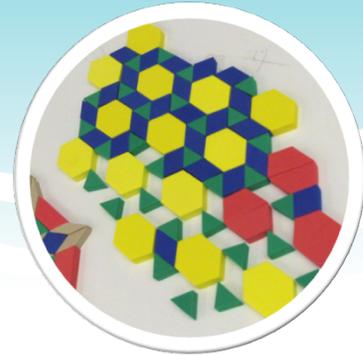


the Math Circles

Year End Summary



Mission Statement

The Math Circles program is dedicated to enriching the experiences of Nova Scotia high school students in all areas of mathematics. Our program vision is to foster enthusiasm for mathematics through interactive, creative and meaningful presentations.

Math Circles

Join in the fun today!

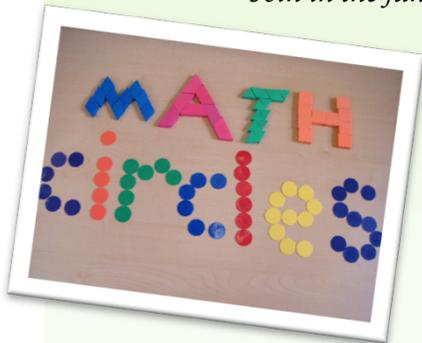


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Executive Summary

This year has marked the start of the expansion of Math Circles in every way. The program has expanded both internally and geographically.

Internally, the support team for this program has been established. The program has hired a Program Director, Angela Siegel, to coordinate the expansion efforts. Dorette Pronk, a member of the Dalhousie faculty, has taken on the role of Presentation Leader. The team has enlisted the support of Danielle Cox, a math graduate student from Dalhousie, as a Teaching Assistant to help create and present new topics. As Outreach Coordinator for the Dalhousie Department of Mathematics, Richard Nowakowski continues to support our program goals and remains an integral part of our team.

This team has worked together to develop presentation topics, complete with pre- and post-lesson materials, on various mathematical topics. A team of high school teachers and educators has been created to help give feedback on the materials to be presented. This Evaluation Team, consisting of seven members, has met quarterly to discuss the presentations and direction of Math Circles.

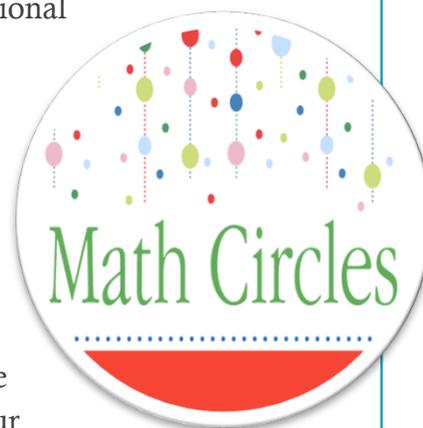
Geographically, our coverage of the province

has grown. Over the 2009-2010 school year, we have continued our monthly local events.

However, we have also brought our show on the road and impacted several school boards that previously had no access to such a program. We visited schools from Cape Breton to Bridgewater and Digby. In Cape Breton alone, we were able to visit 9 of the 11 schools in the Cape Breton Regional School Board along with 3 First Nations schools in that region.

From each of these events, we obtained survey data from the students present that we will utilize to modify our approach moving forward.

Much has been learned from this inaugural expansion year. As we move forward, we have realized the importance of Math Consultants within each School Board. In the regions that we have visited, we have found them to play a major role in establishing our footprint on a region.



Presentation Topics

Below is a list of topics that are currently prepared for presentations around the province:

Fractals
Tessellations
Infinity (and beyond!)
Card tricks & modular arithmetic
The game of Nim
The game of Toads & Frogs
Graph theory: Eulerian tours



Organization

Staff

Internally, four primary staff runs Math Circles. Angela Siegel serves as our Program Director and is responsible for the general organization and direction of the program.

