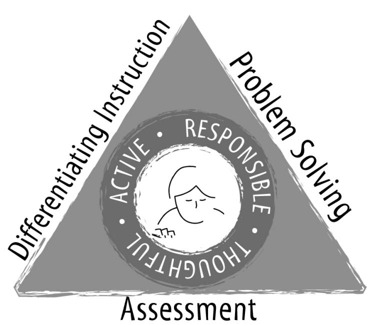
CHARACTERISTICS OF MCGRAW-HILL RYERSON'S *MATHEMATICS 10* PROGRAM

The *Mathematics 10* program was designed for students and educators using the outcomes and achievement indicators published in *The WNCP Common Curriculum Framework for Grades 10–12 Mathematics, January 2008.* This resource package will support educators and all grade 10 students enrolled in Foundations of Mathematics and Pre-Calculus Grade 10 in Alberta, British Columbia, Manitoba, Northwest Territories, Nunavut, Saskatchewan, and Yukon.

The *Mathematics 10* design is based on current educational philosophy and pedagogy. The instructional design adheres to the principles set out in the WNCP Common Curriculum Framework that include beliefs about students and mathematics learning, the affective domain, mathematical processes, the nature of mathematics learning, and instructional focus. Other considerations include chapter sequence, the role of technology, and layout.

Because concern for teachers and students was paramount, the program was developed around two central questions:

1. How would the instructional design benefit/support students?
2. What would teachers require to support their implementation of the new curriculum?



Pedagogical Approach

The program is based on the philosophy that the focus of student learning is to develop a deeper understanding of mathematics and its connection to student lives, careers, and interests. For that reason, the instructional design is based on the premise that students can, and will, take responsibility for their learning, and that they are active and thoughtful learners. With these beliefs in mind, the resource supports a wide range of student interests and learning styles.

Mathematics: Making Links

Throughout the *Mathematics 10* student resource, students are given the opportunity to see the links between real life and mathematics.

- Every unit includes a **unit project** that models mathematics in the real world, engages students' interest, and gives students a meaningful purpose for learning the mathematics presented in the unit. The project is designed to engage students by making links between the mathematics in the unit and students' personal experiences and interests, as well as between mathematics and the real world.
- Most concepts or procedures are introduced in a real-life context.
- The **Big Ideas** at the beginning of each chapter list in student-friendly language the outcomes of the mathematics curriculum that are covered in the chapter. These outcomes may be from different strands that naturally fit together and further illustrate how the program makes important links among concepts within the discipline and with the real world.

- A **career connection** at the beginning of each chapter allows students to see how the math they are learning applies to a career in the real world. The visuals in many chapter openers show people performing work related to the math skills in the chapter. These jobs and careers require varying amounts of education, thus connecting more students to how mathematics may be used in their future lives.

Procedural Fluency and Conceptual Understanding

The three-part lesson structure in McGraw-Hill Ryerson's *Mathematics 10* program is designed to engage students in learning that develops their conceptual understanding and procedural fluency. The three parts are described below.

1. Investigate

- Each investigation is designed to help students build their own understanding of the new concept by working individually and in groups to explore a mathematical concept or procedure.
- The investigations emphasize personal strategies and alternative methods for solving problems.
- **Reflect and Respond** questions at the end of the Investigate help students to generalize learning about the key concept or methods being investigated.

2. Link the Ideas

- Explanations at the beginning of this section help students connect what they did in the Investigate to the **examples** that follow.
- Examples and **solutions** demonstrate how to use the concept explored in the Investigate. Many examples demonstrate how to use commonly available concrete materials and manipulatives. Many include multiple approaches to a solution.
- **Your Turn** questions after each example allow students to check their understanding of concepts.
- **Key Ideas** summarize the key concepts of the lesson.

3. Check Your Understanding

- **Practise** allows for the practice of new skills through approximately five questions.
- **Apply** introduces five to ten problems in a range of real-world contexts.
- **Extend** includes challenging questions that require higher-order thinking. Some may require additional research or connect to one or more other topics within the curriculum.
- **Create Connections** introduces up to three questions that require explanation of students' strategies or reasoning. Each question involves the use of communication related to the mathematics of the section.
- Most chapters have a **Mini Lab**. This provides a hands-on activity that encourages students to further explore the concepts they are learning.

Problem Solving

Problem solving is central to the McGraw-Hill Ryerson *Mathematics 10* program. Significant emphasis has been placed on incorporating problems that:
- have a range of contexts
- can be solved using different problem solving strategies
- may have multiple solutions

A variety of problem solving experiences are provided throughout the units:
- Each unit is based around a **unit project**. Unit project questions throughout the unit ask students to solve a number of problems as they connect the mathematics they are learning to a real-life context. The unit project is wrapped up at the end of the unit as a performance task.
- Students are frequently asked to discuss their methods for solving problems. Doing so reinforces thinking and helps students realize that there may be multiple methods for solving a problem.
- A problem provides the focus for learning in the **Investigate** at the beginning of each section, often making use of concrete materials.
- Students are challenged to higher levels of thinking and to extend their thinking in the **Extend** and **Create Connections** sections of the exercises and the **Extended Response** section in the practice test.

Differentiating Instruction

Differentiating instruction provides educators with the tools needed to create a learning environment where students are actively involved and working together. Hands-on activities engage students and help to meet their diverse needs. Significant emphasis has been placed on:
- variety — provides opportunities for students to be thoughtful about what and how they learn
- choice — encourages students to develop responsibility by making good personal decisions
- balance — is essential in having students actively involved in their learning. Students' needs are best met when they experience a variety of ways to develop and understand concepts.

