BLUEBIRD MATH CIRCLE
Alliance of Indigenous Math Circles

Issue 31: Stitch It

Share your problems, solutions, models, stories, and art:
https://aimathcircles.org/Bluebird

"It does not require many words to speak the truth."

–Chief Joseph, Nez Perce

NEWSFLASH

Join LIVE Bluebird Math Circle to work on these activities together with friends and family.

Monday July 11, 5-6 PM MDT online.

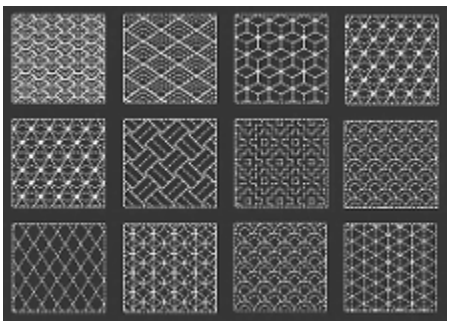
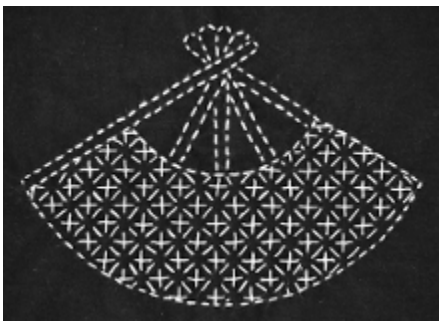
Sign up at **https://aimathcircles.org/Bluebird**

MATH JOKE

Why did the obtuse angle jump in the pool?

Because it was over 90 degrees.

Inspiration: Japanese Embroidery

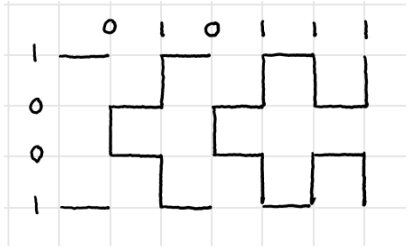



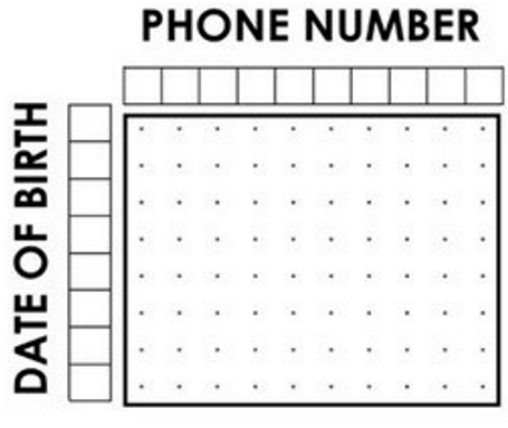
Sashiko is a Japanese style of embroidery that is more than 400 years old. Its name translates to `little stabs,' and refers to the act of stabbing a needle through cloth. One type of sashiko artwork is hitomezashi, shown in the two pictures in the right. It uses simple rules to create beautiful geometric patterns in a rectangular grid.

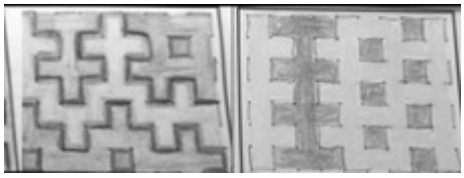
Family Circle: Hitomezashi stitching

Fill in your phone number and date of birth around the grid.
If a digit is odd, then start by drawing a short line segment connecting the first and second dot in its row or column, then draw a line segment connecting the third and fourth dots in the row or column, etc. If the digit is even, then start by connecting the second dot to the third, the fourth dot to the fifth and so on.

Do this for every row and column of dots. The lines mimic stitches alternately going above and below the cloth. Once you complete both the horizontal and vertical stitches, you can color your design.







