Faculty of Mathematic
and Information Scienc
WARSAW UNIVERSITY OF TECHNOLOGY

MiNI BLUEBIRD MATH CIRCLE

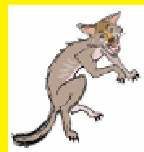
Issue16:
Of Shapes and Curves

Share your problems, solutions, models, stories, and art:
https://akademia.mini.pw.edu.pl/pl/ukraina

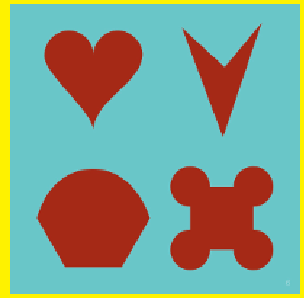
Amazing the things you find when you bother to search for them.

– Sacagawea,
a renowned Lemhi Shoshone
explorer and guide

NEWSFLASH
Join LIVE Bluebird Math Circle to work on these activities together with friends and family.
Monday, March 18, 18:30-20:00 Warsaw, Poland time, online.
Sign up **https://akademia.mini.pw.edu.pl/pl/ukraina**



MATH COYOTE CORNER



Which one doesn't belong?
Image credit: Christopher Danielson

Inspiration: Shapes and Curves in Indigenous Rugs

Look at the pictures. The left one is a Navajo rug. The right one is a Kyrgyz rug (shyrdak). What similarities do you see? What differences? What shapes and curves do you notice on these rugs?

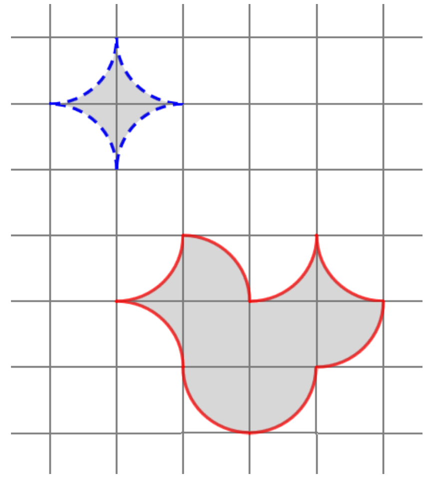
Family Circle: Of Shapes and Curves

Problem 1

On a faraway planet there is an island called Bluebird Nest, and there are two countries there. Each country has its own traditions. If a traveler visits Emerald Nut country, they must bring a present of a few nuts. If they visit Golden Fig country, they are expected to bring a few figs as a gift. Our friend Bluebird is visiting the two countries. Once there was a fence between them, but the fence is long gone. Fortunately, Bluebird found a fragment torn from an old map. The dotted lines show where the fences used to be. The stars show two of the sacred stones where visitors must leave their gifts. The boundary continues off the fragment of paper, so that it's continuous. The fragment also states that the right bottom stone is in Emerald Nut country, so Bluebird leaves some nuts there. Now he needs to figure out what to put on the top left stone, nuts or figs. Could you help?

Problem 2

In the picture we can see two simple closed curves made entirely of quarter-circles of radius 1. One curve is blue and dotted, another is red and solid.



1. Draw your own simple closed curve made of quarter-circles.
2. What is the area of the region enclosed by the red curve? Hint: there is a way to answer without using formulas.
3. Can you draw a region enclosed by such a curve and having the area of 4? Of 8? What about an area which is an odd number?

Ask Bluebird

QUESTION—*How come math problems often come in groups? Where there's one problem, there are more like it! - Anonymous*

BLUEBIRD SAYS— What a shrewd observation! Yes, indeed, math questions are like mushrooms – where is one there must be many more. The mushrooms you see above the ground grow out of mycelium, a root-like structure you can find underground. Similarly, you can dig up interconnected roots of math problems if you know where to look. For example, look at Problem 1 above. It suggests other questions, such as: (1) could you extend the map from the fragment in the picture so that all the pieces of the boundary form a continuous curve which divides the island into two countries? Or (2): suppose we have a river in a plain. It twists and turns so much that it forms spirals and suchlike. There are two countries bounded by the river. Take three points. At least two of them are in the same country. Which two?

As Sacagawea said, 'Amazing the things you find when you bother to search for them.'

FUN FACT OF THE FORTNIGHT

On a piece of paper, you can draw and color in whatever two shapes you want (2D shapes, such as countries somewhere on a map). There will always be a straight line that cuts both perfectly in half.

In 3D space, you can have any three blobs, and you'll be able to divide all three evenly with just one straight cut of a blade. Think of a sandwich with a piece of bread, a piece of cheese, and a piece of ham—and each of these pieces can be of any size and shape, and they don't even need to be placed together.

This observation remains true for higher dimensions. For example, if you can imagine a four-dimensional ham sandwich with four ingredients (pieces of 4D bread, cheese, ham, and lettuce), you could also bisect all four ingredients with a single (three-dimensional) cut. This fact is known as 'the ham sandwich theorem." It has some bizarre implications, for instance, for gerrymandering in politics.

Image credit: Miguel Perfectti/Getty Images

