CS 498 VR

Lecture 10 - 2/19/18

go.illinois.edu/VRlect10

Reviews from last lecture

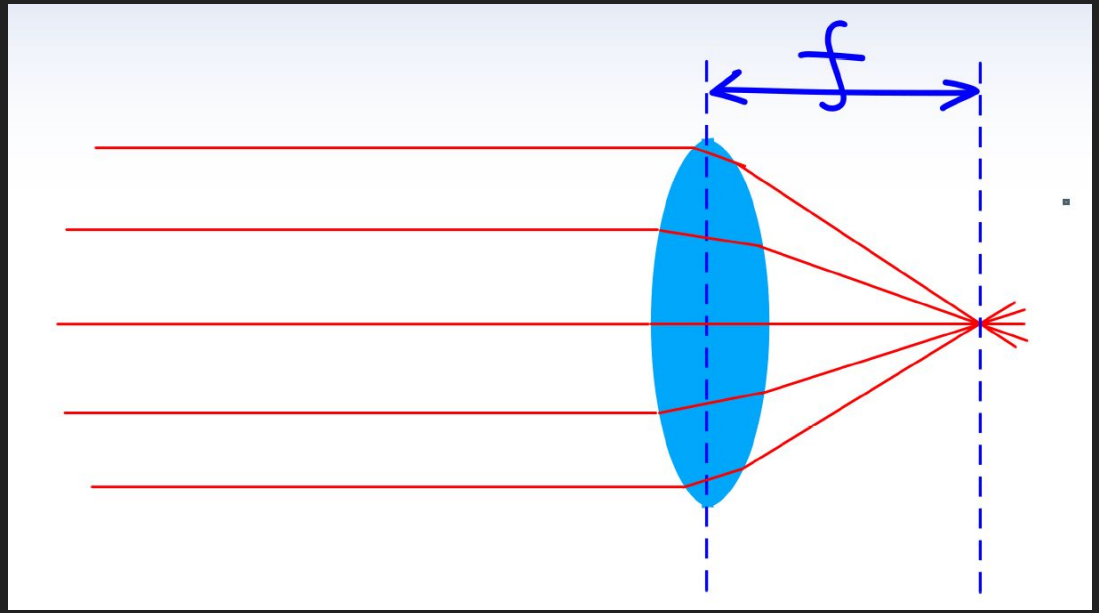
- List all possible light models
  - Do rays converge or diverge?

- Why do we use Snell’s Law?

