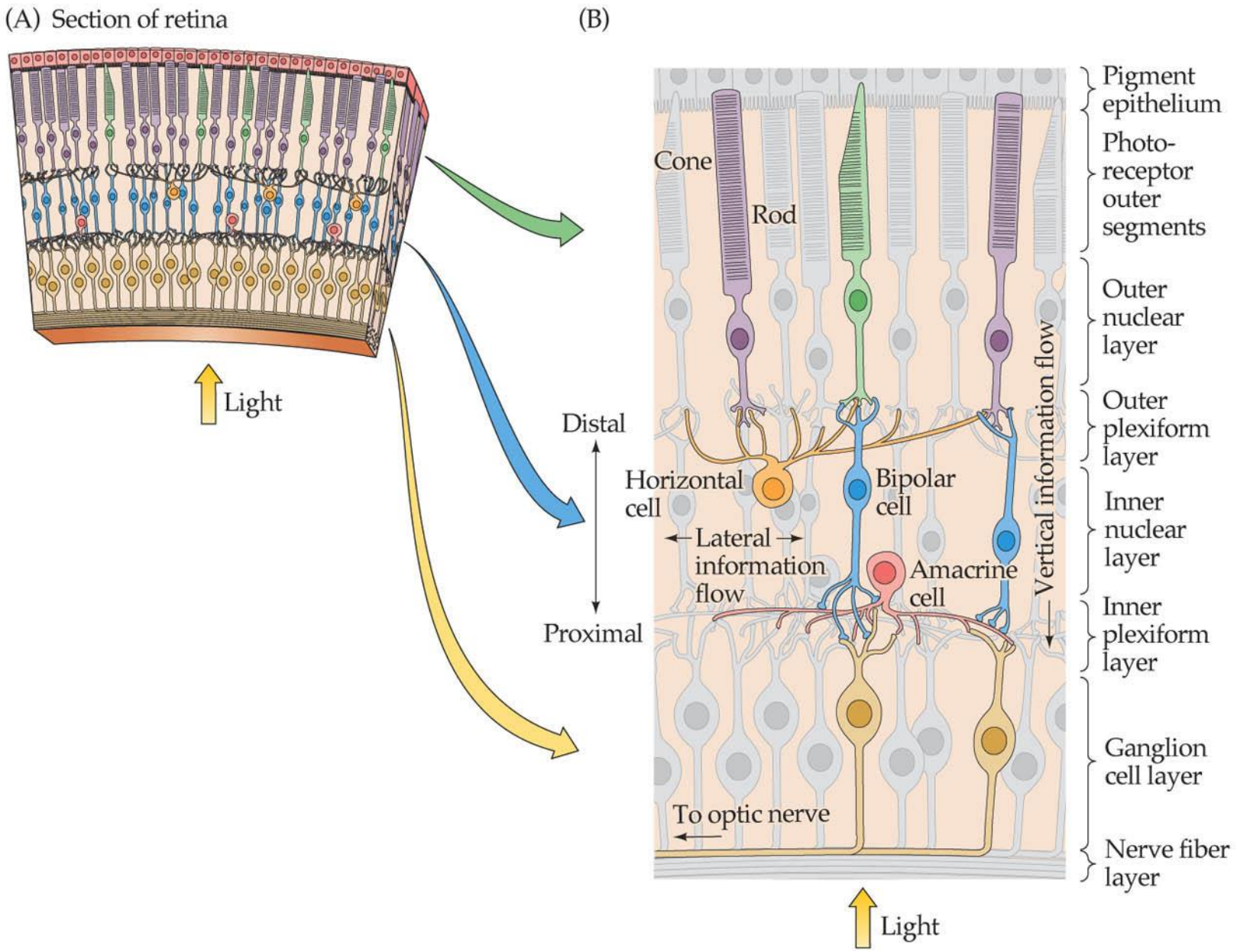
Color Vision

BIO327

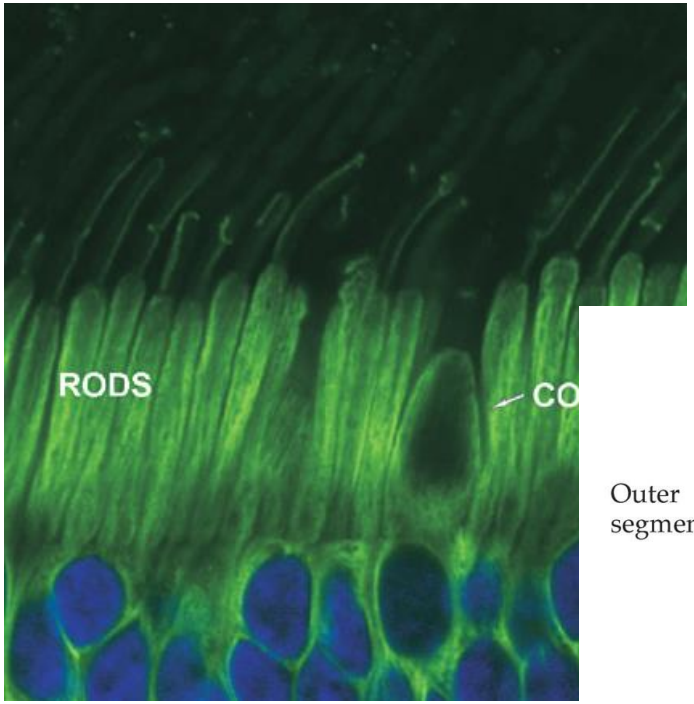
Aspect of Color Vision

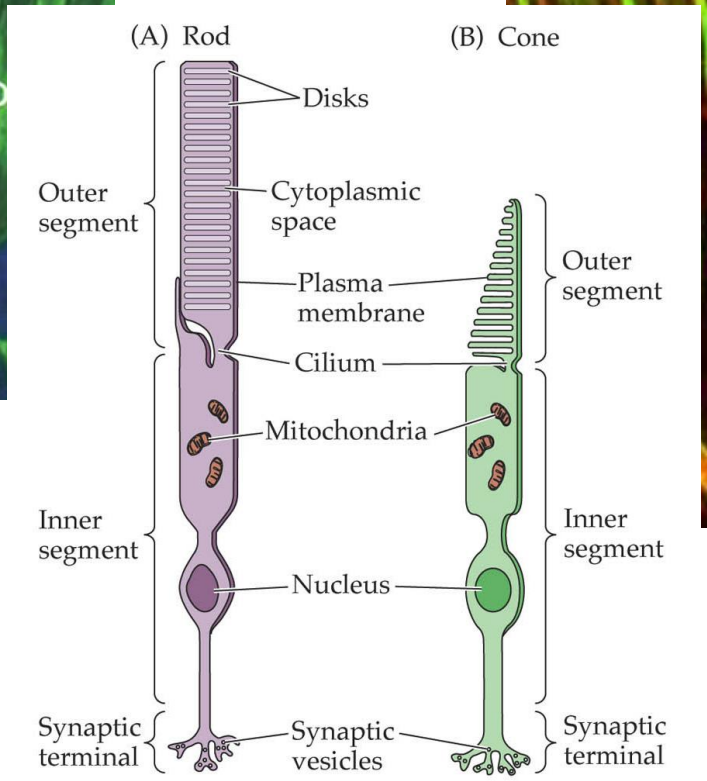
1. Photoreceptors and Visual Pigment
2. Color Opponency Mechanisms in the Retina
3. Subcortical and Cortical Processing of Color Information

