

Seeing out of the Corner of Your Eye

Introduction

Stare at an object straight ahead. Can you see anything else out of the “corner of your eye”? Seeing beyond the center of our *visual field* (everything seen while looking straight ahead) is known as *peripheral vision*. Explore the range of your own peripheral vision.

Concepts

- Peripheral vision
- Rods versus cones

Materials

Peripheral vision disk

Sight cards, black and white reading, 1" × 2", 3–5 per pair of students

Sight cards, color, 1" × 2", 3–5 per pair of students

Procedure

Read the *Procedure* section completely before beginning the activity.

Part 1. Visual Field: Motion and Reading

1. Choose one member of the group to be the subject, and one to be the tester. After the activity has been completed, switch roles.
2. The subject obtains the peripheral vision disk and sits at a desk or table.
3. The subject holds the vision disk horizontally to his or her face, placing his or her nose in the center curve. The disk should be about halfway between the top and the tip of the nose. Use the thumb and forefinger of either hand to hold the disk at the zero point, with the forefinger on the zero (see Figure 1).
4. The tester obtains the reading sight cards and stands in front of the subject.
5. The tester chooses one of the reading sight cards without letting the subject see which one.
6. The tester holds the lower half of the sight card with letters facing inward against the disk before the 110° mark on the subject's left side, out of the subject's sight. The vision disk should intersect the card, with the letters above the disk and the tester's hand below the disk (see Figure 2).
7. The subject focuses on his or her index finger at the zero point (or on an object in the distance that is aligned with the zero point), not moving his or her eyes to the right or left at any time during the test. The tester must watch the subject's eyes to make sure they stay focused straight ahead. This task may be somewhat difficult for the subject initially, as the eyes may tend to wander, especially as the card becomes easier to distinguish. The subject may try to peek to see if the guesses are correct. (It may help if the tester audibly reminds the subject periodically by saying, “Look straight ahead,” or “Stay focused on your finger.”)
8. If at any time during the test the subject averts his or her eyes from the center gaze and glances toward the card, the tester should choose a different card and place the new card at the same place the original card had reached. Continue the procedure with the new card.
9. The tester slowly and steadily moves the card toward the zero point. As soon as the subject detects the card moving into the field of vision, he or she should say, “Motion.” The tester removes the card at this point (without letting the subject see it), and records the angle at which motion was detected for the left side of the visual field.
10. The tester returns the sight card to the angle on the disk at which it was detected and continues to move the card slowly toward the zero point, reminding the subject to continue gazing straight ahead. When the subject can recognize the two letters and/or numbers on the card, he or she should say the letters/numbers out loud. For example, if the card shows 3T, the subject should say “Three tee.” If correct, the tester records this angle for reading. If the subject does not correctly read the card, the tester does not record the angle and the tester continues to move the card toward the zero point, until the card is read correctly by the subject.
11. Repeat the entire procedure using a different sight card on the subject's right side. Record the angles for motion and



Figure 1.

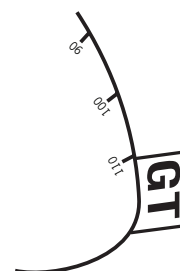


Figure 2.

reading for the right side of the visual field.

12. Switch roles and repeat steps 1–11 using a new sight card.
13. To determine the total visual field, add the left and right angles recorded for motion and for reading, respectively.

Part 2. Visual Field: Motion, Color, Reading, and Shape

14. Repeat steps 1–9 of Part 1, however, substitute color sight cards for the black-and-white reading cards.
15. The tester continues to move the sight card slowly toward the zero point until the subject can recognize the color, the letter or number, or the shape on the card. The subject should announce the detail out loud—for example, “Square,” “Three,” or “Blue.” If correct, the tester pauses and records this angle, labeling with the letter “C” for color, the letter “R” for reading, and the letter “S” for shape. If the subject does not correctly identify a particular detail, the tester continues to move the card toward the zero point, until the detail is announced correctly by the subject.
16. The tester continues to move the sight card toward the zero point until all details of the card—color, reading, and shape (not necessarily in that order)—have been correctly identified.
17. If at any time during the test, the subject averts his eyes from the center gaze, and glances toward the card, the tester should choose a different card and place the new card at the same place the original card had reached. The procedure continues with the new card.
18. Repeat steps 14–17 on the subject’s right side, recording the angles for the right side of the visual field. Remember to use a different card.
19. Repeat steps 14–18, switching roles.
20. To determine the total visual field, add the left and right angles of correct identification for each detail—motion, color, reading, and shape.

