

Introduction to Mathematics

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Introduction to Mathematics

There is a growing sense of excitement and anticipation as teachers, students and parents discover the wonder of mathematics through applications.

Mathematics 9 is a rigorous, academic mathematics curriculum. Developed as a means to make mathematics accessible to all students, this curriculum has renewed a focus on pedagogy and, perhaps most important, the relationship among mathematics, the learner and the real world.

Mathematics 9 is one of a growing number of curricula having a significant applications focus. This curriculum is based on a holistic understanding of the learning process and provides an approach to learning that makes sense to a great many students.

The Mathematics 9 curriculum focuses specifically on the relationship between given skills or aspects of knowledge and the contexts in which people use them. Applications relates the theoretical to the practical and connects the abstract to the concrete. They tie what students already know and their sense of the real world to what they are about to learn. This helps give students a sense of how they might use what they are learning.

What are the different instructional approaches?

The lessons build upon the mathematical knowledge and understanding students already have. It is essential that students see the mathematics lesson as an extension or reconstruction of what they already know. This can lead to some principles, theory and practice of skills to support that theory. Then, *as* mathematical ideas are used by students in decision making and in critical thinking within new contexts, they become integrated as part of the student's knowledge and skill set. This emphasis on actual thinking about the real world makes the mathematics very important to the students, rather than something that they must do.

The most important aspect of the mathematics lesson is that it is engaging. It should genuinely spark curiosity in the student, and inspire a sense of questioning and empowerment—a sense that mathematics is a practical and necessary activity that all humans, in one way or another, do.

To encourage this enthusiasm and interest, an open forum must be created where students can explore ideas and issues without the feeling that there must be a single and, therefore, predictable 'right answer'.

A second important component of an applied lesson is a clear delineation among mathematical concepts, contexts, calculations and critical thinking (4 C's). Students are very willing to tackle even 'drill and practice' if they understand it is an exercise that is useful for accomplishing some activity in which they are interested. In this regard, mathematics students are like those who play basketball, or any other sport that requires drill and practice. The important thing for you the teacher, is to occasionally give the players (i.e., students) a chance to use what they have learned in a game situation.

What is the process of teaching mathematics?

Throughout the process of teaching mathematics, teachers help students make connections with the world they experience around them, and their current and future roles and responsibilities as students, family members, citizens, and workers.

One process for teaching mathematics follows:

- Describe the context of a problem and understand what is involved in doing a project intended to shed light on the problem. At this point, research and key planning questions are addressed.
- Build a workplan and identify important activities. Include the following:
 - why each activity is important
 - what will be achieved by doing each activity
 - what method will be used to assess and evaluate each completed activity.
- Create the product.
- Assess and evaluate the product using both formative and summative methods.
- Assess and evaluate the learning associated with developing the product.

Many students find it very helpful to have the teacher describe the problem-based learning process in which they are engaged. That is:

- posing problems
- posing questions
- generating and identifying alternatives
- making choices
- researching and planning
- generating/constructing products
- evaluating products
- assessing choices/reflecting on decisions
- reflecting on the effectiveness of products

At the end of the process, students should realize that they have learned new mathematical concepts, skills and processes, and they should be able to communicate their understanding with respect to these.

What are the principles of learning mathematics?

A major goal of *Mathematics 9: A Resource for Teachers* is to bring curriculum closer to the issues in students' lives now and in the future. This is done by focussing on the following key principles of learning mathematics:

- developing positive attitudes
- solving problems
- communicating mathematically
- connecting and applying mathematical ideas
- developing mathematical ideas in context
- reasoning mathematically
- using technology
- estimating and doing mental mathematics
- modelling

These key principles are elaborated below:

Developing Positive Attitudes

Research, including provincial assessments, emphasizes the direct relationship between student attitudes and student performance levels. The mathematics classroom should be a learning environment that engages the interest and imagination of all students. When students develop a positive attitude to mathematics, they are more willing to take risks and grow in their tolerance of ambiguity. They are much less likely to communicate, “I can’t do math.”

