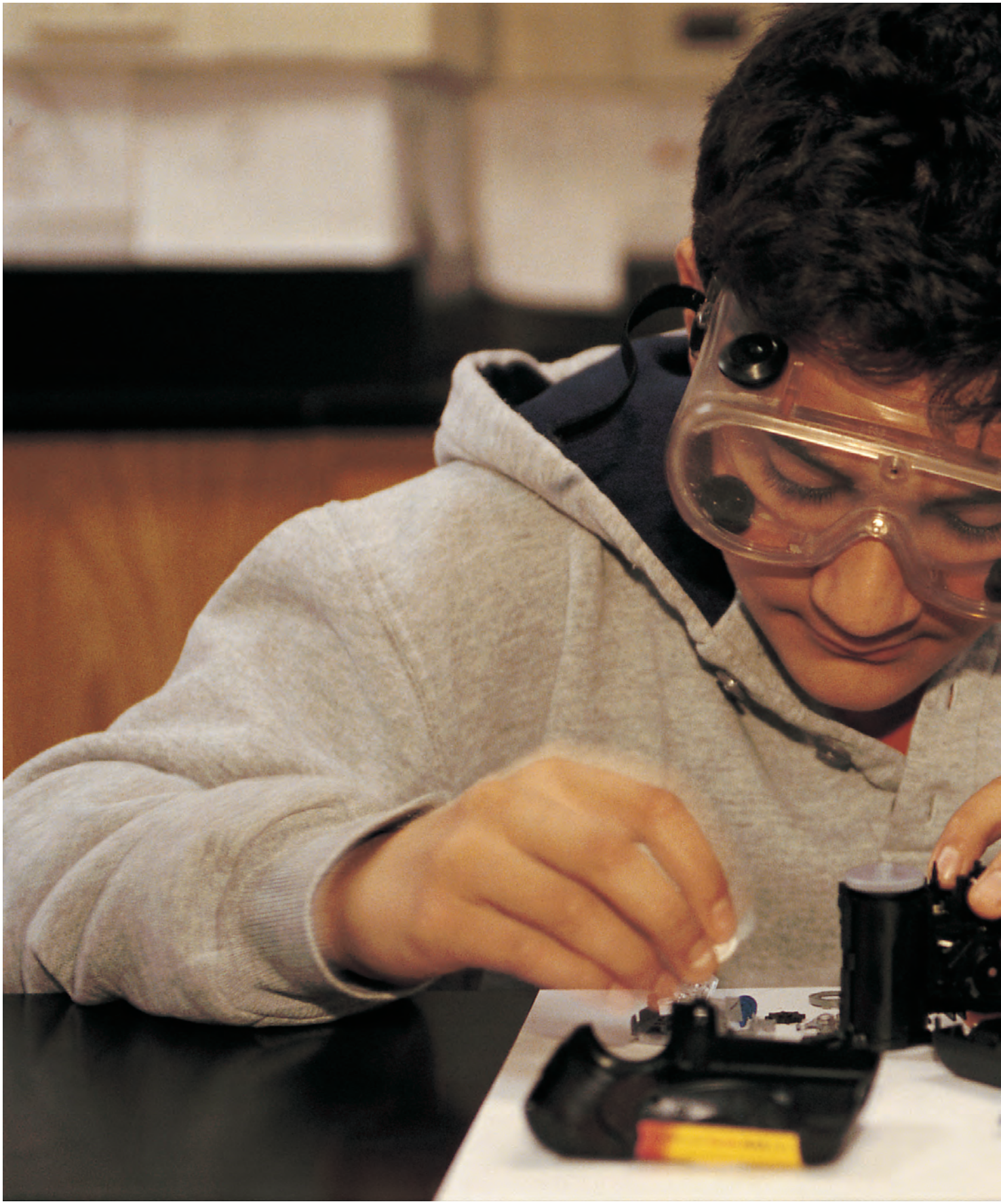

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PART 3 Using Light

LESSON 21

Starting the Anchor Activity

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What type of optical device is this student using? Can you find out how it works?

INTRODUCTION

In this lesson, you will begin the Anchor Activity. You will work on this activity over the next few weeks. What is an Anchor Activity? It is a short project that gives you the opportunity to apply what you have learned in the module to the world around you. In this Anchor Activity, you will select an optical device to examine in more detail. You will investigate what it is used for, how it works, what components are used to make it, and the history of its development. You will use the library, the Internet, and other resources to conduct your research. You will then use the information you collect to make a presentation to the class (supported by a visual aid you have made) about the optical device you select. The work you do for this Anchor Activity will be an important part of your grade for this module. You will be given several homework assignments and a small amount of class time to do this work. However, you will do most of it on your own time. At the end of the module, two to three class periods will be used for Anchor Activity presentations.

