MODULE m7

How Can I Learn More About ...?

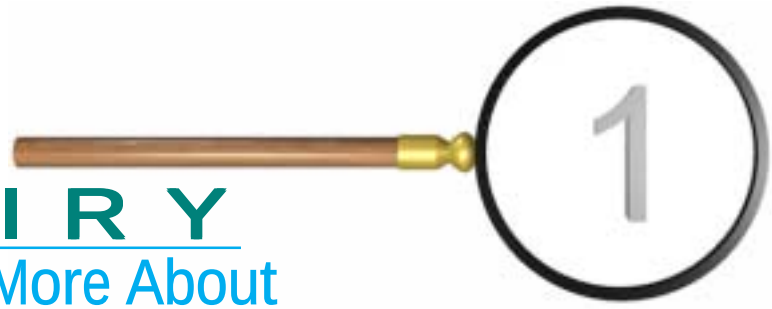
INTRODUCTION

Module 7 provides you with research ideas that may be used to encourage students to find out more about real-world applications of the concepts covered in Modules 1-6. Activities are included to encourage students to think creatively about how these concepts can be used to solve problems.

These inquiries can be used at any time during the *Science, Optics and You* unit of study. They are enhancements to the Modules; for example, Inquiry 4 could be used with Module 5, Shadows.

Inquiry 1: How Can I Learn More About Eyeglasses?
Inquiry 2: How Can I Learn More About Animal Vision?
Inquiry 3: How Can I Learn More About Telescopes?
Inquiry 4: How Can I Learn More About Eclipses?
Inquiry 5: How Can I Learn More About People in Optics?

The following interactive web-based tutorials can be used to enhance this module, explain difficult concepts, and enrich the classroom experience: Eclipse of the Moon and Solar Eclipse, Intel Play QX# Computer Microscope Simulator, and Human Vision, http://micro.magnet.fsu.edu/optics/tutorials/index.html



INQUIRY

How Can I Learn More About Eyeglasses?

Research. Using a variety of media, have groups of students research the following types of eyeglasses: traditional eyeglasses for nearsightedness and farsightedness, bifocal lenses, monocle or eye ring, lorgnette glasses, contact lenses, bifocal contact lenses, sunglasses, or pince-nez glasses. Students may come up with other types of eyeglasses to research. Encourage groups to present their findings to classmates. Models of special types of glasses like lorgnettes or jealousy glasses can be displayed.

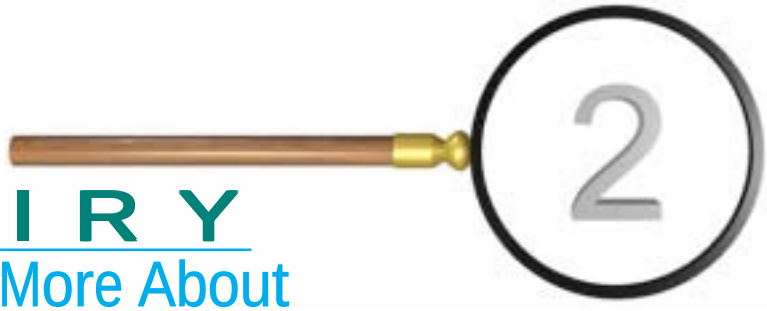
Writing, Research, Practical Applications. Have students pretend that they are visiting an eye doctor because they may need eyeglasses. While in the doctor's office they see a pamphlet that describes how the eye of a person that is near-sighted is different from the normal eye. Have students create a pamphlet that explains this information, and describes what type of lenses would be needed in glasses to correct near-sightedness (myopia).

Careers. Encourage students to conduct an interview with an optometrist or opthamologist or both. Interview questions would differ considerably based on the fact that an opthamologist has a medical degree and an optometrist is a technician.

Reading. Either read aloud, or have students read *The Eyes of Kid Midas* by Neal Shusterman (ISBN 0-812-53460-3). A young boy finds a pair of magic sunglasses that grant him every wish. He struggles with using the glasses for personal gain and must decide whether to keep the glasses or get rid of them. This is suitable for grades 4-6 and would be a good source of discussion about eyeglasses.

Inventions, History, Social Studies. Believe it or not, sunglasses are not a 20th century invention. The Inuit people used materials from their environment to fashion protective eyewear to cut down on the sun's glare. The blinding glare called "snow blindness" is caused when light reflects off snow. Items used to make these sunglasses were driftwood, deer's hooves, and baleen (whalebone).

Have students research the development of protective eyewear and invent or design a type of protective eyewear out of unusual materials found in nature.



