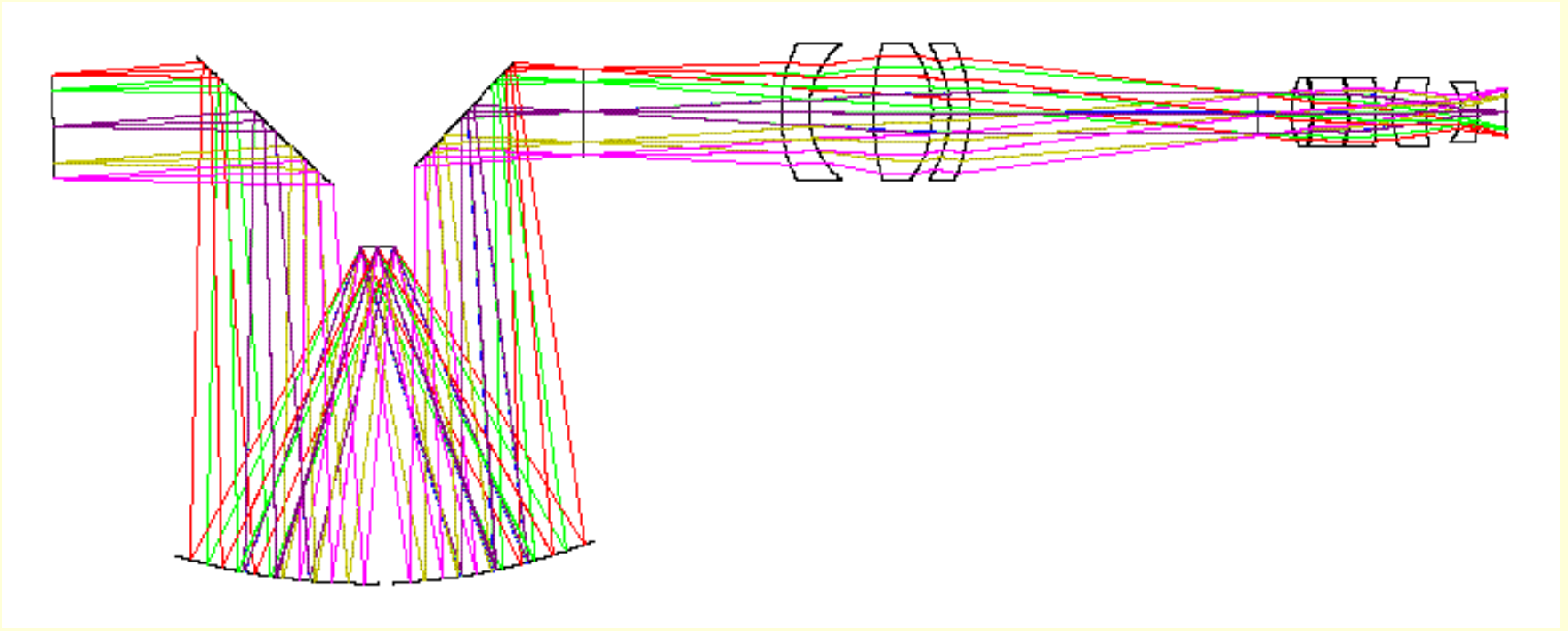


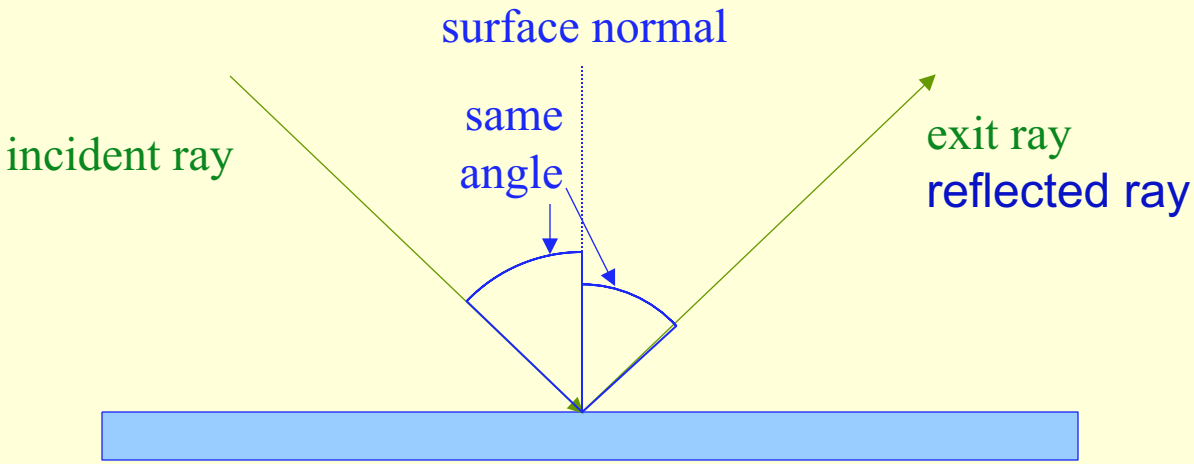
Optics

Mirrors and Lenses

Reflection

- We describe the path of light as straight-line rays
- Reflection off a flat surface follows a simple rule:
  - angle in (incidence) equals angle out (reflection)
  - angles measured from surface “normal” (perpendicular)

Law of Reflection: Angle of incidence = Angle of reflection



Reflection Vocabulary

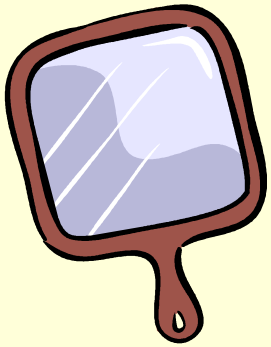
- Real Image –
