# Announcements

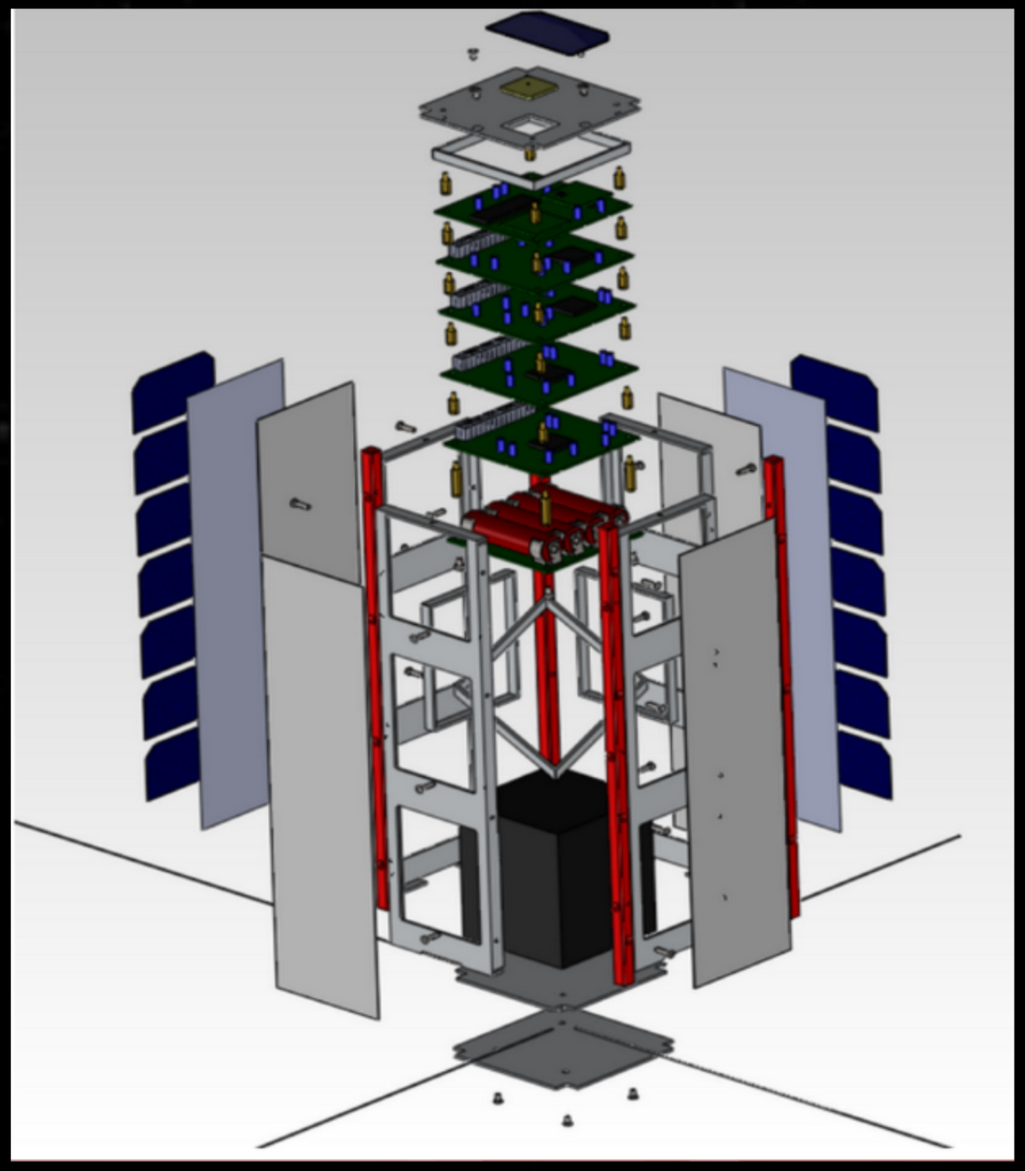
- Project team and abstract due Oct 8, IN CLASS.

- MP2 is due tonight 11:59pm.
- MP3 will be out on Oct 6.

- Reading: Chapter 6 by Mather

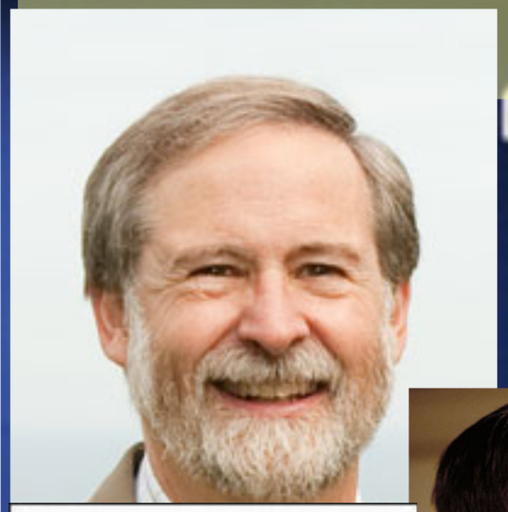
- If you sent me an email about joining JumpLabs project, I need to see you ALL after class.

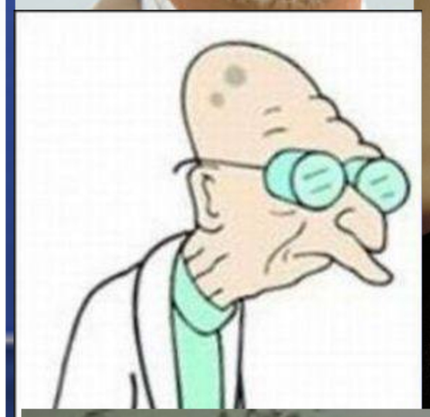
# Virtual Reality Aided Design for CubeSats

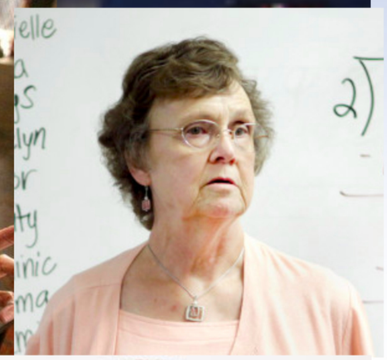


**Contact: Vishwa Shah shah84@illinois.edu**

# Compassion Training/ Improving Education. How a Professor Should Look?



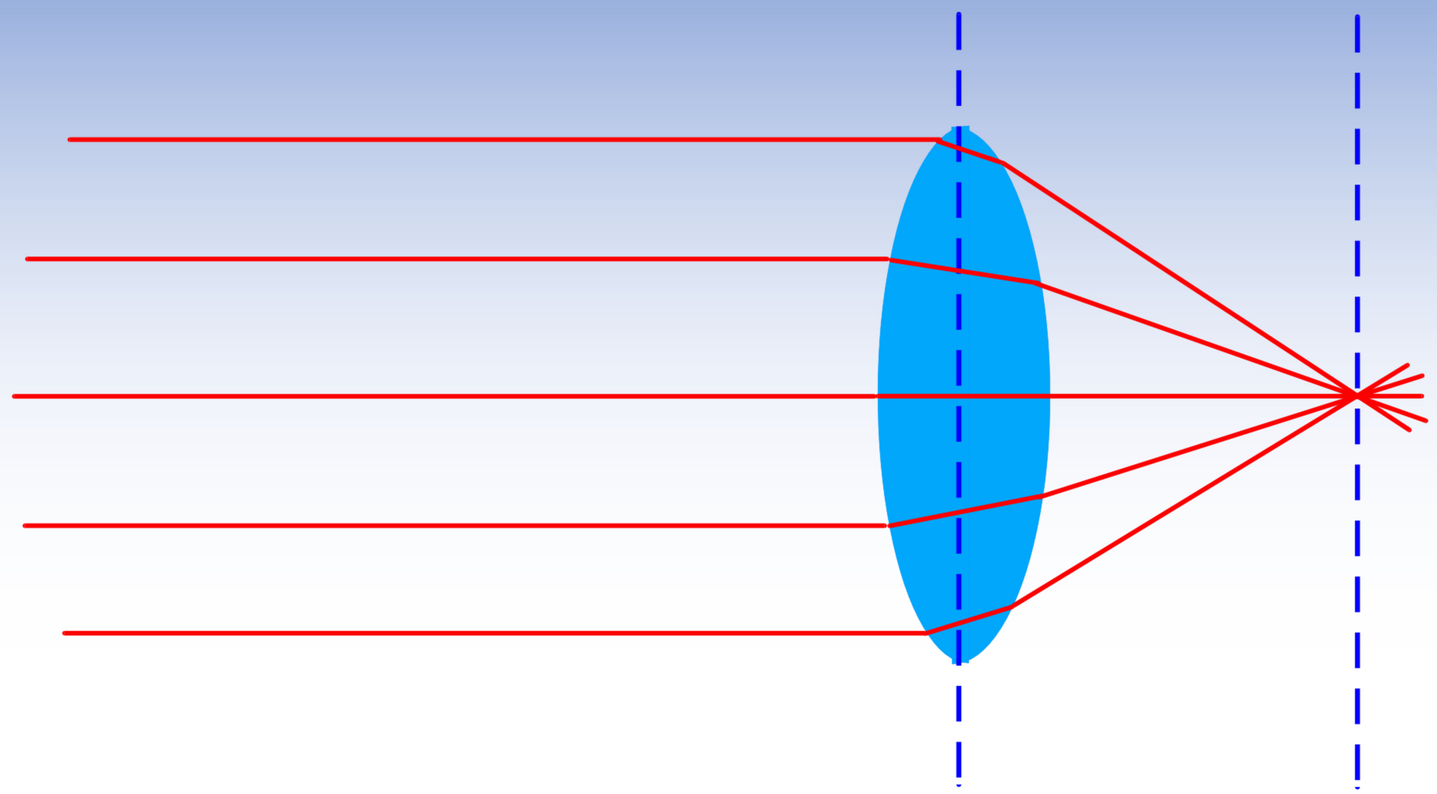


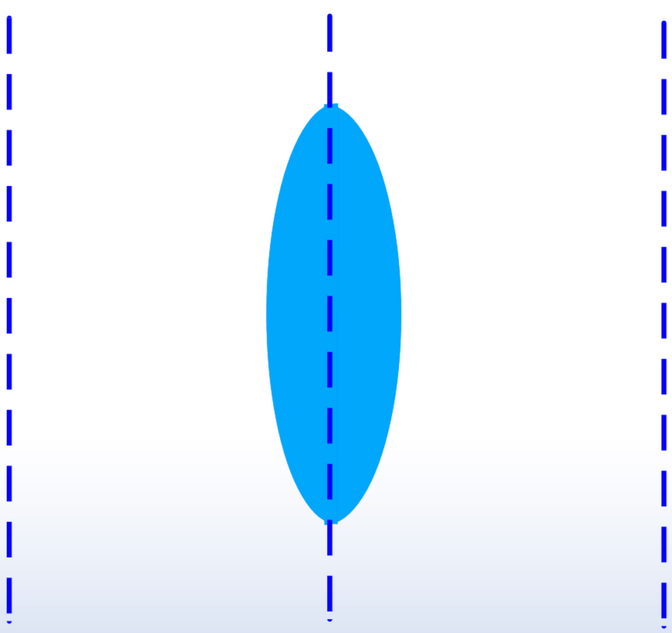
**Contact: Anna Yershova, Steve LaValle, Cinda Heeren**