OBJECTIVES FOR THIS LESSON

Select an optical device to research.

Research the device you have chosen.

Create a visual aid to support an oral presentation about the device you have chosen.

Give an oral presentation on the device you have chosen.

Getting Started

1. What do you think is meant by the term "optical device"?

2. Share your ideas with the class.

3. Can you think of any optical devices you use? Do you know of any others? As your class compiles a list of optical devices, record the list in your science notebook.

MATERIALS FOR LESSON 21

For you

- 1 copy of Student Sheet 21.1: Looking at Optical Devices
- 1 copy of Student Sheet 21.2: Anchor Activity Schedule
- Masking tape
- Index cards

Inquiry 21.1
Looking at Optical Devices

PROCEDURE

1. Working with your group, examine the optical devices that have been placed around the room. Use the observations you make and the information you collect to make short notes about each device in Table 1 on Student Sheet 21.1: Looking at Optical Devices.

2. Be prepared to share with the class the information about the devices that you have examined.

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What is this optical device used for? Which components in the device are used to manipulate light? What do these components do?

Inquiry 21.2
Introducing the Anchor Activity

PROCEDURE

1. After your teacher gives you Student Sheet 21.2: Anchor Activity Schedule, tape it in the front of your science notebook. You will need to refer to it as you work on the Anchor Activity. Follow it carefully.

2. Follow along as your teacher reviews the Anchor Activity Guidelines.

Anchor Activity Guidelines

PROCEDURE

Part 1: Choosing an Optical Device

1. You (and you partner, if you are working in pairs) will choose an optical device to study. You may choose one from the class list of optical devices or identify one of your own.

2. Discuss your choice with your teacher. You may be asked to choose another device if your teacher thinks the choice is inappropriate (perhaps because it is too difficult or too many other pairs have chosen it).

3. Review the information in Step 4. If you are working with a partner, decide how you will divide the work.

4. The information you gather will be divided into three sections. As you gather information, write your notes under these headings:

Function
Answer these questions:

What does the device do?

What is it used for?

How Does the Device Work?
Answer these questions:

What does it do to light and how does it do it?

Does it use lenses, mirrors, prisms, or other optical components?

What role do these optical components play in the device?

How do the components work together to make the device work?

Try to produce a labeled diagram showing how it works.

History and Development of the Device
Try to answer these questions:

Was it invented?

If so, by whom?

When and where did it first appear?

How was it developed into its present form?

Part 2: Finding Resources and Writing an Outline

1. To help with planning your presentation, write an outline of your investigation (see Figure 21.1). Your outline should use the headings provided in Step 4 of Part 1.

