

# Tricks of the Eye

## Grades K-2

### The Big Idea

Today you get to be math magicians. You'll learn what an **optical illusion** is and **uncover the math** behind how our eyes play tricks on us.

### Supplies

- ★ Drinking glasses with smooth clear glass: 2
- ★ Index cards, 4x6 inches: 2 per kid, plus 2 for the coach
- ★ Laptop, smartphone or tablet with internet access (optional, but encouraged)
- ★ Pencils: 1 per kid
- ★ Rulers: 1 per kid
- ★ Scissors: 8 pairs for kids to share
- ★ Water for 2 glasses
- ★ Writing surface, whiteboard, blackboard or large piece of paper
- ★ **To print:** Chocolate Bar Printable, 1 per kid

### Room Set-up:

- ★ You'll need a room with some desks or tables for this week.

### Other Key Prep

- ★ **Print 1 copy per kid** of the Chocolate Bar Printable. You may want to have a few extras on hand in case someone accidentally cuts the wrong squares.

### What's the Math?

- ★ Linear measurement
- ★ Estimation
- ★ Area

## Kickoff

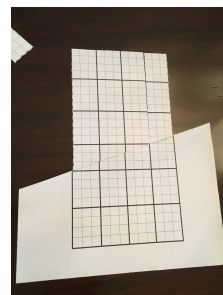
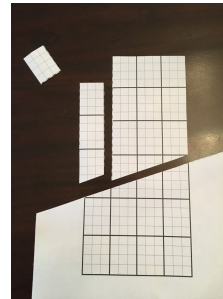
*Intro to the kids:* “Have your eyes ever played tricks on you? Maybe you thought you saw one shape, but it turned out to be something else?”

(Discuss.) “An **optical illusion** happens when our eyes send information to our brains that trick us into seeing something that isn’t really there. It turns out there’s a lot of math happening behind the scenes!”

## Infinite Chocolate Bar (20-25 minutes)

*To the kids:* “First we’ll start with a very cool optical illusion. Have you ever wished you could have an endless supply of chocolate? What if you had a chocolate bar that you could break apart, eat a bite, and put back together again, just like new? Let’s practice with this grid!”

1. Give each kid a **Chocolate Bar Printable**.
2. Start by counting the number of rectangles along the **right-hand column**.
3. Now, ask kids to share the scissors to cut out their Chocolate Bars:
  - ★ First, cut across the diagonal line.
  - ★ Then **cut the top pieces along the dotted lines**. Make sure kids trim the solid white margins off the pieces.
  - ★ Ask kids to **set aside** the smallest “bite” of chocolate
  - ★ Like a puzzle, rearrange the **remaining** pieces to form a **complete chocolate bar**.
4. Ask the kids to count the rectangles along the **right-hand column**.

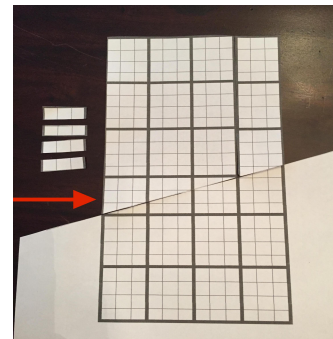


**Ask the kids:**

- ★ “What’s going on here?! Is it really possible to take away a piece of chocolate and still have a complete chocolate bar?” (Discuss. Let the kids examine the bar closely until they discover it’s a little shorter than it was before. This means the total **area** of the new bar is smaller than the original one.)

**To the kids:** “If you look at the little bite of chocolate bar that we set aside, you’ll see that it’s a grid 3 squares **wide** and 4 squares **long** for a total **area** of 12 tiny squares (width x length = area).”

- ★ “Now, look back at your reassembled chocolate bar. Notice that the rectangles in the 4<sup>th</sup> row, through which we made our diagonal cut, are still 3 squares wide but only 3 squares long - that’s a total area of 9 squares in each of those bites, unlike the other bites that have 12 squares.”
- ★ “So, if 4 bites are missing 3 squares each, that means we’re missing a total of 12 squares from the whole chocolate bar – the same number of squares that are in the little bite we set aside!”
- ★ “Can we cut our little bite into 4 mini-bites of 3 squares each?” Let the kids figure out that they should cut the little bite into 4 rows to discover it’s the same number of rows and squares that are missing from the diagonal cut of the giant chocolate bar!



