Fig. 16.1

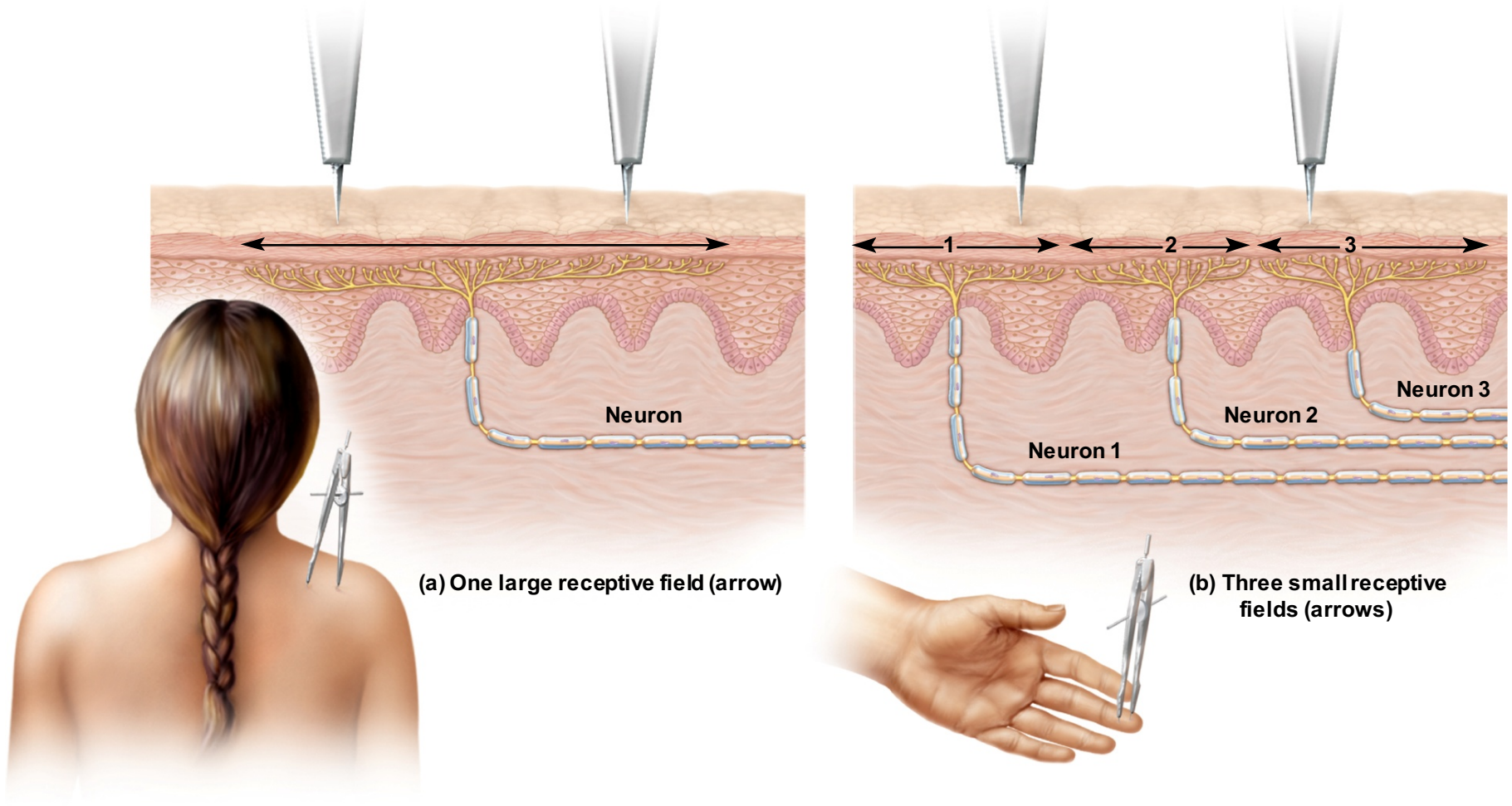


Fig. 16.2

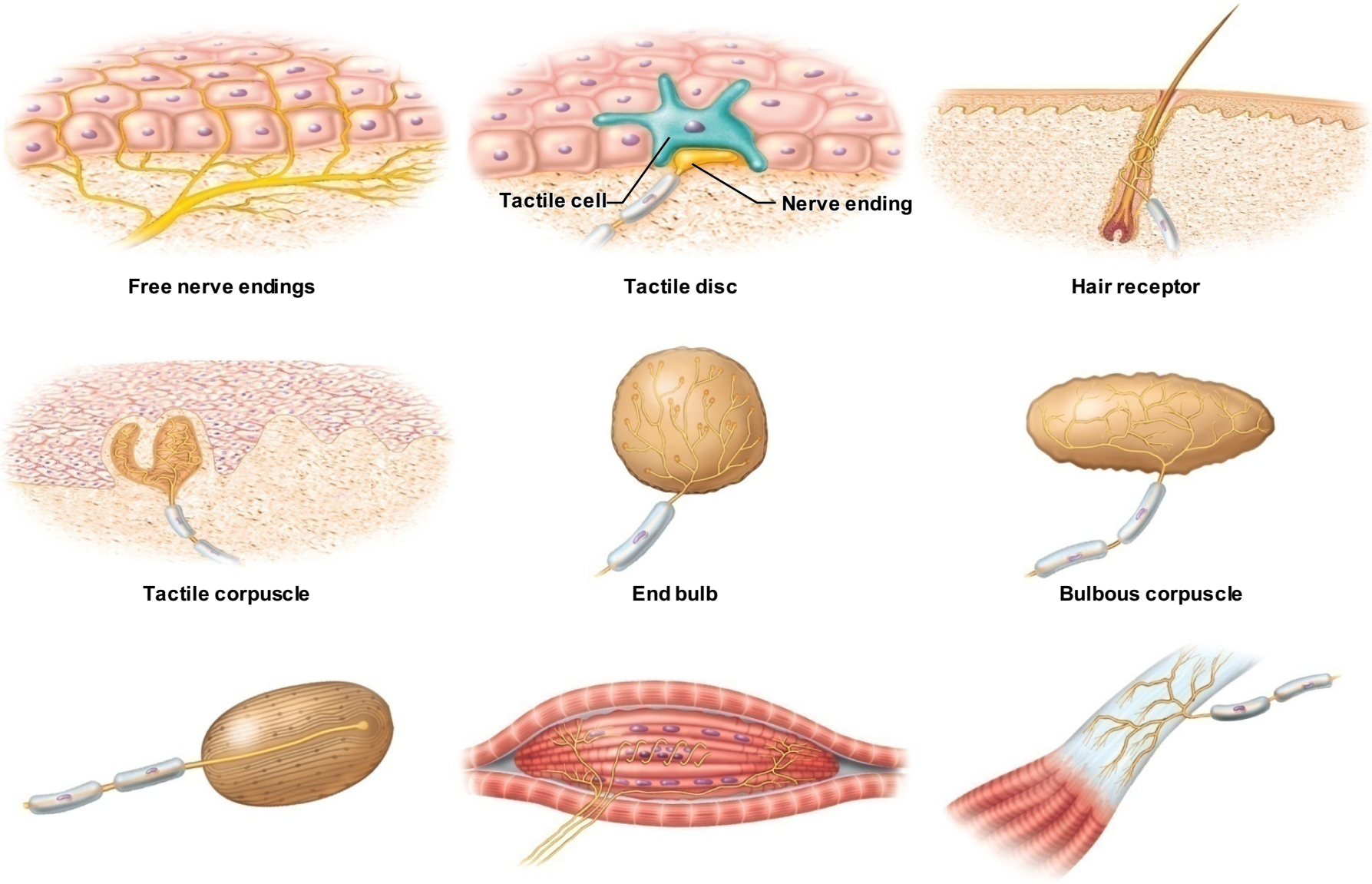


Table 16.1

TABLE 16.1 Receptors of the General Senses

Receptor Type	Locations	Modality
Unencapsulated endings		
Free nerve endings	Widespread, especially in epithelia and connective tissues	Pain, heat, cold
Tactile discs	Stratum basale of epidermis	Light touch, pressure
Hair receptors	Around hair follicle	Light touch, movement of hairs
Encapsulated nerve endings		
Tactile corpuscles	Dermal papillae of fingertips, palms, eyelids, lips, tongue, nipples, and genitals	Light touch, texture
End bulbs	Mucous membranes	Similar to tactile corpuscles
Bulbous corpuscles	Dermis, subcutaneous tissue, and joint capsules	Heavy continuous touch or pressure; joint movements
Lamellar corpuscles	Dermis, joint capsules, periosteum, breasts, genitals, and some viscera	Deep pressure, stretch, tickle, vibration
Muscle spindles	Skeletal muscles near tendon	Muscle stretch (proprioception)
Tendon organs	Tendons	Tension on tendons (proprioception)

Fig. 16.3

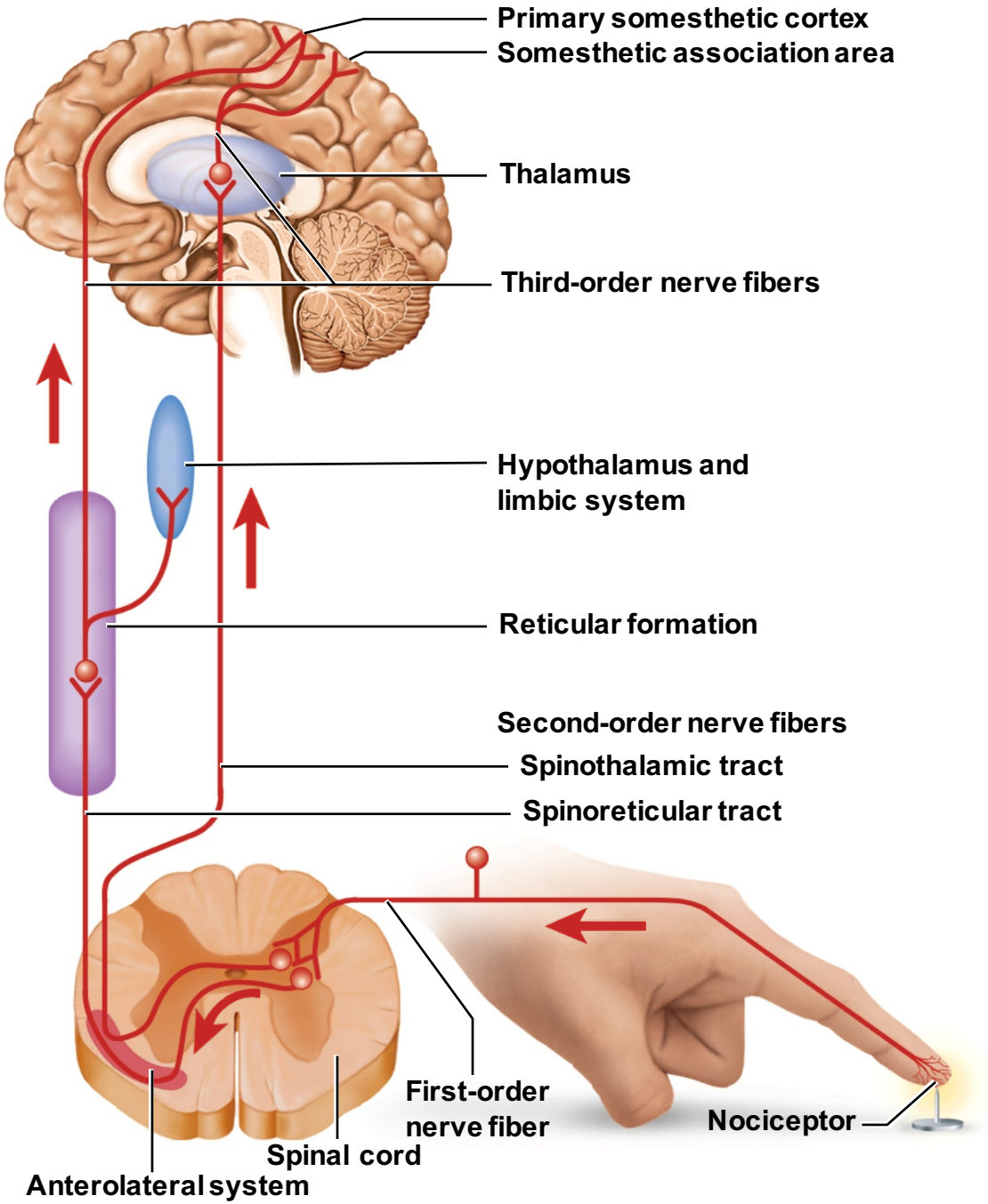
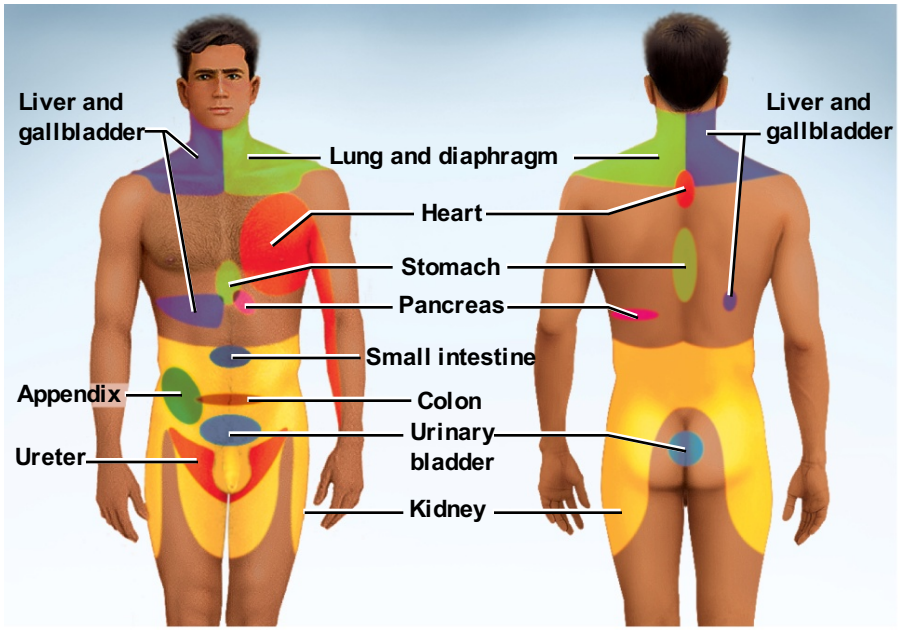
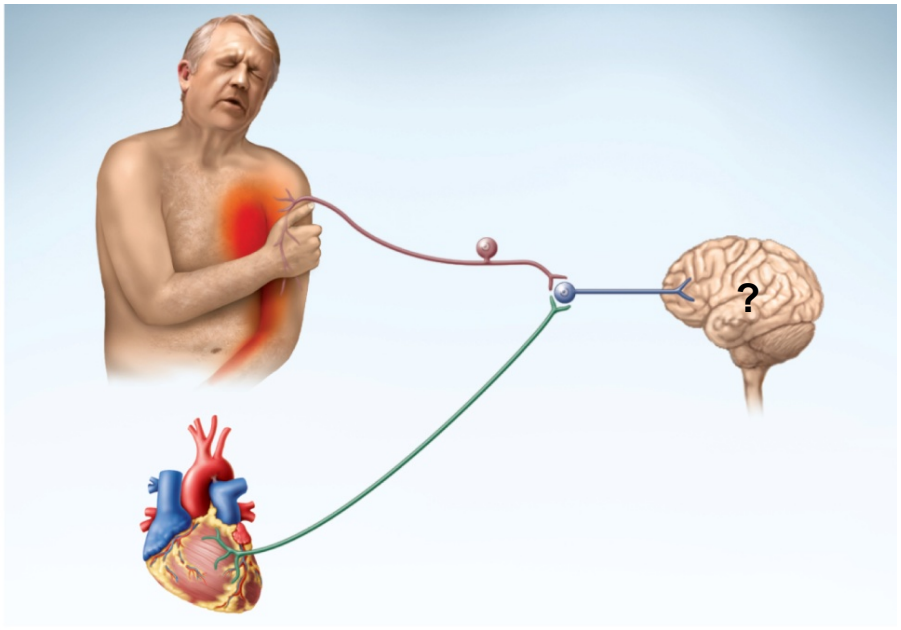


