

Unit 4

Unit 4 Light and Applications of Optics

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Unit 4 Light and Applications of Optics

BIG IDEAS

- A wide range of technologies utilize the properties of light and colour.
- The behaviour of light depends on the materials with which it interacts.
- Light is a form of energy, produced from a variety of sources, and can be transformed into other forms of energy.

Overall Expectations

- **E1** analyze how properties of light and colour are applied in technology and the impact of these technologies on society
- **E2** investigate, through inquiry, properties of light, and predict its behaviour in mirrors and as it passes through different media
- **E3** demonstrate an understanding of characteristics and properties of light, particularly with respect to reflection and refraction and addition and subtraction of colour.

Materials

Please see pages TR-32 to TR-37 for a list of the materials required for this unit and other units.

Overview

In this unit, students will learn about light: what it is, how it is produced, how it interacts with matter, and how technologies have enabled us to make use of light and its properties. Light is a form of energy that affects our daily lives, enabling us to see and to communicate with others. Students will come to recognize that light is essential to life and that light's properties have allowed us to develop technologies based on light that improve our quality of life.

Using the Unit Opener (Student textbook pages 270–273)

- Read the unit opener paragraph aloud with students and ask students what it means to be invisible. Stress the point that light is necessary to see and be seen.
- Review unfamiliar terms such as *force field* and *NASA* and make connections with students' prior knowledge.
- Ask students to describe everyday examples of items that bend or reflect light and how they are used to improve vision, provide security, or enhance our quality of life.
- **ELL** English language learners may need additional support to make connections with unfamiliar terms. Consider pairing English language learners with students who have strong English communication skills. Preview key words that students will encounter in this unit, such as lens, mirror, reflect, refract, absorb, transmit, object, and image. English language learners can use **BLM G-38 English Word Study** to develop their understandings of these terms.
- Have students look at Unit 4 At a Glance on pages 272 and 273, and explain what it tells them about what they will learn. They will see that each topic will answer a question that relates to light and applications of optics, and that each topic includes several key concepts.
- Students can use **BLM 4-1 Unit 4 Anticipation Guide** to record their thoughts about light and applications of optics. Then, at the end of the unit, they can revisit the blackline master and see how their understandings and opinions have changed as a result of their study.
- Students can use **BLM 4-2 Key Terms in Unit 4** to review the meanings of Key Terms.

Preparing for the Unit Projects

- Read Looking Ahead to the Unit 4 Projects, on page 273, to the class. Then allow students to read the projects themselves, on pages 360 and 361, including the assessment checklists.
- Provide instructions on how you would like students to set up their project planning folder(s).
- Have students write an “action plan” or “to-do list” of the tasks they will need to accomplish to be successful with their project(s). You may want to provide them with **BLM A-53 Unit 4 Inquiry Investigation Rubric** and **BLM A-54 Unit 4 An Issue to Analyze Rubric** at this planning stage so they understand what is expected of them.
- Once a week, allow students 10 minutes or so to review their unit project materials and move forward in their preparations.
- The unit projects involve inventing practical applications of light and technology to improve the quality of life in a home or in remote locations.
- For the Inquiry Investigation, encourage students to think about how lighting a room involves providing adequate quantity and quality of light. To bring daylight from the roof to a room will involve collecting light, changing its direction, and dispersing it through a room. Students should pay particular attention to how the path of light is changed by technology.
- An Issue to Analyze requires students to investigate the benefits of using light emitting diode (LED) technology to provide artificial light in remote locations. Encourage students to focus on ways light is produced. Stress the importance of energy transformations as students learn about light production in Topic 4.1.

Get Ready (Student textbook pages 274-275)

Concepts

Perhaps the most important concept for students to grasp is that light travels in straight lines. All the characteristics, properties, and optical phenomena of light result from this critical concept.

- Students should describe difference between a light source that produces its own light and one that is merely reflecting light (questions 1 and 2).
- Students should identify light as a form of energy (questions 2 and 3).
- Students should the results of the interaction of light with some types of materials, for example, absorption and reflection (questions 2 and 3).