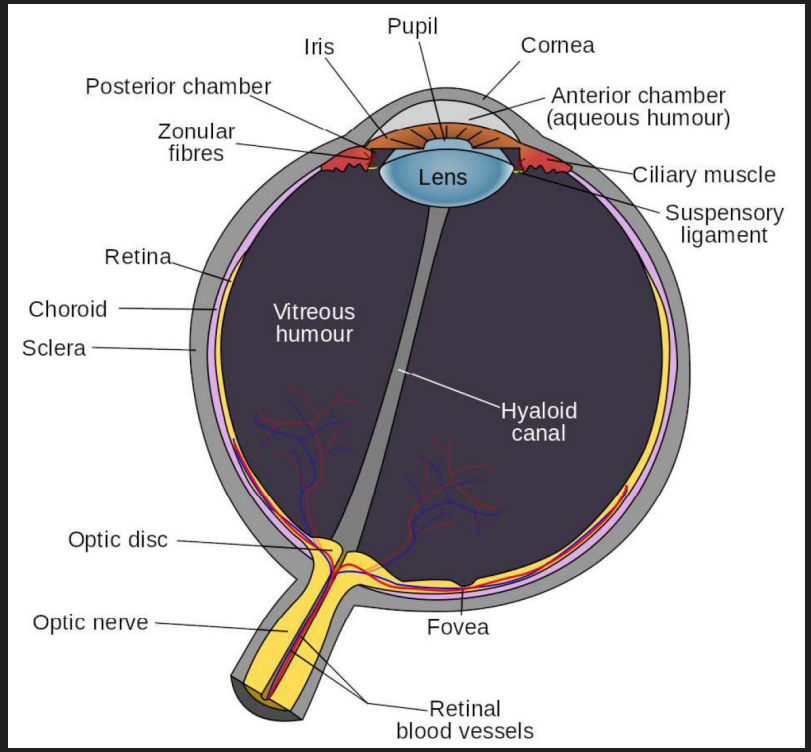
Imaging Properties of a Lens

f depends on: shape, material property

D = 1 / f

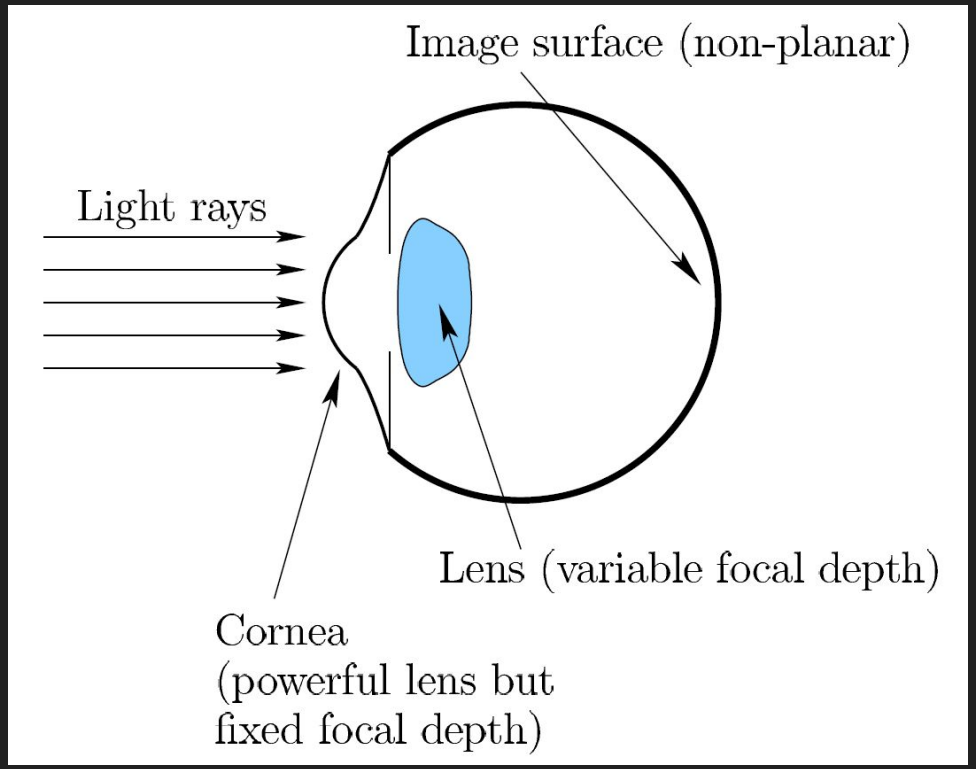


Structure of the Human Eye

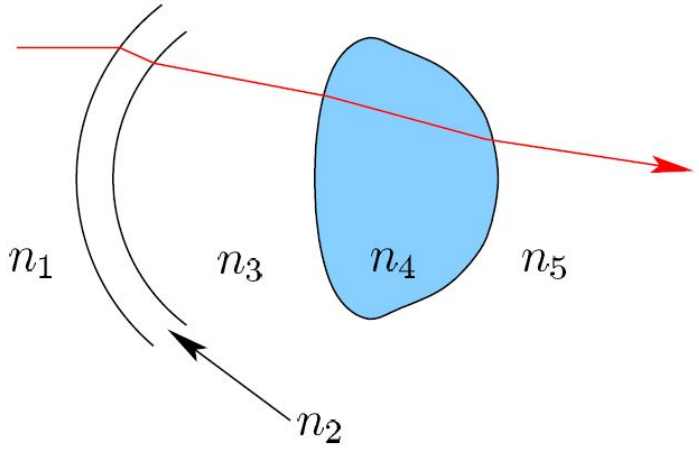


What is the diopter of the human eye?