Fig. 16.4

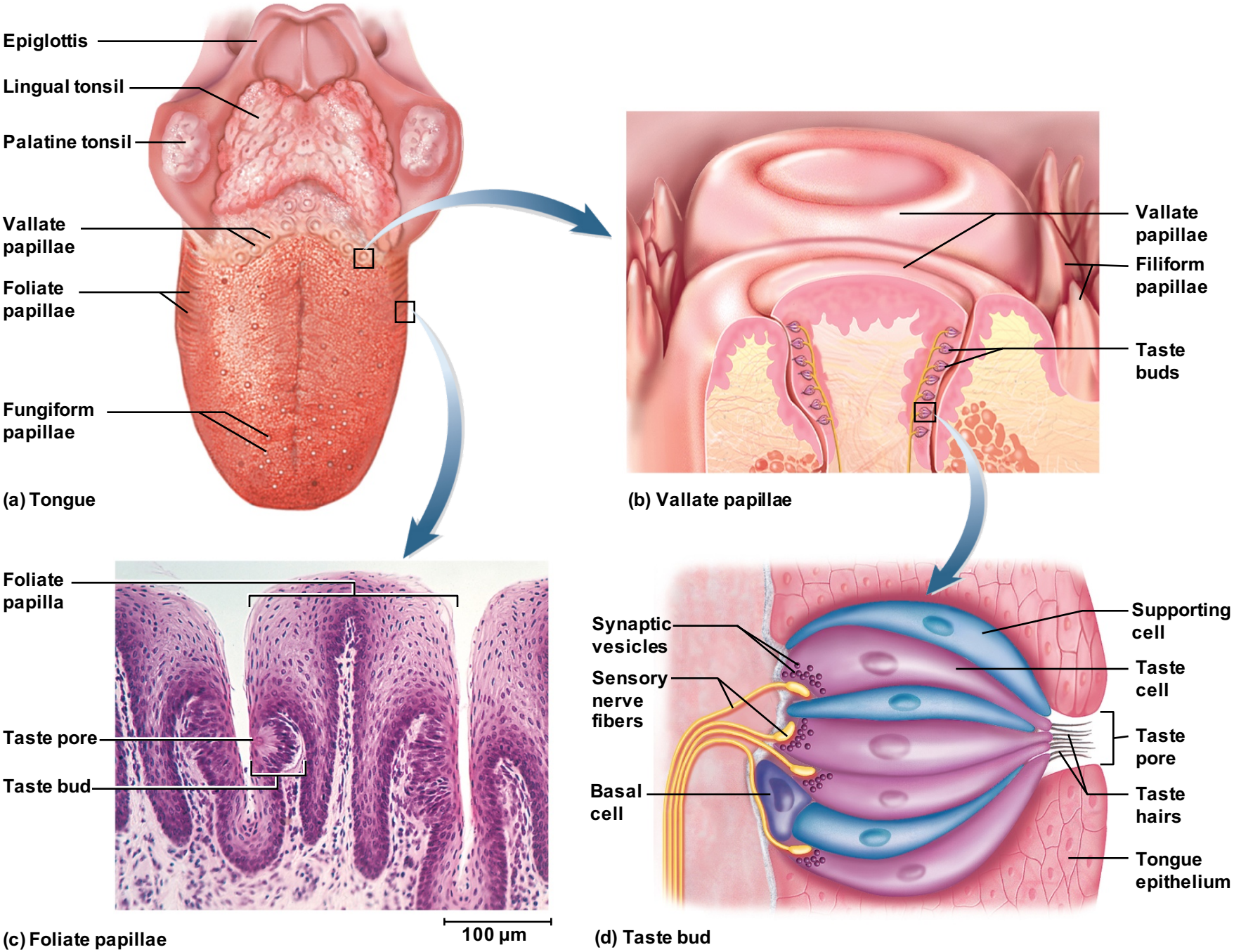


(a)



(b)