Solving Problems

Problem solving should be integrated into all areas of learning. The goal of problem solving is to provide students with opportunities to explore new mathematical concepts by building on previous experience and knowledge. Students must be empowered to:

- read and analyse a problem and identify the significant elements
- select an appropriate strategy that is likely to generate solution(s) to the problem
- draw upon the skills and concepts developed within areas of mathematics as well as in other subject areas
- work individually and in groups
- verify an answer and judge how reasonable it is
- communicate mathematically to different audiences

Communicating Mathematically

Mathematical communication skills are developed when students are actively exploring, investigating, describing, justifying decisions, explaining, and solving problems collaboratively. It is important that students build confidence in expressing their mathematical understanding when communicating and demonstrating what they have learned.

Connecting and Applying Mathematical Ideas

Learning activities should help students understand that mathematics is a changing and evolving domain, one that has benefited from the contributions of many cultural groups. A major instructional focus of mathematics is helping students connect mathematics to their own experiences and future career interests.

Developing Mathematical Ideas in Context

Activities should challenge students to learn mathematical skills and concepts in real-world situations. They should also demonstrate how mathematical ideas are powerful tools by which to understand and influence the world. Students should view mathematics as a vital human activity that evolves through approximation, refinement, and communication.

Reasoning Mathematically

Mathematics instruction should help students develop confidence in their ability to reason and justify their thinking. Students need the freedom to explore, conjecture, validate, and convince others if they are to develop mathematical reasoning skills. It is important that their abilities to reason well and to take risks are valued as much as their ability to find correct answers.

Using Technology

The natural curiosity of students is engaged when a range of technology tools is used such as computers, calculators, and measuring devices. Technology allows students to explore computationally complex situations while concentrating on the underlying mathematical relationships. Students must be able to select and use the most appropriate tools for data collection, analysis, and presentation.

Estimating and Doing Mental Mathematics

Instruction should emphasize the value of estimation. Students need to use reasoning, judgment, and decision-making skills when estimating. Self-confidence and precision in mathematics increase when students can perform simple mental mathematical operations.

