Overview of *Principles of Mathematics 10*

The McGraw-Hill Ryerson *Principles of Mathematics 10* program has six 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. **Communicate Your Understanding** 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 questions are single-step knowledge questions and assist students in building their understanding. **Connect and Apply** questions allow students to use what they have learned to solve problems and make connections among concepts. **Extend** questions are more challenging and thought-provoking. Answers to Practise, Connect and Apply, and Extend questions are provided at the back of the text. Most numbered sections conclude with a few **Math Contest** questions. **Chapter Tasks** are more involved problems that require students to use several concepts from the preceding chapters. Solutions to the 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 3, 6, and 8 and help prepare students for the Tasks.

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

- **Communicate Your Understanding** 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 3, 6, and 8 and combine concepts from the preceding groups of chapters

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

Teacher's Resource

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

- **Teaching Suggestions** for all the sections
- **Practice** and chapter-specific blackline masters
- Answers to the **Investigate** questions
- Responses for the **Communicate Your Understanding** questions
- Responses for the **Chapter Problem Wrap-Up** and **Chapter Tasks**
- Students' **Common Errors** and suggested remedies
- Solutions and rubrics for the **Achievement Check** questions
- **Accommodations** for students with different needs
- **Student Success** strategies for at-risk students

Computerized Assessment Bank CD-ROM

The Computerized Assessment Bank CD-ROM (CAB) contains over 1000 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 MPM2D 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 complete solutions for questions in the Review, Practice Test, and Cumulative Review features.

Exercise and Homework Book

The Exercise and Homework Book extends and supplements topics in the student text Get Ready pages. It includes additional practice questions for all the sections of the student text along with sample solutions.

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, TI-Navigator files to support the student text activities, further support material for differentiated learners, and many other supplemental activities.

To access this site go to:
http://www.mcgrawhill.ca/books/principles10
username: principles
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
- **Vocabulary** items that will be introduced and defined in the chapter, listed in the margin
- 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

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

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** for extra practice or remediation, assessment, or enhancement
- Links to **TI-Navigator™** files on the MHR website

The key items in this section include:

- **Teaching Suggestions** for how to use the Get Ready
- **Assessment** ideas on how to ascertain that students are ready for this chapter
- **Common Errors** and remedies to help you anticipate and deal with common errors that may occur
- **Accommodations** for students having difficulties or needing enrichment

Numbered Sections

The following items are listed in the margin:

- **Tools** and **Technology Tools** needed for the section
- **Related Resources** for extra practice or remediation, assessment, or enhancement

The **Teaching Suggestions** include the following key elements:

- **Student Text Pages** references and **Suggested Timing**
- **Teaching Suggestions** give insights or point out connections on how to present the material from the text
- **Investigate Answers** and **Communicate Your Understanding Responses** let you know the expected outcomes of these activities
- Notes for the **Practise**, **Connect and Apply**, and **Extend** 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**
- **Literacy Connections** provide a way to link the math concepts in the section to literacy (included in some sections)

- **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
- **Student Success** items provide suggestions for alternative ways to approach some key topics for at-risk students
- **Mathematical Process Integration** chart lists questions that provide good opportunities for students to use the processes

End of Chapter Items

The **Chapter Review** and **Cumulative Reviews** (at the end of Chapters 3, 6, and 8) include the following items:

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

The **Practice Test** has the following key features:

- **Student Text Pages** references and **Suggested Timing**
- **Tools** and **Technology Tools** needed for the section
- **Related Resources** 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
- **Using the Practice Test** gives you insights on how to present the information in the Practice Test

The **Chapter Problem** includes the following elements:

- **Student Text Pages** references and **Suggested Timing**
- **Tools** and **Technology Tools** needed for the section
- **Related Resources** for extra practice and remediation, assessment, or enhancement
- **Using the Chapter Problem** 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 3, 6, and 8 and include:

- **Student Text Pages** references and **Suggested Timing**
- **Tools** and **Technology Tools** needed for the section
- **Related Resources** useful for extra practice or remediation, assessment, or enhancement
- **Mathematical Process Expectations** and **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

The **Teacher's Resource CD-ROM** provides various blackline masters, including:

- Generic Masters
- Technology Masters
- Practice Masters
- Assessment Masters
- Chapter-specific Masters

Program Philosophy

Principles of Mathematics 10 is an exciting new resource.

