids **9.3** Surface Area and Volume of Cylinders **9.4** Volume of Cones and Spheres **9.5** Solve Problems Involving Surface Area and Volume	6–11 12–18 364–371 372–380 381–390 391–397 398–405
MT3.02 perform everyday conversions between the imperial systems and the metric system (e.g., millilitres to cups, centimetres to inches) and within these systems (e.g., cubic metres to cubic centimetres, square feet to square yards), as necessary to solve problems involving measurement	**1.1** Imperial Measure **1.2** Conversions Between Metric and Imperial Systems **9.1** Volume of Prisms and Pyramids **9.2** Surface Area of Prisms and Pyramids **9.3** Surface Area and Volume of Cylinders **9.4** Volume of Cones and Spheres **9.5** Solve Problems Involving Surface Area and Volume	6–11 12–18 364–371 372–380 381–390 391–397 398–405
MT3.03 determine, through investigation, the relationship for calculating the surface area of a pyramid (e.g., use the net of a square-based pyramid to determine that the surface area is the area of the square base plus the area of the four congruent triangles)	**9.2** Surface Area of Prisms and Pyramids	372–380
MT3.04 solve problems involving the surface areas of prisms, pyramids, and cylinders, and the volumes of prisms, pyramids, cylinders, cones, and spheres, including problems involving the combinations of these figures, using the metric system or the imperial system, as appropriate	**9.1** Volume of Prisms and Pyramids **9.2** Surface Area of Prisms and Pyramids **9.3** Surface Area and Volume of Cylinders **9.4** Volume of Cones and Spheres **9.5** Solve Problems Involving Surface Area and Volume **Task:** Design a Game	364–371 372–380 381–390 391–397 398–405 412–413

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Modeling Linear Relations

Overall Expectations

MLV.01 manipulate and solve algebraic equations, as needed to solve problems

MLV.02 graph a line and write the equation of a line from given information

MLV.03 solve systems of two linear equations, and solve related problems that arise from realistic situations

Specific Expectations

	Chapter/Section	Pages
Manipulating and Solving Algebraic Equations		
ML1.01 solve first-degree equations involving one variable, including equations with fractional coefficients (e.g., using the balance analogy, computer algebra systems, paper and pencil)	**4.1** Solve One- and Two-Step Linear Equations	154–162
ML1.02 determine the value of a variable in the first degree, using a formula (i.e., by isolating the variable and then substituting known values; by substituting known values and then solving for the variable) (e.g., in analytic geometry, in measurement)	**4.1** Solve One- and Two-Step Linear Equations **4.2** Solve Multi-Step Linear Equations **4.3** Model With Formulas	154–162 163–173 174–183
ML1.03 express the equation of a line in the form $y = mx + b$ given the form $Ax + By + C = 0$	**4.4** Convert Linear Relations From Standard Form	184–189
Graphing and Writing Equations of Lines		
ML2.01 connect the rate of change of a linear relation to the slope of a line, and define the slope as the ratio $m = \frac{\text{rise}}{\text{run}}$	**3.1** Slope as a Rate of Change	100–110
ML2.02 identify, through investigation, $y = mx + b$ as a common form for the equation of a straight line, and identify the special cases $x = a$, $y = b$	**3.1** Slope as a Rate of Change	100–110
ML2 03 identify, through investigation with technology, the geometric significance of m and b in the equation $y = mx + b$	**3.2** Investigate Slope and y-intercept Using Technology	111–117
ML2.04 identify, through investigation, properties of the slopes of lines and line segments (e.g., direction, positive or negative rate of change, steepness, parallelism), using graphing technology to facilitate investigations, where appropriate	**3.3** Properties of Slopes of Lines	118–127
ML2.05 graph lines by hand, using a variety of techniques (e.g., graph using the y-intercept and slope; graph $2x + 3y = 6$ using the x- and y-intercepts)	**3.5** Graph Linear Relations by Hand	138–145
ML2.06 determine the equation of a line, given its graph, the slope and y-intercept, the slope and a point on the line, or two points on the line	**3.4** Determine the Equation of a Line **Task:** Charity Fundraising	128–137 230–231
Solving and Interpreting Systems of Linear Equations		
ML3.01 determine graphically the point of intersection of two linear relations (e.g., using graph paper, using technology)	**5.1** Solve Linear Systems by Graphing **Task:** Charity Fundraising	198–204 230–231
ML3.02 solve systems of two linear equations involving two variables with integral coefficients, using the algebraic method of substitution or elimination	**5.2** Solve Linear Systems by Substitution **5.3** Solve Linear Systems by Elimination **Task:** Charity Fundraising	205–211 212–218 230–231
ML3.03 solve problems that arise from realistic situations described in words or represented by given linear systems of two equations involving two variables, by choosing an appropriate algebraic or graphical method	**5.4** Solve Problems Involving Linear Systems **Task:** Charity Fundraising	219–225 230–231