Fig. 16.6



c: ©Ed Reschke

Fig. 16.7

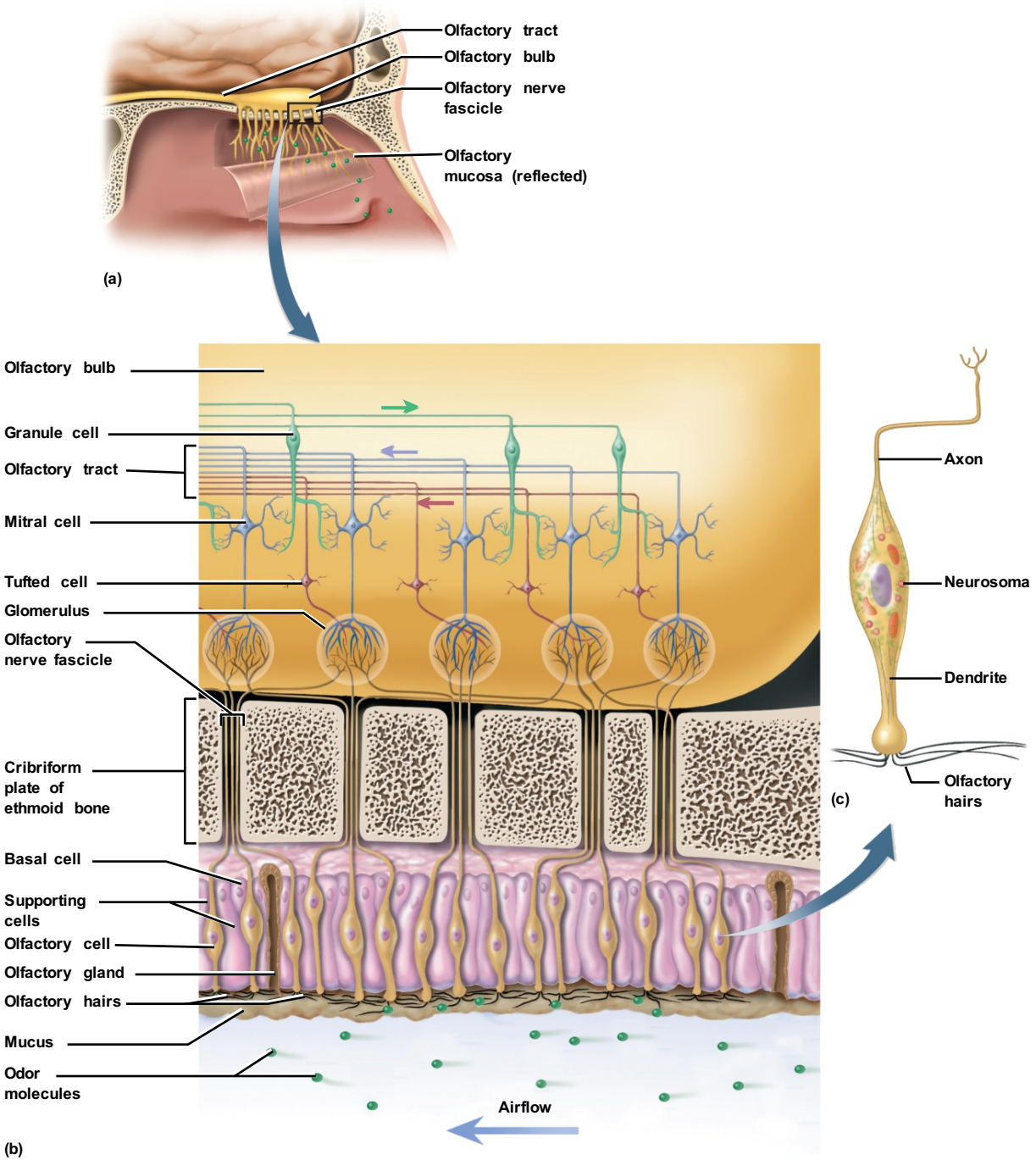


Fig. 16.10

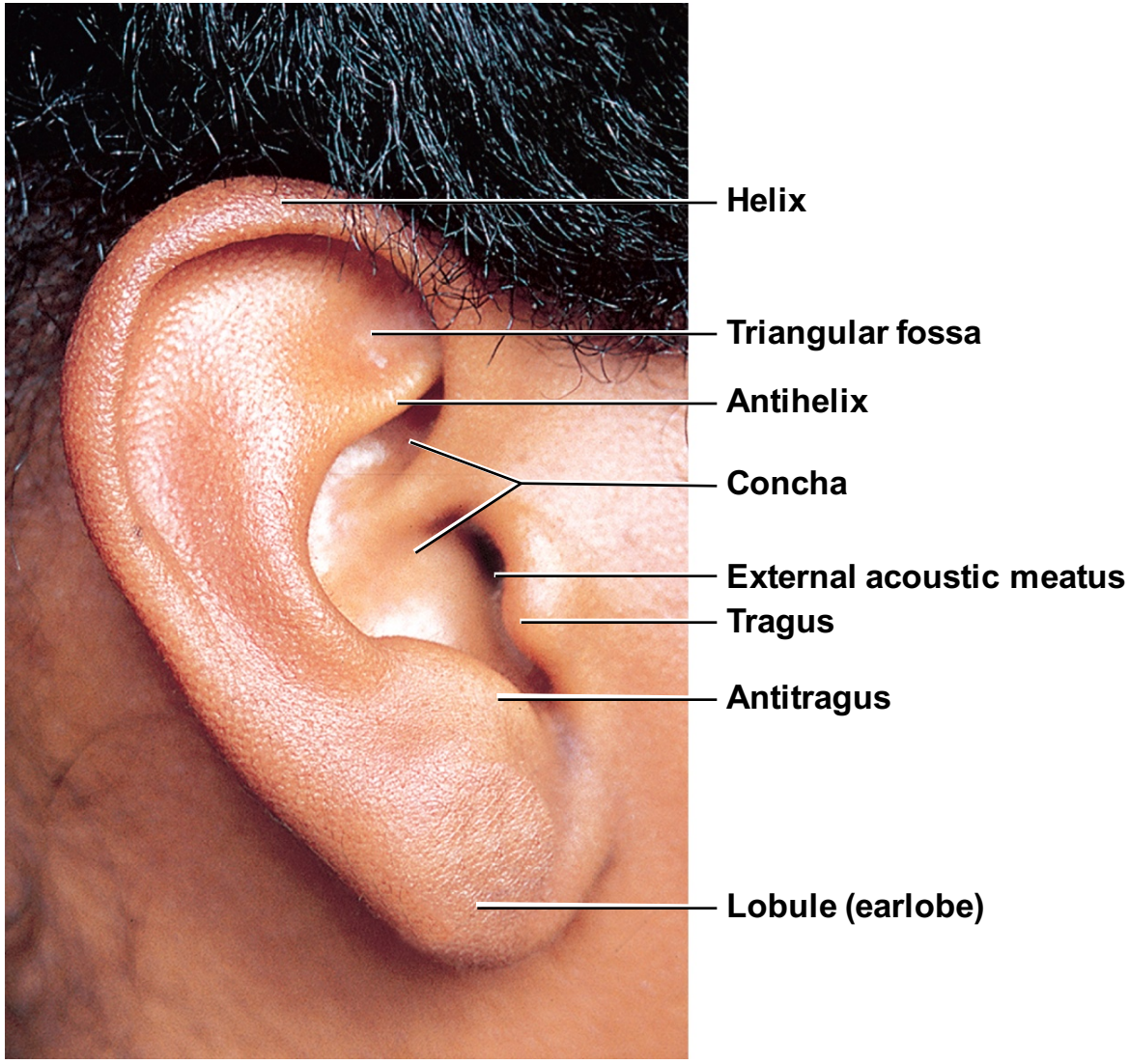


Fig. 16.11

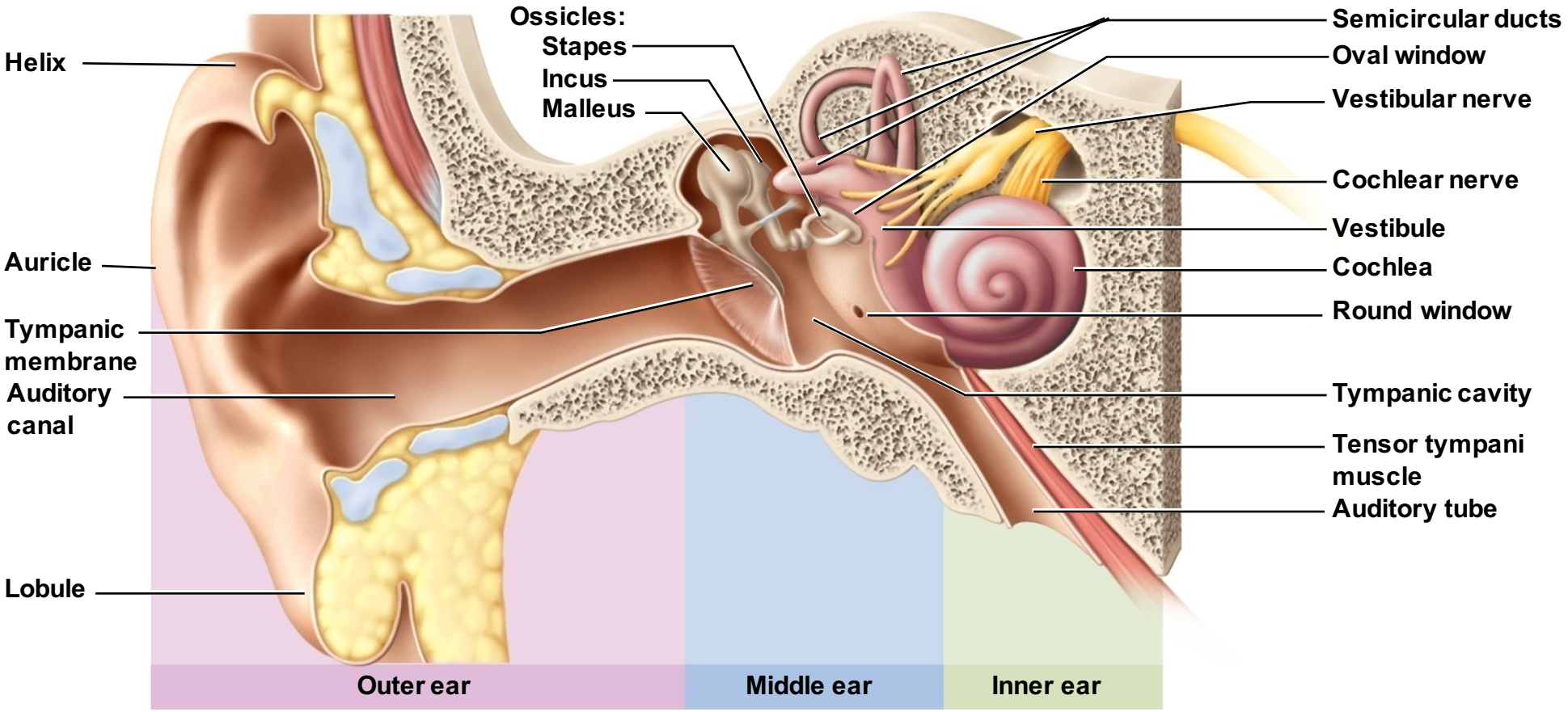


Fig. 16.12

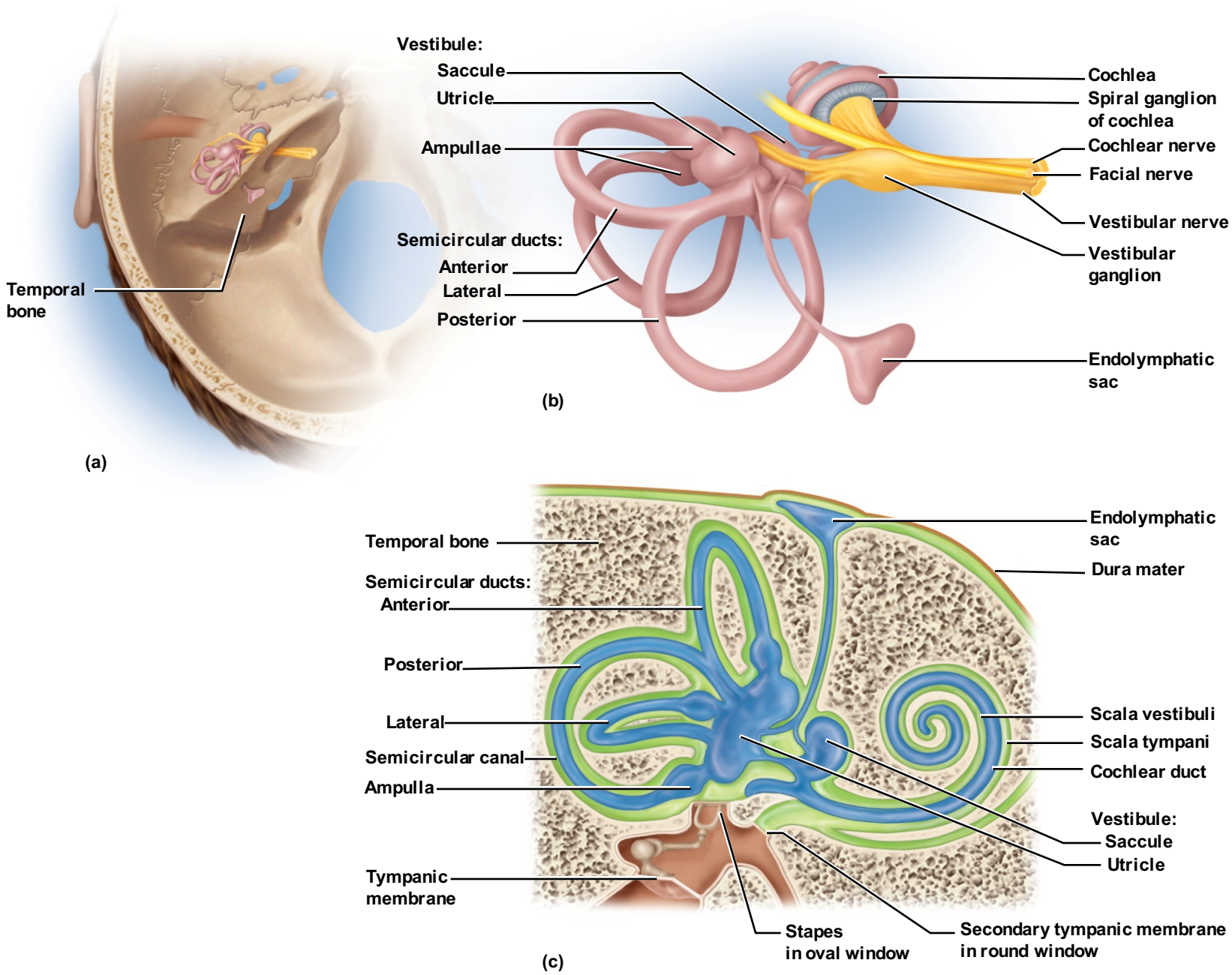


Fig. 16.13

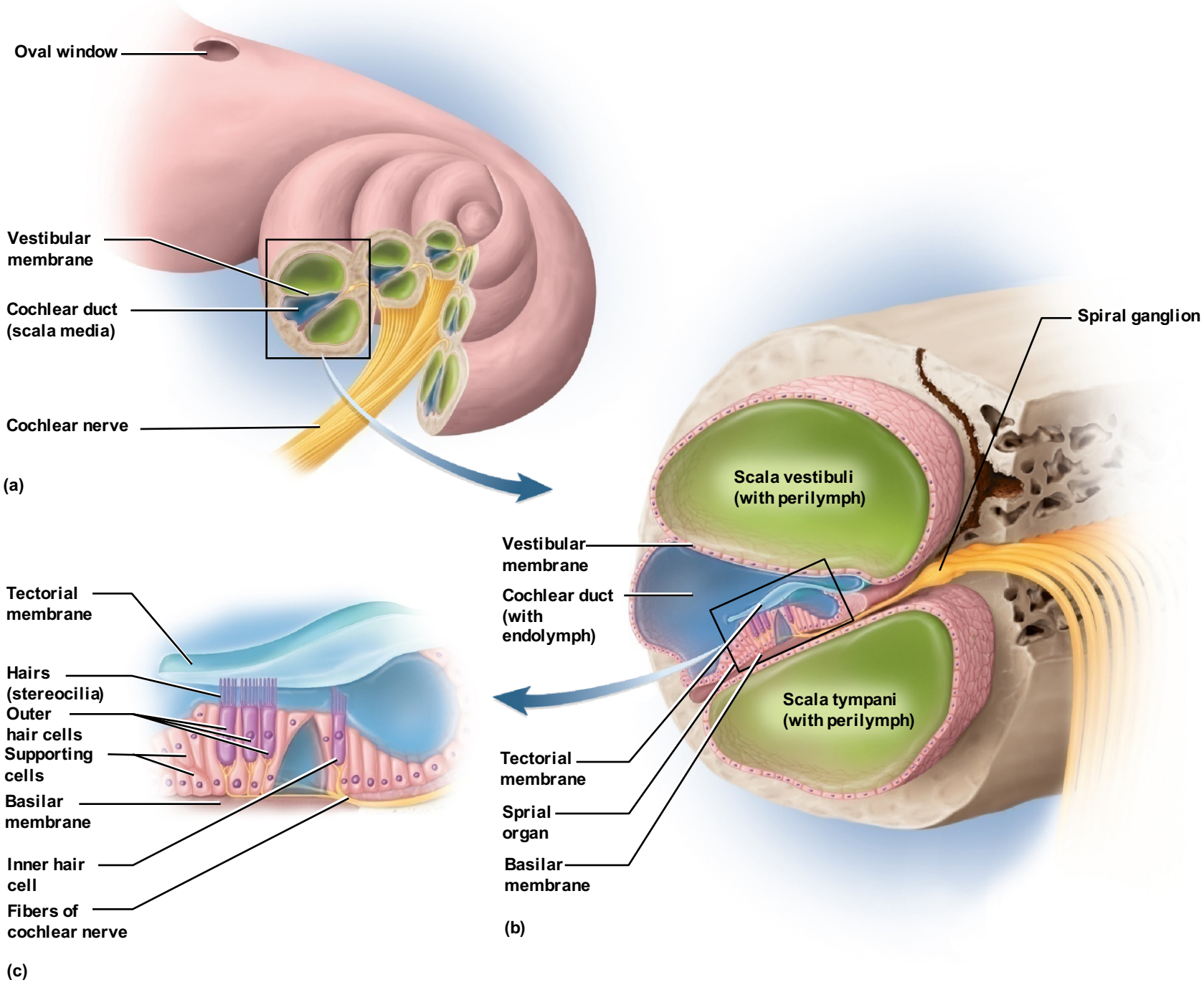


Fig. 16.15

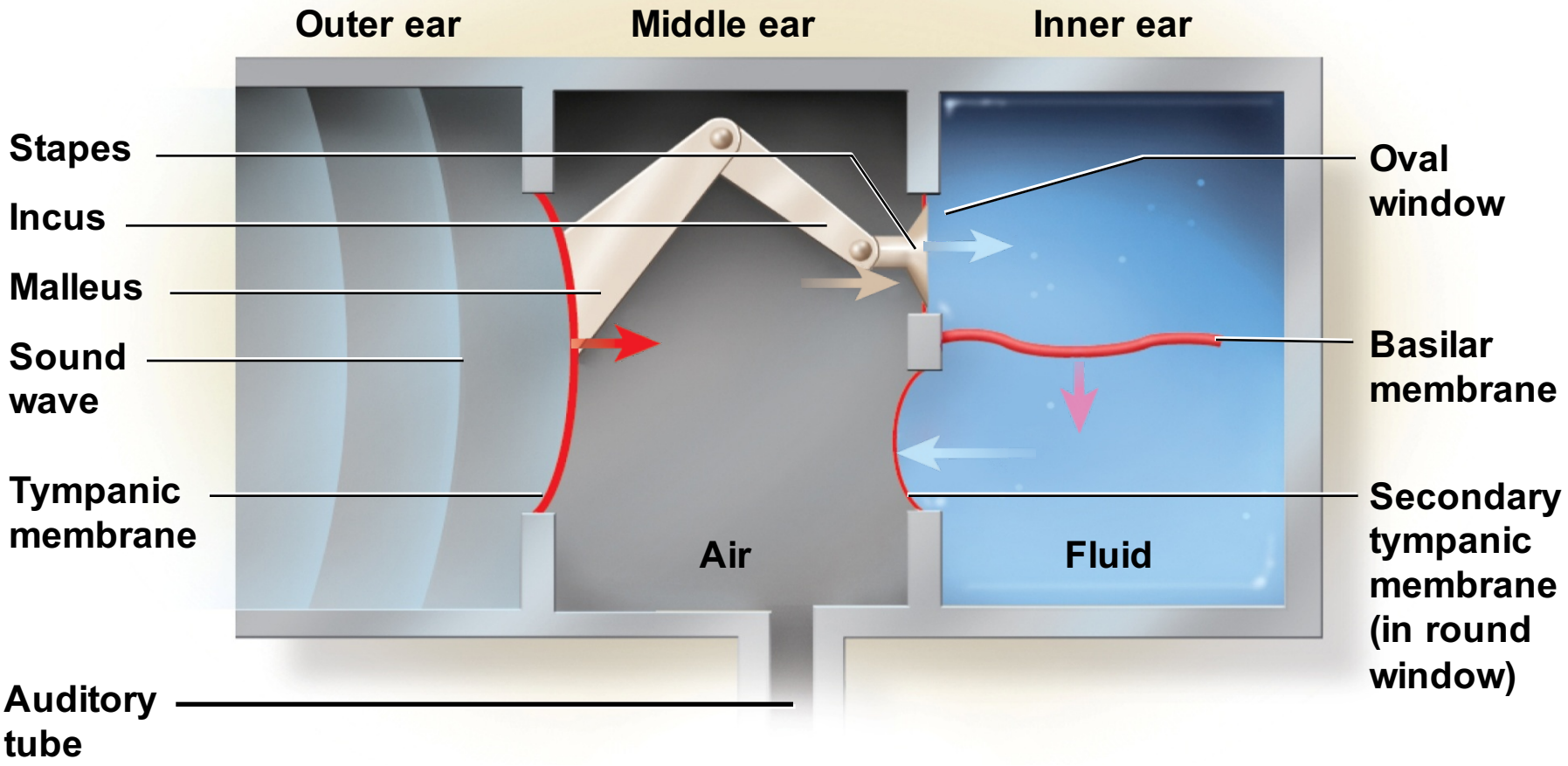


Fig. 16.16

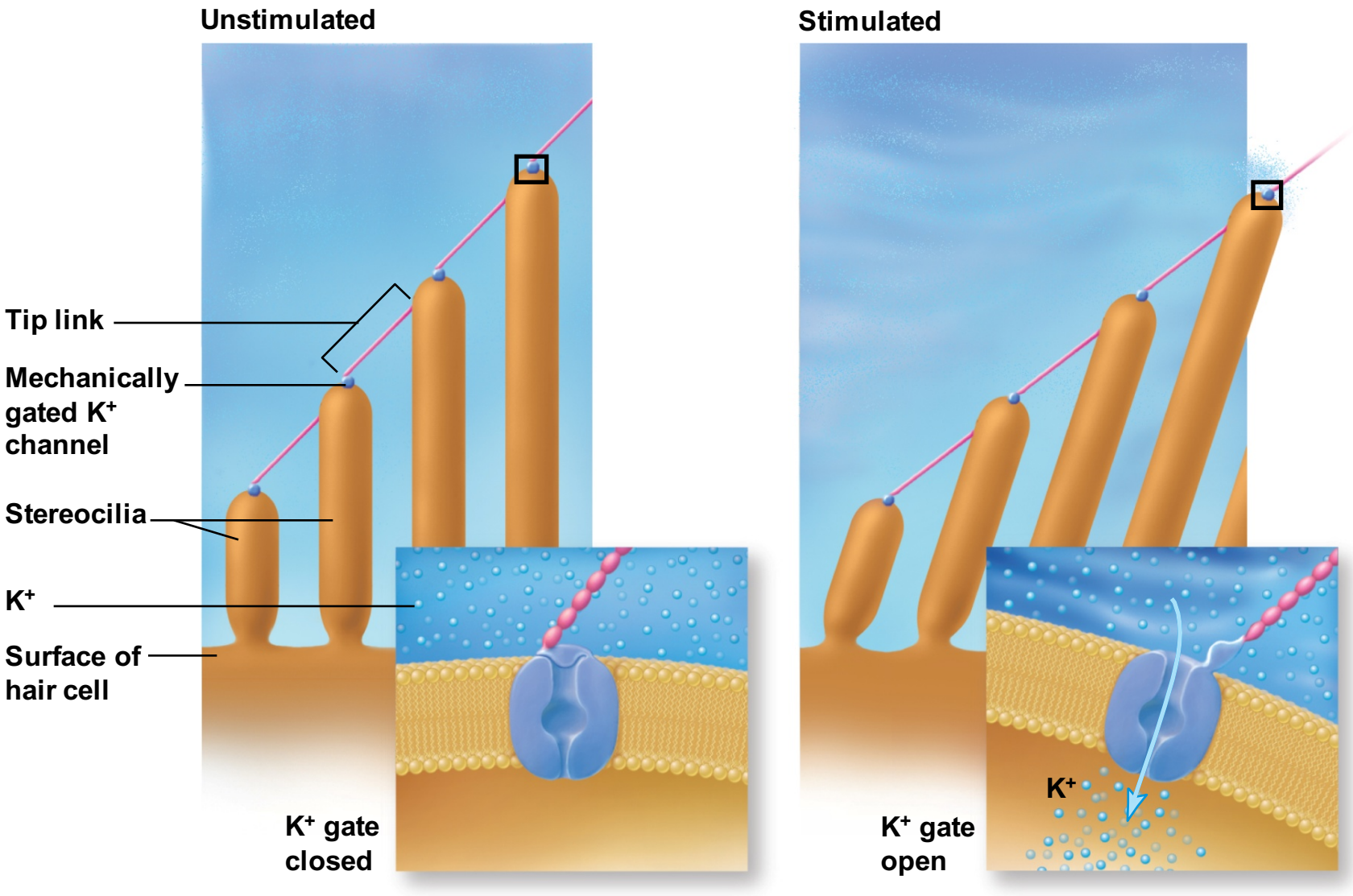
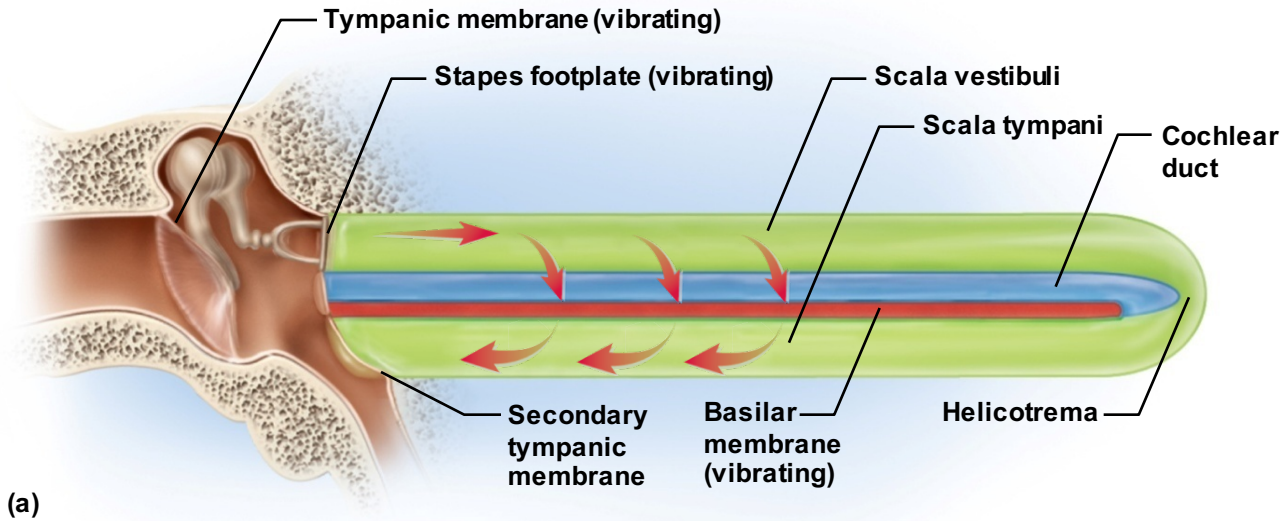
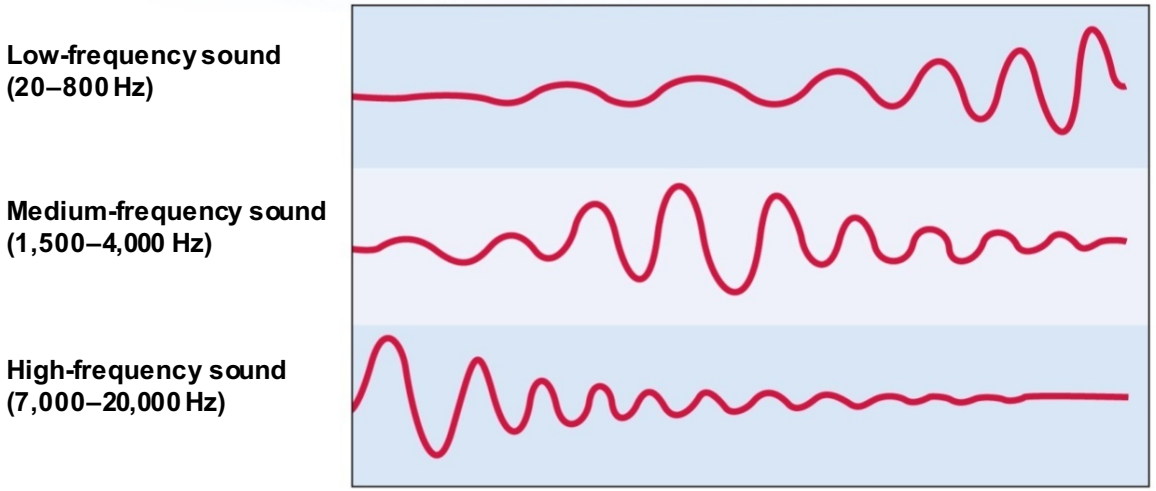


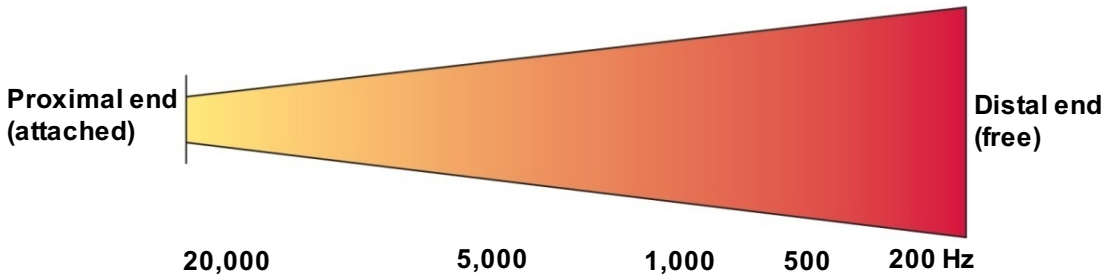
Fig. 16.17



(a)



(b)



(c)