Through contact with Regional School Board members,

teachers and math consultants and monthly meetings with the Faculty of Science

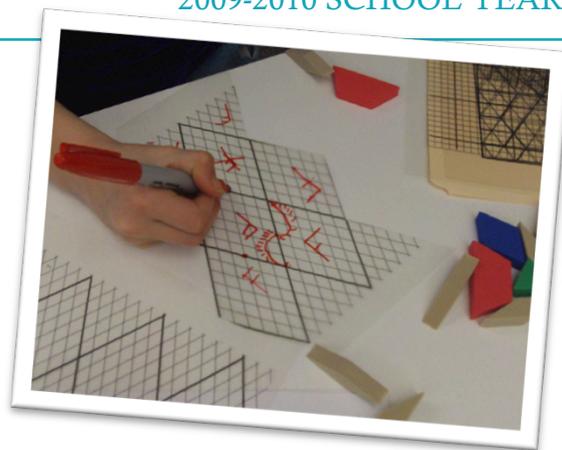
outreach team, she has worked to establish the Math Circles name beyond the reach of the Halifax borders. Richard

Nowakowski, professor and Mathematics Outreach

Coordinator for Dalhousie University, acts as the liaison

between our program and the university. Dr. Dorette Pronk is serving as the Presentation Lead. Danielle Cox, a Ph.D.

candidate in the Department of Mathematics, has joined the team through a Teaching Assistant role. She is responsible for coordinating local Dalhousie events and assisting with presentations on the road.



Internal Support

In order to support the increased workload placed on our Presentation Lead, Dr. Dorette Pronk, a professor at Dalhousie, we have hired Dr. Toby Kenney as a Postdoctoral Fellow. His role is to help contribute to research and take over teaching loads, which would otherwise have taken the efforts of professor Pronk.

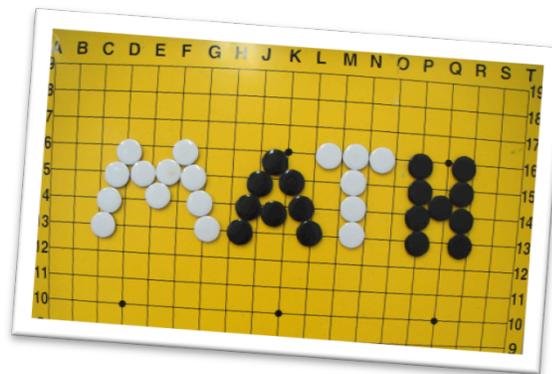
Evaluation Team

To better evaluate the topics and resources that we have been creating, we have put together a group of volunteers that serve as our Evaluation Team. During quarterly meetings throughout the school year, this group gets together with our staff to ensure that our materials move in the right direction and serve as a quality control function. Our presentation team consists of seven individuals: Matt Moffat, Nick Downs and Maria Burns are Nova Scotia high school teachers that have been actively involved with the local Math Circles events over the past several years and are familiar with the type of talks that we strive to give; Aldona Wiacek and Nicole Whiteway are current B.Ed. students focusing on math education; Akhila Pahdmanabhan is a Chemistry M.Sc. student with a B.Ed. that previously taught in the Toronto School Board; and finally, Eva Knoll is a professor of Mathematics Education at Mount Saint Vincent University. Together, they provide valuable feedback on the materials that we are creating.

Presentation Team

The Presentation Team consists of four members: the Program Director, Angela Siegel; two members of the Mathematics Department faculty, Dorette Pronk (our Presentation Lead) and Richard Nowakowski; and Danielle Cox, the Math Circles Teaching Assistant. This team traveled across the province, visiting schools and making presentations to students. Their role was to support the professional development of the high school teachers and enrich the existing math curriculum.

Before any session was presented, the Evaluation Team first reviewed the topic and any recommendations made were considered.