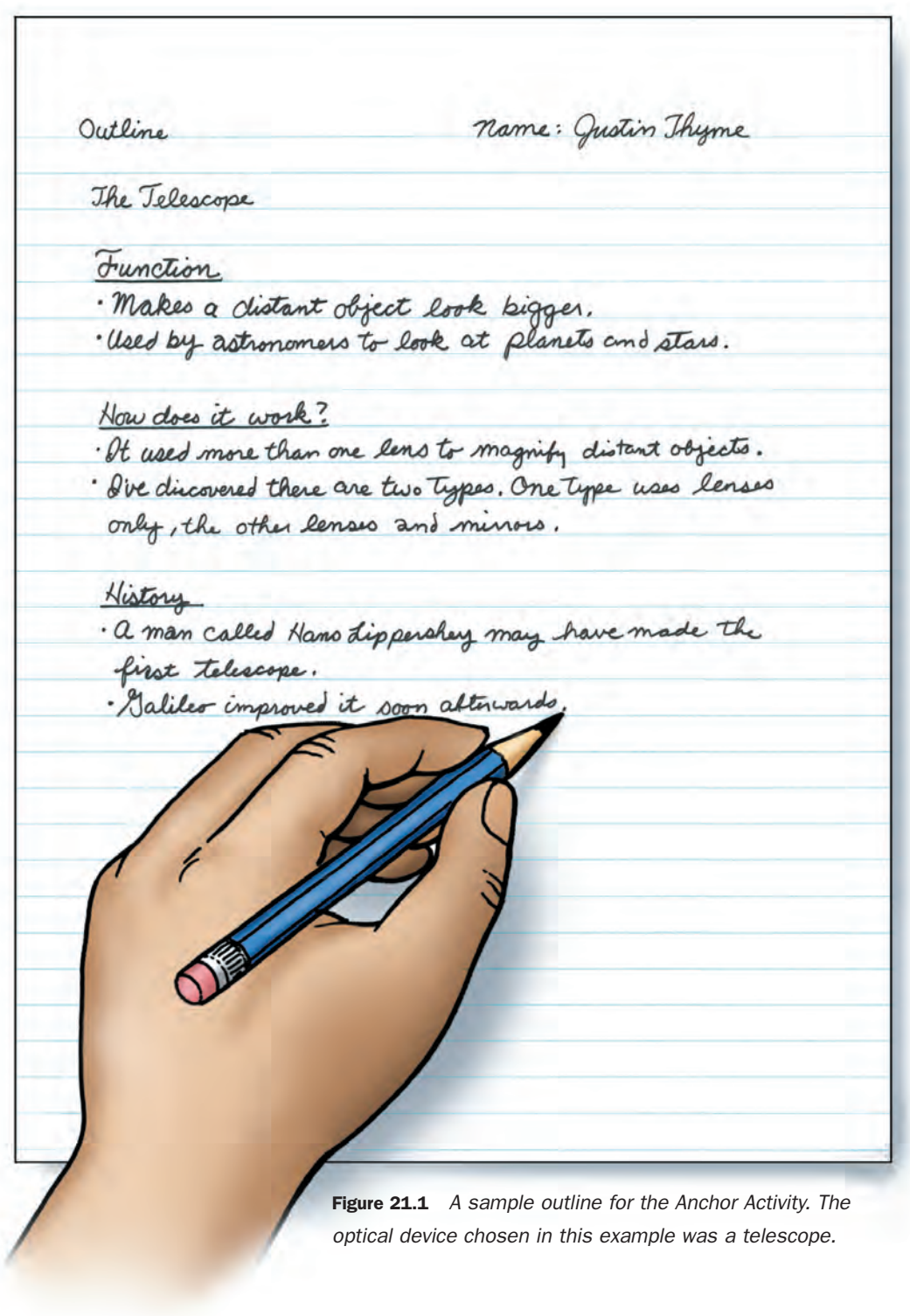

Figure 21.1 *A sample outline for the Anchor Activity. The optical device chosen in this example was a telescope.*

2. As you collect information, record your sources in a bibliography. The bibliography can include sources such as books, CD-ROMs, DVDs, videotapes, TV programs, and magazines. It should include at least one Web site and one book (other than an encyclopedia). A sample bibliography is shown in Figure 21.2.

3. Hand in your outline and a copy of your bibliography on separate sheets of paper by the due date on the schedule. Your teacher will use this information to help you make sure your research is heading in the right direction.

