# Chapter 12 Lenses and Lens Technologies

## What You Will Learn

In this chapter, you will learn how to...

- **describe** the characteristics of images formed by lenses
- **identify** ways in which lenses are used in optical instruments, such as microscopes
- **describe** a technological device and a procedure that use the properties of light

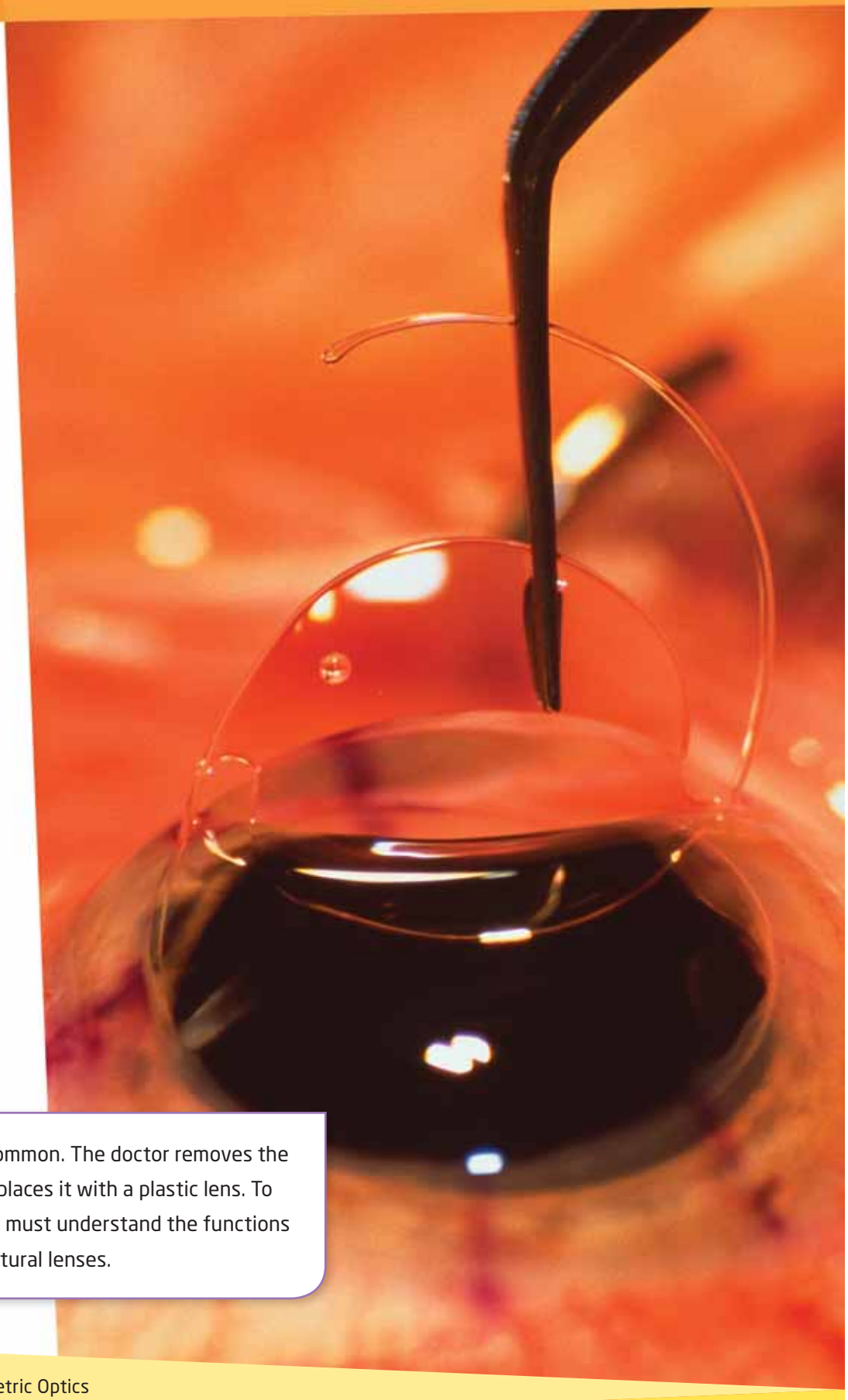
## Why It Matters

Many everyday devices require lenses, such as eyeglasses. By understanding how lenses work, you will be able to appreciate how they contribute to your everyday life.

