

Introduction

INTRODUCTION

Mental Math: Grade 9 Mathematics is a complement to the Grade 9 Mathematics curriculum and is intended to help students develop strategies that allow them to perform mental calculations.

Why Mental Mathematics?

Mental mathematics and estimation is one of the seven processes of the mathematics curriculum.

Mental mathematics and estimation is a combination of cognitive strategies that enhance flexible thinking and number sense. It involves using strategies to perform mental calculations.

Mental mathematics enables students to determine answers without paper and pencil. It improves computational fluency by developing efficiency, accuracy, and flexibility in reasoning and calculating.*

It is used by individuals in their daily lives at home and at work. Mental calculation requires students to call on their knowledge of numbers and mathematical operations. It not only calls on memory but helps improve it as well.

Mental calculation is at the root of the estimation process. It allows us to determine whether results obtained with a calculator are reasonable.

Estimation is used for determining approximate values or quantities, usually by referring to benchmarks or referents, or for determining the reasonableness of calculated values. Estimation is also used to make mathematical judgments and to develop useful, efficient strategies for dealing with situations in daily life.*

Mental calculation is an important way of developing number sense and acquiring a better understanding of place value and mathematical operations. Students who have experience with mental math develop the ability to work with numbers. Mental calculation can be used to prepare for written work by providing an approximate answer to a problem. Using certain mental calculation strategies can eliminate some steps in written calculations and help simplify the process. In short, mental calculation skills are at the heart of numeracy.

* Manitoba Education and Advanced Learning. *Grades 9 to 12 Mathematics: Manitoba Curriculum Framework of Outcomes, 2014* (Winnipeg, MB: Manitoba Education and Advanced Learning, 2014) 9.

Mental calculation is used almost daily in life. We often have to do quick mental calculations at times when we do not have paper, a pencil, or a calculator handy. Mental calculation is therefore a very practical skill. Teachers should provide opportunities for their students to use mental math and estimation on a daily basis. They should encourage their students to find examples of the usefulness of mental calculation in their lives, such as when shopping, doing home renovations, estimating mileage, or working at their jobs.

Strategies

Teachers should promote a variety of mental mathematics strategies. They are encouraged to make students aware of the strategies described in the Strategies section of this document. The strategies that are most effective for mental calculation are often not the same strategies that are most effective for written calculation. Most students are able to develop strong mental calculation techniques, but often need help in doing so. Students may discover and use some mental calculation techniques by themselves but need to be taught other techniques to increase their mental calculation effectiveness. Regular mental calculation activities should be included in all mathematics curricula at all grade levels.

Document Features

The document includes three main sections: this introduction, a section describing strategies, and a series of mental mathematics questions organized by units.

The teacher will find mental mathematics questions relating to a specific substrand of Grade 9 Mathematics as written in *Grades 9 to 12 Mathematics: Manitoba Curriculum Framework of Outcomes*. The *Mental Math: Grade 9 Mathematics* document consists of eight (8) units related to specific substrands and one unit with a review of all substrands:

Unit	Number of Pages
A: Number	13
B: Patterns	6
C: Variables and Equations	16
D: Measurement	6
E: 3-D Objects and 2-D Shapes	6
F: Transformations	7
G: Data Analysis	9
H: Chance and Uncertainty	6
I: Review (All Units)	20

The units may be taught in a different order as determined by the teacher. Every unit consists of several pages of mental math questions.

The unit of study is identified on each page. The questions on each page are divided into three different categories: six (6) general or review questions; four (4) questions related to the unit of study; and two (2) blanks for teachers to insert their own questions.

The answers to the questions are provided in the column on the extreme right-hand side of each page. Sometimes students are asked to provide the one right answer and at other times they are to provide an estimate where a range of values would be correct.

Teachers may want to prepare additional questions to better meet the needs of their students. A section at the bottom of each page entitled Other Questions has been set aside for this purpose. A blank template is also provided in a section titled Reproducible Sheets. Teachers may use it to prepare additional question sheets.

A file in Word format is available in the Mathematics Group on the Maple (Manitoba Professional Learning Environment) site at www.mapleforem.ca. The Word file does not contain the Strategies section of this document but it does contain the section with the Mental Math Questions by Unit. It is provided to enable teachers to add or modify questions to suit the needs of their students.

Immediately following this introduction is a section describing mental calculation strategies along with examples. Some students may already have an inventory of strategies that they can apply; others may not. Teachers can use the strategies information given in this document to help students expand their strategy knowledge.

Methodology

Given their usefulness, mental calculation exercises should be short and done frequently.

They should be short because they require sustained concentration. For example, the first five minutes or so of math class could be devoted to mental calculation exercises. This practice would also serve as a warm-up to the day's lesson. In addition, although mental calculation should be done within a certain period of time, it is preferable not to emphasize speed. Although speed is a factor, it is not a primary goal. It is obviously important to ensure that time spent on mental mathematics activities does not infringe on the time needed for instruction and other learning activities.

Establishing routines in the classroom also encourages students to get to work quickly at the beginning of each class. Teachers could establish a process such as the following:

- As soon as students arrive at the beginning of the class, they can take out a sheet of paper and write down the numbers 1 to 10 if there are 10 questions.
- The teacher can project a mental math page, present questions orally, or distribute a page with written questions.
- The students are given time to answer the questions.
- If students are unable to find an answer to a specific question, they could leave an empty space on that question and go on to the next question. The goal is accuracy and the development of a bank of effective strategies.
- The teacher should, on occasion, spend time discussing various strategies used by the students for one or more of the questions.

To ensure students gain confidence with a new strategy, it is important that they are given adequate opportunity to practise it. It is up to the teacher to provide an adequate number of exercises or problems to ensure that students are able to use the new strategies.

Assessment

Primarily, mental calculation exercises are used as assessment *for* learning. Mental calculation exercises should be done in a classroom environment in which students feel comfortable taking risks without being penalized when they make mistakes. However, teachers should ask students to do a self-evaluation by identifying the questions they had the most difficulty with or those they did not answer correctly. Periodically, teachers may choose to use the mental mathematics questions as assessment *of* learning by asking them to explain the strategy they used for a specific question or questions.

Mental calculation can allow students an opportunity to develop a better understanding of some mathematical concepts. Consequently, mental calculation activities should include periods for thought and discussion. During these periods, the teacher should encourage students to

- suggest a variety of possible correct solutions to the same problem
- explain the different methods used to come to the correct answer and their effectiveness
- explain the thought process that led to an incorrect answer

This type of discussion is very important in learning mental calculation strategies, because it is an effective way for students to present their thinking. Questioning, reflecting, and discussing, which are integral to the activities of mental calculation, are excellent ways of communicating mathematical ideas. This communication requires that students be clear and concise when explaining their thinking to others. It is often when students describe the strategy they used to solve questions that other students discover a new technique. These exchanges about the strategies as well as the results will allow the teacher to identify the difficulties encountered by some students. Subsequently, the teacher can help students discover new, relevant, useful, and important strategies.

Enjoy the mental mathematics experience!

Notes