MEGL Outreach: *Sharing Math with the Masses*

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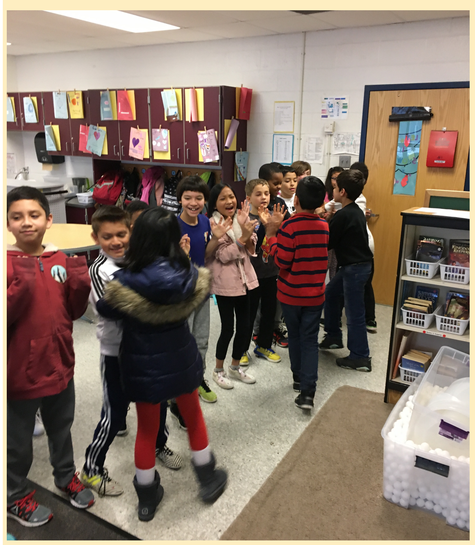
Our mission

- Our goal at MEGL Outreach is to get kids excited about mathematics.
- We do this by creating interactive activities that we bring to local K-12 classrooms, libraries, and other educational venues.
- Our aim is to expose students to aspects of the math world they may not see in the typical curriculum, and to do so in an experiential way.
- Our lab directors hold PhDs and conduct research in pure mathematics, and all of our outreach activities have their roots in this world. We aim to balance substantial mathematical content with accessibility to a wide range of students.

You Can Count on Monsters

This activity is designed for 1st-3rd graders, and is centered on the idea of prime number decomposition. Instead of using words like "multiplication" and "factor", students construct and deconstruct rectangular arrays of colorful glass beads to explore the world of prime numbers. They draw trees that keep track of the decomposition of their numbers, and the final product is a multi-headed monster made from paper plates that encodes that decomposition.

Really Big Numbers



This activity is designed for 4th-6th graders, and explores ideas of magnitude and growth in the real numbers. The students race in groups of 4 to learn about linear growth, play a high five game (pictured here) to learn about polynomial growth, fill a bucket with a thousand ping pong balls to learn about exponential growth, and explore polygons and pizzas to learn about factorial growth. Then we venture to the far reaches of the cosmos to encounter numbers like 10^{80}, only to find out that this number, and every other number, is eventually dwarfed and comparable to zero if we continue out far enough on the number line.

Snowflake Symmetry

This activity works with a wide range of students, from elementary through high school. After an introduction to symmetries appearing in the natural world, the students make paper snowflakes and experiment with them to discover the mathematics of symmetry in the Platonic world. By recognizing that they can combine symmetries in analogy with combining (adding) integers, they explore the similarities and differences between the symmetries of the integers and the symmetries of their snowflakes.

Your Teachers are Lying to You

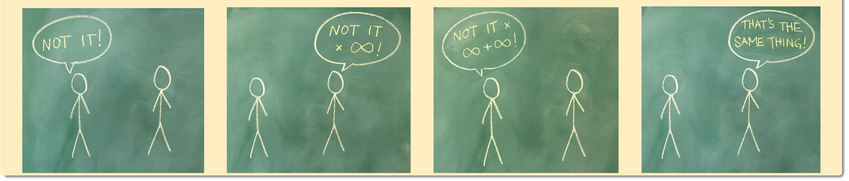
This activity is designed for high school students. By taking a second look at several mathematical "facts" that we learn in school, we see that their truth hinges on hidden assumptions we didn't realize we were making. By experimenting with clocks from a fictional planet, we see that $2 + 2$ doesn't have to be 4. By turning numbers into dance steps, we find squares that have negative area. By drawing on the surface of a balloon, we see that the angles of a triangle don't always add to 180°. By turning the number line into a number circle we learn that the old adage "You can't divide by zero" just doesn't hold water. What all of these discoveries show us is that mathematical truth depends on context, and that shifting context can open up new and interesting worlds to explore.

Hyperbolic Crochet

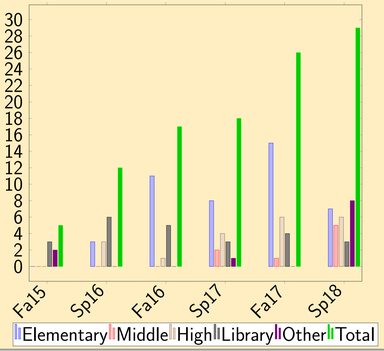
This activity is designed for high school students to adults. Participants take a tour through the history of geometric ideas, discovering along the way the strange and beautiful world of hyperbolic geometry. Though its properties seem counter-intuitive, we see its appearance in the natural world, and eventually use the art of crochet to construct our own miniature versions of the hyperbolic plane.

Playground of the Infinite

Our newest activity explores the strange world of the infinite. We start by understanding finite things, and how to count without counting. This allows us to compare infinite sets, like the rooms in an infinite hotel and the students in an infinite school bus. This leads to strange conclusions, such as two infinite hotels having the same number of rooms as one infinite hotel. Ultimately we discover through a bracelet-making activity that there are infinitely many different sizes of infinity.



Some data



Each semester we visit elementary, middle, and high school classrooms, as well as libraries and other groups like girl scout troops and field trips. This graph shows that our total number of events each semester has grown from 5 in Fall 2015 to 29 in Spring 2018, and that these totals are being more evenly spread across the different locations types. Overall we have reached nearly 4,000 students through our activities.

Future

As of Fall 2018, MEGL has a permanent faculty position devoted to expanding the Outreach program, allowing it to become more robust and diverse. Here are examples of how we plan to grow and increase our impact in the community.

- MEGL is part of Geometry Labs United (GLU), a network of labs that conduct research and outreach. MEGL's outreach program is one of the most developed in the network, and in May 2018 we conducted our first training session. By sharing our activities and best practices with others in the GLU community, our experience can be transferred to the success of other labs across the country.
- Besides continuing the trajectory shown in the bar graph above, we plan to diversify our network and our offerings. This includes traveling outside of Fairfax to more under-served schools and communities, and giving public talks on mathematics and mathematics outreach, to generate excitement and interest in mathematics not only in K-12 classrooms, but in the community at large.
- We are designing follow-up lessons to leave with the teachers whose classrooms we visit. These lessons are intended to give our activities longevity by allowing the students to continue to engage with the ideas after we have left, and to relate them to the existing classroom curriculum.