Biology 70
Part II
Sensory Systems

www.biology.ucsc.edu

1

2

intensity vs spatial position (image formation)

3

color

4

motion

5

depth (monocular)

6

Biology 70 Slides for Lecture 1
Fall 2007

depth (binocular)

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from outline

1. In the lectures on perception we will see how various aspects of sensory information are coded in the stimulus. For vision, know what aspects of light are responsible for coding the position (boundaries or form) of objects, the color of objects, and the motion of objects. Also know the limits of our perception for each of these attributes other aspects of visual processing that "lose" in formation (many examples will come from later lectures).

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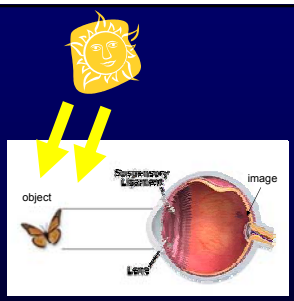

IMAGE FORMATION

light → object → eye → image on back of the eye (retina)

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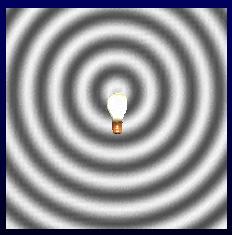
light waves



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ELECTROMAGNETIC WAVE

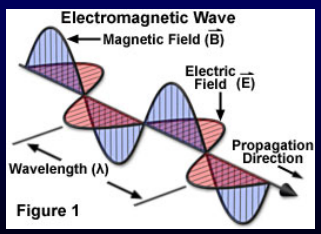

Figure 1

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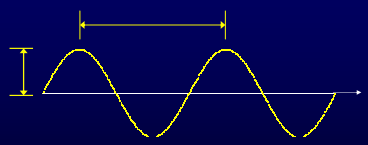
Properties of a light wave



amplitude

wavelength

color

brightness

frequency= speed of light / wavelength

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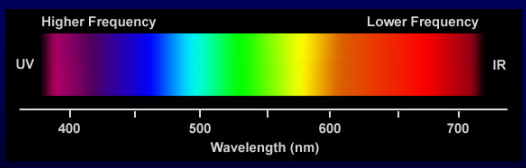
spectrum of visible light



V I B G Y O R

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full electromagnetic spectrum

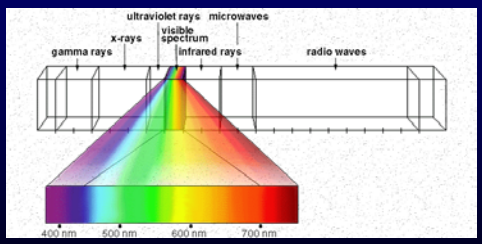

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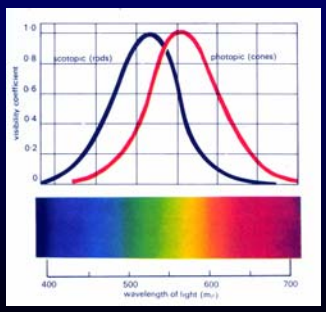
Figure 5.4 E & B (luminance or luminosity)



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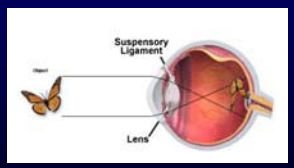
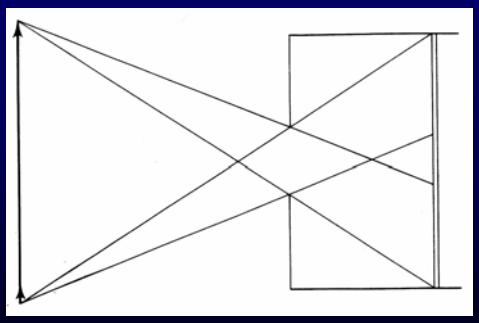
from outline

2. Understand the properties of light and how they are related to brightness and color perception.
   - a. wavelength
   - b. intensity
   - c. luminance

image formation





no image

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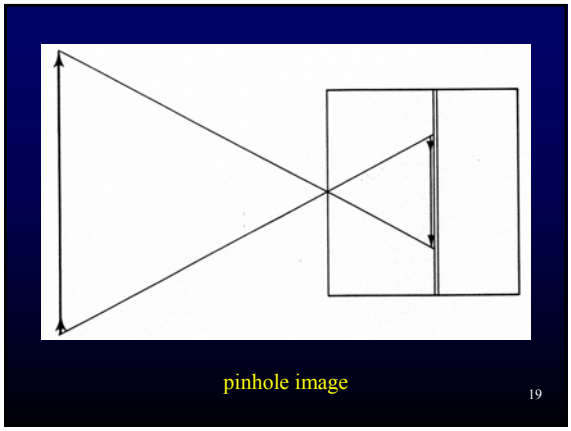

