Table 1.3 *Weber fractions for a number of different sensory dimensions*

Electric shock	0.01
Lifted weight	0.02
Sound intensity	0.04
Light intensity	0.08
Taste (salty)	0.08

Source: From Teghtsoonian (1971).

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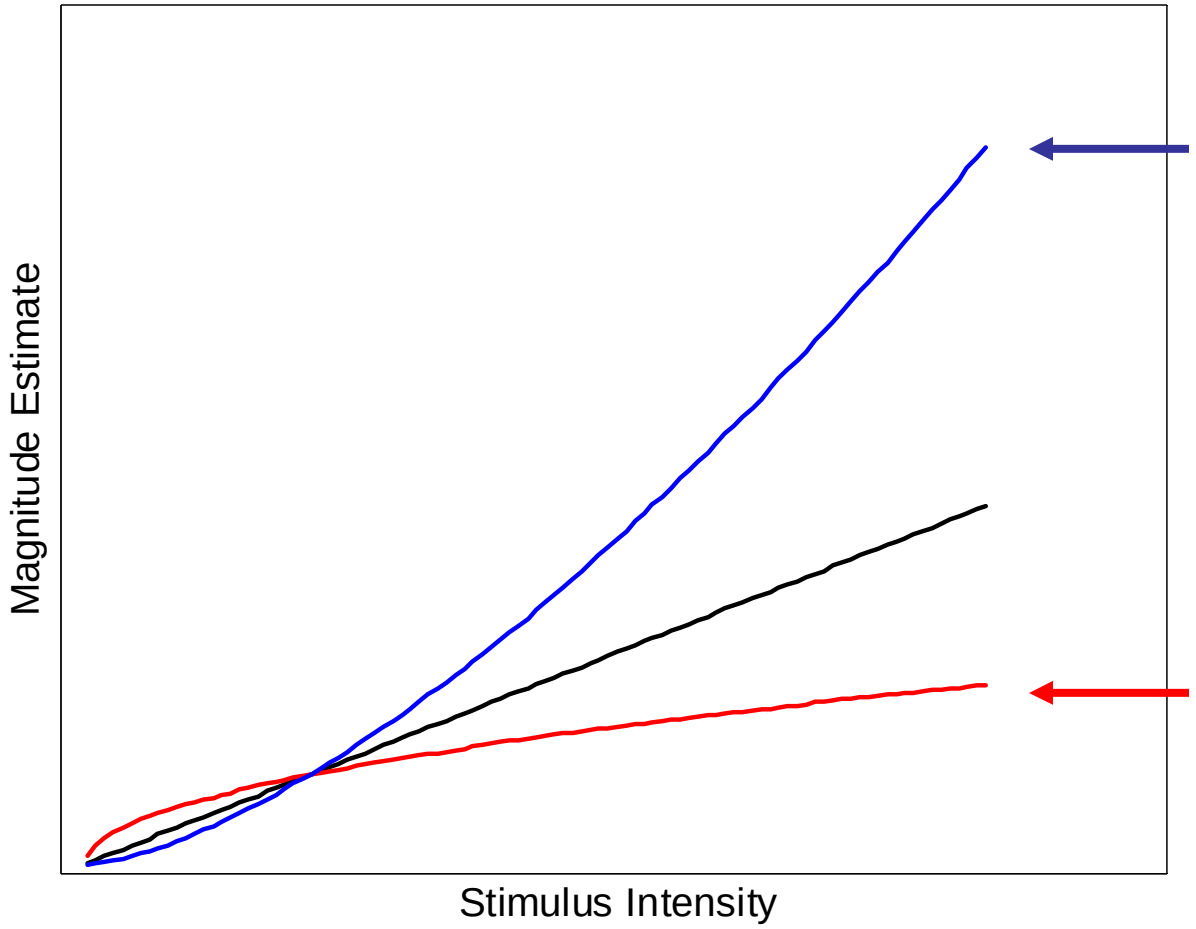
A Weber fraction of 0.01 means that subjects can reliably detect a 1% change in stimulus intensity.

2) Behavioral measurements: ‘psychophysics’

Psychophysics - Quantitative Methods

- **Magnitude estimation**
  - Stimuli are above threshold
  - Observer is given a standard stimulus and a value for its intensity
  - Observer compares the standard stimulus to test stimuli by assigning numbers relative to the standard

Magnitude Estimation



Response expansion: As intensity increases, the perceived magnitude increases more quickly than the intensity

Response compression: As intensity increases, the perceived magnitude increases more slowly than the intensity

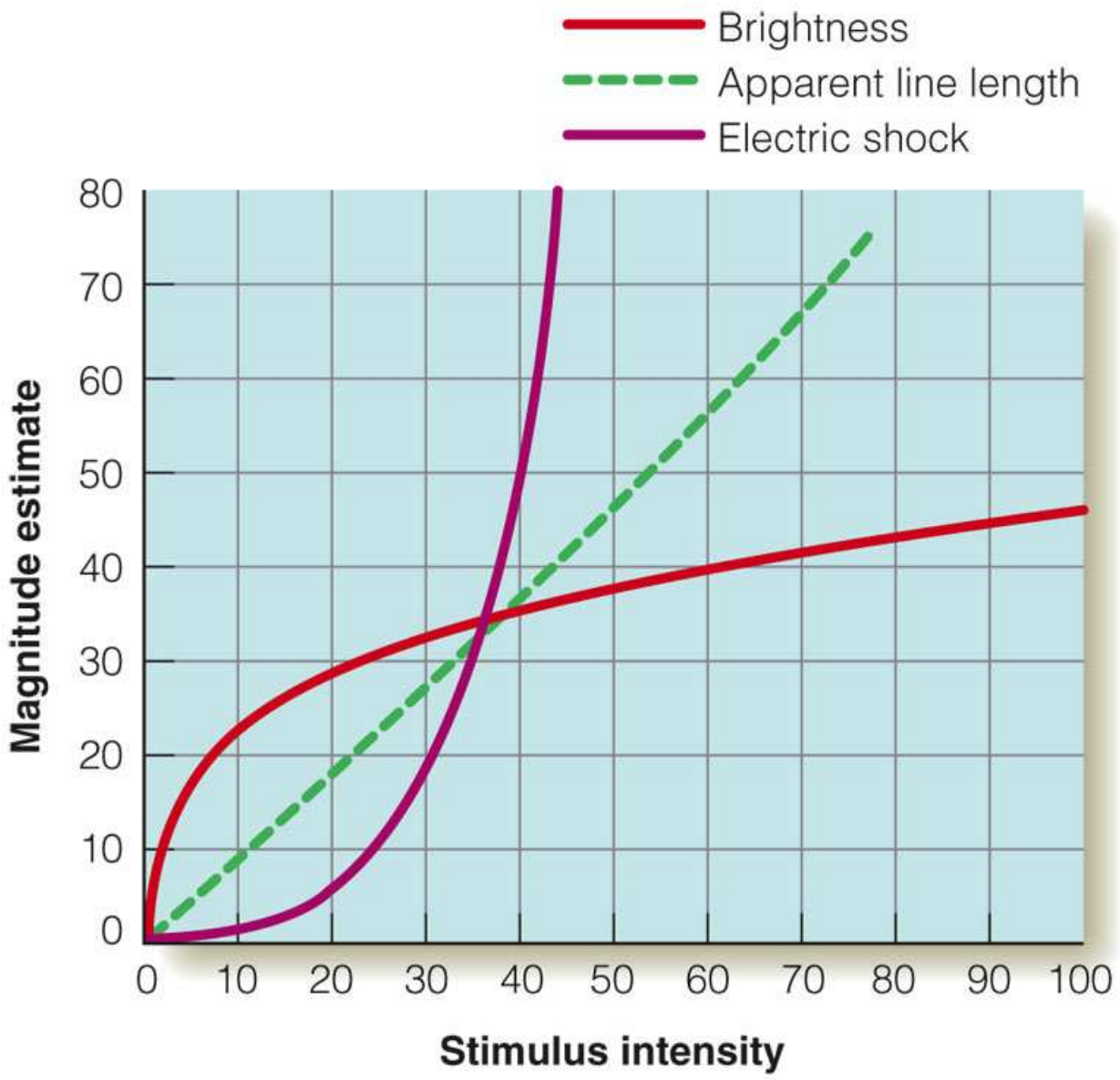


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Figure 1.12 The relationship between perceived magnitude and stimulus intensity for electric shock, line length, and brightness. (*Adapted from "The Surprising Simplicity of Sensory Metrics" by S. S Stevens, 1962, American Psychologist, 17, p. 29-39. Copyright © 1962 by American Psychological Association*.)

