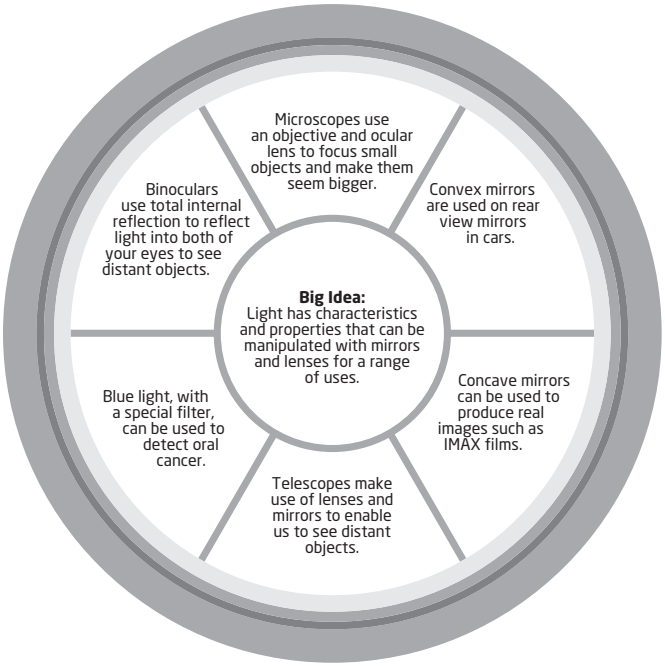
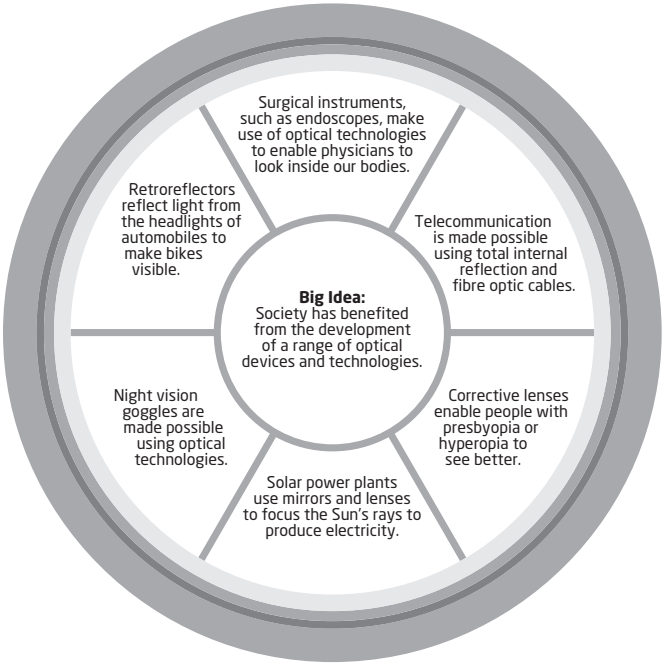
Unit 4 Review Answers (Student textbook pages 524 to 527)

Connect to the Big Ideas

Connect to the Big Ideas answers are also available as a Blackline master on the accompanying CD.





Knowledge and Understanding

1. a.

2. d.

3. a.

4. d.

5. a.

6. Example: All production of light can be categorized according to the energy transformations at the atomic level. Light energy is released when atoms are
- fused (e.g., in the Sun)
- heated (incandescence)
- electrically excited (electric discharge)
- struck by electrons (fluorescence)
- slowly releasing absorbed energy (phosphorescence)
- reacting chemically, without a temperature increase (chemiluminescence)

7. Light is produced in an incandescent source when atoms are heated. Diagram should show atoms vibrating rapidly when heated, releasing light energy.

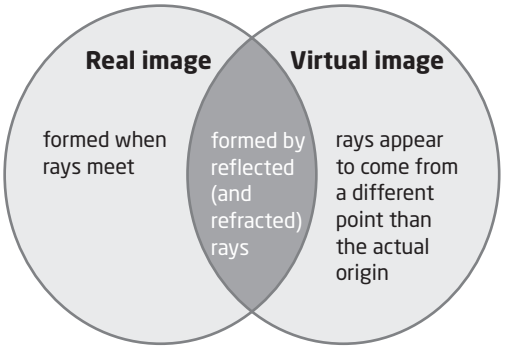
8. Example: When rays of light enter the eye, they must do so through a small hole called the pupil. All rays converge at this point then continue travelling. Rays that were above the pupil continue below the pupil and rays that were below travel to the retina above the pupil.

9. Spherical aberration occurs because the edges of the mirror direct light to different points. See Figure 10.22 on student textbook page 427.

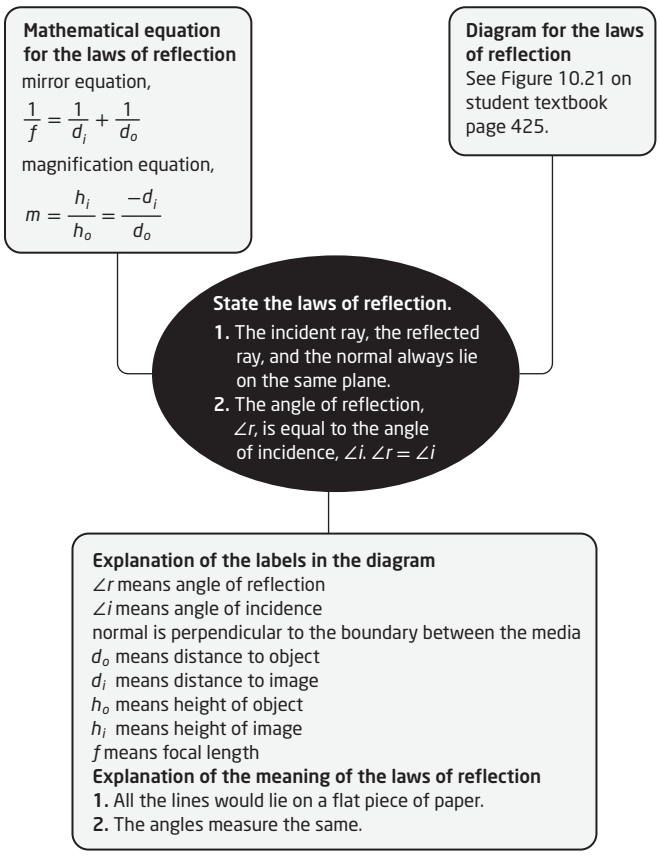
10. Example: Most of the white light entering the bottom right edge of the prism is refracted (redirected) within the prism and comes out the top corner and bottom edge. Some of the light is reflected from the surface and (in this case) bounces back almost exactly along the angle of incidence.