The Principles of Mathematics 10 program is designed to:

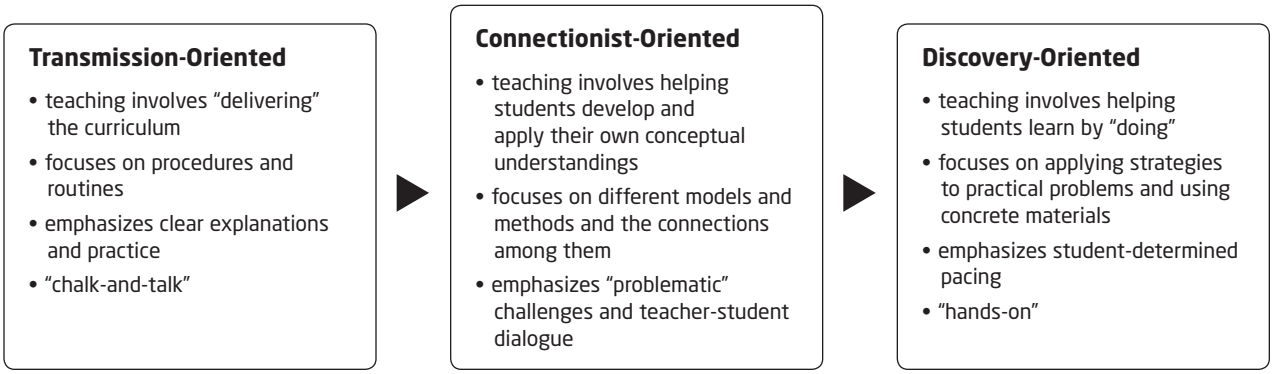
- provide full support in teaching the Ontario MPM2D mathematics curriculum
- support and extend students' progress from concrete to representational and abstract thinking
- offer a diversity of options that collectively deliver student and teacher success

Approaches to Teaching Mathematics

Learning is enhanced when students experience a variety of instructional approaches, ranging from direct instruction to inquiry-based learning.

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

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 *Principles of Mathematics 10* program design.

Feature	Teaching Style(s) Supported
Chapter Problem	connectionist
Investigate, Reflect	discovery, connectionist
Examples	transmission, connectionist
Key Concepts	connectionist, transmission
Communicate Your Understanding	connectionist, discovery
Practise	transmission
Connect and Apply	connectionist, transmission
Extend	connectionist, transmission
Review	transmission, connectionist
Task	discovery, connectionist

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 *Principles of Mathematics 10* program supports the use of manipulatives, where appropriate, and helps teachers adapt to this kind of teaching. The Teaching Suggestions sections in the Teacher Resource provide suggestions for developing student understanding using semi-concrete materials, such as diagrams and charts.

Technology

Although the extensive functions available on the modern scientific calculator are adequate for an introductory secondary school mathematics course, the added power and display capabilities of a graphing calculator can enhance and facilitate the learning experience for the student. In the *Principles of Mathematics 10* program, both scientific calculator keystrokes and graphing calculator instructions are provided in parallel with conventional calculations. Use of the computer algebra system, on the TI-89 calculator, is introduced.