Quantitative Methods - continued

- Magnitude estimation (cont.)
  - Relationship between intensity and perceived magnitude is a power function
  - Steven's Power Law
    - $P = KS^n$

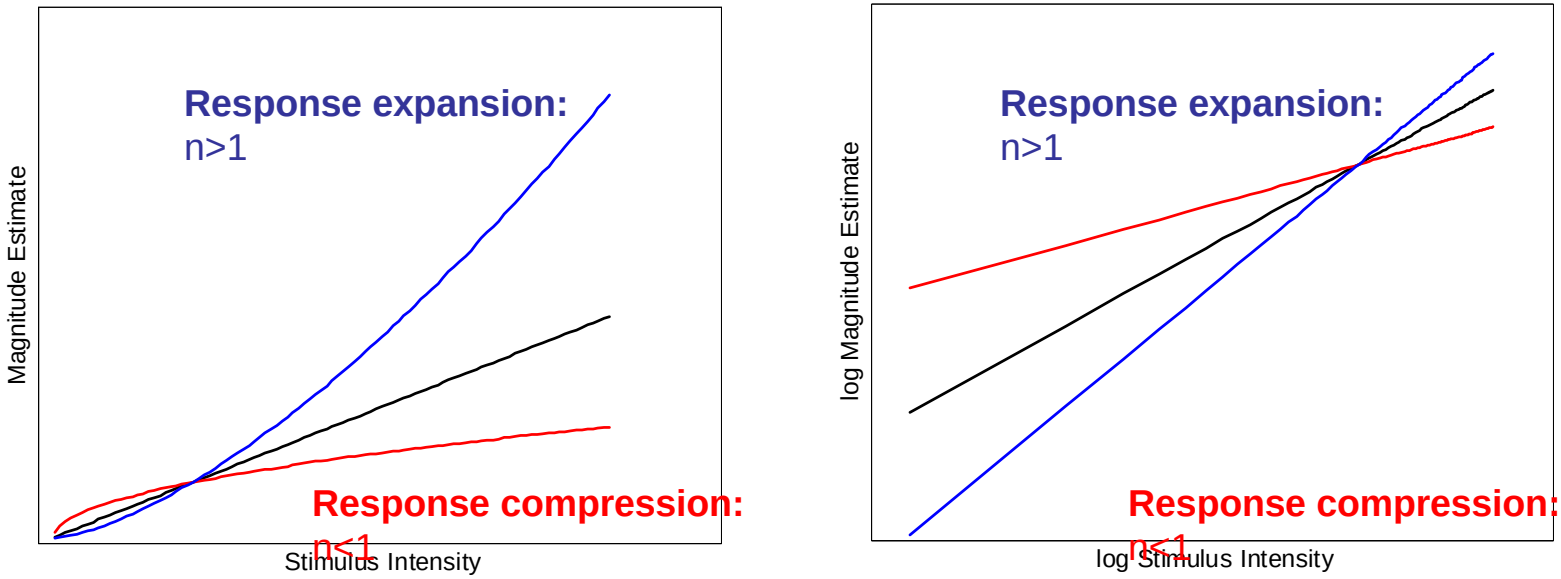
A different way of plotting the data: log-log axes!

$$P = k\,S^n$$

$$\log P = \log (k\,S^n)$$

$$= \log k + \log (\,S^n)$$

$$= \log k + n \log S$$



If **n > 1**, as physical intensity increases, perceived sensation increases at an **increasing rate**.

If **n = 1**, as physical intensity increases, perceived sensation increases at a **constant rate**.

If **n < 1**, as physical intensity increases, perceived sensation increases at a **decreasing rate**.

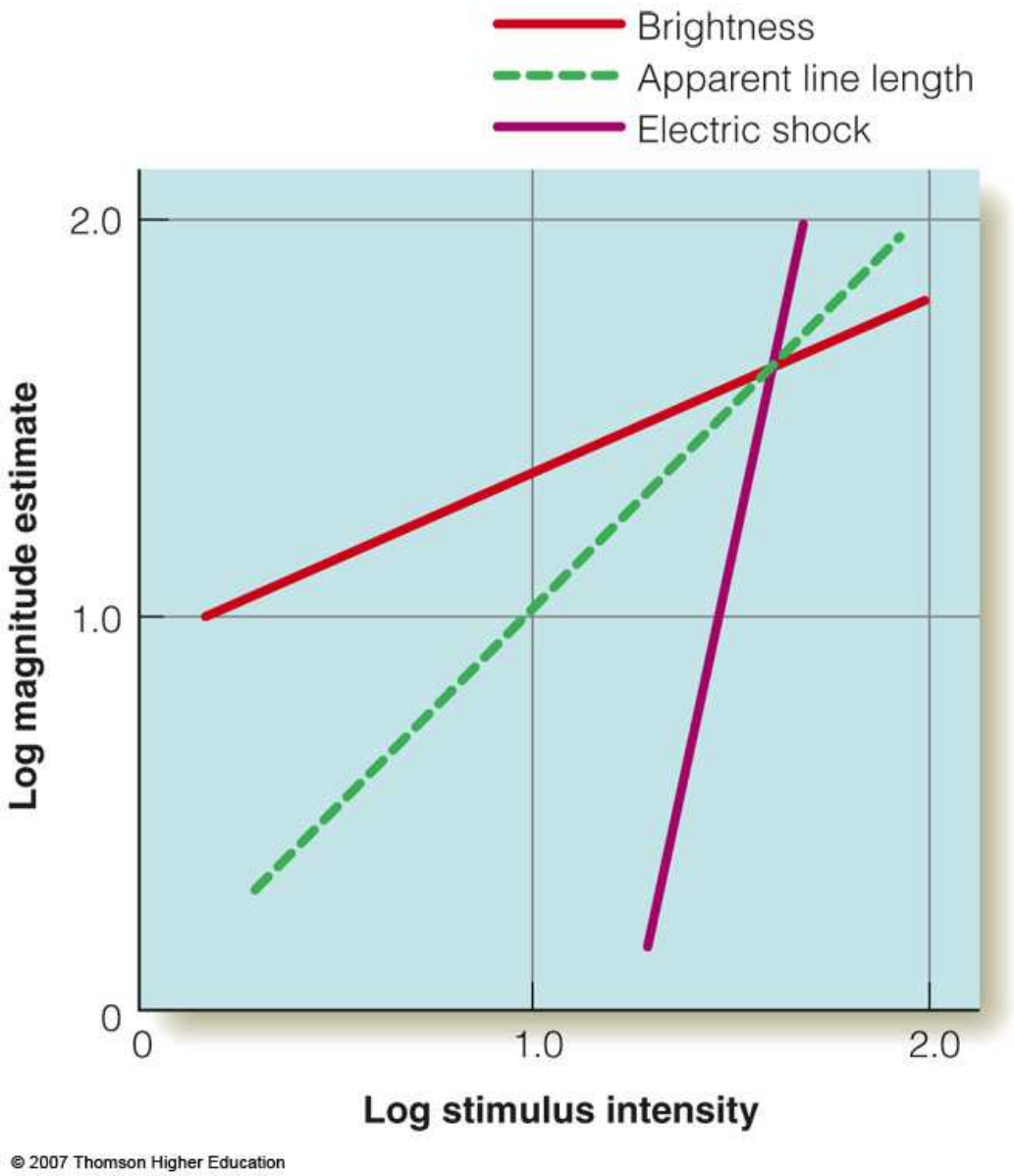


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Figure 1.13 The three functions from Figure 1.12 plotted on log-log coordinates. Taking the logarithm of the magnitude estimates and the logarithm of the stimulus intensity turns the functions into straight lines. (*Adapted from "The Surprising Simplicity of Sensory Metrics" by S. S Stevens, 1962, American Psychologist, 17, p. 29-39. Copyright © 1962 by American Psychological Association.)*

