MathLinks Program Overview

McGraw-Hill Ryerson's *MathLinks* is a new program that meets the outcomes identified in the 2006 *WNCP Common Curriculum Framework for 7–9 Mathematics*.

We used current educational research and practical classroom experience to design a program that meets the needs of Western Canadian students and teachers. Success for students was paramount in the development process. We continually asked ourselves two key questions:

- Will this help students learn mathematics?
- Will this support teachers who are implementing the new curriculum?

Our instructional design includes a variety of instructional and assessment techniques that accommodate the diverse needs of both students and teachers.

Program Design

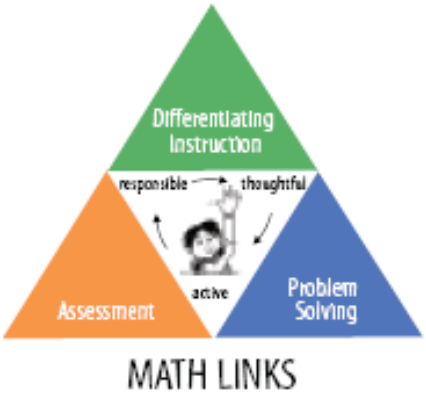
MathLinks includes activities that encourage students to develop responsibility and thoughtfulness toward learning mathematics. The instructional design is based on current educational, psychological, and adolescent-brain research. The design addresses a straightforward question: "How can we assist teachers to ensure that more of their students are successful in mathematics?"

MathLinks balances:

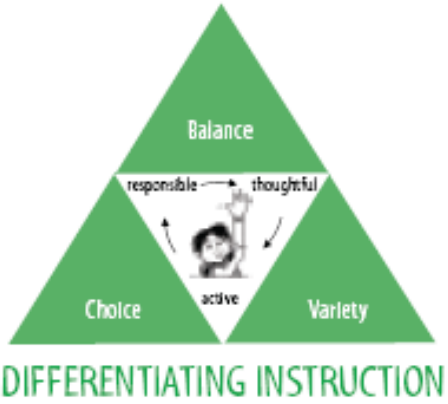
- conceptual understanding and procedural fluency
- mental mathematics, paper-and-pencil arithmetic, and technology
- concrete, pictorial, and symbolic representations
- practice and application
- student and teacher responsibility

This approach is most evident in three cornerstones of the *MathLinks* program:

1. differentiating instruction
2. problem solving
3. assessment



Differentiating Instruction



Differentiating instruction provides educators with the tools needed to create a learning environment where students are actively involved and working together in a heterogeneous classroom. Hands-on activities engage students and help meet their diverse needs.

Differentiation is a way of thinking about teaching and learning. It is supported by a belief that students learn best when they make connections between what is happening in the classroom and their interests or experiences. It reminds us that every student learns differently. Unless students have choices about what and how to learn and unless the classroom connects with the experiences and interests of each individual student, it is unlikely that the range of students will succeed in mathematics (ASCD, 2002).

Selecting differentiating instruction as one of the cornerstones of the *MathLinks* program places significant emphasis on:

- variety
- choice
- balance

Variety – provides opportunities for students to be thoughtful about what and how they learn. Thoughtful students will be motivated to be active learners. Variety is emphasized through:

- **Explore** – introduces new content using an exploration. Many explorations are hands-on activities and involve the use of manipulatives that help students construct their own understanding.
- **Practise/Apply/Extend** – provide students with opportunities to practise and apply the skills and concepts using a range of approaches.
- **Challenges** and **Tasks** – present problems in various contexts related to the content of the chapter.

Choice – encourages students to develop responsibility by making good personal decisions. Choice is supported by a variety of features:

- **Foldables** – provide visual organizers that give students an opportunity to take responsibility for their learning.
- **Link the Ideas** – help students make connections between the Explore and the Examples.
- **Examples** – often include more than one method of solution. Students are encouraged to identify the method they find most appropriate.
- **Key Ideas** – summarize the key concepts.

- **Practise/Apply/Extend** – provide sufficient questions and activities for teachers and students to select from.
- **Chapter Review** – gives an opportunity for teachers and students to wisely choose necessary questions to review the content of the chapter prior to the Practice Test.
- **Challenges** and **Tasks** – introduce problems where the path to the solution is not readily apparent, and where the problem can be solved in more than one way.

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. Teachers require tools that enable them to offer a balance of instructional approaches. Balance is emphasized in the instructional design of *MathLinks* through:

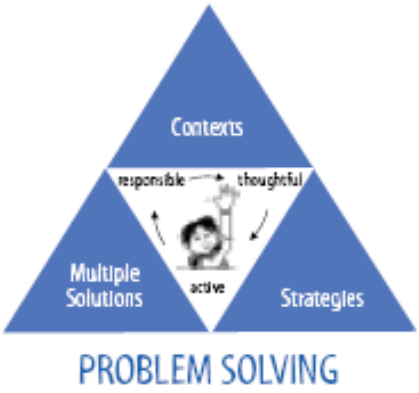
A variety of instructional approaches:

- discovery
- connectionist
- transmission

A variety of assessment tools:

- open-ended questions
- problem-solving tasks
- projects
- tests and quizzes
- performance tasks and rubrics

Problem Solving



Problem solving is one of the main goals of mathematics education. Mathematics should not be taught as a static body of knowledge. The processes of problem solving, reasoning, and communication are as important as the content. To be successful in modern society, students must become good problem solvers.