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®*, provide powerful tools for teaching and learning. The *Principles of Mathematics 10* program supports the use of such software as an optional enhancement to the classroom experience. In addition, support for Computer Algebra Systems is included. 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 *Principles of Mathematics 10* also supports the use of TI-Navigator™ in the classroom. Materials to support the teacher using this technology are available on the McGraw-Hill Ryerson Web site, as listed below. 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 Ryerson Web site at *http://www.mcgrawhill.ca/books/Principles10* has been designed to offer only safe and reliable Web site links for students to explore as an integrated part of the *Principles of Mathematics 10* program.

Literacy

Effective mathematics classrooms show students that math is everywhere in their world. For example, students should see that 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 Connections

Literacy Connections give students help to understand a symbol, a phrase, or a new word. They also provide suggestions for connecting mathematics to literacy, by connecting terms in mathematics to vocabulary used in other contexts. This feature provides one more way for students to feel successful in mathematics.

Writing and Mathematics

Being able to communicate ideas clearly is an important part of the *Principles 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.

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

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

- The **Mathematical Process Expectations** (Problem Solving, Reasoning and Proving, Reflecting, Selecting Tools and Computational Strategies, Connecting, Representing, and Communicating) are embedded throughout the student textbook. The Teacher's Resource identifies which questions provide good opportunities to use the mathematical processes for each numbered section.
- **Math Contest** questions are included at the end of many numbered section exercises to give students more opportunities to solve problems.
- Each chapter begins with an investigation of a real-life problem. The **Chapter Problem** is then revisited throughout the chapter through **Chapter Problem** questions, and ends with the **Chapter Problem Wrap-Up**.
- At the end of chapters 3, 6, and 8, 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 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 *Principles of Mathematics 10* program.

Problem Solving

Problem solving is the basis of the *Principles 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

Critical thinking is an essential part of mathematics. As the students investigate mathematical concepts in *Principles 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

Students are given opportunities to regularly and consciously reflect on their thought processes as they work through the problems in *Principles 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

Students are given many opportunities to use a variety of manipulatives, electronic tools, and computational strategies in the *Principles 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

Principles 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.

Representing

Throughout the *Principles 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

Students use many different ways of communicating mathematical ideas in the *Principles 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

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 **Student Success** 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.

Technology

Principles 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 using spreadsheets, 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 *Principles 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

Several types of software programs are used in *Principles of Mathematics 10*:

Interactive Geometry Programs

- *The Geometer's Sketchpad*®
- *Cabri Jr.*

Spreadsheet Programs

- Corel® *Quattro Pro*® 8
- Corel® *Quattro Pro*® 10
- Microsoft® *Excel*

Technology BLMs are also available, providing students with step-by-step directions on how to use technology, such as software and the Computer Algebra System on the TI-89 calculators, to explore the mathematical concepts of the lesson. These BLMs include:

- T–1 Corel® *Quattro Pro*® 8
- T–2 Corel® *Quattro Pro*® 10
- T–3 Microsoft® *Excel*
- T–4 *The Geometer's Sketchpad*® 3
- T–5 *The Geometer's Sketchpad*® 4
- T–6 *Fathom*™
- T–7 CAS TI-89

The **Technology Appendix**, on pages 476–503, of the student text provides clear step-by-step instruction in the basic functions of the TI-83+/84Plus graphing calculator, the computer algebra system on the TI-89 calculator, and the basic features of *The Geometer's Sketchpad*®.

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. *Principles 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, **Practice Masters** are provided in this Teacher's Resource that both 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. *Principles 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.
- **Communicate Your Understanding** questions allow you to determine if the student has developed the conceptual understanding and/or skills that were the goal of the section.
- **Connect and Apply** 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.
- **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** 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** and a **Chapter Test** 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** include open-ended investigations with rubrics provided. They are presented at the end of Chapters 3, 6, and 8. The Tasks require students to use and make connections among several concepts from the preceding chapters.

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

Principles 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 **Communicate Your Understanding** 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

Principles 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 has a wide variety of generic assessment blackline masters. These BLMs will help you to effectively monitor student progress and evaluate instructional needs.