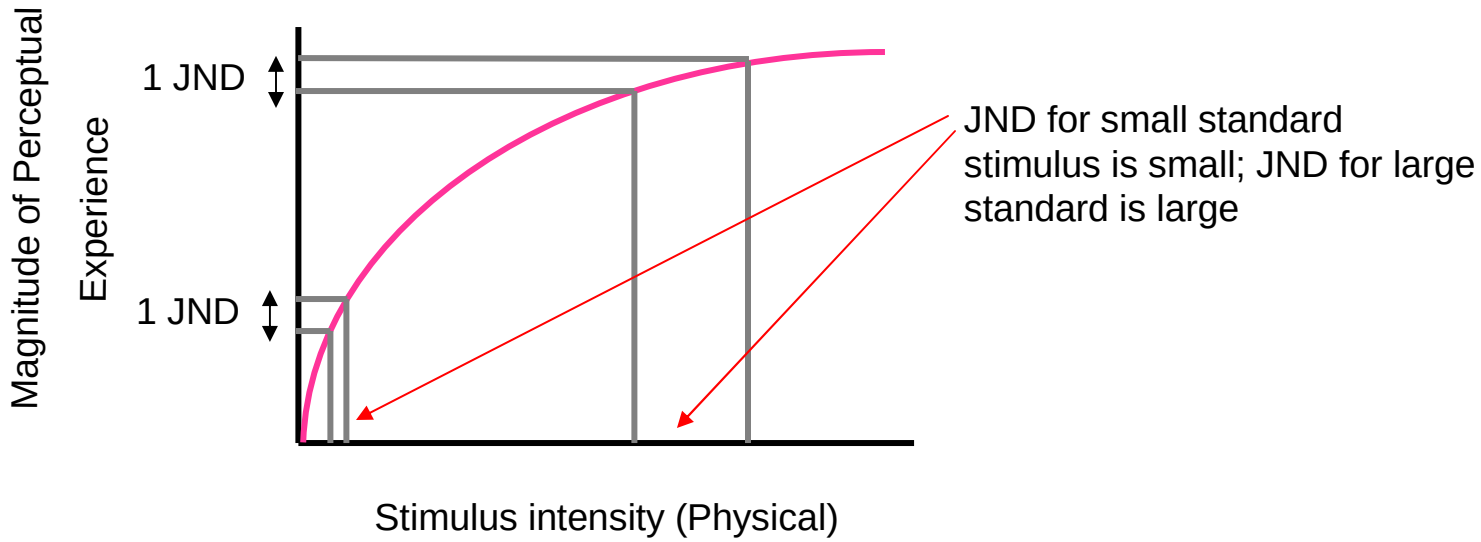
Response Compression and Weber's Law

If we assume:

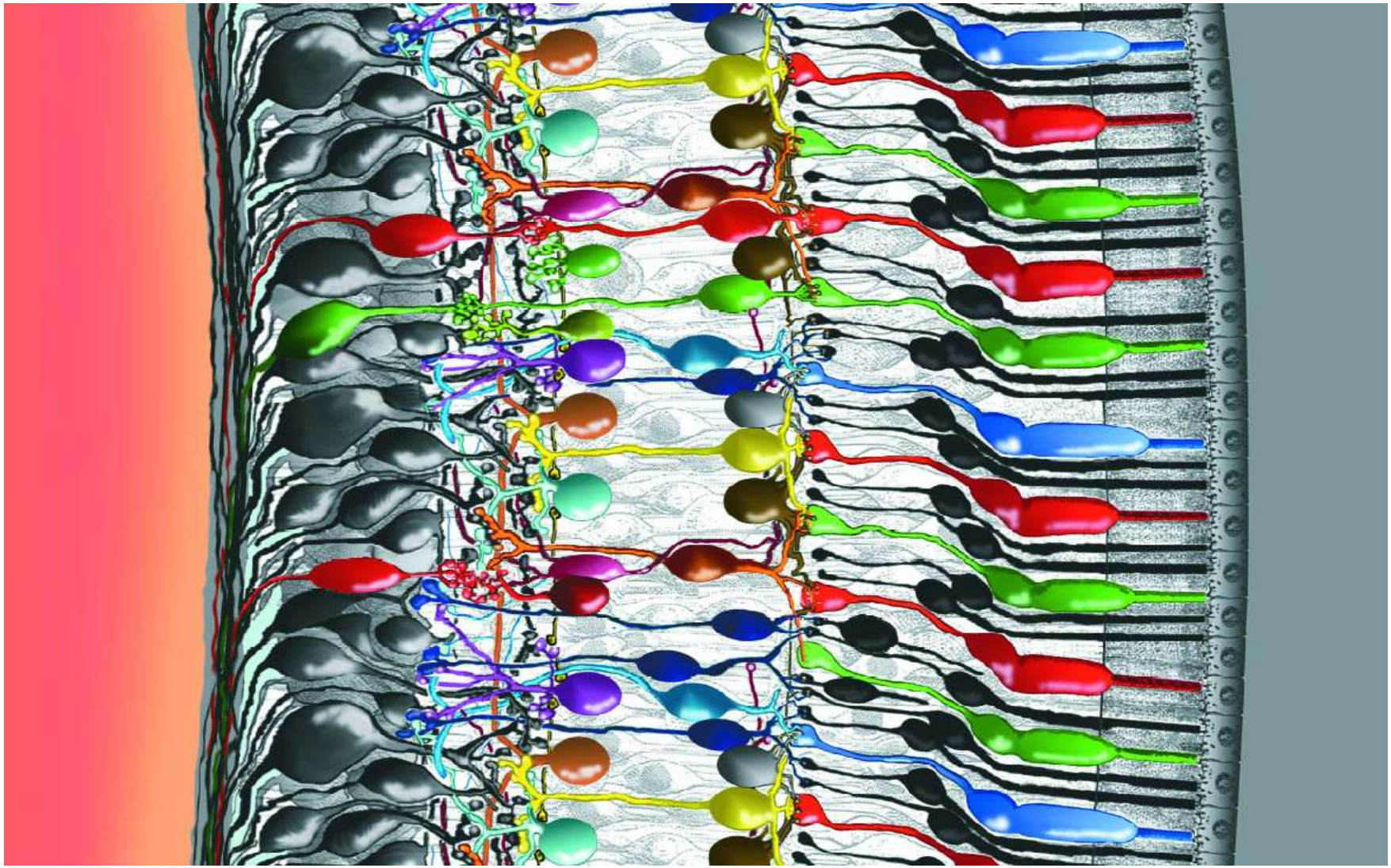
1. Weber's law is true.
2. Each difference threshold feels the same

→ $\Delta I = kI$

. . . then response compression follows.