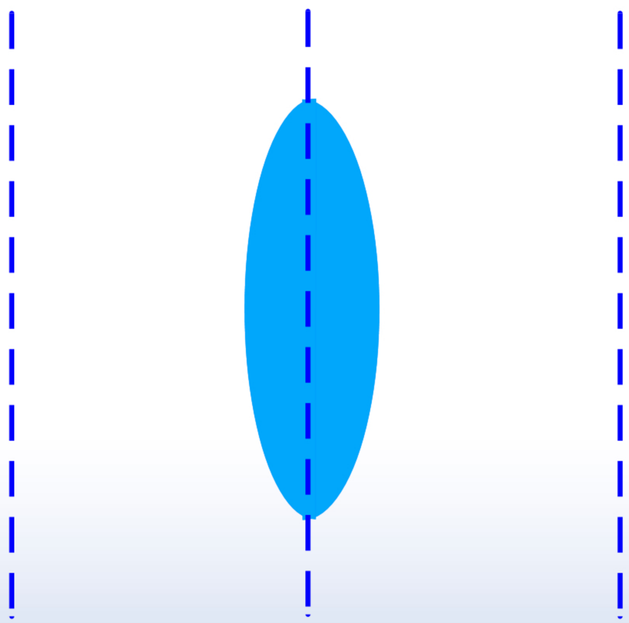
https://www.youtube.com/watch?v=13t69RVq1YY

# Imaging Properties of a Lens

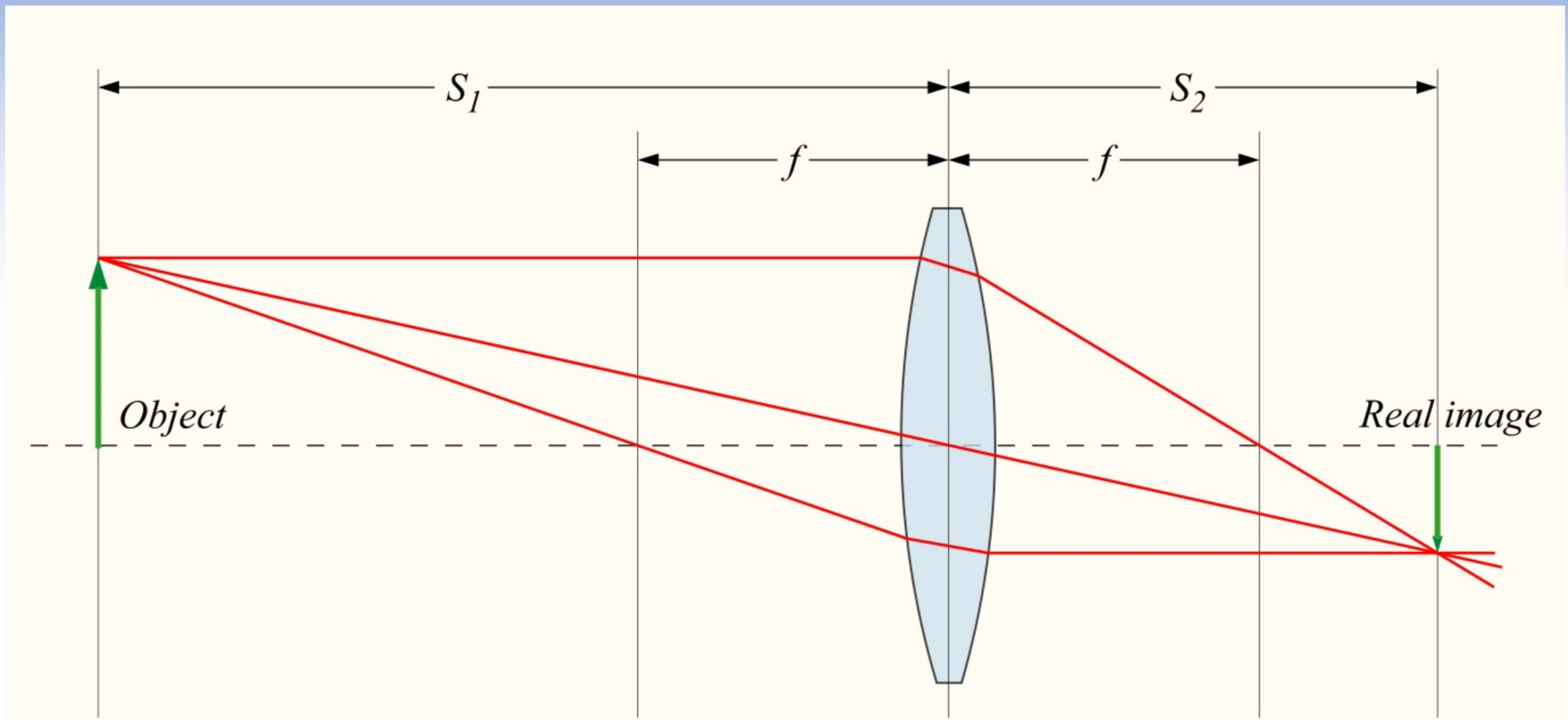


How far should a point be from the lens to produce parallel rays?





# Imaging Properties of a Lens

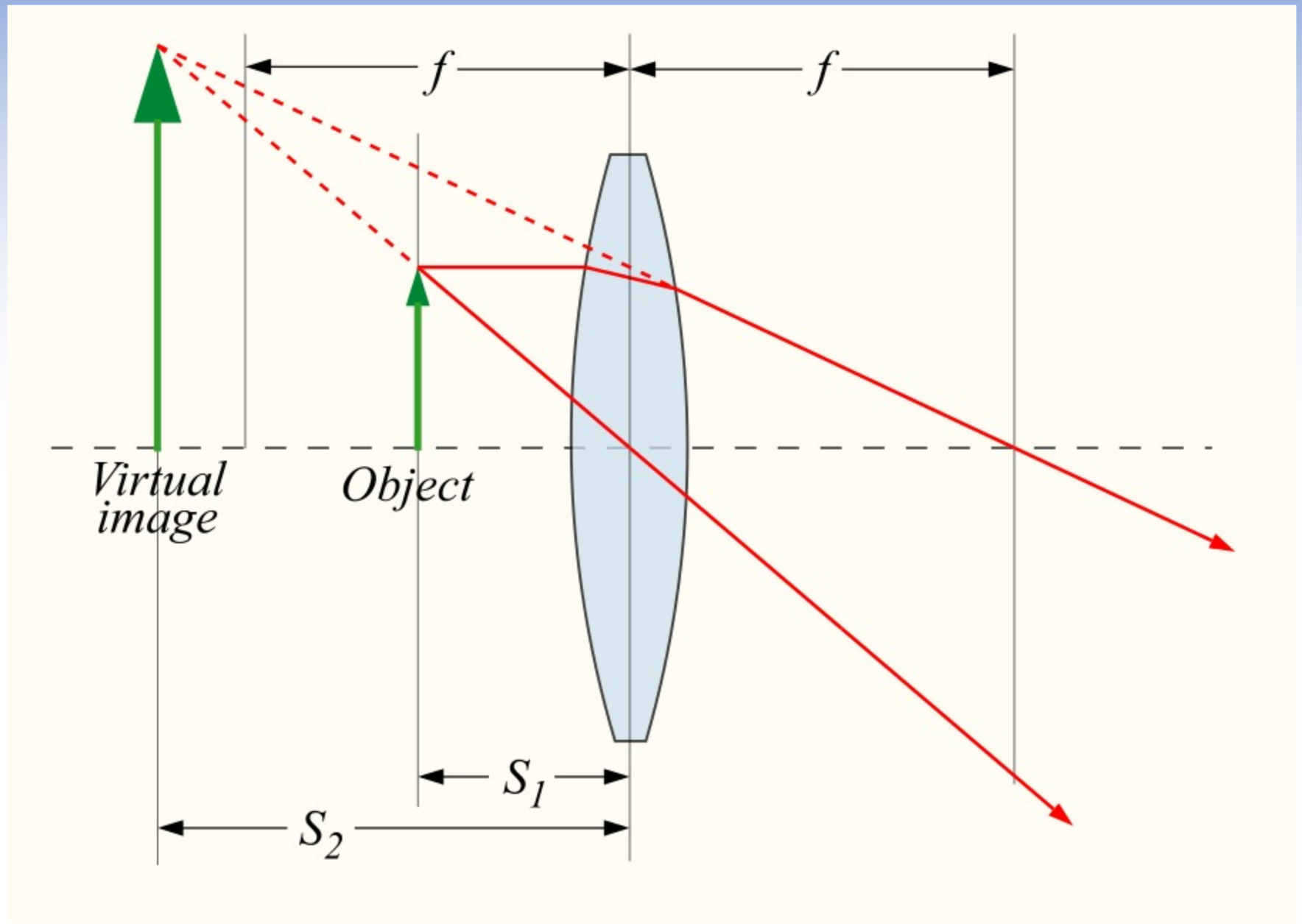



Object is at distance _____ f, its "real image" is in focus at distance_____ f.

Formula:

Sanity check:

# Imaging Properties of a Lens

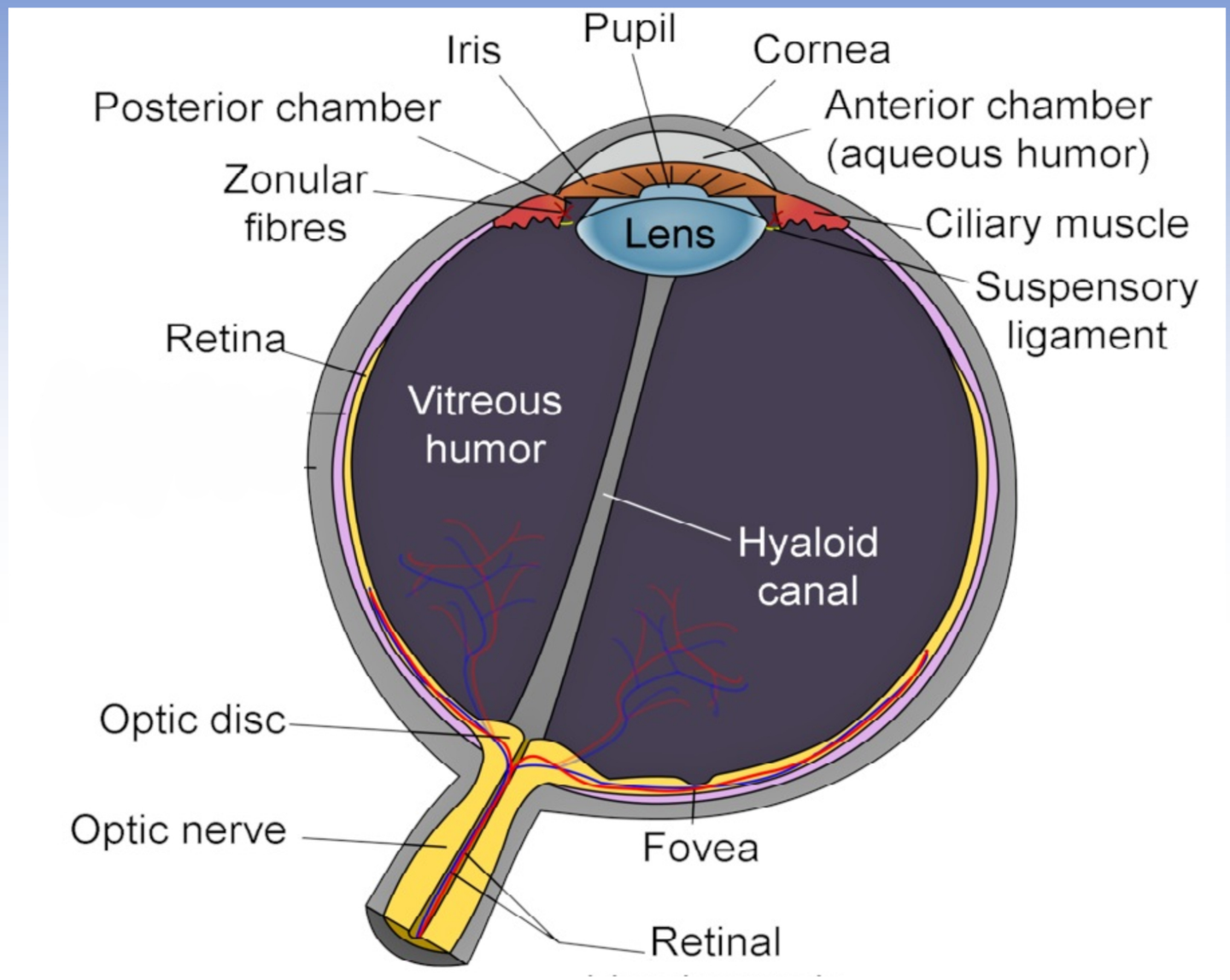



Object is at distance _____ f, its "real image" is _____ focus at distance_____ f.

