

Math in *Motion*

A K–12 resource for system leaders

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The 2014 Summer Learning Program

While all students experience “summer learning loss,” extensive research has shown that its cumulative impact can be very significant for children facing academic and social challenges. The Summer Learning Program is especially designed to help these students improve (and not lose!) literacy and numeracy skills over the summer months. Key aspects include:

- Providing a blend of classroom learning and recreational programming for students identified by their classroom teacher and/or principal as likely to benefit from a summer learning program.
- Providing opportunities for parents to learn more about how their children learn and how to support learning at home.
- Developing opportunities for teachers to gain expertise in teaching primary literacy and numeracy and in supporting the Aboriginal Education Framework.

Operated by the the Council of Directors of Education (CODE) in partnership with the Ministry of Education, the Summer Learning Program is now in its fifth year. It has grown from an original cohort of 28 boards serving approximately 1,200 students in 2010 to



64 boards serving more than 5,000 in 2014. In 2013, the program was expanded to include literacy, numeracy and a literacy program for First Nations, Métis and Inuit (FNMI) students.

From the outset, the program has included a research component. Using a range of methods, from data collection and analysis, to classroom visits and parent surveys, to teacher questionnaires and interviews, the following are consistent results:

- Students who are highly vulnerable, such as those with Individual Education Plans (IEPs) and low Performance Measure Benchmark/Developmental Reading Assessment (PMB/DRA) scores, had substantially decreased learning loss when they attended summer programs – a significant accomplishment.
- Parents of students in the program provided with opportunities to learn new skills to help their children succeed in school, became “active partners” in the program and developed stronger relationships with local schools and teachers.
- Teachers expressed overwhelming support for the summer program, and appeared energized by their students’ success and confidence.

For examples of different ways to set up literacy and numeracy summer classes click here http://www.ontariodirectors.ca/summer_literacy.html

For the *Summer learning is ...* video click here www.ontariodirectors.ca

Math in Motion is published monthly except during the summer. For more information about this newsletter or to make a comment, email Cristina DaSilva (cristina.dasilva@ontario.ca).
Math in Motion is available each month at EduGains. To access them, visit here.

Curriculum Corner

Have you ever wondered why some people have a great sense of direction and others don't? Or how some people can think about an object in their head and what might happen if it was rotated 90°? Well, these people have what is known as spatial sense. Spatial sense is defined as “the intuitive awareness of one’s surroundings and the objects in them” (*Ontario Curriculum, Grades 1–8: Mathematics*, p.9).

It turns out that the kind of thinking that is developed by attention to spatial sense is necessary in all areas of mathematics, in daily living, and in many occupations. That is why we pay close attention to it in *The Ontario Curriculum*, “Geometry and Spatial Sense” strand, and implicit links are made in other areas of the mathematics curriculum, and other subject areas.

Developing an understanding of how objects can be moved through reflections, translations and rotations is foundational to more formal aspects of geometry, but also important to many fields such as art, science, architecture and engineering. Students are constantly bombarded with visual images in the form of diagrams, pictures and patterns. Every mathematics textbook, for example, portrays three-dimensional figures as two-dimensional drawings. Research suggests that those who develop the ability to make sense of these images are better problem-solvers. When students think spatially, they are able to approach problems more flexibly and aren't stuck using just one type of approach.

Students typically demonstrate a deeper understanding of mathematics when skills are learned in context rather than practised in isolation. This is particularly important in the development of spatial thinking where students are developing an awareness of themselves, their surroundings, and objects in space.

The following expectations show how spatial thinking and reasoning can be applied in contexts outside of the mathematics classroom:

- **In Social Studies** ... Grade 1 students will analyse maps, and construct simple maps using appropriate elements, as part of their investigations into inter-relationship between people and significant natural and built features in their community.
- **In Health and Physical Education** ... Grade 5 students will apply a variety of solutions to increase their chances of success as they participate in physical activities.
- **In Visual Arts** ... Grade 8 students will use a variety of materials, tools, techniques and technologies to determine solutions to increasingly complex design challenges, e.g., make an image that might be seen as magnified through a viewfinder.

To access the K to 12 support document *Paying Attention to Spatial Reasoning* click here [<http://www.edu.gov.on.ca/eng/literacynumeracy/LNSPayingAttention.pdf>]



Assessment Angle

Learning goals are tools that help teachers and students take actions to learn – *know* what to learn, *understand* why they are learning it, and *direct* and *monitor* their learning. Learning goals identify the knowledge and skills that students are expected to attain as a result of their own and their teacher's efforts to promote learning. In mathematics, the knowledge and skills that students are to learn are set out in the curriculum policy in the form of overall, specific and math process expectations.