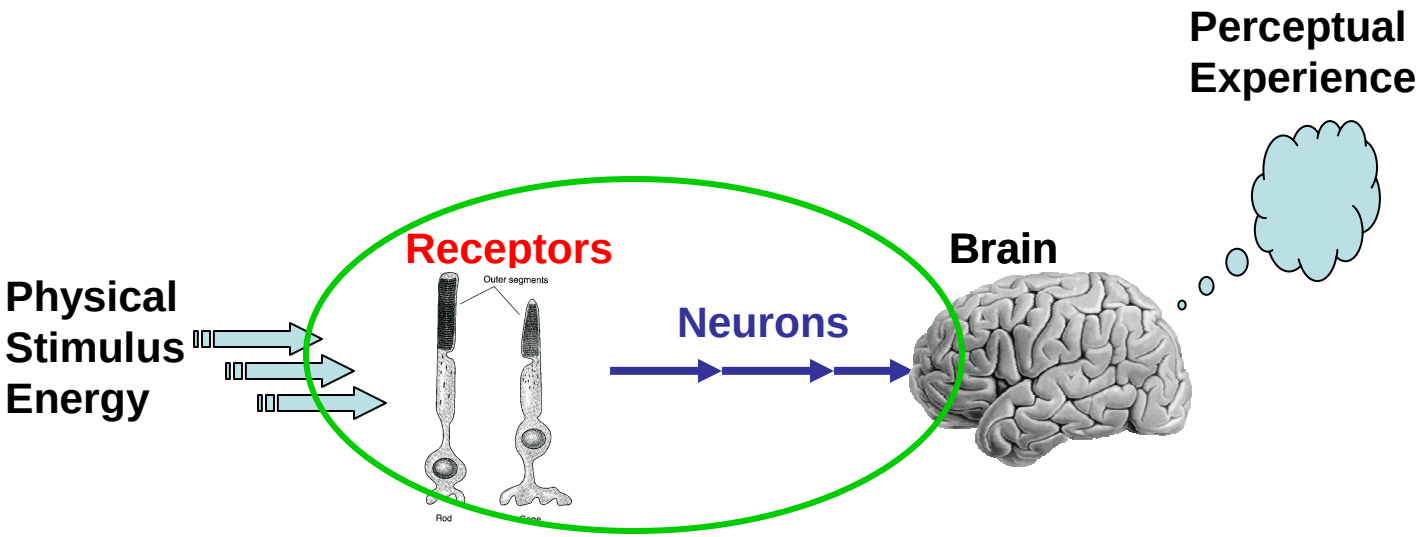


Chapter 2: Introduction to the Physiology of Perception



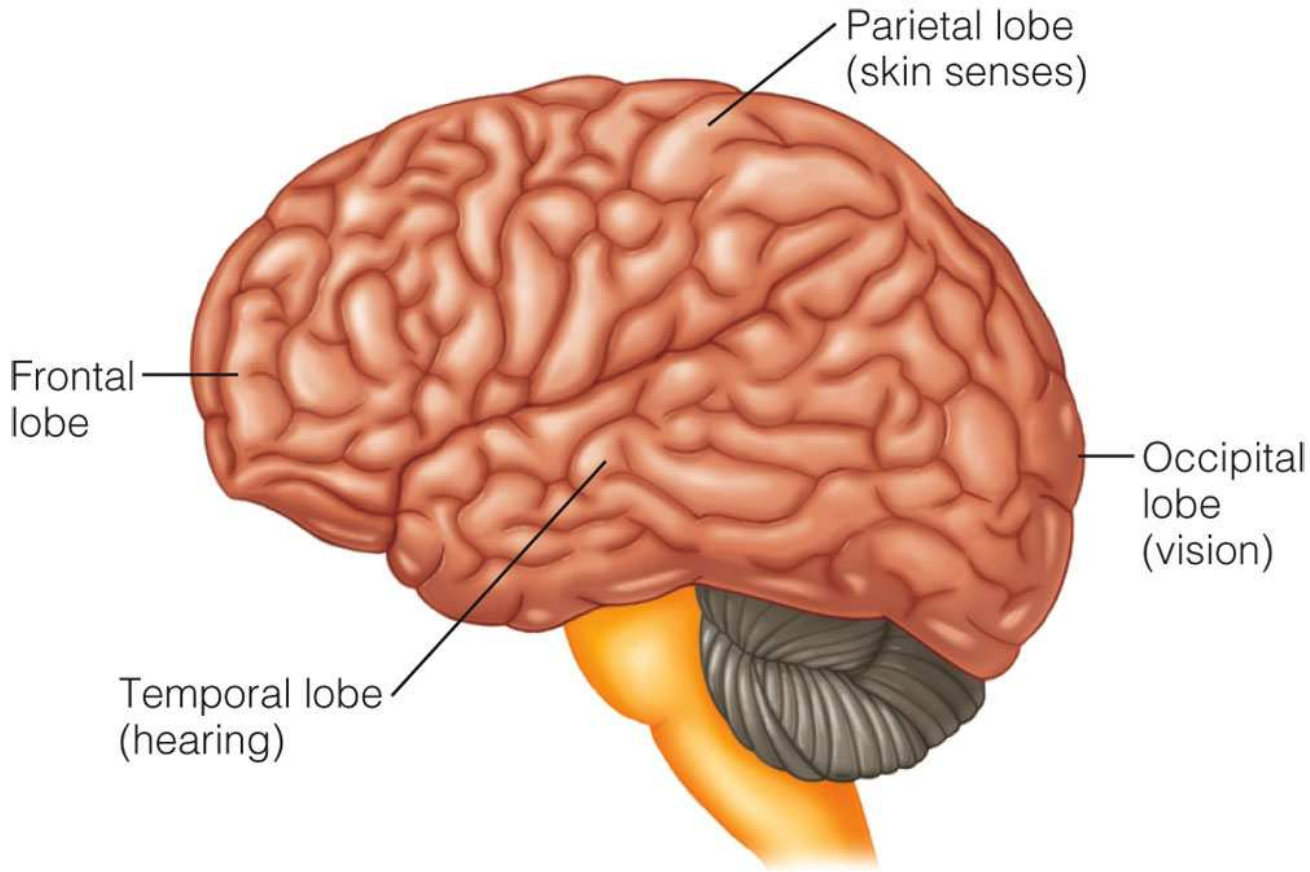
Overview of Questions

- How are physiological processes involved in perception?
- How is light transformed into electricity in the eye?
- How is what we see determined by the properties of the receptors in our retinas?



Basic Brain Structure

- The brain has modular organization
  - The sensory modalities have primary receiving areas



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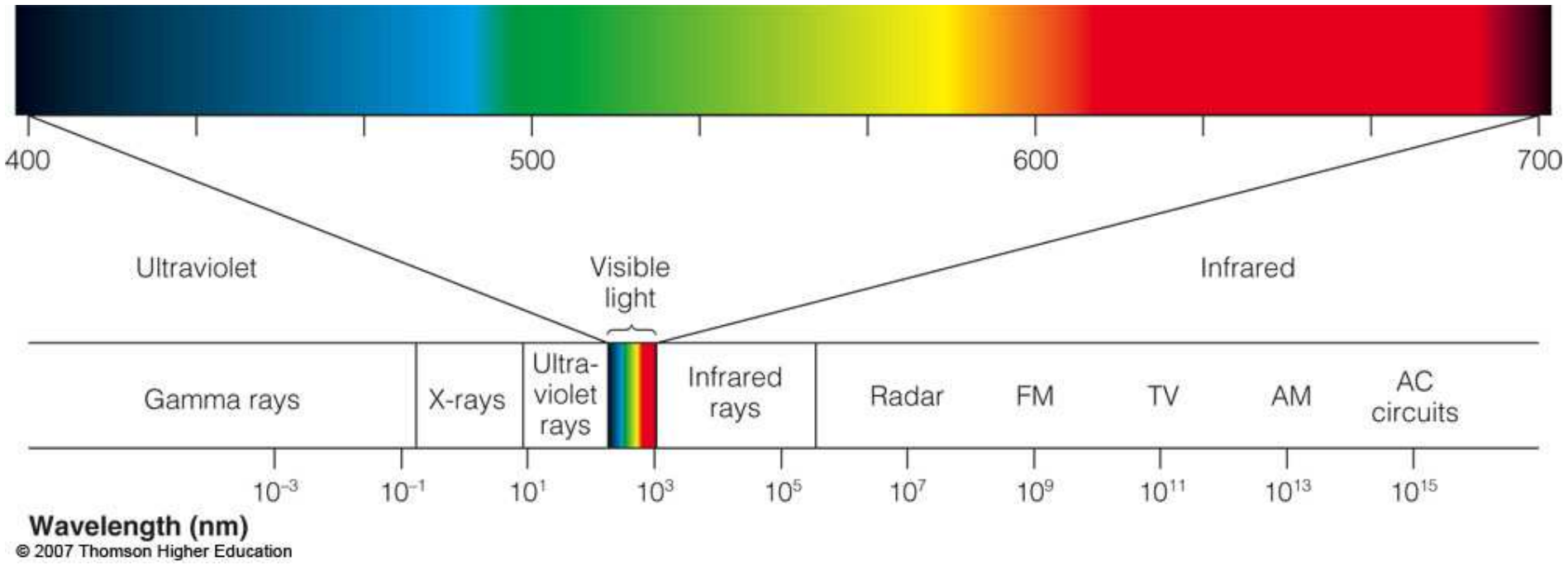
Light is the Stimulus for Vision