The "virtual image" is formed at distance _____.

Formula:

# Structure of the Human Eye




The diopter of the human eye is about _____

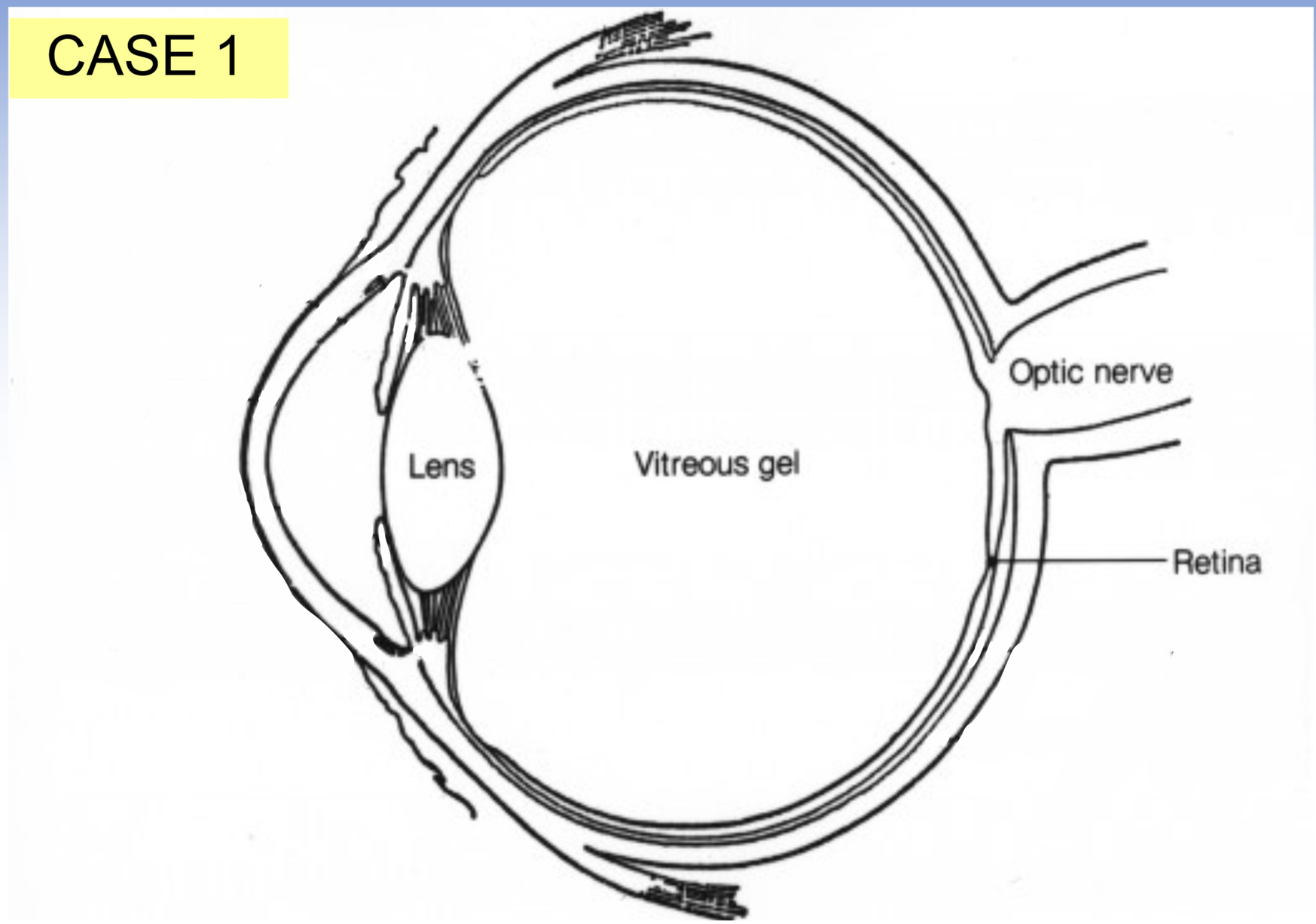
Eye lens is not _____ Retina (and retinal image) is not _____

Ciliary muscle has the ability_____

Optic nerve forms _____

# Imaging System Inside of a Human Eye

CASE 1



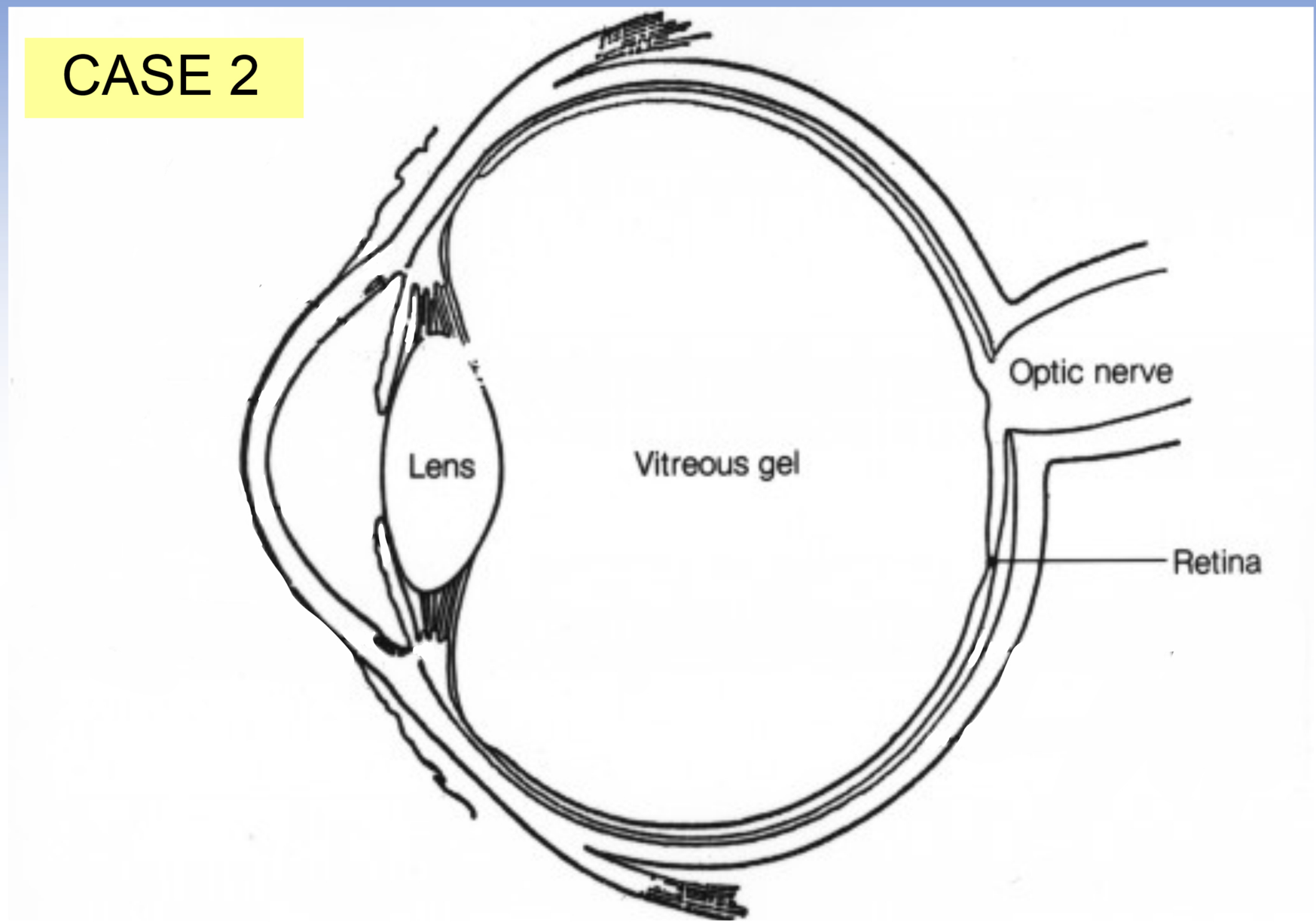

The eye muscle is _____

Object is at _____ Rays are _____

The rays _____ get converged _____retina. The image is _____

# Imaging System Inside of a Human Eye

CASE 2

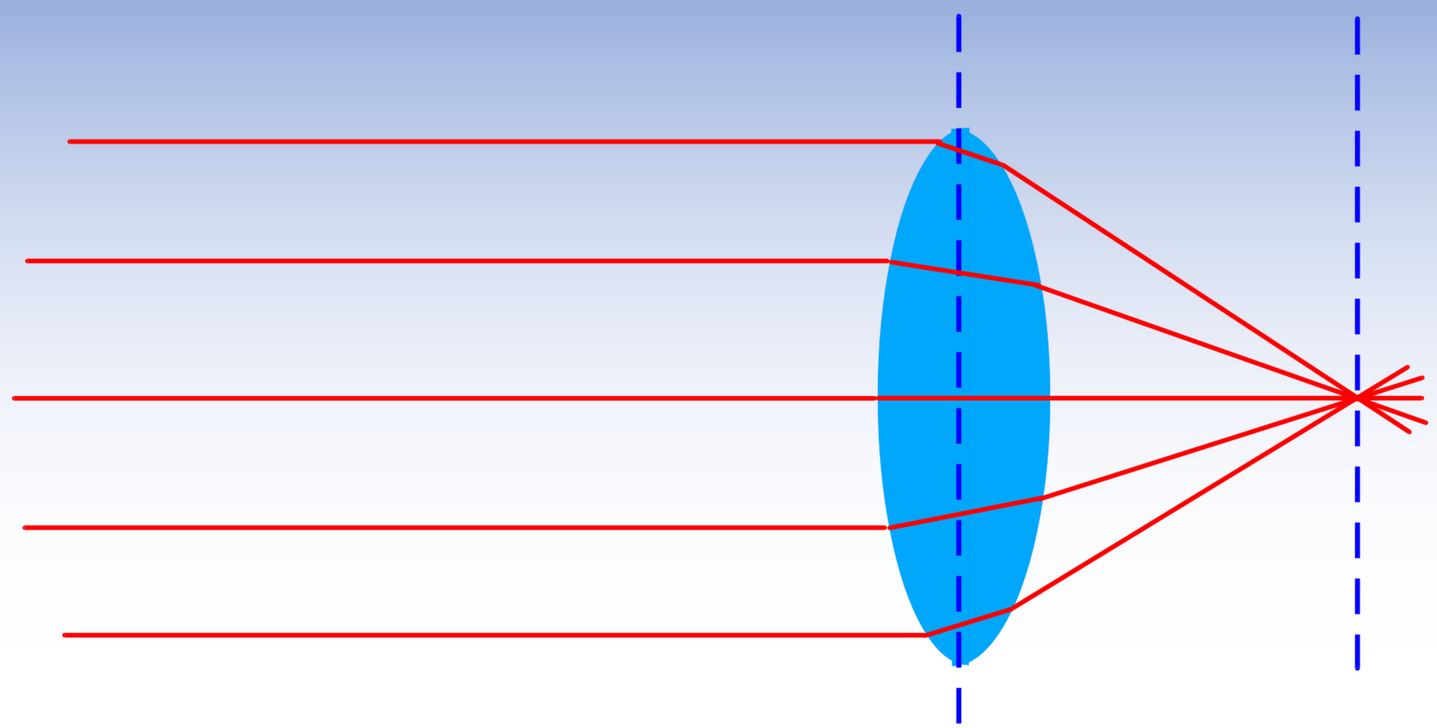



The eye muscle is _____

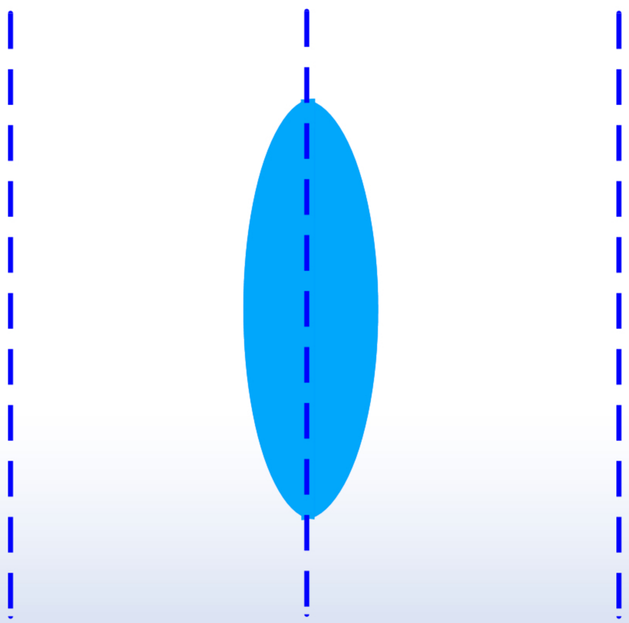
Object is at _____ Rays are _____

The rays _____ get converged _____retina. The image is _____

# Imagine Properties of the Human Eye



How far should a point be from the eye to produce parallel rays?



