

# **Two Eyes See More Than One**

#### **OBJECTIVES**

Students discover how having two eyes helps us see in three dimensions and increases our field of vision.

#### The students

- discover that each eye sees objects from a slightly different viewpoint to give us depth perception
- observe that depth perception decreases with the use of just one eye
- measure their field of vision
- observe that their field of vision decreases with the use of just one eye

#### **SCHEDULE**

**Session I** About 30 minutes

Session II About 40 minutes

#### **VOCABULARY**

depth perception field of vision peripheral vision

#### **MATERIALS**

#### For each student

- 1 Activity Sheet 2, Parts A and B
- blindfold (optional)\*

#### For each team of two

- 1 box cravons\*
- 3 cups, paper
- field of vision collar

- 1 straw
- card, index (cut in half widthwise)
- 3 pennies\*
- 1 ruler, metric\*

#### For the class

1 roll string

1 roll tape, masking

1 pair scissors\*

#### **PREPARATION**

#### **Session I**

- Make a copy of Activity Sheet 2, Part A, for each student.
- Each team of two will need a metric ruler, three paper cups, and three pennies. Students will either close or cover their eyes, or you may use blindfolds. (Students should use their own blindfold—a bandanna or long strip of cloth brought from home and stored in their science journals for use—in this and other activities.)

#### Session II

- Make a copy of Activity Sheet 2, Part B, for each student.
- 2 For each team, cut a length of string 50 cm (about 20 in.) long. Cut enough index cards in half (widthwise) to give each team half a card. Snip the corners of the cards to eliminate sharp edges.
- Each team of two will need a field of vision collar, a length of string, a straw, half an index card, and a 2-in. piece of masking tape.

<sup>\*</sup>provided by the teacher

#### **BACKGROUND INFORMATION**

Human beings have two eyes located about 6 cm (about 2.4 in.) apart. Each eye sees the world from a slightly different viewpoint, or angle, and sends its own set of signals to the brain. The brain combines these signals into one composite image that has depth to it. Two images combined into one gives us **depth perception**, the ability to judge how far away an object is. Depth perception enables us to see the world in three dimensions instead of two.

Our *field of vision* includes everything we can see at any given moment without moving our eyes. When we look straight ahead, our field of vision encompasses a roughly circular region from shoulder to shoulder, forehead to waist. Moving our eyes or turning our head changes what we see but does not enlarge our field of vision.

**Peripheral vision** is the outer edges of our field of vision. It enables us to see something without looking directly at it. Peripheral vision is what we use when we see something "out of the corner of our eye."

Due to the arrangement of light-sensitive cells in the retina, our sense of sight is less acute along the periphery of our visual field. There we can detect motion, size, and shape, but not color or fine detail. But peripheral vision is important nonetheless. It helps us cross the street safely!

Depth perception is seriously compromised with the use of just one eye. That is why people who can see out of only one eye are often prohibited from driving or operating certain kinds of machinery. Likewise, our field of vision is much larger with two eyes than it is with one. In short, one eye is not simply a replacement, like a spare tire, for the other. Our eyes work together to help us negotiate our way in the world around us.

#### **▼** Activity Sheet 2, Part A

#### Two Eyes See More Than One

- 1. How far apart are your eyes? <u>about 6</u> cm
- 2. Draw a straight line from each eye to the X.
- 3. What do the two lines show?

how each eye sees the world from a different angle



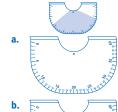
- 4. Work with a partner to drop pennies into the cups.
  - a. Using two eyes. How many pennies dropped into the cups when you used two eyes? Answers will vary.
  - b. Predict. Predict how many pennies will drop into the cups when one eye is covered. Answers will vary.
  - c. Using one eye. How many pennies dropped into the cups when you used one eye? Answers will vary.
- 5. Was your depth perception better when you used one eye or two eyes? better with two eyes

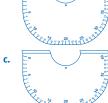
#### **▼** Activity Sheet 2, Part B

#### Two Eyes See More Than One

- 6. Measure your field of vision. Your partner will record your test results below.
  - a. With both eyes open I can see the index card between <u>Varies</u> and <u>Varies</u>.
  - b. With my left eye closed
    I can see the index card
    between <u>Varies</u>
    and <u>Varies</u>
  - c. With my right eye closed
    I can see the index card
    between <u>Varies</u>
    and <u>Varies</u>.

7. Now color in the diagrams to show your field of vision in each test, like this:





- 8. Is your field of vision larger with one eye or with two eyes? larger with two eyes
- 9. How does your peripheral vision help you stay safe?

  Peripheral vision lets us see things, like a moving car, out of the corner of our eye.

#### **Session I**

Divide the class into teams of two. Distribute a copy of **Activity Sheet 2, Part A,** to each student and a ruler to each team. Have students work together to measure the distance between their eyes.

Ask, How far apart are your eyes?

Tell students to record this measurement on question 1 of their activity sheet.

Draw an X on the board. Tell students to hold out their thumb at arm's length, close one eye, and line up their thumb with the X.
Then tell students to switch eyes. Ask, What happens when you switch eyes?