  - Image is made from “real” light rays that converge at a real focal point so the image is REAL
  - Can be projected onto a screen because light actually passes through the point where the image appears
  - Always inverted

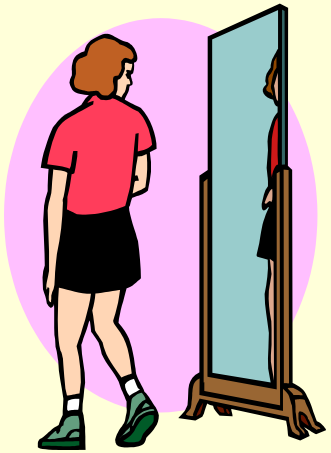
Reflection Vocabulary

- Virtual Image–
  - –“Not Real” because it cannot be projected
  - –Image only seems to be there!

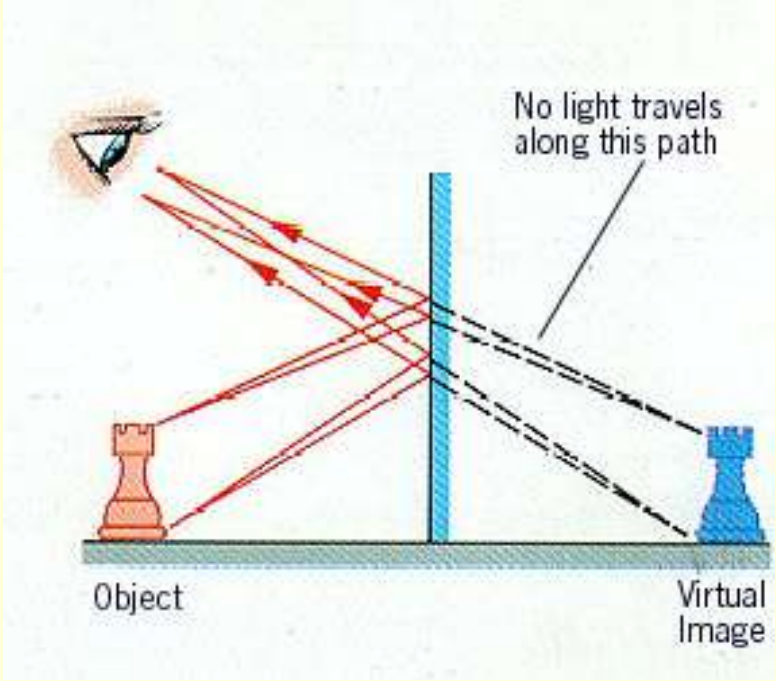
Mirrors and Reflection

- Mirrors reflect light.