## Skills You Will Use

In this chapter, you will learn how to...

- **predict** the characteristics of images formed by lenses using ray diagrams and algebraic equations
- **predict** the characteristics of images produced by converging lenses and **test** your predictions through inquiry
- **analyze** and **evaluate** the effectiveness of a technological procedure related to human sight
- **evaluate** the benefits to society of a technological device that uses properties of light



Cataract eye surgery is very common. The doctor removes the clouded lens of the eye and replaces it with a plastic lens. To perfect the procedure, doctors must understand the functions of the eye and artificial and natural lenses.

# Activity 12-1

## The Disappearing Finger

Your eyes are relatively sensitive to seeing objects and detecting movement at the edge of your vision. Can you determine the sensitivity of your eyes yourself? In this activity, you will estimate your field of view.

While looking at a distant object, cover your right eye with your left hand.

### Procedure

1. Look straight ahead, and focus on a distant object.
2. Cover your right eye with your left hand. Extend your right arm sideways.
3. While continuing to stare straight ahead, wiggle the centre finger on your right hand. Keeping your arm outstretched, slowly move your arm forward until you can just see your finger.
4. Keep your head position fixed, and move your left eye toward the wiggling finger. Record your observations.
5. Ask another student to estimate the angle between your head (think of your nose as a normal) and your outstretched arm. Record this angle.
6. Repeat steps 1 to 5, making the appropriate changes, to investigate your vision in your right eye.

### Questions

1. Explain the observations you recorded in step 4.
2. When looking ahead, what is your approximate field of view, expressed as an angle?

# Study Toolkit

These strategies will help you use this textbook to develop your understanding of science concepts and skills.
To find out more about these and other strategies, refer to the Study Toolkit Overview, which begins on page 560.

Reading Effectively

## Making Connections to Prior Knowledge

You may already know some facts about lenses and the human eye from your own experiences, from reading other texts, or from the media. This prior knowledge can help you understand new information in this chapter. As you read, ask yourself these questions:

- What personal experience does this remind me of? (connect text to self)
  Example: My glasses help things at a distance come into focus.
- What have I read about this before? (connect text to text)
  Example: I read an article about athletes having laser eye surgery.
- What are some new developments in vision correction? (connect text to world)
  Example: On the news, I heard about contact lenses that dispense medication for eye diseases while also correcting vision.

### Use the Strategy

Read the first two paragraphs on page 487. Make some connections to your prior knowledge about lenses. Draw a **concept map** to show the connections.

Organizing Your Learning

## Using Graphic Organizers

Different graphic organizers can be used for different purposes, as shown in the table below.

**Uses for Different Graphic Organizers**

| Purpose | Possible Graphic Organizers | Pages Where Sample Is Shown |
|---|---|---|
| To organize main ideas and supporting details | **Web, chart, spider map** | 565-566 |
| To show cause and effect, steps in a process, or a sequence | **Cause-and-effect map, web, flowchart** | 565-566 |
| To compare and contrast | **Venn diagram** | 566 |
| To analyze a series of numbers or results | **Graph, table** | 556, 545 |

### Use the Strategy

Read the text about Galileo's telescope and Kepler's telescope on page 502. Identify the main ideas and record them using a graphic organizer of your choice. Compare your completed graphic organizer with that of a classmate. Which one helps you understand and remember the information better? Why?

Word Study

## Word Families

A word family is a group of words that share a common element. For example, the words in the table on the right all have the ending *-opia*, meaning a condition related to sight. Recognizing word families can help you grasp the meanings of similar words.

### Use the Strategy

Make a table like the one on the right. Find three more words in the *-opia* word family, and add them to the table.

**Words Sharing the Ending *-opia***

| Word | Combining Part | Common Element | Definition of the Whole Word |
|---|---|---|---|
| myopia | my | *opia* | Near-sightedness |
| hyperopia | hyper | *opia* | Far-sightedness |
| presbyopia | presby | *opia* | Condition in which lenses of the eye become stiff and the muscles can no longer make the lenses change shape |