Generic Assessment BLM	Type	Purpose
A–1 Assessment Recording Sheet	Chart	Organize comments for assessment of student observations, portfolios, and presentations
A–2 Attitudes Assessment Checklist	Checklist	Assess students' attitude as they work on a task
A–3 Portfolio Checklist	Checklist	Assess students' portfolios
A–4 Presentation Checklist	Checklist	Assess students' oral and written presentations
A–5 Problem Solving Checklist	Checklist	Assess students' problem-solving skills
A–6 Knowledge/Understanding General Scoring Rubric	Rubric	Evaluate students' understanding of expectations under the Knowledge/ Understanding category
A–7 Thinking General Scoring Rubric	Rubric	Evaluate students' understanding of expectations under the Thinking category
A–8 Application General Scoring Rubric	Rubric	Evaluate students' understanding of expectations under the Application category
A–9 Communication General Scoring Rubric	Rubric	Evaluate students' understanding of expectations under the Communication category
A–10 Observation Assessment General Scoring Rubric	Rubric	Assess students' understanding of the expectations under all four categories
A–11 Group Work Assessment Recording Sheet	Worksheet	Record comments as students work on group tasks
A–12 Group Work Assessment General Scoring Rubric	Rubric	Assess students' group-related work
A–13 How I Work	Worksheet	Students self-assess independent and group work
A–14 Self-Assessment Recording Sheet	Worksheet	Students self-assess their understanding of chapter material
A–15 Self-Assessment Checklist	Checklist	Students self-assess their understanding of chapter material
A–16 My Progress as a Mathematician	Checklist	Students self-assess their understanding of mathematics, in general
A–17 Teamwork Self Assessment	Worksheet	Students evaluate their work as part of a team
A–18 My Progress as a Problem Solver	Checklist	Students self-assess their ability at solving problems
A–19 Assessing Work in Progress	Worksheet	Student groups assess their progress as they work to complete a task
A–20 Learning Skills Checklist	Checklist	Assess students' work habits and learning skills
A–21 Opinion Piece Checklist	Checklist	Assess students' work on an opinion piece
A–22 Report Checklist	Checklist	Assess students' work on a report
A–23 News Report Checklist	Checklist	Assess students' work on a news report

Intervention

Principles of Mathematics 10 accommodates a broad range of needs and learning styles, including those students requiring accommodations, at-risk students, students with limited proficiency in English, and gifted learners. This Teacher's Resource provides support in addressing multiple intelligences and learning styles through the following strategies:

- **Accommodations** in the margin provide suggestions for students having difficulties or needing enrichment
- **Student Success** items in the margin provide suggestions for alternative ways to approach some key topics for at-risk students

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.

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

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 • 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 formula sheets • 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 Enrichment

Some students benefit from having their programs enriched by extending their learning and emphasizing higher-order thinking skills. For the purposes of this resource manual, the term "enrichment" will be applied to activities that enrich and extend a student's program. This form of enrichment differs from acceleration. Acceleration involves reaching well above grade level expectations and thereby modifying a student's program. Students whose programs have been modified in this way are often identified as "Intellectual-Gifted" by an Identification Placement and Review Committee (IPRC). Modifying a student's program falls beyond the scope of this Teacher's Resource.

Accommodations for Enrichment

Instructional	Environmental	Assessment
• Structure learning activities to develop higher-order thinking skills (analysis, synthesis, and evaluation) • Provide open-ended questions • Value learner's own interests and learning style, and allow for as much student input into program options as possible • Encourage students to link learning to wider applications • Encourage learners to reflect on the process of their own learning • Encourage and reward creativity • Avoid repetitive tasks and activities	• Encourage a stimulating environment that invites exploration of mathematical concepts • Display pictures of role models who excel in mathematics • Provide access to computer programs that extend learning	• Reduce the number of questions to allow time for more demanding ones • Allow for opportunities to demonstrate learning in non-traditional formats • Pose more questions that require higher-level thinking skills (analysis, synthesis, and evaluation) • Reward creativity

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.