Topics

Of the list of topics prepared this year, we have focused our presentation efforts on the following seven presentations: 1) Tessellations; 2) Fractals; 3) Eulerian circuits; 4) Mathematical Jury Duty; 5) Toads & Frogs; 6) Nim; and 7) Infinity. Each of the topics has been well received when presented to the “right” audience. Over the course of the year, we have learned to query the classroom teacher more prior to a presentation so that we can better tailor the talks to the current skill-level of the

audience. In some instances, we have found that it is actually best to change the entire topic to be presented. While the manipulation and problem solving of Eulerian Circuits works very well in a grade 10 class, it may not be challenging enough for a grade 12 calculus class. Discussion of our topics follows.

1) Tessellations are presented using a collection of foam manipulatives in the shape of regular polygons (triangles, squares, and hexagons) along with rhomboids and trapezoids. Students work with the shapes to form tilings and to understand the need for naming conventions within the realm of regular tilings.

The students come to this conclusion through supervised peer-led exercises.

2) Fractals are presented through active play of the Chaos game. The class is asked to work as a team to make decisions that drive the movements of volunteers at the front of the room. The class then records this activity on their own sheets and continues the game, resulting in a fractal pattern, on their own sheets.

3) When presenting Eulerian circuits, students are presented with maps of a fictitious pirate land. They are then asked to help the pirates build or remove bridges such that certain criterion can be met. Students work in pairs and attempt to accomplish this task as a team. When requests cannot be



completed, the students are asked to rationalize and explain why the request is impossible.

4) Mathematical Jury Duty began as a talk on probability. We found, over time, that this topic was challenging to prepare for an unknown audience. Throughout the school year, this talk evolved into one that touches on many different areas of math (cryptography, fractals, probability, etc.), yet maintains the underlying theme of being a crime sleuth mystery.

5) Toads & Frogs is a game that has been utilized at Math Circles for several years. This year, we created supporting material to go hand-in-hand with the game and revive its content.



The game involves six student volunteers at the front of the room, being controlled (under game rule sets) by the rest of the class. The students making move decisions are asked one by one what move should be made next; the volunteers then make the corresponding move. Not only is this game excellent for use in classes that need an energy boost, but it also serves to get everyone involved and still allow for exploration of topics such as pattern recognition, quadratic equations, symmetry and more.

6) The game of Nim is presented as an introduction to impartial game theory. Students enjoy the manipulation of tokens and often get so involved in the fun of “playing” that they do not realize that they are, in fact, doing mathematics. Binary notation is hidden behind the joy of problem solving.

7) While the topic of Infinity can be an intimidating one for many, the attempt was to approach it through real-life situations that are extrapolated into the infinite. Fun and entertaining photos and stories were incorporated to make the topic more approachable. While this remains a topic most-suited for higher-level thinkers, we found that, in this fashion, it was attainable for most groups that we worked with.

Outreach

Local Events

Monthly Wednesday evening events took place at Dalhousie University in the new Student Learning Centre (pictured right). The new space configuration allowed for easy group work and encouraged creativity and teamwork.

As we have built up a rapport with the students attending our local events over the years, we utilized this group as a test bed for talks that are being reworked. This group is familiar with our presentation style and is open to giving honest feedback.

We typically begin with an introductory activity for the first 15-30 minutes, allowing for late arrivals due to traffic or long travel times. This year, we had participants from schools drive in from



Bridgewater, Coxheath and Windsor for a few talks, and this introductory period ensures that they miss no essential information if they must arrive partway into the presentation.

Following the introductory presentation, the main topic begins. Typically, we break after 45 minutes for pizza and camaraderie and then start up again, once everyone has had their fill of both food and fun. The remainder of the presentation takes about an hour.

Attendance for the talks this year varied greatly from fall to spring, with the highest attendance (45 students) being in the winter term. In general, fall/winter attendance was high and spring low. After speaking with a few teachers, we found that the standard

Wednesday time frame, while fine in the fall and winter months, was creating conflicts in the spring term. We will plan to reevaluate the date and time through school/teacher feedback next year and adjust to that which best meets the needs of the students we are targeting.