Virtual Images in Plane Mirrors



If light energy doesn't flow from the image, the image is "virtual".

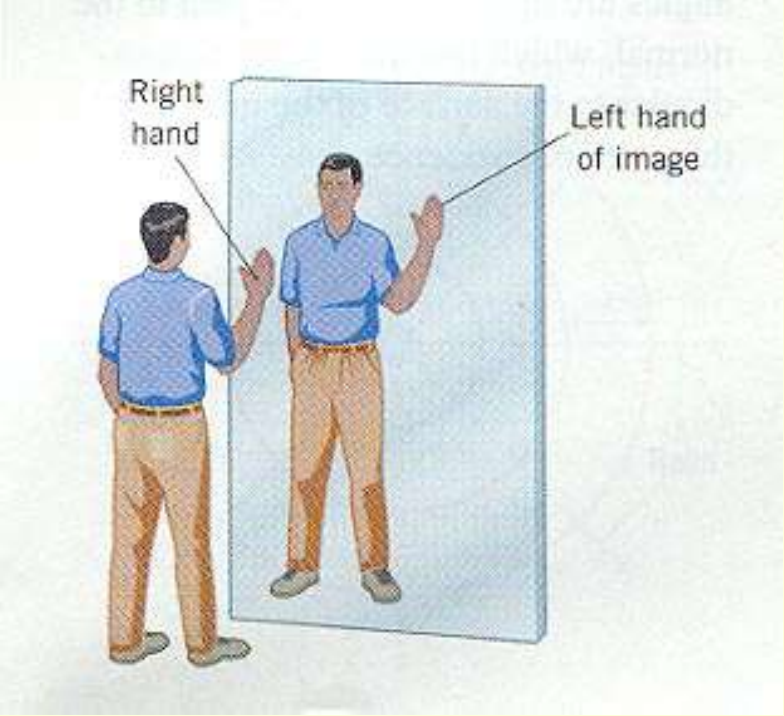
Rays seem to come from behind the mirror, but, of course, they don't. It is virtually *as if* the rays were coming from behind the mirror.

"Virtually": the same as if

As far as the eye-brain system is concerned, the effect is the same as would occur if the mirror were absent and the chess piece were actually located at the spot labeled "virtual image".

LEFT- RIGHT REVERSAL

AMBULANCE



Concave Mirrors

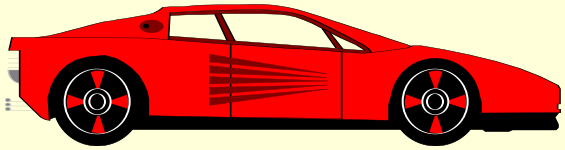
- Curves inward
- May be real or virtual image

Convex Mirrors

- Curves outward
- Reduces images
- Virtual images

– Use: Rear view mirrors, store security…

CAUTION! Objects are closer than they appear!