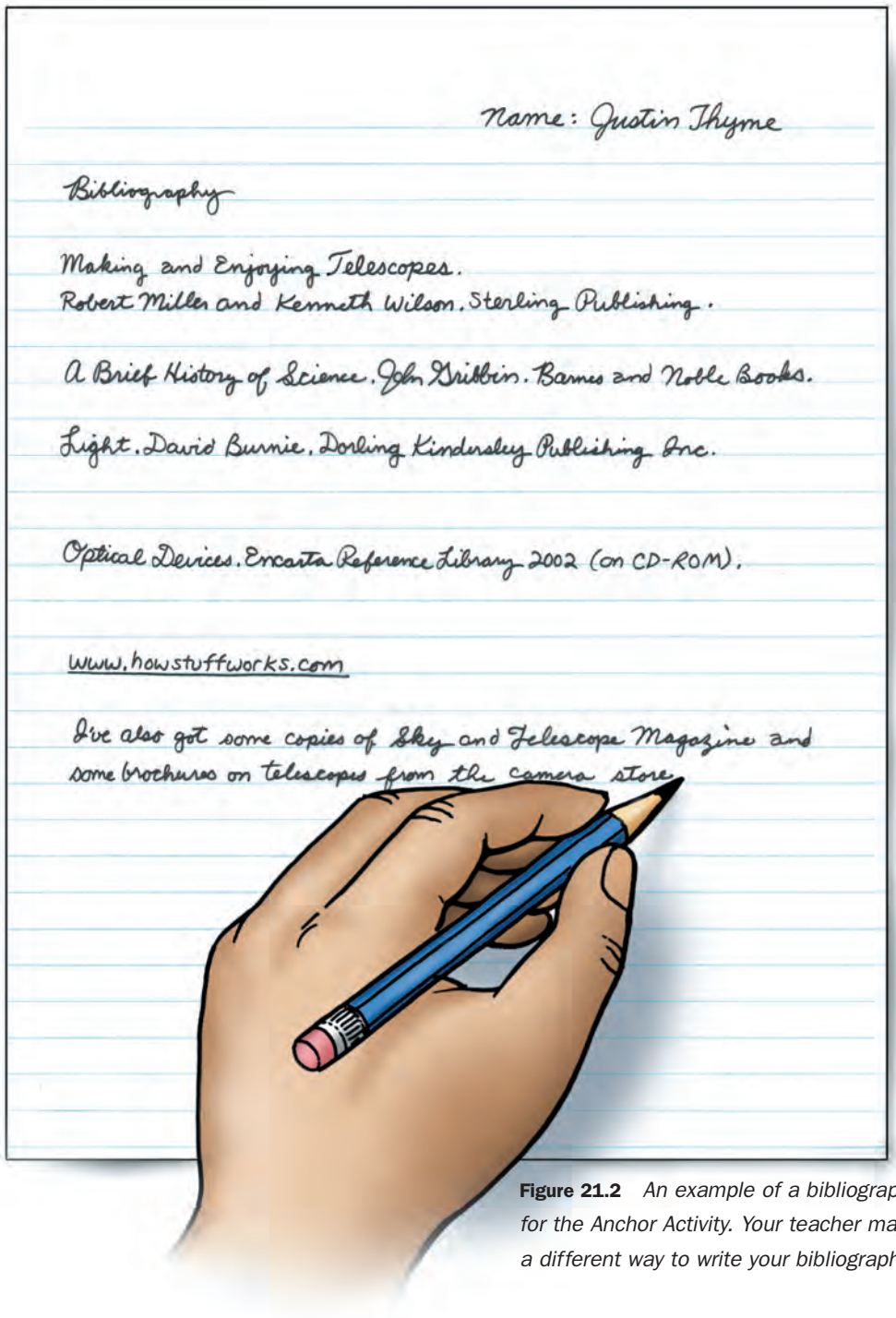

Figure 21.2 *An example of a bibliography written for the Anchor Activity. Your teacher may show you a different way to write your bibliography.*

Part 3: Preparing Your Presentation

1. Prepare your presentation. You will give a 3-minute oral presentation supported by at least one visual aid. Your visual aids can be a poster, Web page, computer (PowerPoint™) or flashcard presentation, or model. Your teacher will outline some points to think about when making your visual aid.

2. Design your visual aid carefully. If you make a poster, be sure it is clearly labeled and does not contain too much information.

3. Create your visual aid.

4. Practice your oral presentation. Ask your parents, teacher, or friends to suggest ways to improve your presentation. Follow these suggestions:

- If working with a partner, make sure you design your presentation so that you both contribute equally to the presentation.
- Refer frequently to the visual aid as you give your presentation.
- If you get nervous when speaking or have a bad memory, make short notes (not complete sentences) on index cards to use during your presentation.
- Make sure your voice can be heard clearly in the back of the room.

Think carefully about how you design your visual aid.

5. Table 21.1 shows the rubric your teacher will use to score your presentation. Use this rubric to help you plan your presentation so that you obtain a high score.

Table 21.1 Scoring Rubric for the Anchor Activity Presentation

Section	What You Should Include	Points awarded	Total Points
Content	**Function** Provide an accurate description of what your optical device does or what it is used for.	5	5
	How does it work? Explain how the device works. How do the different parts of the device work together to perform its function?	10	10
	History and Development When was the device first used? Who developed it? How was it improved?	5	5
Presentation	Speaking loudly and clearly Using your visual aid as you present Organizing your presentation	3 3 4	10
Visual Aid	Using a layout and design appropriate to your visual aid Labeling diagrams, tables, and pictures Originality of materials	5 5 5	15
Bibliography	Include at least five complete references, with at least one Web site and one book (other than an encyclopedia)	5	5
		Total	**50**

Part 4: Presenting Your Anchor Activity

1. Your teacher will tell you the day on which you will make your presentation. Be sure you are prepared.

2. You will have only 3 minutes to make your presentation.

3. Speak clearly. If you are working with a partner, make sure you both contribute equally to the presentation. Don't forget to refer to your visual aid as you make your presentation.