You can work with a slightly larger grid, assigning 0s and 1s to the horizontal and vertical grid lines. 1s mean that you start on the first dot, 0 means you start with the second one. For example, take vowels and consonants in your name or use heads/tails on a coin toss or the even and odd digits of your favorite number. Create a few fun designs - then think about some mathematical questions we could ask. Try to draw what the other side of the fabric would look like if one actually embroidered the design.

Here are a few possibilities:

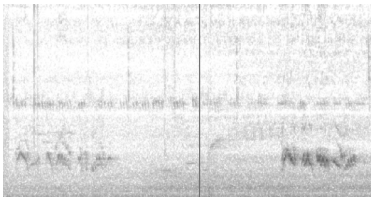
1. What is the minimum and maximum number of colors you can use to color the design, if you don't want neighboring regions to have the same color?
2. What kind of structures do you see in your design? For example, there are `islands' or polyominoes - how large are they in area and/or perimeter? What kinds of paths do you see?

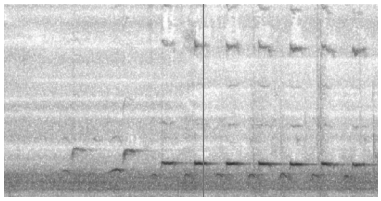
Extension: Use a triangular or radial grid to make a design.

Ask Bluebird

QUESTION—*What do the sound waves of the bluebird look like?* From Marie Brodski

BLUEBIRD SAYS—Any sound wave is a combination of elementary sounds or pure tones. Just like musical notes each of these tones have their own frequency or pitch, and the different pitches at various volumes (amplitudes) make up all the sounds we hear, including the bluebird's song. We can visualize amplitudes and frequencies in time in a spectrogram. The figure in the left is a spectrogram of a few seconds of a bluebird's song, while the one in the right came from a robin. In an interesting new development, a birdsong identifier app (Merlin) has been produced recently by researchers at Cornell Lab of Ornithology based on image analysis of the spectrograms of different birds' songs.





You can experiment with different sounds and spectrograms in the Chrome Lab: https://musiclab.chromeexperiments.com/Experiments (click on Spectrogram to see color spectrograms of different sounds).

FUN FACT OF THE FORTNIGHT There are many fun math facts, and sometimes people assume that everything in math is already a known fact. This could not be further from the truth. There are many, many open questions nobody knows the answer to. The best thing is that you can ask some new ones yourself! Here are a few fun open questions in mathematics:

Twin prime conjecture: Are there infinitely many twin primes? A prime number is only divisible by 1 and itself, it has no other factors. Two primes are called twin primes if their difference is 2, for example, 11 and 13 or 17 and 19 are twin primes. The question whether there are infinitely many of them is widely believed to have been asked by Euclid, although there is no written record of this. The current largest twin prime pair known is $2996863034895 \cdot 2^{1290000} \pm 1$, with 388,342 decimal digits. It was discovered in September 2016. In 2013, Yitang Zhang proved that for some integer N that is less than 70 million, there are infinitely many pairs of primes that differ by N. Subsequent work by other mathematicians quickly reduced the bound on N to 246, but that is still far from 2.

Palindromic number conjecture (Gruenberger 1984): Take any positive integer with two or more digits. Add it to the number obtained by reversing its digits. Continue until a palindromic number is obtained. For example, start with 285. 285+582=867, 867+768=1635 and 1635+5361=6996, which is a palindromic number since it reads the same left to right and right to left. Most small numbers terminate quite quickly. However, try 89. You will need to do many additions till you come up with a thirteen-digit palindrome! Some numbers like 196 and 295 in base 10 may never become palindromic, but nobody knows this for a fact.

Kobon triangles (Kobon Fujimura, 1979): How many non-overlapping triangles can you create with n lines? Below you can see the cases for n=3, 4 and 5. Experiment with more lines and try to get as many triangular regions as possible! Nobody knows a general formula that answers this question. The last two open questions are from the K-12 Open Questions collection compiled by Gord Hamilton, aka Mathpickle. If you'd like to see many more beautiful examples, check out his website at https://mathpickle.com/