The National Council of Teachers of Mathematics (NCTM), in *Principles and Standards for School Mathematics* (2000) and *Curriculum Focal Points for Prekindergarten through Grade 8 Mathematics: A Quest for Coherence* (2006), identified problem solving as a vital process by which mathematics should be taught.

The 2006 *WNCP Common Curriculum Framework for 7–9 Mathematics* (p. 8) claims, "…learning through problem solving should be the focus of mathematics at all grade levels."

McGraw-Hill Ryerson has built the *MathLinks* program with problem solving as one of its three cornerstones. 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

Contexts – are necessary to actively engage students in learning and problem solving. *MathLinks* includes a variety of interesting and real-life problem situations and applications. Contexts are emphasized in the following features:

- **Math Link** – introduces a problem at the beginning of each chapter that draws on the mathematics presented in the chapter. At the end of most sections, a **Math Link** question encourages students to use the requisite content and problem solving skills they will need to complete the **Math Link: Wrap It Up!**
- **Math Link: Wrap It Up!** – culminates the **Math Link** feature in each chapter with a performance-based task.
- **Apply** – includes contextual problems for all students to solve.
- **Extend** – includes contextual problems for students to solve that challenge higher levels of thinking.
- **Challenges** – present contextual activities related to the mathematics of the chapter.
- **Task** – provides a performance-based activity that uses the mathematics from several of the previous chapters.

Different Strategies – are necessary for students to become efficient problem solvers. A four-step problem solving model is outlined at the beginning of the *MathLinks* student resource: Understand, Plan, Do It!, and Look Back. Throughout the resource, the model and various problem solving strategies are highlighted in the margins. Strategies include:

- Model It
- Draw a Diagram
- Make an Organized List or a Table
- Work Backward
- Guess and Check
- Look for a Pattern
- Organize, Analyse, and Solve
- Estimate and Check
- Solve a Simpler Problem
- Identify All Possibilities
- Use a Variable
- Solve an Equation
- Make an Assumption

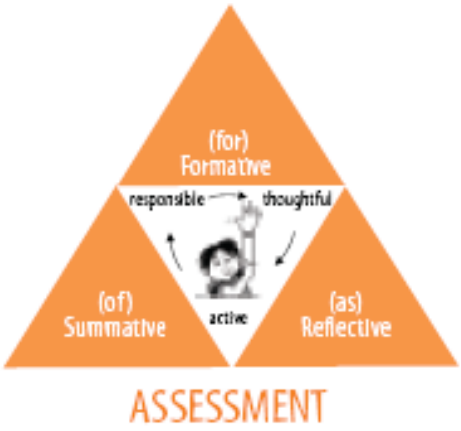
Multiple Solutions – help students develop divergent thinking approaches when solving problems. Opportunities for multiple solutions are evident in the following features:

- **Examples** – often include more than one method of solution.
- **Practise/Apply/Extend** – provide students with opportunities to practise the skills using a variety of approaches.
- **Challenges** and **Tasks** – present problems where the path to the solution is not readily apparent and where the problem can be solved in more than one way.

Assessment

Assessment is the process of gathering evidence about students' progress and making valid inferences from that evidence for a variety of purposes (NCTM, 1995). Assessment can:

- inform teachers about the effectiveness of their instruction and guide them in decision-making regarding how best to meet students' learning needs.
- provide students, parents, and other educational practitioners with information about a student's progress.
- provide teachers with the necessary data to describe student growth in a variety of domains.



In 2006, the WNCP published *Rethinking Classroom Assessment With Purpose in Mind* "premised on the belief that assessment has various purposes, and that it is important to intentionally design and use classroom assessment methods to serve the intended purposes" (p. viii).

McGraw-Hill Ryerson has created *MathLinks* with assessment as one of three cornerstones. Significant emphasis has been placed on assessment:

- *for* learning
- *as* learning
- *of* learning

Assessment *for* Learning (Formative) – occurs throughout the learning process. It is designed to make each student's understanding visible, so that teachers can decide what they can do to help students progress. This type of assessment is emphasized by the following features:

- **Get Ready** – these pre-assessments are in the BLMs for each chapter of the Teacher's Resource and also begin each chapter of the *MathLinks 9 Practice and Homework Book*. They are designed to activate student knowledge to help teachers assess students' readiness to begin learning new concepts.
- **Math Link** and **Literacy Link** – at the beginning of each chapter, these features activate learning necessary for students' success in the upcoming chapter.
- **Show You Know** – provides questions relating to each worked example that give students an opportunity to demonstrate their understanding of key skills before moving forward.