Accommodations for At-Risk Students

Each chapter of the Teachers' Resource has several margin items labelled **Student Success**. Students learn in different ways. For all students to have the opportunity to succeed, we need to use a variety of teaching strategies to deliver the mathematics 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 strategies listed below). 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.

Student Success items are suggestions for alternative ways to approach some key topics. By addressing these 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.

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.

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 Communicate Your Understanding 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.

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 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 (BLM provided on the *Principles of Mathematics 10: Teacher's Resource* CD-ROM). 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
Students work through a problem in front of the class, verbalizing their 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.

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.

Four Corners
Students move to one corner of the room based on preference or opinion. (Example: To analyze a particular quadratic relation, students choose from algebraic model, graphical model, dynamic model (GSP), data model (table of values).)

Graffiti
There are two different methods of graffiti. In the first method, students in groups take turns adding information to a sheet of paper passed around the group (for example, adding lines to a solution). In the second method, groups or pairs of students move around the room and add information to questions posted on chart paper around the room.

Gallery Walk
Groups move from station to station, read what is already there and add information, and eventually return to their original station. (Example: groups might first create a word problem on chart paper at their station, move to the next station and solve the problem there, and eventually return to their first station to see the solution to their problem.)

Graffiti plus Gallery Walk
Combines the Graffiti and Gallery Walk strategies described above.

Curriculum Correlation between McGraw-Hill Ryerson *Principles of Mathematics 10* and The Ontario Curriculum (MPM2D)

This course enables students to broaden their understanding of relationships and extend their problem-solving and algebraic skills through investigation, the effective use of technology, and abstract reasoning. Students will explore quadratic relations and their application; solve and apply linear systems; verify properties of geometric figures using analytic geometry; and investigate the trigonometry of right and acute triangles. Students will reason mathematically and communicate their thinking as they solve multi-step problems.

Mathematical Process Expectations

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

Problem Solving	• 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;
Reasoning and Proving	• 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;
Reflecting	• 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);
Selecting Tools and Computational Strategies	• select and use a variety of concrete, visual, and electronic learning tools and appropriate computational strategies to investigate mathematical idea and to solve problems;
Connecting	• 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);
Representing	• 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;
Communicating	• communicate mathematical thinking orally, visually, and in writing, using mathematical vocabulary and a variety of appropriate representations, and observing mathematical conventions.

The mathematical process expectations are integrated throughout *Principles of Mathematics 10*.

The codes for the curriculum expectations are consistent with the codes used in the PDF document Grade 10 Math Principles (Reference; Principles of Mathematics Expectations MPM 2D), which is based on The Ontario Curriculum, Grades 9 and 10, Mathematics, 2005. The document is available on-line from The Ontario Curriculum Unit Planner (OCUP), in the section Grade by Grade PDFs of Ontario Curriculum Expectations. <http://www.ocup.org>

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

Overall Expectations

By the end of this course, students will:

- determine the basic properties of quadratic relations;
- relate transformations of the graph of $y = x^2$ to the algebraic representation $y = a(x - h)^2 + k$;
- solve quadratic equations and interpret the solutions with respect to the corresponding relations;
- solve problems involving quadratic relations.