How far can an object be so you can focus on it?

X >30cm

X = 20 - 30cm

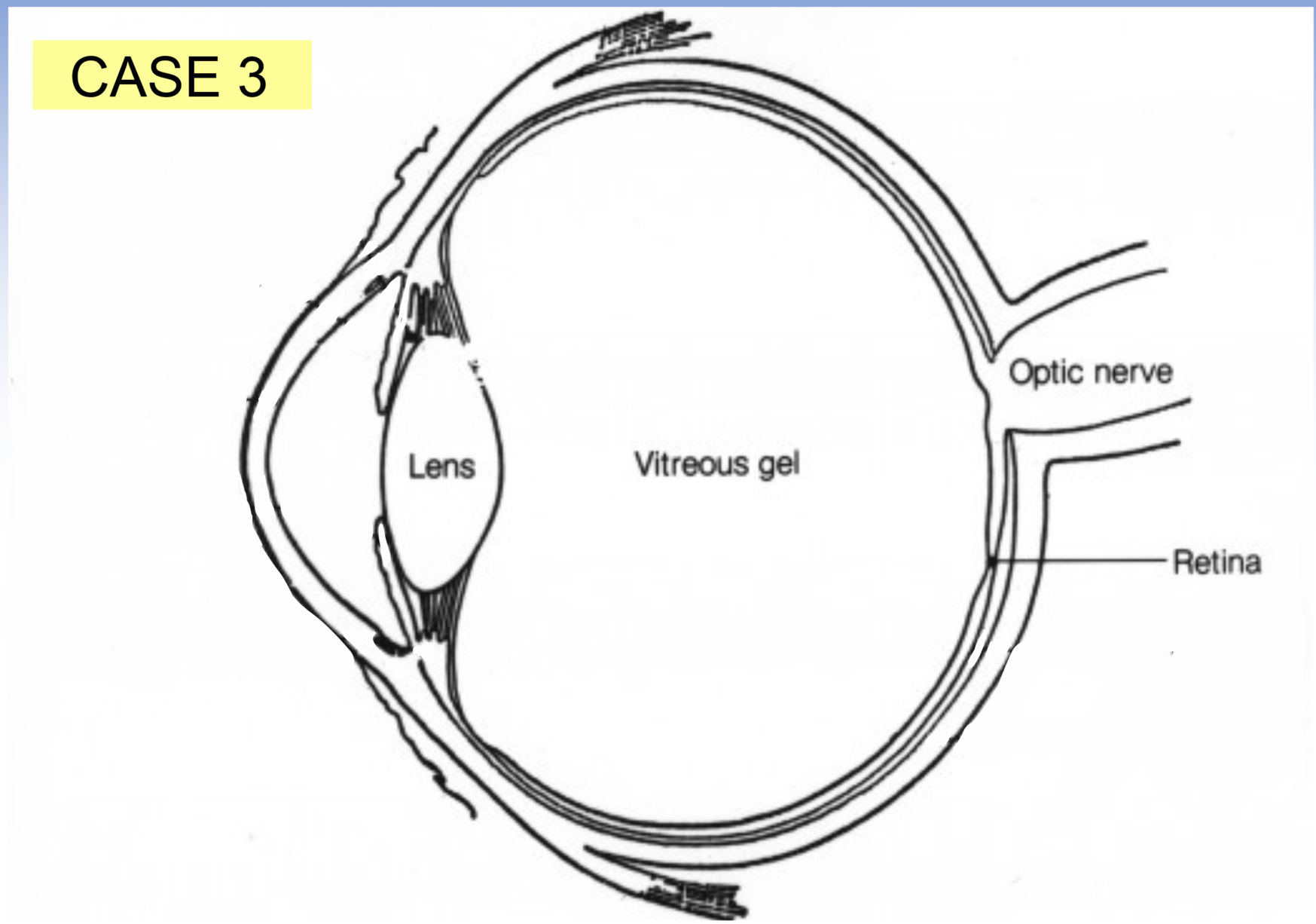
X = 10 - 20cm

X = 5 - 10cm

X = X < 5cm

# Imaging System Inside of a Human Eye

CASE 3

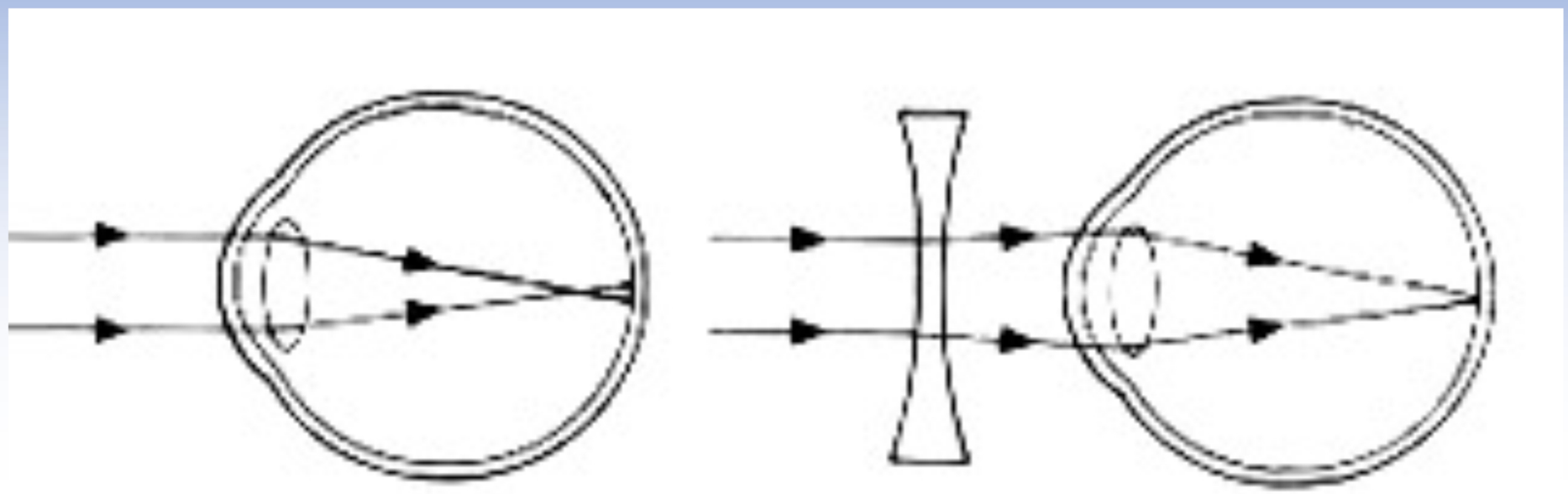



The eye muscle is _____

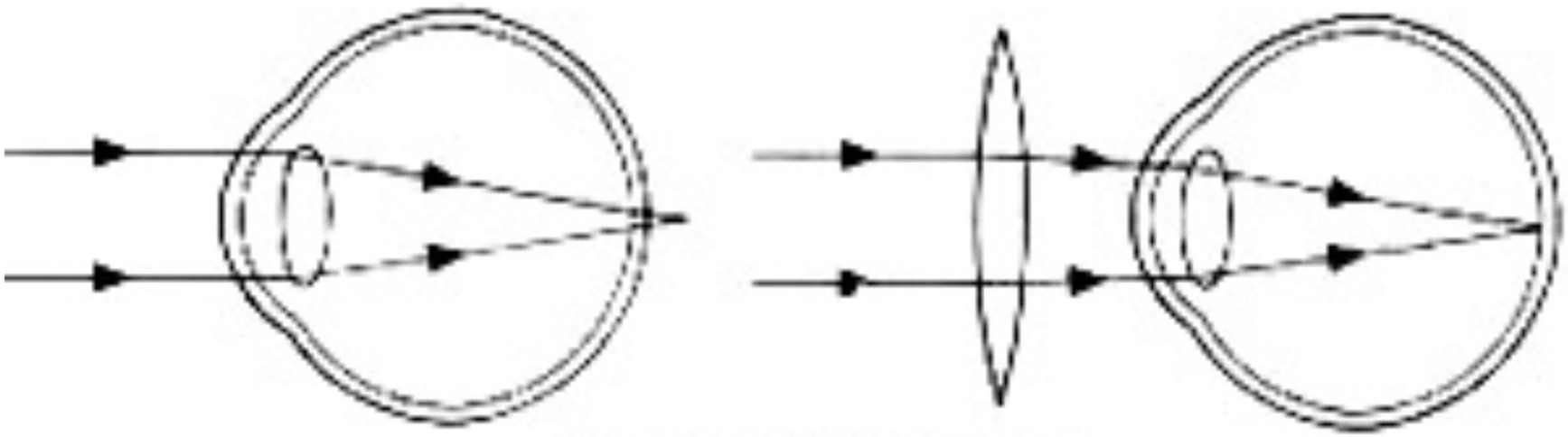
Object is at _____ Rays are _____

The rays _____ get converged _____retina. The image is _____

# Vision Defects of a Human Eye



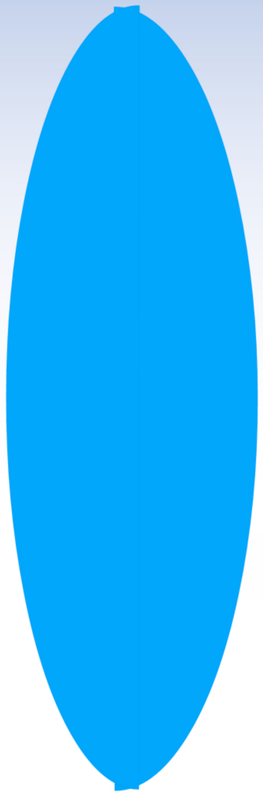
**A Short Sighted Eye**

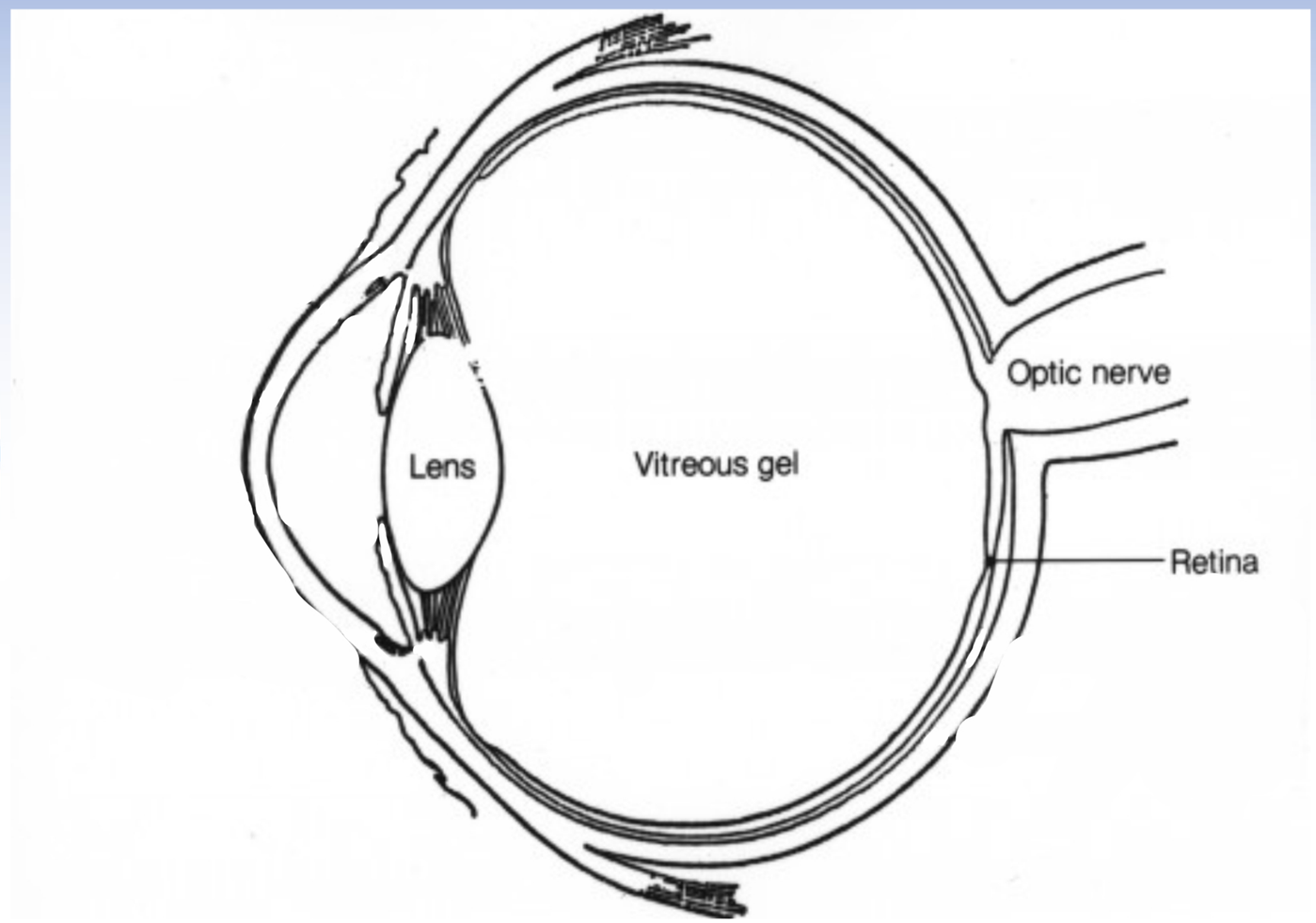


**A Long Sighted Eye**

# Imaging System Inside of a Human Eye

CASE 4





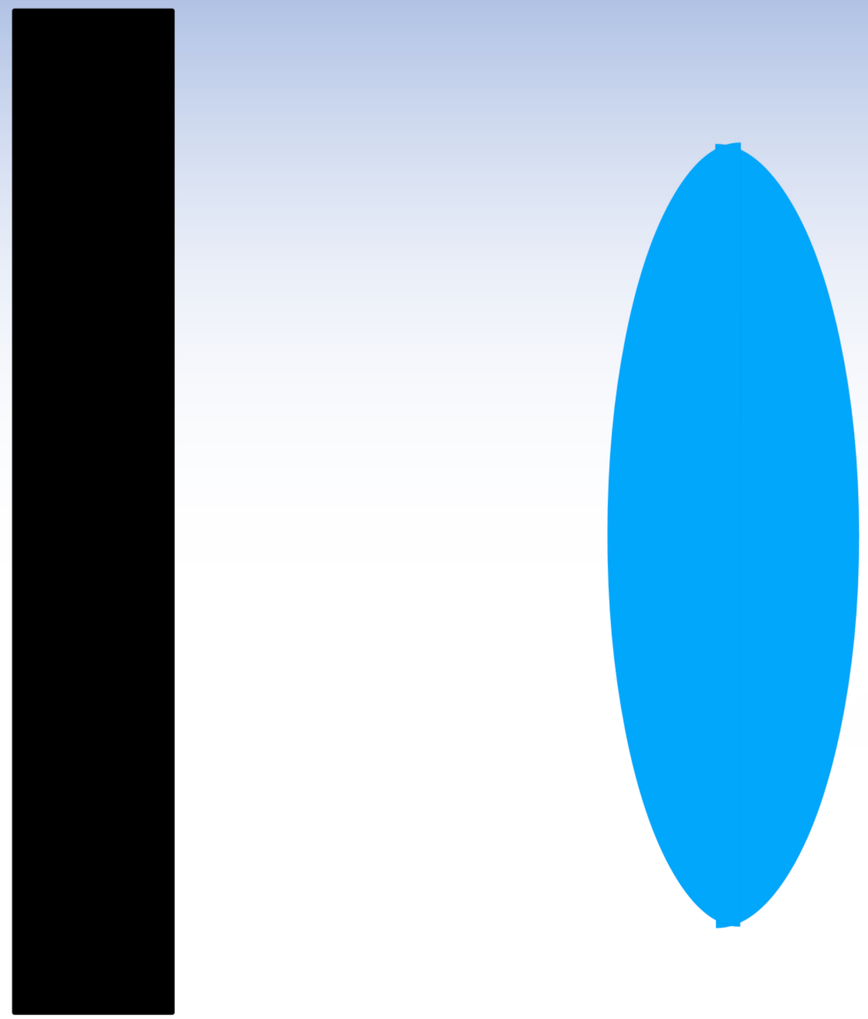

The eye muscle is _____

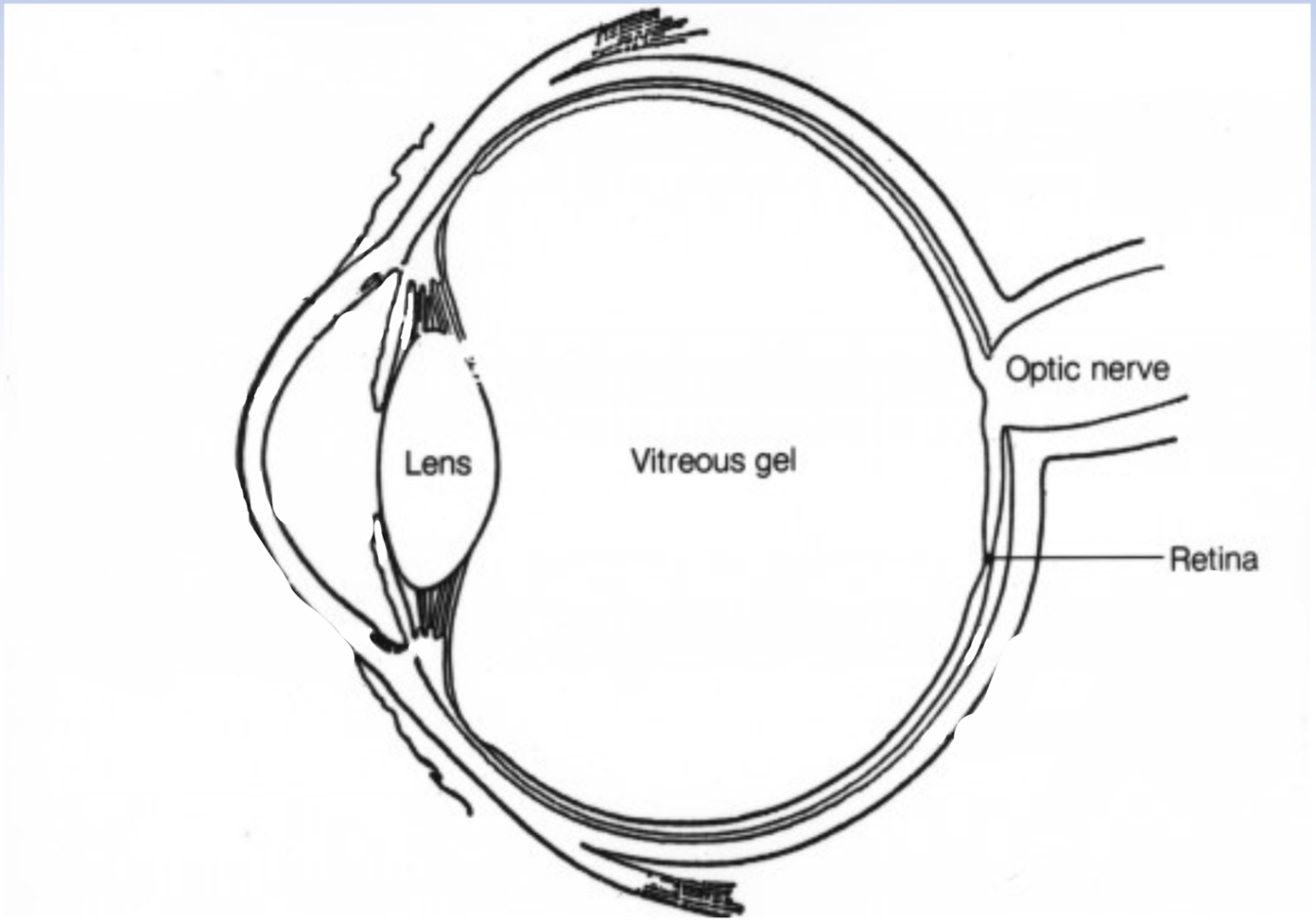
Object is at _____ Rays are _____

The rays _____ get converged _____retina. The image is _____

# Imaging System Inside of a Human Eye

CASE 5






The eye muscle is _____

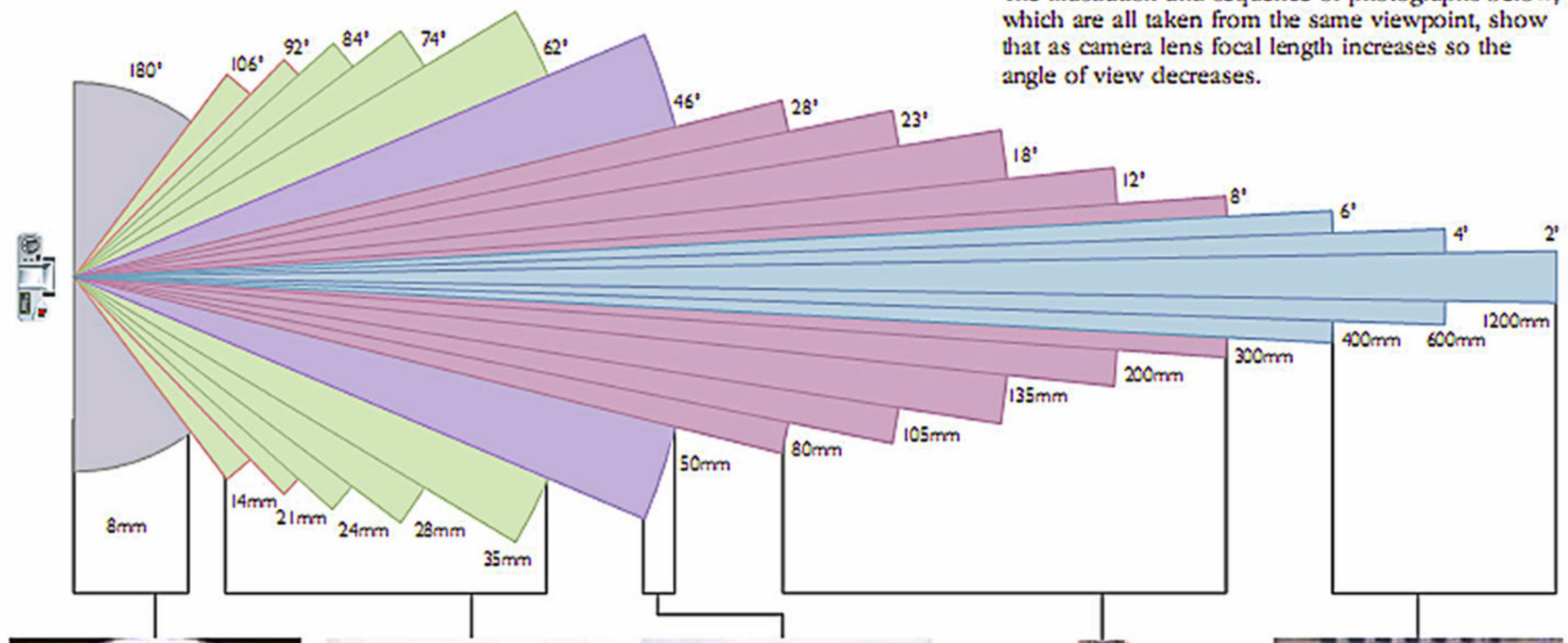