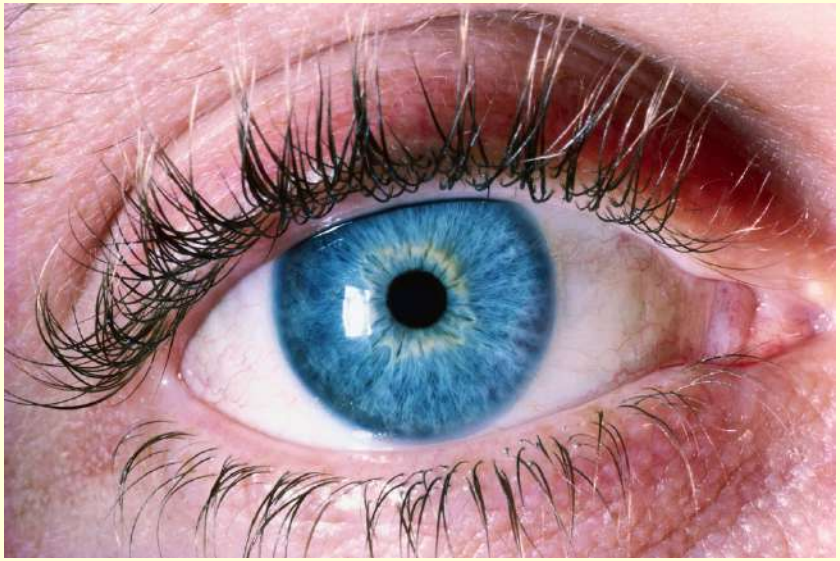


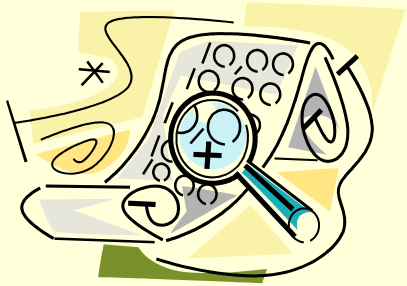
Refraction

- Light also goes *through* some things
  - –glass, water, eyeball, air, lenses

Lenses and Refraction

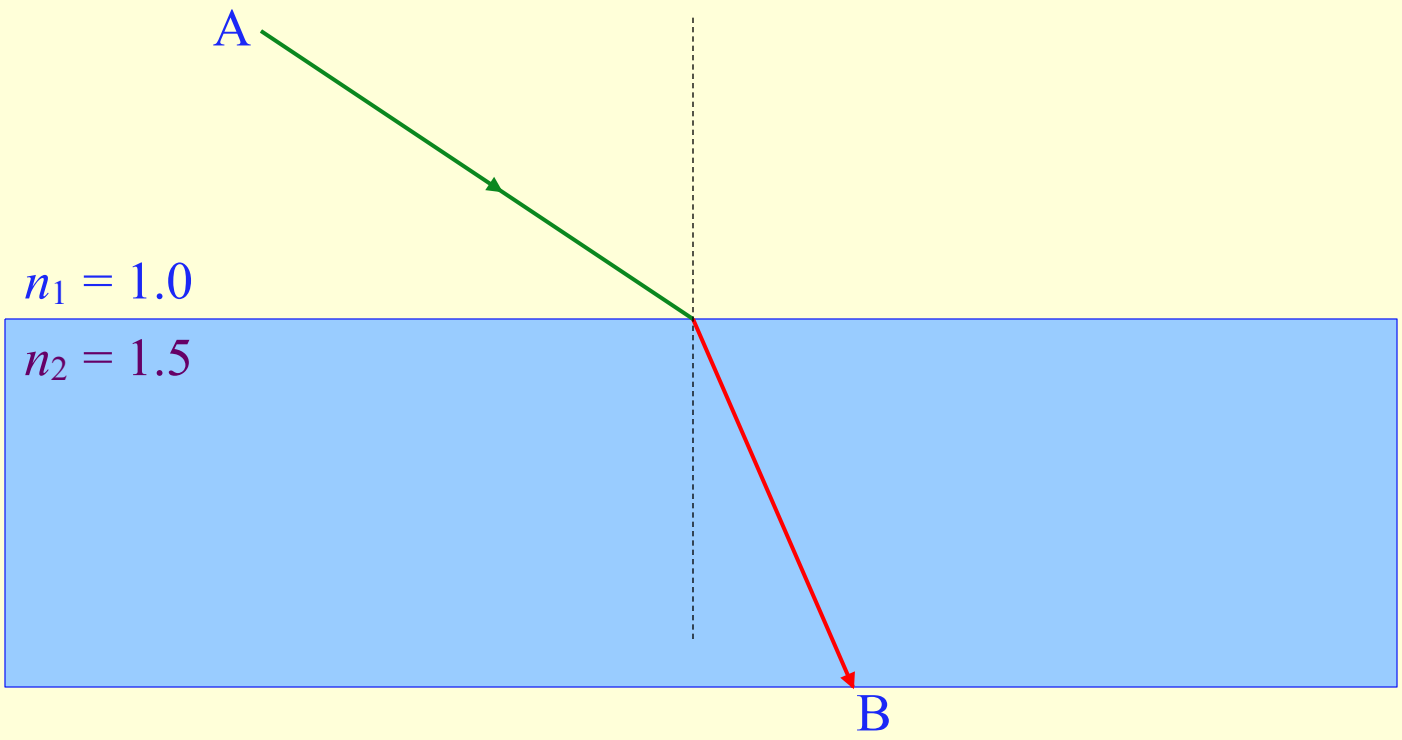
- Lenses refract light





Refraction at a plane surface

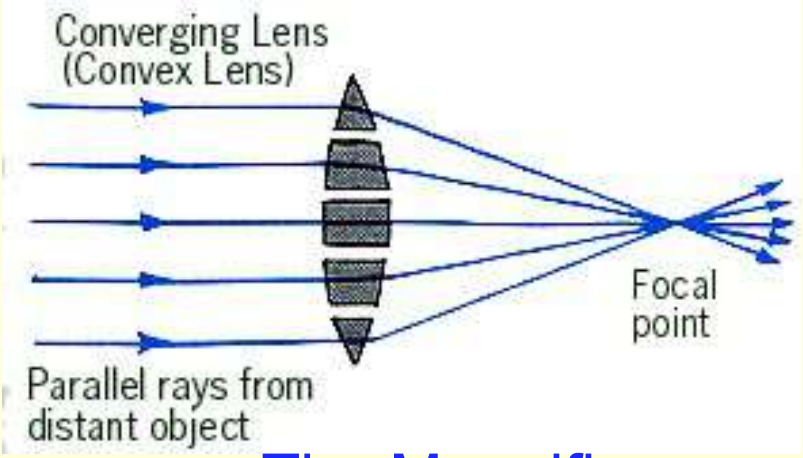
