Math Trails – Taking Math out of the 4 Walls of the Classroom

CURRICULUM CONNECTIONS
This lesson was used as an introduction to the Grade 3/4 Geometry and Spatial Sense units. The curriculum connections were broad and covered new information as well as a review of past concepts in order to create a more universal understanding of geometry before beginning the unit.

Students learned to identify and classify 2D shapes and 3D figures in their natural and built environments. Students demonstrated understanding by participating in math trail-based centres within the classroom and by completing a Math Trails activity during which they created their own geometry problems and solutions using shapes in the outside environment. Concepts covered include: identifying and classifying shapes and figures, constructing figures from a picture/model, and identifying symmetrical and congruent figures.

LESSON OVERVIEW
Suitable Grade(s): Grade 3/4
Math Strand: Geometry and Spatial Sense
Expectations Addressed: The expectations addressed were very broad, reflecting that this lesson was 1) meant as a general introduction to the concepts of the unit and 2) differentiated for two grades and multiple learning levels and styles within those grades.

Grade 3:
Overall Expectations:
- compare 2D shapes and 3D figures and sort by geometric properties
- describe relationships between 2D shapes and between 2D shapes and 3D figures

Specific Expectations:
- identify and compare various polygons and sort by geometric properties
- compare and sort prisms and pyramids by geometric properties using concrete materials
- solve problems requiring the greatest or least number of 2D shapes needed to compose a larger shape
- identify and describe 2D shapes that can be found in 3D figures

Grade 4:
Overall Expectations:
- identify 3D figures and classify by their geometric properties
- construct 3D figures using 2D shapes

Specific Expectations:
- draw lines of symmetry through 2D shapes
- identify and compare different types of quadrilaterals, sort and classify
- construct 3D figure from picture or a model
LESSON DETAILS

This lesson used Math Trails as a general introduction to the **Geometry and Spatial Sense** unit. The length of the lesson was **80 minutes**. The lesson was designed for a 3/4 combined class that consisted of a variety of learning styles and levels. Learning styles and management issues within the class were considered in the designing of this lesson, and account for many of the lesson decisions (for example, having multiple differentiated centres designed for specific students instead of actual trail cards, having specific roles for each student within their groups, and spreading out the modelling/input throughout the lesson).

**General Lesson Structure:**

**Mental Set (5 min) –** Students were on the carpet, think/pair/share about geometry (“What do you think of when I say “geometry”? What pictures and words come to mind?”). Students wrote/drew (depending on learning style) ideas on post-it notes during “pair” and then we “shared” by creating a class anchor chart entitled “Geometry Is…”.

**Learning Goal:** Today we will find and describe 2D shapes and 3D figures around our school.

**Success Criteria:**
- We will find 2D shapes and 3D figures in our classroom and around our school.
- We will describe what these shapes and figures look like, and will sort them by number of sides, number of edges, and number of corners.
- We will create our own geometry problems, using shapes that we find in our environment.

**Social Goal:** We will be practicing listening attentively.

*This social goal was chosen specifically because: 1) This skill needed to be practiced; 2) It was an important component of cooperative learning; 3) It was essential for safety, especially outside, for students to listen for instructions. In this class, there was a student who was prone to impulsive decisions that could include running away. After a discussion with the school principal and classroom teacher, it was decided that the student would be allowed to participate in the outside aspect of the lesson if accompanied by a CYW, but it was important for safety that the rest of the class listened attentively outside for all signals in case we needed to quickly come inside or do a head count. The class had already practiced a clap-back signal several times, but we added a whistle signal for outside that was discussed during the presentation of the social goal.*

**Input/ Modelling (3 min) –** This class had a very short period of effective carpet time. For this reason, input and modelling were chunked and interspersed with guided, kinesthetic-based learning. In the first input, students were introduced to the concept of discovering geometry in their environment, and the math centres were explained. This class already had math groups that were set-up by learning style and level, and I created math centres that met the specific needs of each group (to facilitate learning
and also as a form of classroom management – engagement can be an issue in this class, as can competition over specific activities, so by designing activities that met the needs of each group I eliminated a lot of the behaviour that may have arose). Centres were set-up prior to the lesson and were placed around the room. *(Picture 3)*

**Guided (10 min)** – The math centres were set-up as a guided introduction to Math Trails within the classroom, and were designed to introduce students to both the concept of Math Trails/ discovery-based learning and to general concepts in geometry. Students were given ten minutes to complete the activity at their specific centre *(please see attached centre descriptions)*. Centres were used instead of the traditional “Amazing Race” format in this class because: 1) Classroom management and known behaviour issues within the class; 2) The variety of learning styles and levels (including the combined grade); 3) Time constraints.

