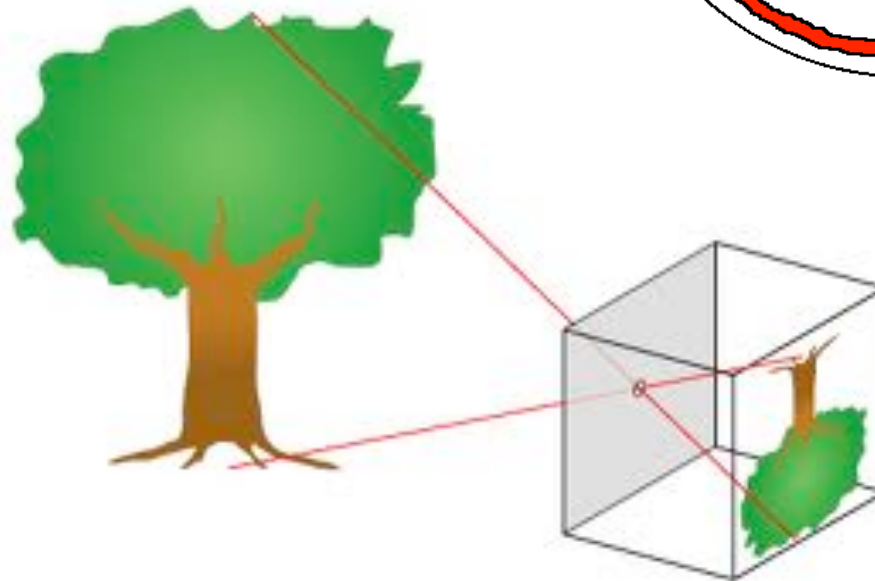
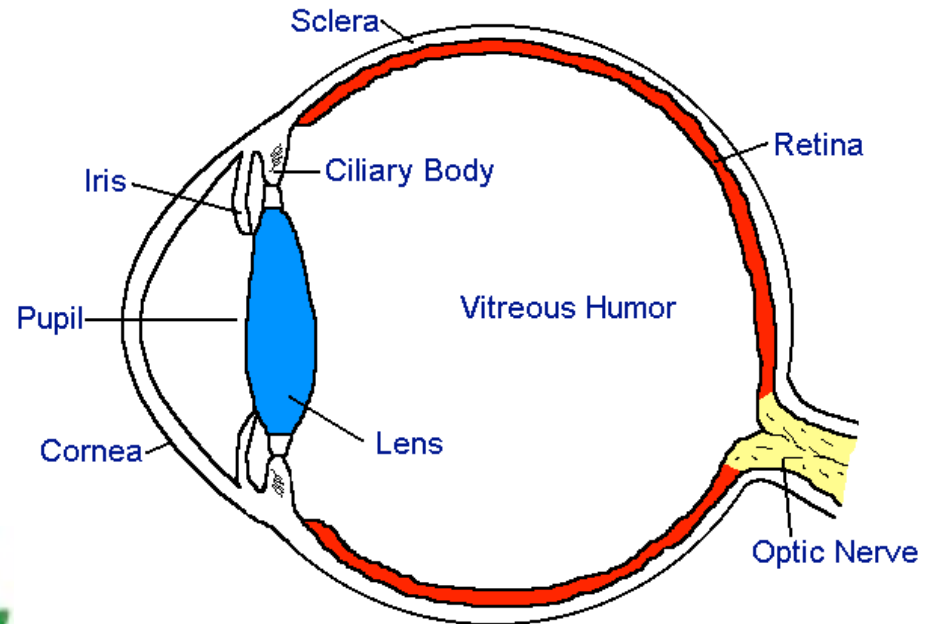


# PHY385-H1F Introductory Optics

Class 12 – Outline: Section 5.7, Sub-sections 5.7.1 – 5.7.6

- Fibre-Optics
- The Human Eye
- Corrective Lenses
- Pinhole Camera
- Camera
- Depth of Field



Physics at UofT

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/ Departmental Items / Physics Colloquium / Wave-particle duality at the