School Visits

This year marked the exciting start to our ability to take Math Circles on the road. We started our journey off in the fall with visits to Bridgewater. Over the school year, we were able to present to students from 23 different school throughout six of the seven Regional School Boards within Nova Scotia as well as 3 First Nations Schools, 3 private schools, a program called Ihmotep's Legacy Academy, promoting academic success for students of African heritage. We focused our spring visit around Cape Breton and were able to hit 7 out of 10 high school in the Cape Breton Regional School Board as well as 3 First Nations schools in that region. In total, we gave 15 presentations over our time there to a total of 410 students.



Math Fun Days

In order to allow for schools within a reasonable range of us to benefit, we created a new initiative this year called Math Fun Days. We hosted this event on the Dalhousie campus. For its inaugural year, we feel that this event was a tremendous success. In total, 166 students from eleven schools attended, representing 5 separate Regional School Boards (of a total 7) around the province. The event consisted of 3 separate days of mathematical fun. Initially, we had planned on two days' worth of presentations, but the event and wait list became so large that we added another day to the schedule. Schools arrived at 10:00am for an interactive presentation on some area of mathematics. This year, we ran 2 sessions (days) of Mathematical Jury Duty and 1 session of Mathematics & Art (Tessellations and Fractals). The presentations were split in half with a break for lunch and a tour of the Dalhousie campus. Afterwards, we returned to complete our work and conclude with a short presentation about what could be done with mathematics and a math degree.

Regional School Boards

Schools that we were able to outreach to listed by Regional School Board:

Annapolis Valley Regional School Board

Highbury Education Centre (New Minas)

Cape Breton-Victoria Regional School Board

Baddeck Academy (Baddeck)

Holy Angels High School (Sydney)

Breton Education Centre (New Waterford)

Memorial Composite High School (Sydney Mikes)

Cabot High School (Neil's Harbour)

Riverview Rural High School (Coxheath)

Glace Bay Senior High School (Glace Bay)

Sydney Academy High School (Sydney)

Chignecto-Central Regional School Board

Ecole Acadienne de Truro

South Colchester Academy (Brookfield)

Halifax Regional School Board

Auburn Drive High School (Cole Harbour)

Lockview High School (Fall River)

Citadel High School (Halifax)

Millwood High School (Lower Sackville)

Halifax West (Clayton Park)

Prince Andrew High School (Dartmouth)

J.L. Ilesley (Spryfield)

First Nations School Board

Chief Allison Bernard Memorial High School (Eskasoni)

We'koqma'q Mi'kmaq School (Whycocomagh)

Wagmatcook School (Wagmatcook)

South Shore Regional School Board

Bridgewater Jr/Sr High School

Tri-County Regional School Board

Barrington Municipal High (Barrington Passage)