pinhole image

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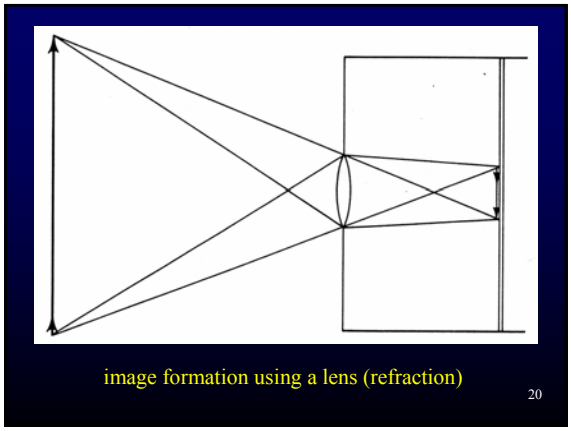

image formation using a lens (refraction)

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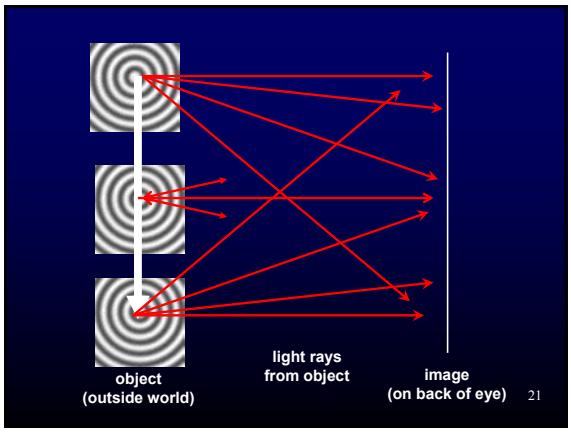

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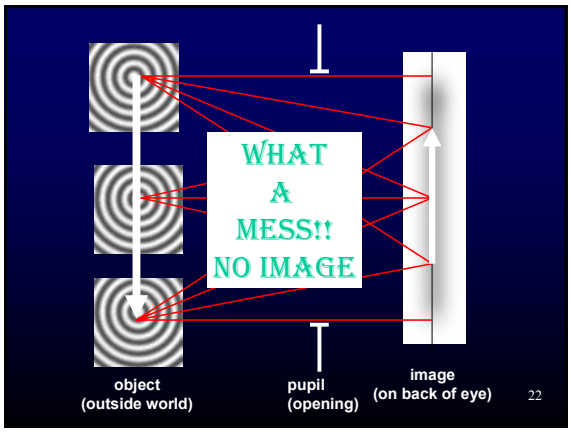

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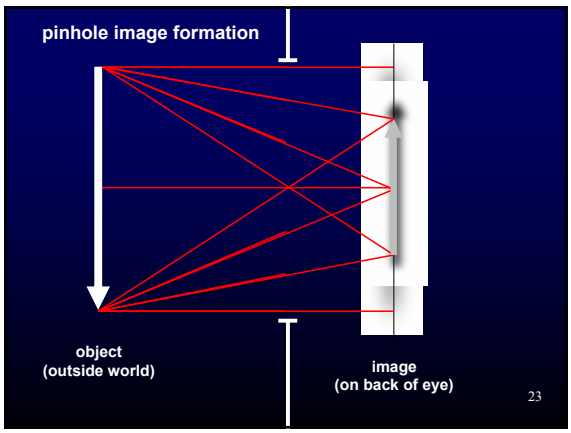

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image formation

OK,
so pinholes can form images
but very dim (loose a lot of light).