4. After your presentation, hand in your visual aid and the final version of your bibliography.

REFLECTING ON WHAT YOU'VE DONE

1. Discuss with your group which of the presentations that you observed was the most interesting and which was presented best. Try to identify the reasons for your choice(s).

2. How do you think your presentation could have been improved? Make a short list of these improvements in your science notebook.

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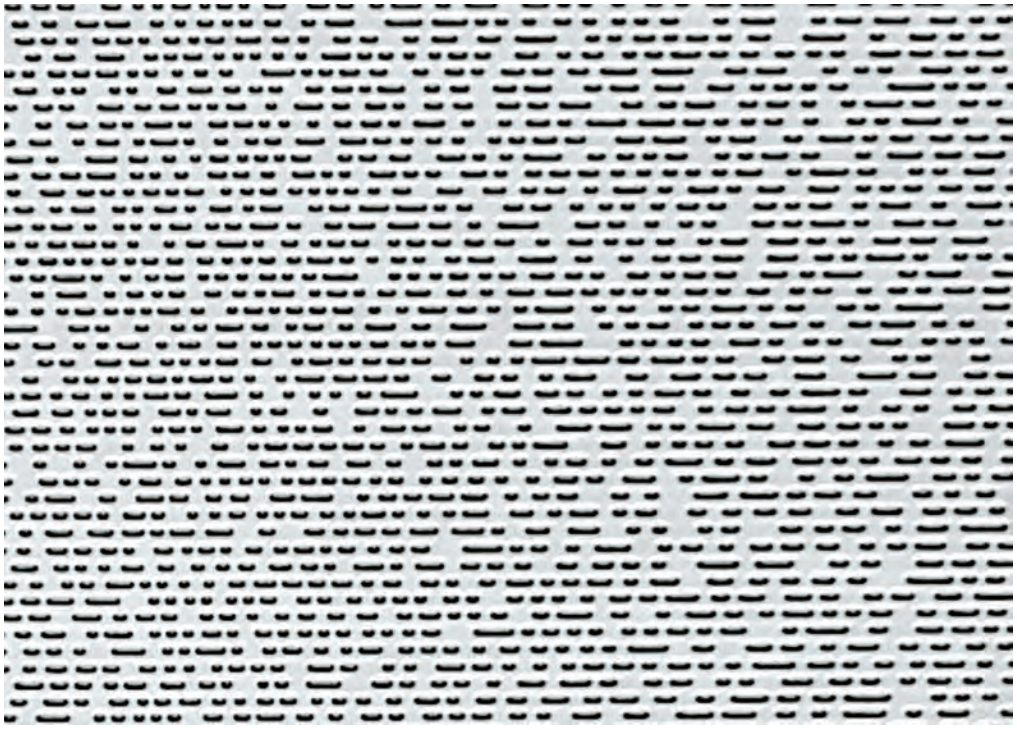
When making a presentation, use your visual aid to help you explain how your optical device works.

Optics in Action—Digital Data and Amazing Music

What is 1.2 millimeters thick, 12 centimeters in diameter, and can hold the same amount of information as a book 65,000 pages long? You may be surprised to discover you have a few of these at home. But you may be using them for a different purpose.

The item in question is a compact disc, or CD. The most common uses of these shiny disks include storing music, movies—DVDs, similar to CDs—and computer data. CDs store all of these in digital form. What does this mean and how do CDs work?

Look at this close-up photo of a CD. It was taken using a microscope. Can you see the small marks in the disk? These marks are pits and flats arranged in a spiral track on the disk. The track on the CD is thinner than a human hair and about 5 kilometers long. As the CD spins (many hundreds of times each minute), a laser beam follows these tracks and scans these pits and flats. The pits and flats are a form of code. The flats are read as a 1 (on) and the pits as a 0 (off). This 1 and 0, or on-off code, is called a binary, or digital, code. This code is used to store information on the CD. □



STEPHEN W. PADDOCK, PH.D. HOWARD HUGHES MEDICAL INSTITUTE, DEPARTMENT OF MOLECULAR BIOLOGY, UNIVERSITY OF WISCONSIN

A CD under a microscope

LIBRARY OF CONGRESS, PRINTS & PHOTOGRAPHS DIVISION LC-USZ62-125429

Vinyl records were widely used to play music. Ask a parent or grandparent what an LP was. How fast did it spin? What was the name of the first record they bought?