#### Ask, Has your thumb moved?

Explain that because our eyes are about 6 cm apart, each eye looks at the thumb from a slightly different viewpoint, or angle (see Figure 2-1). Switching eyes changes the angle from which the thumb is viewed, revealing the X behind the thumb. Tell students to complete questions 2 and 3 on their activity sheet.

Ask, If each eye sees things from a different angle, why don't we see double?

#### **Additional Information**

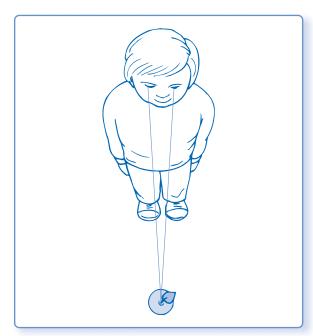
**Safety Note:** Encourage students to exercise caution when using the ruler around the eyes.

Tell students to hold the ruler flat against the tip of their nose (not in front of their eyes) while their partner looks at the ruler to see the distance from pupil to pupil.

Students should find that their eyes are about 6 cm (2.4 in.) apart, or a little less.

Students should notice that their thumb appears to "jump," or change positions. It no longer aligns with the X.

no



▲ Figure 2-1. At about 6 cm apart, each eye views the world from a slightly different angle.

Students may suspect that the brain has something to do with combining the images. Accept all reasonable answers.

Explain that when we look at an object with two eyes, each eye sends a set of signals to the brain. The brain combines the signals to form one image.

Ask, Why do we need two eyes?

Tell students that one eye is not simply a replacement for the other. Our eyes work together to help us see better. They will learn how in the next exercise.

Students will probably say yes.

case one gets injured.

**Additional Information** 

Students may suggest that two are needed in

Distribute three paper cups and three pennies to each team. Ask students, **Do you think you could direct your partner's hand to drop a penny into each cup with his or her eyes closed?** 

With the help of a student volunteer, demonstrate how to do this activity, as follows:

- a) Place the cups on a desk or work table and sit about 4 feet away on one side of your student partner.
- b) Give the student a penny to hold, and tell the student to close his or her eyes (or use a blindfold).
- c) Using only verbal commands (such as "to your left/right" or "forward/backward"), direct the student's hand so that the penny is over the cup closest to you. When you think that the penny is above the cup, say "Now," and have the student drop the penny (see Figure 2-2).
- d) Do the same for the second and third cups.

Tell students that they are to give directions for dropping the pennies first with both eyes open, then with one eye closed or lightly covered. (Students can also use their hand or a blindfold to cover one eye.) When they have finished, students should trade places with their partner and repeat the activity.

Have students begin. Tell them to answer question 4 on the activity sheet as they work.



▲ Figure 2-2. Testing depth perception.

After all students have had an opportunity to test their abilities, ask, Did more pennies drop in the cup when you used two eyes to give directions or when you used one?

Explain that having two eyes that view the world from different angles allows us to judge distance, or tell how far away something is. Write the term *depth perception* on the board. The ability to judge distance is called **depth perception**. Have students answer question 5 on their activity sheet.

Tell students that in Session II they will learn more about how our two eyes work together to help us see more.

Collect the cups and pennies, and return them to the kit.

#### **Session II**

Draw another X on the board. Tell students to look directly at the X but to concentrate on everything they can see around the X.

Write the term *field of vision* on the board and read it aloud. Tell students that their **field of vision** includes everything they can see without moving their eyes or head.

Ask, How big is your field of vision?

Ask, What does it mean to see something "out of the corner of your eye"?

Write the term *peripheral vision* on the board and read it aloud. Tell students that **peripheral vision** is the ability to see something "out of the corner of your eye," or along the edges of your field of vision.

Inform students that they are going to test their peripheral vision—first with both eyes, and then with just one—to determine the size of their field of vision.

#### **Additional Information**

Two. Students probably found that they misjudged the distance of the cups when viewing them with just one eye.

Most people's field of vision covers an area that ranges from shoulder to shoulder, forehead to waist.

Students should be familiar with the phrase. It means to see something along the edges of your field of vision.

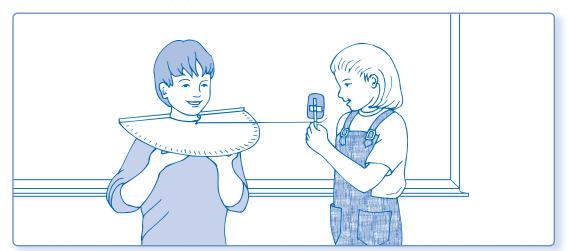
#### **Additional Information**

Divide the class into teams of two. Distribute a copy of **Activity Sheet 2**, **Part B**, to each student.

Tell students that each team is going to assemble a special "collar," which they will use to measure their field of vision.

Show students how to assemble the collar, as follows (see Figure 2-3):

- a) Tie one end of the piece of string in a knot at the hole in the center of the collar neck.
- b) Tie the other end of the string to the straw.
- c) Tape the piece of index card to the end of the straw, like a lollipop.



