A. Eye: Vision

Retina: Miniature Camera–Computer

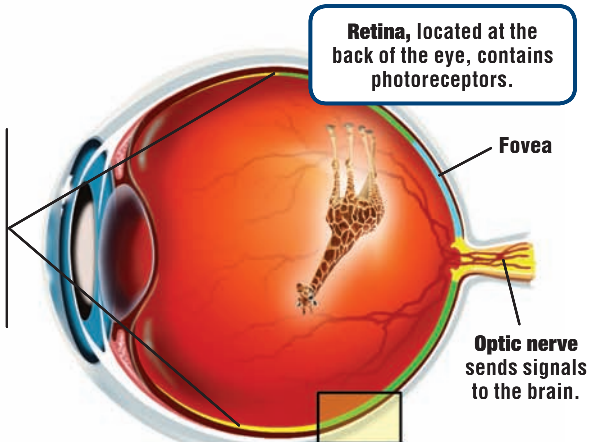
What happens to light waves?

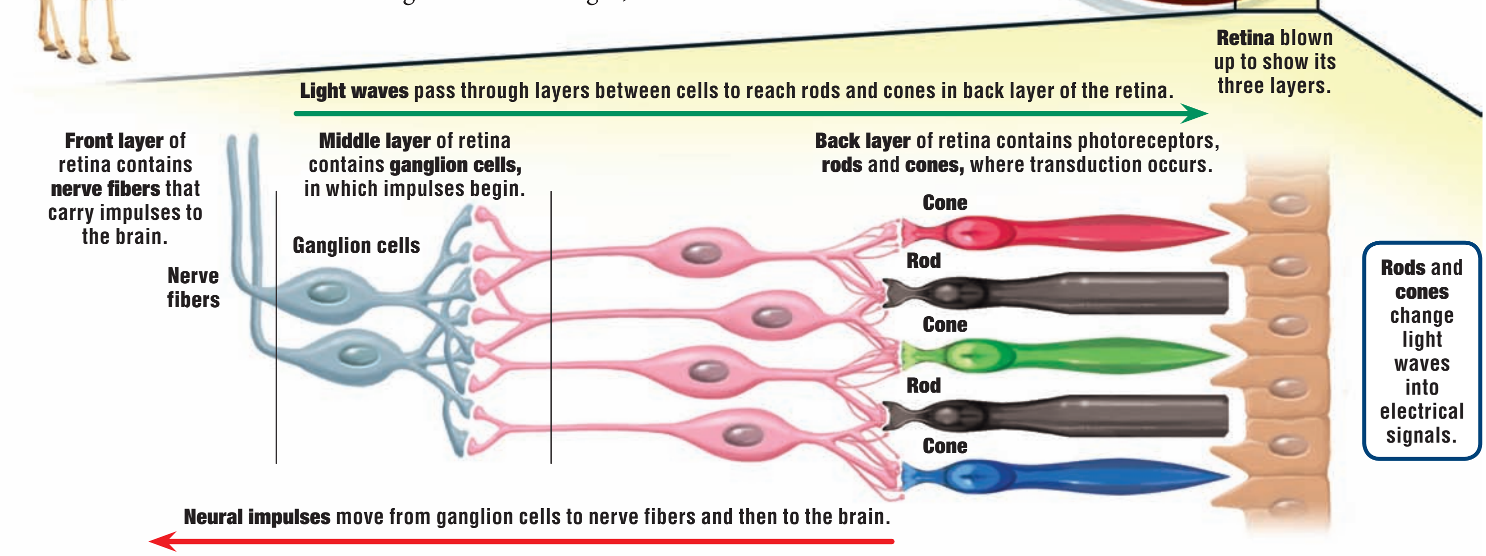
Some miniaturized electronic cameras can record amazingly detailed video pictures. But they are primitive compared to the retina, whose microscopic cells can transform light waves into impulses that carry detailed information to the brain about all kinds of shapes, shadows, sizes, textures, and colors. Think of the retina as a combination of a video camera and a computer whose batteries never run out as it transforms light waves into impulses—the process of transduction. And here's how transduction occurs.

You already know that an object, such as a giraffe, reflects light waves that enter the eye and are bent, focused, and projected precisely on the retina, at the very back of the eyeball.

The ***retina*** has three layers of cells. The back layer contains two kinds of photoreceptors that begin the process of transduction, changing light waves into electrical signals. One kind of photoreceptor with a rodlike shape is called a rod and is located primarily in the periphery of the retina. The other photoreceptor with a conelike shape is called a cone and is located primarily in the center of the retina in an area called the ***fovea*** *(FOH-vee-ah).*

We have enlarged a section of retina to show that it has three layers. We'll explain the function of each layer. Start with #1, located below the figure on the far right, and move left to #3.





1 Each eye has about 120 million rods, most located in the retina's periphery.

Rods are photoreceptors that contain a single chemical, called rhodopsin *(row-DOP-sin),* which is activated by small amounts of light. Because rods are extremely light sensitive, they allow us to see in dim light, but to see only black, white, and shades of gray.

To see color, we need the cones. Each eye has about 6 million cones, most located in the retina's fovea (Goldstein, 2010).

Cones are photoreceptors that contain three chemicals called opsins *(OP-sins),* which are activated in bright light and allow us to see color. Unlike rods, cones are wired individually to neighboring cells; this one-on-one system of relaying information allows us to see fine details.

Next, we finally get to transduction, which begins in the rods and cones.

2 The process of ***transduction*** begins when chemicals in the rods and cones break down after absorbing light waves. This chemical breakdown generates a tiny electrical force that, if large enough, triggers ***nerve impulses*** in neighboring ***ganglion*** cells; now, transduction is complete.

3 ***Nerve impulses*** generated in ganglion cells exit the back of the eye through the ***optic nerve,*** which carries impulses toward the brain. The point where the optic nerve exits the eye has no receptors and is called the ***blind spot.*** You don't notice the blind spot because your eyes are continually moving.

What's surprising about the eye is that it does not "see" but rather is a sophisticated computer for transduction, for changing light waves into impulses. For you to "see something," impulses must reach the visual areas in the brain, our next stop.