Fig. 16.19

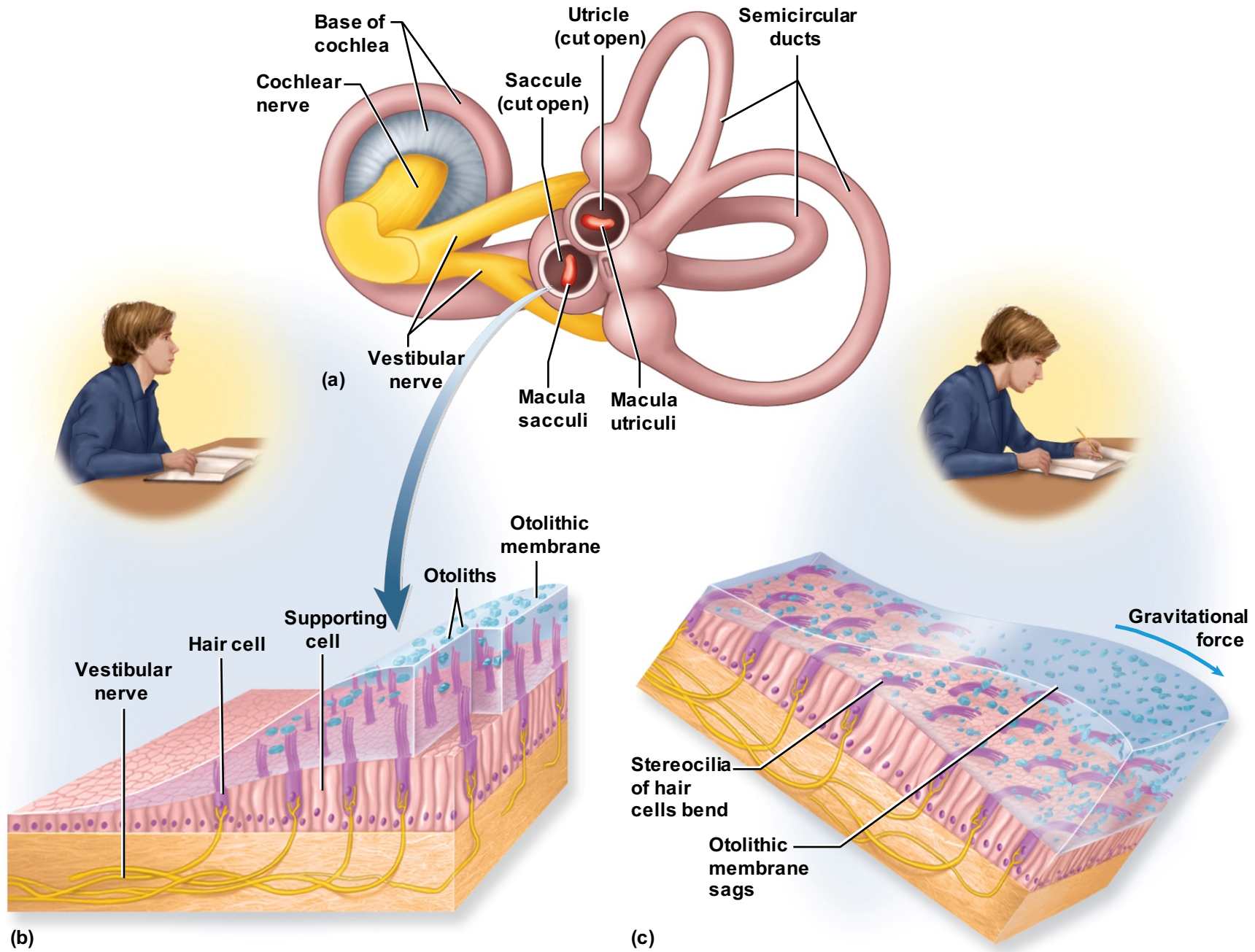


Fig. 16.20

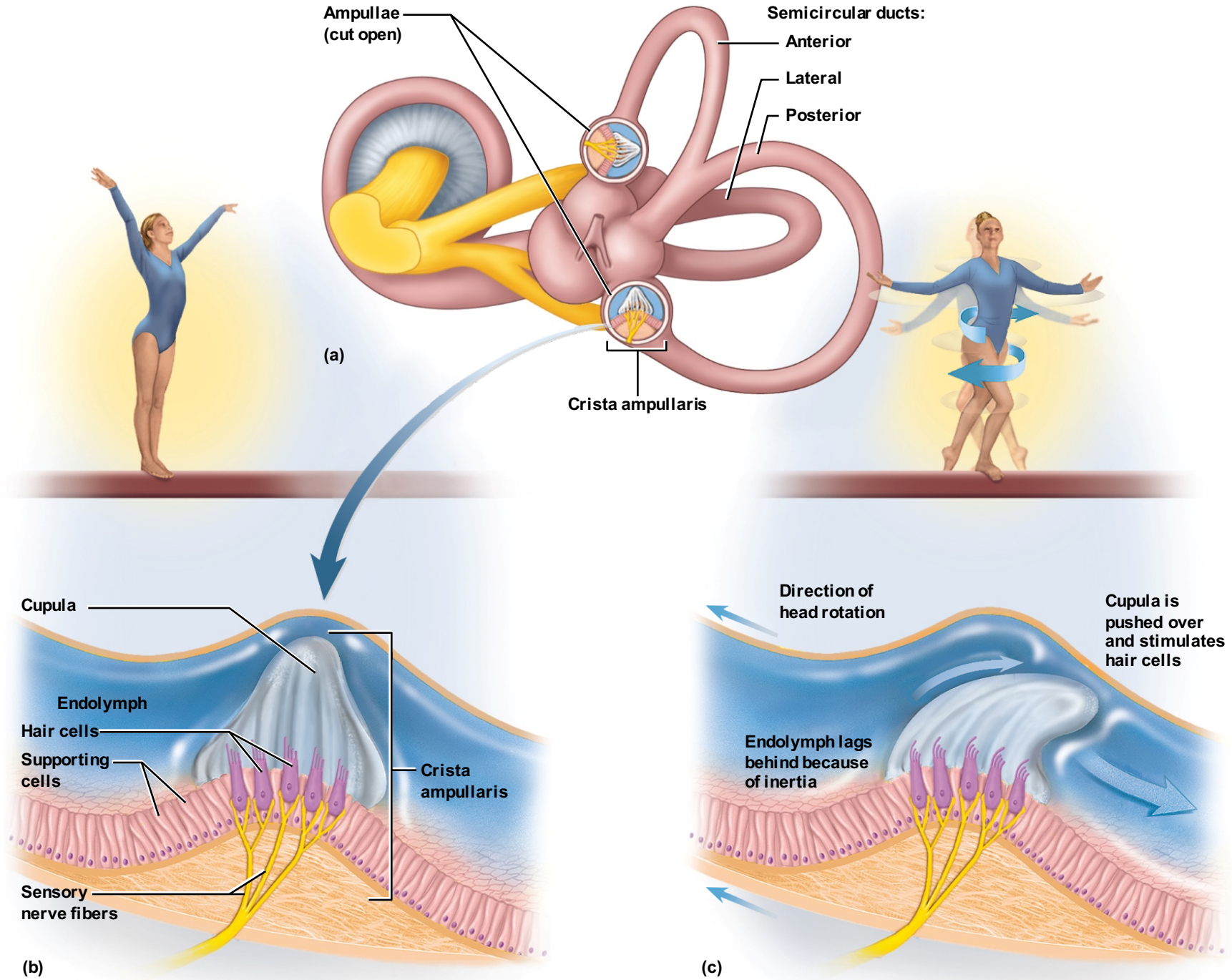


Fig. 16.21

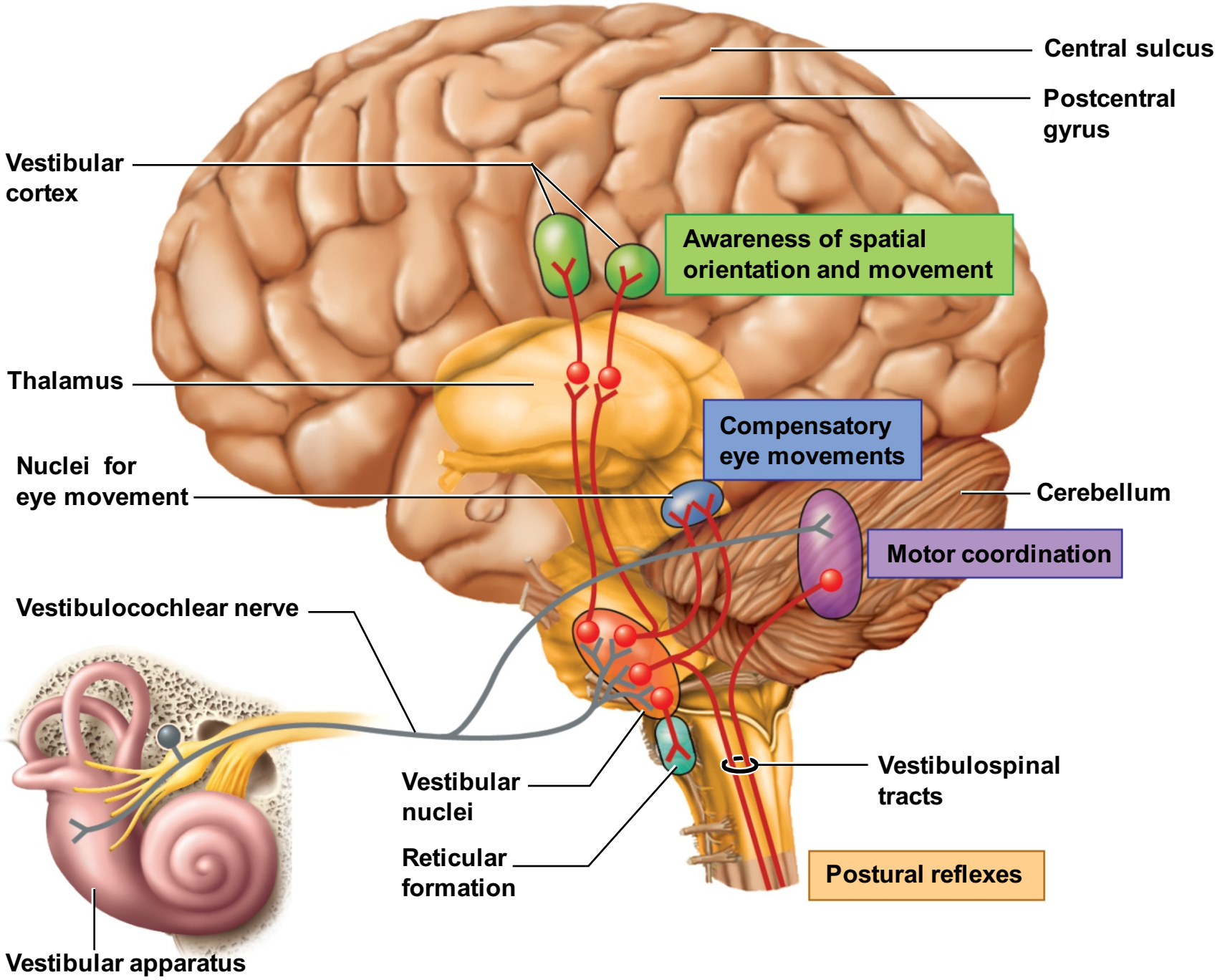


Fig. 16.22

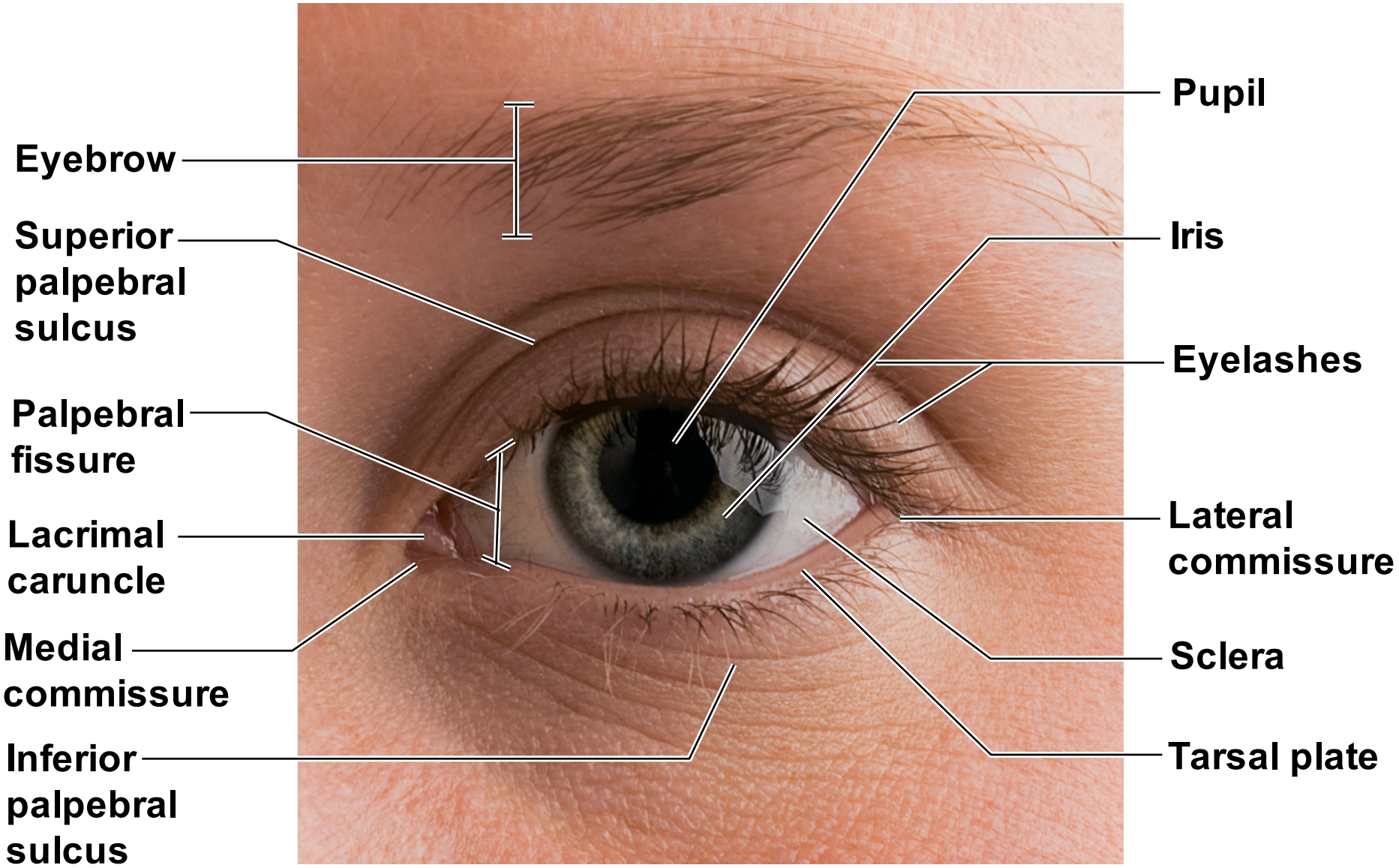


Fig. 16.23

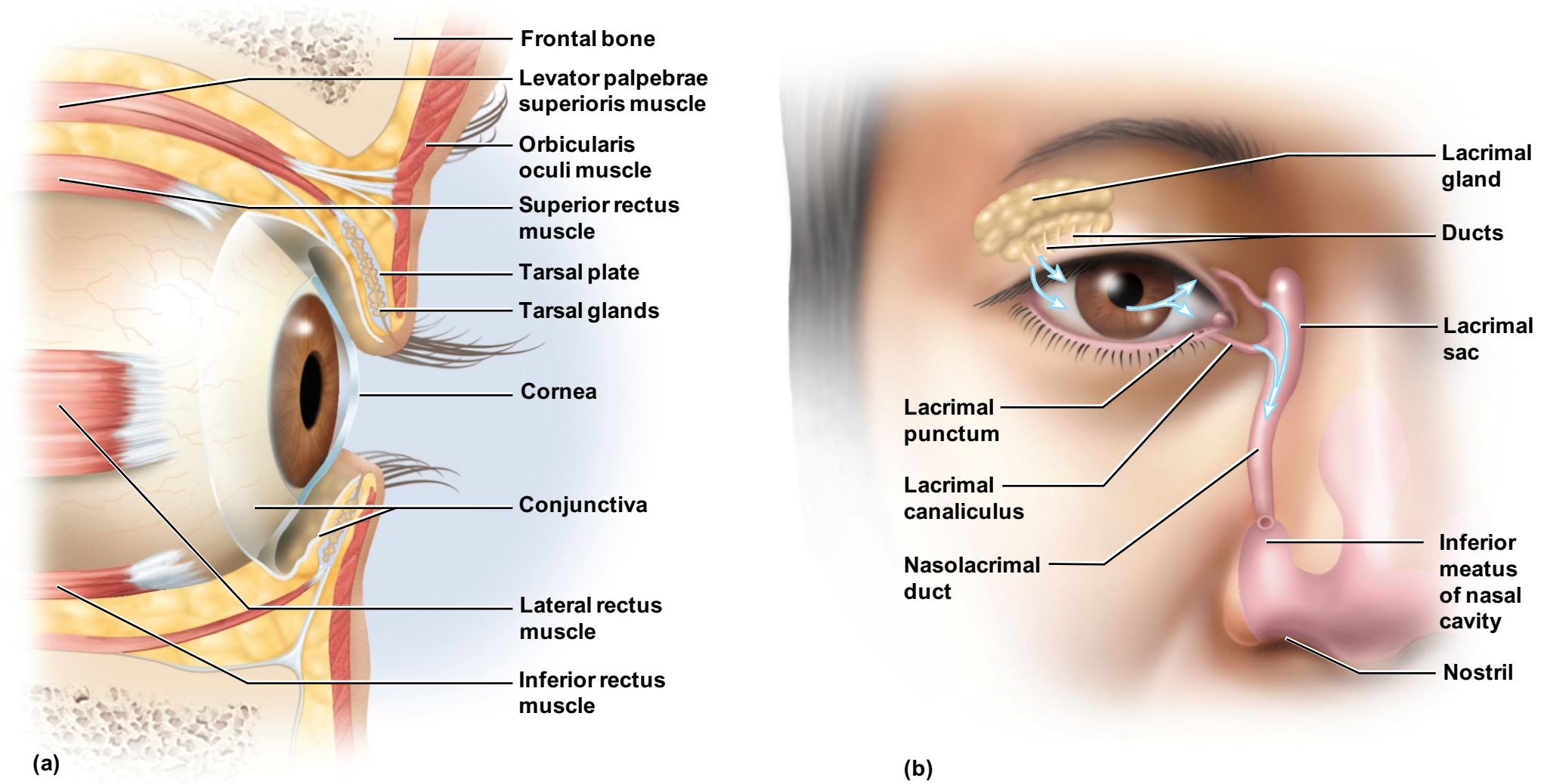