INQUIRY

How Can I Learn More About Animal Vision?

Several of the activities that follow encourage students to research different animals and how they see, where their eyes are located, and why these animals have these special adaptations. The book, *Extraordinary Eyes: How Animals See the World*, by Sandra Sinclair (ISBN 0-8037-0806-8), is an excellent resource that students can use to provide context for their animal vision projects.

Model of the Human Eye. Research and make a model of the eye and all of its parts. Include a written description of how the eye parts work together to produce an image. Encourage students to use what they learned about lenses to design "working" models. Have them investigate materials that have the same properties as lenses, for example, clear gelatin.

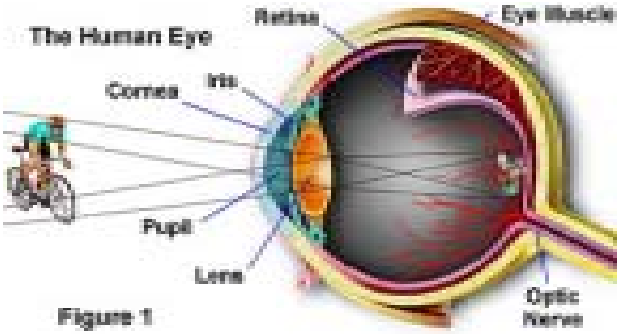


Figure 1

Vision in Animals. Some animals have eyes in different places. The position of an animal's eyes determines what it can see. Have students choose an animal that has eyes in an unusual place (for example a hammerhead shark, a starfish, a snail, or a scallop), and find out where their eyes are located and what they can see. Students report on their findings.

Art and Writing. If you could have eyes anywhere on your head, where would you put them and why? What would these new eyes help you see? Draw a picture of yourself with eyes in different places and write a short story about how these new eyes would help you see.

Binocular Vision. Humans and other animals have binocular vision. (Binocular means two eyes.) Binocular vision is also called 3-D vision. Research what would happen if you did not have two eyes. What things would change in your day to day activities? Have students write a story explaining the consequences of being able to see out of only one eye.

Mythology. The mythological creature, Cyclops, had one eye. Read to students the story of Cyclops and have them imagine what Cyclops would see as compared to what they can see with two eyes. How would having one eye affect Cyclops' vision?

Animals with Compound Eyes. Have students complete the following activity: Some animals have compound eyes. These are eyes that are made of many lenses rather than just one. Insects, spiders, and crustaceans (crabs, lobsters, shrimp, and crayfish) are examples of animals that have compound eyes. Students find out what these animals can see, and design an animal that has compound eyes. The drawing of the animal should be neat and any features that are unusual should be labeled. Encourage students to make up a name for your animal, and write a short description of where the animal lives, what it eats, and how the eyes work to help it survive in its environment.

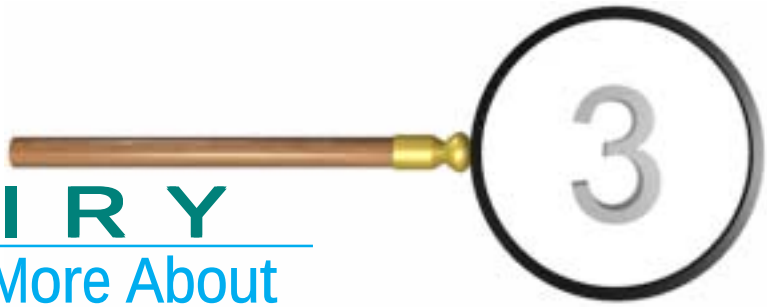
Research Color Vision. Humans and some other animals are able to see color. Students research why we can see colors. What does it mean for someone to be color-blind? What causes color-blindness? Invite a guest speaker to address the class and/or have students interview someone who is color blind and share their results with the rest of the class. Approve questions before students schedule their interviews.

Birds. Have students find pictures of birds in magazines and create "bird collages." This will provide a frame of reference with which to complete the rest of this activity. The eyes of birds are more advanced than many animals. Some can see very far distances. Students can choose a type of bird to study and draw the head and eyes of the bird. Have students compare drawings. "How are the eyes of birds that hunt for food different from the eyes of birds that eat seeds?" is one question that may be answered. List students' questions about animal eyes on chart paper, checking them off as answers are given through student presentations.

Reading. Read aloud *Silverwing* by Kenneth Oppel (ISBN 0-689-82558-7). Although this is a fictional account of a family of bats, there is a lot of information on how bats navigate, why they fly at night and not during the day and how echolocation is used. Comparisons are made between bats and other animals. This is an entertaining story that contains a great deal of information about vision.