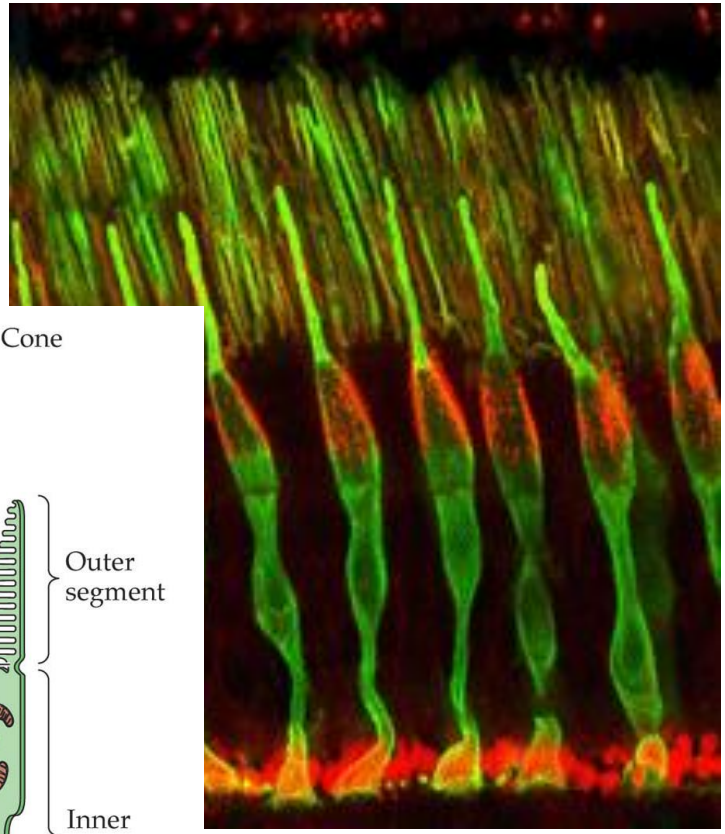
Color is not a physical property but a property bestowed by our brain.


(A) Section of retina
Light
(B)
Cone
Rod
Distal
Proximal
Horizontal cell
Bipolar cell
Lateral information flow
Amacrine cell
Vertical information flow
To optic nerve
Light
Pigment epithelium
Photo-receptor outer segments
Outer nuclear layer
Outer plexiform layer
Inner nuclear layer
Inner plexiform layer
Ganglion cell layer
Nerve fiber layer

Rod and Cone Photoreceptors

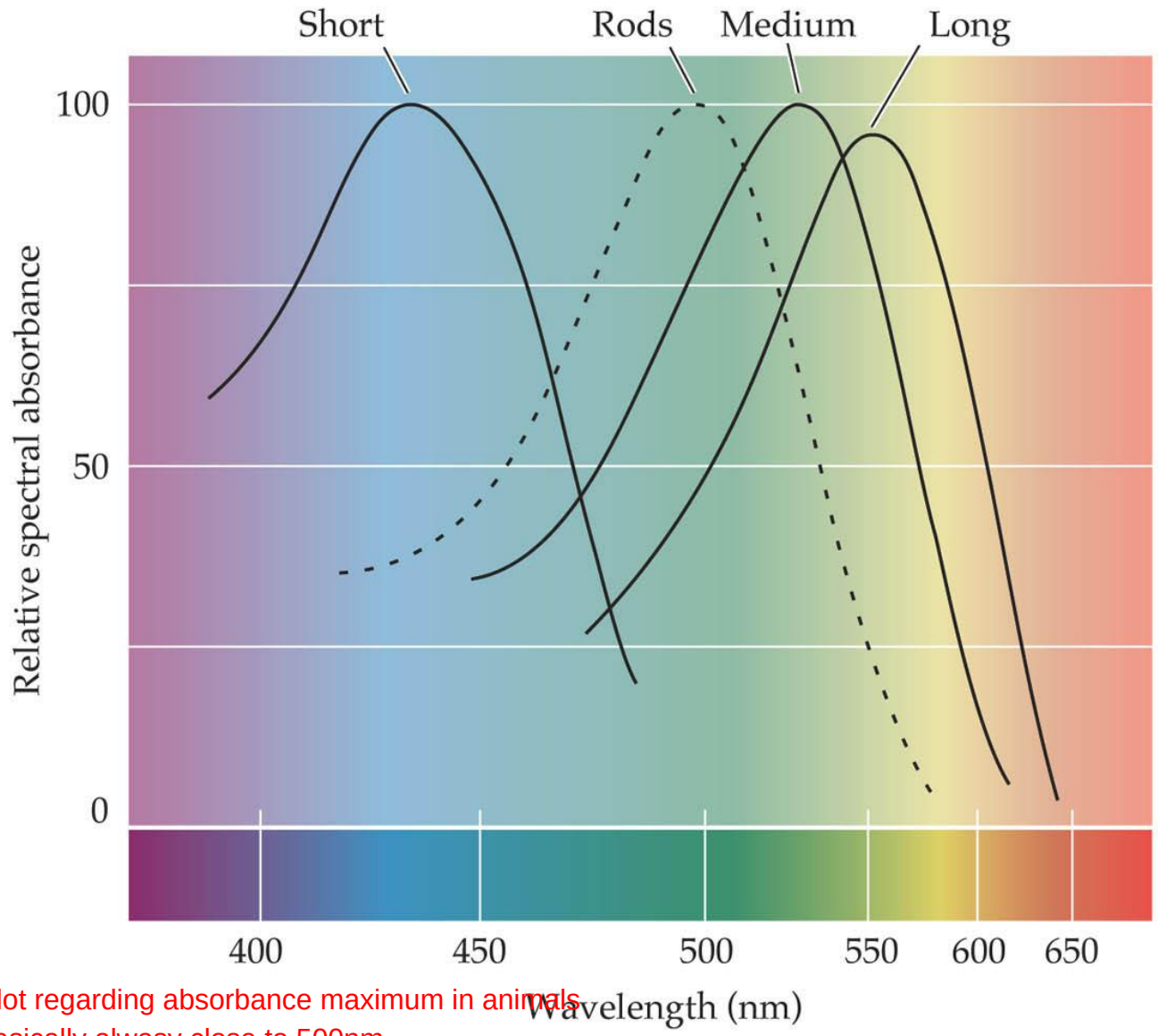






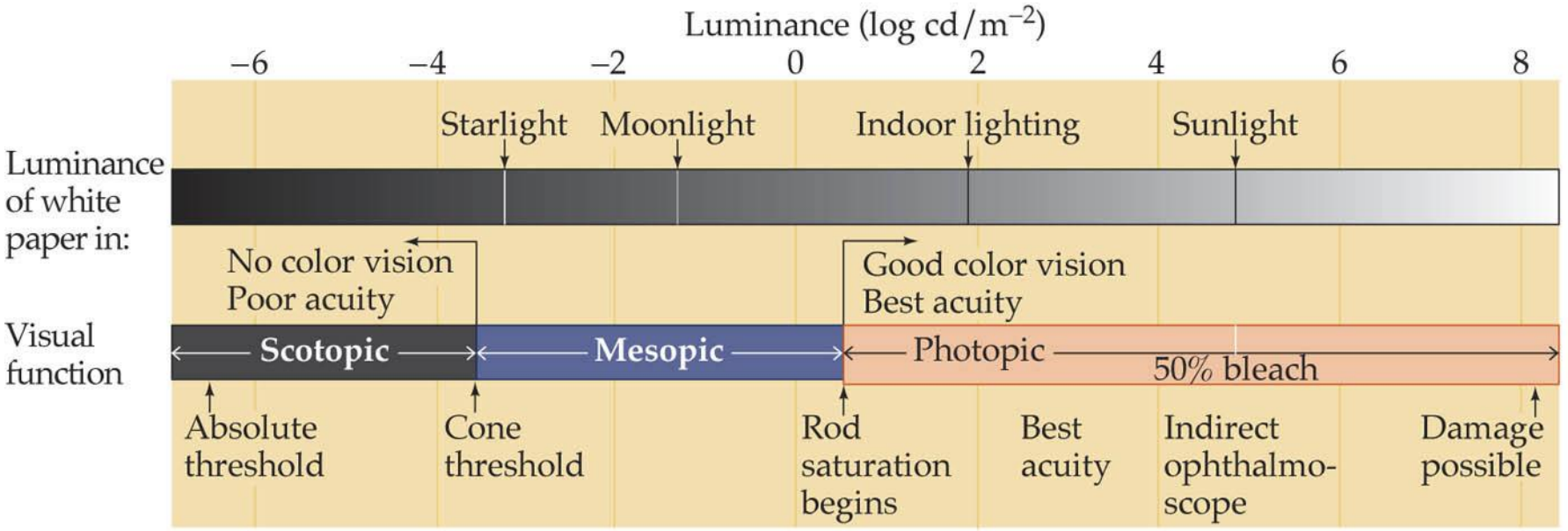
blue cones are inherenetly 20 times less sensitive than M and L cones