▲ Figure 2-3. Using the field of vision collar.

Explain that one student in each team (Student A) will sit or stand looking straight ahead and wear the collar. His or her partner (Student B) will slowly move the card on the straw in a semicircle around the front of Student A, beginning with the string resting on number 1 on the collar.

Student A will tell Student B when the index card enters and when it leaves his or her view.

Student B will note the collar numbers at which this occurs (for example, 3 and 25) and record them in the left-hand column on

Student A should support the collar from underneath with his or her hands, so that it is parallel to the floor.

You may want to have a student volunteer help you demonstrate the procedure.

Student A's activity sheet. That range of numbers represents Student A's field of vision. (In this example, student A's peripheral vision ends before 3 and after 25.)

Students should repeat the test two more times: first with the left eye covered, then with the right eye covered. (If necessary, invite students to use blindfolds to cover one eye; their hands will then be free to support the collar.) Again, Student B will record the range of collar numbers on Student A's activity sheet.

Then, have students switch places and measure Student B's field of vision.

When all teams have finished testing, tell students to use their own test results to complete the diagrams in the right-hand column on their activity sheet. Then ask, Is your field of vision larger with one eye or with two?

Finally, ask, How does peripheral vision help keep you safe?

Have students complete their activity sheets.

#### **Additional Information**

**Safety Note:** Remind students not to press their hand tightly over the eye to cover it, but to cup their hand loosely over the eye.

From the information in their diagrams, students should conclude that their field of vision is larger with two eyes.

Peripheral vision keeps you aware of what is going on around you without your having to look directly from side to side all the time.

## REINFORCEMENT

Have students examine the bulletin board they made in Activity 1. Ask them to note the location of the eyes on each animal's head. How does the location of the eyes affect each animal's vision? Which animals probably have a large field of vision? A small field of vision? Which animals probably have good depth perception? Poor depth perception?

## **S**CIENCE JOURNALS

Have students place their completed activity sheets in their science journals.

## CLEANUP

Return the field of vision collars, along with the string and tape, to the kit. (You could use the collars as part of an optometry exhibit for the school fair, along with an eye chart, color blindness cards, and other simple vision test materials.) Collect the boxes of crayons. Have students store their blindfolds in their science journals.

## SCIENCE AT HOME

What are some of the indoor and outdoor games that students play at home? Tell students to close or cover one eye the next time they play checkers, hopscotch, shoot basketballs, and so on. Ask students to describe what it is like to play the games using just one eye. Is it harder? Why?

#### Connections

#### **Science Challenge**

Give students the following instructions for another way to measure their field of vision: Hold your arms straight out from your sides. Look straight ahead, and wiggle your thumbs. Slowly bring both arms forward until you can see both thumbs wiggling. Now close your right eye and bring your right arm forward until you can see the thumb wiggling. Open your right eye and hold your right arm in place. Close your left eye and bring your left arm forward until you can see that thumb wiggling. Draw a picture of the three fields of vision you tested—one picture for your right eye, one for your left eye, and one for both eyes together. What does the picture show? (The field of vision is much larger for both eyes together than it is for either eye separately.)

#### **Science Extension**

- ► Have students repeat the field of vision test, but this time have them write a word or draw a colored shape on the index card. Students will discover that their vision is less acute along the edges than in the middle of their visual field. That is, they are less able to identify what is written or drawn on the card.
- Invite students to examine again the "animal eyes" bulletin board display they made in Activity 1. Ask students to identify each animal as a predator (an animal that hunts and eats other animals) or a prey animal (one that is hunted and eaten). Lead students to realize that predators need to judge distance and depth in order to hunt and catch other animals successfully, so their eyes generally are on the front of the head, like humans' eyes. On the other hand, prey animals need to see all around them so they can escape predators coming from different directions, so their eyes are on the side of the head. (Also see the

Science and Language Arts connection.)

To demonstrate the effect of the eyes' overlapping fields of vision in an amusing way, have each student roll a sheet of paper into a long tube about 2.5 cm wide. Tell students to keep both eyes open, look through the tube with their right eye, and hold their left hand next to the far end of the tube, with their palm facing the left eye. Students will see an apparent hole in their left hand. Ask them to explain this illusion. (The brain combines the two images—the hole seen with the right eye and the hand seen with the left eye—into one image.)

#### **Science and Language Arts**

Provide age-appropriate books about animal vision to read to small groups or for students to read independently. Eyeopeners!: All About Animal Vision by Monika and Hans D. Dossenbach explains how animals have eyes that are specially adapted to their environments. The book provides close-up photographs of animal eyes and tells how animals use their eyes to survive.

### Science, Technology, and Society

Explain that many years ago, before radio and television, stereoscopes were a popular form of home entertainment. A stereoscope lets you see pictures in three dimensions by using two photographs taken from slightly different viewpoints. Students may recognize today's version of the stereoscope —a View-Master®, the children's toy that uses pairs of photographs on a disc inserted into a viewer. Obtain one of these toys for students to try.