Fig. 16.24

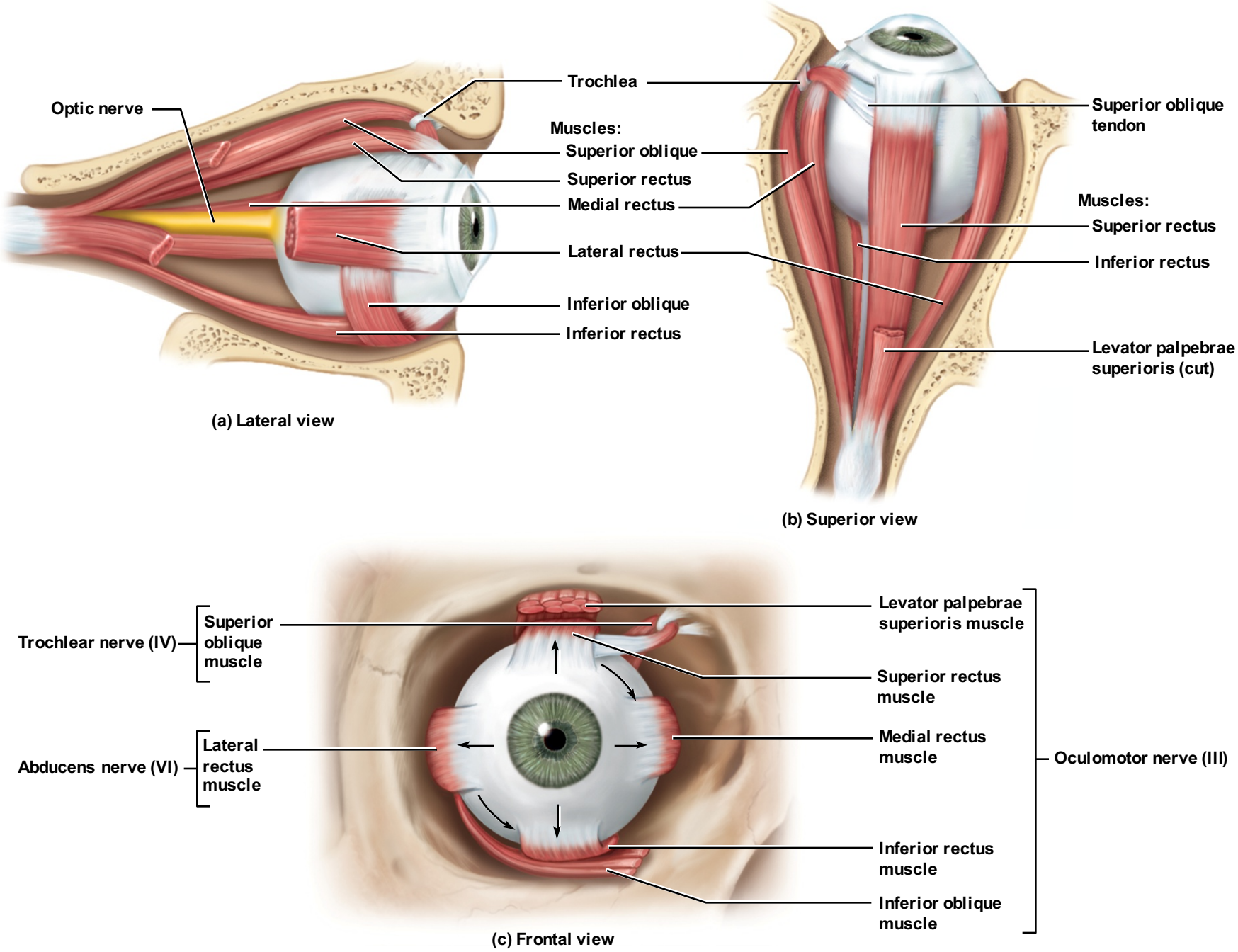


Fig. 16.25

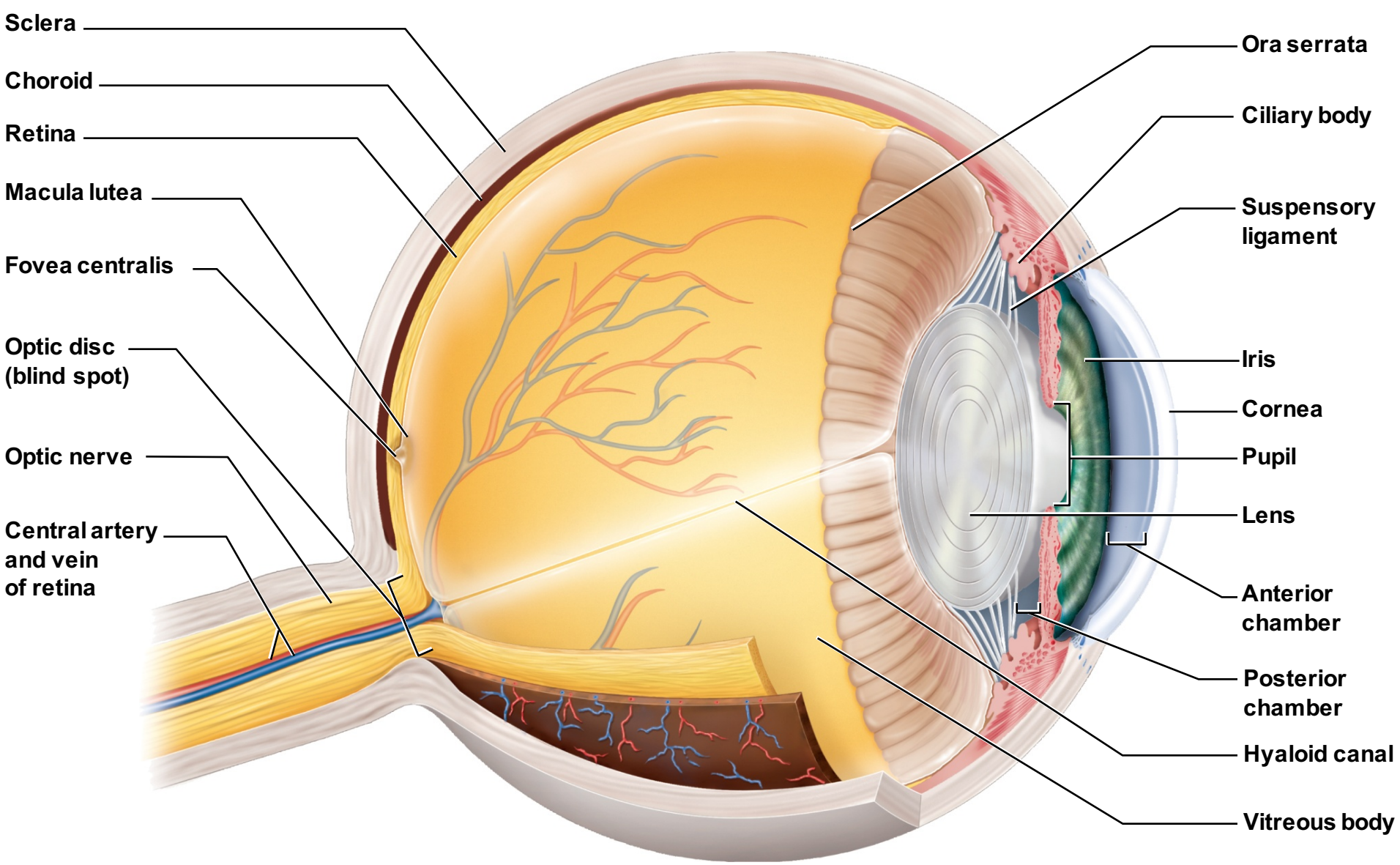


Fig. 16.26

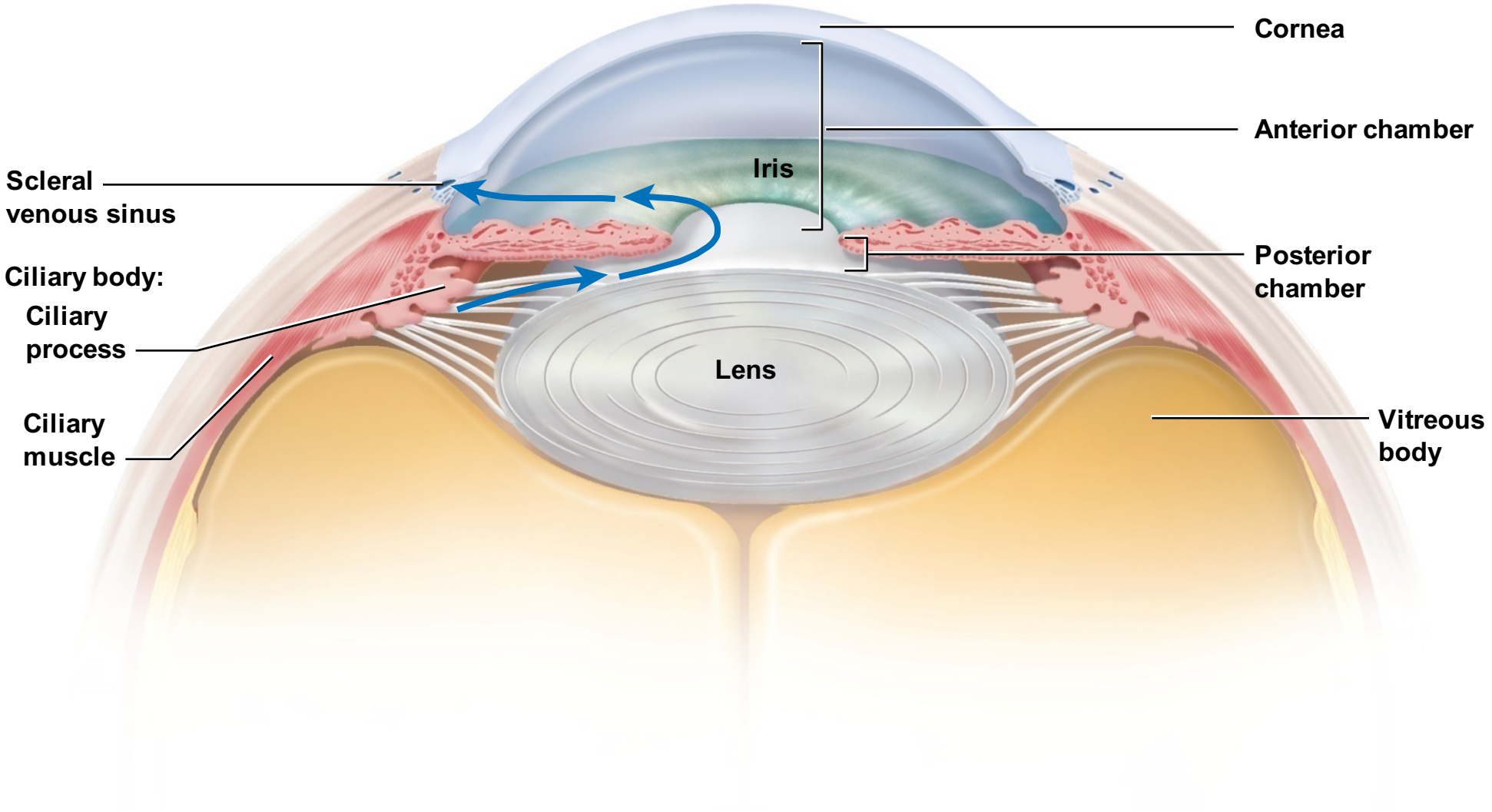


Fig. 16.27

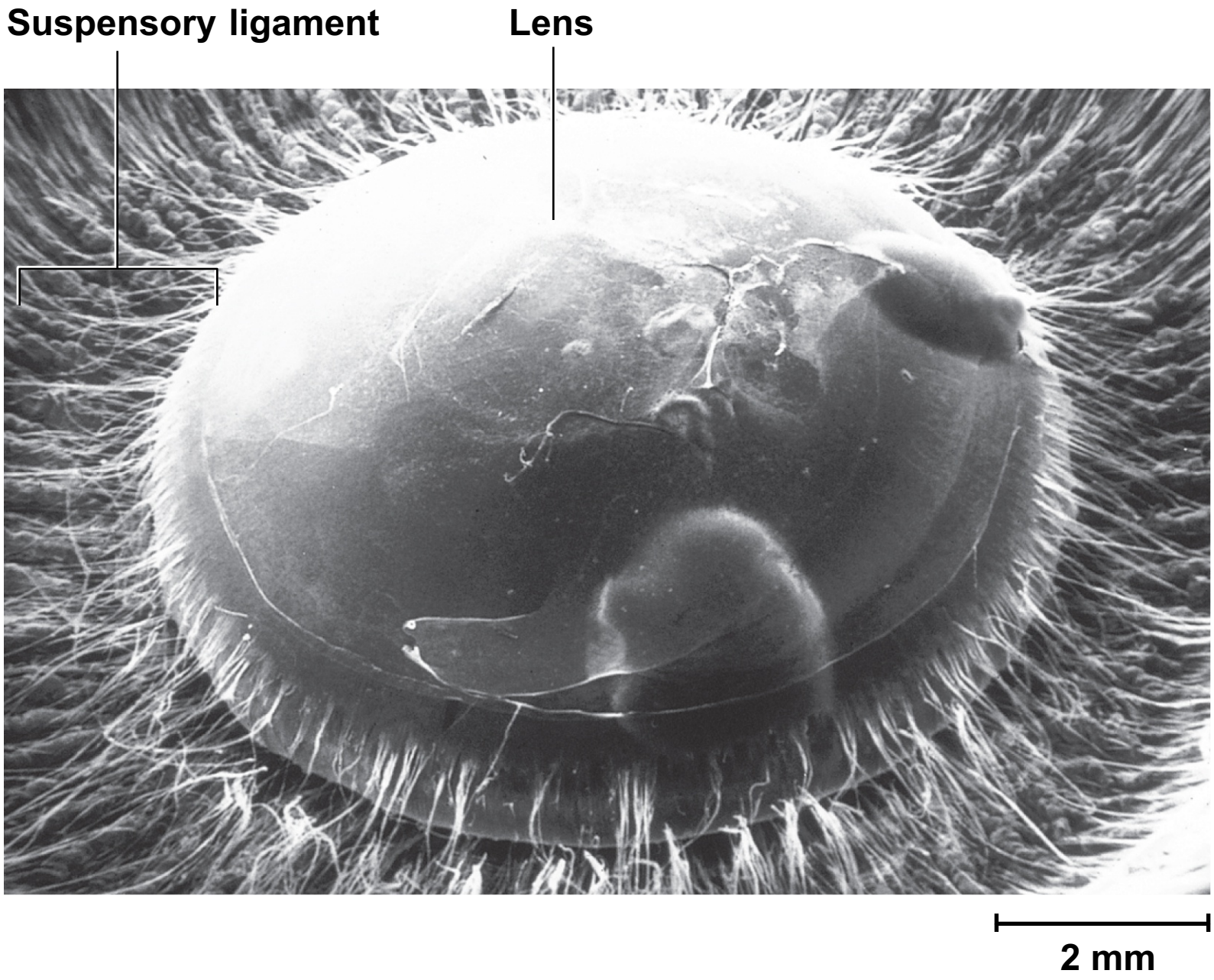
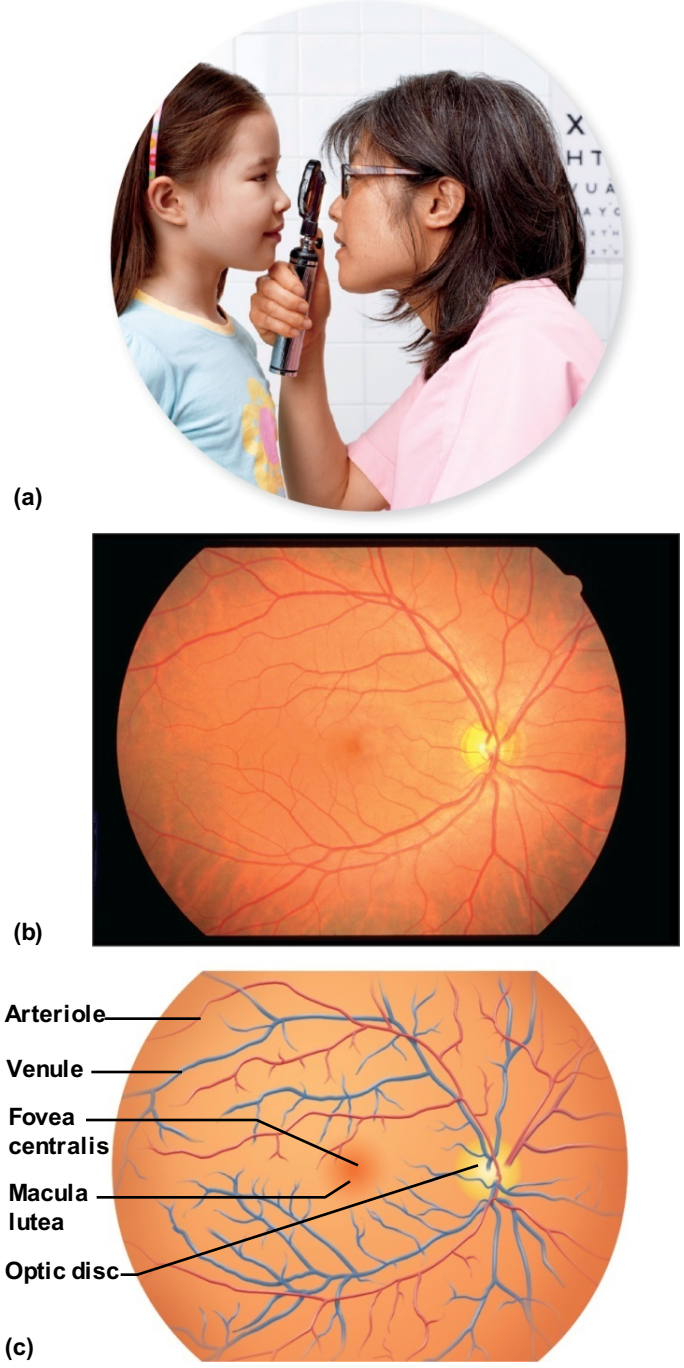