Structure of the Human Eye



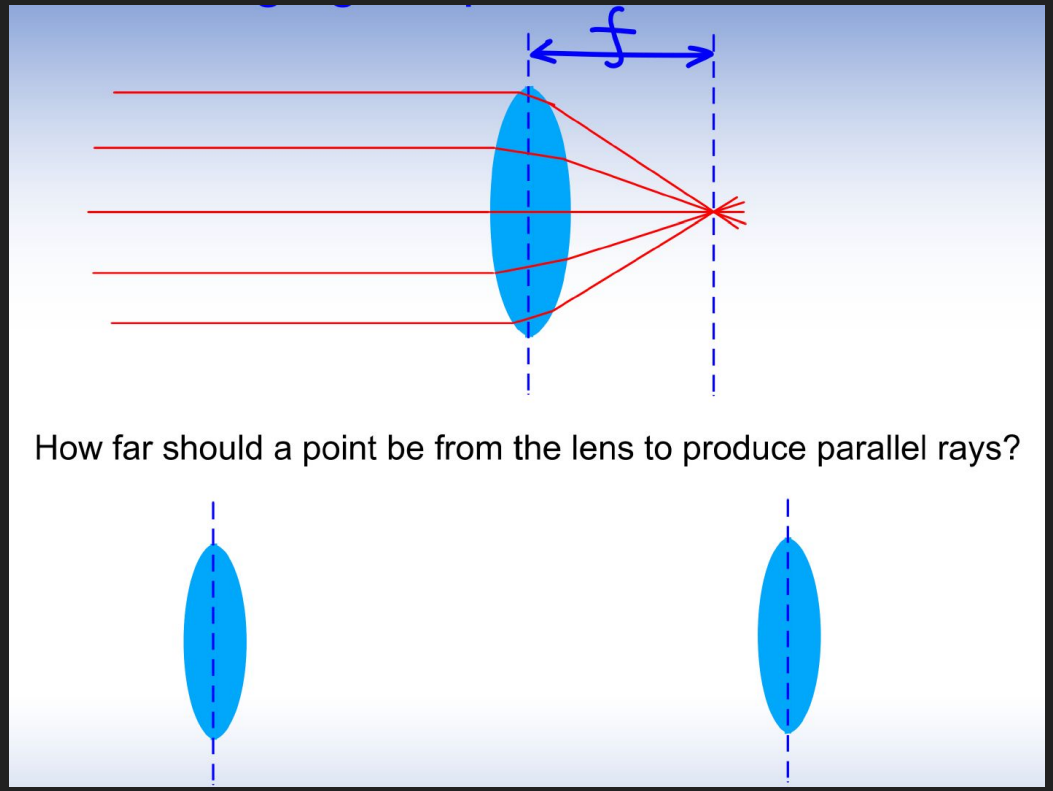
Optical Power of the Human Eye



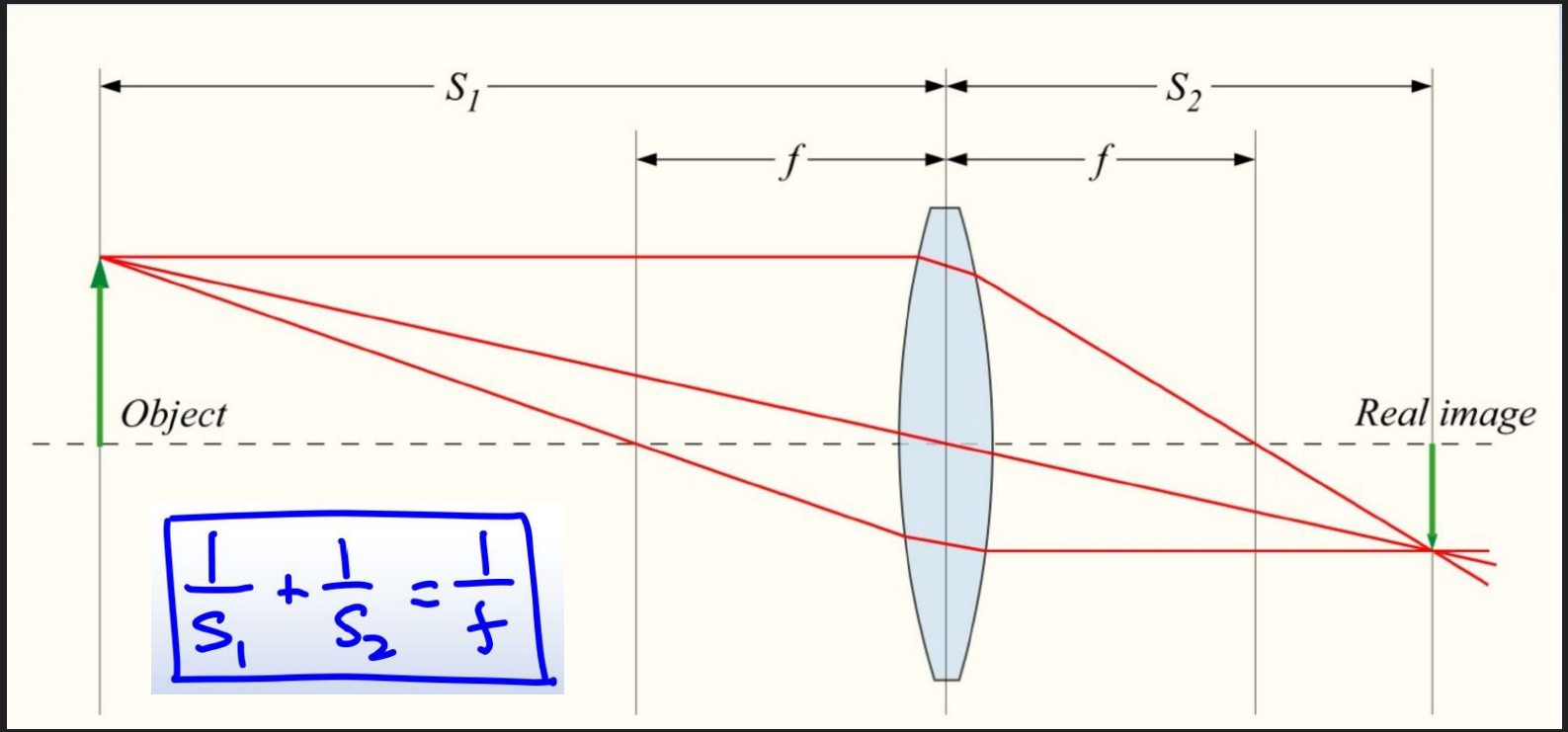
1. $n_1 = 1.009$ (air)
2. $n_2 = 1.376$ (cornea)
3. $n_3 = 1.336$ (aqueous fluid)
4. $n_4 = 1.413$ (lens)
5. $n_5 = 1.337$ (vitreous fluid)