- Electromagnetic spectrum
  - Energy is described by wavelength
  - Spectrum ranges from short wavelength gamma rays to long wavelength radio waves
  - Visible spectrum for humans ranges from 400 to 700 nanometers
  - Most perceived light is reflected light



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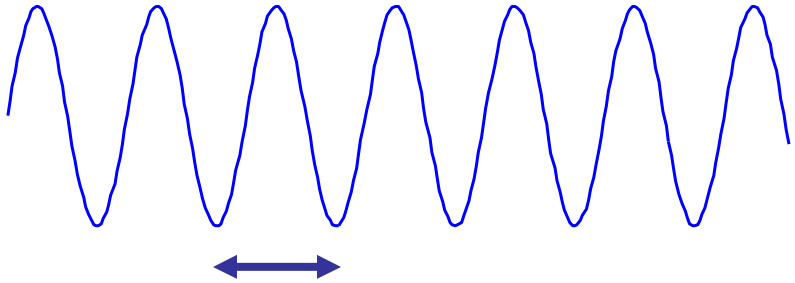
Wavelength and frequency



the **speed of light c = 299792458 m/s**

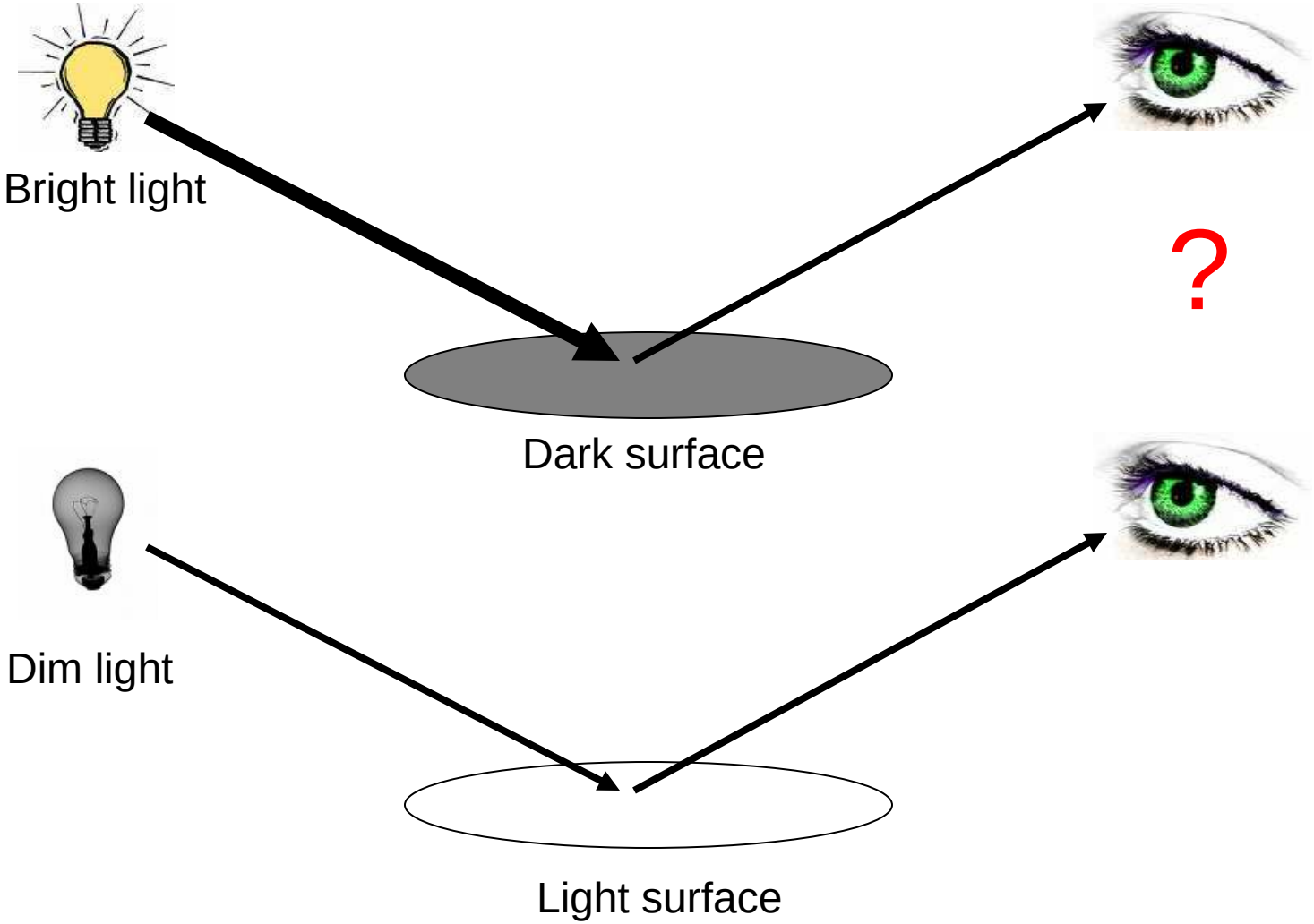
$$\text{Frequency} = \frac{\text{Speed}}{\text{Wavelength}}$$

(1 THz = 1 trillion Hz)

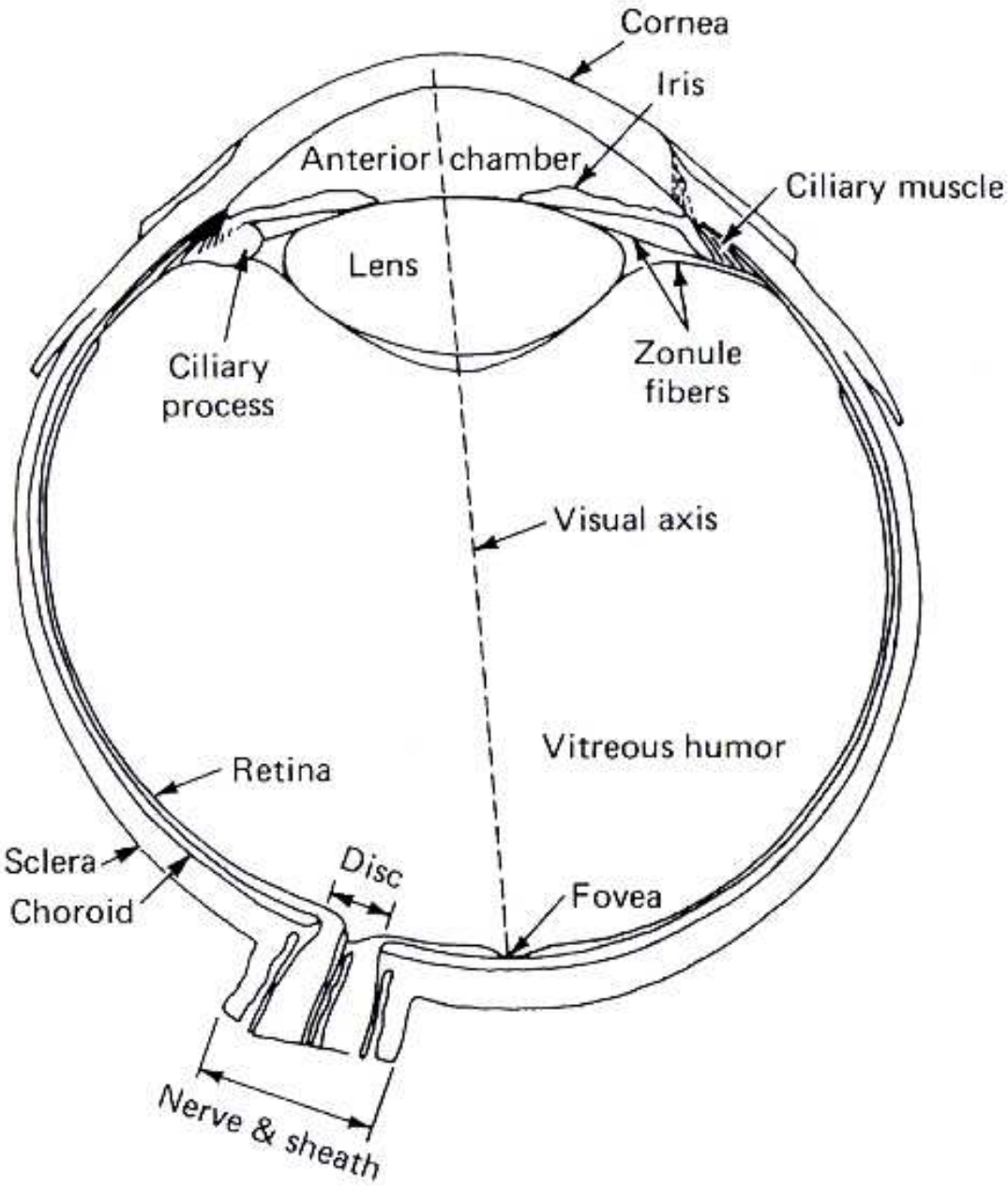
Color	Wavelength (nm)	Frequency (THz)
Red	780 - 622	384 - 482
Orange	622 - 597	482 - 503
Yellow	597 - 577	503 - 520
Green	577 - 492	520 - 610
Blue	492 - 455	610 - 659
Violet	455 - 390	659 - 769