- **Reflect and Check** and **Communicate the Ideas** – provide an opportunity to determine students' understanding of concepts through conversations and/or written work.
- **Math Links** and **Math Link: Wrap It Up!** – provide opportunities throughout the chapter for performance-based assessment that can be used in conjunction with, or in place of, other more traditional forms of formative assessment.
- **Practise/Apply/Extend** – include questions at a variety of difficulty levels for all students to answer and check their understanding.
- **Chapter reviews** and **cumulative chapter reviews** – provide a range of question types that students need to be familiar with.
- **Problems of the Week** – encourage ongoing problem solving and provide opportunities to use personal strategies in mathematics.
- Additional support in the Teacher's Resource notes and Blackline Masters and in the Teacher Centre of the McGraw-Hill Ryerson Online Learning Centre provides assistance for identifying and supporting weaknesses in students' learning.

Assessment *as* Learning (Diagnostic) – emerges from the idea that learning is not just a matter of transferring ideas from teacher to student, but is an active process whereby students interact with new ideas. Students must learn to be critical assessors who make sense of information, relate it to prior knowledge, and use it for new learning. This type of assessment is provided to assist the teacher in programming by identifying student weaknesses and gaps. Throughout the student resource and Teacher's Resource, this is emphasized by the following features:

- **Literacy Link** – graphic organizers, such as thematic maps, Frayer models, spider maps, concept maps, sequence charts, and webs provide students with additional ways to monitor their learning.
- **Foldable** – provides visual and manipulative organizers that give students an opportunity to be self-directed as they express and monitor their own learning.
- **Reflect and Check** – provides early opportunities for students to construct knowledge about, and understanding of, the section content.
- **Communicate the Ideas** – gives students opportunities to explore their initial understandings of a concept.
- **Warm-Up** and **Math Learning Log** – materials in the Teacher's Resource that provide additional support in identifying and facilitating student learning.
- **Problems of the Week** and activities in the Meeting Student Needs boxes in the Teacher's Resource – address a variety of learner needs, including those of English-language learners and gifted and enrichment students.
- Introductory questions and exploration activities provided in the Teacher's Resource – designed to open discussion in the classroom.

Assessment *of* Learning (Summative) – is designed to provide evidence of achievement to parents, other educators, the students themselves, and sometimes to outside groups. This type of assessment is emphasized by the following features:

- **Practice Test** – includes multiple choice, numerical response, short answer, and extended answer questions. **Chapter Tests** are also provided as Blackline Masters in the Teacher's Resource.
- **Math Link: Wrap It Up!** – can be used as a summative, performance-based activity. A rubric is included in the Teacher's Resource and student exemplars are provided in the Teacher Centre of the McGraw-Hill Ryerson Online Learning Centre.
- **Challenges** and **Tasks** – provide contextual activities that relate to the mathematics of the chapter. An accompanying rubric can be found in the Teacher's Resource. Student exemplars are provided in the Teacher Centre of the McGraw-Hill Ryerson Online Learning Centre.
- **Computerized Assessment Bank (CAB)** – offers a database of additional questions covering a range of question types and difficulty levels that can be used to develop quizzes, chapter tests, and final exams.
- **Final Exam** – found in the Teacher Centre of the McGraw-Hill Ryerson Online Learning Centre, includes 50 multiple choice questions, 10 numerical response questions, and 4 written response questions.

MathLinks 9 Teacher Planning

Getting to know the lesson plan components.

STRAND/ORGANIZER: *STRAND/ORGANIZER the lesson is based on*

General Outcome: *WNCP General Outcome covered*

Specific Outcomes: *WNCP Specific Outcomes covered*

Achievement Indicators*: Suggested WNCP Achievement Indicators covered in the lesson*

Resources/Materials: Specific resources or materials used in the lesson

Introduction: Opening information regarding the lesson to be shared with students

Procedures/Activities/Instruction: Additional information related to the activities used in the lesson

Assessment: Suggested assignments for all levels. Sufficient questions are provided to accommodate the range of students in your classroom.

Foldable Entry: Suggested entries or terms that could be used in the Foldable. Students should be encouraged to add entries they think will assist in their learning.

Literacy Link: Suggested writing assignments that may serve as Assessment *as* Learning tasks

Math Learning Log: Suggested writing assignments that may serve as Assessment *as* Learning tasks

Adapted Resource/Materials: Specific resources or materials from the Adapted Program used in the lesson

Problems of the Week: Additional problems available as Blackline Masters on the Teacher CD-ROM and in the Teacher Centre of the McGraw-Hill Ryerson Online Learning Centre. These problems require students to think beyond the chapter and experiment with a variety of approaches.

For more information, view the ***MathLinks* 9 Lesson Planner Package and Program Overview Video**. In the main menu, select **Program Overview***.*