Specific Expectations

	Chapter/Section	Pages
Investigating the Basic Properties of Quadratic Relations		
By the end of this course, students will:		
QR1.01 – collect data that can be represented as a quadratic relation, from experiments using appropriate equipment and technology (e.g., concrete materials, scientific probes, graphing 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 (Sample problem: Make a 1 m ramp that makes a 15° angle with the floor. Place a can 30 cm up the ramp. Record the time it takes for the can to roll to the bottom. Repeat by placing the can 40 cm, 50 cm, and 60 cm up the ramp, and so on. Graph the data and draw the curve of best fit.);	**4.1**	164–167
QR1.02 – determine, through investigation with and without the use of technology, that a quadratic relation of the form $y = ax^2 + bx + c (a \neq 0)$ can be graphically represented as a parabola, and that the table of values yields a constant second difference (Sample problem: Graph the relation $y = x^2 - 4x$ by developing a table of values and plotting points. Observe the shape of the graph. Calculate first and second differences. Repeat for different quadratic relations. Describe your observations and make conclusions, using the appropriate terminology.);	**4.2**	168–173
QR1.03 – 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), and use the appropriate terminology to describe them;	**4.3, 4.4**	174–188
QR1.04 – compare, through investigation using technology, the features of the graph of $y = x^2$ and the graph of $y = 2^x$, and determine the meaning of a negative exponent and of zero as an exponent (e.g., by examining patterns in a table of values for $y = 2^x$; by applying the exponent rules for multiplication and division).	**4.6**	194–201
Relating the Graph of $y = x^2$ and Its Transformations		
By the end of this course, students will:		
QR2.01 – identify, through investigation using technology, the effect on the graph of $y = x^2$ of transformations (i.e., translations, reflections in the *x*-axis, vertical stretches or compressions) by considering separately each parameter a, h, and k [i.e., investigate the effect on the graph of $y = x^2$ of a, h, and k in $y = x^2 + k$, $y = (x - h)^2$, and $y = ax^2$];	**4.3**	174–179
QR2.02 – explain the roles of a, h, and k in $y = a(x - h)^2 + k$, using the appropriate terminology to describe the transformations, and identify the vertex and the equation of the axis of symmetry;	**4.4**	180–188

	Chapter/Section	Pages
QR2.03 – sketch, by hand, the graph of $y = a(x - h)^2 + k$ by applying transformations to the graph of $y = x^2$ [Sample problem: Sketch the graph of $-\frac{1}{2}(x - 3)^2 + 4$, and verify using technology.];	**4.4**	180–188
QR2.04 – determine the equation, in the form $y = a(x - h)^2 + k$, of a given graph of a parabola.	**4.4**	180–188
Solving Quadratic Equations		
By the end of this course, students will:		
QR3.01 – expand and simplify second-degree polynomial expressions [e.g., $(2x + 5)^2$, $(2x - y)(x + 3y)$], using a variety of tools (e.g., algebra tiles, diagrams, computer algebra systems, paper and pencil) and strategies (e.g., patterning);	**5.1, 5.2**	210–227
QR3.02 – factor polynomial expressions involving common factors, trinomials, and differences of squares [e.g., $2x^2 + 4x$, $2x - 2y + ax - ay$, $x^2 - x - 6$, $2a^2 + 11a + 5$, $4x^2 - 25$], using a variety of tools (e.g., concrete materials, computer algebra systems, paper and pencil) and strategies (e.g., patterning);	**5.3, 5.4, 5.5, 5.6**	228–255
QR3.03 – determine, through investigation, and describe the connection between the factors of a quadratic expression and the x-intercepts (i.e., the zeros) of the graph of the corresponding quadratic relation, expressed in the form $y = a(x - r)(x - s)$;	**6.3**	282–291
QR3.04 – interpret real and non-real roots of quadratic equations, through investigation using graphing technology, and relate the roots to the x-intercepts of the corresponding relations;	**6.3**	282–291
QR3.05 – express $y = ax^2 + bx + c$ in the form $y = a(x - h)^2 + k$ by completing the square in situations involving no fractions, using a variety of tools (e.g. concrete materials, diagrams, paper and pencil);	**6.1**	264–273
QR3.06 – sketch or graph a quadratic relation whose equation is given in the form $y = ax^2 + bx + c$, using a variety of methods (e.g., sketching $y = x^2 - 2x - 8$ using intercepts and symmetry; sketching $y = 3x^2 - 12x + 1$ by completing the square and applying transformations; graphing $h = -4.9t^2 + 50t + 1.5$ using technology);	**6.1, 6.3**	264–273, 282–291
QR3.07 – explore the algebraic development of the quadratic formula (e.g., given the algebraic development, connect the steps to a numerical example; follow a demonstration of the algebraic development [student reproduction of the development of the general case is not required]);	**6.4**	292–303
QR3.08 – solve quadratic equations that have real roots, using a variety of methods (i.e., factoring, using the quadratic formula, graphing) (Sample problem: Solve $x^2 + 10x + 16 = 0$ by factoring, and verify algebraically. Solve $x^2 + x - 4 = 0$ using the quadratic formula, and verify graphically using technology. Solve $-4.9t^2 + 50t + 1.5 = 0$ by graphing $h = -4.9t^2 + 50t + 1.5$ using technology.).	**6.2, 6.4**	274–281, 292–303
Solving Problems Involving Quadratic Relations		
By the end of this course, students will:		
QR4.01 – determine the zeros and the maximum or minimum value of a quadratic relation from its graph (i.e., using graphing calculators or graphing software) or from its defining equation (i.e., by applying algebraic techniques);	**6.1**	264–273