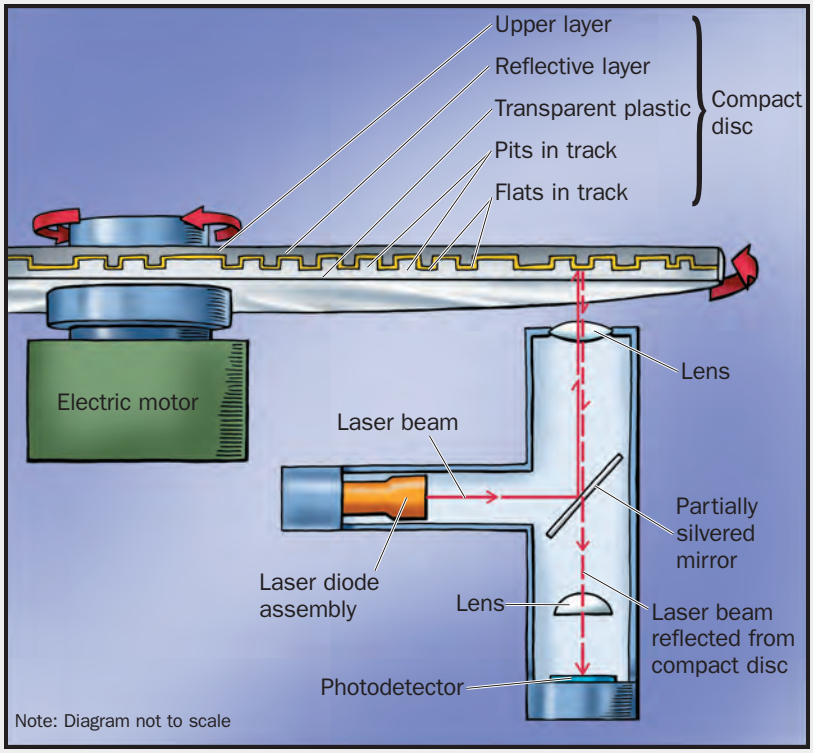
Listening to Music the Analog Way

Ask one of your parents how they listened to music and they would probably say they used vinyl records or cassette tapes.

Both records and tapes store information in analog form. What does this mean? Analog signals are replicas (that is, copies) of the original. For example, the wiggly shapes of the grooves in a vinyl record vary with the strength and nature of the signal. Vinyl records can be played (very quietly) using just a needle! But when you play a CD, the digital code on the CD must be decoded before it can be converted into music.

Inside an Audio CD Player

One job of a CD player is to keep a laser targeted on the tracks on the spinning CD. The laser sits below the CD and aims at the track starting from the center of the disk. The light from the laser is reflected from the shiny surface of the CD. A component called a photodetector also sits under the CD. It detects whether the laser was reflected from a flat or scattered from a pit. It turns these digital light signals into electrical signals and sends these signals to a microprocessor. The microprocessor decodes the signal into music.



