# UNIT 3

## Summary

**ESSENTIAL QUESTION**

**How can we investigate properties and applications of electromagnetic radiation?**

### TOPIC 3.1:
### How does electromagnetic radiation shape your world?

- Electromagnetic radiation is an important part of your world.
- Sources of electromagnetic radiation are all around you.
- Electromagnetic radiation enhances how we sense our world.

**Key Term**

electromagnetic radiation

### TOPIC 3.2:
### How can models explain the properties of electromagnetic radiation?

- Visible light can be used to model all types of electromagnetic radiatio
- The ray model of light explains that light travels in straight lines.
- The wave model of light explains that light has wave-like properties.
- The particle model of light explains that light has particle-like propertie

**Key Terms**

| | |
|---|---|
| ray model of light | particle model of light |
| wave model of light | wavelength |
| amplitude | frequency |

## TOPIC 3.3:

### How does light behave when it encounters different materials and surfaces?

- Light can be reflected, absorbed, transmitted, or refracted.
- Light behaves differently when it encounters transparent, translucent, or opaque materials.

**Key Terms**

| | |
|---|---|
| reflection | absorption |
| transmission | refraction |

## TOPIC 3.4:

### How does light behave when it is reflected?

- Light is reflected in predictable patterns.
- Light reflected by a plane mirror produces an image that is nearly identical to the object.
- Light reflected by curved mirrors behaves in unique ways.
- Many technologies take advantage of light's behaviour when it strikes a reflective surface.

**Key Terms**

| | |
|---|---|
| laws of reflection | plane mirror |
| concave mirror | convex mirror |

## TOPIC 3.5:

### How does light behave when it moves from one medium to another?

- Light changes direction and speed when it moves from one medium to another.
- Light refracts as it passes through lenses.
- Refraction plays a role in human vision.
- Many technologies take advantage of light's behaviour when it moves from one medium to another.

**Key Terms**

| | | |
|---|---|---|
| lens | converging lens | diverging lens |

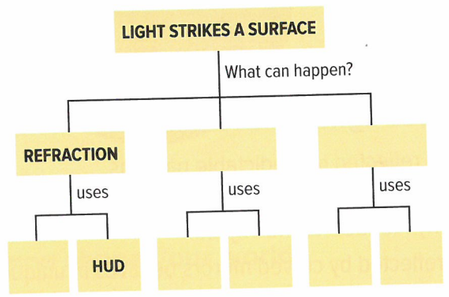
# UNIT 3

# Review

## What Do You Know?
Connecting to Concepts

### Visualizing Ideas

**1.** Copy and complete the concept map.




**2.** Design a graphic organizer to show concepts that are related to the different types and properties of electromagnetic radiation.

### Using Key Terms

**3.** Below are four sets of terms from this unit. For each set, write one or two sentences that use all the terms correctly.

- **a)** transmission, converging lens, ray model of light, refraction
- **b)** wave model of light, frequency, wavelength
- **c)** concave mirror, focal point, real image
- **d)** density, refraction, normal

### Communicating Concepts

**4.** Explain the connections among the following terms as they apply to visible light: photons, particle model of light, wavelength.

**5.** The Sheringham Point Lighthouse on Vancouver Island is shown below. Explain why its light would look brighter to a ship that is 200 m away from it than one that is 800 m away.

**6.** Describe two beneficial uses and two dangers associated with different types of electromagnetic radiation.

**7.** Describe one way that light behaves like a wave, but not a particle.

**8.** Describe one way that light behaves like a particle, but not a wave.

**9.** Why do scientists talk about a wave model of light instead of saying that light is a wave?

**10.** Explain how a doctor could use electromagnetic radiation to diagnose a medical condition.

**11.** Describe the ray model of light and why it is useful.

**12.** Describe three ways that types of electromagnetic radiation are the same and three ways they are different.

**13.** Describe two ways a criminal investigator could use electromagnetic radiation to solve a crime.

**14.** Identify the type(s) of electromagnetic radiation that play a role in each of the following:

- **a)** sun tans
- **b)** skin cancer
- **c)** remote sensing
- **d)** the Internet
- **e)** astronomy

## What Can You Do?
Connecting to Competencies

### Developing Skills

**15. a)** A student uses a rope to produce a wave. Five complete wavelengths pass a point in one second as the wave goes by. Draw a model of the rope wave. Include labels to indicate its wavelength and frequency.

**b)** Draw a model of a rope wave with a longer wavelength and lower frequency than in part a). State a frequency that would make sense for the model you drew.

**16.** The archerfish below catches an insect by spitting a stream of water at it to knock it off an overhanging plant. The insect falls in the water, and the fish eats it. The eyes of the fish remain underwater when it hunts. Does the fish aim directly at the insect? Use a sketch to explain why or why not.

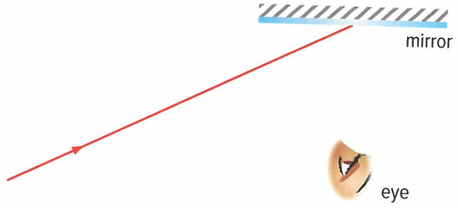
**17.** Design a demonstration that uses a ray of light and a plane mirror to show that the angle of incidence equals the angle of reflection when light reflects off a mirror. You can use any additional materials that you require. Include a materials list, safety guidelines, and a drawing of your set up.