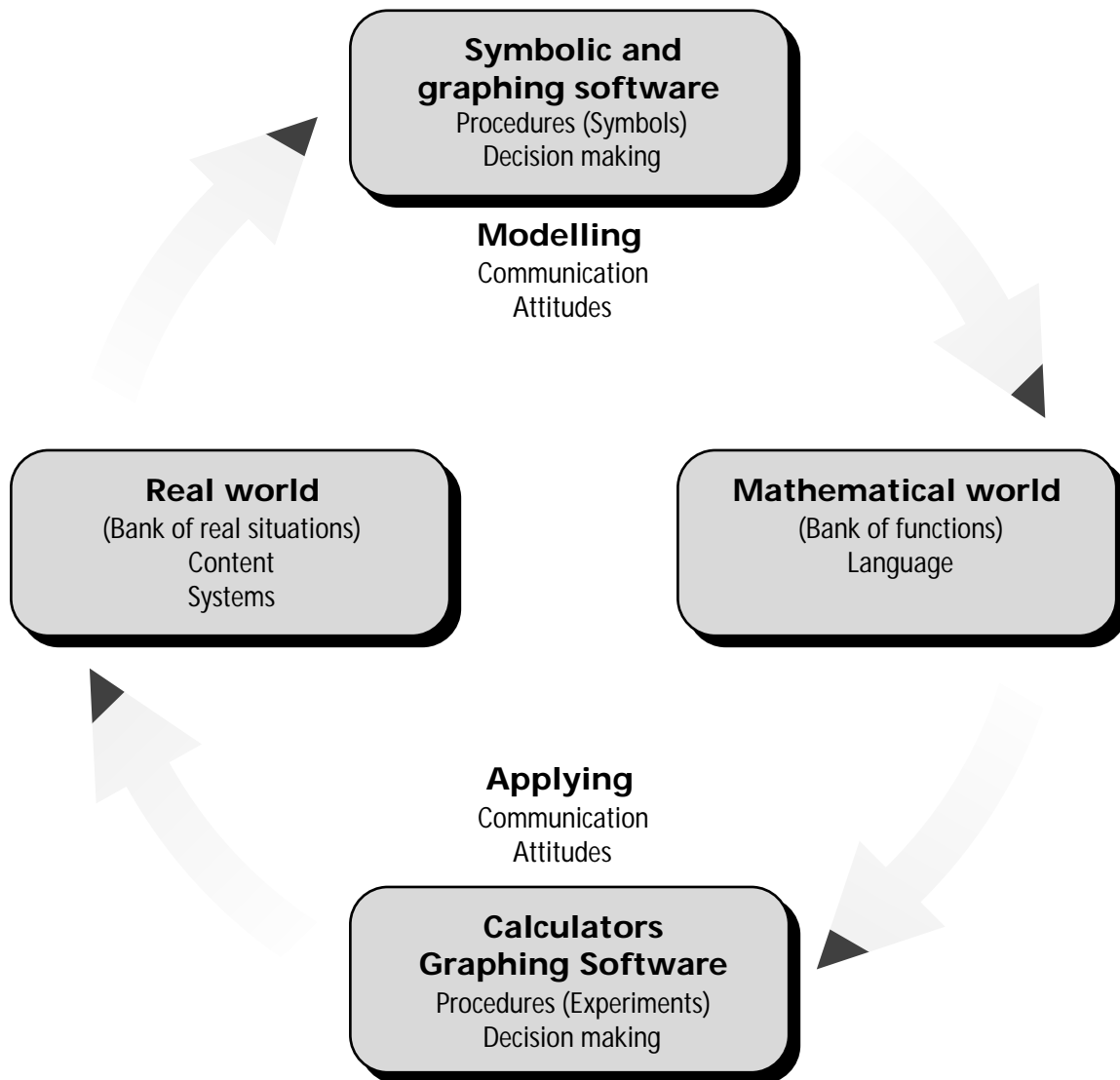
Modelling

An important element of problem-based learning is that students create and use mathematical models of real-world situations. Modelling a situation means translating the situation into mathematical language in order to better understand the real world, for example, modelling the trajectory of a projectile with a quadratic function. See Figure 1: Modelling.

Figure 1: Modelling

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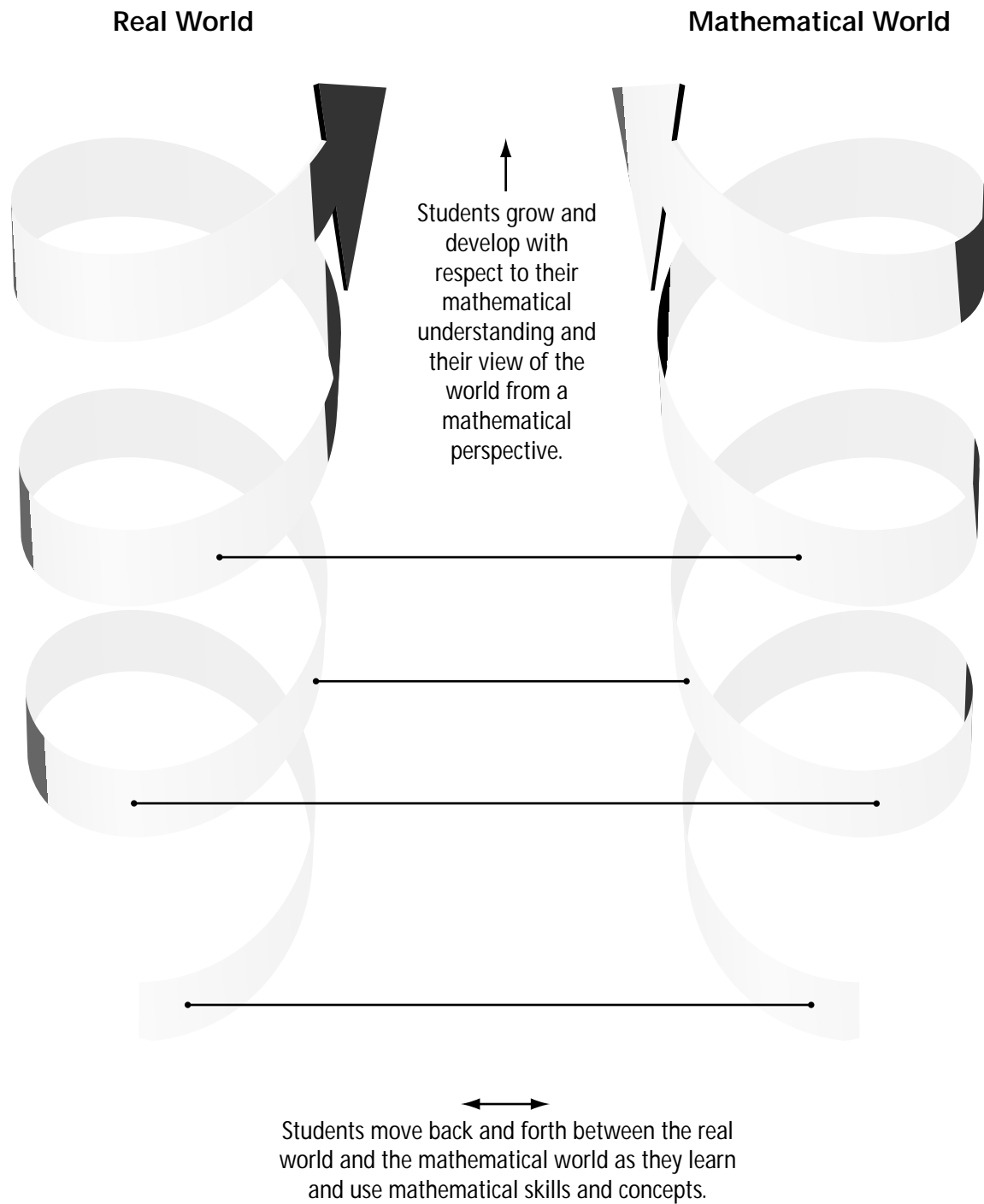
Who are the key players in Mathematics 9?

