Chapter 12 Lenses and Lens Technologies

Materials

Please see the teaching notes for each activity for a list of the materials required. Please see page TR-31 for a summary of the materials required in this chapter and other chapters.

Advance Preparation

- Gather different concave and convex lenses with holders, magnifying glasses, light sources (light bulbs or candles), small objects, protractors, cardboard tubes (optional), coloured pencils (optional), metric rulers, measuring tapes, and metre sticks.
- Students can review the Key Terms in Chapter 12 using **BLM 12-1 Chapter 12 Key Terms.**
- Reserve the resource centre for research on laser eye surgery.

In this chapter, students will examine both the physics related to lenses, and some of the technologies we have developed that use lenses. They will also examine the operation of the high-tech devices involving lenses, and how we have used these technological devices to overcome weaknesses in our eyes.

Using the Chapter Opener (Student textbook pages 484 and 485)

- Tell students that the photo shows a common operation called cataract surgery. Ask students how long they think it has been since people were first able to have cataract surgery. One clue is that the ancient Egyptian Code of Hammurabi (the earliest known code of laws) describes the amount doctors should be paid for a successful surgery—about a year's wages for an average labourer if the doctor restores the sight of a "gentleman," but only a 10th as much for a slave. Evidence from the period suggests that these operations were done with either bronze or stone knives, while the patient was fully awake.
- A cataract occurs when the lens of the eye (the part that focuses light and allows light entry into the eyeball) becomes cloudy. This happens for the same reason that clear plastic clouds: aging caused by ultraviolet radiation and oxidization. Originally cataract surgery just replaced the old lens with another clear medium with the right shape to focus light on the retina.

Alternative Context

- Ask students if they think it is possible to use ice to start a fire. In theory, you could make a lens using a very clear ice and focus the rays of the Sun with it, thus creating a fire. You can demonstrate the idea by focusing sunlight through a lens onto dried grass. As an extension, challenge students to find a way to freeze water into a clear lens that can focus the Sun's rays well enough to char paper. Students can also practise shaping the lens. This might make an interesting long-term investigation.

Activity 12-1 The Disappearing Finger (Student textbook page 485)

Pedagogical Purpose

This activity lets students test the range of their peripheral vision and also their own eyesight. It also is a good example of the limits of the eye as an optical device.

Planning	
Materials	Oversized protractor (optional)
Time	5 min

Background

The limiting factor here is that the light has to reach from the finger into the lens of the eye and be refracted far enough that it will land on the photosensitive parts of the retina. With both eyes focussed ahead, typical field of vision encompasses about a 90° arc. Moving the eyes far left and right, with the head stationary, typical field of vision encompasses about a 200° arc.

Activity Notes and Troubleshooting

- This activity could take place individually, as students enter the class.
- If assigned as homework, a family member can help find a way to measure the angle.
- The math or physics department may have an oversized protractor to help students measure the angle. Alternatively, have a group of students create a protractor on flipchart paper that students can stand on.
- To wrap up, collate students' results to develop a class average. Identify and account for any outliers in the data.
- Extension—Have students design a carnival game for the school fair that makes use of what they learned. For example, players could have to identify an object in the periphery, or a "magician" could guess objects he cannot "see" by placing them at the extremity of the field of view.

Additional Support

- DI This is a spatial and bodily-kinesthetic learning experience.
- A separate object (not a hand) could be moved around the student in an arc. This adds a degree of objectivity since the observer cannot be fooled into "seeing" by their other senses. Additional checks such as identifying the object or number of fingers could be used.

Study Toolkit

Strategy	Page Reference	Additional Support
Making Connections to Prior Knowledge	As student read pages 487 or 505, have them use a concept map to make connections to prior knowledge about lenses or microscopes.	Refer students to Study Toolkit 4, in particular the section on Concept Maps on page 565 of the student textbook. They may also find **BLM G-42 Concept Map** helpful.
Using Graphic Organizers	As students read page 502, make a graphic organizer to identify main ideas about telescopes. After reading page 510, have students arrange the steps involved in night vision into a cause-and-effect map.	Refer students to Study Toolkit 4, in particular the Cause-and-Effect Map section on page 566 of the student textbook. They may also find **BLM G-45 Spider Map** and **BLM G-41 Cause-and-Effect Map** helpful.
Word Families	Have students create a table as shown on page 486, with space to add *-opia* words and information as they read. After reading page 489, have students create a new table for *converging* and *diverging*.	Refer students to pages 507 to 509 for more words in the *-opia* family (*myopia, hyperopia,* and *presbyopia*). Astigmatism also relates to vision trouble, but does not belong to the same word family. Have students suggest why (e.g., a quality problem rather than a shape problem). They may also find **BLM G-40 Word Study** helpful.