## the nmf weekly

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## Math and Folding Sheets

G'Day!
This is your math friend James. Today I am answering a question from Mary.

## WHY DO YOU LIKE TO FOLD SHEETS?

I have a feeling Mary watched a video I made on folding "fitted sheets." These are bottom sheets for the bed with some elastic in them so that you can hook the corners of the sheets around the corners of the mattress. This then keeps the sheets firmly in place and all is good ... except for when you do you laundry, that is, wash and dry them and then try to fold them to put away into your closet. They are very difficult to fold!

Most people just scrunch the sheets into a loose bundle and don't mind having a messy stack of sheets hidden in a closet. But some people decide to take folding on as a challenge: How do you fold these fitted sheets in some neat way?

I never used to fold my fitted sheets. But a few years ago, someone wrote to me and challenged me to figure it out--l am a math guy, after all, they said. So I did, and made a video about it.

You can watch the video too, if you like. It's here. I explain my thinking process behind solving the challenge, and people seem to like that. Thinking and understanding are always good things!

But Mary's question now has me thinking about folding in general. How about we explore folding something simpler, say, just a strip of paper?

Imagine picking up the right end and folding the strip in half to give a picture like this.


2 layers


Now pick up the right end again and fold the folded strip over to the left. Can you see it will give a picture like this?


4 layers

Are you game for a third fold? Picking up the right end (let's always pick up from the right) and folding over to the left gives this picture.

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> Folding a strip of paper in half one time gives 2 layers of paper. Folding a strip of paper in half two times gives 4
> layers of paper. Folding it in half three times gives 8 layers of paper.

How many layers of paper would you have if you folded the piece of paper in half a total of ten times?

## BELIEVE IT OR NOT ...

Folding a strip of paper in half about 48 times produces enough layers to make a wad of paper high enough to reach the Moon!

Let's now fold a square piece of paper. Fold one in half twice as shown.


Then cut off the corner at 45 degrees.

When you unfold the paper you will see a square hole. (Try it!)


Fold a piece of paper a different way, cut off a corner and see what other shaped-holes you can produce.

Mathematicians have proved something astounding:
Given a square piece of paper, it is possible to fold it and cut off a corner of the folded paper, and produce a hole of ANY shape you could possibly want! (Well, the shape has to be a polygon, that is, have straight edges.)

This is called the FOLD AND CUT THEOREM.

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## Check out the FOLD AND CUT THEOREM on NumberPhile here.

## puzzle \#2

Fold a square piece of paper, cut off a corner with a single straight cut, and produce a triangular hole.

## Can you do it?



## BELIEVE IT OR NOT ...

In 2002, then a high-school student, Britney Gallivan managed to fold a strip of paper in half 12 times. She started with a strip 4000 feet long!

Here's a strip of paper 54,000 feet long folded in half 13 times. It was completed in 2011 by students at St. Mark's School -- but they had to tape strips of paper together.


Do you have a math question for me to answer, or try to answer?

## Write to me at the website. Each week l'll pick a new question and give my thoughts on it!

## About the Author: Dr. James Tanton

The NMF Weekly is written by mathematician Dr. James Tanton as a resource for friends and fans of the 2021 National Math Festival.

Learn more at globalmathproject.org/nmfweekly \& nationalmathfestival.org



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