Light and surfaces:
most light is reflected light

Reflected light is a combination of the light source and the reflectance properties of the suface



Anatomy of the human eye



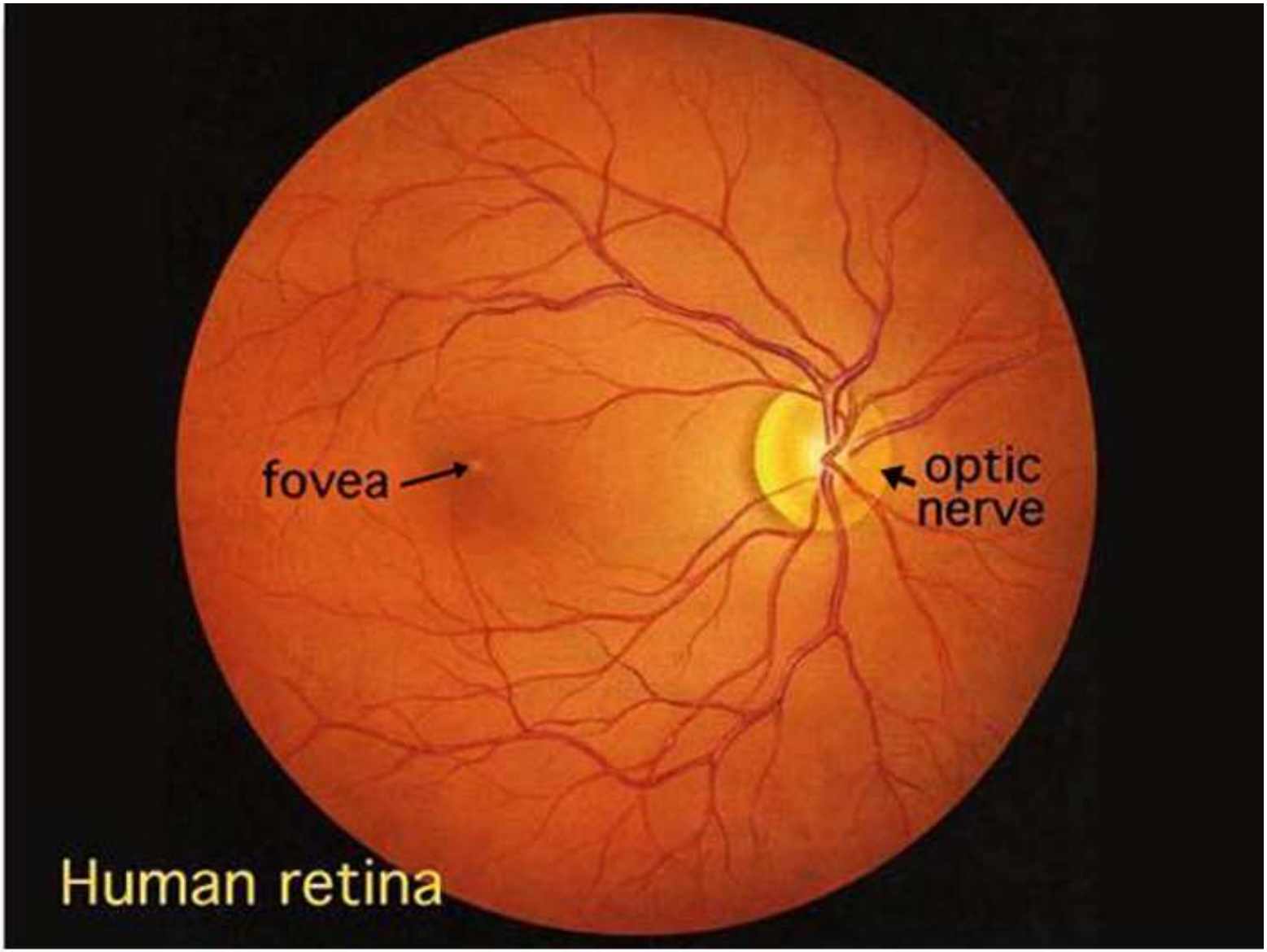
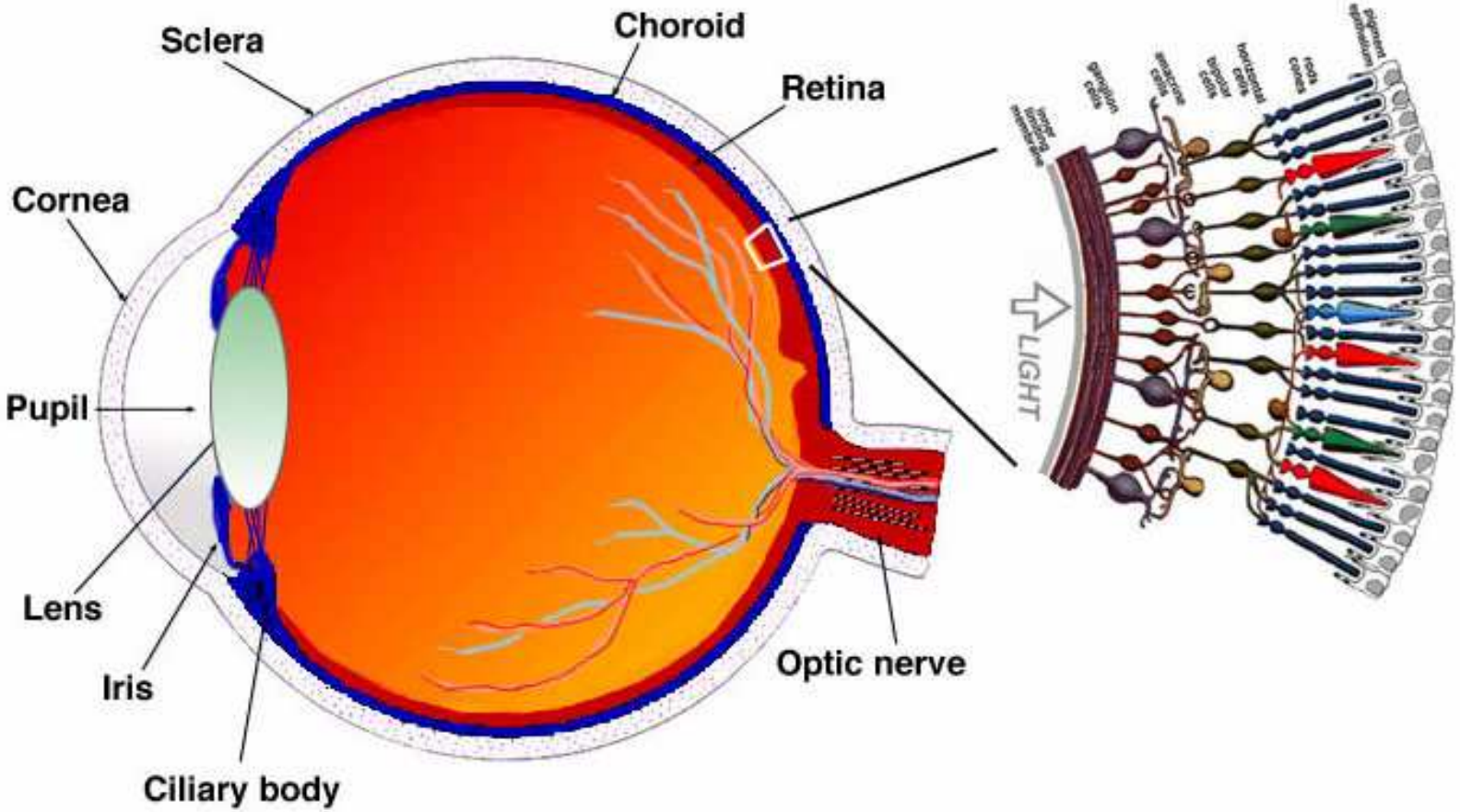
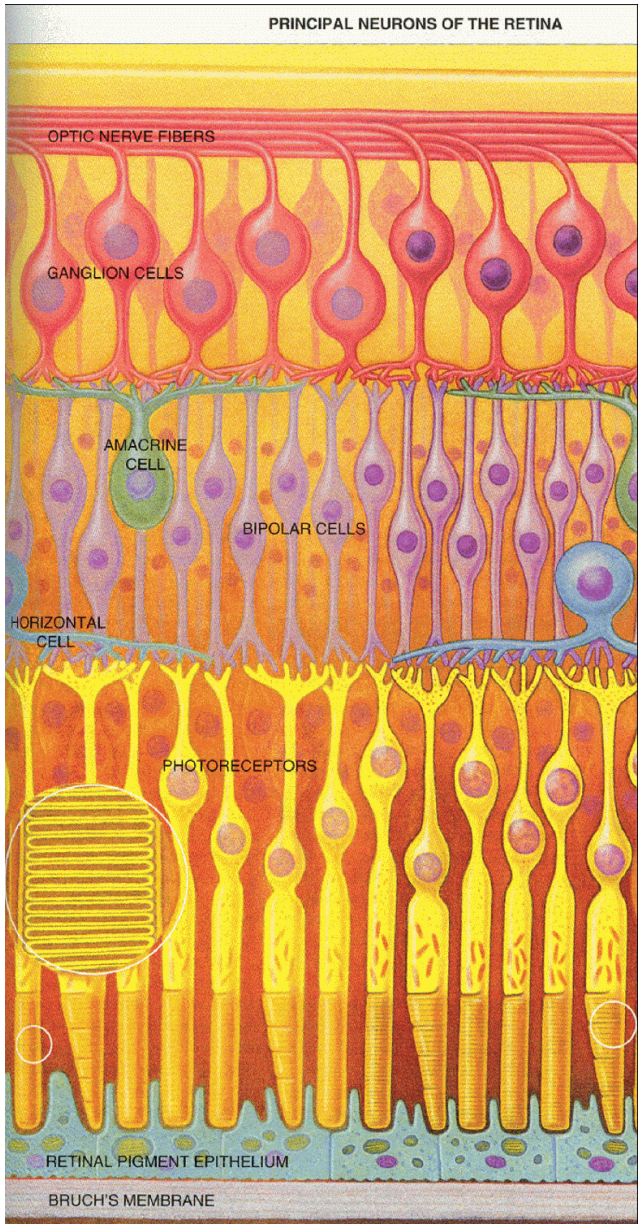