Care has been taken in the McGraw-Hill Ryerson *Mathematics 10* program to ensure that all students—including special needs students (with learning disabilities or gifted), students at risk, English language learners, or students from different cultures—can access the mathematics and experience success.
- Visuals that illustrate how to carry out investigations accompany the instructions, where appropriate.
- Visuals and graphics are paired with questions and content in other strategic locations in the student resource.
- An **organizer** at the beginning of each chapter provides tips to help students organize and interpret the unit content.

FOLDABLES® Study Tool

- A **Foldable** at the beginning of each chapter provides a useful tool students can use to organize what they learn and keep track of what they still need to work on.
- **Key Terms** are listed in the chapter opener. When they are first used, they are highlighted in purple and defined in a marginal box, with the aid of visuals where appropriate.
- Key Terms, as well as other useful words, are defined in the **Glossary**.

- The Teacher's Resource provides strategies and blackline master support for accommodating different learning styles, special needs, English language learners, First Nations, Métis, Inuit, francophone, and at-risk students.
- The Assessment *for* Learning suggestions on the back page of each chapter foldout serve to activate student knowledge and concepts related to the topics in the upcoming chapter.
- The open-ended nature of many of the problems and tasks accommodate the needs of all students by allowing for multiple entry points.
- **Did You Know?** boxes present interesting information related to the math or context of the lesson. Some provide literacy information or connections to other subject areas.

Ten Needs of the Learner

Anna Sfard (2003) has identified ten needs of the intermediate learner. She claims these needs are the driving force behind learning and must be fulfilled if the learning is to be successful. The needs are universal, but may be expressed differently in different individuals and at different ages.

1. **The Need for Meaning**

   Learners look for order, logic, and causal dependencies behind things, events, and experiences. This approach requires students to actively engage in generating the meaning for themselves. It also directs students' thinking so no time is lost investigating incorrect paths. While students are developing meaning for new concepts, they are guided to develop patience, persistence, and tolerance in the face of insufficient clarity.

2. **The Need for Structure**

   This need follows from the need for meaning. Meaning involves relationships among concepts. The connections among concepts already learned and new concepts being introduced should be an integral part of instruction. Such connections must include not only real-world applications and relevance, but also assistance in building mathematical abstractions, so students can see how the results can be transferred from one context to another (Wu, 1997). The more connections that exist among facts, ideas, and procedures, the better students' conceptual understanding.

3. **The Need for Repetitive Action**

   A person who has created meaning and structure for a mathematical concept is aware of a repetitive, constant structure in certain actions. A reasonable level of mastery of basic skills is an important element in constructing mathematical knowledge (Fuson and Briars, 1990; Fuson and Kwon, 1992; Hiebert and Wearne, 1996; Siegler, 2003; Stevenson and Stigler, 1992). If students are to reflect on the processes of mathematics, they must first master those processes to a sufficient degree. This does not mean a focus on rote repetition. Rather, it should be a process of reflective practice, where mastery of the action leads to reflection on the meaning of that action, which leads to further understanding and learning.

4. **The Need for Difficulty**

   True learning implies coping with difficulties. The goal of learning is to advance students from abilities they now possess to those they have not yet developed. The best way to accomplish this goal is to present students with tasks that are demanding but still within their reach.

5. **The Need for Significance and Relevance**

   Significance means linking new knowledge to existing knowledge, so this need also stresses the importance of helping students build connections. Significance and relevance do not come from only the concrete and the real; they also come from problems that are more abstract. Focusing only on real-life applications would lead to a fragmented, incomplete picture of mathematics.

6. **The Need for Social Interaction**

   There is an inherent social nature to learning and making meaning. Jerome Bruner states that the fundamental vehicle of education is social interaction not "solo performance" (Bruner, 1985). The most obvious forms are student–teacher or student–student exchanges, but even interaction with a textbook is a form of social interaction (Sfard, 2003). Cooperative learning is another form of learning interaction in which the teacher does not have the central role.

7. **The Need for Verbal–Symbolic Interaction**

   Interaction in learning means communication, and communication means using language (speech) and symbols (written language as well as mathematical symbols) to convey thoughts. If mathematical learning is to take place in an interactive setting, students must be encouraged to "talk" mathematics.

8. **The Need for a Well-Defined Discourse**

   Discourse goes beyond the idea of a conversation. It refers to all communication practices of the classroom, both written and verbal. Discourse implies that the resulting communication follows specific rules. Researchers now recommend that rules be adjusted to the needs and potential of the learning child (Siegler, 2003). This does not mean giving up the need for rigour, but it does mean carefully choosing which rules we use and which rules we modify, and making these rules clear to students.

9. **The Need for Belonging**

   The desire to belong and be counted as a member of a particular social group is a powerful force behind our actions. Learning by participation requires us to be a part of a learning community. Students need to feel respected and free to speak their mind in the classroom. However, the extent to which students value mathematics is influenced by the value given to mathematics by the wider community (Comiti and Ball, 1996). Thus, it may be difficult to instill a desire to embrace mathematics in an environment where mathematics is not valued. The most promising directions for improvement seem to be those that incorporate historical context in the mathematics content, portray mathematics as something unique in our world, and present it as something to be valued for its own sake (Sfard, 2003).

10. **The Need for Balance**

    To meet learners' wide range of needs, the pedagogy must be variegated and rich in possibilities. The need for balance suggests an advantage in searching for the good in all theories. It does not imply that old and new are mutually exclusive. The reality is that there must be a bit of everything in the classroom: problem solving as well as skills practice, teamwork as well as individual learning and teacher exposition, real-life problems as well as abstract problems, and learning by talking as well as silent learning.