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Measuring Your Blind Spot

Introduction

Seeing is believing. See for yourself that you have a blind spot. Then measure it!

Concepts

- Blind spot (optic disk)
- Retina
- Lens
- Similar triangles

Background

The lens in the front of the eye focuses images on the retina in the back of the eye. In the retina, the image impulses are converted to nerve impulses which are then sent via the optic nerve to the brain for interpretation. In the retina there is an area known as the optic disk. (See Figure 1.) In the optic disk area, the nerve fibers converge and leave the eyeball. In addition, a central artery and vein also pass through the eye in the optic disk area. Because the passageway for these structures is through this part of the retina, there are no receptor cells in the optic disk area, therefore, since there is no image reception occurring in the optic disk, this area is often referred to as the "blind spot."

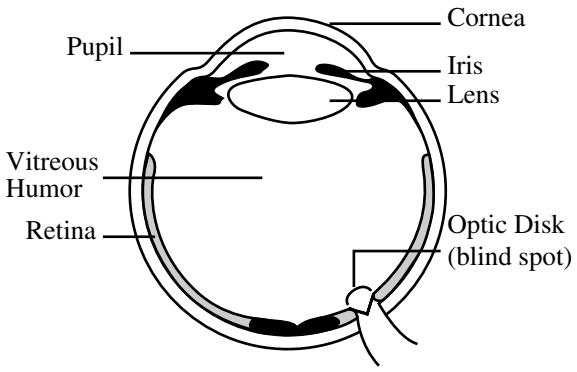

Figure 1. Structure of the eyeball

Materials

Blind Spot Visual Chart
Meter stick

Safety Precautions

This activity is considered nonhazardous, but since the eye is the center of experimentation, exercise cautions. Protective eyewear will not interfere with experimental results and should be worn during this activity.

Procedure

1. Obtain a Blind Spot Visual Chart. Use a ruler to measure the distance between the dot and asterisk. This is distance **g** in Figure 2.
2. Follow the directions on the chart and experience the blind spot phenomena for both your left and right eye.

Perform steps 3–5 with a laboratory partner *being careful when measuring near the eyes*. Safety glasses should be worn.

3. Have your lab partner hold a meter stick along the side of your head as you determine where the marker disappears and reappears as you view the Blind Spot Visual Chart. Stop moving the chart when the marker disappears and have your lab partner measure from the front of your eye to the chart. This measurement is distance **a** in Figure 2. Then measure the distance from your eye to the chart when the marker reappears. This is distance **b** in Figure 2.

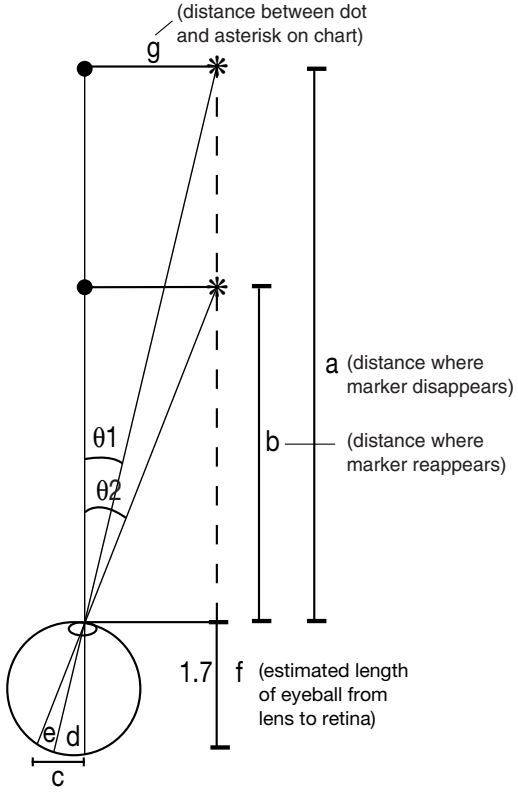

Figure 2. Geometry of blind spot calculation

4. Record the measured distances.
5. Repeat the experiment to secure measurements for your lab partner.
6. Use the measurements and the diagrams in the Discussion section to calculate the width of your blind spot, labeled **e** in Figure 2.

Discussion/Results

The size of the blind spot will vary from individual to individual. The calculation for the width of the blind spot is only an estimate based upon some basic geometry and several assumptions. Two methods are shown below for calculating the size of the blind spot. Refer to Figure 2 for the following formulas and calculations.

The distance of the blind spot is shown as **e** in Figure 2. Both distances **d** and **c** can be calculated using similar triangles and the measured distances **a** and **b**. The blind spot (**e**) can be calculated as:

$$\mathbf{e = c - d}$$

Method 1: Equivalent triangles

Example calculations are shown for results that have measured distances **a** = 48 cm and **b** = 38 cm.

Using distances **a** and **b**, **c** and **d** can be calculated:

$$\frac{12\text{ cm}}{38\text{ cm}} = \frac{c}{1.7\text{ cm}} \qquad \frac{12\text{ cm}}{48\text{ cm}} = \frac{d}{1.7\text{ cm}}$$

$$\mathbf{c} = .54\text{ cm} \qquad \mathbf{d} = .43\text{ cm}$$

$$\mathbf{e = c - d}$$

$$\mathbf{e} = .54\text{ cm} - .43\text{ cm} = .11\text{ cm}$$

Method 2: Trigonometry

The relationship can also be expressed as (calculator must be in radian mode):

$$\mathbf{e} \approx \mathbf{f}(\theta_2 - \theta_1) \text{ where:}$$

$\mathbf{f}$ = distance between retina and lens

$$\theta_1 = \tan^{-1}\left(\frac{g}{a}\right) \qquad \theta_2 = \tan^{-1}\left(\frac{g}{b}\right)$$

Using 1.7 cm as an estimate of eyeball length:

$$\mathbf{e} \approx 1.7\left[\tan^{-1}\left(\frac{12\text{ cm}}{38\text{ cm}}\right) - \tan^{-1}\left(\frac{12\text{ cm}}{48\text{ cm}}\right)\right] = 1.7\,(.0658) = 0.11\text{ cm}$$

Close left eye. Position dot in front of right eye at arm's length. Stare at the dot and move paper toward your face. Note when the asterisk disappears and then reappears.

Close right eye. Position asterisk in front of left eye at arm's length. Stare at the asterisk and move paper toward your face. Note when the dot disappears and then reappears.

Blind Spot Visual Chart

Connecting to the National Standards

This laboratory activity relates to the following National Science Education Standards (1996):

Unifying Concepts and Processes: Grades K–12
Constancy, change, and measurement
Form and function
Content Standards: Grades 5–8
Content Standard C: Life Science, structure and function in living systems
Content Standards: Grades 9–12
Content Standard C: Life Science, matter, energy, and organization in living systems

References

Sanny, J. *The Physics Teacher.* September, 1999, 37, pp 348–49.

Materials for *Measuring Your Blind Spot* are available from Flinn Scientific, Inc.

Catalog No.	Description
AP5383	Meter Stick, Plastic
AP8294	Meter Stick, Natural with Plain Ends
FB0762	Giant Eye Model, 6-Part
FB0763	Eye Model, 7-Part in Orbit
FB1099	Eye Model

Consult your *Flinn Scientific Catalog/Reference Manual* for current prices.