**CAN THE EYE DO BETTER
IN
IMAGE FORMATION ???**

**LENSES
and
REFRACTION**

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refraction

refraction: light waves bend when they go between different materials (glass and air; air and water)

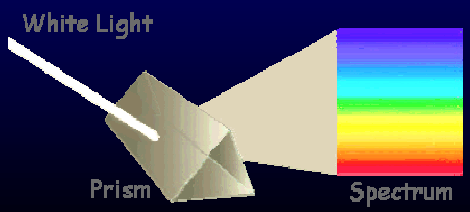

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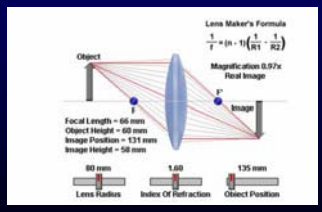
image formation by a lens

By bending light rays a lens enables ALL the light from one point in the **OBJECT** (e.g. head of arrow) to be **FOCUSED** to one point in the **IMAGE**



http://www.micro.magnet.fsu.edu/primer/java/lenses/lensvariations/

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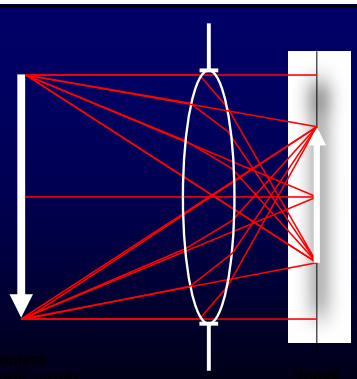

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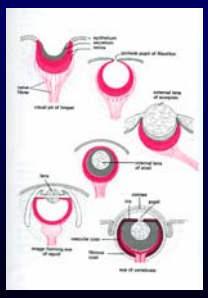
figure 3.1 E & B



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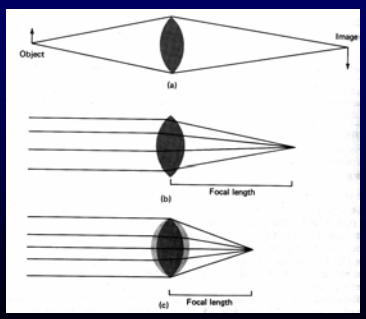
refraction by a lens; strength of a lens



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from outline

3. Patterns of light coming from an object must be focused to form an image. Know the following terms related to image formation:
   a. refraction
   b. accommodation
   c. diopter
   d. pupillary reflex

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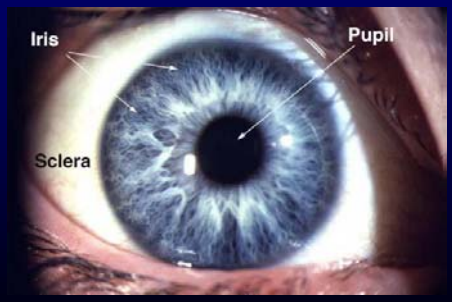
iris, pupil, sclera



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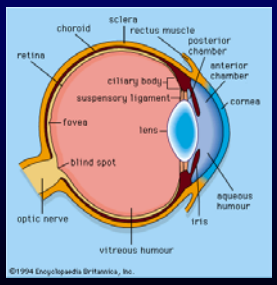
parts of the eye



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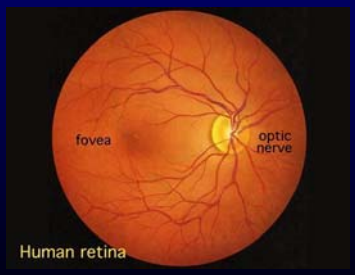
fundus of the eye (fovea, macula, optic nerve, blind spot)



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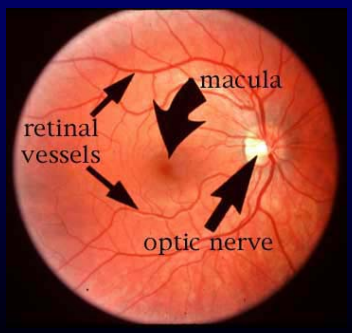
fundus photo



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movietime

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from outline

4. Be able to *identify* and discuss the *function* of the various parts of the eye:
   - a. cornea
   - b. iris-pupil
   - c. aqueous humor
   - d. lens
   - e. ciliary muscle
   - f. suspensory ligament
   - g. vitreous humor
   - h. retina
   - i. choroid
   - j. sclera
   - k. fovea
   - l. macula
   - m. blind spot
   - n. optic nerve

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ciliary muscle and accommodation

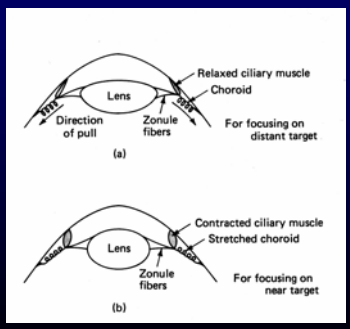
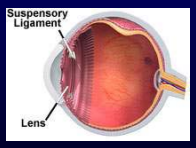


image formation and accommodation

accommodation and image formation

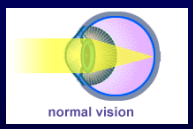


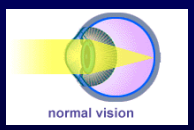
http://www.micro.magnet.fsu.edu/primer/java/humanvision/accommodation/index.html

from outline

3. Patterns of light coming from an object must be focused to form an image. Know the following terms related to image formation:
   a. refraction
   b. accommodation
   c. diopter
   d. pupillary reflex

