

Is Seeing Believing?

OBJECTIVES

Students view optical illusions of size, shape, color, and motion.

The students

- ▶ make predictions about optical illusions of size and shape, and then measure for accuracy
- ▶ observe the effect of background color on colored squares
- ▶ examine a printed color picture with a magnifier
- ▶ make a flip book and use it to create the illusion of motion

SCHEDULE

Session I About 20 minutes

Session II About 30 minutes

Session III About 30 minutes

VOCABULARY

optical illusion

MATERIALS

For each student

- 1 Activity Sheet 4, Parts A–C
- 1 newspaper color comics frame*
- 1 ruler, metric*
- 1 pair scissors*

For each team of two

- 1 box crayons*
- 1 magnifier

For the class

- 1 btl glue, white
- 1 sheet paper, construction, black
- 1 sheet paper, construction, light gray
- 1 sheet paper, white*
- 2 shts paper, construction, dark gray
- 2 shts paper, construction, light gray
- 2 shts paper, construction, medium gray
- 1 stapler*
- 1 roll tape, transparent*

*provided by the teacher

PREPARATION

Session I

- 1 Make a copy of Activity Sheet 4, Part A, for each student.
- 2 Before class, draw Figure 4-1 on the board. Use a ruler to make sure that both horizontal lines are exactly the same length.
- 3 Each student will need a ruler.

Session II

- 1 Make a copy of Activity Sheet 4, Part B, for each student.
- 2 Cut two squares (each about 2 inches square) from a sheet of light gray construction paper. Before class, tape one gray square to the middle of a sheet of black construction paper. Then tape an identical gray square to the middle of a sheet of white paper.
- 3 Cut the sheets of light, medium, and dark gray construction paper into 2-in. squares. Each student will need one square of each shade.

- 4 Have each student bring in a color comic strip from a newspaper. Have extra comics on hand for students who forget to bring theirs. (Weekend editions usually contain color comics.)
- 5 You will need a sheet of black paper and a sheet of white paper, each with a light gray square taped in the middle. Each student will need a pair of scissors, some glue or tape, a magnifier, and a color comic frame from a newspaper. Each team of two will need a box of crayons.

Session III

- 1 Make a copy of Activity Sheet 4, Part C, for each student.
- 2 Each student will need a pair of scissors. You will need a stapler to fasten the pages of each student's flip book.

BACKGROUND INFORMATION

Human beings rely heavily on the sense of sight to take in information about the world. Sometimes, however, things are not what they seem to our brain to be, but are instead illusions. An illusion is a false perception—something that appears to be different from what it really is. An **optical illusion** is an illusion involving vision.

There are different types of optical illusions. Some involve size or shape. For example, some lines can make other lines appear longer, shorter, straighter, or more crooked than they really are. So too shapes can appear larger or smaller than they are. Sometimes the background and foreground of a picture can appear to change places, dramatically altering our perception of the image.

There are also illusions of color. The same color can appear lighter or darker, depending on the color that surrounds it. We see another common color illusion every time we look at a printed picture or

watch television: Our brain blends together tiny dots of different colors, creating the illusion of one solid color. The dots can be seen upon closer inspection with a magnifier.

There are also illusions of motion. When a series of images moves faster than our eyes can receive them or our brain can process the information, the images blend together to give the illusion of one image in motion. We experience this phenomenon every time we watch a movie.

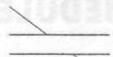
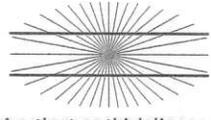
In this activity, students will view several different kinds of optical illusions and in doing so, learn that seeing is not always believing.

▼ Activity Sheet 4, Part A

Is Seeing Believing?

Illusions of Shape and Size

Look at each picture. Answer the question. Then use a ruler to check your answer.

 <p>1. Which line is longer? the vertical line</p>	 <p>2. If the two slanted lines were connected, would they form one straight line? yes</p>
 <p>3. Are the two thick lines straight or curved? straight</p>	 <p>4. Is the top line wider than the bottom line? Both are the same.</p>
 <p>5. Are the middle circles the same size? yes</p>	 <p>6. Do you see a candle or two faces? (You do not need a ruler for this picture.) Either answer is correct.</p>

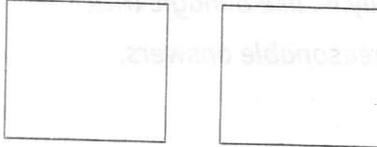
▼ Activity Sheet 4, Part B

Is Seeing Believing?

Illusions of Color

Glue one dark colored square and one light colored square in the spaces below.
Cut two small squares from the medium colored paper.
Glue the small squares on top of the large squares.

7. Compare the colors of the small squares. Do they look the same? no



8. Colors look darker when the background is light.
9. Colors look lighter when the background is dark.
10. Look at your picture. What is it a picture of? varies

11. List all the colors you see in the picture.
Answers will vary.

12. Glue or tape part of the picture in the box on the left. Circle a small section and look at it closely with a magnifier. Draw what it looks like in the box on the right.

Newspaper color comics frame should be cut and adhered here.

