Wavelength-Dependent
Laser Exposure of the Eye

Laser devices emit monochromatic optical radiation across a very wide spectral range, from UV-C to IR-C.
The primary danger of laser radiation is the hazard posed by beams entering the eye, which is the organ most sensitive to light. Depending on the wavelength, different parts of the eye can be at risk. A laser beam with a wavelength between 400 and 1400 nm and low divergence can be focused by the eye onto a spot as small as 10 to 20 microns in diameter.

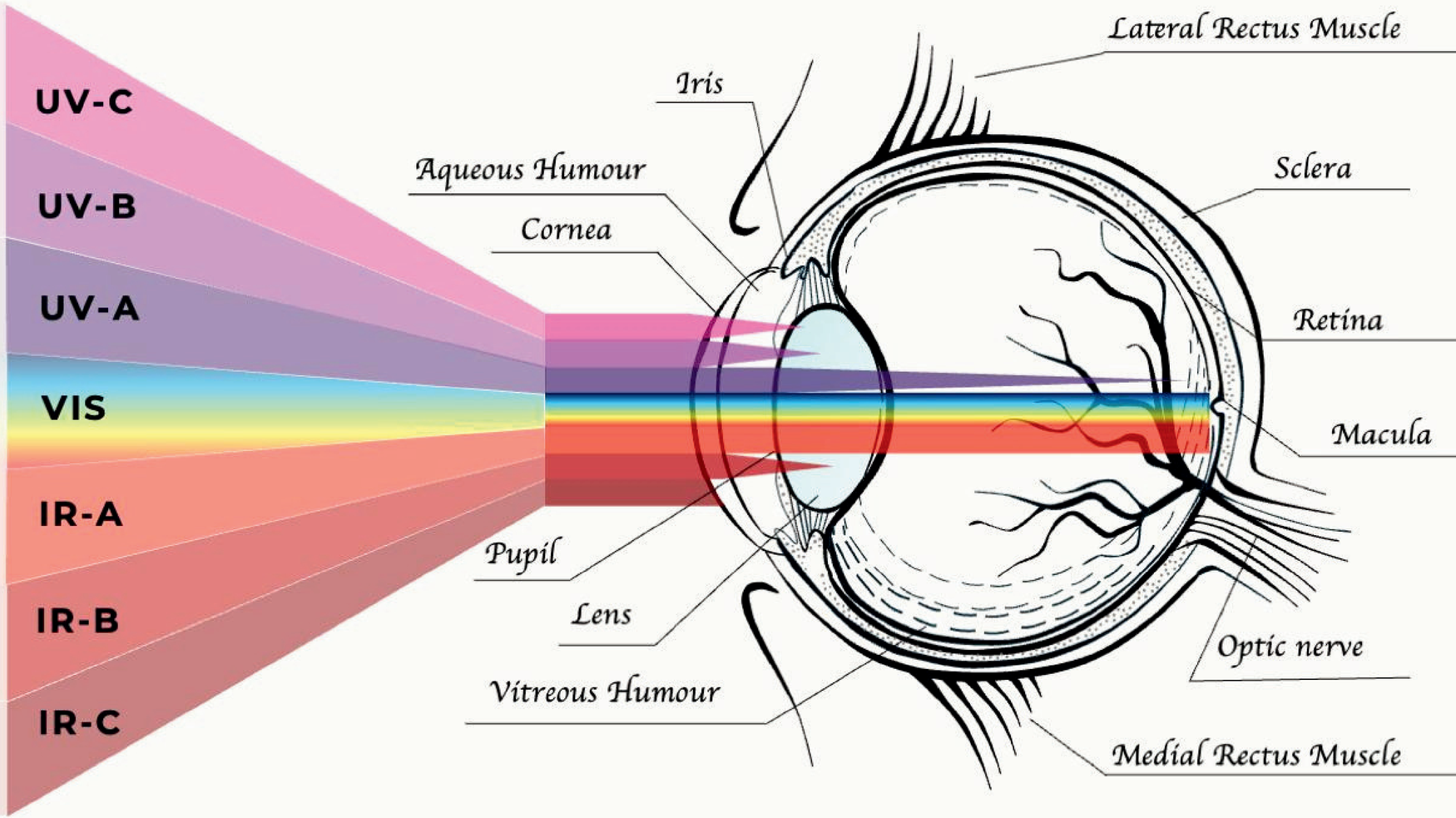
UV-B and UV-C (180–315 nm) are fully absorbed by the corneal surface, causing photokeratitis through protein denaturation. This condition is temporary as the cornea regenerates quickly.

UV-A (315–400 nm) passes through the cornea, lens, and aqueous humor, with the lens being the primary absorber. Photochemical reactions denature lens proteins, leading to cataract formation.

Visible light (400–700 nm) passes through the cornea and is focused on the retina, specifically on the macula, where critical vision occurs. The aversion reflex, which takes 0.25 s, can reduce exposure to bright light, but intense lasers may cause damage before this reflex occurs.

Near-infrared (700–1400 nm) energy is focused on the retina but is not interpreted into vision. However, the retina absorbs this energy, which can cause damage. A documented effect is the formation of a bubble that bursts, damaging retinal cells with an audible "popping" sound inside the eye.

Infrared B and C (1400 nm to 1 µm) are absorbed by the corneal tissue, where energy absorption by tears and tissue water raises the temperature, leading to protein denaturation on the corneal surface and resulting in damage.



CIOP PIB

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