Absortionspectra of Human Visual Pigments



cones differ a lot regarding absorbance maximum in animals
but rods are basically alwasy close to 500nm

Rods and Cones have distinct working ranges

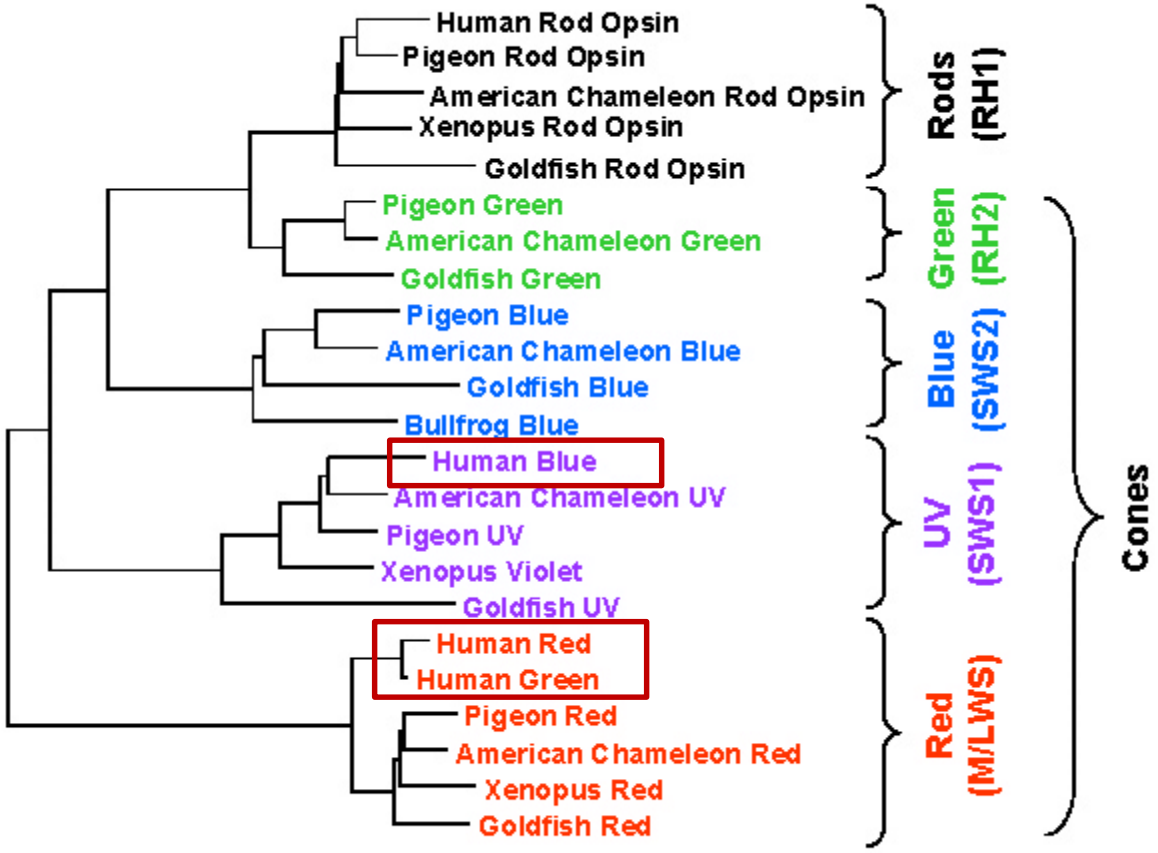


cone vision has quite good temporal resoution
rods not so much

humans only have 5% cones in eye, but we have the fovea as a specialization
evolutionary, rods were later, cones were first

The vertebrate genome contains 5 photoreceptor opsins

not so for humans. standard vertebrate cone number has 4 cones



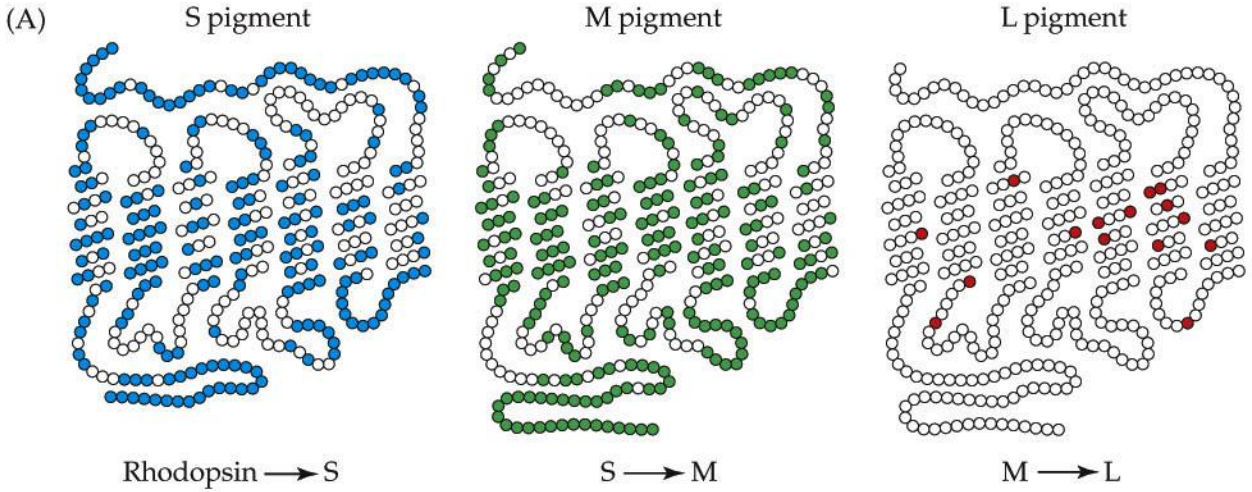
genetically, humans have UV opsins, but it was shifted in blue range
humans have only one red opsin, but there was a duplication and one turned into green

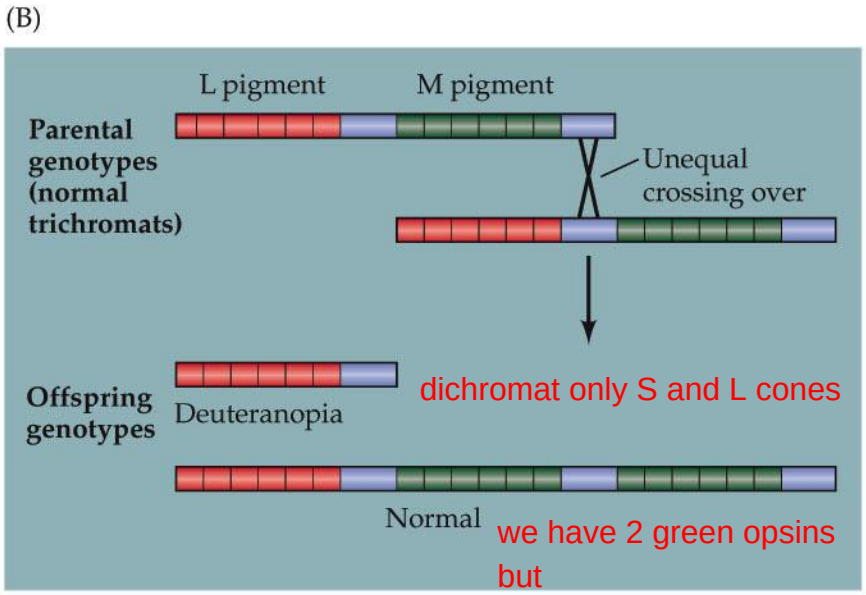
color vision evolved to distinguish bright fruits from green leaves