**18.** Create a sketch that shows the path that visible light follows in the following cases:

- **a)** from the Sun to a mountain to the surface of a mirror-like lake to a viewer's eye
- **b)** from a desk lamp to a word on this page through a viewer's eye to the retina

### Thinking Critically and Creatively

**19.** Imagine that the room in the diagram below is dark and has black walls. The air in the room is free from dust and smoke. A very narrow beam of light enters the room in the direction indicated by the ray. If you stay at the position indicated by the eye, can you see the mirror on the opposite wall? Explain why or why not.




**20.** A beam of light strikes a sample of matter.

- **a)** How many possible outcomes are there as light and matter interact?
- **b)** What happens to the light in each case?

**21.** Identify three sports in which the laws of reflection can be applied. For each sport, describe how these laws are applied.

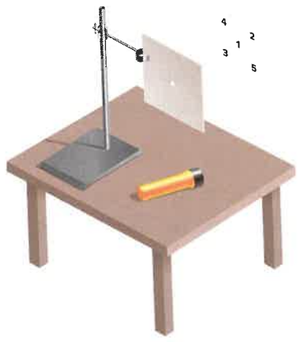
# Unit 3 Review *(continued)*

**22.** Name at least three skills from mathematics that you depended on as you studied electromagnetic radiation and light in this unit. Explain how your understanding of this unit might have been different if you did not have or know about these math skills.

**23.** At truck inspection stations and border crossings, security guards often need to see the underside of large semi-trailers and other vehicles.

- **a)** How might they use a mirror to see under the vehicles?
- **b)** What type of mirror would work best for this application? Use a drawing to support your response.

**24.** The equipment in the diagram below was set up for an experiment to demonstrate that light travels in a straight line. Infer how the experiment probably works. Explain your reasoning.



**25.** Sometimes, on a sunny day, campers start a campfire using a lens to light paper or dry grass.

- **a)** What type of lens do you think would work best for this application?
- **b)** What is happening to the sunlight when it passes through the lens? Draw a sketch to illustrate your answer.

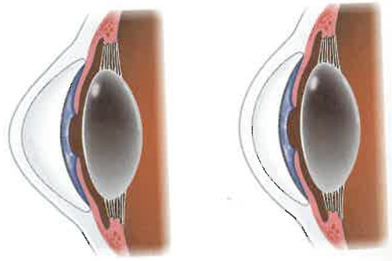
## Understanding Big Ideas
## Making New Connections

### Applying Your Understanding

**26.** The first-known sunglasses were invented at least 2000 years ago by the Inuit to avoid snow blindness. Snow blindness is a painful, usually temporary condition caused by too much ultraviolet light getting into the eyes. The condition is more likely to occur in winter, when there is snow on the ground.

- **a)** Why is snow blindness more likely to occur when snow is on the ground?
- **b)** Infer from the photo how the design of Inuit snow goggles helped protect the eyes.
- **c)** Soot was often rubbed on the eye slit. What would be the purpose of that?

**27.** The diagrams below show two eyes. One has defective vision. Identify this eye, explain why you chose it, and explain how the defect could be corrected.

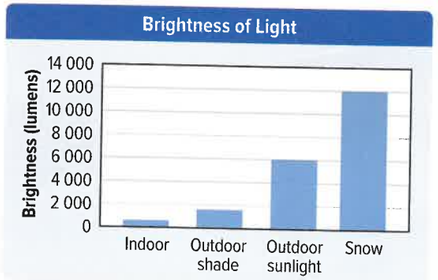




### Thinking Critically and Creatively

**28.** Describe how curved mirrors could be used to increase safety on winding roads through mountainous regions.

**29.** Sunglasses are tinted to reduce the amount of visible light that reaches your eyes. The tinting is made up of light-absorbing substances. But the substances do not block eye-damaging ultraviolet radiation. Sunglasses with UV-filtering lenses let visible light pass through and absorb UV radiation.




- **a)** The graph compares the brightness of light, measured in units of lumens, in different places. Most eyes are comfortable up to about 4000 lumens. After that, people start to squint. How bright is light reflected from snow? How would that brightness of light make your eyes feel?
- **b)** What argument could you make to persuade people who do not wear sunglasses with UV-filtering lenses that they should?
- **c)** Wraparound sunglasses offer more protection than standard ones. Explain why that is the case, and why wraparound sunglasses would be especially useful when water- or snow-skiing and when at the beach.

### Connecting to Self and Society

**30.** How many different ways have you used and been affected by electromagnetic radiation today? List as many ways as you can, explaining a little bit about each one. See if you can come up with at least 20 (yes, you read that correctly).

**31.** Read and reflect on the paragraph below. Then write a paragraph describing your views in response to this question: "Should scientists receive funding to do scientific inquiry on concepts that have no apparent application?"

> When scientists were researching certain wave and particle properties of light in the 1950s, the work they were doing was described as "a solution looking for a problem." They had no idea how their discoveries could be applied. By 1960, they had invented the laser, and it took at least another 30 years before this invention began to transform the way people live and communicate around the world. Barcodes, smart phones, surgical techniques, light shows, music and video streaming—none of these and many other modern applications would exist without the laser.

**32.** Mirror-like surfaces are useful to society. They are often used in beneficial technology. However, they can also be a great deal of fun. Use what you learned about mirrors in this unit to design a funhouse for people to enjoy. Your design should use at least one plane mirror, one convex mirror, and one concave mirror. For each mirror, explain the effect it would create in the funhouse.