Fig. 1. Human retina as seen through an opthalmoscope.

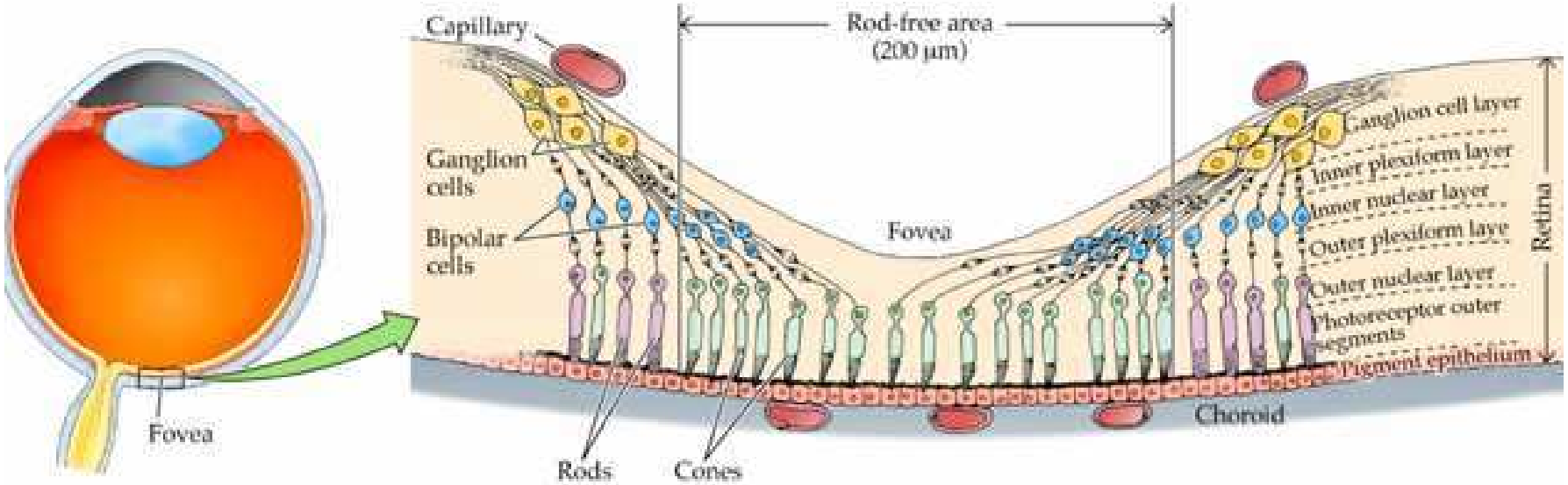

Sclera
Choroid
Retina
Cornea
Pupil
Lens
Iris
Ciliary body
Optic nerve
LIGHT

The retina is organized ‘backwards’ with respect to incoming light.

light



The fovea is free from capillaries, ganglion cells, and inner layer cells.
It only contains cones.