Figure 4.25: A ray of light travels through five media before hitting the retina. The indices of refraction are indicated. Considering Snell's law, the greatest bending occurs due to the transition from air to the cornea. Note that once the ray enters the eye, it passes through only liquid or solid materials.

Imaging Properties of a Lens

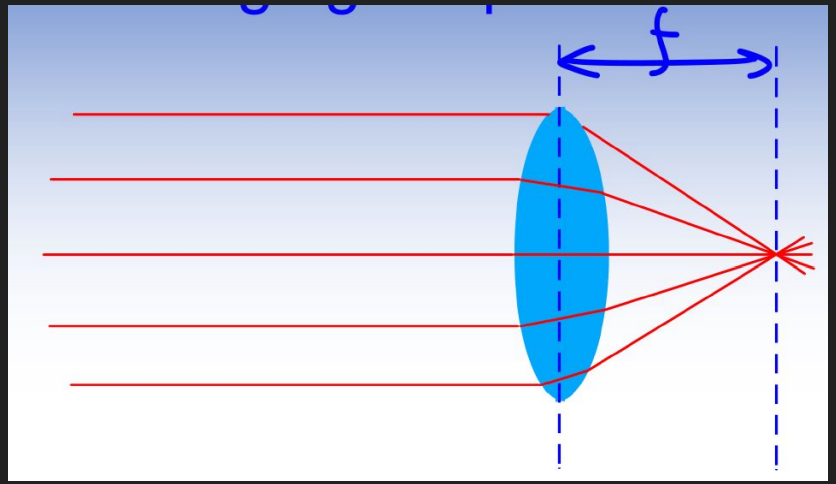


$S_1, S_2, f > 0$

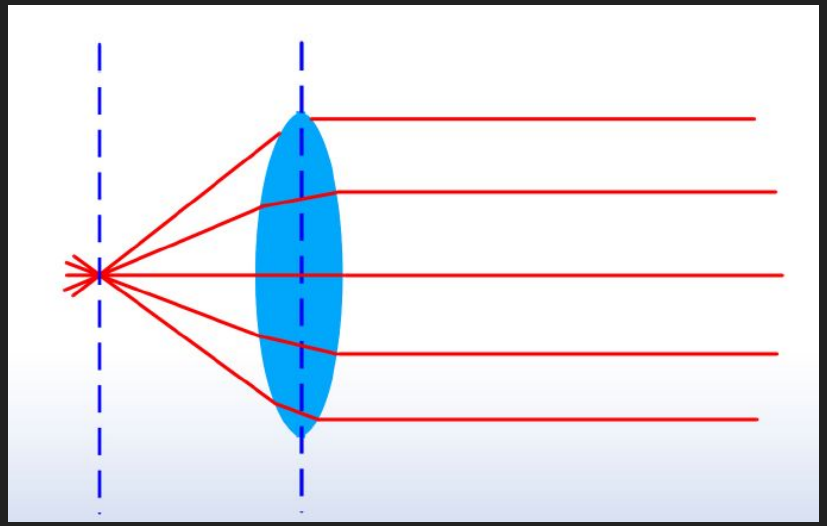


$$\frac{1}{S_1} + \frac{1}{S_2} = \frac{1}{f}$$

Imaging Properties of a Lens

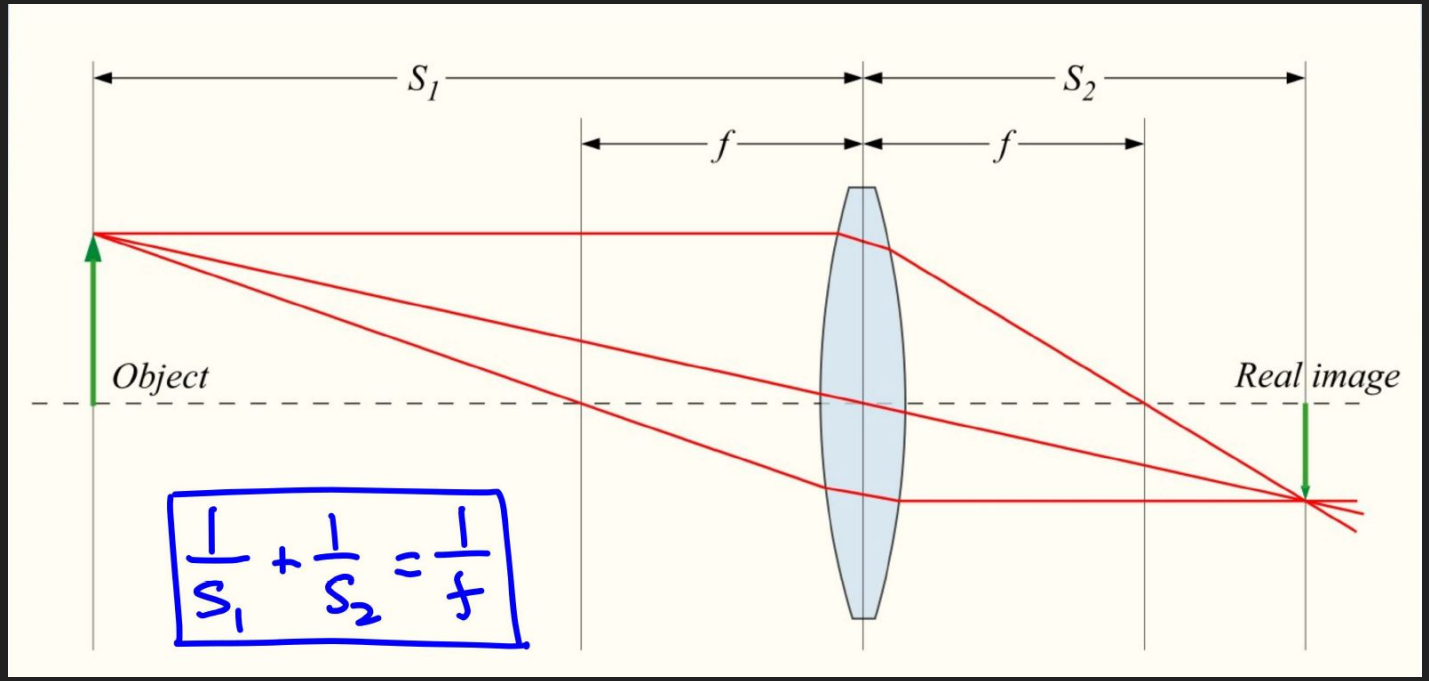


$$\frac{1}{s_1} + \frac{1}{s_2} = \frac{1}{f}$$



Do the formula still work for parallel rays?

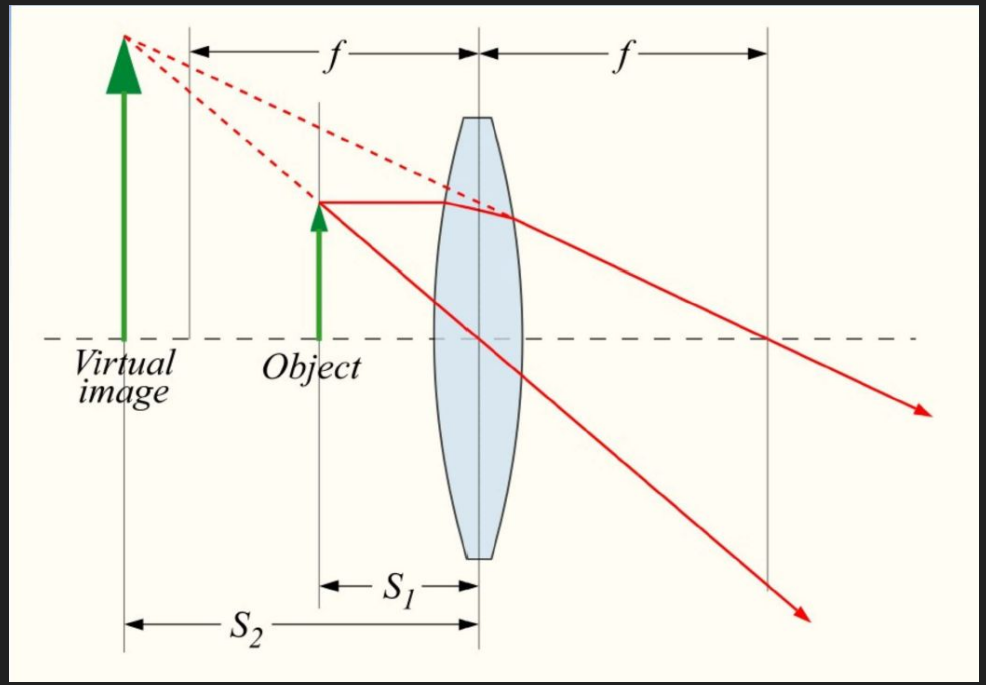
Imaging Properties of a Lens



Object is at distance ___ f, its “real image” is in focus at distance ___ f.

Imaging Properties of a Lens

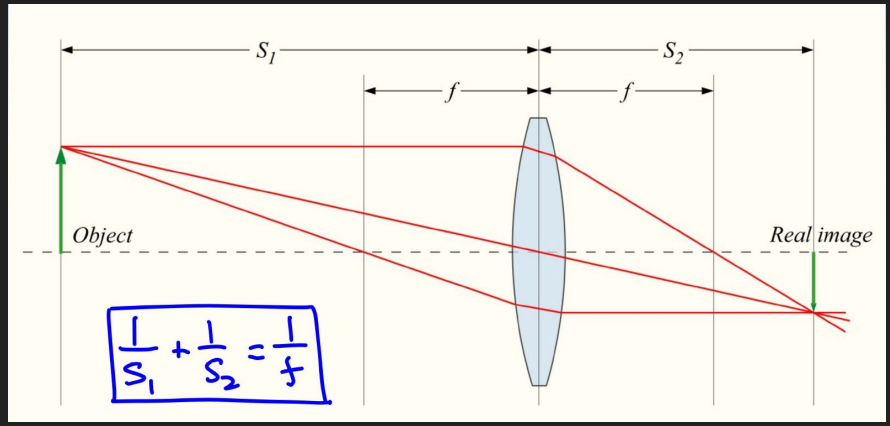
$$\frac{1}{s_1} + \frac{1}{s_2} = \frac{1}{f}$$

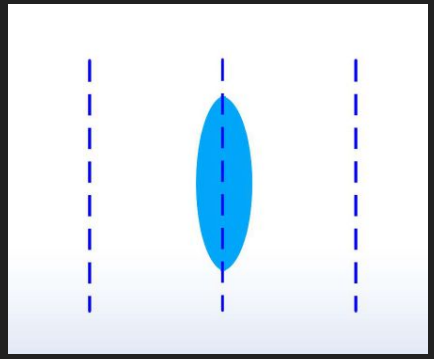


Object is at distance _____ f, its "real image" is _____ focus.

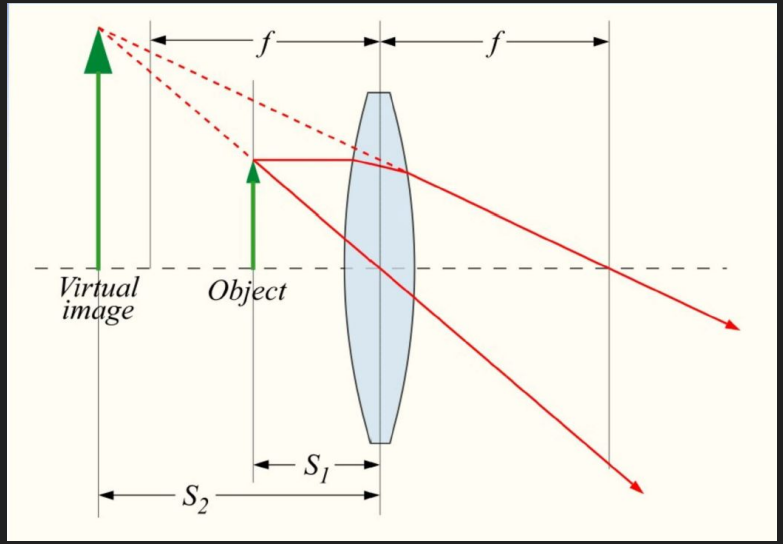
The "virtual image" is formed at distance _____.