Object is at _____ Rays are _____

The rays _____ get converged _____retina

# Lens Aberrations

## FOCAL LENGTH AND ANGLE OF VIEW

The illustration and sequence of photographs below, which are all taken from the same viewpoint, show that as camera lens focal length increases so the angle of view decreases.




**Fisheye lens**
Extreme wide-angle lenses of 6–8mm are known as fisheyes. They record a circular image of at least 180°, with some lenses even looking behind the camera with a 220° angle of view. The resulting image is very distorted, with vertical and horizontal lines bowed.

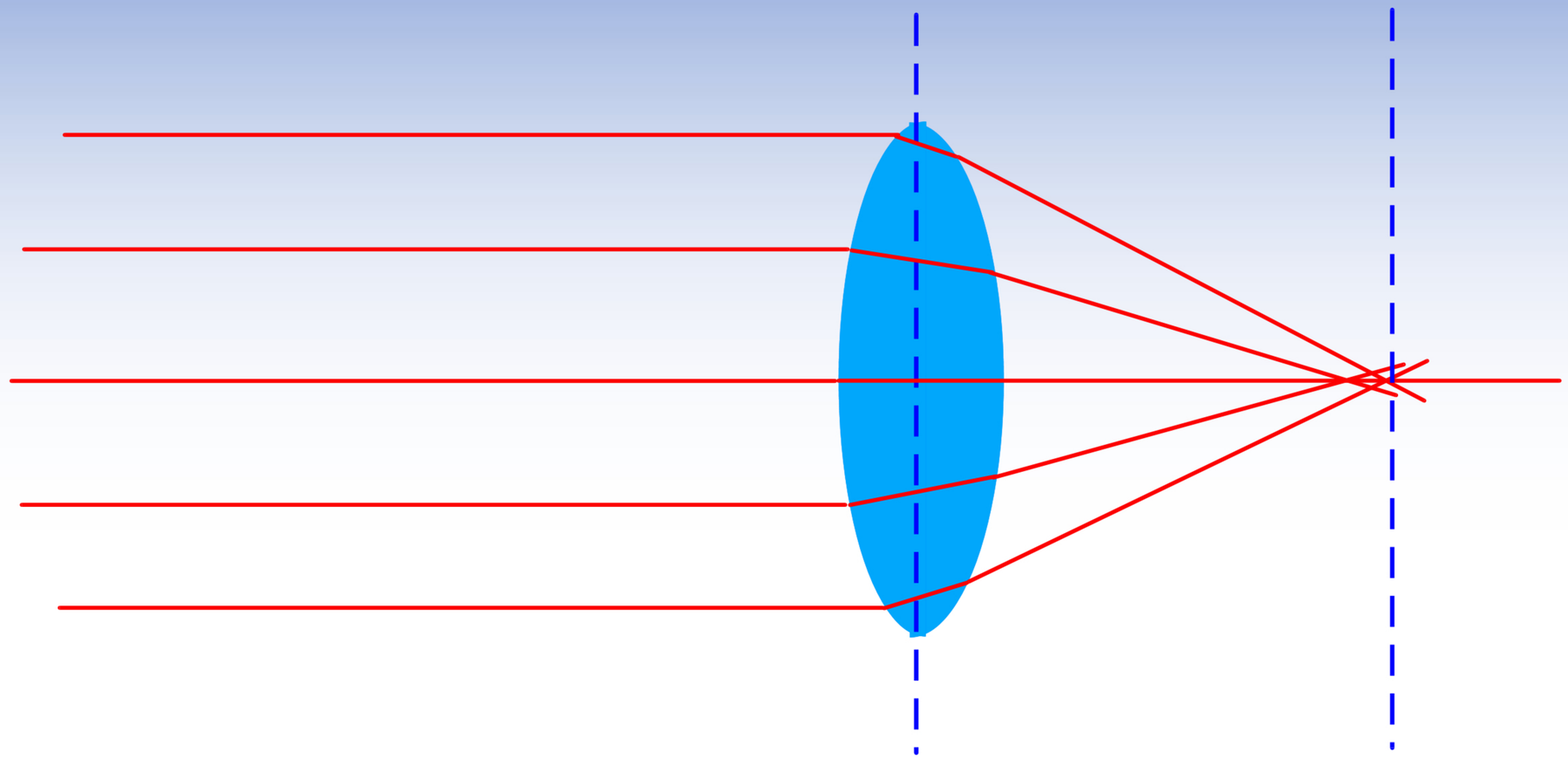
**Wide-angle lens**
Wide-angle lenses of 18–35mm have more general applications than fisheye lenses. Angles of view are generous and depth of field at all apertures is extensive. Poor-quality wide-angle lenses may sometimes show some distortion toward the edges of the image.