NGSS Alignment

This laboratory activity relates to the following Next Generation Science Standards (2013):

Disciplinary Core Ideas: Middle School

MS-LS1 From Molecules to Organisms: Structures and Processes
 LS1.A: Structure and Function
 LS1.D: Information Processing

Disciplinary Core Ideas: High School

HS-LS1 From Molecules to Organisms: Structures and Processes
 LS1.A: Structure and Function

Science and Engineering Practices

Developing and using models
 Planning and carrying out investigations
 Constructing explanations and designing solutions

Crosscutting Concepts

Cause and effect
 Systems and System Models
 Structure and function

Tips

- This activity is appropriate for a unit on light and color, the nervous system, or the senses.
- Reading sight cards can be made from white index cards or cardstock. Cut the paper into 1" × 2" rectangles, and use a black marker to write two numbers or letters or a combination of a number and letter on the top half of each. See Figure 2. For color sight cards, use a colored marker to make an outline of a shape such as a triangle, square or circle, and write one letter or number in the same color inside each shape. An alternative method would be to test one variable at a time by using colored construction paper to test for color, and draw shapes on white cards to test for shape identification.
- A peripheral vision disk is available from Flinn Scientific (Catalog No. FB0057) or can be made from cardboard or sturdy cardstock (see the References below).
- Student results for color and shape will vary greatly. Color is usually detected before shape. However, this depends on the color and shape being tested. Results of testing show red is easier to detect than blue, and green is hardest to detect. Therefore, the shape of a green-colored object may be discerned before the color.

- The testing done in this activity should not be considered for diagnostic purposes, but students may be interested to know that normal range for peripheral vision is 180° when using both eyes. When using one eye, the total visual field from left to right is normally 150°. A good extension to this activity would be to repeat Part 1 with one eye covered, and again with the other eye covered.
- Research has shown that cell phone usage in an automobile severely limits use of peripheral vision, even for a period of time after the driver has stopped using the phone. Have students discuss the need for peripheral vision while driving, and debate the pros and cons of restricting cell phone usage in cars.
- Some animals have wide peripheral vision to better detect predators. Have students conduct literature research on peripheral vision in animals and compare to humans.
- This activity is available as a student laboratory kit from Flinn Scientific, Catalog No. FB1871. To further explore vision, try the “Visual Perception Activity Stations” kit (Catalog No. FB1872), which investigates depth perception, eye–hand coordination, afterimages, and peripheral vision.

Discussion

The retina, a thin tissue lining the back of the eye, contains specialized nerve cells, called *photoreceptors*, that are sensitive to light. The two different photoreceptors are known as *rods* and *cones*, so named because of their shapes. Rods are more numerous (over 120 million) compared to cones and are more concentrated around the *periphery* (outside edges) of the retina (see Figure 3). They are more sensitive to light than cones and help us see in dim light. Rods are not sensitive to color, however, which is why it is difficult to distinguish colors in a dark room. Rods are very good at detecting motion. A moving object can usually be detected in the peripheral vision before the object can be clearly identified.

Although cone receptors are found throughout the retina, the center of the retina, the *macula*, has a much higher density of cones than the periphery. In the center of the macula is the *fovea*—a densely packed area of cones with no rods (see Figure 3). Cones are responsible for color vision. Even though the eye has fewer cone receptors (6–7 million) than rod receptors, cones are vital to our central vision and the ability to see fine details. Cones are used primarily when we read. Try focusing on a letter in the middle of a word in a sentence and see how many other words you can read to the right or left without moving your eyes.

When one looks at something directly, the image is focused on the macula. When something is seen out of the corner of the eye, the image is focused on the periphery of the retina, where more rods and fewer cones are found.

References

“Out of Sight!” *Neuroscience for Kids*, <http://faculty.Washington.edu/chudler/neurok.html> (accessed January 2015).
Peripheral Vision, http://www.exploratorium.edu/snacks/peripheral_vision/index.html (accessed January 2015).

Materials for *Seeing out of the Corner of Your Eye* are available from Flinn Scientific, Inc.

Catalog No.	Description
FB1871	Peripheral Vision—Super Value Laboratory Kit
FB1872	Visual Perception—Activity-Stations Kit

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

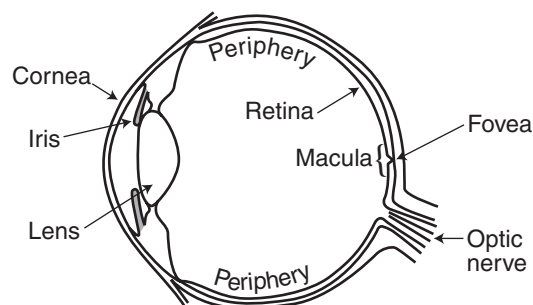


Figure 3.