Blind Spot

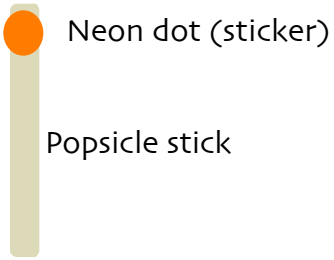
Using math and a popsicle stick, you can measure the diameter of your optic nerve

Materials: (per pair students)
- A popsicle stick (also called a craftstick)
- A small, neon-colored, round sticker
- A meter stick
- A ruler
- A friend to help you measure
- Calculator (optional)

What To Do:

(1) Put a neon dot at the end of your popsicle stick (or pencil). You are now ready to measure the size of your right eye's blind spot. (see **Figure 1**)

Figure 1

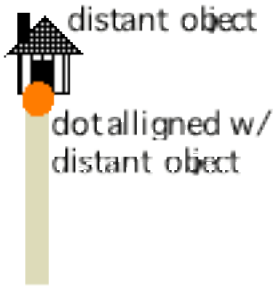


Your blind spot is a hole in your retina where the optic nerve enters the back of your eyeball. Because it a hole, this part of the retina has no rods or cones. So images that form on this part of the retina are not received by the brain—so, you have a blind spot.

(2) Close your left eye and keep it closed. With your right eye open, look at some object in the distance (something more than ten feet away). *It is very important that you keep your left eye closed and your right eye fixed on this object while you examine your blind spot.*

(3) With your arm extended straight out in front of you (elbows straight), hold your neon dot so that the red dot appears to cover the distant object you are looking at with your right eye. (see **Figure 2**)

Figure 2



(4) *Keeping your right eye 's gaze fixed on the distant object*, slowly move the neon dot to the right. Eventually, the bright red dot should disappear in your

peripheral vision. If you have moved the red dot more than about 20° from its position straight out in front of you, you have gone too far.

(5) When you find the location of the spot where the red dot disappears, move the dot up and down. *Remember to keep your right eye focused on the distant object straight in front of you and keep your arm straight with your elbows locked!* How high is your blind spot when the dot is held out at arm's length? Using a ruler, have a friend help you measure the height (H) of your blind spot. (see **Figure 4**)

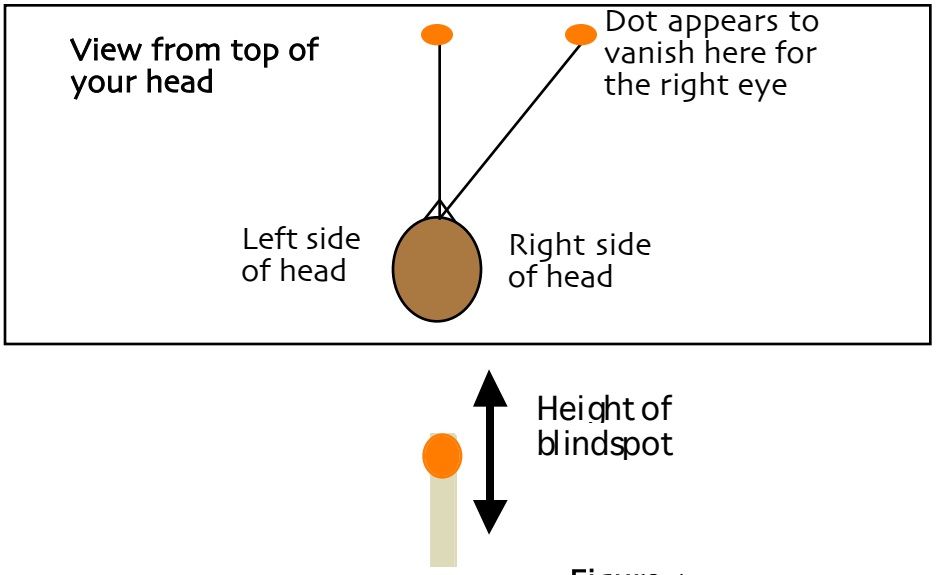


Figure 4

(6) Collect the following measurements:

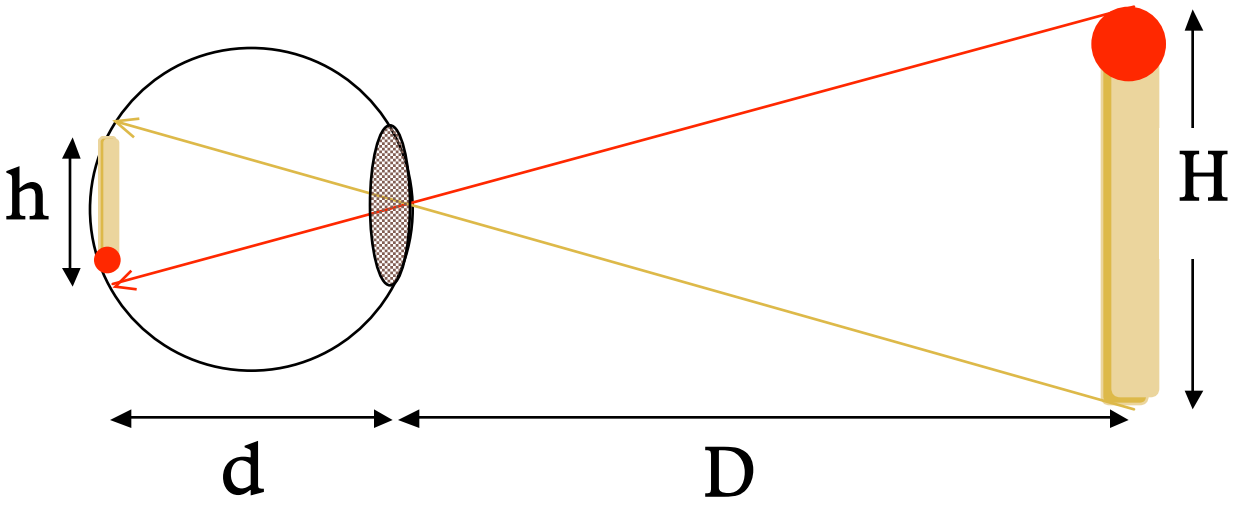
H = The height of your blind spot (in cm)
D = The distance from your eye to the stick (in cm)

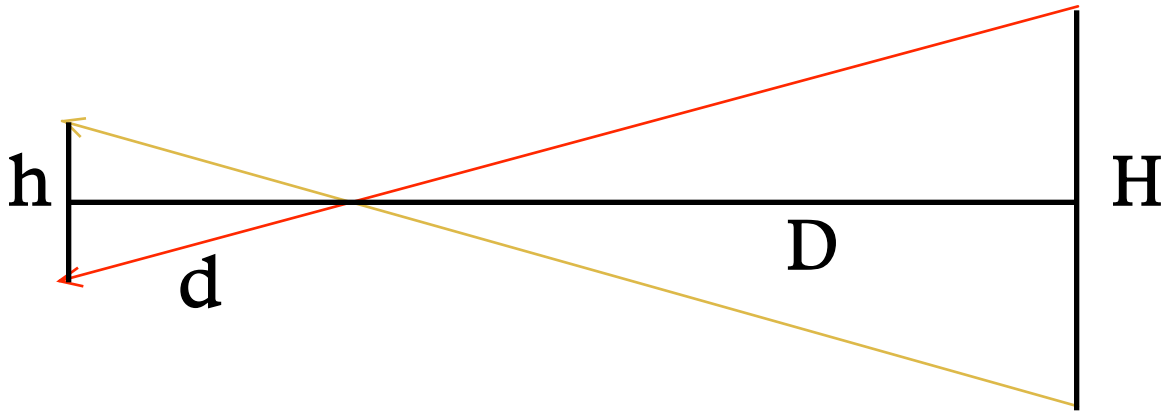
Here is a measurement you'll need:

d = The diameter of your eyeball = 2 cm

(7) With this data you are ready to estimate the size of your optic nerve. You'll use the geometry and mathematics of similar triangles to make this estimate. **Figure 5** below shows the relationship between the sides for triangles that are similar. Because light travels in a straight line from objects to your retina, we can make use of these same relationships to find the size of any image on the back of your eye (the retina). **Figure 5** also shows a ray diagram that demonstrates how the size of any object and the size of its image can be found by applying the knowledge that the ratio of the length and height of similar triangles are equal.

