

HEADING INTO THE 1st DIMENSION:

Science and Engineering Practices

March 3, 2018 | Pier 15, San Francisco, CA



Blind Spot

To see or not to see.

The eye's retina receives and reacts to incoming light and sends signals to the brain, allowing you to see. One part of the retina, however, doesn't give you visual information—this is your eye's “blind spot.”

Tools and Materials

- A few 3 × 5 cards or other stiff paper
- Black marking pen (felt-tip works best)
- Optional: yard stick or meter stick and a partner



Assembly

Mark a dot and a cross on a card as shown.



To Do and Notice

Hold the card at eye level about an arm's length away. Make sure that the cross is on the right.

Close your right eye and look directly at the cross with your left eye. Notice that you can also see the dot.



Focus on the cross, but be aware of the dot as you slowly bring the card toward your face. The dot will disappear, and then reappear, as you bring the card toward your face. Try moving the card closer and farther to pinpoint exactly where this happens.

Now close your left eye and look directly at the dot with your right eye. This time the cross will disappear and reappear as you bring the card slowly toward your face.

Try the activity again, this time rotating the card so that the dot and cross are not directly across from each other. Are the results the same?

What's Going On?

The optic nerve—a bundle of nerve fibers that carries messages from your eye to your brain—passes through one spot on the light-sensitive lining, or retina, of your eye. In this spot, your eye's retina has no light receptors. When you hold the card so the light from the dot falls on this spot, you cannot see the dot. The fovea is an area of the retina that is densely packed with light receptors, giving you the sharpest vision.

Going Further

Here are a few variations of this activity that you might try.

Fill in your blind spot:

Draw a straight line across the card, from one edge to the other, through the center of the cross and the dot, and try again. Notice that when the dot disappears, the line appears to be continuous, without a gap where the dot used to be. Your brain automatically “fills in” the blind spot with a simple extrapolation of the image surrounding the blind spot. This is why you don't notice the blind spot in your day-to-day observations of the world.

Measure the size of your blind spot without a partner:

Take a new card and mark a cross near the left edge of a 3 × 5 card. Hold the card about 10 inches from your face. (It's helpful to use a meter stick or ruler to measure this distance; you'll need it to calculate the size of your blind spot.)

Close your left eye and look directly at the cross with your right eye. Move a pen across the card until the point of the pen disappears in your blind spot. Mark the places where the pen point disappears. Use the pen to trace the shape and size of your blind spot on the card. Then you can measure the diameter of the blind spot on the card (see equation below).

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Measure the size of your blind spot with a partner:

Hold your 3 x 5 card at arm's length. Have your partner measure the distance from the card to your eye. Slowly move the card horizontally left and right, and note where the cross disappears and reappears. Have your partner measure the distance between the two places where the dot disappears and reappears.

In our simple model, we are assuming that the eye behaves like a pinhole camera, with the pupil as the pinhole. In such a model, the pupil is 0.78 in (2 cm) from the retina. Light travels in a straight line through the pupil to the retina. Similar triangles can then be used to calculate the size of the blind spot on your retina. The simple equation for this calculation is

$$s/2 = d/D$$

where s is the size of the blind spot on your retina (in cm), d is the diameter of the blind spot on the card, and D is the distance from your eye to the card (in the examples above, 10 in [25 cm] or the length of your arm, roughly 2–2.5 feet (60–75 cm)). Note that d and D must always be expressed in the same units, whether inches or centimeters.