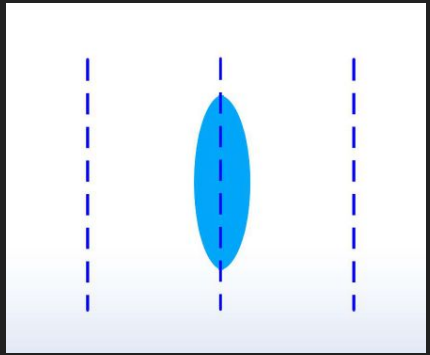
Examples of Use Cases





Examples of Use Cases





Structure of the Human Eye

The diopter of the human eye is about ____.

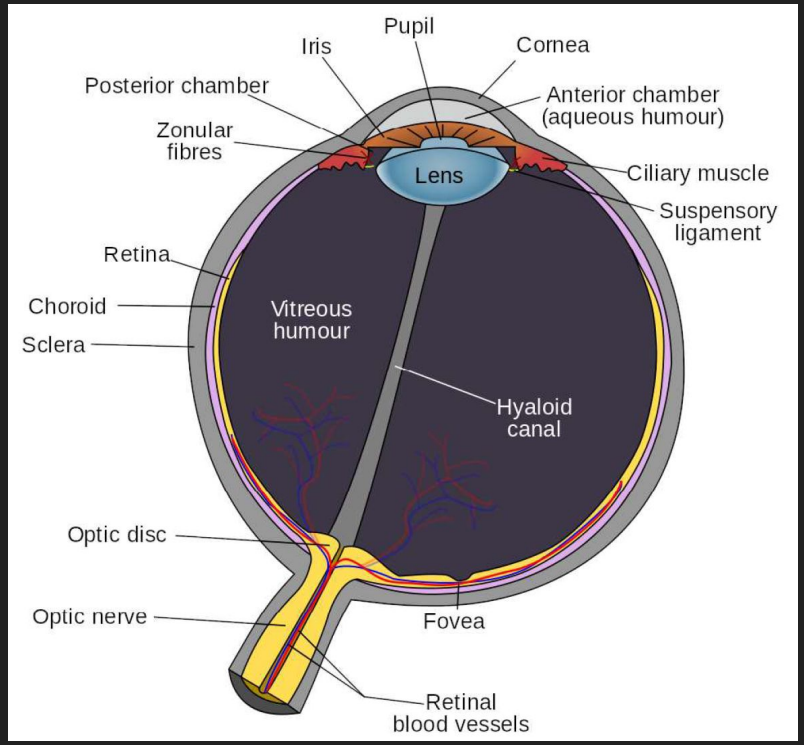
Eye lens is not _____.

Retina (and retinal image) is not _____.

Ciliary muscle has the ability _____ _____(lose at age ≈ 40).

Optic nerve forms _____.

Assume the person has no vision defect.



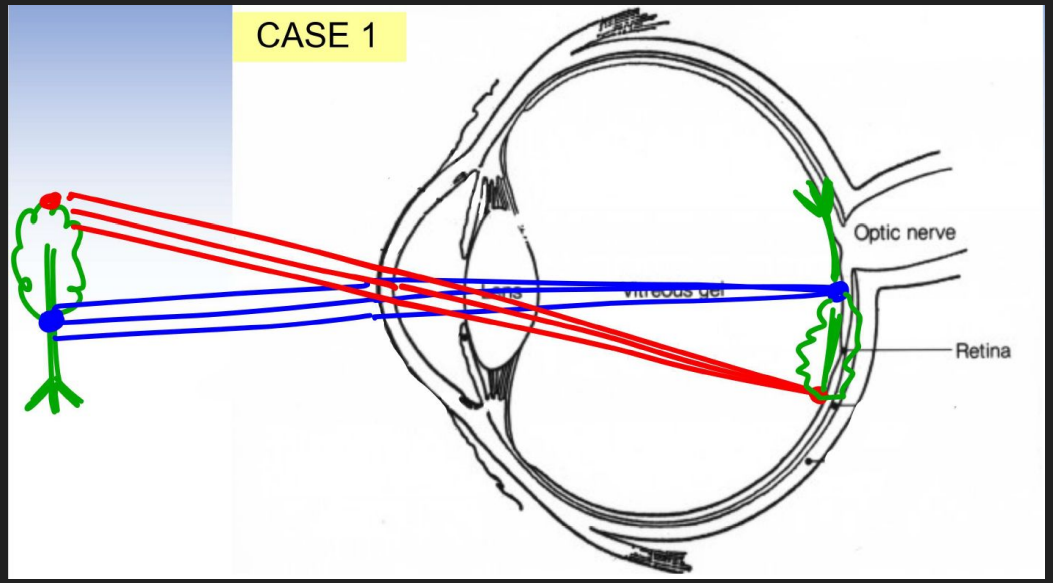
Imaging System Inside of a Human Eye

The eye muscle is _____.

Object is at __ Rays are _____

Rays __ get converged __ retina.

The image is _____.



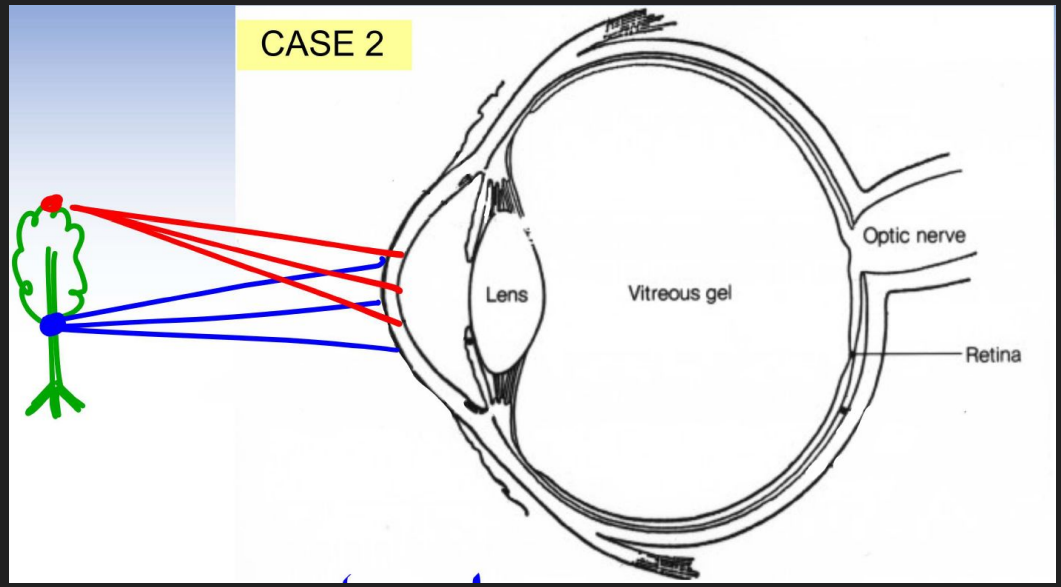
Imaging System Inside of a Human Eye

The eye muscle is _____.