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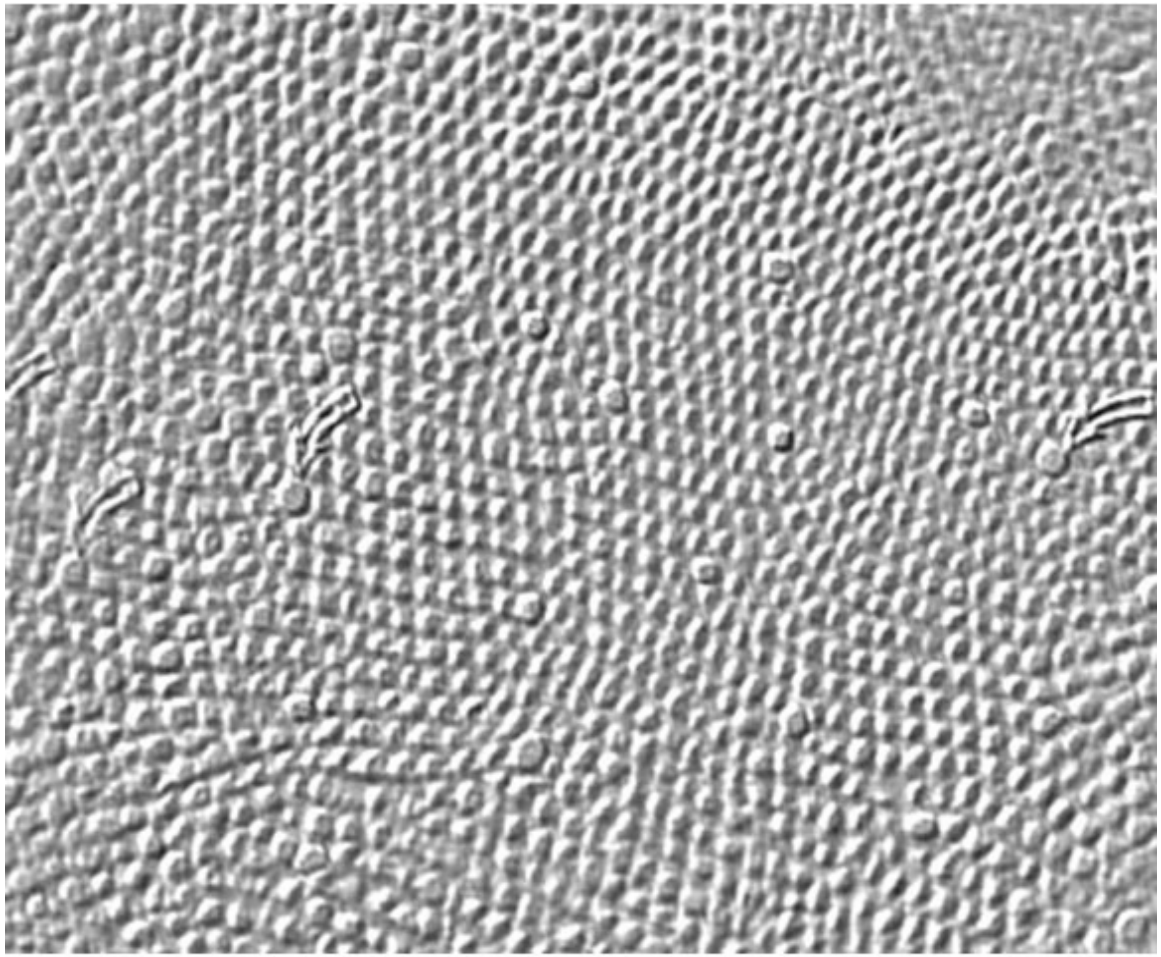
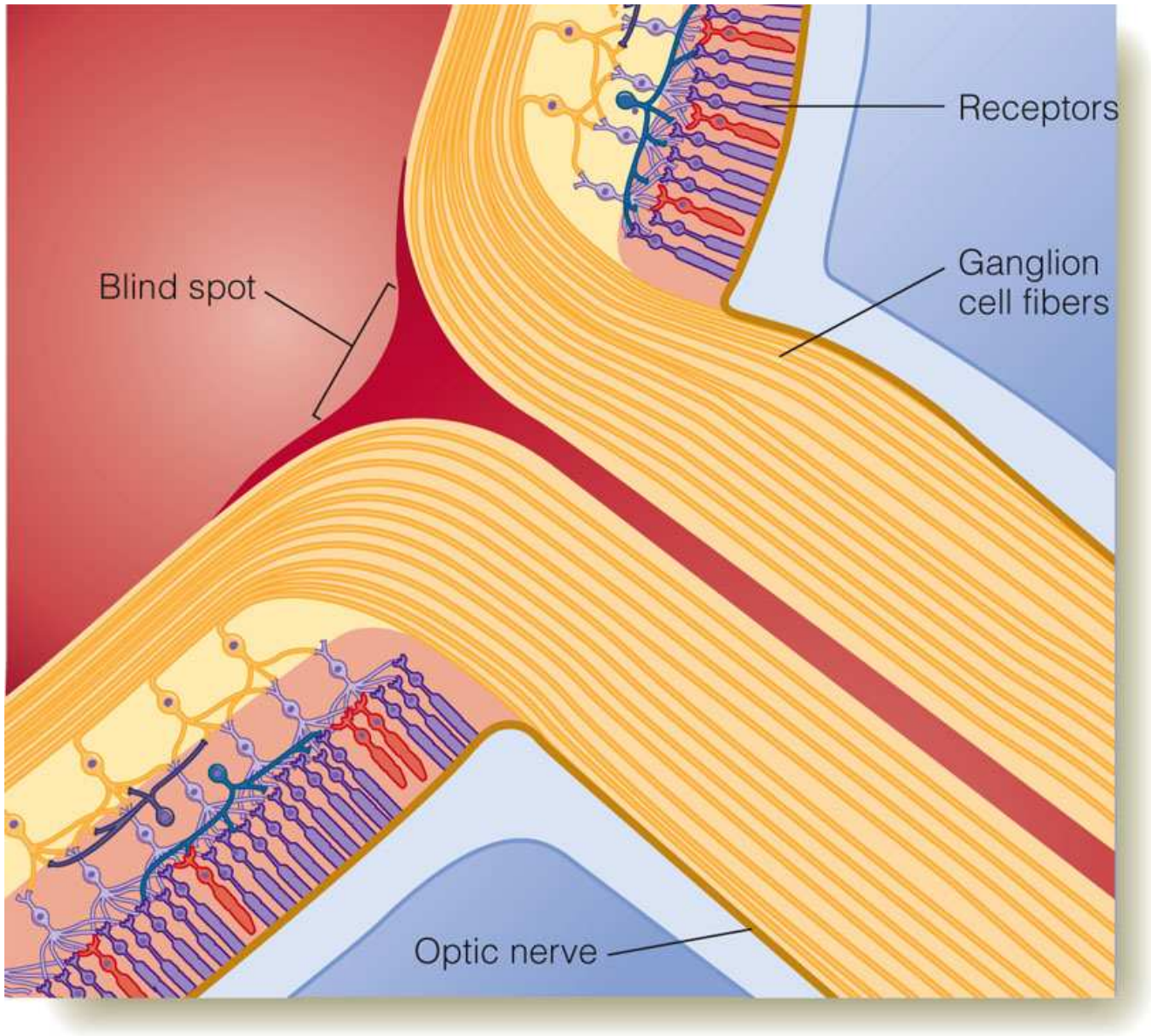
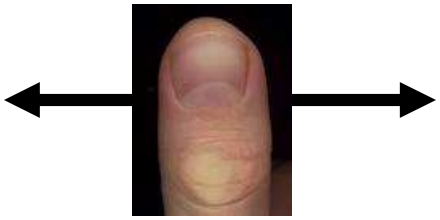


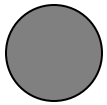
Tangential section through the human fovea.
Larger cones (arrows) are blue cones.

There are no photoreceptors where the ganglion cells leave the eye.

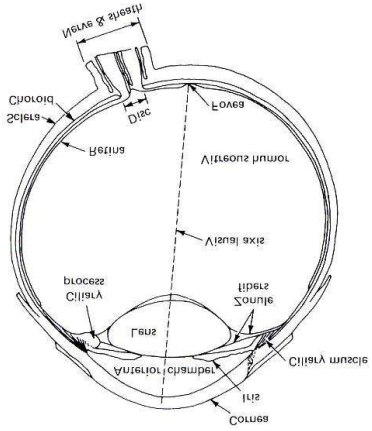


Find your own blind spot!





1) Cover your right eye with your right hand
2) Look straight ahead
3) Hold your left thumb up at arms length to where you're looking
4) Move your thumb slowly leftward until it disappears!



"When King Charles II heard about the blind spot, he took great delight in walking around his court decapitating his ladies in waiting or beheading criminals with his blind spot before they were actually guillotined. I must confess I sometimes sit in faculty meetings and enjoy decapitating our departmental chairman." - *V.S. Ramachandran*