To identify learning goals, begin by examining the expectations – what knowledge and skills are embedded within them? An example of developing a progression of learning goals from the Grade 4 strand, Geometry and Spatial Sense, follows:

1. **Begin by selecting an overall expectation.**
(*The learning will focus on the second half of the first overall expectation, “compare various angles to benchmarks”.*)
2. **Cluster the overall expectation with related specific expectations.**
3. **Identify one or more process expectations that are authentically connected to the learning context and/or content.**
4. **Examine the knowledge and skills embedded in the expectations, focussing on the verbs and the content.**
5. **Design the learning goals.**

One possible organization of learning goals is to develop a broad goal, which will describe the learning in global terms, and a series of specific goals that can become the focus of various learning experiences.

We are learning to identify angles we see in the world around us, so that we can become good mathematical thinkers and problem solvers.

As part of our learning, we will:

- identify a variety of benchmark angles
- compare angles in our environment to benchmark angles
- know the measure of different benchmark angles in degrees
- make reasoned guesses or conjectures about the size of angles that we see around us, and defend our conjectures.

6. Clarify the learning goals together

Be sure to have clarifying conversations with students to determine the extent of their understanding of the goals.

The next issue of *Math in Motion* will explore the role of success criteria as they relate to these learning goals.

Example:

Overall Expectations

By the end of Grade 4, students will:

- identify quadrilaterals and three-dimensional figures and classify them by their geometric properties, and compare various angles to benchmarks

Specific Expectations*

By the end of Grade 4, students will:

- identify benchmark angles (i.e., straight angle, right angle, half a right angle), using a reference tool, and compare other angles to these benchmarks
- relate the names of the benchmark angles to their measures in degrees

Mathematical Process Expectations

(Reasoning and Proving) Throughout Grade 4, students will:

- develop and apply reasoning skills (e.g., classification, recognition of relationships, use of counter-examples) to make and investigate conjectures and construct and defend arguments

* The examples and sample problems have been removed for the sake of space.

Resource Round-up

Spatial Reasoning and MathCLIPS

Digital technologies allow us to see into space and experience spatial relationships like never before. GIS, GPS, Google Earth are tools that we use to manipulate objects in ways we could never have done before with pencil/paper or chalk/board.

The featured resource below is called “Representations of Linear Growing Patterns.” This digital tool can be found at mathCLIPS.ca in the tools menu and at mathies.ca in learning tools. It helps build understanding of the relationships between three representations of linear patterns.

Learners manipulate the features of graphs, pictures or equations. Every change to one representation causes changes to the other two representations. This tool may be used to help learners visualize, predict and confirm relationships between the features of the representations (e.g. describe the effects on the graph and make the corresponding changes to the equation). They can determine the other two representations of a linear relation, given one representation.

The screenshot shows the MathCLIPS interface for "Exploring Different Reps". It features three main representation areas:

- Pattern Rule Representation:** Shows the equation $(\text{Number of Tiles}) = (\text{Position Number}) \times 4 + 2$. The numbers 4 and 2 are in adjustable boxes with up/down arrows.
- Pictorial Representation:** Shows four stages of a linear pattern labeled 0, 1, 2, and 3. Each stage consists of a vertical column of blue tiles with two red tiles on top. The number of blue tiles increases by 4 in each stage.
- Graphical Representation:** A coordinate plane with "Position Number" on the x-axis (0 to 5) and "Number of Tiles" on the y-axis (0 to 24). A dashed line passes through points (0, 2), (1, 6), (2, 10), (3, 14), and (4, 18). A legend indicates that colored points can be dragged and black points can be clicked.

At the bottom, there are navigation controls including a "Replay Scene" button and a scene indicator "Scene 2 of 3".

21st Century Learning on EduGAINS

The new 21st Century Learning domain at www.EduGAINS.ca offers educators an opportunity to see innovation in action, access local resources, learn more about the experiences of Ontario educators and learn from international and local research.

Please take a few minutes to tell us what you think about Math in Motion? Do you find it helpful in raising awareness about mathematics resources and sharing effective practice? Click here <http://fluidsurveys.com/s/math-in-motion-feedback-survey/>