

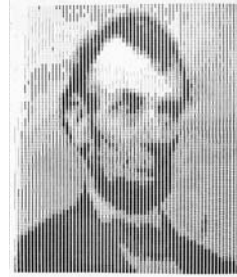
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Biology 70 *Part II* *Sensory Systems*

www.biology.ucsc.edu

1



2

intensity vs spatial position (image formation)



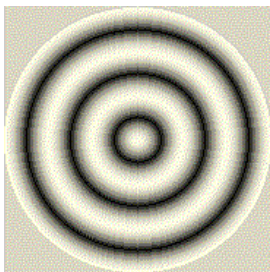
3

color



4

motion



5

depth (monocular)



6

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depth (binocular)



7

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).

8

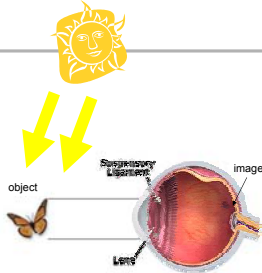
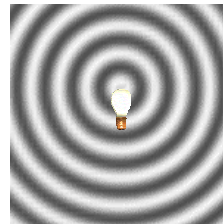


IMAGE FORMATION

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

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light waves



10

ELECTROMAGNETIC WAVE

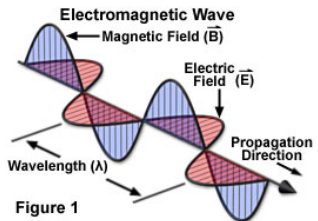
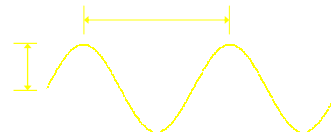


Figure 1

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Properties of a light wave



amplitude

wavelength

color

brightness

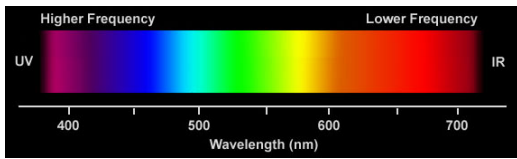
$$\text{frequency} = \text{speed of light} / \text{wavelength}$$

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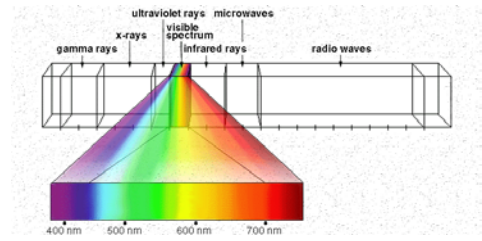
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spectrum of visible light



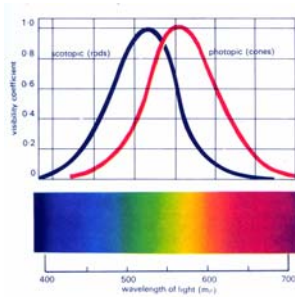
13

full electromagnetic spectrum



14

Figure 5.4 E & B (luminance or luminosity)



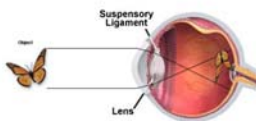
15

from outline

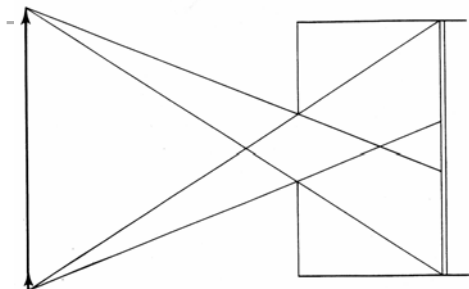
2. Understand the properties of light and how they are related to brightness and color perception.
 - a. wavelength
 - b. intensity
 - c. luminance