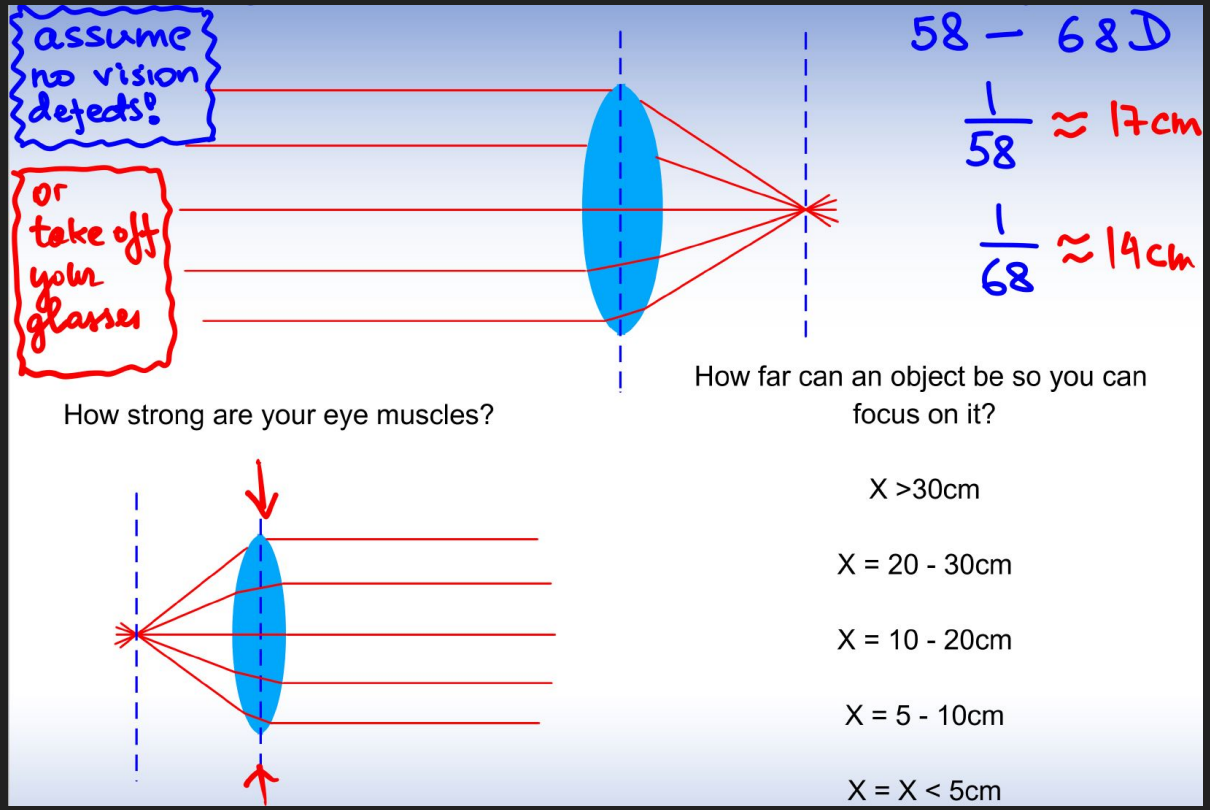
Object is at _____ Rays are _____.

The rays _____ get converged on retina.

The image is _____ .



Imagine Properties of the Human Eye



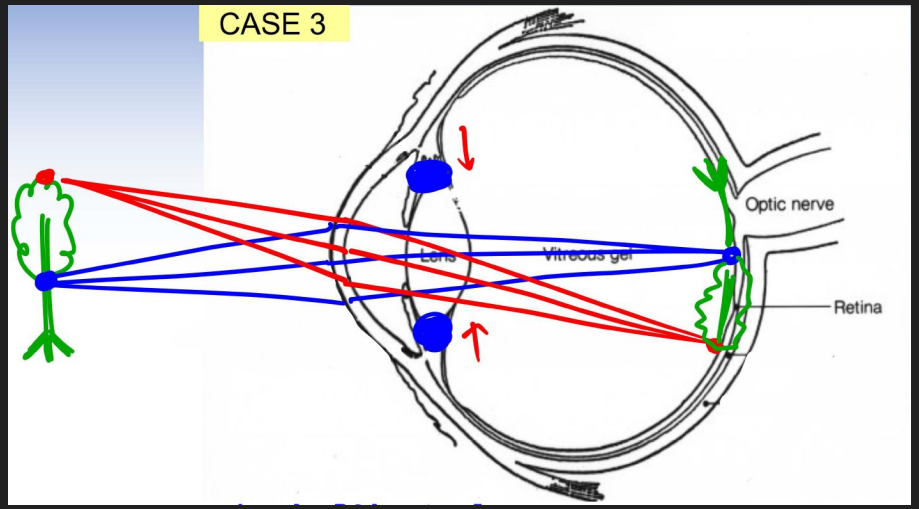
Imaging System Inside of a Human Eye

The eye muscle is _____ .

Object is at _____ Rays are _____ .