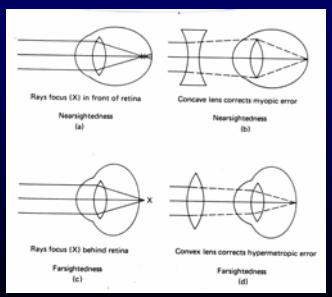
myopia and hyperopia





http://www.plainsoptical.com/poDisorders.htm

myopia and hyperopia



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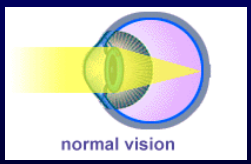
astigmatism



http://www.plainsoptical.com/poDisorders.htm

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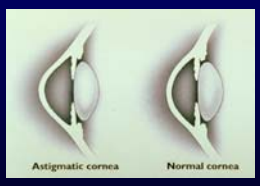
astigmatism



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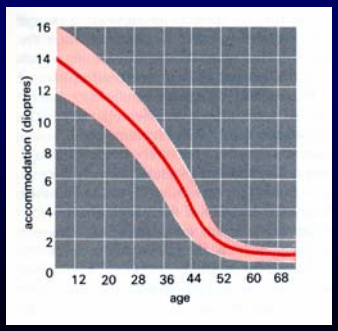
presbyopia (figure 3.10 E & B)



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LASIK surgery

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http://cleareyesight.com/ebroon_dr/Images/lasik2.gi

from outline

5. What are the following terms relating to visual disorders? we will NOT go over each of these in lecture, you are responsible for obtaining the definitions, etc, from WWW sites (see Disorders of the Eye above)

a. emmetropia
b. myopia
c. hyperopia
d. astigmatism
e. presbyopia
f. strabismus
g. cataract
h. glaucoma
i. detached retina
j. keratoconus
k. lasik surgery
l. diabetic retinopathy
m. AMD (age related macular degeneration)
n. conjuntivitis

