

- (b) UV rays can lead to skin cancer, as well as promote premature wrinkling. They also can cause the surface of the eye to become cloudy.
12. (a) An oncologist might use gamma rays to try to destroy cancer cells in a person's body.
- (b) Students' answers may vary. Accept all reasonable answers. The person is constantly moved while undergoing therapy that shines a gamma ray into the person's body. The only part of the body to receive a continuous exposure to the gamma rays is the part identified as being made up of cancer cells.

Pause and Reflect Answer

Infrared photography could be used to show that a house may be poorly insulated, and radiates an excess amount of heat. Police may use infrared measurements to detect the presence of an illegal marijuana grow operation. (In British Columbia police can use this technique only when they are in possession of a search warrant.)

Other Assessment Opportunities

- BLM 2-12, Chapter 4 Quiz
- Assessment Checklist 1, Making Observations and Inferences
- Assessment Checklist 4, Laboratory Report
- Process Skills Rubric 3, Controlling Variables
- Process Skills Rubric 5, Fair Testing
- Assessment Rubric 1, Concept Rubric
- Assessment Rubric 5, Conduct an Investigation Rubric
- Assessment Rubric 12, Using Tools, Equipment, and Materials Rubric

CHAPTER 4 ASSESSMENT, p. 164–165

PREPARE YOUR OWN SUMMARY

Student summaries should incorporate the following main ideas:

1. Features of Waves
 - All waves are disturbances that result in the movement of energy from one place to another.
 - Waves are characterized by wavelength, amplitude, and frequency.
 - As the wavelength increases, the frequency decreases.
2. Prisms
 - A prism is a piece of shaped glass or other transparent material that has a different density than air.

- Light refracts as it enters a prism and then again as it exits the prism.
 - A prism can split sunlight into the visible spectrum.
 - A spectrum can be recombined into white light using additional prisms.
3. The Visible Spectrum
 - White light contains a mixture of all the colours of the rainbow.
 - ROY G BIV identifies the colours of the rainbow as red, orange, yellow, green, blue, indigo, and violet.
 - If one or more colours are removed from the rainbow and then the remaining colours are recombined, the colour is no longer white.
 4. Wavelengths Longer than Visible Light
 - Radio waves are the longest wavelength of all light waves and are used in communication and in imaging soft tissues using MRI technology.
 - Microwaves have the shortest wavelength of all radio waves and are used in satellite-based telecommunications, radar, and also in ovens to heat food.
 - Infrared waves detect radiation that we experience as heat. These waves are used in night vision goggles and to observe crops and forests.
 5. Wavelengths Shorter than Visible Light
 - Ultraviolet waves are absorbed by the skin to help make vitamin D and are also the source of some skin cancers and premature skin wrinkling. Fluorescent materials absorb ultraviolet light and then glow characteristic colours that are used in forensic analysis.
 - X rays are high energy rays that can image bones, teeth, and some tissues. They are used at airports to scan luggage during security checks, as well as to scan the insides of engines without having to disassemble the engine.

CHAPTER REVIEW ANSWERS

Note: Part (d) of question 15 should be deleted.

Checking Concepts

1. (a) Crest
(b) Amplitude
(c) Wavelength
(d) Trough
2. As wavelength increases, frequency decreases, and vice versa. Another way to say this is that they are inversely related.
3. Light waves and sound waves both carry energy. Their waves both can be characterized by frequency, wavelength, and amplitude.

4. Students' answers may vary. One way to measure the wavelength of a small water wave is to hold a ruler over the top and sight two wave crests at the same instant along a ruler. Using a flashing light, or strobe light, that has variable speed, it is possible to change the rate of flashing so that it makes the wave appear to stand still.
5. (a) All colours of light have waves with the same general shape as that of a transverse wave. (Also correct: The light waves move at the same speed in a vacuum, regardless of the colour.)
(b) Different colours of light differ in that their waves have different wavelengths and frequencies.
6. Hertz (Hz) is the unit used to measure frequency. 1 Hz means one vibration per second.
7. Wavelength measures the distance from crest to crest (or any place on a wave to the same place on the next wave), while amplitude measures the distance from the crest to the equilibrium position, which in a water wave is the position of the surface of the water when there is no wave (or from the trough to the equilibrium position).
8. (a) 0.5 m
(b) 1.0 m
9. (a) 0.4 m
(b) 2.1 m
10. (a) 0.6 m
(b) 2.0 m
11. A shirt can appear blue in white light because the pigment in the blue shirt absorbs non-blue colours such as red and green, while at the same time reflecting blue.
12. Radio waves and infrared waves have waves that are longer than visible light, while ultraviolet waves, X rays, and gamma rays have waves that are shorter than visible light.
13. Radio waves are used in MRI technology to form an image of soft tissues such as those in the brain. The person is placed in a very strong magnetic field. The atoms that make up the tissue behave like little magnets. When stimulated with a small amount of radio waves, the magnets can flip. This causes a radio signal to be released, which is detected by the MRI machine. These signals represent information about the tissues that can be converted into pictures.

Understanding Key Ideas

14. Light waves and waves in a fish pond are both disturbances that carry energy. They can both be characterized by wavelength, frequency, and amplitude.
15. (a) 14 crests/7 s = 2 Hz
(b) 30 crests/5 s = 6 Hz
(c) 0.5 crests/10 s = 20 Hz
16. Wavelength and frequency cannot both increase together because as the wavelength gets longer, the troughs and crests get farther and farther apart. This means that the frequency must decrease rather than increase.
17. Students' tables may vary. Sample answer:

RADIATION TYPE	DIFFERENCES	SIMILARITIES
Infrared waves	Lowest frequency, lowest energy, invisible	<ul style="list-style-type: none"> - All are forms of radiation that move in the form of waves. - All move at the same speed. - All carry energy.
Visible rays	Visible to humans, intermediate frequency and energy	
X rays	Highest frequency, can pass through humans, highest energy, invisible	

18. (a) The red light has the longest wavelength.
(b) The violet (or blue, if that is what she sees) has the highest frequency.
(c) Mei Lin would remove green, most likely, and if she did that, recombining the red and blue would yield orange.
19. Students' answers may vary but may include the following points: X rays cause cancer if received in too great a dosage. A huge over-exposure could even cause burns or other direct damage to tissue.