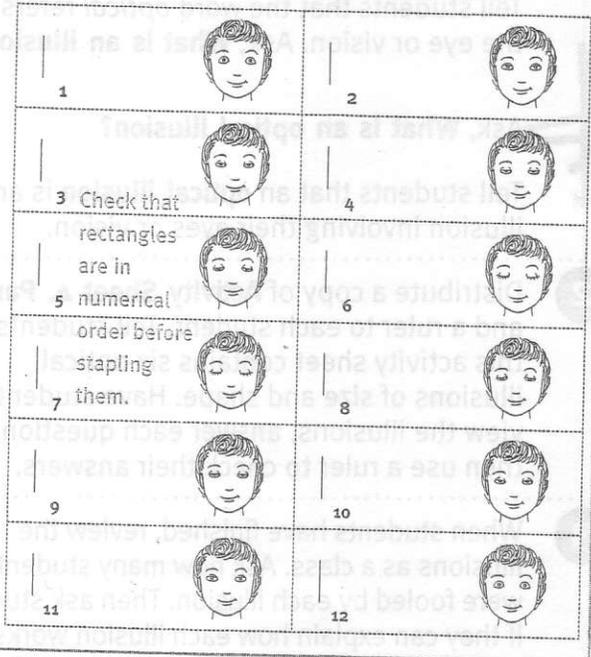
Drawings should include different-color, different-size dots.

▼ Activity Sheet 4, Part C

Is Seeing Believing?

Illusions of Motion

Cut along the dotted lines.
Place the rectangles in order, with 1 on top and 12 on the bottom.
Your teacher will staple the squares to make a little book.



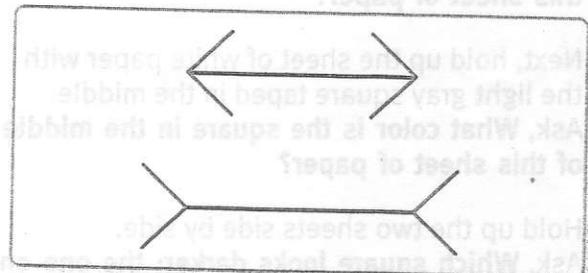
Guiding the Activity

Session I

- 1 Bring students' attention to the figure you have drawn on the board (see Figure 4-1). Ask students, Which horizontal line is longer: the top one or the bottom one?

Just show this picture.

Students should perceive the bottom line as longer.



▲ Figure 4-1. In this optical illusion, two lines of equal length appear unequal.

Ask a student volunteer to come to the board and measure both horizontal lines with a ruler. When the student has finished, ask, Which line is longer?

Students may be surprised to learn that the lines are the same length.

Guiding the Activity

Explain that this diagram is an example of an optical illusion. Write the term on the board. Tell students that the word *optical* refers to the eye or vision. Ask, **What is an illusion?**

Ask, **What is an optical illusion?**

Tell students that an **optical illusion** is an illusion involving their eyes or vision.

2 Distribute a copy of **Activity Sheet 4, Part A**, and a ruler to each student. Tell students that this activity sheet contains six optical illusions of size and shape. Have students view the illusions, answer each question, and then use a ruler to check their answers.

3 When students have finished, review the illusions as a class. Ask how many students were fooled by each illusion. Then ask students if they can explain how each illusion works.

Finally, challenge students to create some optical illusions of their own on the back of their activity sheet.

Session II

4 Hold up a sheet of black paper with a light gray square taped in the middle (see the Preparation for Session II). Ask students, **What color is the square in the middle of this sheet of paper?**

Next, hold up the sheet of white paper with the light gray square taped in the middle. Ask, **What color is the square in the middle of this sheet of paper?**

Hold up the two sheets side by side. Ask, **Which square looks darker: the one on black paper or the one on white paper?**

Remove the square from one of the sheets and tape it to the other, so that both gray squares are on the same sheet. Ask, **Which square is darker?**

Additional Information

something that appears to be different from what it really is, like a magic trick

Accept all reasonable answers.

You can draw some of the better ones on the board, or photocopy each student's work and make a class booklet of optical illusions.

Against the black background, the gray square should look white.

Against the white background, the square should look gray.

The square on white paper should look darker.

Students will probably be surprised to discover that the squares are the same color.

Guiding the Activity

Tell students that just as there are optical illusions of size and shape, so are there illusions involving color. Ask, **What made the small squares appear to be different colors?**

- 5 Distribute a copy of **Activity Sheet 4, Part B**, three 2-in. squares of colored construction paper (one dark, one light, and one medium gray), a pair of scissors, and some glue to each student.

Tell students to glue one light-color and one dark-color square to their activity sheet. Then have them cut two smaller squares from the medium-color paper and glue one small square to the middle of each large square (see Figure 4-2).

When students have finished, ask them to study their colored squares and answer questions 7 through 9 on the activity sheet. To review their conclusions, ask, **What effect does background color have on the color of the small squares?**

- 6 Tell students that there is another illusion of color that tricks their eyes every time they look at pictures in a newspaper, magazine, or book.

Have students retrieve the color comic strips they have clipped from a newspaper. Ask students to identify the subject of their picture and to name some of the colors they see. Tell them to record their observations on their activity sheet.