Bats and Vision. Have students answer the following questions: Are bats really blind? How do bats gather food? Are there different kinds of bats? What kinds of bats are found in Florida? How are bats like other nocturnal animals? How are the eyes of bats like those of other nocturnal animals? Local nurseries often provide workshops on making bat houses and producing environments that will encourage bats to live there. Attending a workshop such as this and then presenting this information to the class is a way to tie classwork to real-world applications.

Careers. There are several careers that involve the study and care of eyes. Students can research or interview an ophthalmologist, an optometrist, or an optician. As a class, design a questionnaire to find out how much education is required, what they like best about their job, what they like least about their job, what the potential salary is, and other things that students might want to find out. Groups of students present their findings to the class.



INQUIRY

How Can I Learn More About Telescopes?

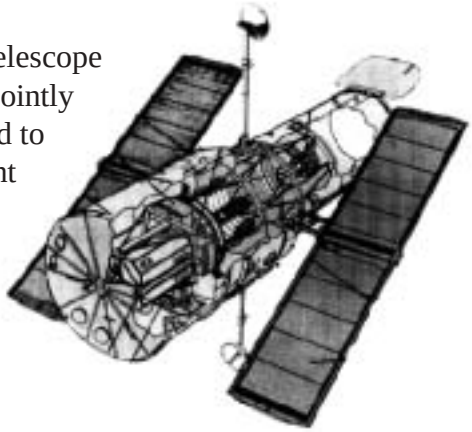
Who really invented the telescope? There is still some confusion about the first person to use a telescope. Have students work in groups, each group researching one of the following people: Galileo Galilei, Johannes Kepler, Hans Lippershey, or James Metius. Each group will share results by presenting their "case" to the class. Then have the class decide who (if anyone) they think should be given credit for inventing the telescope and why.

Students could design an instrument that summarizes their findings and asks others (parents, friends, other teachers and students) who they think the first person to use a telescope was. In addition, students discuss if it is important to give credit at all. Is it important to know *who* the first person was to use a telescope or is the invention itself the issue?

As an extension to this activity, once students have decided who they believe should get the credit, have them look in a variety of encyclopedias, textbooks, and other media and record which inventor was given credit most often.

THE HUBBLE TELESCOPE.

Current issues. At a cost of two billion dollars the Hubble telescope is the most expensive scientific instrument ever built. Built jointly by NASA and the European Space Agency, it was designed to allow astronomers to look at the universe in new and different ways. There have been problems with the telescope. Have students research the problems scientists have had with this telescope and how scientists and astronauts fixed these problems?



Writing. Set the scene with the following statement:

> *The Hubble Space Telescope just had a tune-up. Just like your car, the giant telescope that orbits Earth needs a checkup every year or two. The Hubble telescope uses instruments called gyroscopes to point it at stars and galaxies and to keep it in place while a picture is taken. It has six gyroscopes, and needs at least three working perfectly in order to point itself correctly. Recently four of the six gyroscopes broke, and had to be repaired.*

Students research how the astronauts fixed this problem and prepare a "repair journal" that includes what they would do daily during a space mission to prepare and repair the telescope. (John Grunsfeld, an astronaut on the Space Shuttle mission to Hubble kept a repair journal. Students can read his journal on the Internet.)

Working in Space. One of the difficult things about working in space is doing work with gloved hands and spacesuits. During the recent Hubble Telescope repair mission, astronauts had difficulty with the seemingly simple task of using a screwdriver to remove or tighten a screw. Have students design a task for a partner to do while they are wearing gloves. For example, students could use gardener's gloves or work gloves to simulate the gloves astronauts use to put a nut on a bolt, use a screwdriver to put a screw into a block of wood, or some other job that they may have to do. In their Science Notebooks, students write a paragraph describing what you experienced while doing this activity.

Make a Telescope. The following is a story of how Hans Lippershey (1570-1619) may have invented the first telescope. It may be true or it may be a story that has been told many times, but this is how the story is usually told. Use the story to introduce the activity.

Lippershey was handling some lenses in his shop when he happened to look through two lenses that were shaped differently. He was holding them up toward the light of the open doorway, when he was startled to see a distant church tower seem to jump to the door of his shop. He was amazed to see even the weathervane on the church spire clearly. His first idea was to use this curious effect he discovered to attract customers. He set up a display with the two lenses, so people who came to his shop could look through them and see how the church appeared to be so close. Lippershey eventually enclosed the two lenses in a tube to make what he called a looking glass.