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image formation



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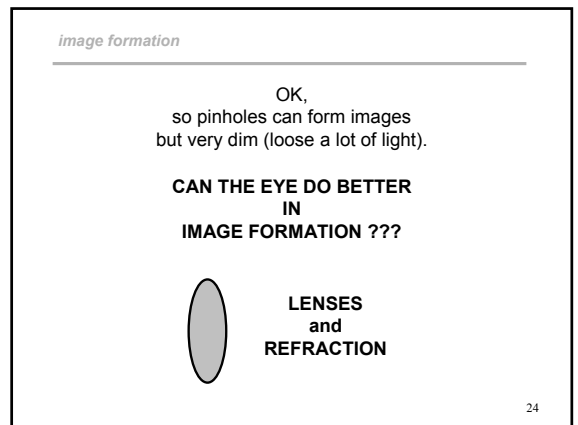
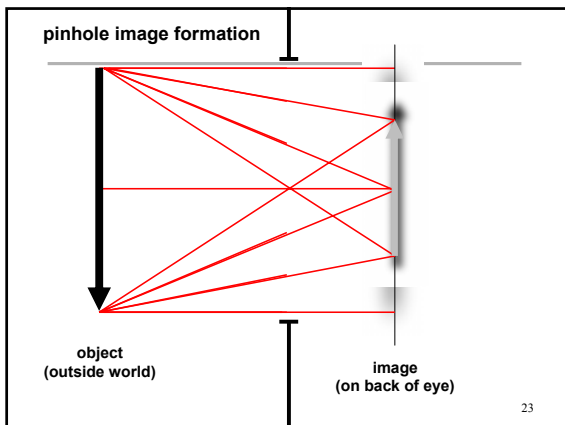
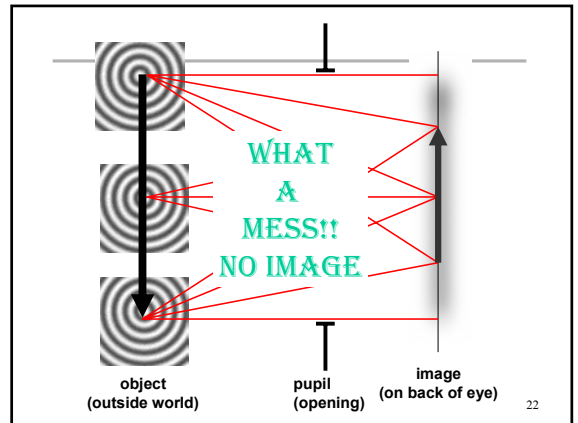
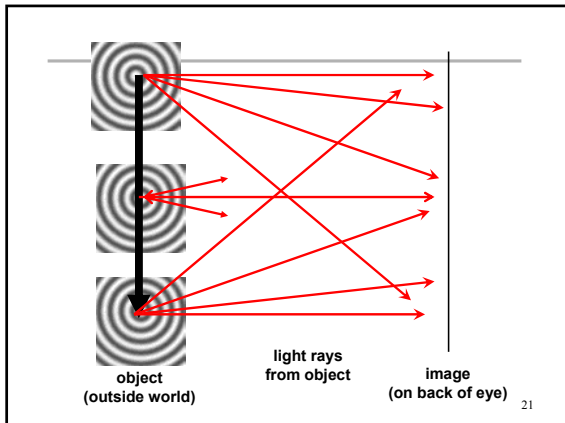
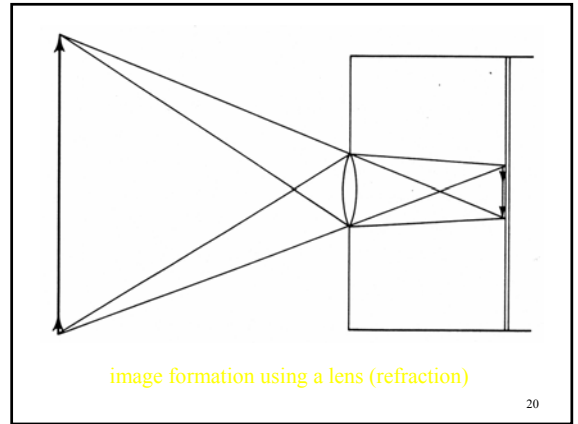
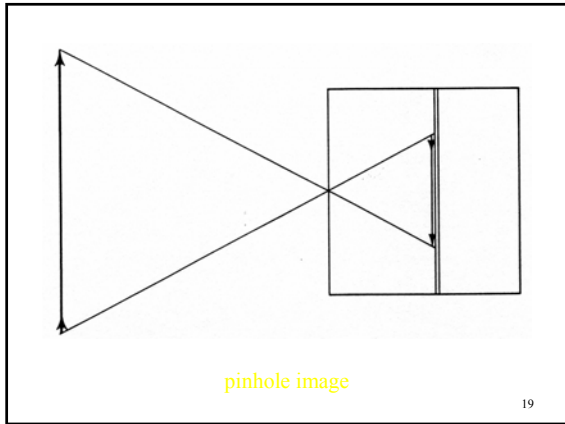