## Wave-particle duality at the macroscopic scale

— filed under: [Physics](#), [Colloquium](#)

**Yves Couder**

**Université Paris Diderot**

**Date and time** Oct 27, 2011  
from 04:10 PM to 05:00 PM

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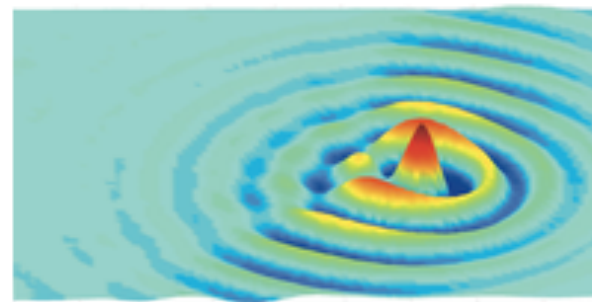
**Location** McLennan Physics (MP) 102

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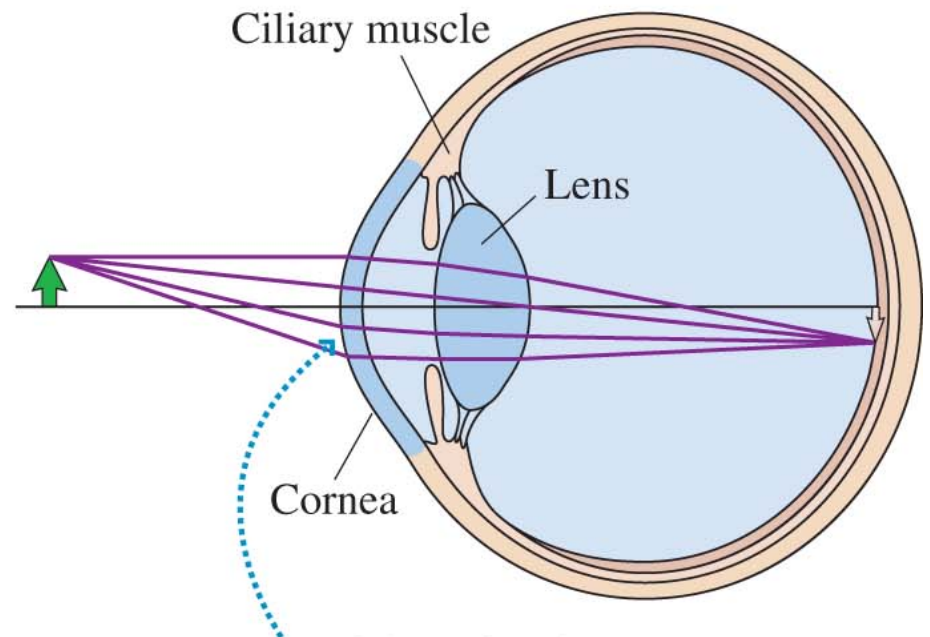
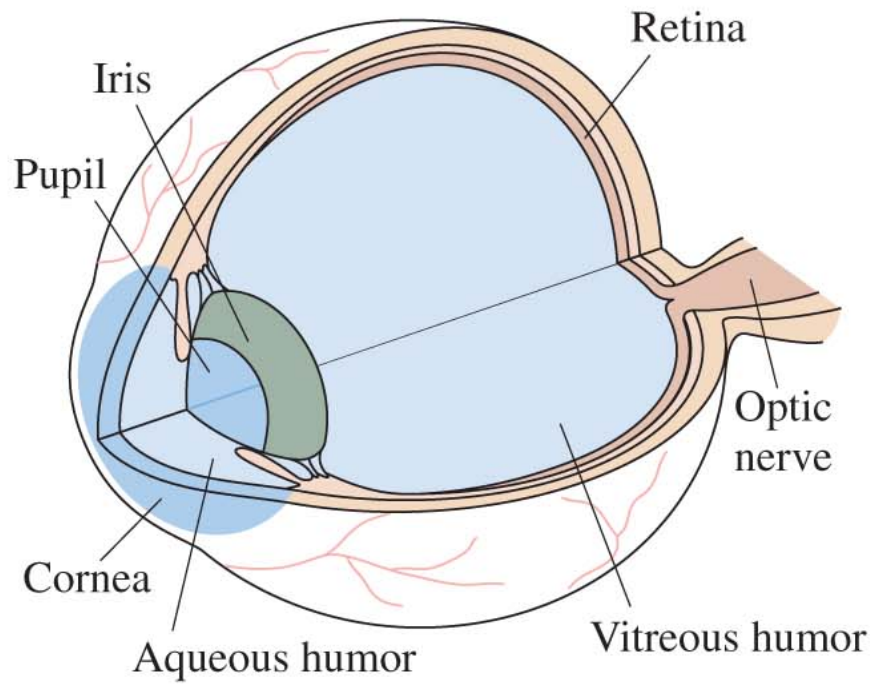
**Host** Stephen Morris