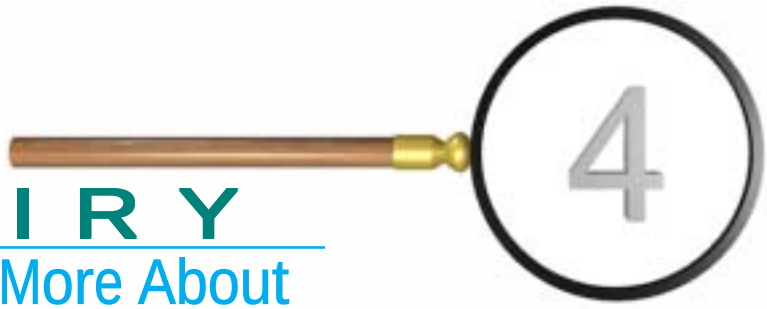
MATERIALS:

- ❑ Tape
- ❑ Scissors
- ❑ Cardboard tubes of varying diameters
- ❑ Science Notebook
- ❑ Flat pieces of cardboard that may be cut to be the "lens holders" for telescopes

1. Encourage students to experiment with the lenses in the package and two cardboard tubes of different diameters put together so that one of the tubes can move back and forth inside of the other one. (This reinforces the concepts of focal length encountered in Module 2).

2. Have students devise a way to attach the lenses at opposite ends of the tube. Encourage them to record in their Science Notebooks the type of lenses they used (the names of the lenses are on the envelopes), make diagrams of how they put together their telescope, and include instructions on how to make a home-made telescope.

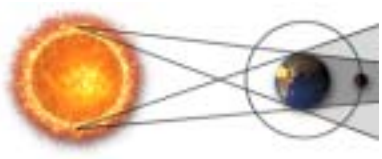
Galileo's Telescope

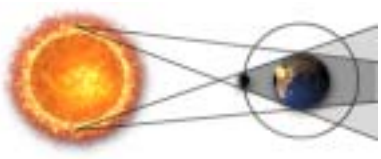


INQUIRY

How Can I Learn More About Eclipses?

What is an eclipse? The moon revolves around the earth and the earth and moon revolve around the sun. As this occurs, some of the sun's light is blocked by the moon's shadow or by the earth's shadow. When the earth's shadow falls upon the moon, a lunar eclipse occurs; conversely, when the moon's shadow falls upon the earth, a solar eclipse occurs.





These are difficult concepts to model for students particularly because we usually try to do this with light bulbs and models of Earth and the moon. Light bulbs, however, are small sources of light and the light spreads as it nears the models. A better way to demonstrate a solar eclipse, for example, would be to use a wall clock or other large circular object and a coin or other small circular object. If the clock is the sun and the coin is the moon, students can position themselves and the objects so that the coin eclipses the clock.

Activity. Encourage students to design a way to demonstrate both solar and lunar eclipses to someone who does not understand them. Having completed Modules 4 and 5, students should be able to discuss shadows, light, and clarity of images that are produced when there is a bright light source (like the sun). Challenge students to use sunlight to provide the distinct shadows they need. Have students present and explain their models to the class.

Cultural interpretations. People from many cultures have developed myths and legends about eclipses. Some believe that an eclipse is a sign of impending natural disaster such as a flood or an earthquake. Others believed that it meant the death or downfall of a ruler. The Chinese believed that an eclipse of the sun occurred because a dragon was eating the sun. As a result, the Chinese would produce great noise such as drumming and banging on pans to frighten the dragon away and to bring back the sunlight.

Have students research any myths or legends about eclipses from other cultures. For example, myths from India, China, Japan and the native cultures of North and South America. There are many Native American myths and legends that are based on solar and lunar eclipses. These are

attempts to explain to others natural occurrences. Native Americans see themselves as part of the Earth and part of nature as a whole so their stories are used to teach young and old alike about natural events and about relationships among people and people and nature. "How Coyote Was the Moon," for example, is a Kalispel story about the moon in general and it could be used to get students talking about the moon and what it looks like. *Keepers of the Earth* by Michael J. Caduto and Joseph Bruchac (ISBN 1-55591-027-0), is an excellent source for Native American myths and legends that enhance classroom science. Science activities accompany each of the stories.