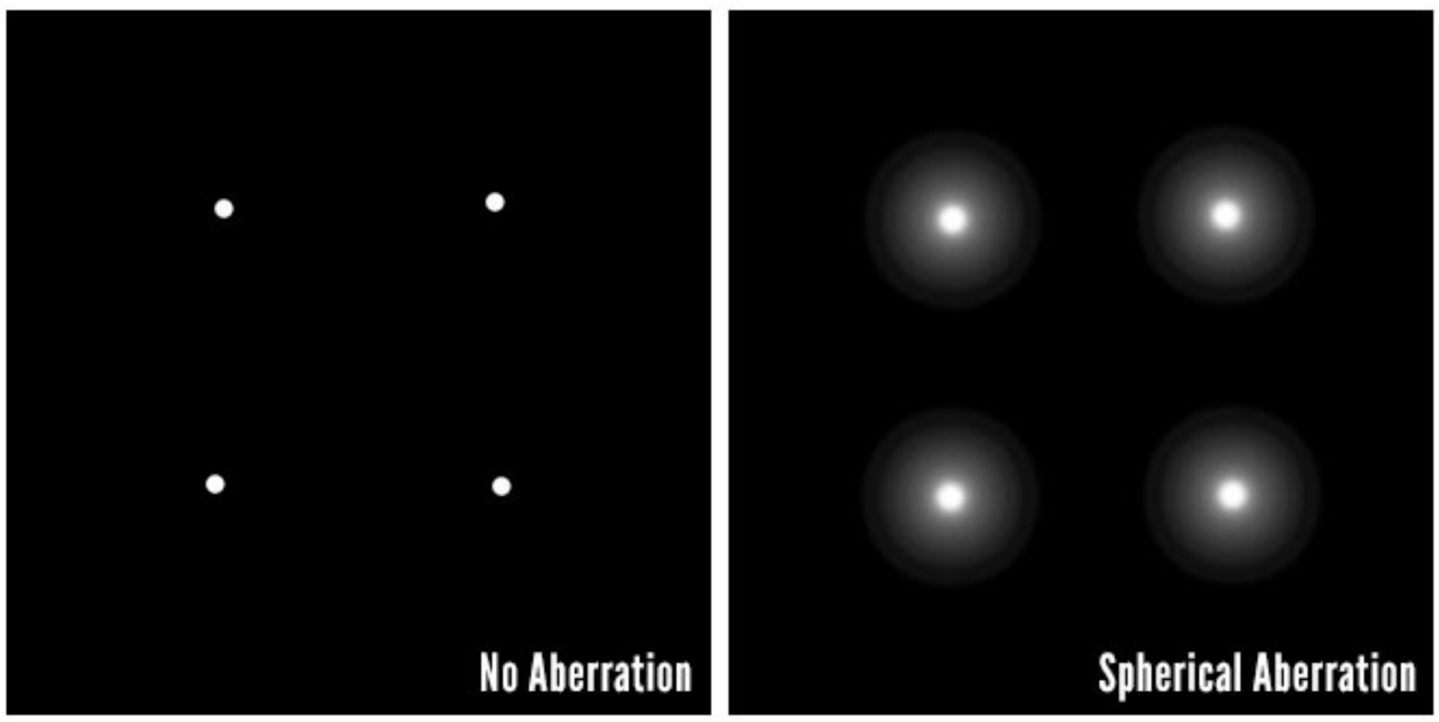
**Standard lens**
A standard 50mm lens is fitted on most 35mm SLRs. Useful for most types of subject, it often has a wide maximum aperture, making it good in low light. It does not show the same distortion as a wide or long lens, and its angle of view is similar to that of the human eye.

**Long-focus lens**
Angles of view of long-focus lenses of 80–400mm start to diminish rapidly. With so little of the scene filling the frame, the subject is shown very large, making a long lens ideal for distant subjects or detailed close-ups. Depth of field decreases as the lens gets longer.

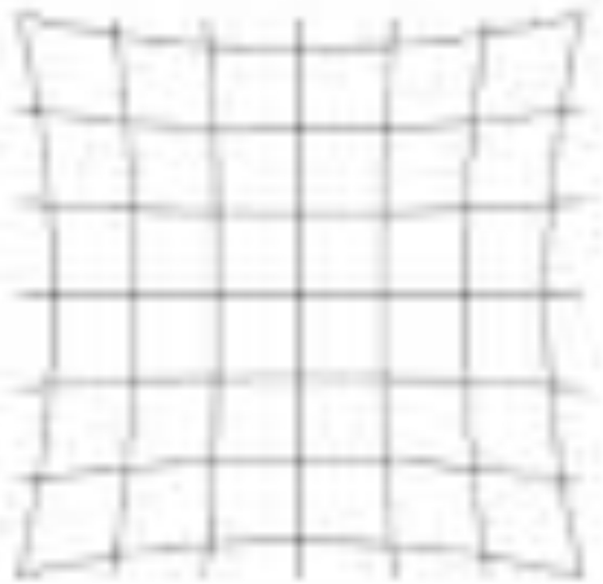
**Extreme long-focus lens**
Focal lengths above 400mm are specialized and are not usually found on standard zooms. The use of a tripod to support the lens is essential because of its relatively heavy weight. A long lens has a shallow depth of field and a small maximum aperture.

