



A Twisted Tale

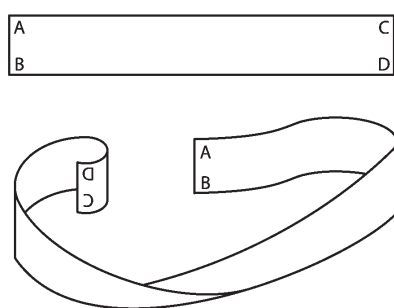


photo by David Benbennick

A sheet of paper (like this newspaper page) has two sides, or **faces**: front and back. You might think nothing you could do to a piece of paper could change that, but keep reading!

Try this experiment

Make a strip of paper that is about 2 inches wide and about 22 inches long. (You can cut two 2-by-11-inch strips from a sheet of printer paper and tape them together end to end.)



Lay the strip down and mark an A on the top left corner, a B on the lower left corner, a C on the upper right corner, and a D on the lower right corner.

The strip clearly has two sides — the side with the letters on it and the side with no letters. There's no way for an ant walking on the paper to get to the other side without crossing an edge of the paper.

Now get a piece of tape. Bring one short side of the paper close to the other short side, then give the paper a half-twist so that A is

next to D and B is next to C. Tape the ends together to keep that loop's half-twist in place.

Next, pick up a pencil and start drawing down the middle of the loop, going all the way around it. Were you able to travel all the way around and return to your starting point without lifting your pencil or crossing an edge? You've proven that this strip actually has only one side!

A mathematician's puzzle

You just made a **Möbius** (MOE-bee-us) **strip**, or Möbius band. This perplexing object is named after August Ferdinand Möbius, one of the German mathematicians who discovered it in 1858.

The Möbius strip has several uses in the real world. For instance, your parents or grandparents can remember music recordings on 8-track tapes, which play both sides of the tape without you having to eject it and flip it as you would for a cassette tape. And a conveyor belt with a half-twist allows the entire surface area to have the same degree of wear, and therefore last longer, than a conveyor belt that is a simple untwisted loop.

There are other applications of the Möbius strip in chemistry and physics. For example, charged particles that get caught in the Earth's magnetic field may move in a Möbius band.

Mini Fact:

An ant could crawl along the entire surface, covering both sides, without ever crossing an edge.

Another experiment

What do you think will happen if you cut with scissors along the pencil line all the way around? Try it and see.

How many loops did you get? Are they separate or interlocking? How many twists do they have? Were you surprised at the result?

Möbius art

The Möbius strip has appeared in art, such as a famous woodcut by the 20th-century Dutch graphic artist M.C. Escher. (See the art here: bit.ly/1kjLly4) Does this art remind you of the image we mentioned earlier of an ant walking the entire strip?

More mind-twisting

A curious mathematical object called a **Klein bottle**, described by German mathematician Felix Klein in 1882, doesn't have an inside or outside — just one side!



photo courtesy Judah Lesser

Resources



On the Web:

- bit.ly/1LDHjgg
- wonderopolis.org/wonder/what-is-a-mobius-strip

At the library:

- "The Everything Kids Math Puzzles Book" by Meg Clemens, Sean Clemens and Glenn Clemens

Try 'n' Find

Words that remind us of the Möbius strip are hidden in this puzzle. Some words are hidden backward or diagonally, and some letters are used twice. See if you can find:



ART, BAND, BELT,
BOTTLE, CHEMISTRY,
CONVEYOR, EDGE,
ESCHER, FACE,
KLEIN, LOOP,
MATHEMATICIAN,
MOBIUS, PHYSICS,
SIDE, STRIP, SURFACE,
TAPE, TWIST.

W J G R Z E C A F P I R T S M
S U I B O M V H Y E N F A K R
C L C S A Y L M E E P N D E E
I X G M U N E O E M L A E G H
S K T B Y R D V O D I T T D C
Y L R S E K F J N P I S T E S
H E A W I L T A E O B S T O E
P I N Q B W T J C G C H N R B
Z N A I C I T A M E H T A M Y

Cook's Corner

Pecan Tartlets

You'll need:

- 1 (9-inch) refrigerated pie crust
- 1 1/4 cups packed light brown sugar
- 2 large eggs

- 1 teaspoon vanilla extract
- 3/4 cup chopped pecans



* You'll need an adult's help with this recipe.

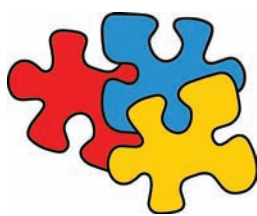
What to do:

1. Preheat oven to 350 degrees. Divide pie crust into 12 equal pieces and press the pieces into the bottoms and up the sides of a 12-cup mini muffin pan.
2. In a large bowl, whisk together brown sugar, eggs and vanilla. Fold in the pecans.
3. Spoon the pecan mixture into the pie crusts to fill them about three-quarters full.
4. Bake for 25 to 30 minutes or until the filling is puffed up and the crust is lightly golden brown. Serves 12.

Adapted from "The Robin Takes 5 Cookbook for Busy Families" with permission from Andrews McMeel Publishing (andrewsmcmeel.com).

Puzzling

Unscramble the words below that remind us of math puzzles.



emyrteog _____

dsei _____

cuafesr _____

inodnmesi _____

Answers: geometry, side, surface, dimension.

Mini Jokes



August: What's a Möbius strip's favorite game?
Angel: Twister!

Eco Note



A little eco-math for you: If you throw something on the ground, how long does it take for it to become part of the Earth again? A piece of paper = a month. An aluminum soda can = at least 200 years. A plastic six-pack ring = 450 years! Clean up your trash!

adapted with permission from "The New 50 Simple Things Kids Can Do to Save the Earth" by The Earthworks Group, Andrews McMeel Publishing (andrewsmcmeel.com)

Thank You



The Mini Page thanks Dr. Larry Lesser, professor of mathematics education at The University of Texas at El Paso, and Judah Lesser for help with this issue.

Teachers:

For standards-based activities to accompany this feature, visit: bbs.amuniversal.com/teaching_guides.html

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