	Chapter/Section	Pages
QR4.02 – solve problems arising from a realistic situation represented by a graph or an equation of a quadratic relation, with and without the use of technology (e.g., given the graph or the equation of a quadratic relation representing the height of a ball over elapsed time, 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?).	**6.5**	304–315

Analytic Geometry

Overall Expectations

By the end of this course, students will:

- model and solve problems involving the intersection of two straight lines;
- solve problems using analytic geometry involving properties of lines and line segments;
- verify geometric properties of triangles and quadrilaterals, using analytic geometry.

Specific Expectations

	Chapter/Section	Pages
Using Linear Systems to Solve Problems		
By the end of this course, students will:		
AG1.01 – solve systems of two linear equations involving two variables, using the algebraic method of substitution or elimination (Sample problem: Solve $y = \frac{1}{2}x - 5$, $3x + 2y = -2$ for x and y algebraically, and verify algebraically and graphically);	**1.2, 1.3, 1.4**	20–41
AG1.02 – solve problems that arise from realistic situations described in words or represented by linear systems of two equations involving two variables, by choosing an appropriate algebraic or graphical method (Sample problem: The Robotics Club raised $5000 to build a robot for a future competition. The club invested part of the money in an account that paid 4% annual interest, and the rest in a government bond that paid 3.5% simple interest per year. After one year, the club earned a total of $190 in interest. How much was invested at each rate? Verify your result.).	**1.1, 1.2, 1.3, 1.4, 1.5**	8–47
Solving Problems Involving Properties of Line Segments		
By the end of this course, students will:		
AG2.01 – develop the formula for the midpoint of a line segment, and use this formula to solve problems (e.g., determine the coordinates of the midpoints of the sides of a triangle, given the coordinates of the vertices, and verify concretely or by using dynamic geometry software);	**2.1**	56–69
AG2.02 – develop the formula for the length of a line segment, and use this formula to solve problems (e.g., determine the lengths of the line segments joining the midpoints of the sides of a triangle, given the coordinates of the vertices of the triangle, and verify using dynamic geometry software);	**2.2**	70–79
AG2.03 – develop the equation for a circle with centre (0, 0) and radius r, by applying the formula for the length of a line segment;	**2.4**	92–99
AG2.04 – determine the radius of a circle with centre (0, 0), given its equation; write the equation of a circle with centre (0, 0), given the radius; and sketch the circle, given the equation in the form $x^2 + y^2 = r^2$;	**2.4**	92–99

