he put the cards didn't matter, since he tried to put all of them vertically. But we all know…

Anyway, it was a fascinating daily gather with seemingly "magical tricks" explained by completely logical math. A magician never explains his tricks. That is a mathematician's job.

Wednesday's Daily Gather

by Dylan

They were the words no one expected. They were the words that no one wanted to hear. They were the words that should never be spoken at a math camp. "We're having a Spelling Bee!"

The Spelling Bee consisted of three referees, Jonah, Alice, and Ashley, and a simple scoring system. 2 points would be rewarded for correctly spelling a word out loud. 1 point would be rewarded for correctly spelling that word on the blackboard. 0 points would be rewarded for an incorrect spelling, no matter how valiant the effort. As per a typical spelling bee, contestants could ask for the definition of the word, a sentence involving the word, the etymology of the word, and a slow pronunciation of the word. After the unwilling participants begrudgingly accepted the rules, the MathILy-ER Spelling Bee (MathIERBee) began.

The first two rounds were composed of easier words than the latter, of course, but nonetheless, each correct answer was met with a resounding "YAY" from Jonah and ostentatious clapping from the audience/contestants. Each incorrect answer was met with the silence of the crowd, along with Jonah's apologetic disapproval. Unlike a formal Spelling Bee, the MathIERBee was characterized by attempted wisecracks by the crowd, unnecessary requests for definitions of certain words (Yan) and unusual word choices by the referees. Many of the latter words led to people "Gaussing" for a word and being "prooven" wrong in the end. More than a few people spelled their compatriots last names wrong, to Jonah's apparent chagrin. Nonetheless, the thingiey eventually ended when Alex spelled a thingy (corollary) correctly in the Grand thingies. Unfortunately, none of the MathIERBee finalists, Alex, Clarissa, and Robert, received prizes for their "word"liness. Fortunately for the rest of the class, there were no punishments given to the non-winners. Perhaps the MathIERBee was a friendly reminder to interact with the rest of the camp rather than stay in the dorm (noted, Jonah.) Or, it was just to show how mathematicians are actually decent spellers. Either way, the whole class would like to see a Spelling Bee between the referees to see if they can spell too.

Thursday's Daily Gather

by Mia T.

At the beginning of Thursday's Daily Gather, Alice handed out tessellations to each table. These fascinating images consisted of repeating and interlocking patterns. Alice invited us to examine and categorize the tessellations. We quickly formed one large group at the back of the classroom where we attempted several different systems of categorizations. One promising candidate was a system of categorizing tessellations based on the polygons that made up the pattern. Some tessellations, however, contained more than one type of polygon, or had patterns that implied additional polygons. Even more unsatisfying, a few of the tessellations did not seem to have any polygons, such as the tessellation of interlocking hands.

Alice then suggested a different system for sorting the tessellations - we could sort on the basis of symmetry, specifically, reflection symmetry. Each group of three or four took a single tessellation and tried to identify as many lines of symmetry as possible. Alice then projected some of the tessellations up on the screen and drew lines of symmetry so that they intersected. Three lines were drawn to form a triangle. These intersections, Alice explained, were also rotation points. The group then determined the number of possible rotations around each point and labeled the tessellation to reflect this.

After that, we broke back up into small groups to draw triangles of our own. The triangles had to be drawn so that they could not be subdivided any more with another line of symmetry. The new indivisible triangles had different rotation points at each vertex, that is, rotation points that could not be translated to the site of another vertex and replace that vertex.

Alice projected some of these on the board and taught us the notation used for each of them. A tessellation whose lines of symmetry could be used to create a triangle whose vertices were rotation points around which six, three, and two rotations, respectively, were possible, would have the notations *632. An interesting case involved four lines of symmetry that together formed a rectangle. At the very end of the Daily Gather, we made triangles based on other transformations undergone, including rotations and translations. This topic will be continued in a future Daily Gather. To be continued…

Friday's Daily Gather

by Alex

On Friday's Daily Gather, Jessica Godwin from the University of Washington came to talk to us about probability and statistics. To begin the lesson, we got into groups and were handed some pennies. However, these pennies were no ordinary coins; these coins had been bent so that they were shaped more like curves, with the tails side on the inside of the curve and with the heads side on the outside of the curve. We flipped them many times to test whether or not these coins remained fair even though they had been physically modified. After many trials, the groups came up with the following results:s

Group 1: 51 heads/73 flips, 69.9% heads
Group 2: 102 heads/200 flips, 50.5% heads
Group 3: 43 heads/90 flips, 48.4% heads

After going through many trials, questions began to arise among the students regarding the factors that may have played a role on the resulting probability of flipping heads for each group. Some factors included the center of gravity of the new coin, whether the coin was dropped, flipped or tossed, the orientation of the penny coin as it was dropped, flipped, or tossed, how the coin was flipped, and the psychological influence of having an expected answer. One important question arose: how would we define a fair coin? Would the coin have to maintain a probability of ½ every time data is gathered from it to be considered fair?

To answer these questions, Jessica talked to us about the possible things you can do by gathering data. Data is very useful in creating a hypothesis. However, there can never be enough data to prove a hypothesis, no matter how many times an experiment has been tested or how strong the evidence is. The probability of success for an experiment can be anything from 0 to 1, and as Jessica stated, the mathematical chance of getting the right probability from just data is 1 out of infinity.

While it may be impossible to obtain an exact probability, statisticians often find a reasonable range of probability instead. Jessica demonstrated the impact of having a large number of trials with the random number generator. She tested sample sizes of 5 coin flips, 25 coin flips, and 100 coin flips, with each sample size being tested 100 times. With each successive experiment, the range of the bars along the histogram of results steadily decreased. The results of the first two experiments were extremely spread out, but by the time she tested the sample size of 100, the variability of coin flips decreased to 0.44 to 0.66 probability of flipping heads.

Returning to the results that the students gathered, there are two possible answers. First, we could assume that we won the lottery and predicted the exact probability of flipping that many number of heads in a certain number of trials. The second answer is that the coin wasn't fair, and depending on the results, we can rationally select this answer. Jessica ran another program showing us that there was a 60% chance of getting group 3's results of 43 heads out of 90 flips, while on the other end, there would have been less than 1% chance of flipping group 1's 51 flips out of 73 heads on a fair coin.

Jessica ended the daily gather with a few final points. If the definition of fair is exactly 0.50, is 0.51 different enough from 0.50 for us to call a certain experiment unfair? While statisticians cannot prove that a coin is exactly fair, they can say that it is between the fair range of 0.45 and 0.55. The importance of having many trials with a large sample size is to generate this range that can be used to determine an approximate probability. By doing multiple trials, we can obtain an uncertainty, which includes a plus and minus range. This contributes to the idea of standard deviation, so that we can have an idea of how "wrong" the predicted probability of an experiment may be.

Summary of the Week

by Aryanathan

Monday

On Monday, we studied the disappearing circles game. We defined winning and losing positions. We then wrote all of the winning and losing positions we found and looked for a pattern. Stephen noticed that when the binary forms of the number of circles in each row were written on top of each other, if the number of ones in every column was even, there was a winning position for player 2. (Such a position became referred to as a Stephen's position.) Otherwise, it was a winning position for player 1. However, we still needed to prove this.

We also continued studying SOZOMs. We defined a new type called n-cycling SOZOMs-SOZOMs that, when raised to the nth power, become itself *without* reaching the identity matrix. We also found more evidence to support Nellie's conjecture. Aryan, Dylan, and