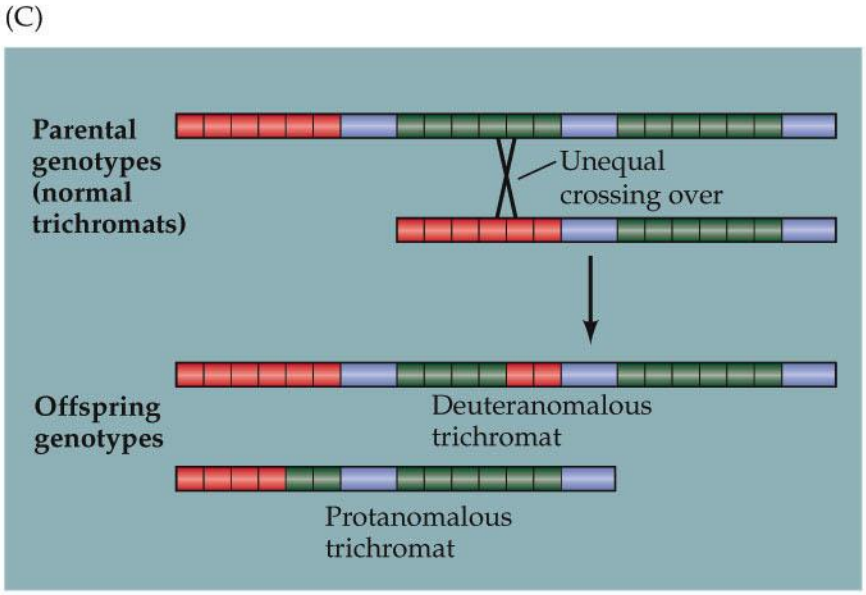
Humans and old world monkeys have reinvented trichromatic vision
New world monkeys are largely dichromats

But: interesting polymorphisms in the green opsin gene in humans and howler monkeys

Genetic mechanism of color blindness in man

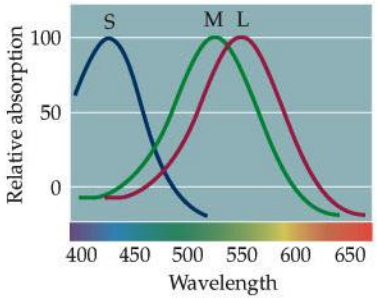




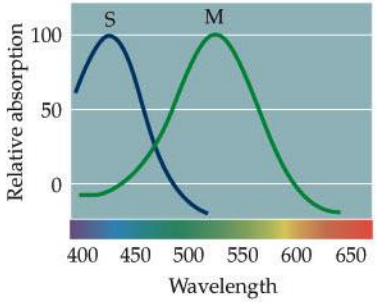


dichromatic boys prevalence: 8%

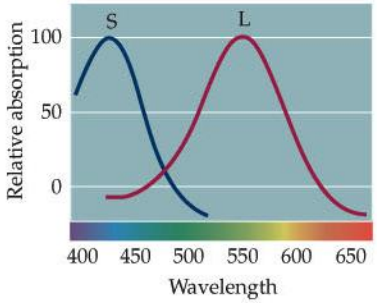
(A) Normal (trichromat)