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“[The double-slit experiment] is impossible, *absolutely* impossible, to explain in any classical way, and ... has in it the heart of quantum mechanics. In reality, it contains the *only* mystery. We cannot explain the mystery in the sense of “explaining” how it works. We will *tell* you how it works. In telling you how it works we will have told you about the basic peculiarities of all quantum mechanics.” - **Richard Feynman**, *The Feynman Lectures on Physics Volume I*, Ch.37



The human eye.



Most of the refraction occurs at the cornea's surface.

# Eyes

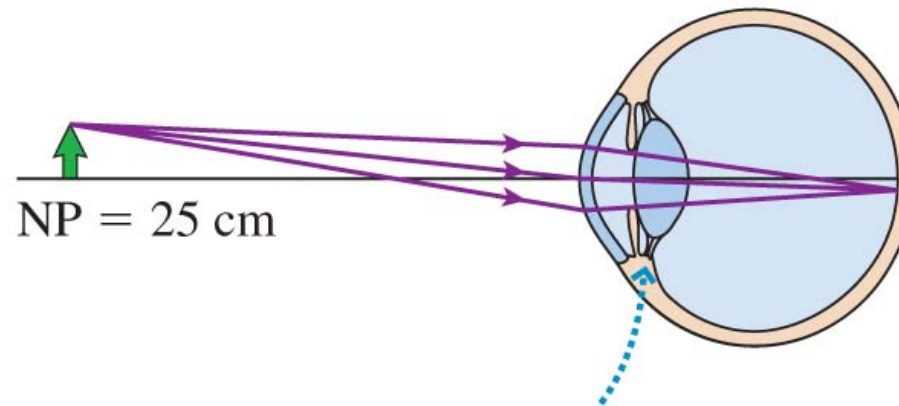
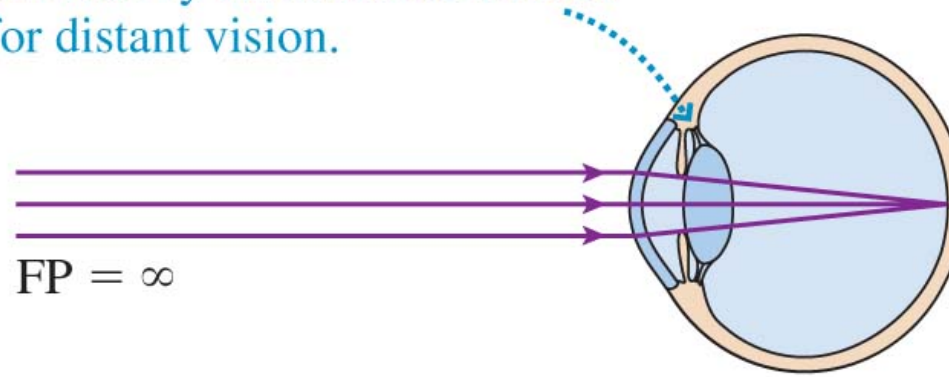
- The compound eye is made of many ommatidia. Each detects light from a certain direction, and sends an intensity signal to the brain.
- Human eye is a positive double-lens arrangement which projects a real image onto a light-sensitive concave retina.
- Most of the focusing power of the eye comes from the air-cornea interface.
- The lens is pliable (although less so with age), and so it has a variable focal length.