Fig. 16.28



a: ©Peter Dazeley/Getty Images; b: ©Lisa Klancher

Fig. 16.30

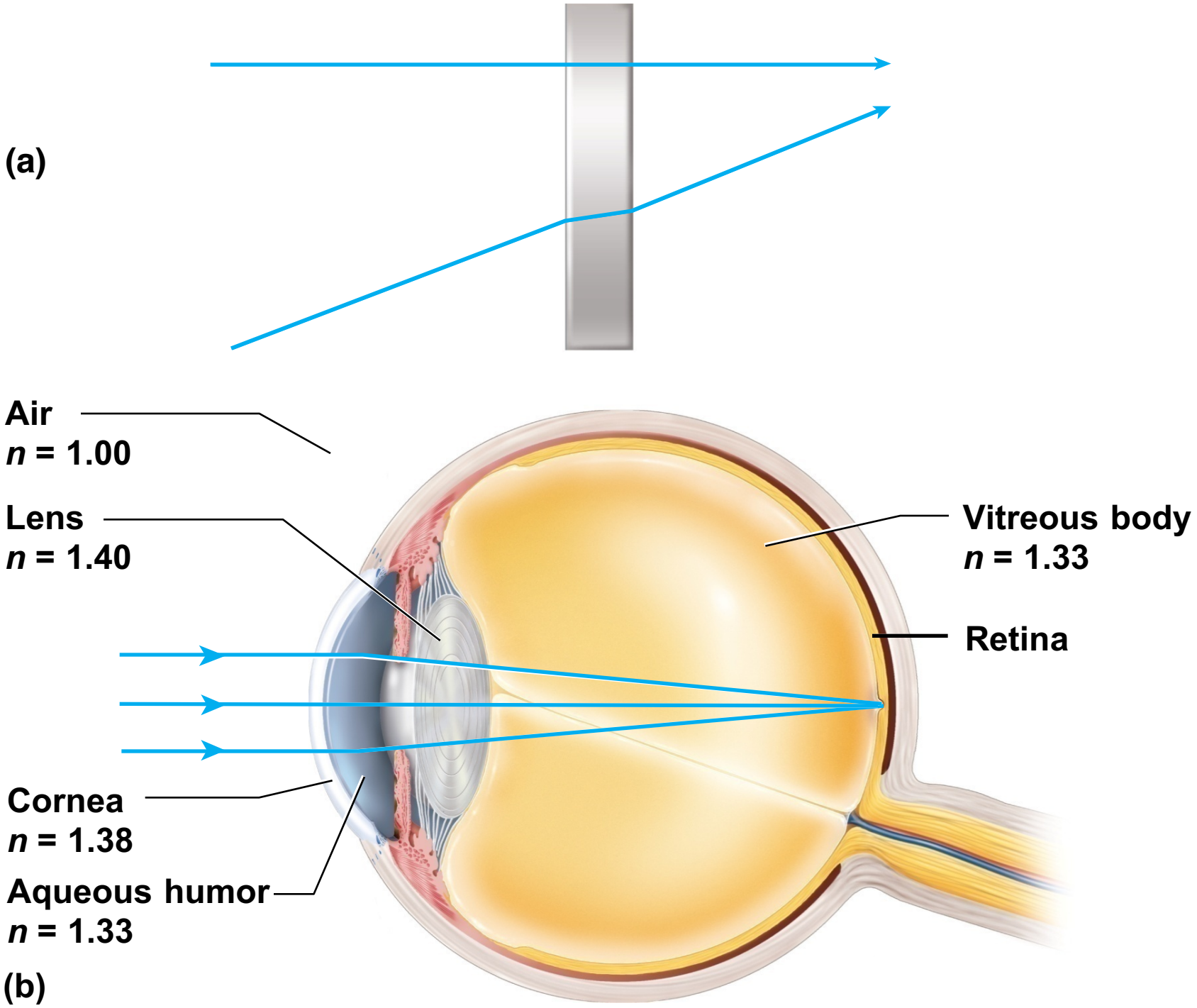
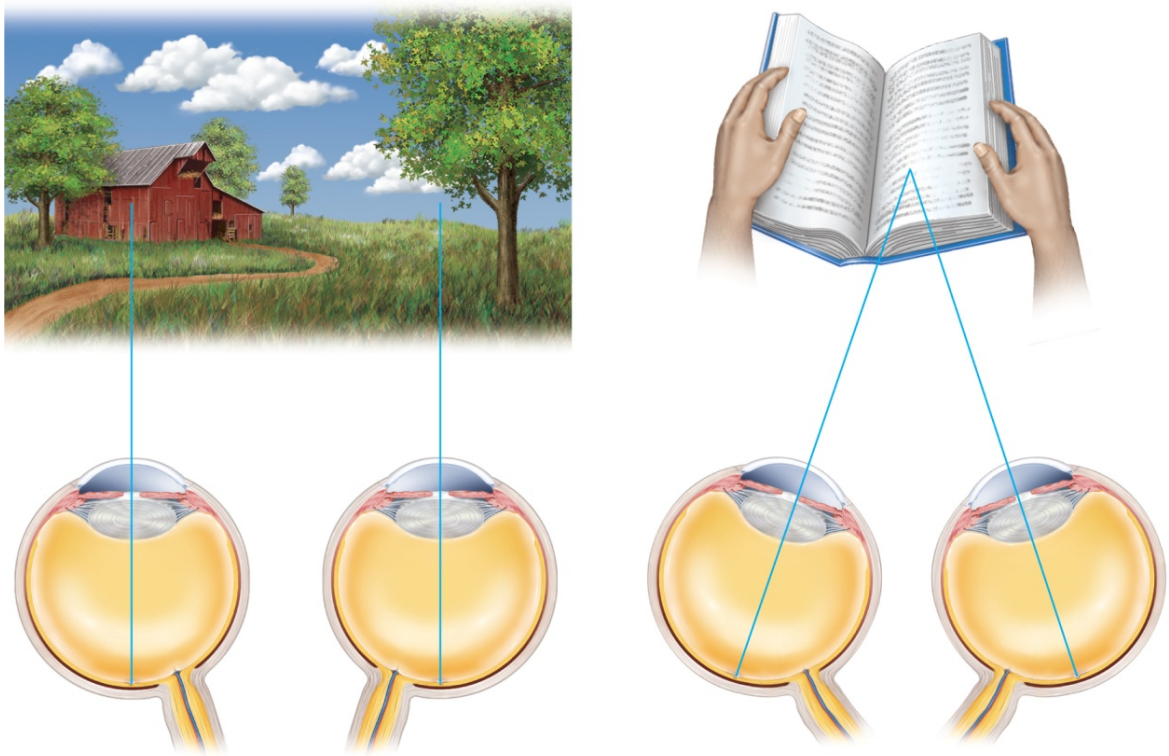


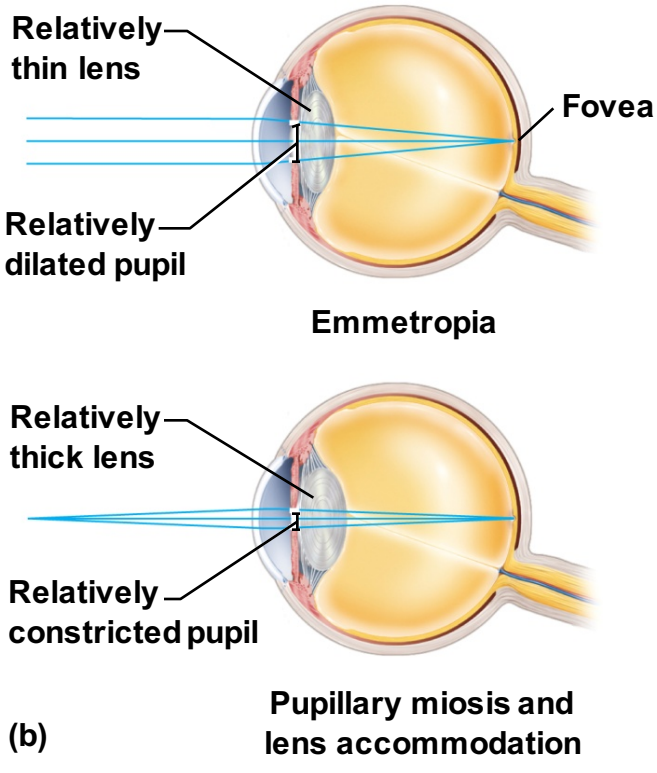
Fig. 16.31



Emmetropia

Convergence

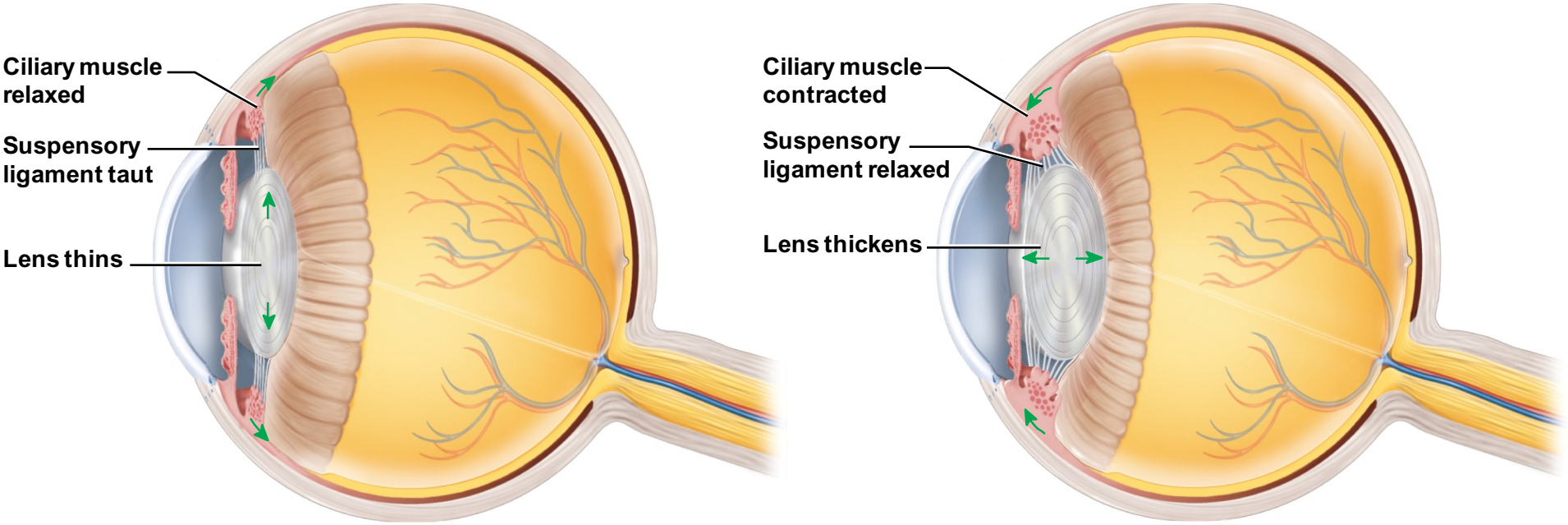
(a)



(b)

Pupillary miosis and lens accommodation

Fig. 16.32



(a) Distant vision (emmetropia)

(b) Near vision (accommodation)

Table 16.2

TABLE 16.2	Common Defects of Image Formation
Astigmatism[55]	Inability to simultaneously focus light rays that enter the eye on different planes. Focusing on vertical lines, such as the edge of a door, may cause horizontal lines, such as a tabletop, to go out of focus. Caused by a deviation in the shape of the cornea so that it is shaped like the back of a spoon rather than part of a sphere. Corrected with *cylindrical lenses,* which refract light more in one plane than another.
Hyperopia[56]	Farsightedness—a condition in which the eyeball is too short. The retina lies in front of the focal point of the lens, and the light rays have not yet come into focus when they reach the retina (see top of fig. 16.33b). Causes the greatest difficulty when viewing nearby objects. Corrected with *convex lenses,* which cause light rays to converge slightly before entering the eye.
Myopia[57]	Nearsightedness—a condition in which the eyeball is too long. Light rays come into focus before they reach the retina and begin to diverge again by the time they fall on it (see top of fig. 16.33c). Corrected with *concave lenses,* which cause light rays to diverge slightly before entering the eye.
Presbyopia[58]	Reduced ability to accommodate for near vision with age. Caused by declining flexibility of the lens. Results in difficulty reading and doing close handwork. Corrected with *bifocal lenses* or reading glasses.