	Chapter/Section	Pages
AG2.05 – solve problems involving the slope, length, and midpoint of a line segment (e.g., determine the equation of the right bisector of a line segment, given the coordinates of the endpoints; determine the distance from a given point to a line whose equation is given, and verify using dynamic geometry software).	**2.3**	80–91
Using Analytic Geometry to Verify Geometric Properties		
By the end of this course, students will:		
AG3.01 – determine, through investigation (e.g., using dynamic geometry software, by paper folding), some characteristics and properties of geometric figures (e.g., medians in a triangle, similar figures constructed on the sides of a right triangle);	**3.1**	110–116
AG3.02 – verify, using algebraic techniques and analytic geometry, some characteristics of geometric figures (e.g., verify that two lines are perpendicular, given the coordinates of two points on each line; verify, by determining side length, that a triangle is equilateral, given the coordinates of the vertices);	**3.2**	117–127
AG3.03 – plan and implement a multi-step strategy that uses analytic geometry and algebraic techniques to verify a geometric property (e.g., given the coordinates of the vertices of a triangle, verify that the line segment joining the midpoints of two sides of the triangle is parallel to the third side and half its length, and check using dynamic geometry software; given the coordinates of the vertices of a rectangle, verify that the diagonals of the rectangle bisect each other).	**3.3, 3.4, 3.5**	128–151

Trigonometry

Overall Expectations

By the end of this course, students will:

- use their knowledge of ratio and proportion to investigate similar triangles and solve problems related to similarity;
- solve problems involving right triangles, using the primary trigonometric ratios and the Pythagorean theorem;
- solve problems involving acute triangles, using the sine law and the cosine law.

Specific Expectations

	Chapter/Section	Pages
Investigating Similarity and Solving Problems Involving Similar Triangles		
By the end of this course, students will:		
TR1.01 – verify, through investigation (e.g., using dynamic geometry software, concrete materials), the properties of similar triangles (e.g., given similar triangles, verify the equality of corresponding angles and the proportionality of corresponding sides);	**7.1**	330–341
TR1.02 – describe and compare the concepts of similarity and congruence;	**7.1**	330–341
TR1.03 – solve problems involving similar triangles in realistic situations (e.g., shadows, reflections, scale models, surveying) (Sample problem: Use a metre stick to determine the height of a tree, by means of the similar triangles formed by the tree, the metre stick, and their shadows.).	**7.2**	342–351
Solving Problems Involving the Trigonometry of Right Triangles		
By the end of this course, students will:		

	Chapter/Section	Pages
TR2.01 – 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 (e.g., $\sin A = \frac{\text{opposite}}{\text{hypotenuse}}$);	**7.3, 7.4**	352–377
TR2.02 – determine the measures of the sides and angles in right triangles, using the primary trigonometric ratios and the Pythagorean theorem;	**7.3, 7.4**	352–377
TR2.03 – solve problems involving the measures of sides and angles in right triangles in real life applications (e.g., in surveying, in navigating, in determining the height of an inaccessible object around the school), using the primary trigonometric ratios and the Pythagorean theorem.	**7.5**	378–385
Solving Problems Involving the Trigonometry of Acute Triangles		
By the end of this course, students will:		
TR3.01 – explore the development of the sine law within acute triangles (e.g., use dynamic geometry software to determine that the ratio of the side lengths equals the ratio of the sines of the opposite angles; follow the algebraic development of the sine law and identify the application of solving systems of equations [student reproduction of the development of the formula is not required]);	**8.1**	396–404
TR3.02 – explore the development of the cosine law within acute triangles (e.g., use dynamic geometry software to verify the cosine law; follow the algebraic development of the cosine law and identify its relationship to the Pythagorean theorem and the cosine ratio [student reproduction of the development of the formula is not required]);	**8.2**	405–411
TR3.03 – determine the measures of sides and angles in acute triangles, using the sine law and the cosine law (Sample problem: In triangle ABC, $\angle A = 35°$, $\angle B = 65°$, and AC = 18 cm. Determine BC. Check your result using dynamic geometry software.);	**8.1, 8.2, 8.3**	396–419
TR3.04 – solve problems involving the measures of sides and angles in acute triangles.	**8.4**	424–429