# Retina

- The retina is filled with rods and cones
- The spot where the optic nerve exits contains no receptors and is insensitive to light: ***blind spot*** (we don't notice it because our brain fills in the gap with what it expects)
- At the centre of the retina is the **macula**, which contains twice as many cones as rods
- At the centre of the macula is the **fovea centralis**. It contains no rods, and the cones are very densely packed.
- We constantly move our eyeballs to cause the light coming from the object of primary interest to fall on the fovea centralis.

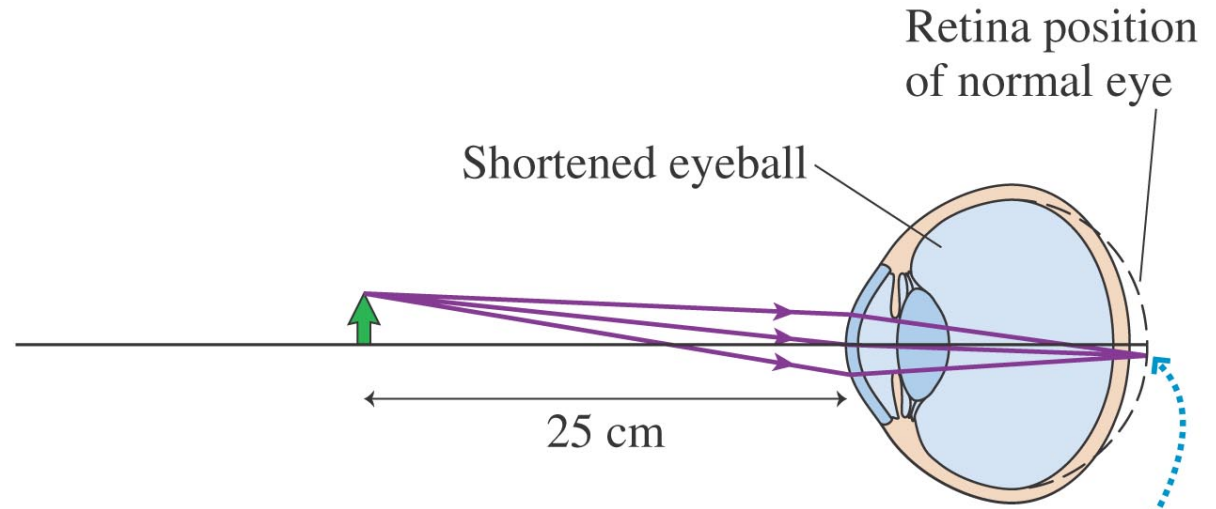
# The Normal Eye

The ciliary muscles are relaxed for distant vision.

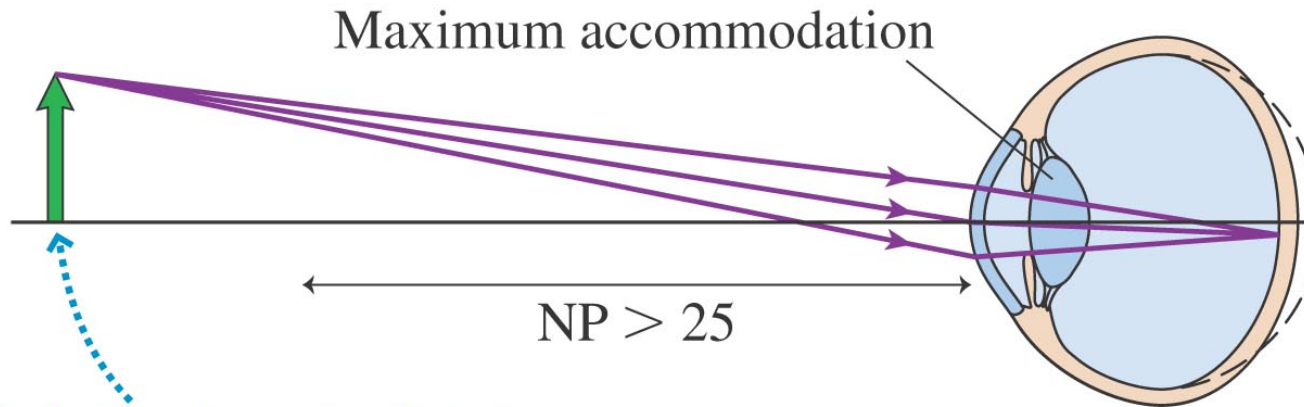


The ciliary muscles are contracted for near vision, causing the lens to curve more.