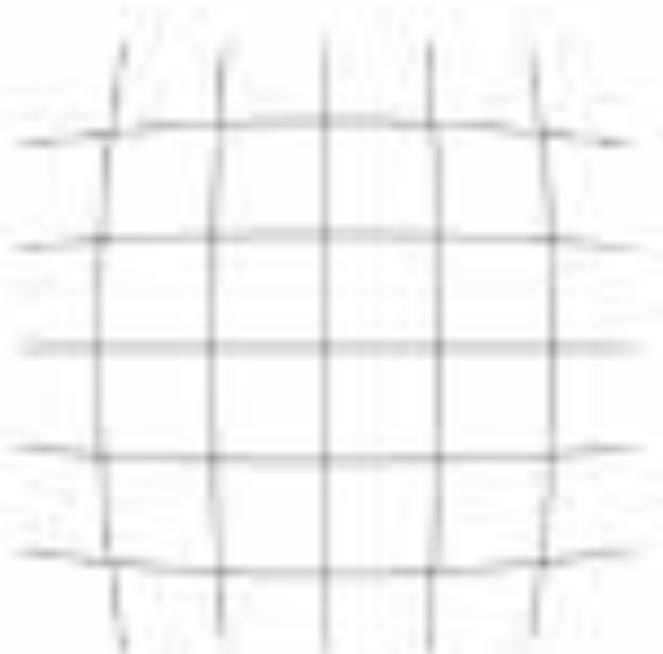
# Spherical Aberrations

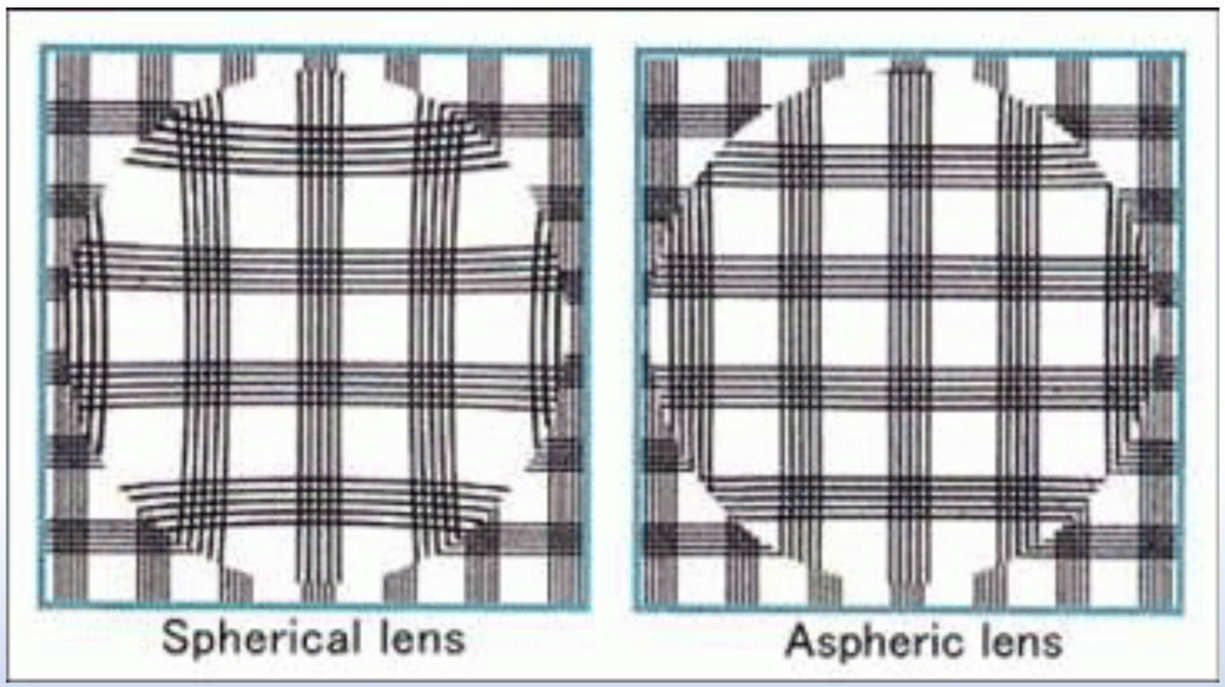




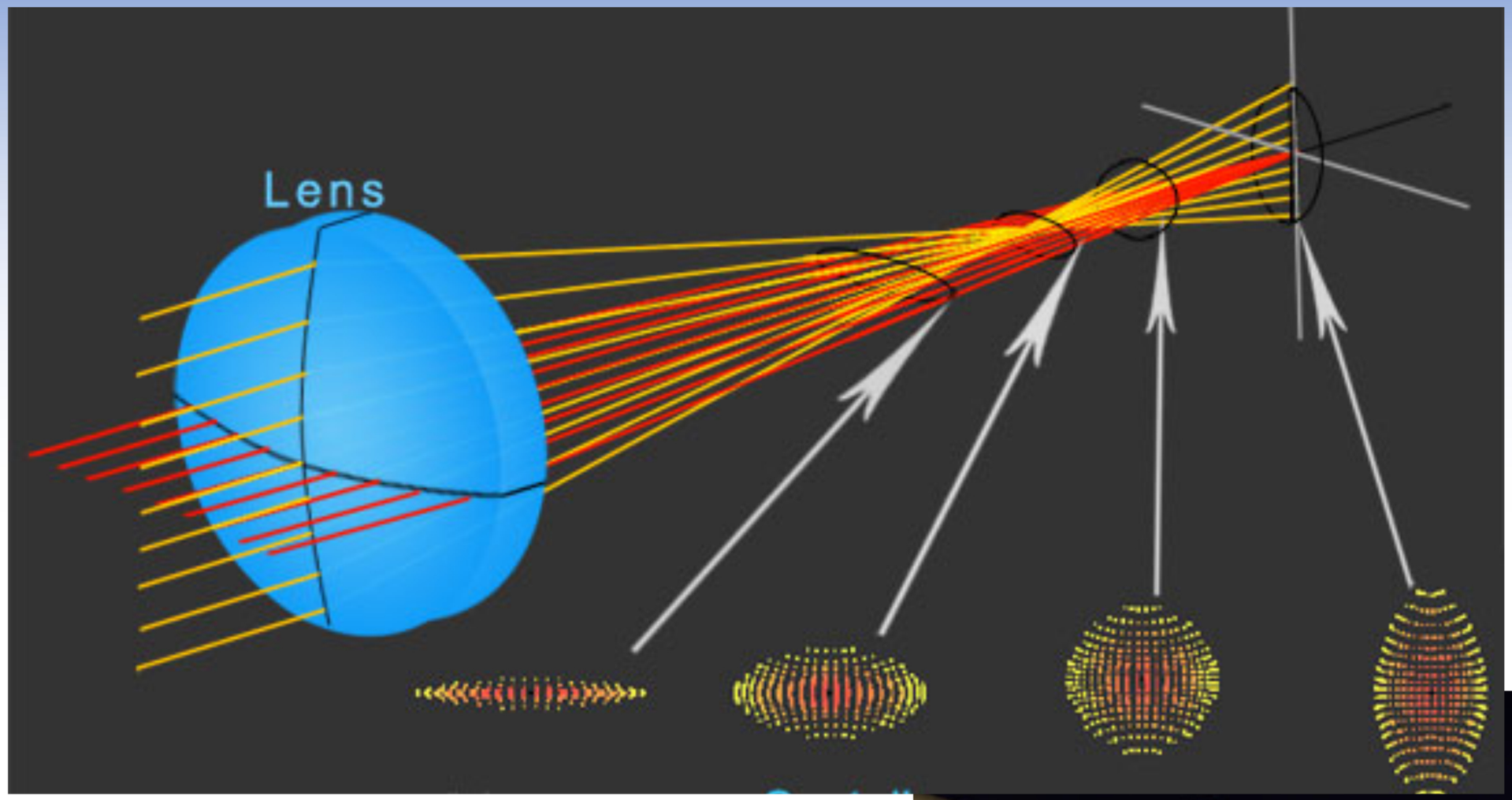

# Optical Distortion

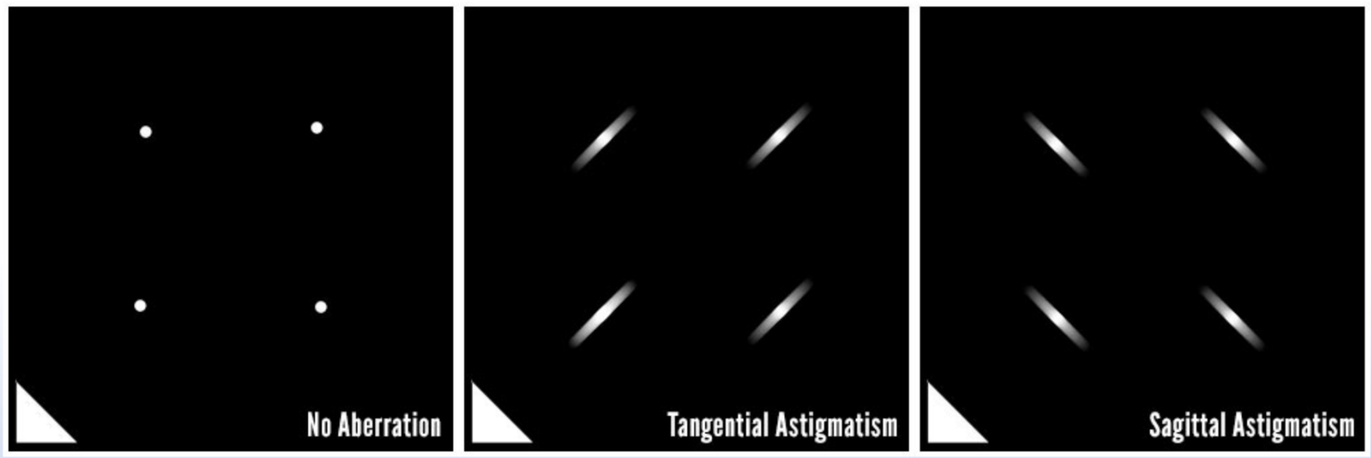


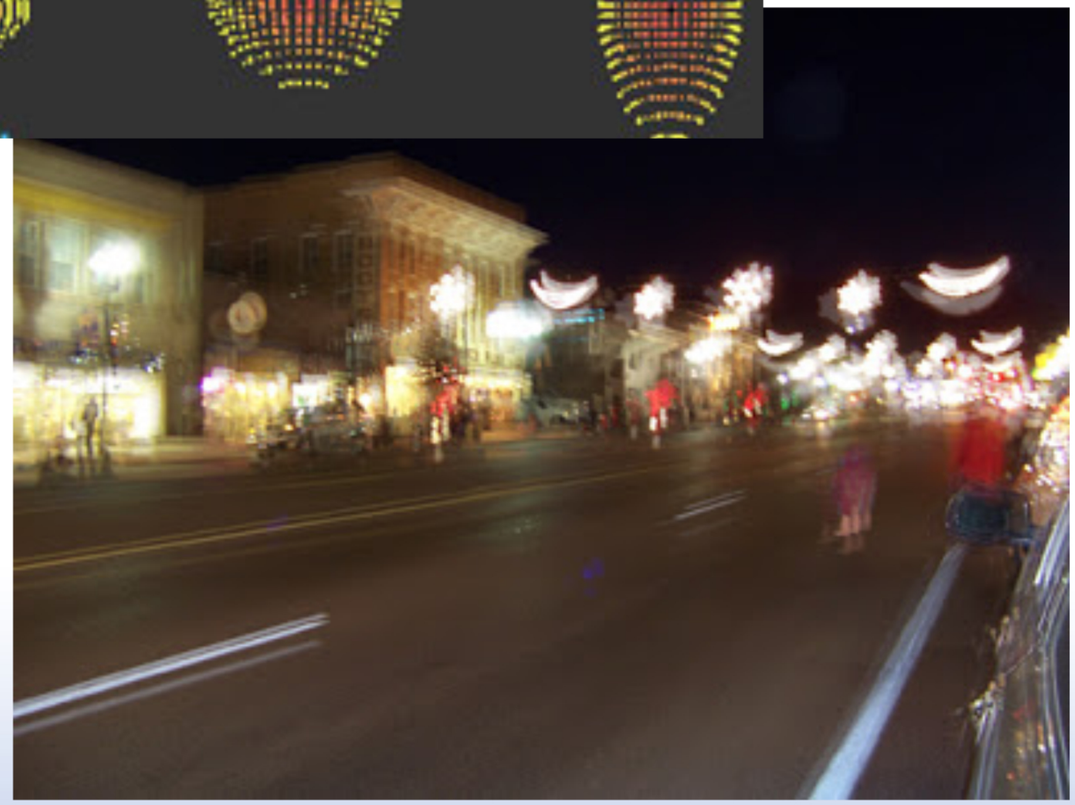