The Learner

The Mathematics 9 curriculum places an emphasis on students. It is designed to provide opportunities for all students to understand, enjoy and ultimately use mathematics in their present and future lives. It allows students to use intuitive sense to draw valid and useful connections between abstract concepts and concrete situations. With this kind of experience, students are able to explore potential applications in various fields of endeavor, ranging from business and finance to science or engineering. In many cases, a student's interest in this kind of mathematics will come from an interest they have in a particular career. Just as often, it can grow out of personal hobbies and interests, or out of curiosity about the mathematics they have begun to explore in this way.

The mathematics learner comes from a diverse population that includes exceptionally bright students wanting to learn about mathematics from a contextual point of view, in a hands-on way, and those students for whom the algorithmic approach is a struggle, and the mathematics doesn't make much sense. These students need to understand mathematics as it relates to who they are rather than as something external to themselves or their world. The more that they are able to 'construct' the mathematics *for themselves*, the more likely they will view mathematics as *part of themselves*. See Figure 2: Moving Between the Real World and the Mathematical World.

Figure 2: Moving Between the Real World and the Mathematical World



The Teacher

Teachers of a mathematics curriculum make a point of knowing about mathematics in the real world. They tend to look, and to help students look at the whole picture, keeping in mind that mathematics is not just learning the various operations, but also understanding how it can be used to make decisions and construct meaning in the world. They see the teaching of mathematics as a broad and deep responsibility. They realize that mathematics must become richer than pure calculation for most students to develop skills and a true sense of numeracy.

Mathematics teachers begin to teach a concept by placing it in the context of the student's own experience—a context that the student can easily understand.

Mathematics teachers are open to the learning of mathematics, and use the appropriate materials and resources to help them. However, mathematics does not mean that teachers have to transform everything they do. Rather, teachers constantly need to add to their personal repertoire of instructional strategies. Teachers, for example, use more than one approach to stimulate individual learning. When a student says, "I don't get it," teachers try a second and third way of approaching the problem. This constant search for new, innovative and effective ways to teach mathematics helps make mathematics accessible to everyone.

Parents and Community

The excitement that is engendered in the Mathematics classrooms takes students beyond the artificial bounds of the classroom. What children produce is important to their view of the world, so it is necessary to get them into that world, investigating, exploring, and making mathematical sense of it.

The nature of the mathematics curriculum broadens the concept of the mathematics classroom itself. The classroom now extends to the edge of the universe. Parents and the community will find many classrooms looking considerably different from the way they do now.

Teachers find a real-world way to describe applications to parents. Their homework assignments include mathematics application questions that stimulate discussion and debate with siblings and parents.

These parents may be the resources that teachers need to bring the mathematics into the classroom. Many parents have interesting backgrounds in mathematics or have access to people who do.

One of the characteristics of the mathematics curriculum is that it is not fixed or static. It varies with the character of each community, school and classroom. It is no longer a dry and lifeless discipline for the initiates—it is an adventure.