11. Myopia is near-sightedness caused by an eyeball that is longer than the focal length of the cornea, while hyperopia is far-sightedness caused by a too-short eyeball.

12.



13. Example:



Thinking and Investigating

14. See the ray diagram for step 3 in Table 10.3 on student textbook page 423.

15. Example: Mark a line on the paper where the back of each spoon will be held. Focus a flashlight beam on each spoon. Note where the rays converge in front of the bowl of each spoon, marking the focal point of the spoon.

16. The focal length is 4 cm. See the ray diagram for step 5 in Table 10.2 on student textbook page 422.

17. For the real image, see the ray diagram for step 4 in Table 10.3 on student textbook page 423. For the virtual image, see the ray diagram for step 5 in Table 10.1 on student textbook page 416.

18. Example: The index of refraction is calculated by dividing the speed of light by the density of the medium. Because hydrogen is less dense than glass, the light can travel faster through it.

19. $F_2 = F_1$ and $F_1 = ½$ 15 cm = 7.5 cm

20. Example: The convex lens in a camera refracts the incoming light rays so that rays from the top of the image are directed to the bottom of the camera and rays that were below travel to the top. The redirection also makes the rays converge nearer the lens, creating a smaller, inverted image. See Figure 12.25 on student textbook page 507.

21. Example: Compare refraction in the sample to refraction in a known sample of glass. If light refracts at the same angle, then the sample is glass. If the light refracts at a smaller angle in the unknown sample, then it is likely quartz, since glass has a higher refractive index than quartz.

Communication

22. See Figure 12.10 on student textbook page 492.

23. Example:

	Causes	Treatments
Myopia	eye longer than focal length of cornea	• concave lens lengthens focal length • laser reshaping of cornea
Hyperopia	eye shorter than focal length of cornea	• convex lens shortens focal length • laser reshaping of cornea
Presbyopia	(aging) eye muscles cannot adjust lens shape	• bifocal lenses with both convex and concave sections
Astigmatism	oval shaped (not round) cornea	• hard contact lenses matched to eye distortion

24. Example: Did you know that recycling can help people improve their vision? Eyeglasses are expensive. For people in the developing world, the price is out of this world. Even if your glasses can't help you see anymore, they are still useful technology. If you wear eyeglasses, donate your old pair rather than throwing them out. The glasses will be taken to developing countries and matched to a person who cannot afford to buy glasses. Give the gift of sight, a vision for the future.

25. Example: Perhaps the most dangerous part of getting operated on is recovering from the cut. Before fibre optics, surgeons had to cut big openings so they could see organs and do repairs. Fibre optics (and tiny, remote instruments) let surgeons do the same operations through finger-nail sized openings. The fibre optics carry the light and video signal that let surgeons see what they are doing. This reduces exposure to infection, and makes recovery time a fraction of what it used to be.

26. Red light in sunsets is attributed to refraction of sunlight by liquid aerosols (droplets in the atmosphere), which tend to refract blue light back into space and red light to Earth's surface, where it is seen as a sunset. See Figure 11.24 on student textbook page 469, which shows how red light is refracted Earthward by water particles.

Application

27. Example: Because CFLs require less energy than incandescent bulbs, fewer greenhouse gasses are released to create the power to light them.

28. Examples:

- **a.** plane mirror reflects image of back of teeth; convex mirror enlarges field for precision work; concave mirror redirects and intensifies light reaching area
- **b.** convex mirror provides wide angle of view for security surveillance; plane mirror provides view on outside of counter beneath cashier
- **c.** convex mirror provides wide angle view of around corner of switchback; plane mirror helps see around corners

29. So that drivers can read AMBULANCE correctly in their rearview mirror and get out of the way.

30. A convex lens could gather light from a wider angle, redirecting it onto photovoltaic cells.

31. Reflection laws can be applied to bouncing balls, so any sport that makes use of bounce to direct balls could be listed; since the angles of incidence and reflection are equal. For example, billiards, tennis, handball, basketball, or hockey.

32. Example: The diameter of the aperture is important because it determines how much light enters the optical instrument. Photographers must adjust the amount of light to control the characteristics of pictures taken. Telescopes must adjust the amount of light depending on the observed object's luminosity or distance from Earth. An aperture narrower than the lens can help reduce aberration by excluding light rays from the edges of the lens.

Literacy Test Prep

Multiple Choice

33. b.

34. c.

35. d.

36. c.

37. b.

Written Answer

38. Example: A telescope mirror must be highly reflective. Metals are very reflective. Mercury is useful because it is a liquid at room temperature so it forms a parabola (desired shape) when rotated. The expansion and contraction of the liquid does not change the liquid's reflecting properties (as they would for a solid mirror). However, unlike other (solid) metals, mercury is toxic, the mirror must be horizontal, and it must rotate to create the desired shape.