Skills

- Students should be able to predict and test the results of mixing colours. (question 4)
- Students should be able to identify, analyze, and interpret orientation of images (questions 5 and 6).
- Students should be able to identify parallel, perpendicular, and intersecting lines (question 7).
- Students should be able to use a protractor to draw and measure angles accurately (question 8).
- Students should be able to categorize words related to light and optics (question 9).

Students can review some of these skills using **BLM 4-3 Skills for Unit 4**.

Get Ready Answers

1. **a)** natural light: fire, moon, stars, fireflies; artificial light: flashlight, glow stick
b) sun
c) bicycle reflector, mirror in flashlight, reflecting surface on clothing, water, eye glasses, metal guitar strings
2. **a)** White light is made up of many **colours**.
b) A **prism** can separate light into colours.
c) Light travels in a **straight** path in one medium.
d) Light **reflects** off shiny surfaces.
e) Light **refracts** when passing through a lens.
3. **a)** iv. **b)** ii. **c)** v. **d)** iii. **e)** i.
4. **a), b)** orange, green, purple, black, and variations of these
5. MOM will read correctly, DAD will not.
6. r, i
7. **a)** line A and line E
b) line D and line B
c) Answers may vary. Line F and line A.
8. **a)** 20°
b) Students should draw an angle A with a measure of 75° .
8. Categories will vary. For example:
Applications of Optics (instruments or devices that are based on properties of light and optics): kaleidoscope, microscope, telescope
Properties of Light (characteristics used to describe light): speed, straight, beam
Reflection of light (characteristics used to describe reflection of light): image, mirror, reflection

Assessment OF Learning for Unit 4

Activity	Evidence of Learning	Supporting Learners
Unit 4 Inquiry Investigation, page 360	Students complete a thorough and accurate drawing and prepare a plan for a light tunnel that will effectively carry light from the roof to a room in a house.	<ul style="list-style-type: none"> • Ensure students understand that mirrors change the direction of light and that lenses bend light rays so they converge or diverge. Students will need both concepts to make their plan work in a house. • Provide lenses and mirrors so students can check their predictions as they work.
Unit 4 Issue Analysis Project, page 361	Students describe the use of LED technology in providing light to remote locations and demonstrate an understanding of how LEDs produce light and enable their use in remote areas where electricity is limited.	<ul style="list-style-type: none"> • ELL English language learners will need help, possibly from a peer tutor or other students with strong communication skills, to be able to complete the research and produce the project. Consider student groupings that will facilitate this learning. • Students can use BLM G-13 How to Do a Research-Based Project, BLM G-16 Scientific Research Planner, BLM G-17 Research Worksheet, and BLM G-18 Internet Research Tips to help them plan and organize their research. • Encourage students to choose a presentation medium that suits their analysis and their strengths.

Assessment FOR Learning for Unit 4

Tool	Evidence of Learning	Supporting Learners
Get Ready, questions 1 to 3, page 274	Students identify several natural and artificial sources of light and different ways to describe light energy.	<ul style="list-style-type: none"> • Have students categorize light sources around them as real or artificial, and sources or reflectors. These could include the Sun, classroom lights, shiny surfaces, and so on. • Have students categorize objects around them as absorbing, reflecting, or transmitting.
Get Ready, question 4, page 275	Students make a prediction, then test and evaluate it.	<ul style="list-style-type: none"> • Point out that predictions do not have to be correct. They are just the starting point for an inquiry. The test and analysis of the prediction is the important part.
Get Ready, questions 5 and 6, page 275	Students determine vertical and horizontal symmetry for letters of the alphabet.	<ul style="list-style-type: none"> • Supply students with small plane mirrors for students to test properties of symmetry evident in these and other letters of the alphabet. • Remind students to use capital letters.
Get Ready, questions 7 and 8, page 275	Students identify relationships between lines, and draw and measure angles accurately.	<ul style="list-style-type: none"> • Supply students with protractors. • Review properties of lines, angles, and the intersections between lines. Use road analogies and others examples to provide real-world context.
Get Ready, question 9, page 275	Students identify relationships between key words related to light and optics.	<ul style="list-style-type: none"> • Have students begin by putting the words into only two categories, then introduce a third category. • Review the meanings of these key words with students.