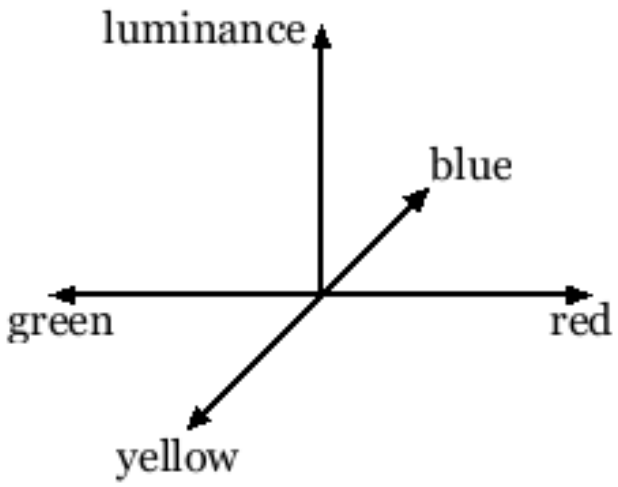
(B) Protanopia

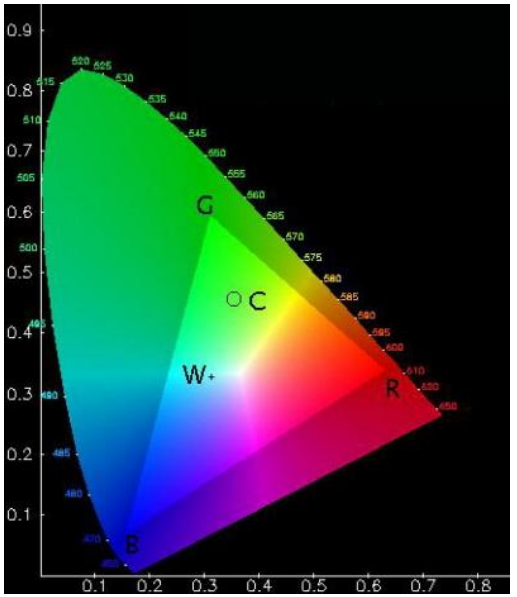


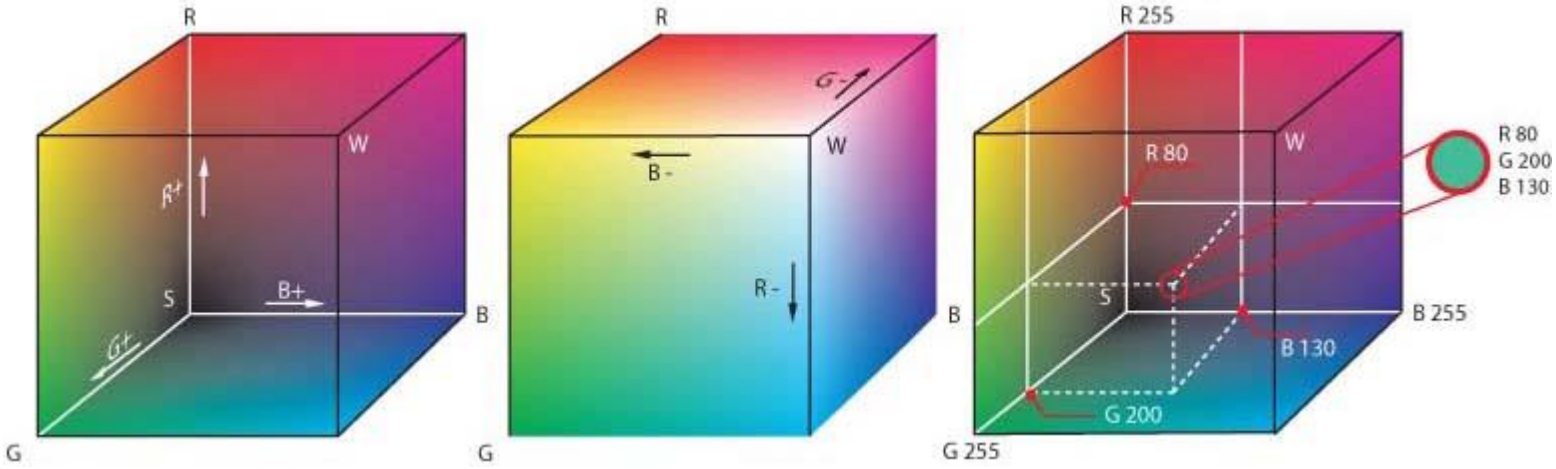
(C) Deuteranopia



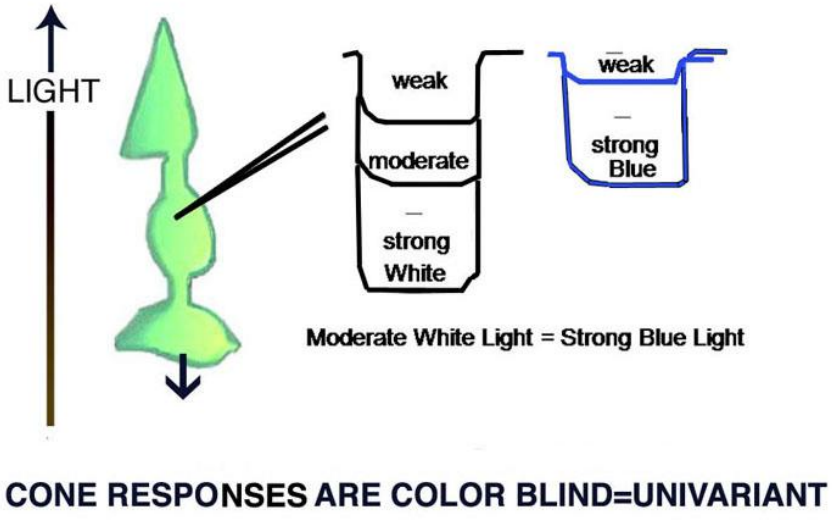
Any visual stimulus can be plotted on a 3D color space

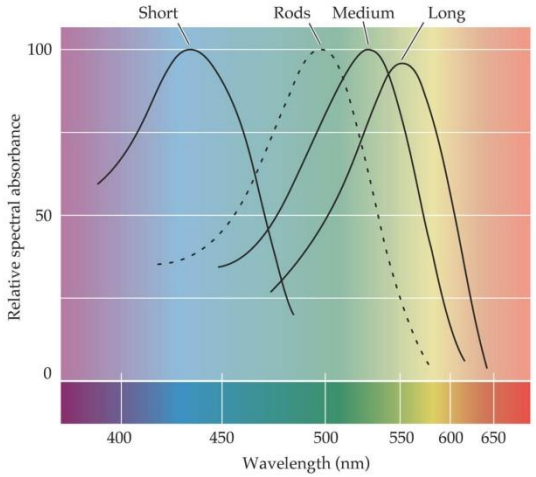




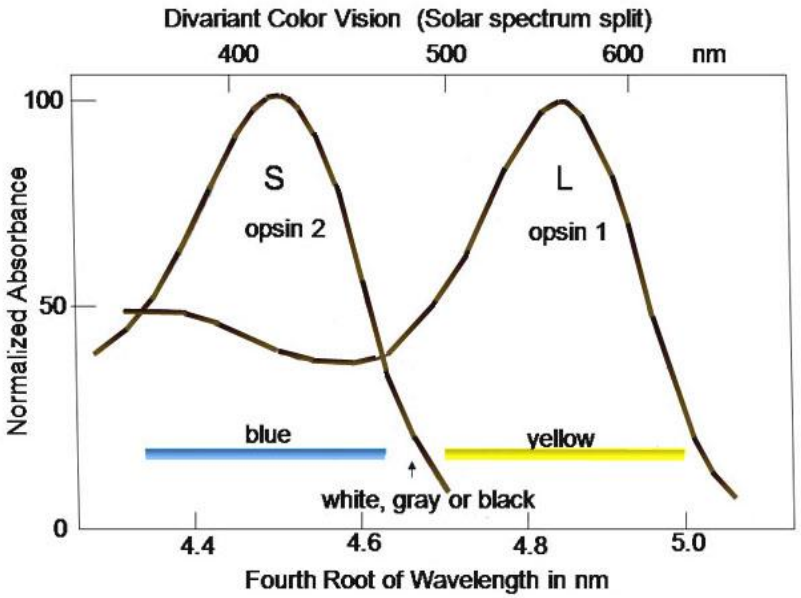


Color detection is not achieved by photoreceptors
- photoreceptors are just counting photons

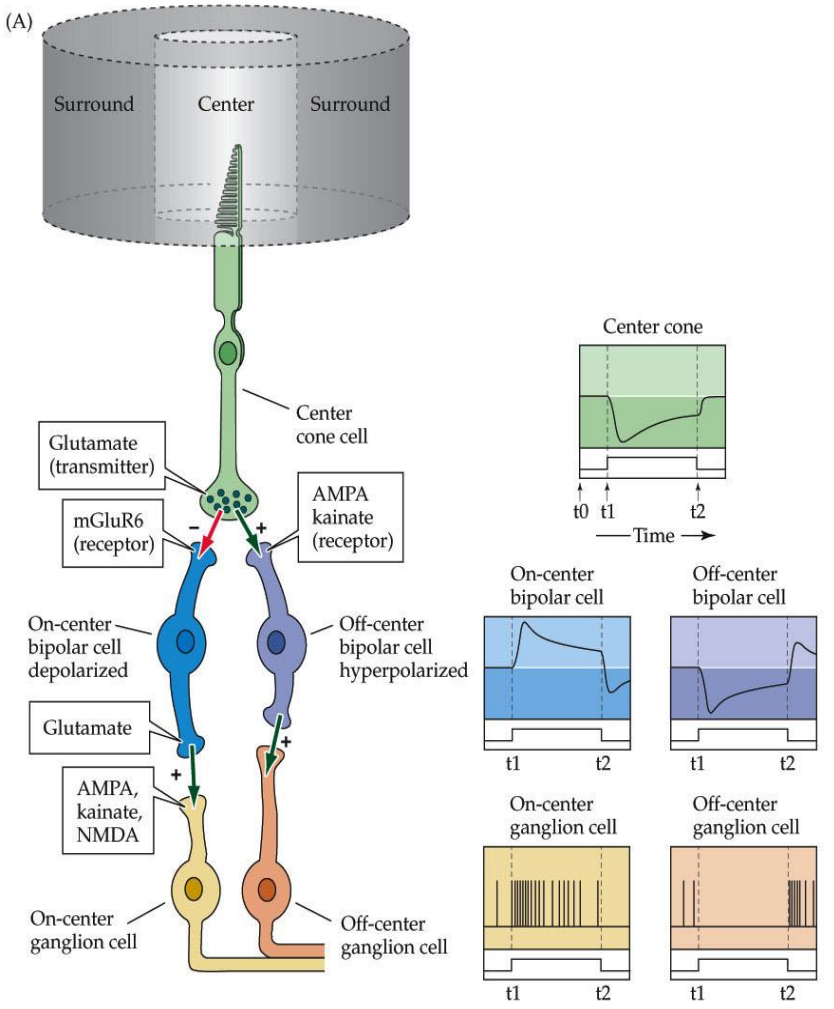


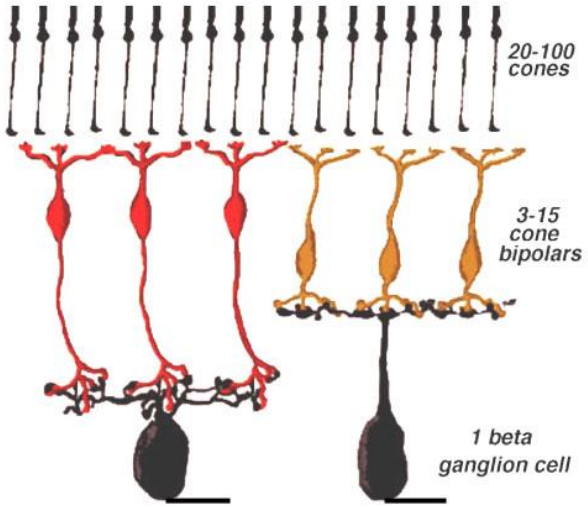


Color detection is only possible by comparing at least two different photoreceptor activations