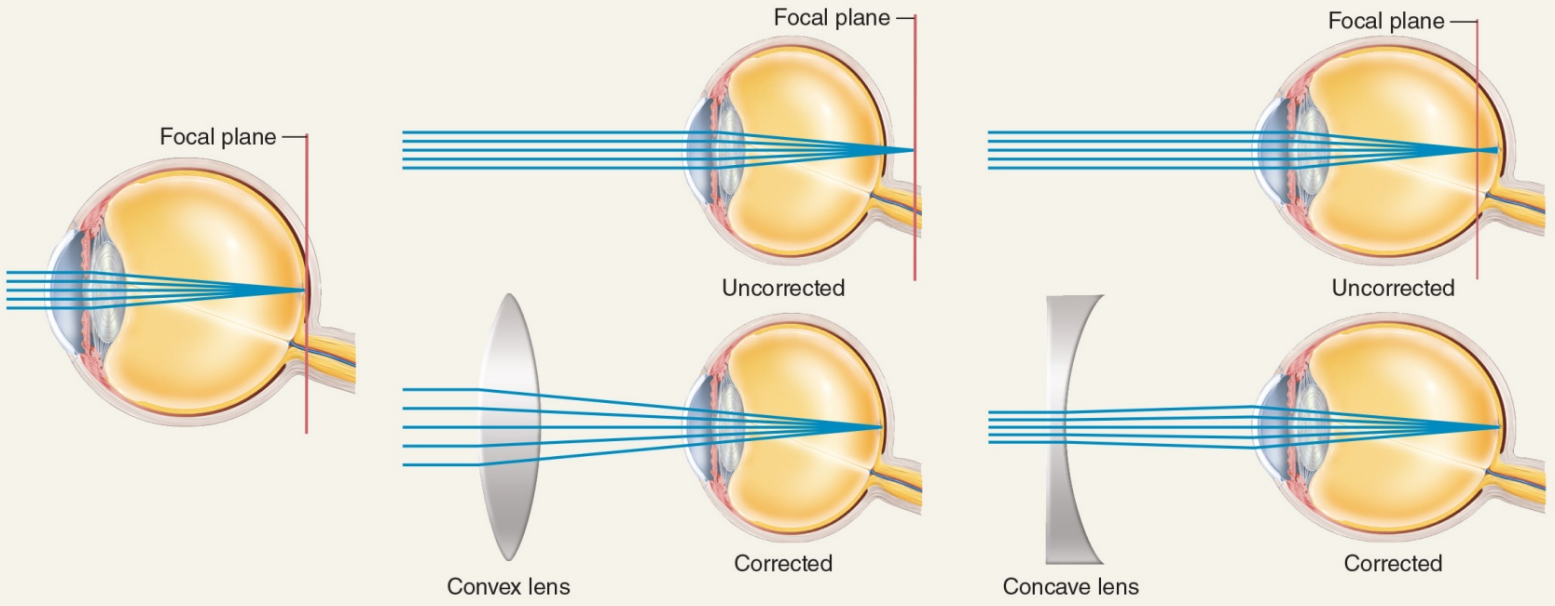
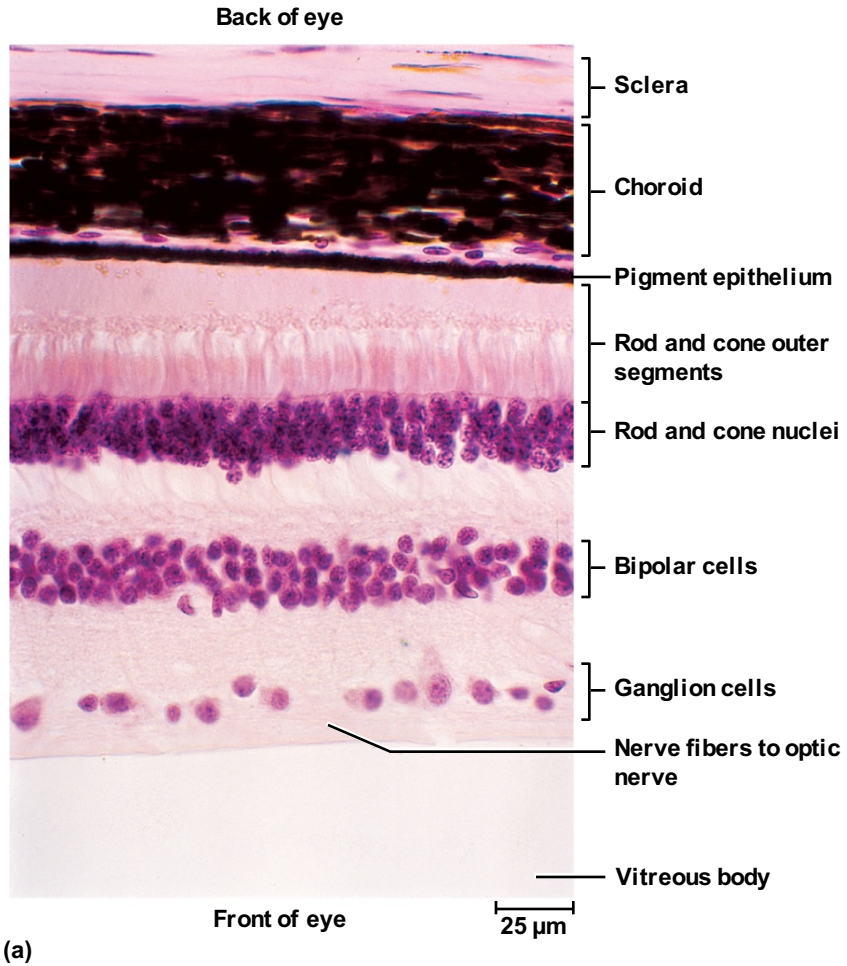


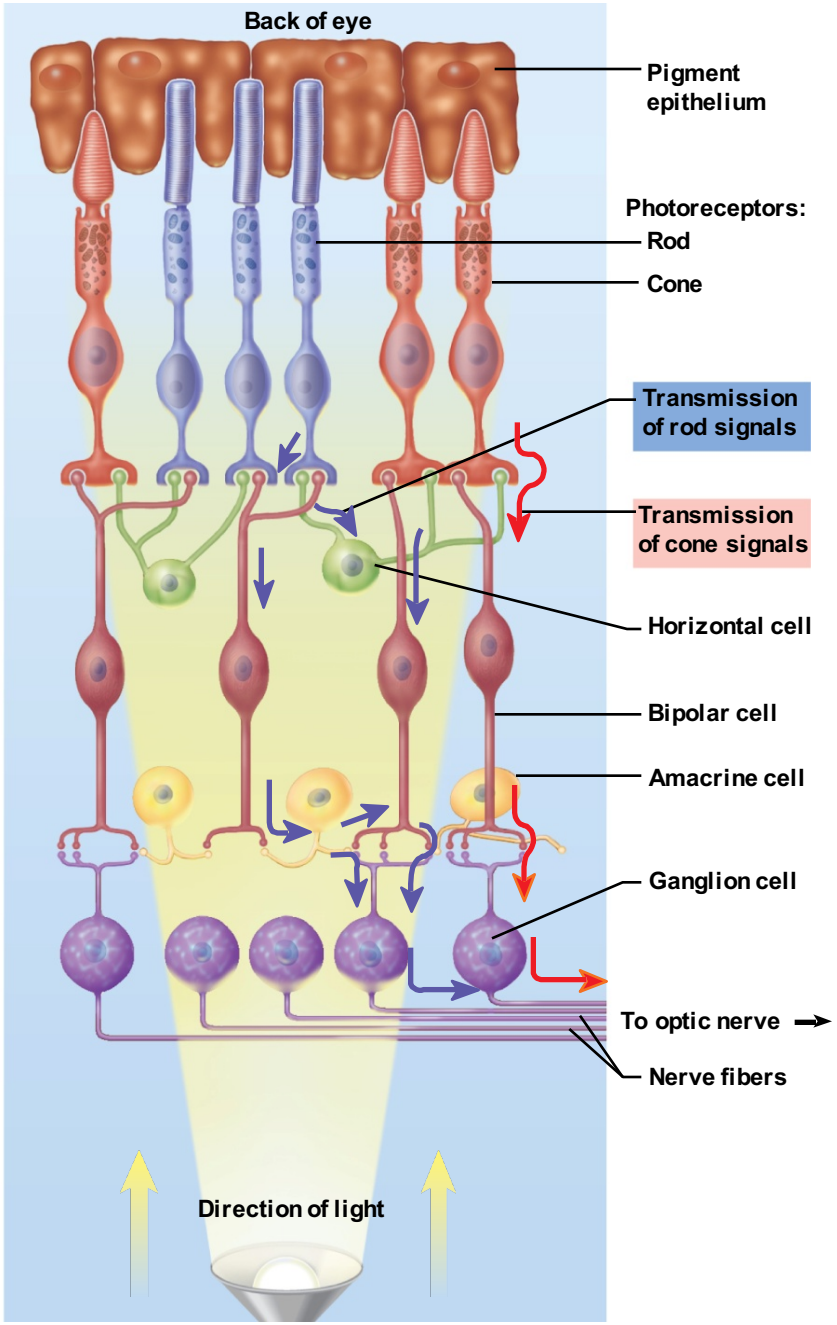
FIGURE 16.33 Two Common Visual Defects and the Effects of Corrective Lenses. (a) The normal emmetropic eye, with light rays converging on the retina. (b) Hyperopia (farsightedness) and the corrective effect of a convex lens. The lens causes light rays to begin converging before they enter the eye, so they reach their focal point farther forward than usual, on the retina of the shortened eyeball. (c) Myopia (nearsightedness) and the corrective effect of a concave lens. By causing light rays to diverge before they enter the eye, this lens shifts the focal point posteriorly so that it falls on the retina of the elongated eye.

[55] *a* = not; *stigma* = point; *ism* = condition
[56] *hyper* = excessive; *op* = eye; *ia* = condition
[57] *my* = closed; *op* = eye; *ia* = condition
[58] *presby* = old; *op* = eye; *ia* = condition

Fig. 16.34



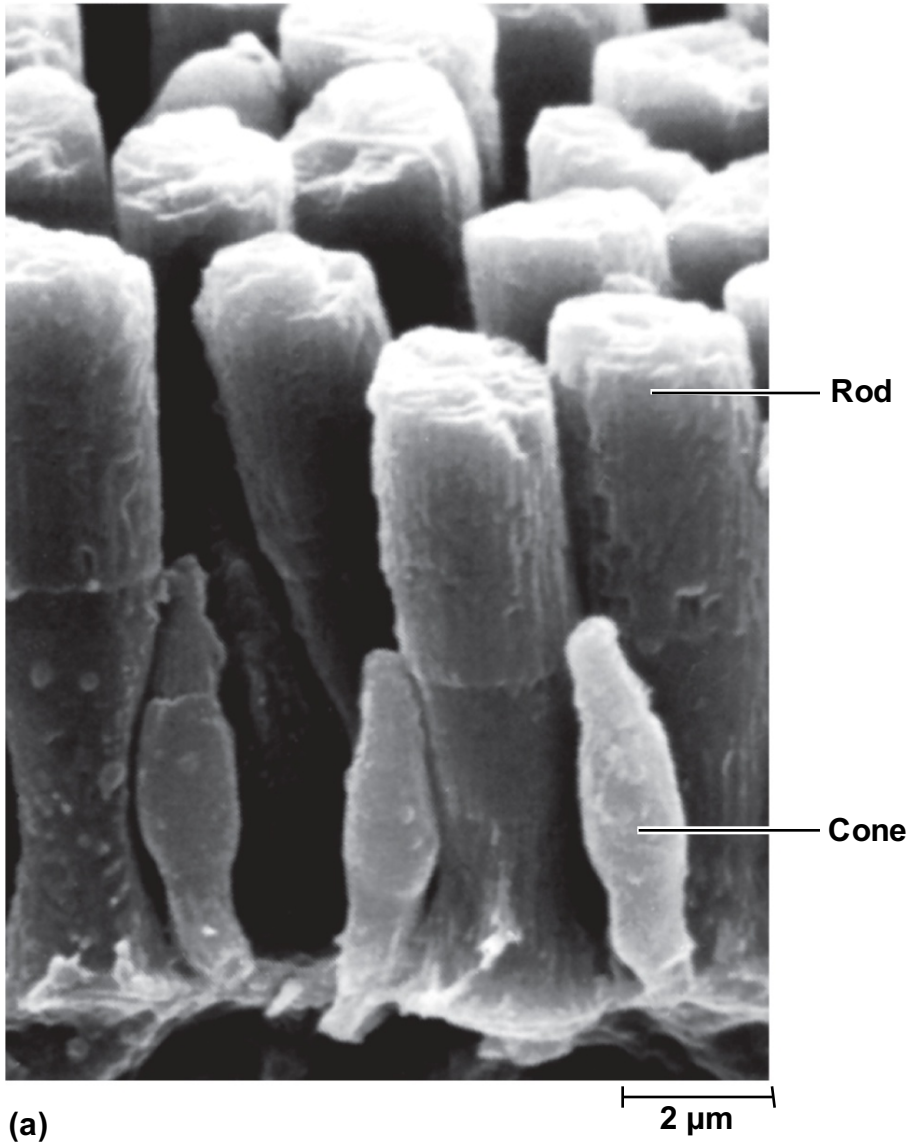
(a)



(b)

a: ©McGraw-Hill Education/Dennis Strete

Fig. 16.35



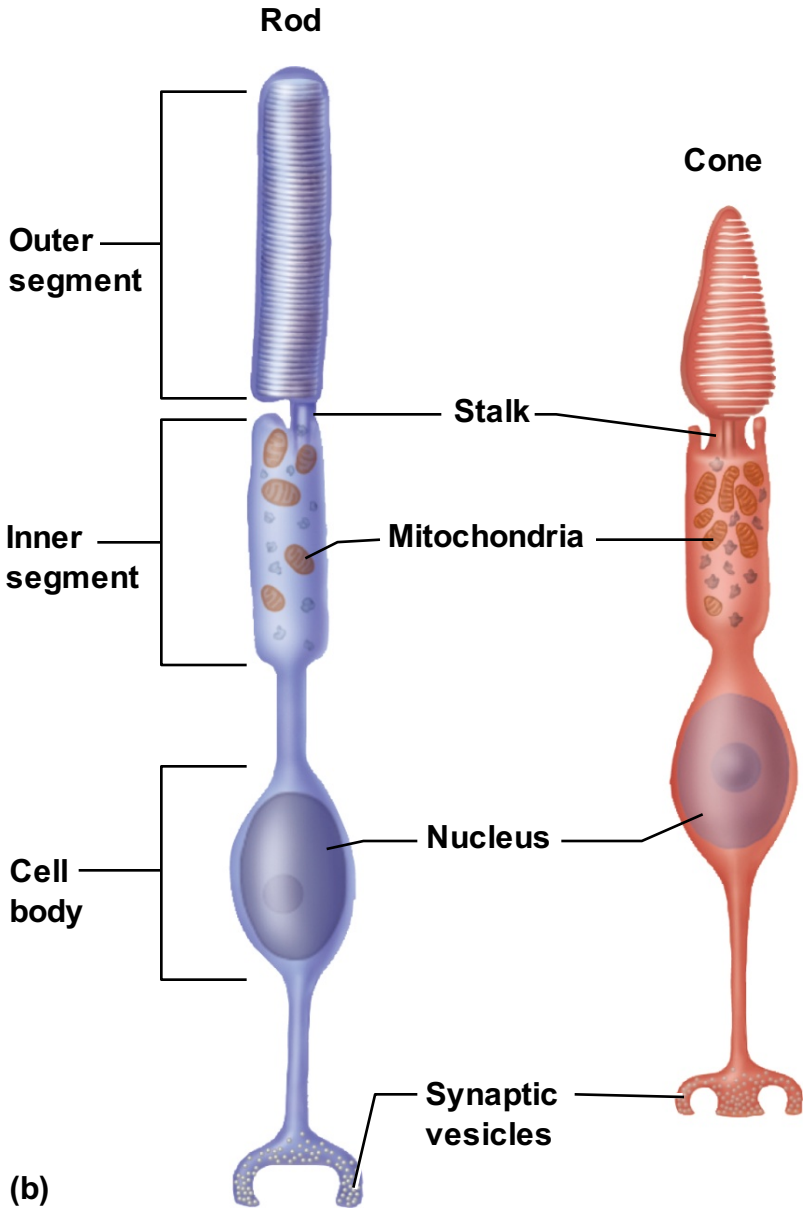
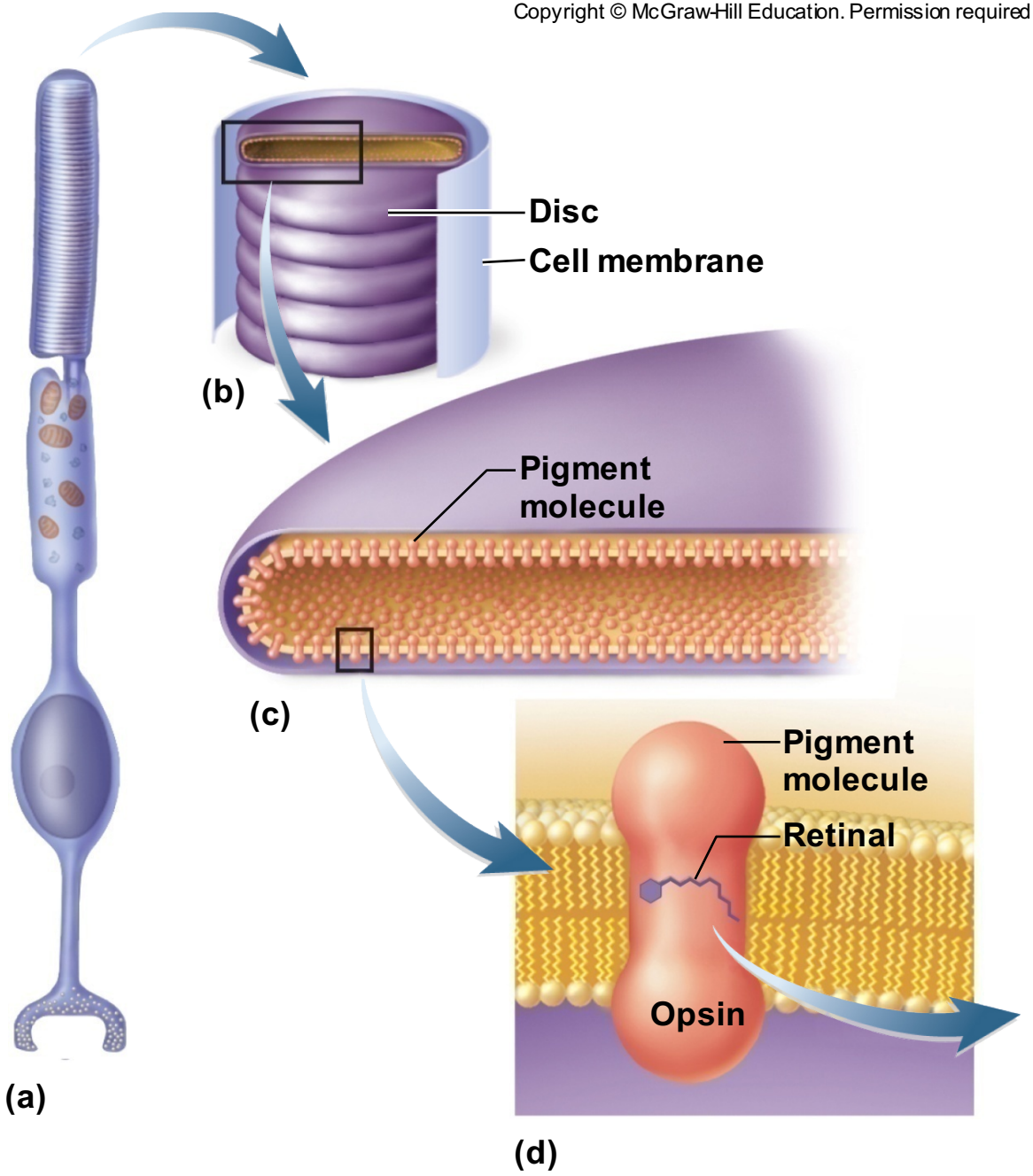
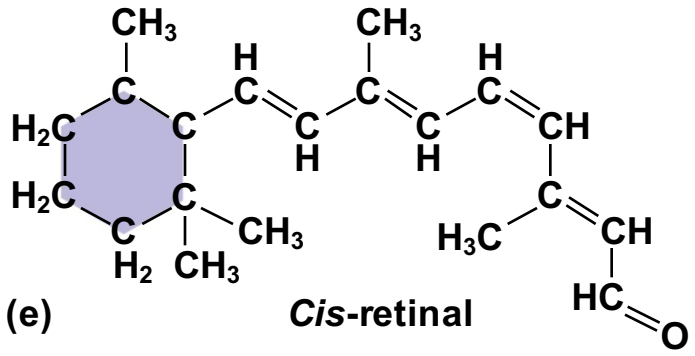