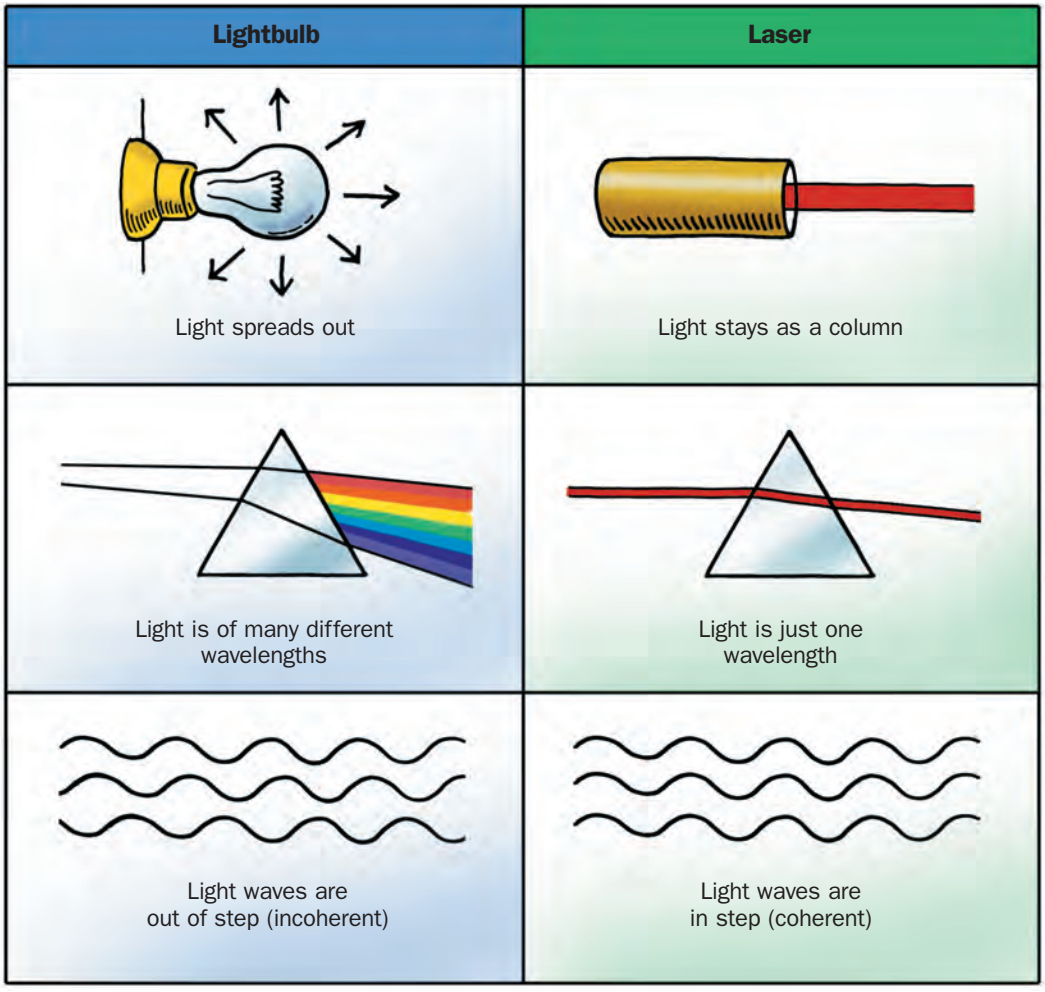
A CD player uses a laser to read the information on a CD.

JEFF MCADAMS, PHOTOGRAPHER, COURTESY OF CAROLINA BIOLOGICAL SUPPLY COMPANY

A CD player converts a digital code into music. What's your preference, Mozart or rap?