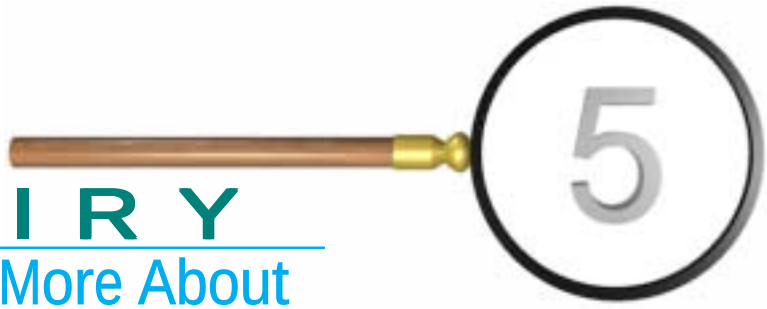
Role Play. Students design a skit or play that illustrates various cultural beliefs about eclipses. These skits could be performed for the rest of the class as they study how different cultures interpret the meaning of eclipses.

Medical research. Whenever a solar eclipse occurs, we are warned by the media and the medical community not to look directly at the sun. While looking directly at the sun is never a good idea, it is particularly harmful during a solar eclipse. Challenge students to find out why by asking the question, "Why is it harmful to look directly at the sun during an eclipse?" Encourage students to list reasons why the sun's rays are particularly concentrated, describe cases of actual damage to the eye caused by looking at the sun, and to list sources for their information. Then, have students design a way to present this information to a larger audience: the school, other classes, or the general public.

History. It is believed that Christopher Columbus used his knowledge of solar eclipses to impress West Indian natives. Because he knew when the eclipse was to occur, he was able to use this natural event to solidify his power over the native population. Discuss with students the quote "knowledge is power" and have students brainstorm and research other instances where knowledge of the natural world translates into power for those who "own" the knowledge.

Reading. Read to the students *A Connecticut Yankee in King Arthur's Court* by Mark Twain (ISBN 0553211439). This is the story of a man who travels back to the time of King Arthur. It includes an episode where he uses the knowledge of when a solar eclipse occurred to save his own life.

Writing. Obtain an almanac and provide students with a list of dates when solar eclipses occurred. Have them choose a date and then write a story in which the solar eclipse plays an important part. Use *A Connecticut Yankee in King Arthur's Court* as a guide.



INQUIRY

How Can I Learn More About People in Optics?

This is a series of suggestions for research about people who have influenced the study of optics, people who have invented instruments that have extended the study of optics, or people that have influenced the process of scientific discovery. Provided here are different ways of looking at science, discovery, and invention that could be used as the basis for research projects in your classroom. Reports, public presentations, poster sessions, computer programs, debates, skits, role-plays, and models, are appropriate ways to present student work.

Scientific discoveries usually happen as a consequence of a problem identified or a question that has been asked. However, scientists do not work in isolation and do not conduct their work outside of the realm of political and historical events. Some early scientists and inventors had direct connections to kings and courts that supported their work by providing an income, a place to live, and a way to disseminate their findings.

Galileo, for example, supported himself, his family and his extended family through an official appointment to the University of Padua and the sponsorship of the de Medici family in Florence, Italy. The political and religious climate of the times prevented Galileo from widely disseminating his writings that contradicted the popular belief of the time that the Earth was the center of the solar system. There are many stories of scientists and inventors that were either helped or hindered by the political and religious milieu in which they lived and worked.

Some discoveries are the result of serendipity – an unexpected result of an experiment or an accidental discovery or breakthrough. This is not to say that scientists wait around for something to happen. Usually, the serendipitous discoveries occur as the result of curiosity and a desire to understand how the world works. Sometimes being the right person in the right place is enough to propel a curious person into the spotlight as a discoverer, developer or inventor.

Charles Darwin, for example, is one such example. He did not organize the expedition to the Galapagos Islands; rather he was invited to join the crew on its second voyage to test a new clock that had just been invented to work on ships. As a result of his observations, curiosity, and ability to write about his adventure, he has become one of the most influential scientists of recent history.

While observing charts from a Cambridge telescope, Jocelyn Bell and Anthony Hewish discovered pulsars in 1967. They were not trying to discover pulsars since no one knew that they existed! Instead they were measuring radio emissions from stars, working with astronomers both in Great Britain and the United States, accessing different kinds of optical instruments.

Have students use a variety of media to research people that have made discoveries, invented instruments, or used instruments in new and exciting ways related to the study of light and optics. Encourage creativity and inventiveness in presentations of what students discover.

The *Science, Optics & You* Timeline in Optics, http://www.micro.magnet.fsu.edu/optics/timeline/index.html, traces important events in the science of optics and the physics of light and color from the beginning of recorded history to the present. Many of the scientists and discoveries that students will be interested in can be found on this timeline and are a good starting point for their research.