## Reversing Arrows (15 minutes)

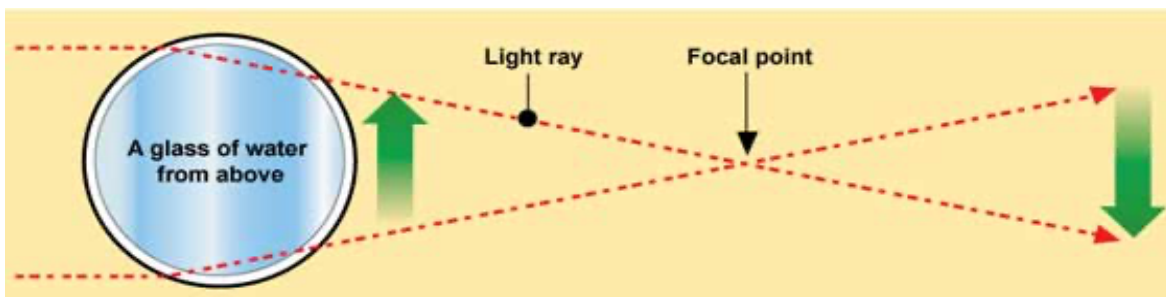
*To the kids:* “Next up is an optical illusion called reversing arrows.”

1. Give each kid an index card and ask them to **draw a thick arrow** on the card.
2. Fill 2 clear glasses with water and put them on a table.
3. Divide the kids into 2 groups and have each gather around a glass.
4. One at a time, have kids place their arrow cards **behind the water and against the glass** pointing either left or right, and then slowly **move the card backward** while watching through the water.



*Ask the kids:*

- ★ “What happens when you move your arrows backward?” (Discuss. They appear to change direction!)
- ★ “Why do you think the arrow reverses itself?” (Discuss. It happens because of **refraction**, the **bending of light**. When light travels through water, it bends, so the rays pop out shining toward a single center point, called the focal point. Any images on the other side the focal point will look reversed to us.)



## To See or Not to See (10 minutes)

*To the kids:* “OK, are you ready for one more optical illusion? Does anyone know what a **blind spot** is?” (Discuss.) “It’s a spot in the air where your eye can’t see anything. There is 1 spot on the inside of your eyeball where there are no **cones** or **rods**, which are the parts in your eye that pick up light. Everyone has a blind spot, so let’s find yours!”

1. Give each kid **another index card, 1 ruler, and**

**1 pencil.** Have them draw an **x** on the right side of the card. Then have them measure



about 5 inches to the left of the **x**, and draw a dot the size of a penny. (Mark up your own index card to demonstrate.)

2. Have the kids hold their cards at **eye level** an arm’s length away. Make sure the **x** is on the **right**.
3. Tell them to **close their right eye** and look **directly at the x** with their **left eye**. (They should be able to see both shapes.)
4. Have them **slowly** bring the card toward their face, focusing on the **x**. They **must** keep looking right at it – no looking to the side!

*Ask the kids:* “What happens as you bring the card closer?” (Discuss. The dot should **disappear, then reappear** as they bring the card even closer to their face. Let them try moving the card closer and farther to pinpoint where it happens!)

5. Now have the kids **close their left eye** and look directly at the **dot** with their right eye.

*Ask the kids:*

- ★ “What happened this time?” (Discuss. This time the **x disappears**, then reappears as the card comes closer.)
- ★ “Is the distance from your face about the same for both eyes?”
- ★ “Will the dot still disappear if it’s as big as a quarter?” (Let the kids **fill in** around the dot to try a new size.)
- ★ “What if it’s a different shape, like a triangle or square?”

6. Next, have the kids draw a **straight line** from the **dot** to the **x** using a ruler.
7. Have the kids repeat the exercise, focusing on the **x** with their **left eye**.

*Ask the kids:*

- ★ “What happens when you bring the card closer?” (Discuss. The dot disappears, but the line looks continuous without a gap where the dot used to be.)
- ★ “Why isn’t there a gap where the dot used to be?” **Party Fun Fact:** When our eye can’t see what’s in a certain spot, our brain fills in that area to **match** what surrounds it.

## **Grand Finale: Crazy Circles (5 minutes)**

Show the kids **this cool optical illusion video** from your laptop, phone or tablet: <http://safeshare.tv/v/ss571e3c0b2ad60>