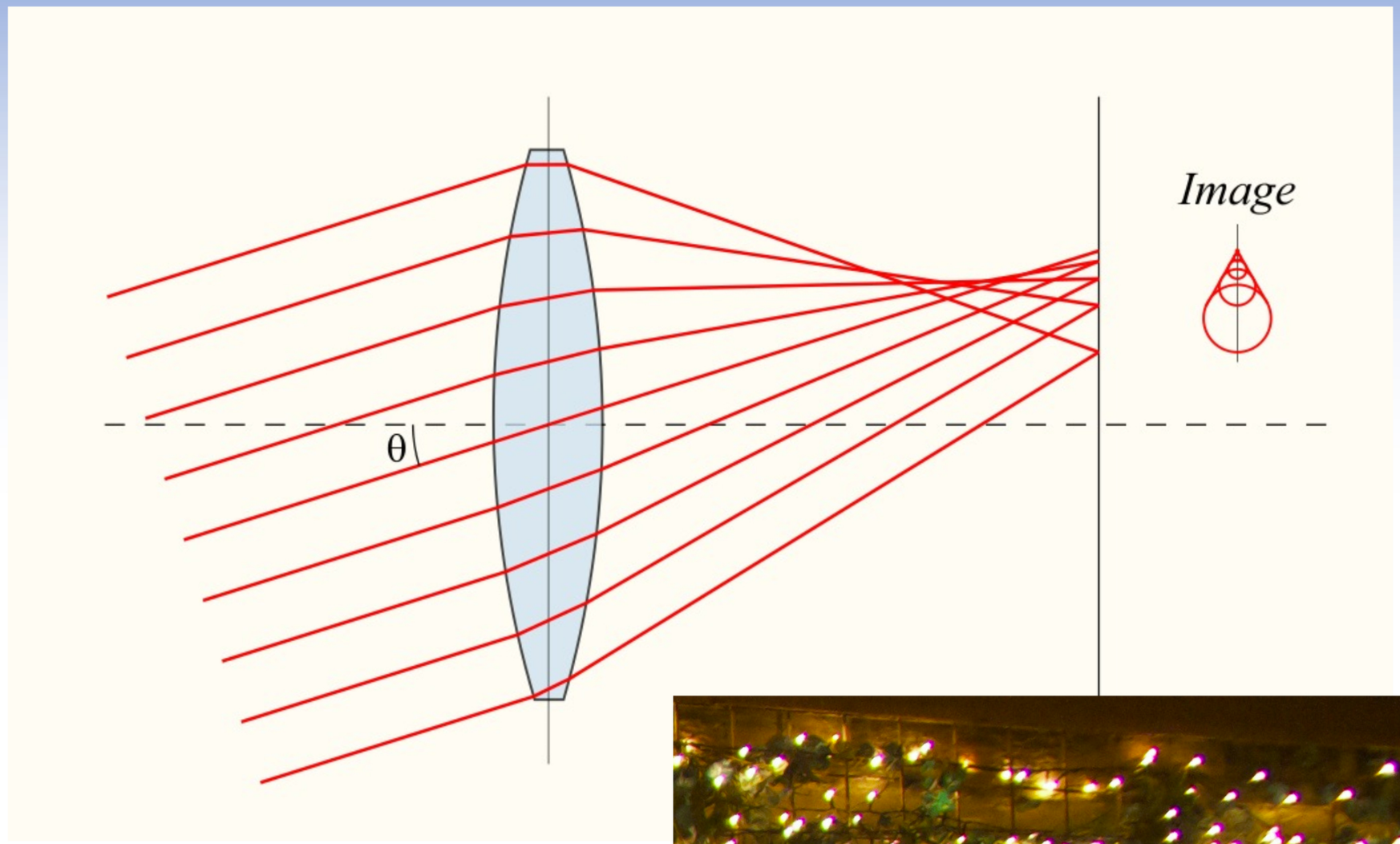

# Astigmatism

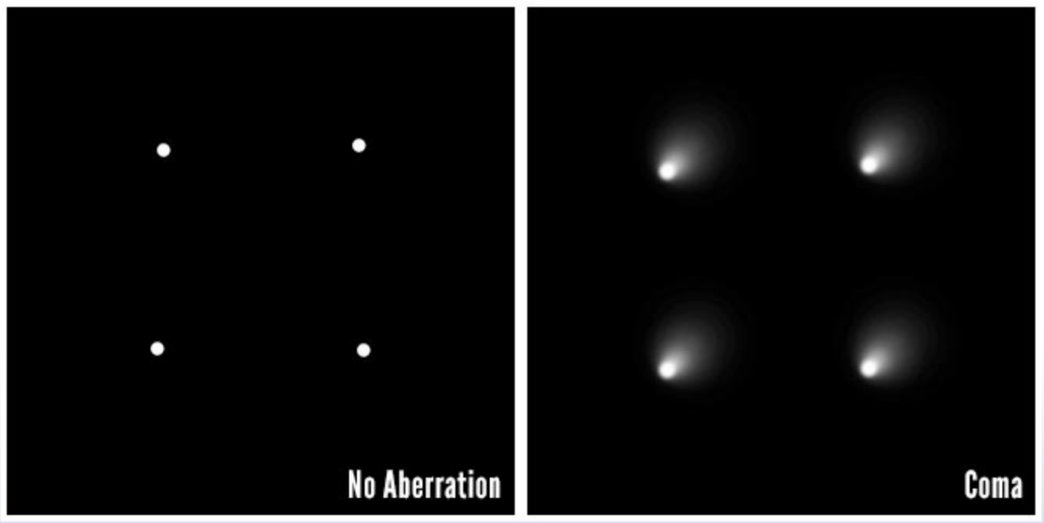


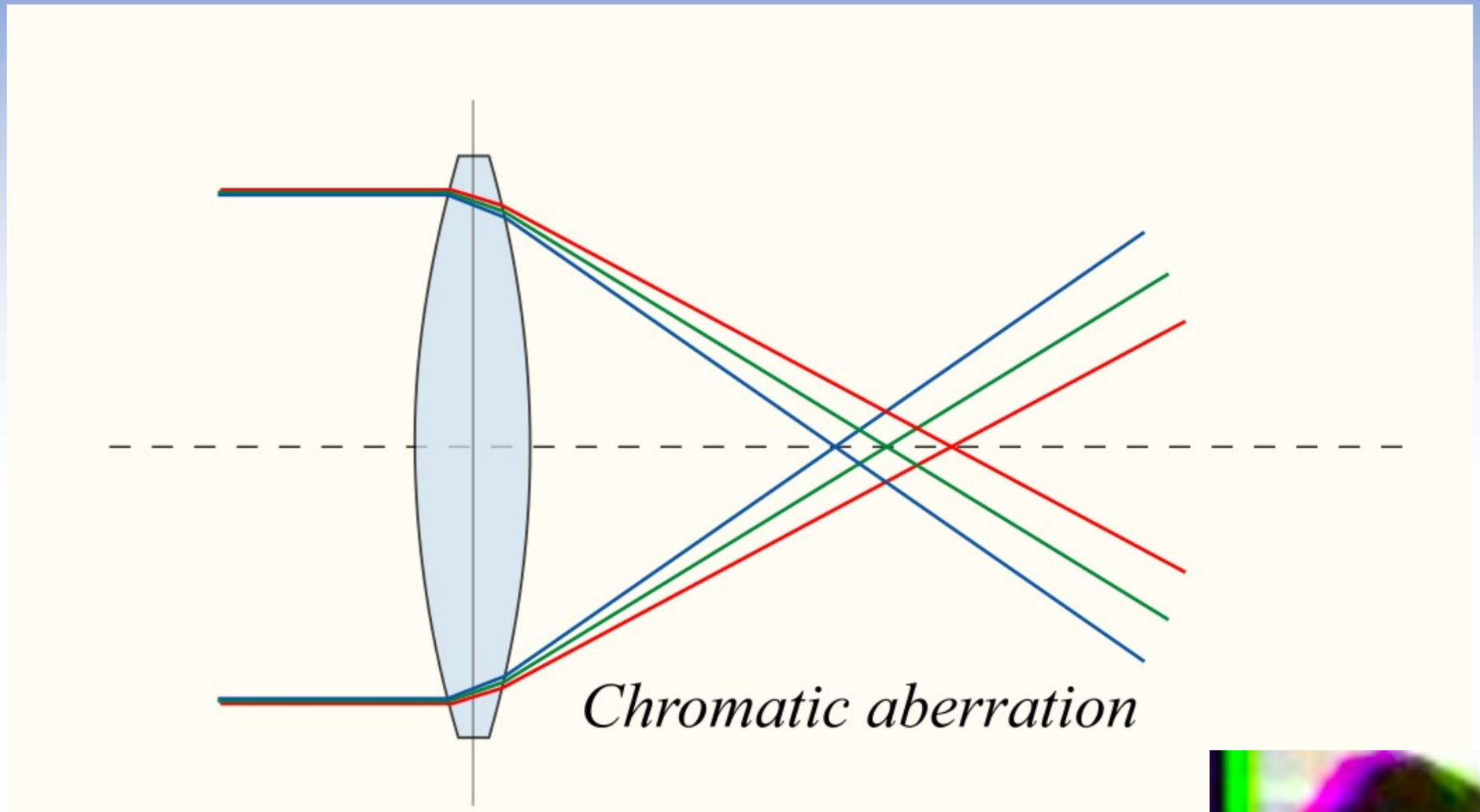



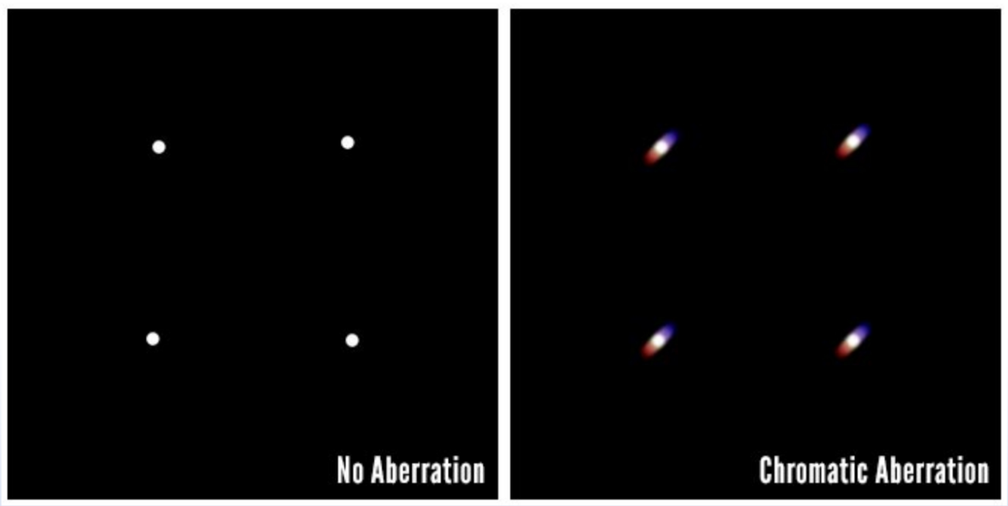
# Coma




# Chromatic Aberration




https://www.youtube.com/watch?t=6&v=-bcRYQKY4jc