Fig. 16.36





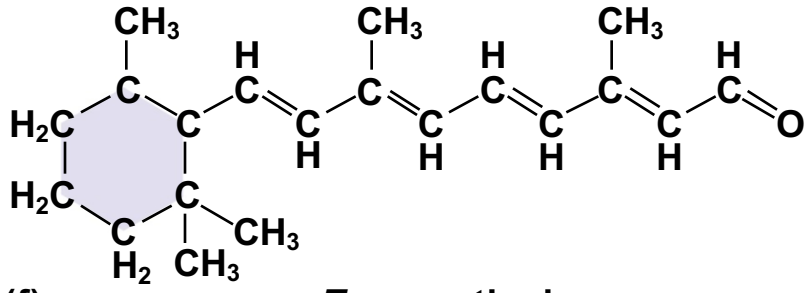


Fig. 16.37

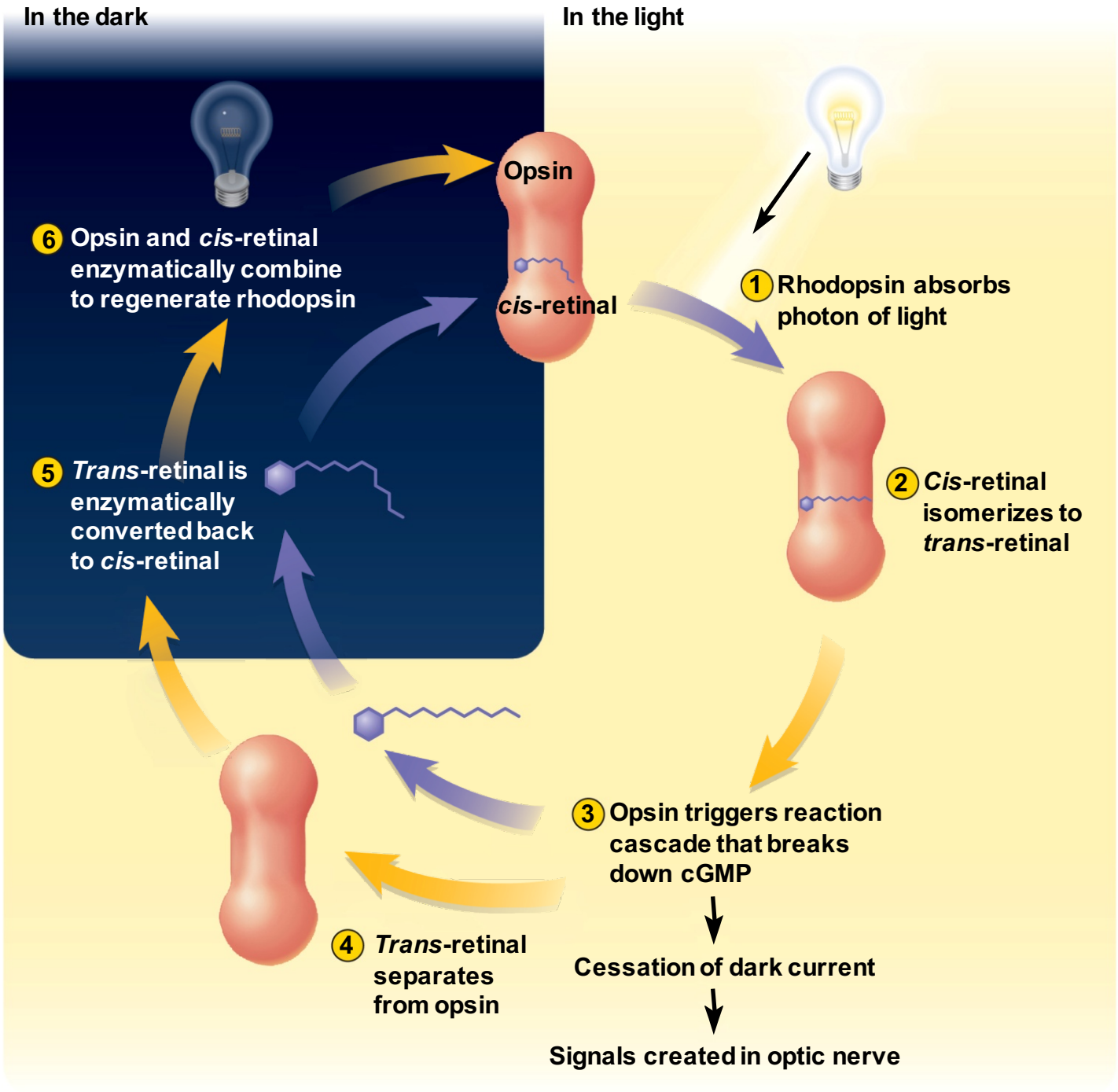
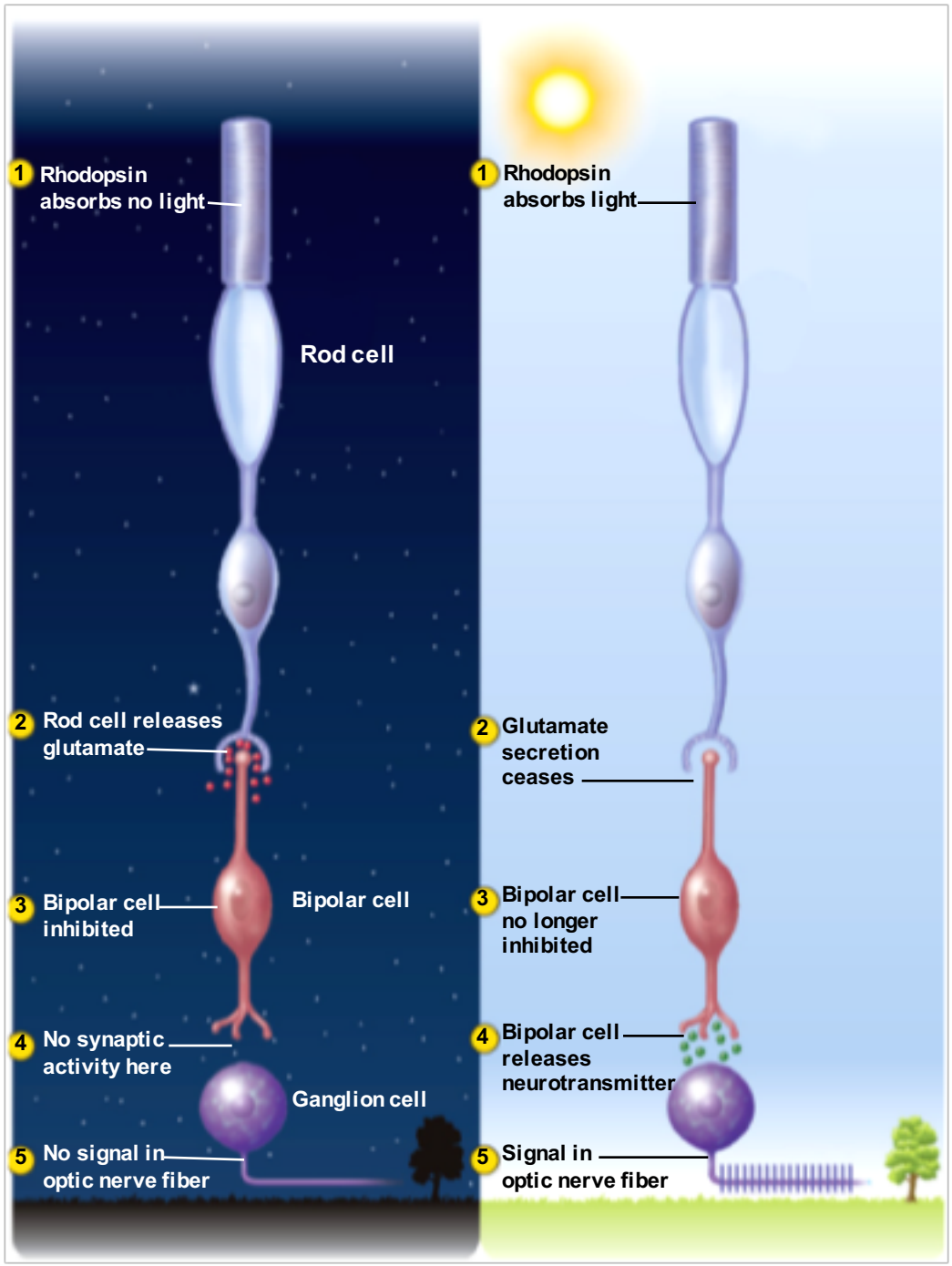


Fig. 16.38



(a) In the dark

(b) In the light

Fig. 16.39

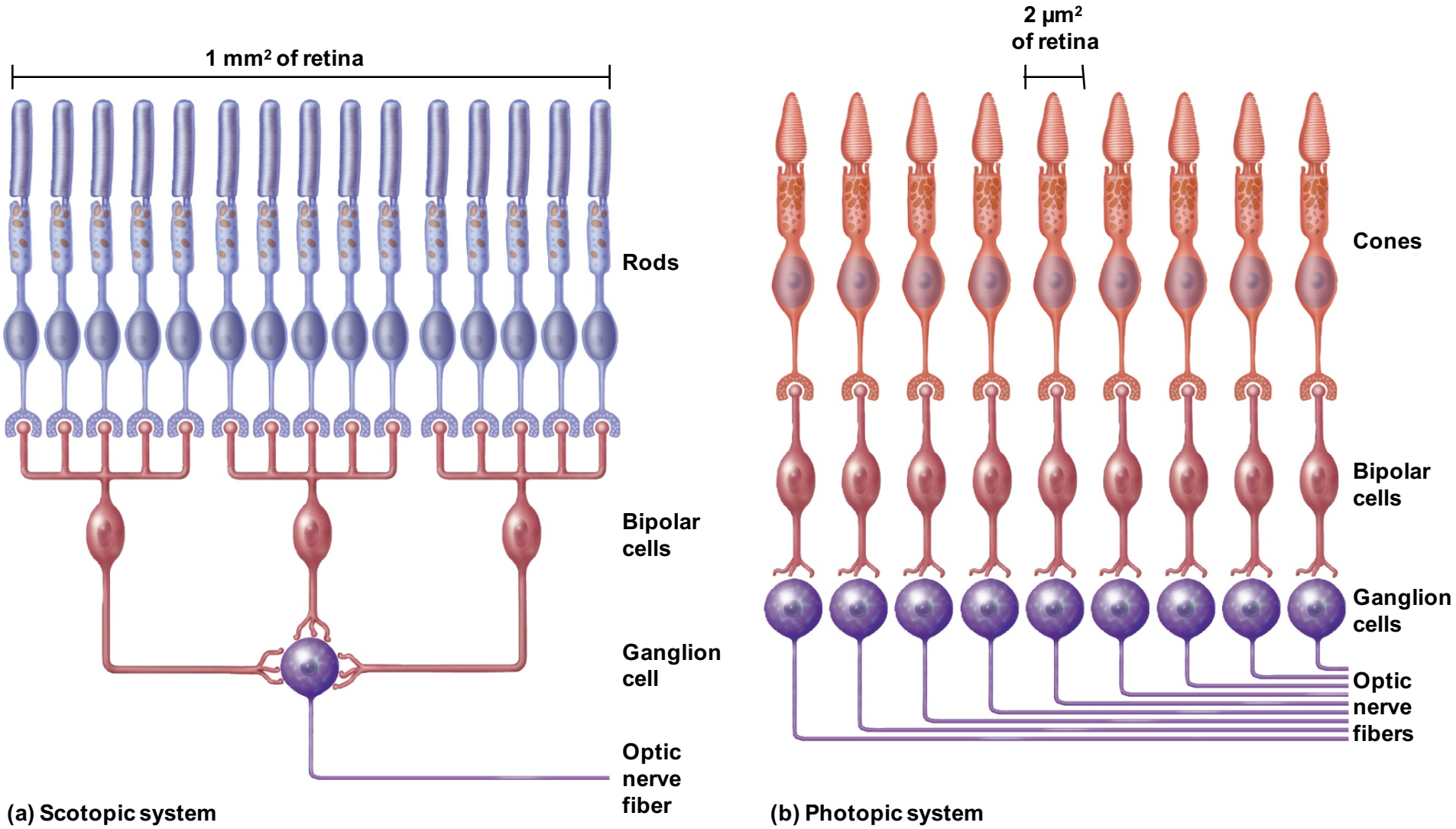
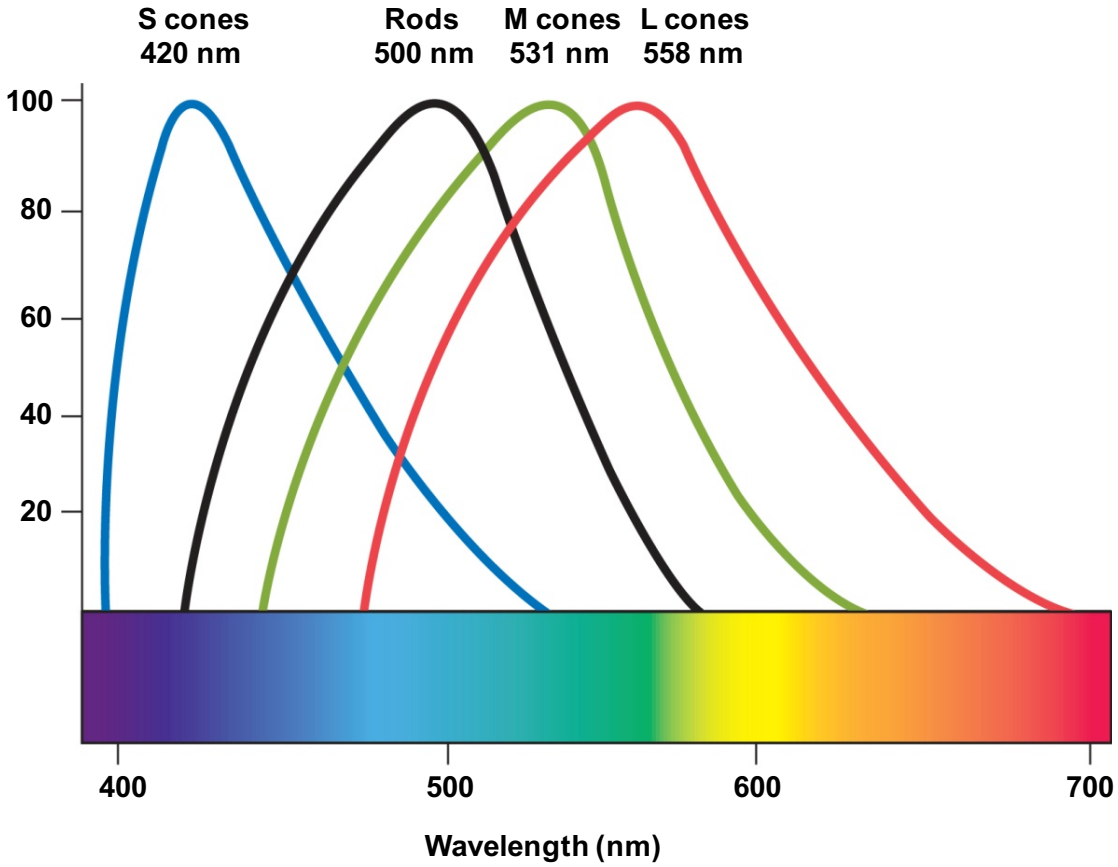


Fig. 16.40



Wavelength (nm)	Percentage of maximum cone response (S : M : L)	Perceived hue
400	50 : 0 : 0	Violet
450	72 : 30 : 0	Blue
500	20 : 82 : 60	Blue-green
550	0 : 85 : 97	Green
625	0 : 3 : 35	Orange
675	0 : 0 : 5	Red

Fig. 16.43