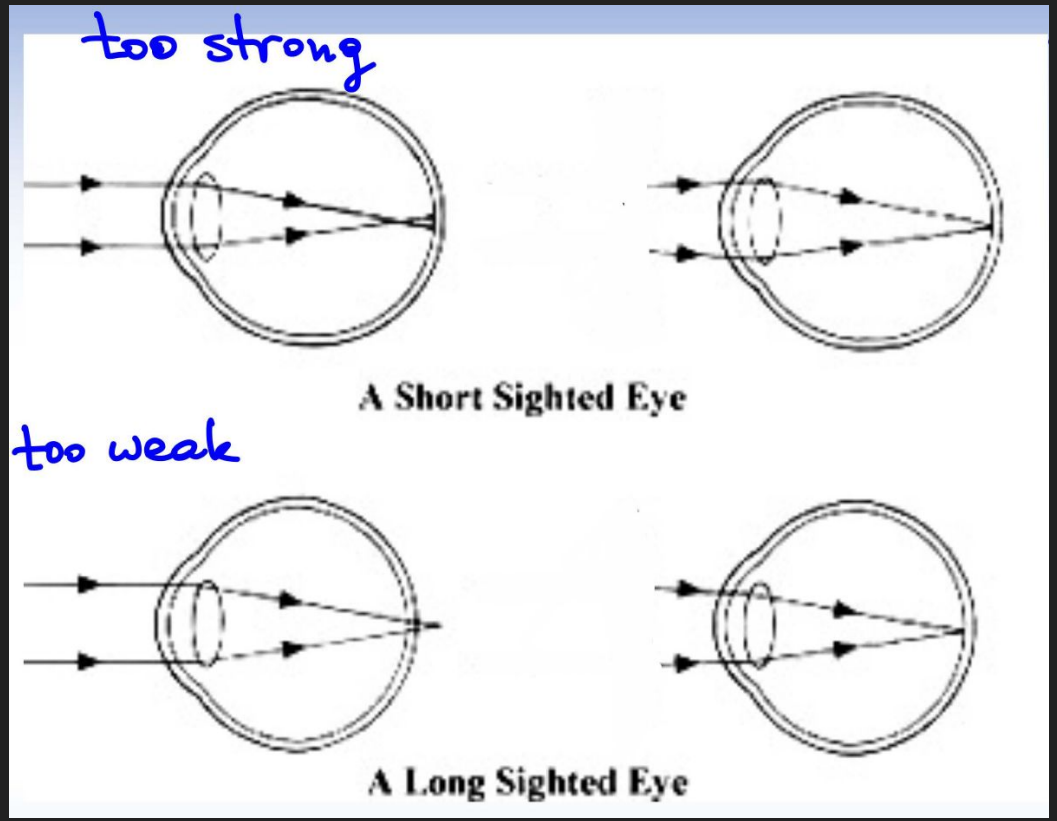
The rays _____ get converged ___ retina.

The image is _____.



Vision Defects of a Human Eye

- Relaxed muscles
- Objects at infinity



Hard to diagnose

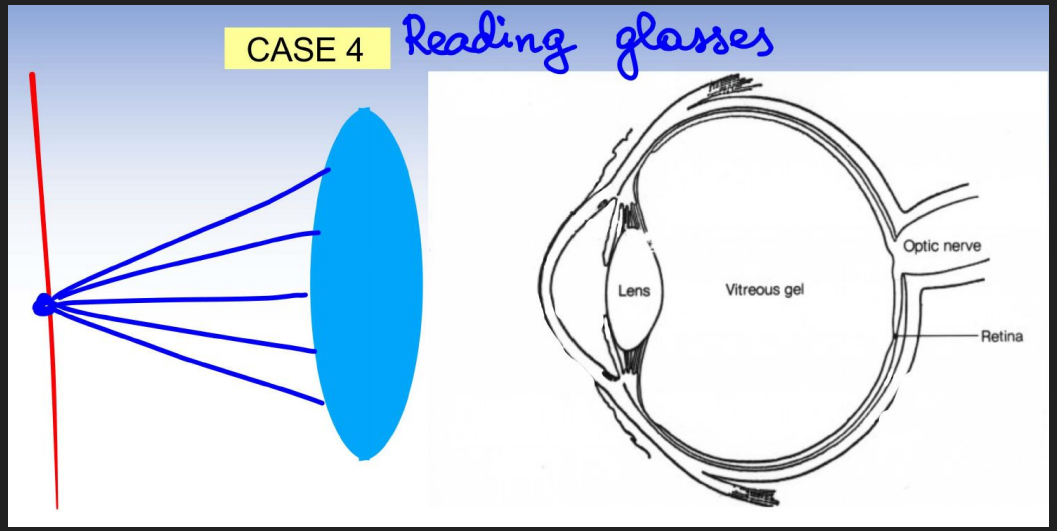
Imaging System Inside of a Human Eye

The eye muscle is _____ .

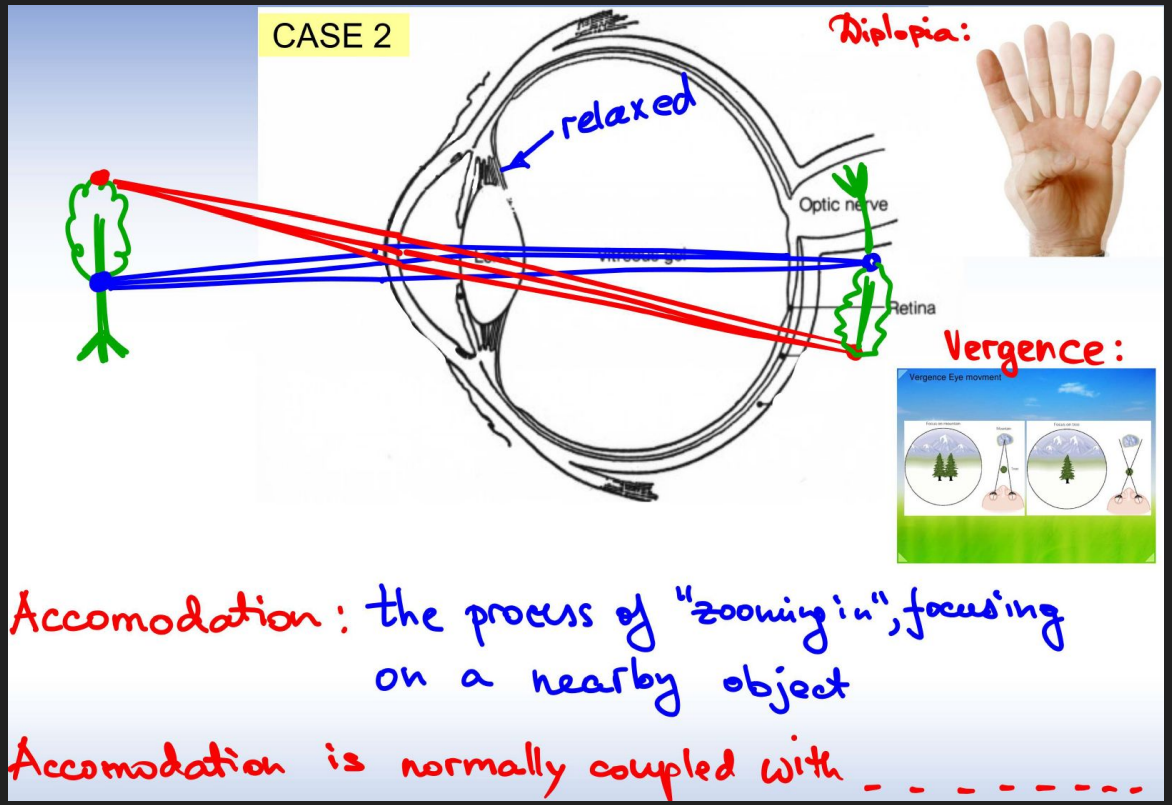
Object is at _____
Rays are _____ .

