

## Math and Mirrors

G'day! This is your math friend James. Today I am answering a question from Jim in Arizona.

### "CAN YOU DO SOMETHING WITH MATH AND MIRRORS?"

I first thought that Jim might be wondering why mirrors seem to flip images horizontally (and why they don't flip them vertically). Many people wonder this. But he wasn't: he wants to know if I know any math puzzles about mirrors.

(But if you do want to know why mirrors seem to flip images, I recommend watching [this fabulous video](#) from Physics Girl.)

So, do I know any mirror puzzles? Well, how about this?

### puzzle #1

**Stand in front of a big mirror mounted on a wall.**

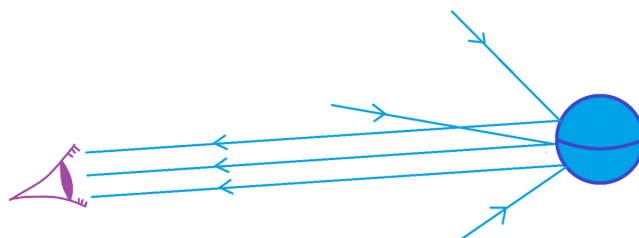
**Using some painters' tape — something that doesn't leave a residue when removed — or a washable marker designed for writing on glass, mark two horizontal lines on the mirror: one at the bottom of your chin and one at the top of your forehead. (I tried to take a photo of me doing this.)**

**Now, back away from the mirror. Next, walk closer to the mirror.**

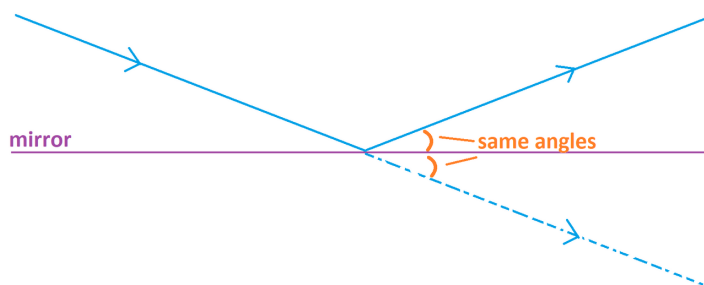
**What weird thing do you notice? Can you explain what you observe?**



When we look at an object what we see is the set of rays of ambient light each that happen to bounce off of the object to head straight to our eyes.



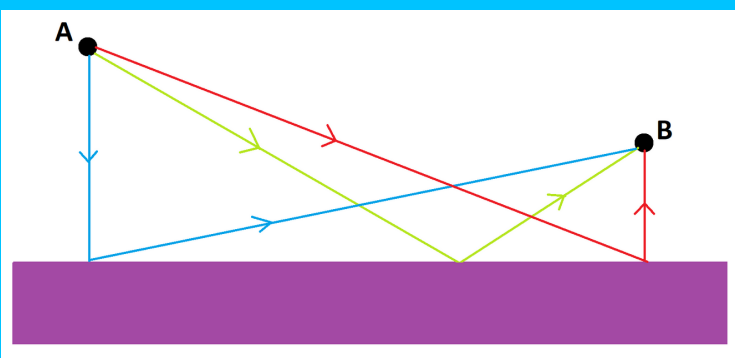
Light travels in straight lines, except when it intercepts objects and reflects off them. But even then the geometry of reflection is such that light rays still mimic straight line paths. For example, a ray of light hitting a flat mirror bounces off the mirror at the same angle to the surface as it would make if it could pass through the mirror in a straight line.



## puzzle #2

A lazy dog is at point A on one side of a wall and wants to walk to point B on the same side of the wall. But being a dog, it wants to stop along the way at the wall to sniff at the wall.

The dog could walk straight to the wall and then head to B. Or the dog could walk to the point directly below B and then head to B. Or the dog could walk to some intermediary point between these two extremes, sniff the wall there, and then walk to B.



Being lazy, the dog wants to walk the shortest path possible.

Where exactly should the dog sniff the wall so that its path from A to that point along the wall and then to B is as short as possible?

Puzzle 2 is famous among mathematics teachers. And it seems really tricky as no numbers are given in the puzzle!

How far is the point A from the wall? How far is the point B from the wall? How far apart are A and B? We don't know!

The puzzle requires us to somehow use pure geometry to describe a point along the wall that you can then convince people does gives the shortest dog path possible. Whoa!

But you might guess from theme of this essay that thinking of light rays and mirrors might be helpful. Have fun!

## WRITE TO ME

**Do you have a math question you'd like me to answer, or try to answer?**

**Have an adult help you to write to me at the website. Each week I'll pick a new question and give my thoughts on it! Plus I'll give me solutions to the most recent puzzles.**

## OTHER RESOURCES

**Check out MATHICAL for award-winning math books for middle-schoolers and teens, the YouTube channel NUMBERPHILE for math videos galore, and MORE MATH! for even more resources. Wowza!**

**It's a favorite, but here again is a video from Numberphile about reflections.**

### 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/nmf-weekly](https://globalmathproject.org/nmf-weekly) & [nationalmathfestival.org](https://nationalmathfestival.org)