no image

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refraction

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

White Light

Prism

Spectrum

25

image formation by a lens

Object

Image

Optical Center

Focal Length

Object Height

Image Height

Image Position

Object Position

80 mm

1.60

135 mm

Lens Radius

Index Of Refraction

Object Position

Lens Maker's Formula

$$\frac{1}{f} = (n - 1) \left(\frac{1}{R_1} - \frac{1}{R_2} \right)$$

Magnification 0.97x

Focal Image

26

object (outside world)

(glass) lens

image (on back of eye)

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figure 3.1 E & B

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refraction by a lens; strength of a lens

Object

Image

(a)

(b)

Focal length

(c)

Focal length

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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:

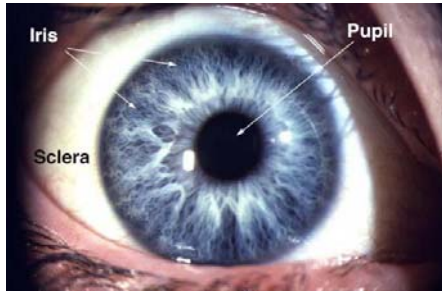
- refraction ➡
- accommodation
- diopter ➡
- pupillary reflex

30

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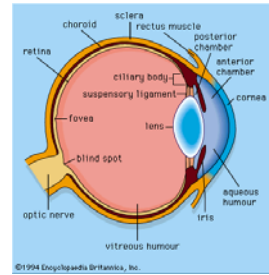
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iris, pupil, sclera



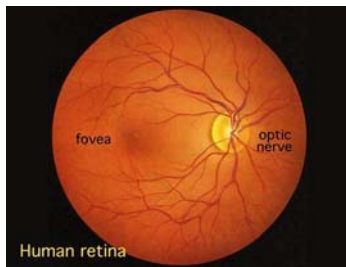
31

parts of the eye



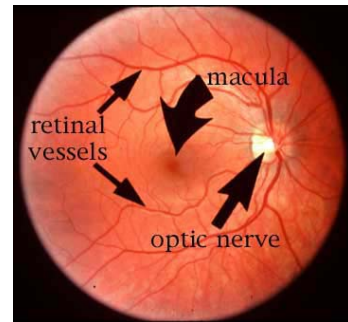
32

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



33

fundus photo



34

movietime



35

from outline

4. Be able to *identify* and discuss the *function* of the various parts of the eye:

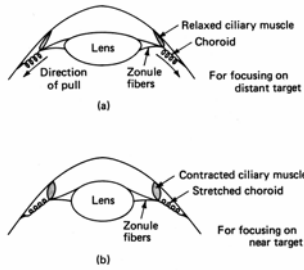
- | | |
|------------------------|----------------|
| a. cornea | h. retina |
| b. iris-pupil | i. choroid |
| c. aqueous humor | j. sclera |
| d. lens | k. fovea |
| e. ciliary muscle | l. macula |
| f. suspensory ligament | m. blind spot |
| g. vitreous humor | n. optic nerve |

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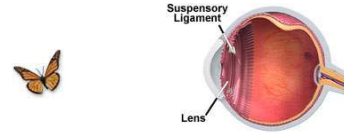
ciliary muscle and accommodation