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Quadratic Relations in the Form $y = ax^2 + bx + c$

Overall Expectations

QRV.01 manipulate algebraic expressions, as needed to understand quadratic relations
QRV.02 identify characteristics of quadratic relations
QRV.03 solve problems by interpreting graphs of quadratic relations

Specific Expectations

	Chapter/Section	Pages
Manipulating Quadratic Expressions		
QR1.01 expand and simplify second-degree polynomial expressions involving one variable that consist of the product of two binomials [e.g., $(2x + 3(x + 4)]$ or the square of a binomial [e.g., $(2x + 3)^2$], using a variety of tools (e.g., algebra tiles, diagrams, computer algebra systems, paper and pencil) and strategies (e.g., patterning)	**7.1** Multiply Two Binomials	280–289
QR1.02 factor binomials (e.g., $4x^2 + 8x$) and trinomials (e.g., $3x^2 + 9x - 15$) involving one variable up to degree two, by determining a common factor using a variety of tools (e.g., algebra tiles, diagrams, computer algebra systems, paper and pencil) and strategies (e.g., patterning)	**7.2** Common Factoring	290–297
QR1.03 factor simple trinomials of the form $x^2 + bx + c$ (e.g., $x^2 + 7x + 10$, $x^2 + 2x - 8$) using a variety of tools (e.g., algebra tiles, diagrams, computer algebra systems, paper and pencil) and strategies (e.g., patterning)	**7.4** Factor Trinomials of the Form $x^2 + bx + c$	306–311
QR1.04 factor the difference of squares of the form $x^2 - a^2$ (e.g., $x^2 - 16$)	**7.3** Factor a Difference of Squares	298–305
Identifying Characteristics of Quadratic Relations		
QR2.01 collect data that can be represented as a quadratic relation, from experiments using appropriate equipment and technology (e.g., concrete materials, scientific probes, calculators), or from secondary sources (e.g., the Internet, Statistics Canada); graph the data and draw a curve of best fit, if appropriate, with or without the use of technology	**6.2** Model Quadratic Relations	245–253
QR2.02 determine, through investigation using technology, that a quadratic relation of the form $y = ax^2 + bx + c$ $(a \neq 0)$ can be graphically represented as a parabola, and determine that the table of values yields a constant second difference	**6.4** Rates of Change in Quadratic Relations	264–271
QR2.03 identify the key features of a graph of a parabola (i.e., the equation of the axis of symmetry, the coordinates of the vertex, the y-intercept, the zeros, and the maximum or minimum value), using a given graph or a graph generated with technology from its equation, and use the appropriate terminology to describe the features	**6.1** Explore Non-Linear Relations **6.3** Key Features of Quadratic Relations	238–244 254–263

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	Chapter/Section	Pages
QR2.04 compare, through investigation using technology, the graphical representations of a quadratic relation of the form $y = x^2 + bx + c$ and the same relation in the factored form $y = (x - r)(x - s)$ (i.e., the graphs are the same) and describe the connections between each algebraic representation and the graph (e.g., the y-intercept is c in the form $y = x^2 + bx + c$; the x-intercepts are r and s in the form $y = (x - r)(x - s)$	**8.2** Represent Quadratic Relations in Different Ways	329–335
Solving Problems by Interpreting Graphs of Quadratic Relations		
QR3.01 solve problems involving a quadratic relation by interpreting a given graph or a graph generated with technology from its equation (e.g., given an equation representing the height of a ball over elapsed time, use a graphing calculator or graphing software to graph the relation, and answer questions such as the following: What is the maximum height of the ball? After what length of time will the ball hit the ground? Over what time interval is the height of the ball greater than 3 m?)	**8.1** Interpret Quadratic Relations **8.4** Solve Problems Involving Quadratic Relations **Task:** Home Run Derby	320–328 344–351 356–357
QR3.02 solve problems by interpreting the significance of the key features of graphs obtained by collecting experimental data involving quadratic relations	**8.3** The Quadratic Relation $y = ax^2 + c$ **Task:** Home Run Derby	336–343 356–357

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