# Hyperopia (far-sightedness)



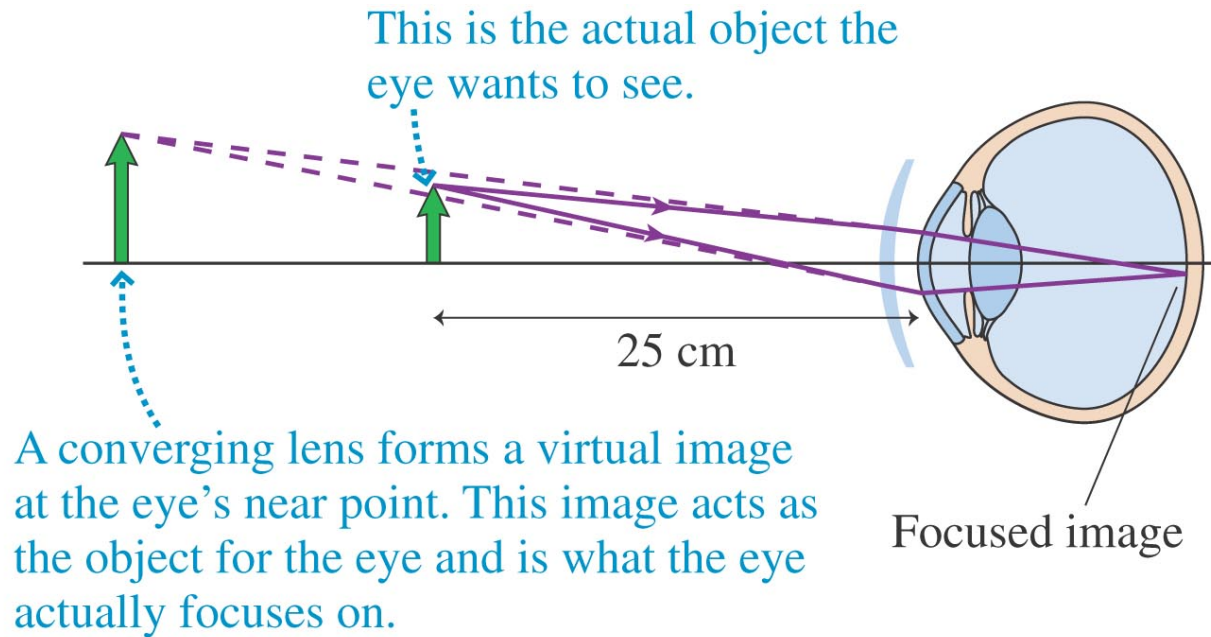
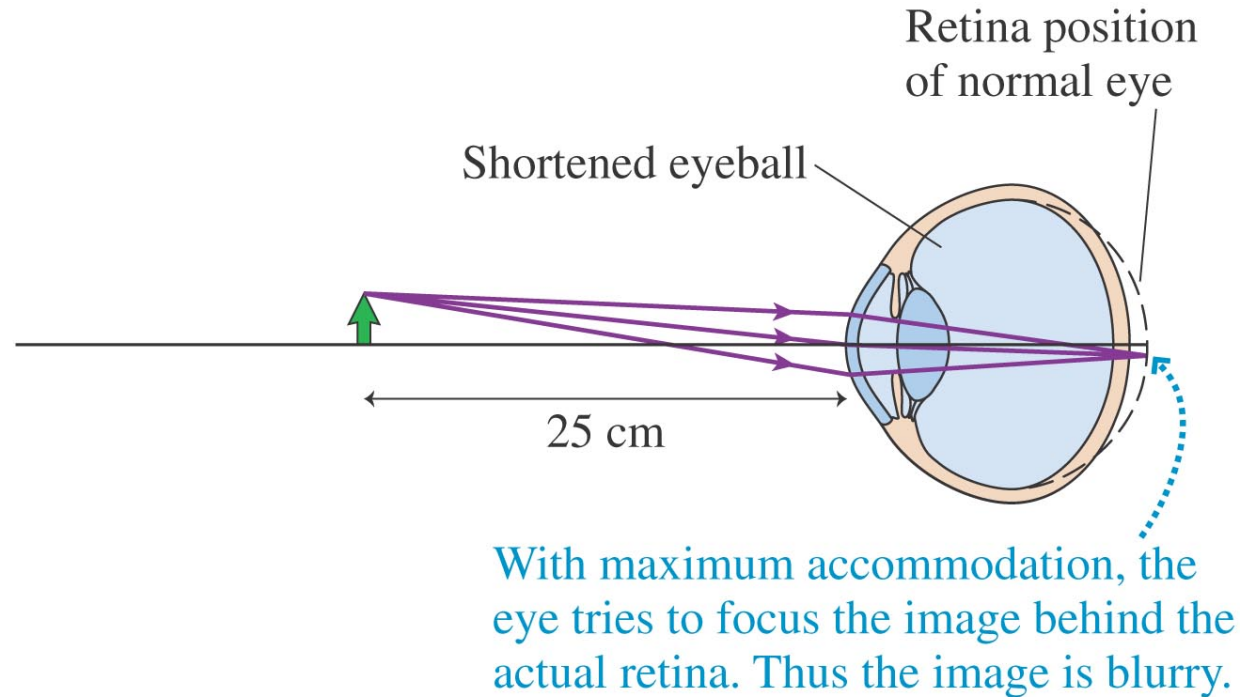
With maximum accommodation, the eye tries to focus the image behind the actual retina. Thus the image is blurry.