LIGHT IN STEP— A LASER COMPONENT

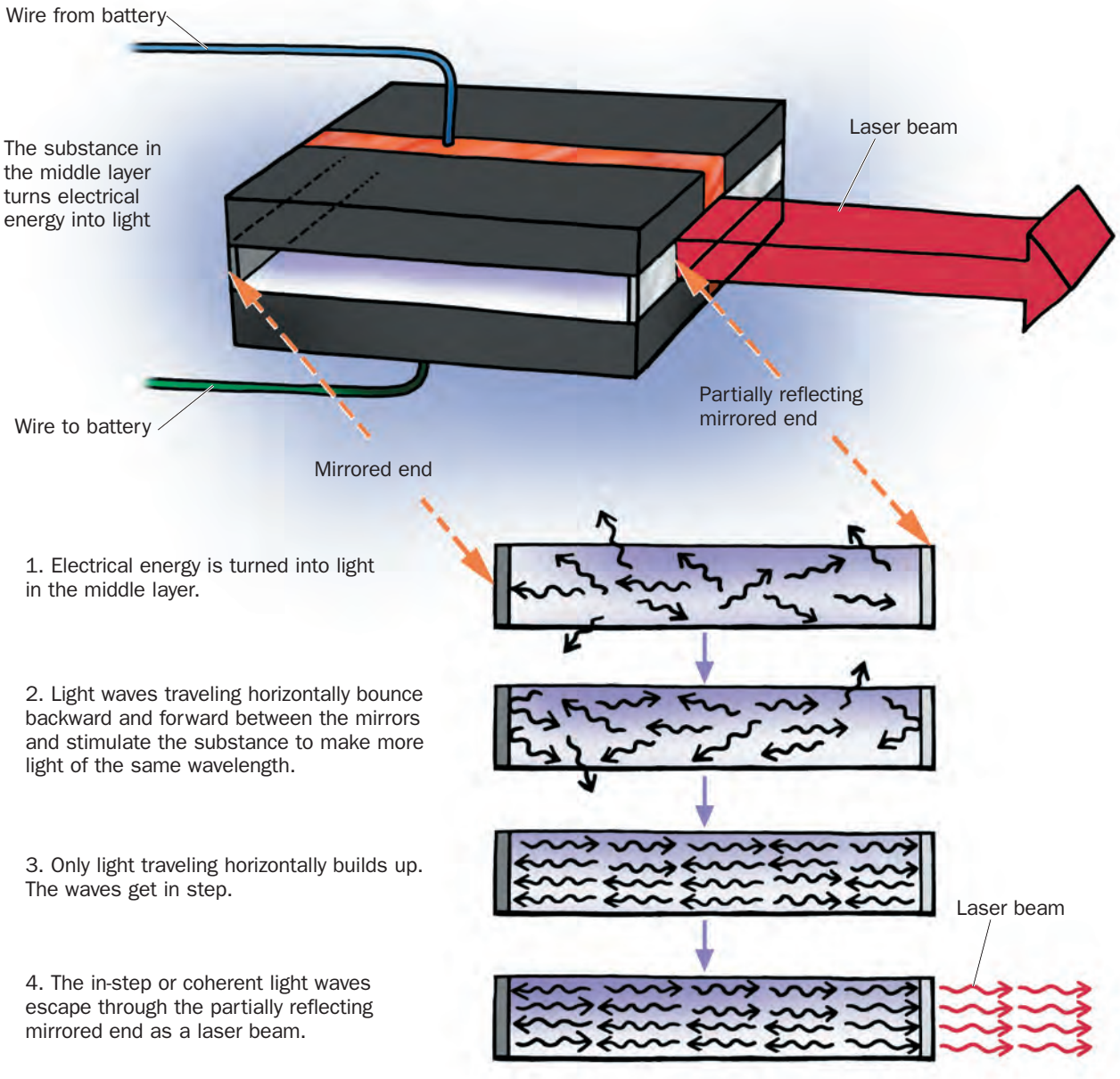
Lasers produce light. What is the difference between light from a laser and light from a lightbulb? There are a number of differences. You know that light from a lightbulb is of many different wavelengths or colors. Light from a laser is only one wavelength. A particular laser produces only one color of light—it is monochromatic. Light waves leaving a lightbulb are released at random. The waves are therefore out of step with each other. Light waves from a laser are in step with each other. These in-step waves are said to be coherent. Finally, because the waves are all in step, the laser light doesn't spread out as much from its source as light from a lightbulb. This is why laser light is often referred to as a laser beam. The illustration below summarizes the difference between light from these two sources.



Unlike light waves from other sources, light from a laser doesn't spread out much. The light waves from a laser are all the same wavelength and are in step with one another.

Lasers take a variety of forms but the way they work is very similar. Some lasers used for research into nuclear energy or as weapons are the size of buildings; others are small enough to fit inside a grain of salt! Inside a CD player, laser light is made inside a component called a laser diode—less than 1 centimeter long. Laser diodes are solid-state lasers. This means they are made from layers of different solids. The laser diode shown has three layers. Examine the diagram carefully.

The laser diode is designed so that its middle layer makes light of a certain wavelength when electrical energy is passed across the layers. Mirrors at the ends of the middle layer of the laser diode stop most of this light from



*In a laser diode, electrical energy is used to cause a substance to make light. This light is then used to make more light of the same wavelength. "Laser" stands for "**L**ight **A**mplification by **S**timulated **E**mission of **R**adiation."*

escaping. The light bounces backward and forward between the mirrors. As it bounces back and forth it stimulates the atoms that make up the substance in the middle layer to release more light. This additional light is identical in wavelength to the original light. This light is all traveling in the same direction and has the same wavelength. These light waves are all in step. Eventually, many of the light waves bouncing back and forth get in step with one another—rather like water waves going backward and forward in a bathtub.

The light builds up—is amplified—to such a high intensity that even the small fraction of light that does escape through a partially reflecting mirrored surface (like the half-silvered glass you used in Lesson 14) at one end of the diode is still very bright. This light escapes as a laser beam.

In other lasers, laser light is made within crystals or gases. Different types of lasers produce light of different wavelengths. Laser light is used when a compact and intense light source is needed. For example, delicate surgery or the accurate reading of a code by a CD player or a store checkout all require the type of light produced by a laser. □

SYMBOL TECHNOLOGIES, INC.

Lasers are used to read the bar codes on most of the things we buy.