Figure 5



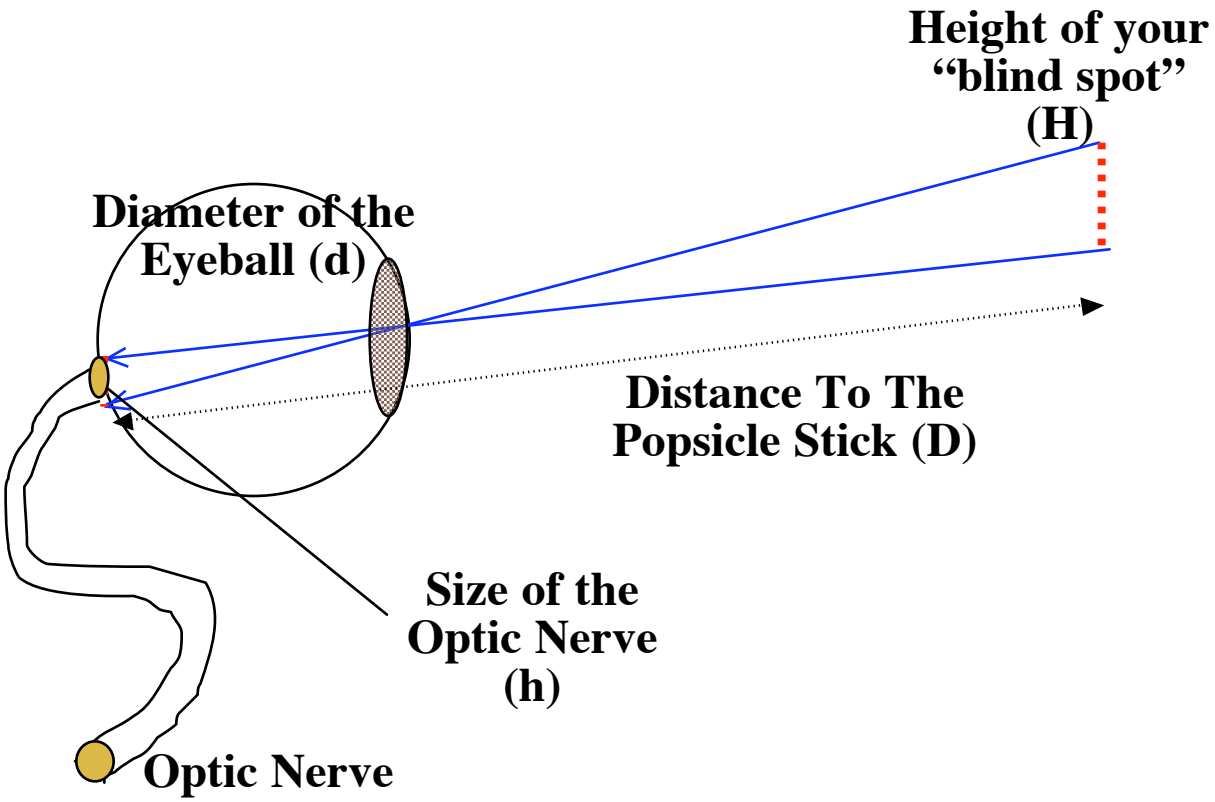


$$D/H = d/h$$

Figure 6 shows the relationship between the height where the dot appears to vanish (H), the distance between the eye and the stick (D), the diameter of the eyeball (d), and the unknown that you need to solve (the size of the optic nerve or hole in your retina, or h). This calculation will give you the diameter of your optic nerve – the size of the hole in the back of your eye. The formula you will use is:

$$h = d\,(H/D)$$

Figure 6



How Did You Do?

The diameter of your optic nerve is about 2-3 mm. How did your estimate compare?