Ecole Secondaire de Clare

Digby Regional High School

Shelburne Regional High School

Other Schools/Programs

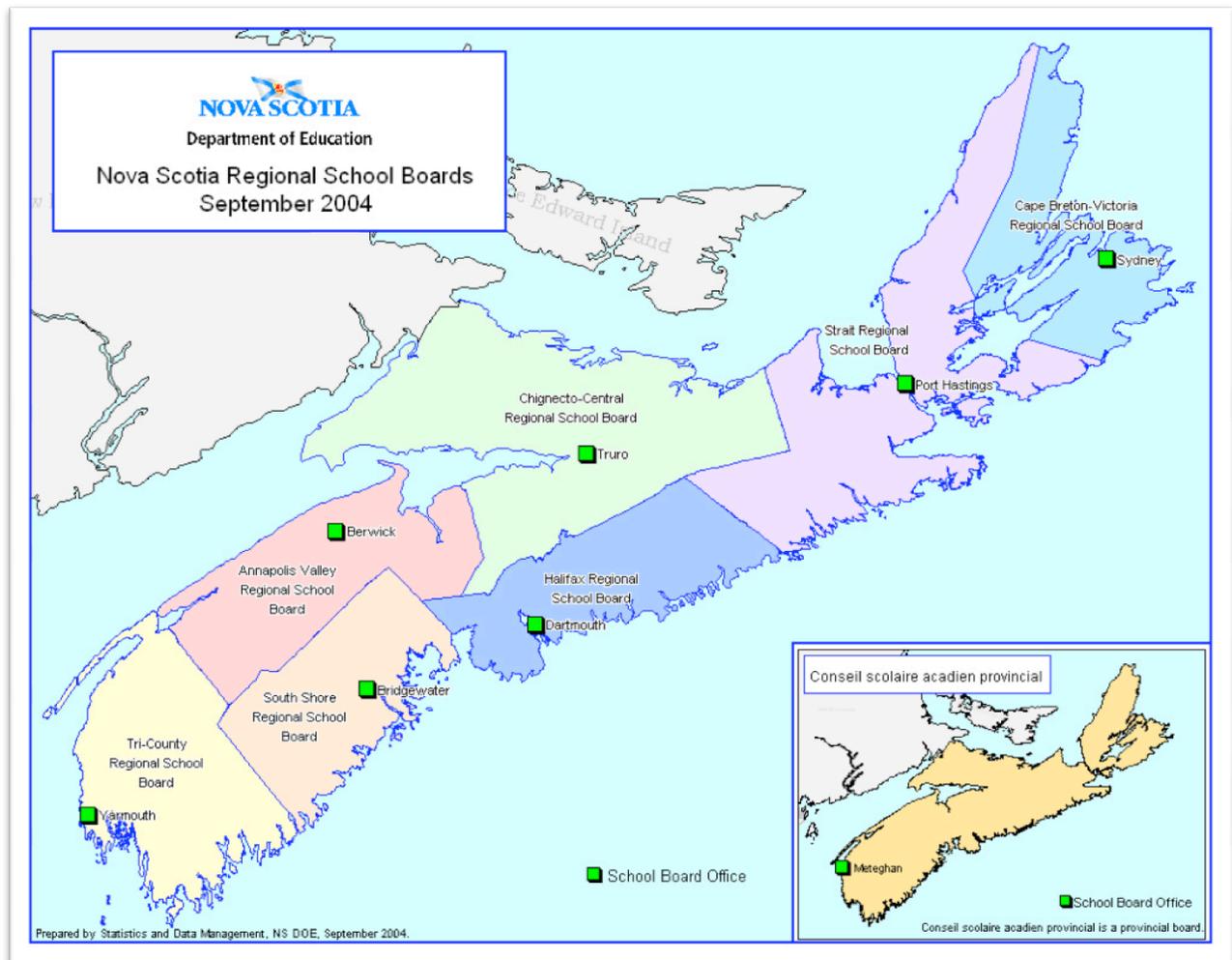
Halifax Grammar School (Halifax)

King's Edgehill (Windsor)

Home School Association (Halifax)

Sacred Heart (Halifax)

