



BLUEBIRD MATH CIRCLE

Alliance of Indigenous Math Circles

Issue 32

Hiding in Plain Sight: Vyshyvanka Codes

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

Try not to be unhappy when you're working. If you are unhappy, you put that aside, because your feelings go into your work, and that's not what you want to be passed through.

—Jessica Lomatewama,
 master Hopi basketweaver

NEWSFLASH

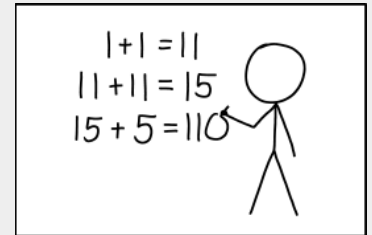
Join LIVE Bluebird Math Circle to work on these activities together with friends and family.

Monday July 25, 5-6 PM MDT online.

Sign up at <https://aimathcircles.org/Bluebird>

MATH JOKE

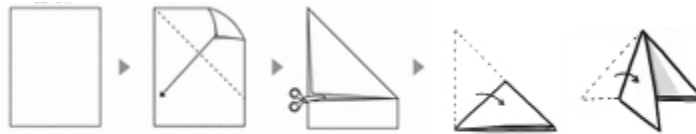
by xkcd



REMEMBER, ROMAN NUMERALS ARE ARCHAIC, SO ALWAYS REPLACE THEM WITH MODERN ONES WHEN DOING MATH.

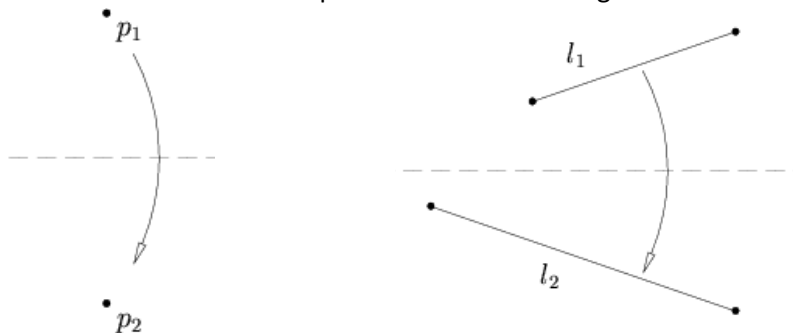
Warm Up: Letter Snowflakes

To warm up, we will play with paper snowflakes. That helps us to "touch the symmetry" and explore it by hand. Have paper and scissors ready! Fold a square(*) sheet of paper several times, with the fold line always going through the paper's center:



(*)Make your sheet square first, if it isn't already! Images by education.com and twinkl.com

To fold nicer and to notice more math, play with edges and corners as you go. Edges=lines, corners=points. Before folding, picture each fold in your mind. Which edge must fold on top of which edge? Trace the two edges with your hands before folding them together, to get a good feel. Which corner must fold on top of which corner or edge? Poke the corners to feel them, too.



Images from https://en.wikipedia.org/wiki/Huzita-Hatori_axioms

How many triangles does your snowflake fold create? That number, divided by two for the mirroring, names your symmetry: here, 4-fold symmetry. Now, draw a chunky letter that touches all three edges of your triangle. It must touch not only at a point, but along some interval. In this example, we highlight the intervals where the letter **M** touches the edges of the triangle:



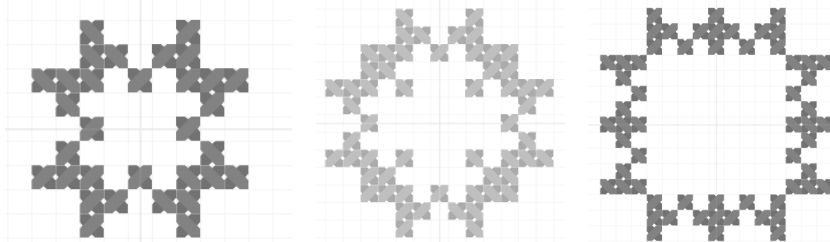
Cut out your letter. Then unfold your letter snowflake. Reflections and rotations will hide your letter in plain sight. These paper snowflakes are beautiful to many of us because humans are attracted to symmetry. There's much symmetry in snowflakes. The 4-fold snowflake in our example has 4 lines of symmetry (unlike the ice snowflakes that can only be 3-, 6-, or 12-fold). Do you see the 4 symmetry lines? With your finger, trace the symmetry lines where two copies of your letters mirror (reflect) one another. That's where the letter you drew touched the edges earlier. Ask your friends and family to guess what your unfolded snowflake spells. That's surprisingly hard! Fold the snowflake back, one step at a time, and ask them to guess again at each step. After people decode a few different letters, they grow their math eyes and get much better at seeing the hidden writing.

Family Circle: Vyshyvanka Codes

Vyshyvanka is an embroidered Ukrainian shirt. Each region has its own traditions for vyshyvanka colors and designs; you can see some of them in this map of Ukraine "embroidered" region by region. The artists who cross-stitch their vyshyvankas often hide names or inspirational messages in their designs. Here is the same letter **M** hiding in several cross-stitch patterns. Can you find each copy of M? There are many ways to use symmetry for hiding the same letter!



image by Qypchak on Wikipedia



Design your own vyshyvanka secret messages. First, decide how to "pixelate" your letters. Color squares on physical or virtual graph paper to make letters. Second, draw 4 or 8 symmetry lines and reflect your letters. This online designer tool comes with pre-made letters you can use, as well as simple elements for making letters from scratch: <https://www.ornament.name/creator>

Ask Bluebird

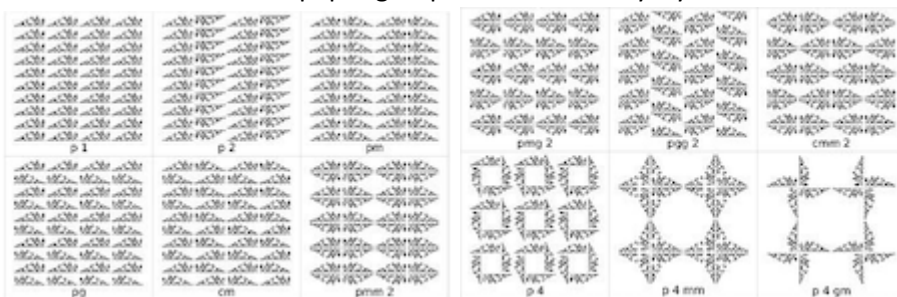
QUESTION—How fast is the fastest bird? From Mythili P

BLUEBIRD SAYS—Measuring all the things? That's very mathematical! Measuring the speed of flight is pretty hard. That's why scientists are still making fresh discoveries about flying animals, as their technology improves. For a level flight (rather than a gravity-assisted dive) people used to believe *Common Swifts* (69 mph) were the fastest creatures. Hence the name. Swift is still the fastest-flying *bird*. But the proven speed record in the air recently went to the Brazilian Free-Tailed *Bat* (99.5 mph).



Vyshyvanka blue bird by artfetr on ebay.com

FUN FACT OF THE FORTNIGHT Some embroidery designs can repeat again and again and again in all directions. In other words, the designs can cover any amount of fabric. That takes certain kinds of symmetry. Turns out, there are exactly seventeen types of these designs, called *the seventeen wallpaper groups*. The area of math studying these beautiful objects is called *group theory*. A Ukrainian researcher Iryna Zasornova found these twelve wallpaper groups in traditional vyshyvankas:



Vyshyvanka Day, by Vladimir Yaitskiy on Wikipedia