This is the closest point at which the eye can focus.

Hyperopia  
(far-sightedness)

CORRECTION:  
Converging lens.





Retina position  
of normal eye

# Myopia (near-sightedness)

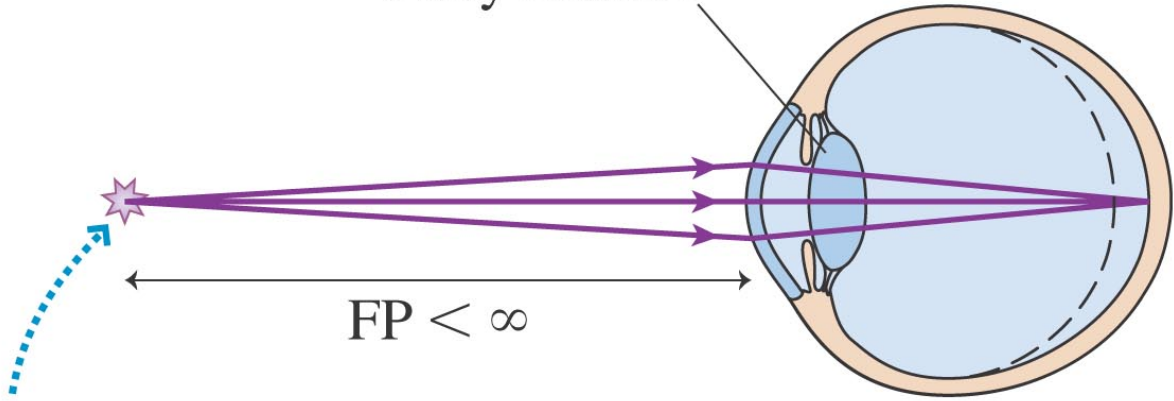
Elongated eyeball



Parallel rays from  
distant object

A fully relaxed eye focuses the image in front of the actual retina. The image is blurry.

Fully relaxed



This is the farthest point at which the eye can focus.

Myopia  
(near-sightedness)

CORRECTION:  
Diverging lens