- 7 Divide the class into teams of two. Distribute a magnifier and a box of crayons to each team. Ask students to look more closely at their picture with a magnifier. Ask, **What do you see now?**

Ask, **How many different colors of dots do you see?**

Additional Information

the background that surrounded them



▲ *Figure 4-2. Using light and dark backgrounds to create an optical illusion of color.*

Students should conclude that a color looks lighter on a dark background, and darker on a light background.

Students should be able to see dots of color.

Students should be able to distinguish five colors: red, blue, yellow, white, and black dots. Dots that overlap may appear to mix and form secondary colors—green, purple, orange, and so on.

Guiding the Activity

Ask, **Are the dots all the same size?**

Ask, **What do you notice about the areas where the dots are small?**

Ask students to trim their comic and tape or glue one frame in the left-hand box in question 12. Then have students circle a detail in their picture, study the circled area with a magnifier, and draw what they see in the box to the right of their picture.

When students have finished, ask, **Why don't we notice these dots when we look at pictures in newspapers and magazines?**

Collect the crayons and return the magnifiers to the kit.

Session III

8 Ask students, **Do you like to watch cartoons? Do you know how cartoons are made?**

Ask, **How do the artists make the characters in their drawings look as though they are moving?**

9 Distribute a copy of **Activity Sheet 4, Part C**, and a pair of scissors to each student. Tell students to cut out the rectangles along the dotted lines, then place them in order, with rectangle 1 on top and rectangle 12 on the bottom.

Staple the left-hand side of each student's pile of rectangles to make a booklet (see Figure 4-3). Doublecheck that rectangles are in numerical order before stapling them together.

Demonstrate for students how to "fan" the pages of the booklet. Then have students try it.

Additional Information

No. Some dots are larger than others.

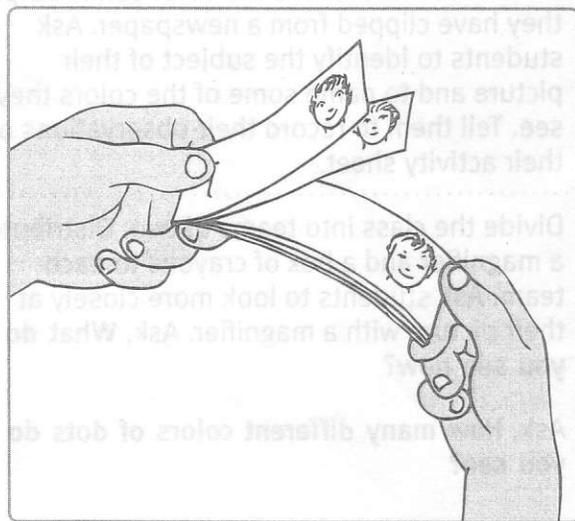
There is more white space between dots that are small. As a result, these tend to be the lighter areas in the picture.

Students' drawings should consist of a series of different-color, different-size dots—primarily in red, blue, yellow, and black.

Because the dots of color are so small and so close together, they appear to blend, forming solid regions of light and dark colors that our brain interprets as a picture.

Some students may know that animated cartoons are made of a series of individual "still" drawings.

Students may suspect that it is an optical illusion, but probably do not know how it works. Accept all answers.



▲ **Figure 4-3.** Fanning the pages of a flip book to create the illusion of motion.

Guiding the Activity

- 10 After students have had an opportunity to play with their flip books, ask, **What did you notice when you fanned the pages of your book?**

Tell students that they have just created an optical illusion of motion, similar to what they experience when they watch cartoons on television. Ask, **How can still pictures be made to appear that they are moving?**

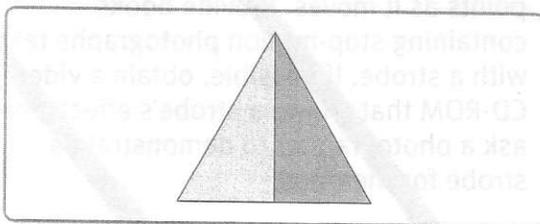
Additional Information

The eyes in the pictures appeared to blink.

When a series of pictures is flashed before our eyes in rapid succession, the pictures appear to blend together to give the illusion of one image in motion. (Students may be interested to know that movies used to be called "moving picture shows." Today they are still referred to as "motion pictures.")

REINFORCEMENT

Ask students what they think will happen if they combine the illusions of shape, color, and motion. Have them try it by cutting out a triangle from a piece of white paper, coloring half of the triangle blue and the other half red, then poking a pencil through the middle of the triangle and spinning it like a top. What happens to the shape of the spinning paper? What happens to the colors? Why?



SCIENCE JOURNALS

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

CLEANUP

Collect the boxes of crayons. Have students store their flip books in their science journals with their activity sheets.

SCIENCE AT HOME

Ask students if they have ever made or seen shadow puppets. Tell students that shadow puppets are simple illusions of light and shadow. Students can make their own shadow puppets at home by shining a flashlight on a blank wall in a darkened room and positioning their hands in front of the beam of light. Challenge them to invent three different shadow puppet characters. You can then have students present them to the class or even put on a shadow puppet show.