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image formation and accommodation

accommodation and image formation



38

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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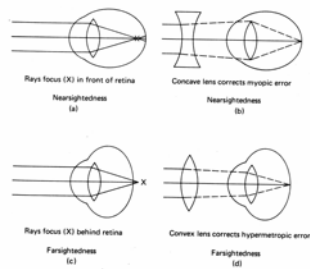
myopia and hyperopia



www.plainsoptical.com/poDisorders.htm

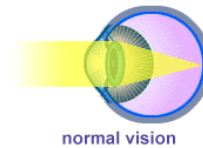
40

myopia and hyperopia



41

astigmatism




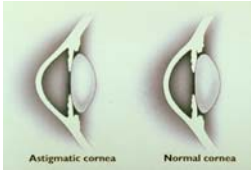

www.plainsoptical.com/poDisorders.htm

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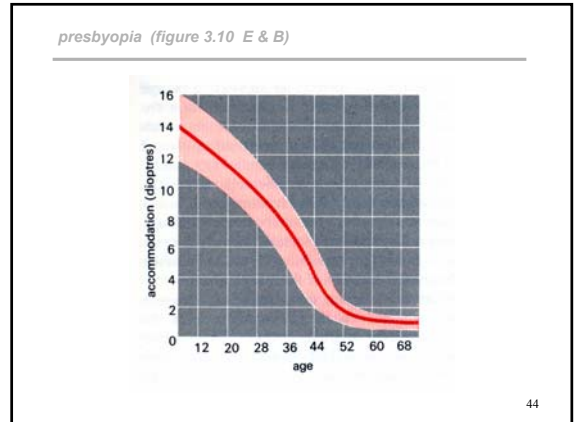
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astigmatism

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


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cataracts



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keratoconus



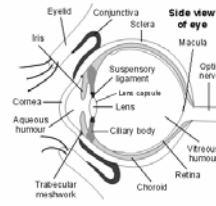
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conjunctivitis (conditions known as 'pink-eye')

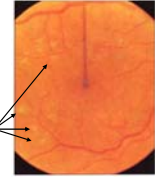
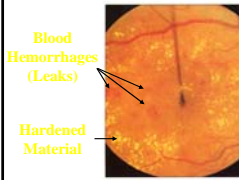
Conjunctivitis



<http://images.google.com/images?doctype=Text&TheEyeChart.com/eyes/eyes/eyes/>

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diabetic retinopathy



Before laser photocoagulation

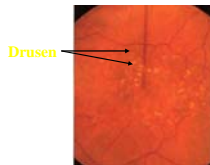
After laser photocoagulation

Before laser photocoagulation

After laser photocoagulation

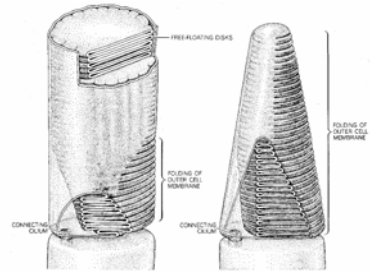
50

ARM (age-related macular degeneration)



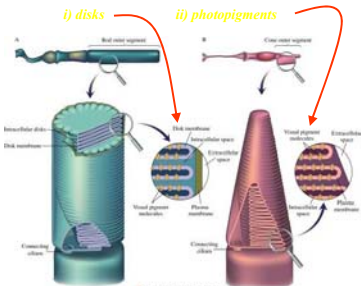
51

rod and cone



52

rod and cone



53

rhodopsin crystal structure



cytoplasmic

extracellular

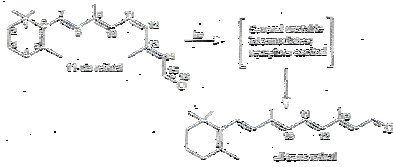
Palczewski, et al., (2000),
Science, 289, 739-745.

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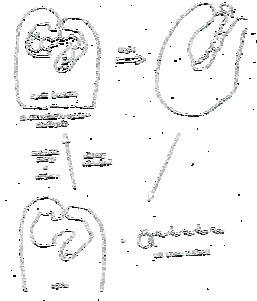
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phototransduction: cis- to trans- photoisomerization of retinal



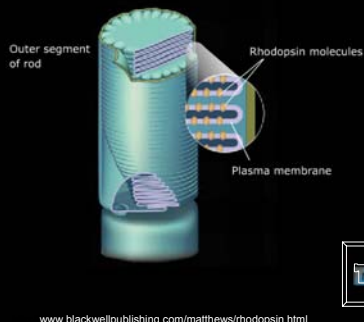
55

regeneration cycle



56

Photoisomerization of rhodopsin



57

from outline

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

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