The rays ____ get converged ____ retina.

The image is _____ .



Imaging System Inside of a Human Eye



Imaging System Inside of a Human Eye

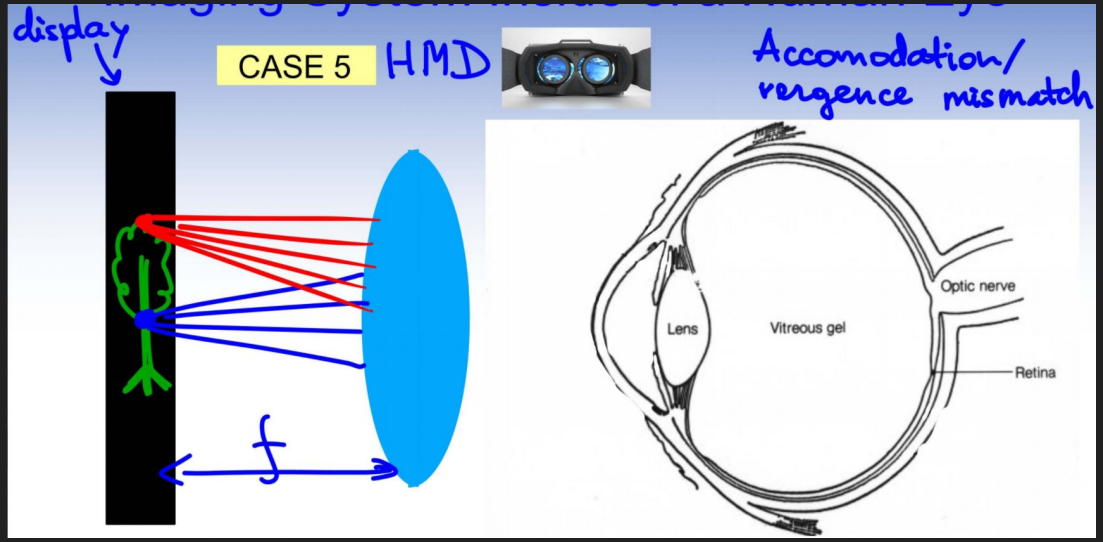
The eye muscle is _____ .

Object is at _____ Rays are _____ .

Rays _____ get converged

_____

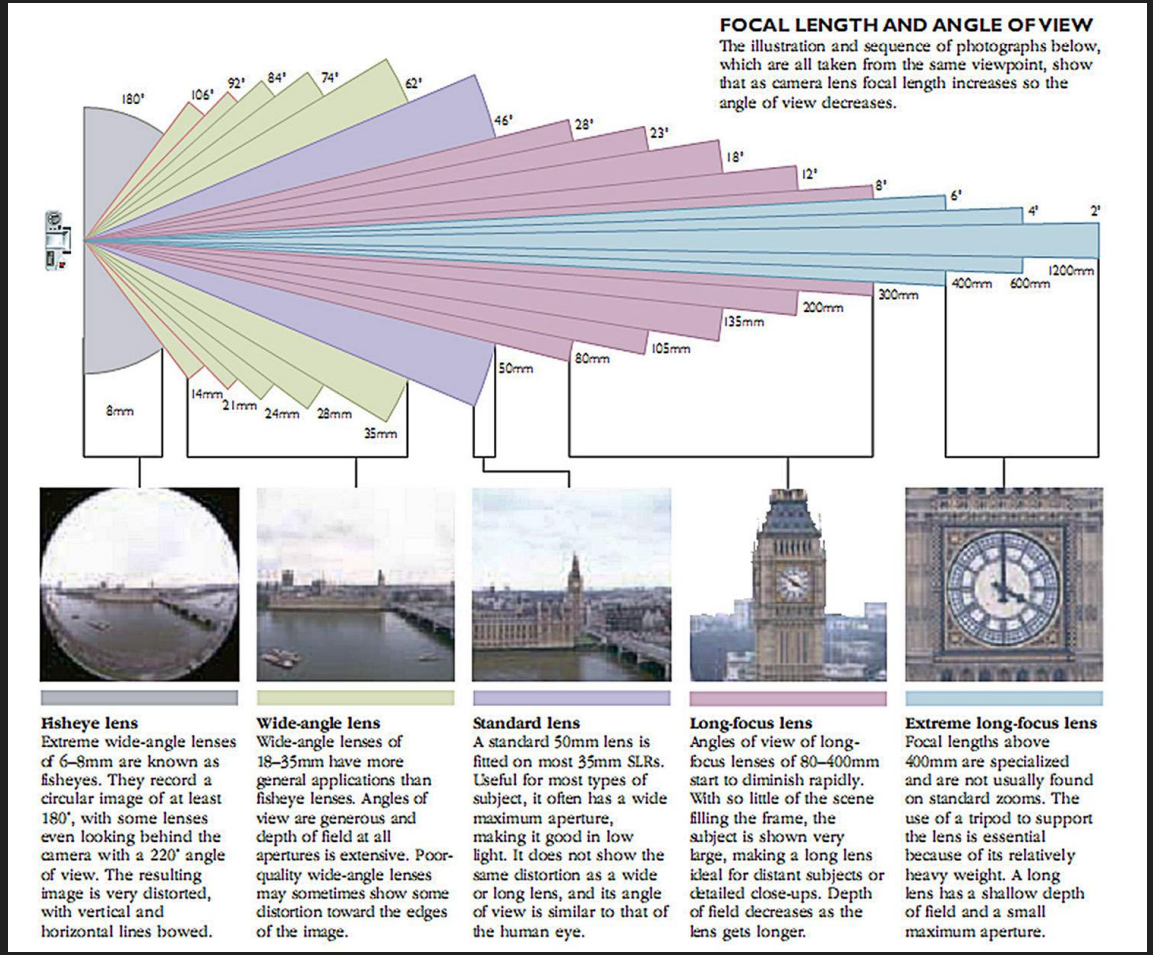
retina.



Lens Aberrations

Trade off:

- Size
- Weight
- Focus length
- Field of view
- Distortion
- Cost
- Ease of manufacturing



Recap from today lecture

- How does an image appear on the retina?
  - Is it a real image or virtual image?

- Is the human eye a concave or convex lens?
  - After light rays pass through a convex lens, what does the focus distance depend on?

Announcements

- MP 2.2-2.4 was due before this lecture!
- MP 3 & 4 are posted!
- Teams for final projects are posted!
- Details for the 4th credit hour assignment are posted!

- Read Ch. 4 & 5.1