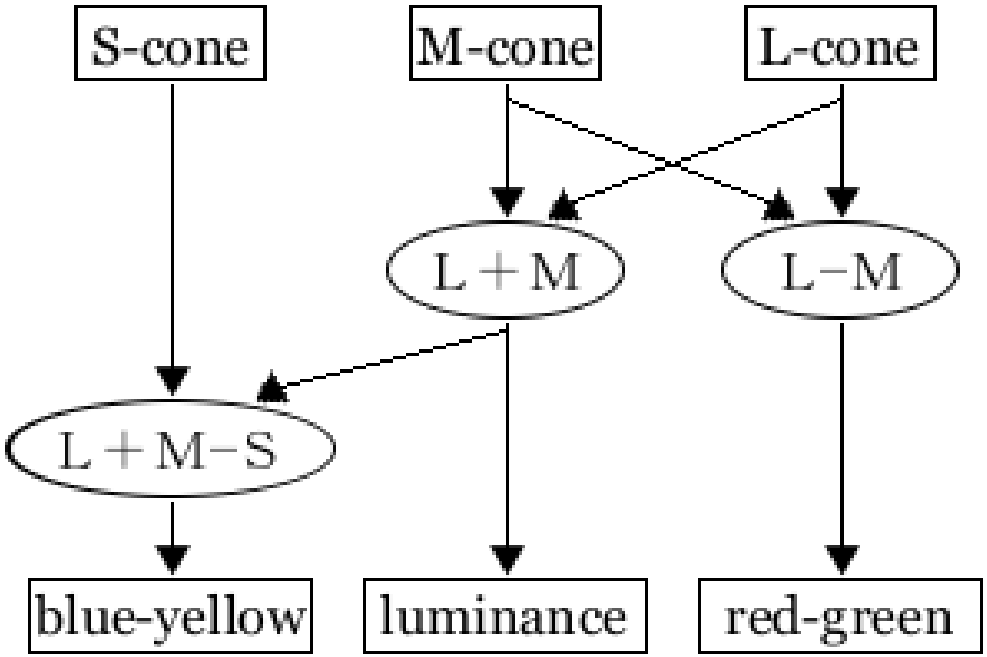


The cellular bases of comparison are the ON and OFF pathways





Comparison between color changes takes place in the retina

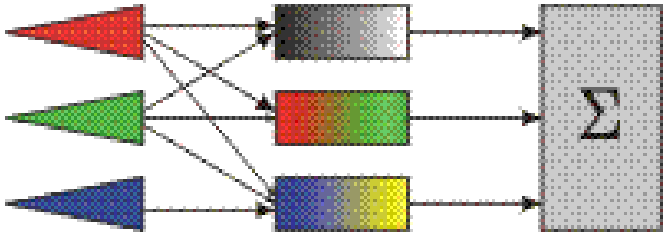


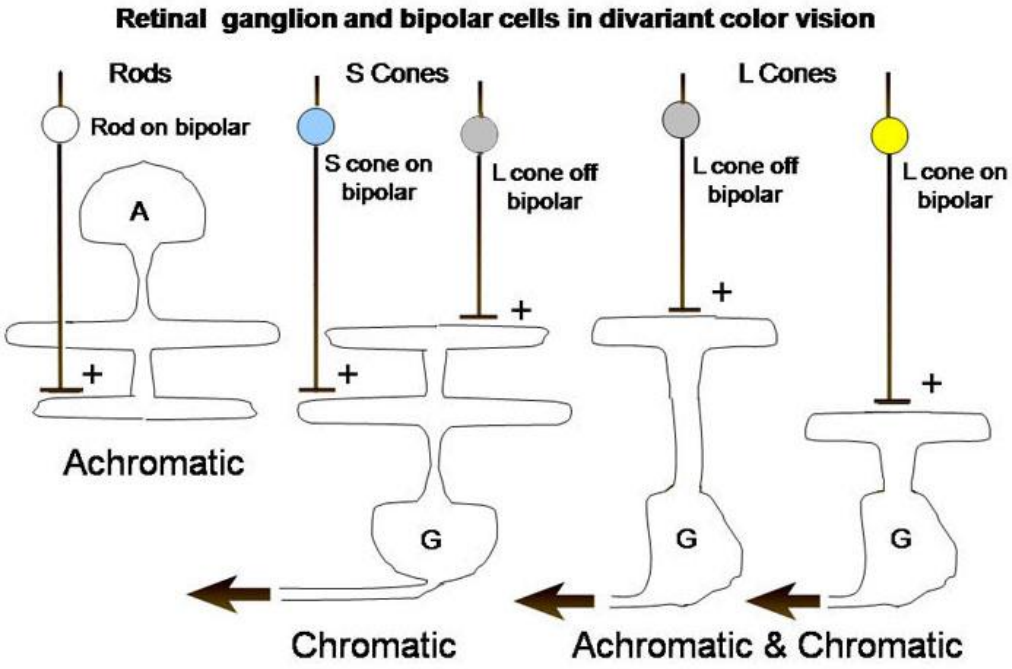
not by S cones influenced, so increase in blue light doesnt make us see stuff brighter i think

There are two chromatic channels:

(L+M)-S

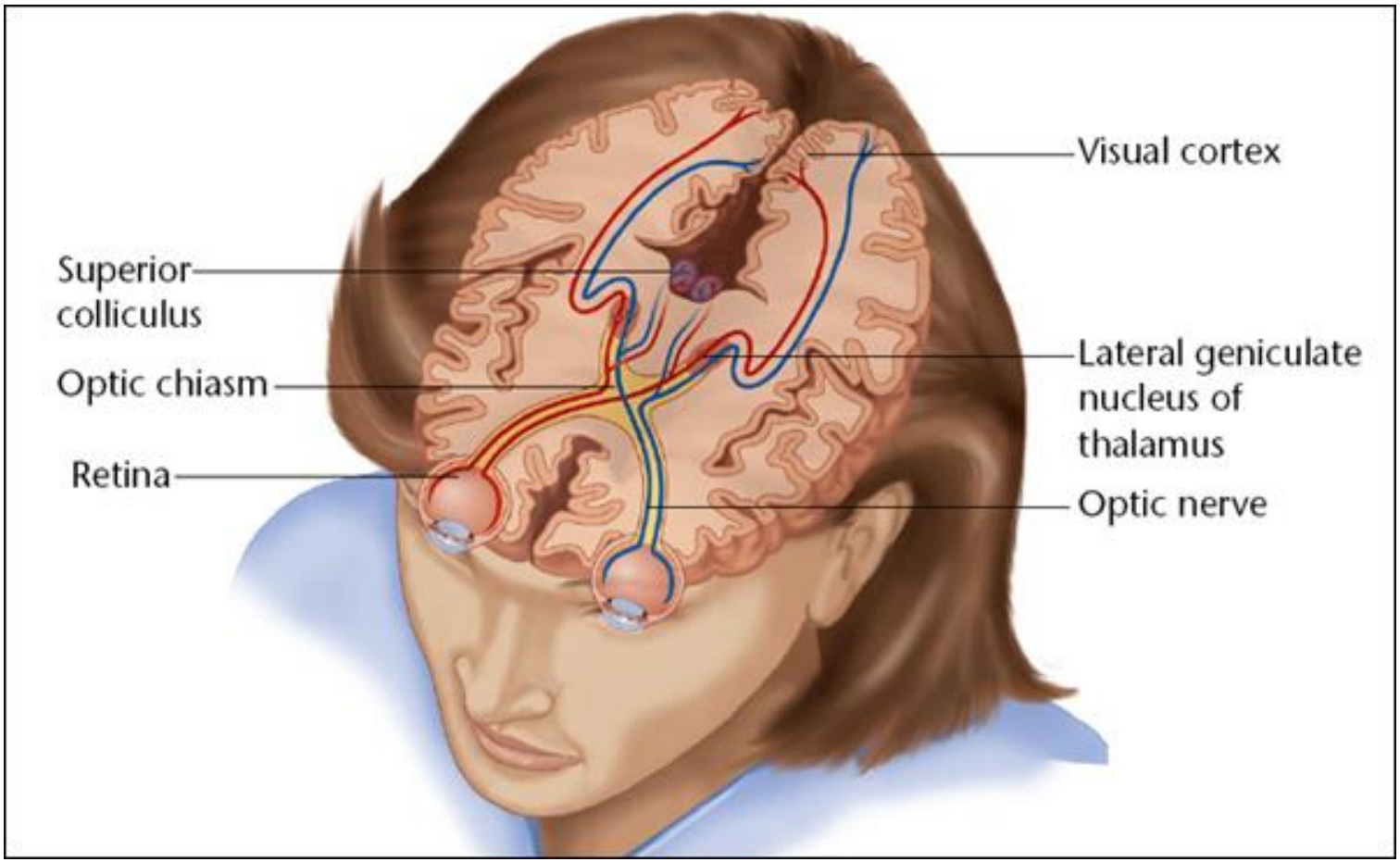
L-M



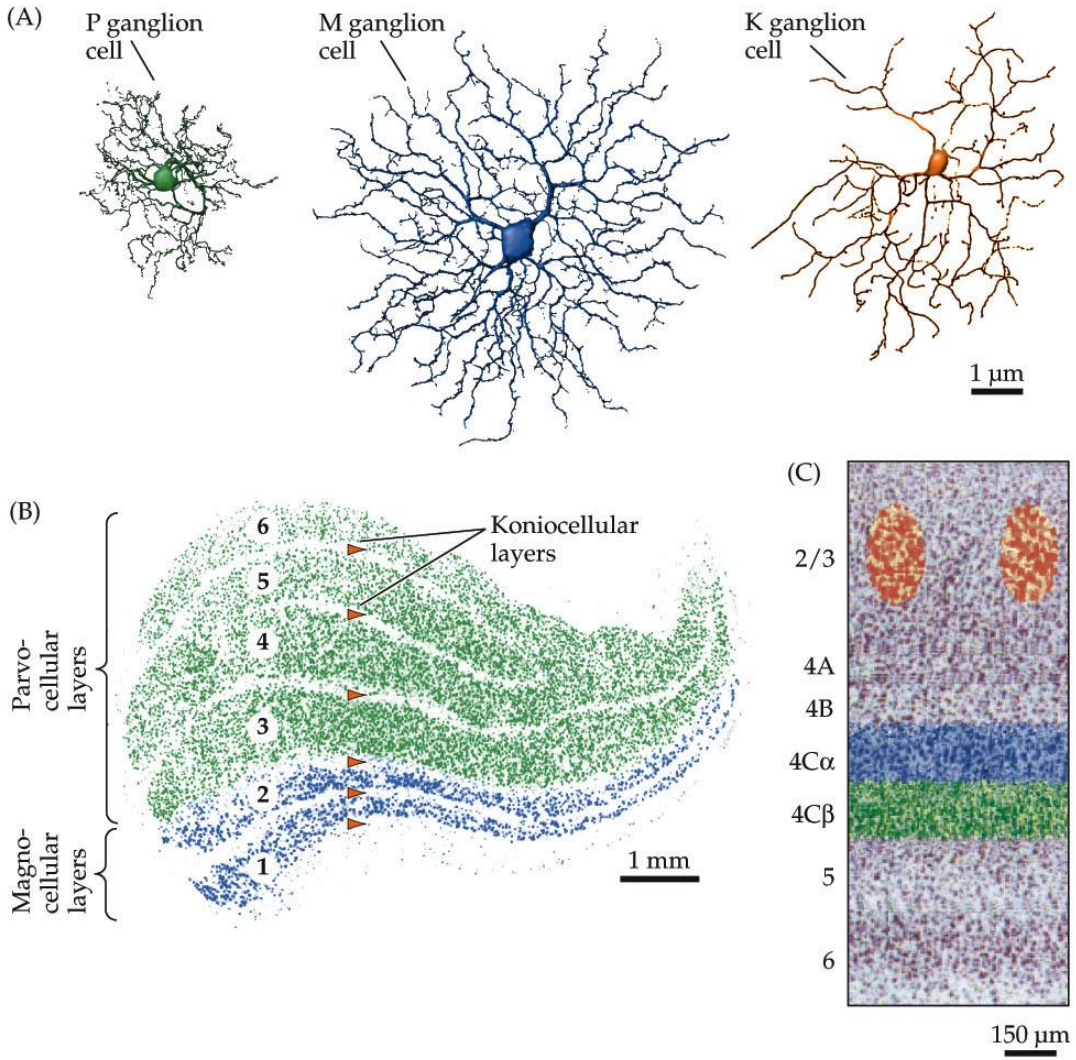


The crucial ganglion cell is the bistratified ganglion cell

The next stage of color processing is in the LGN



LGN

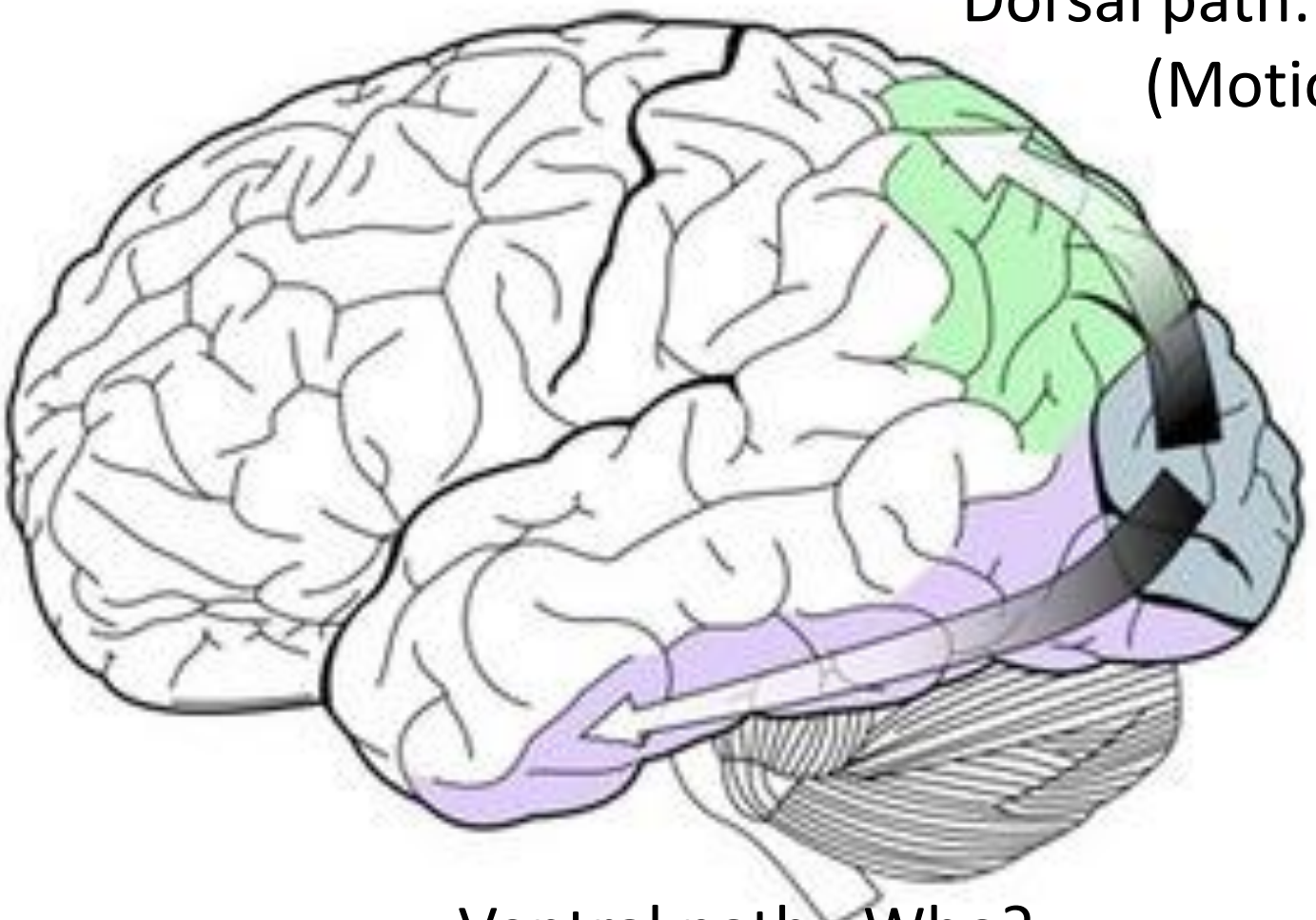


M: Rods; perception of movement, depth, and luminance changes

P: Cones; long- and medium-wavelength; perception of **color** and form (fine details).