Ihnotep's Legacy



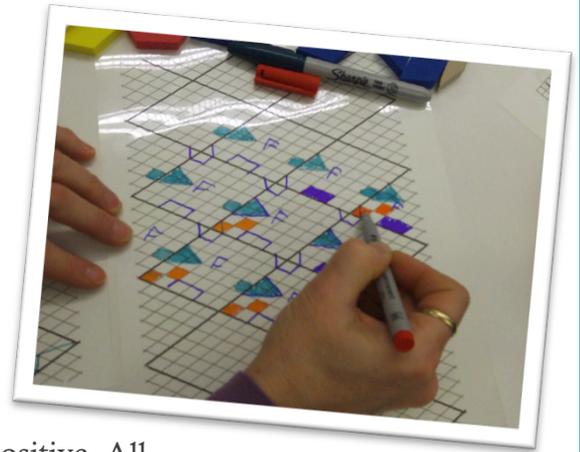
Feedback

Surveys

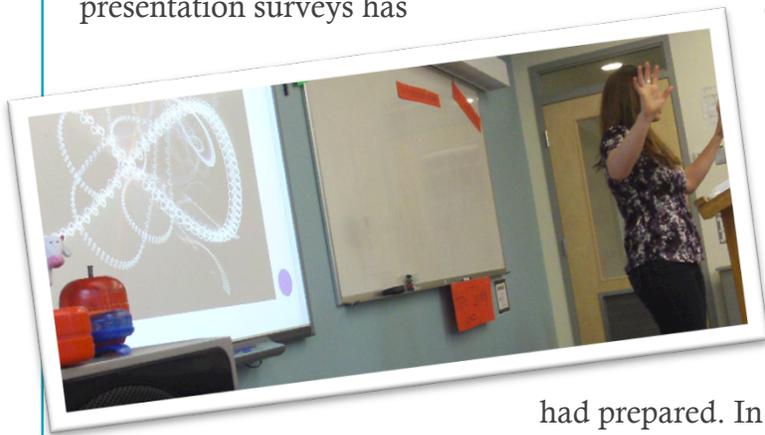
Following presentations, we have initiated a survey protocol in order to better assess our performance. The survey form contained both quantitative assessments of our performance and their ability to comprehend the materials presented, as well as qualitative feedback on various aspects of the talk.

Overall, the feedback that we have received over the course of our school visits and presentations this year have been very positive. All

school boards and teachers that we have interacted with have expressed a desire for us to return. For the initial year of travel, we feel that the responses that we have had have been extremely successful. That being said, much has been learned and will be modified moving forward. The topics presented have had, as expected, different reviews based on class demographics. Intuitively, a Calculus class perceives a topic different from a Fundamental Math 10 class. The feedback obtained through post-presentation surveys has



driven future decisions on how to modify the initial content so that the materials can be best received. (Full survey results are available upon request.)



had prepared. In general, the dynamics of our team is varied and, as such, the team is split on what level we should present our material to the students. We found that in most instances, half the team felt that we should increase the depth of the material to be covered and the other half felt that we should focus on a more high-level overview of the subject so as not to lose anyone. In practice, we found that both parties were correct for certain situations. Depending on class dynamics, we need to be able to either skim the surface of a subject, maintaining the meaning and motivation for the material, or delve into some of the more specific nuances. As such, we are realizing that knowing the class make-up beforehand is invaluable.

Evaluation Team

Feedback from our Evaluation Team has been very interesting. Over the course of three team meetings, we were able to gain qualitative feedback to the lessons and lesson plans that we

Student Testimonials

- I liked that the talk was fun, hands-on and using our heads.
- The presenters were enthusiastic and friendly.
- I enjoyed how much the presenters seemed to love what they were teaching us.
- I liked how they were able to relate math into something from everyday life.
- What I liked: Everything!

Moving forward into the 2010-2011 school year

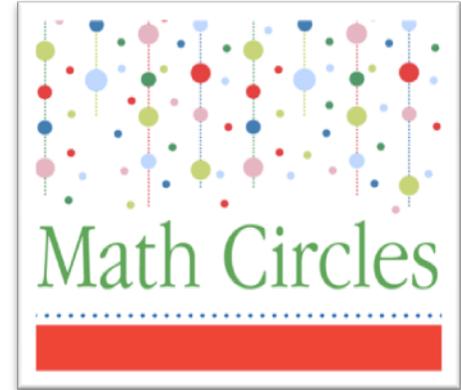
As we move forward into the next school year, we are ready for bigger and better things. As a direct effect of the feedback that we have received to date, we will be more deeply surveying schools about the background knowledge level of the students and the motivation of the teachers that we will be presenting to, so that we can more closely design their presentation to their needs and expectations. We have learned throughout the course of the year that the Math Consultants for each Regional School Board are able to provide invaluable support for our involvement in their region. As such, we will hope to make use of their connections and resources moving forward. We look forward to producing several new lessons. We plan to further promote and make available the materials that we have created over this school year by making them available on our website.

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Join in the fun today!