**Input/ Modelling (5 min)** – At the carpet, Math Trail-type questions were modeled using a picture of a chain-link fence on the document camera. Students were introduced to 1) the activity (going outside, in their math groups, to look for geometry problems based on the environment); 2) the rules and the whistle signal *(Picture 4)*; 3) group roles *(Picture 5)*.

**Independent (30 min)** - Students spent 20 minutes outside creating their own Math Trails. In each group, the roles were: photographer, note-taker, and chalk-drawer (designing problems on the pavement for their group to photograph/ use). These roles were assigned based on student ability. Roles were created to increase individual accountability and engagement. All students were expected to participate in observations and creating questions. The final ten minutes were spent inside, with the groups using their notes and pictures to create 2-3 math problems to share with the class. *Although this lesson could have been built so that the entire lesson was students following a pre-set trail, especially because it was an introduction to the unit, I chose to have the students create their own trails because I wanted the students to experience creating their own questions and because of the nature of the class – students were very inquisitive and used to discovery-based, independent learning.*

**Closure (15 min)** – Students brought their questions back to the carpet. Students shared a question they created with an elbow partner. I had planned to ask some volunteers to share their group’s ideas, but instead had a specific group share because of a teachable moment: one group had accidentally smashed a crayon into the carpet, and then turned it into a geometry problem by sorting the crayon pieces into sizes/ shapes. I asked this group to share and then we discussed as a class how we could use potentially problematic situations to create learning opportunities. Posted math questions on a classroom anchor chart for later reference *(did not do presentations with this class because of attention and carpet time limitations, but in a different group could have shared questions/ photographs on the doc cam/ smartboard in presentations)*. Ended with a clean-up.
PICTURES

Image One: Mental Set

Image Two: Goals

Image Three: Centres

Image Four: Guidelines
### TEACHER REFLECTION

#### 3 Highlights of my lesson:

1) I had one group of learners (a pre-established math group) that could be very volatile – they were capable of producing amazing work together but also of having emotional conflicts that could disrupt the rest of the class. During Math Trails, one of the students accidentally stepped on a crayon, smashing it into several pieces on the carpet. One of the other students quickly became frustrated and an argument began. I asked the students if there was a way they could turn this event into a geometry problem. The students talked about it and later presented me with a problem that involved sorting the crayon pieces into categories based on shape. I had the group present this problem during our class reflection to illustrate the idea of finding math problems everywhere, as well as the idea of searching for the silver lining in discouraging situations.

2) I had one student who is a selective mute, and will not communicate verbally with teachers/students. I assigned her the role of “chalk drawer” within her group, hoping that she would be able to participate in creating geometry problems artistically. To my delight, halfway through the lesson I had several students call me over to look at her work: she had drawn an intricate geometric pattern on the pavement, which had attracted the attention of many of the groups. I loved that she had been able to communicate her ideas to the whole class, without any verbalization.

3) I had been nervous about my take on Math Trails: I was using it as an introduction to the unit, not as closure; I had forgone the Amazing Race concept for differentiated centres; and I had students designing their own trail with very little exposure to the unit or the lesson style. I was gratified to see the quality of the math problems that the students created, and the way they in turn took the Math Trail concept and adapted it to suit their own learning, while maintaining the integrity of the lesson and meeting their learning goals.

#### Something that surprised me…

I was surprised by how quickly students embraced the concept of Math Trails. I had been curious to see if engagement levels changed in the guided versus the independent versions of the trail, and found that it did, to some degree. Even though I had differentiated the guided portion of the lesson to the best of my ability to reflect the learning needs of the students, I still had some behaviour and less engagement within this more constrictive element of the Math Trail. When the students were allowed to go outside to create their own trails, engagement was even higher and the quality of work was exceptional. This reaffirmed for me the importance of discovery-based, student-guided learning. Students need to be given guidelines and expectations, but when they are provided with the opportunity to make their own learning choices, they can benefit greatly.

#### What I learned about using Math Trails in Math class:

- It is important to create clear instructions and anchor charts reflecting these instructions.
- Math trails can be used to introduce a unit (although I believe it would be a more effective closing than a unit).
- Integrating technology (cameras, smartboard, etc.) is a great way to enhance Math Trails: in the future, I would like to have students videotape their trails and post to class website.
- Math Trails are excellent for covering many expectations and learning styles at once.