K: S-cones

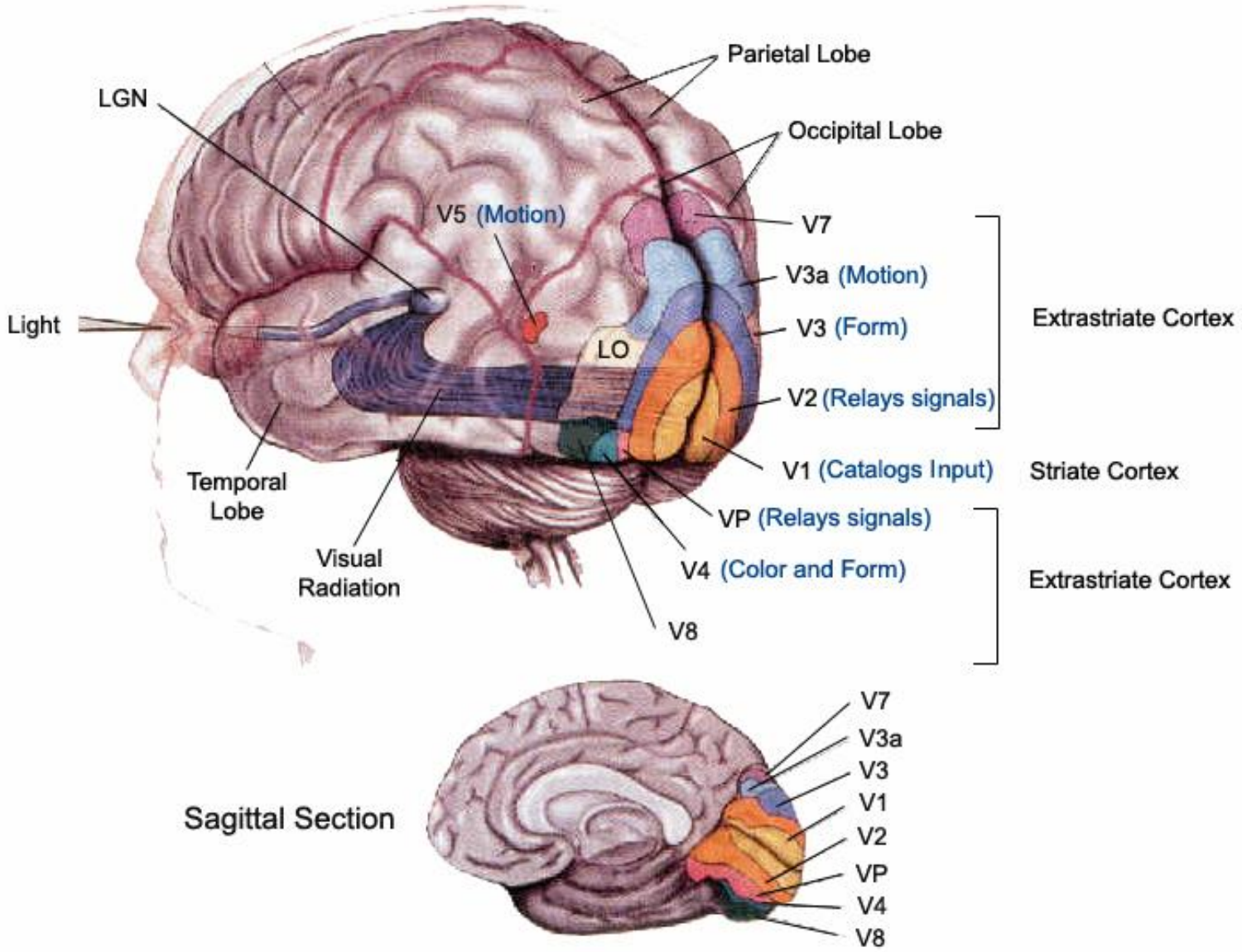
Dorsal path: Where?
(Motion, Location)



Ventral path: Who?
(Form, Color)

skipped

Visual Cortices



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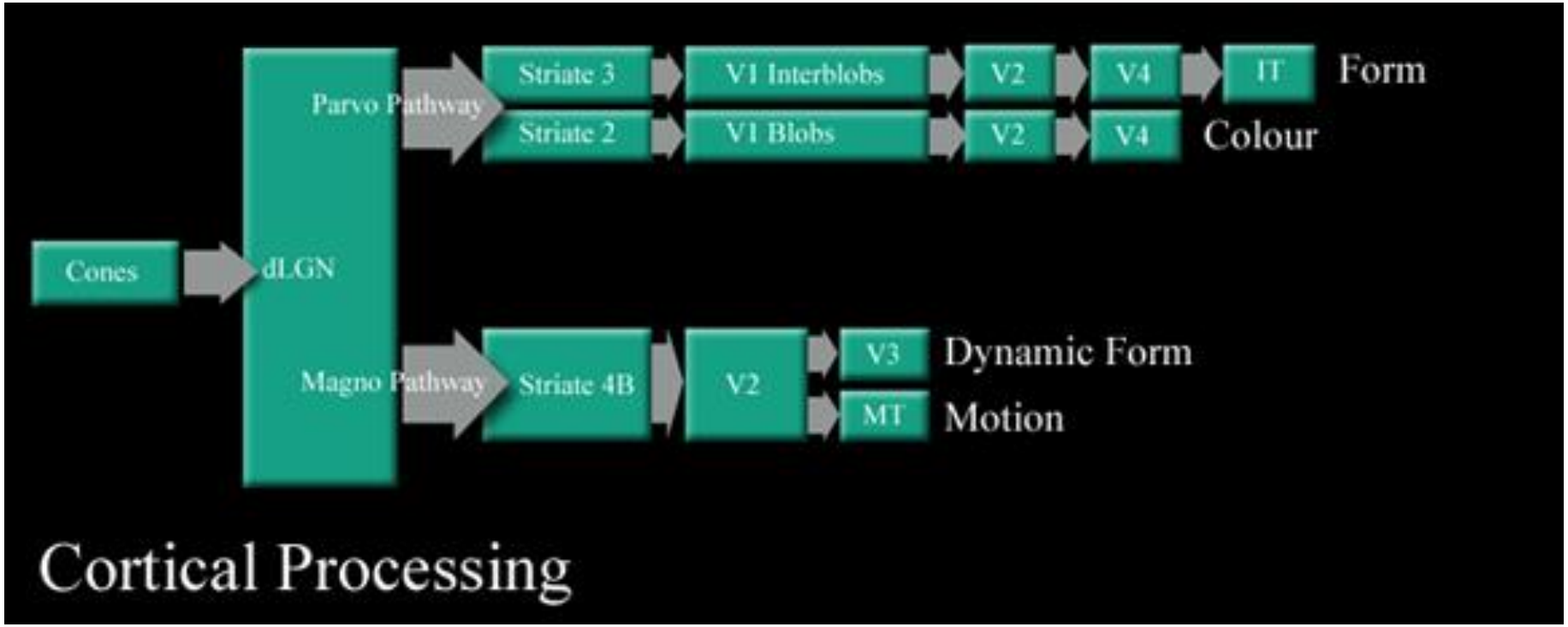
Cones
dLGN
Parvo Pathway
Magno Pathway
Striate 3
Striate 2
V1 Interblobs
V1 Blobs
V2
V2
V4
V4
IT
Form
Colour
Striate 4B
V2
V3
MT
Dynamic Form
Motion
Cortical Processing