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cataracts

Normal **Cataract**

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keratoconus

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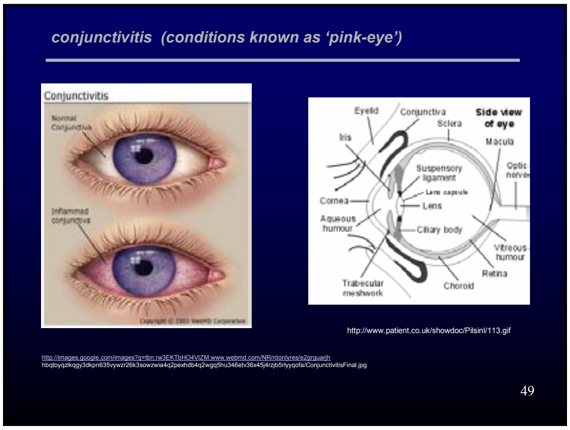
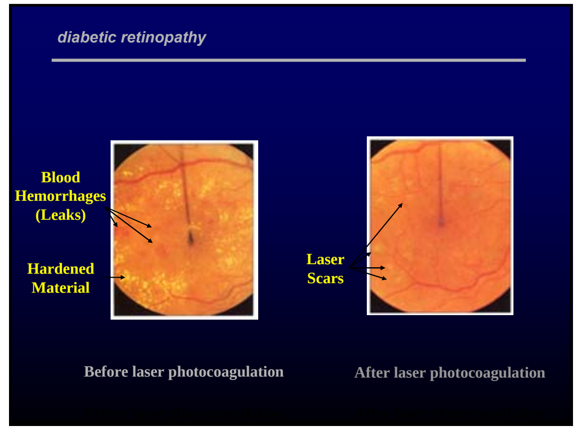
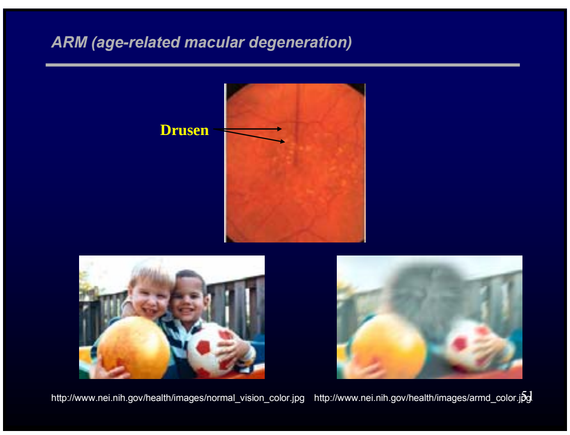
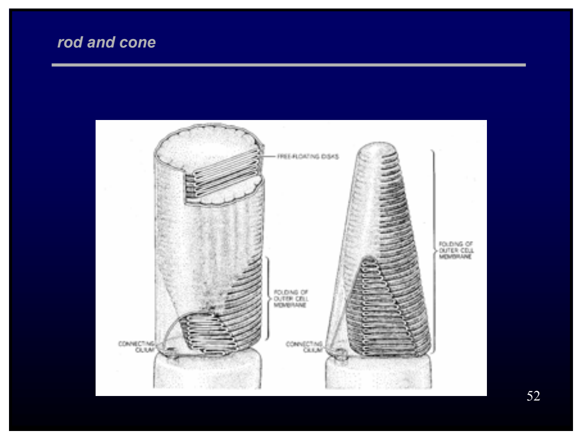
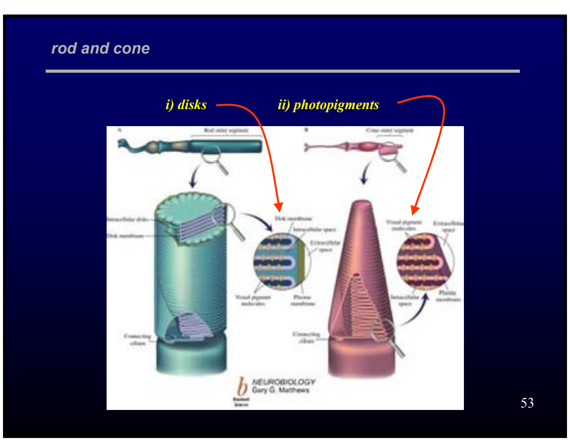
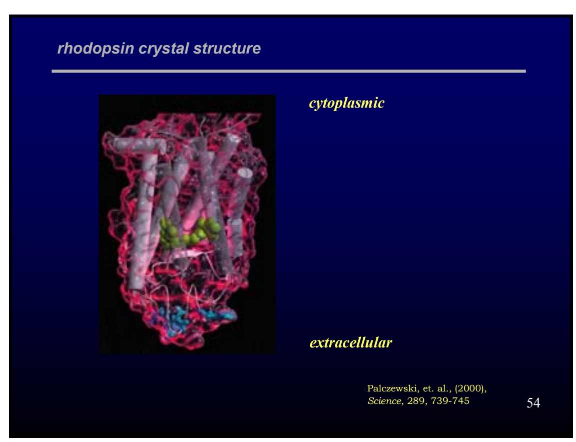




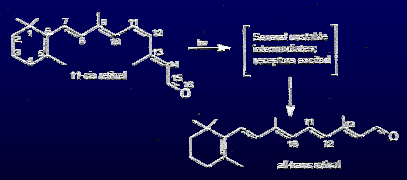








phototransduction: cis- to trans- photoisomerization of retinal



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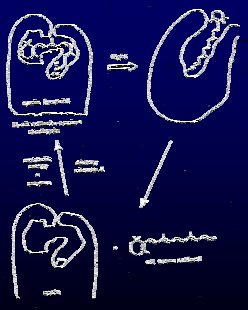
regeneration cycle



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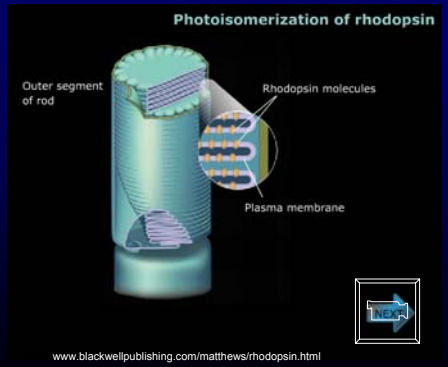

www.blackwellpublishing.com/matthews/rhodopsin.html

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from outline

6. Describe the process of visual transduction, being sure to understand:
   a. 11-cis and all-trans retinal
   b. rhodopsin
   c. vitamin A and regeneration

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