- Light bends at interface between two mediums
  - bends more the larger the difference in refractive index



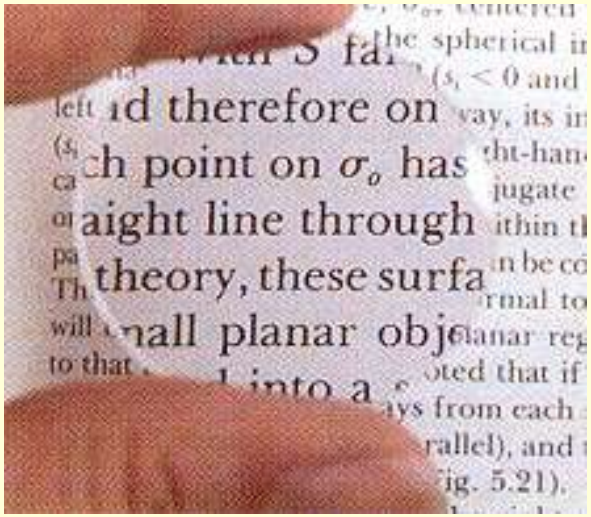
Convex Lenses

Thicker in the center than edges.

- Lens that converges (brings together) light rays.
- Forms real images and virtual images depending on position of the object

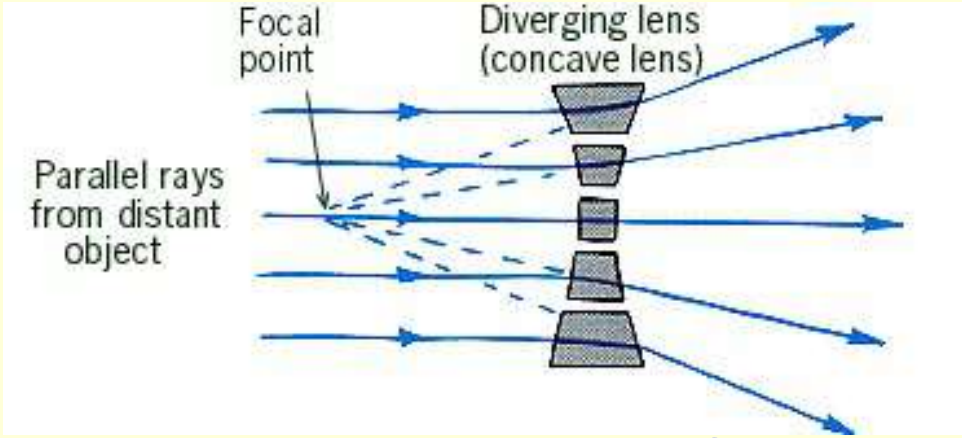


The Magnifier

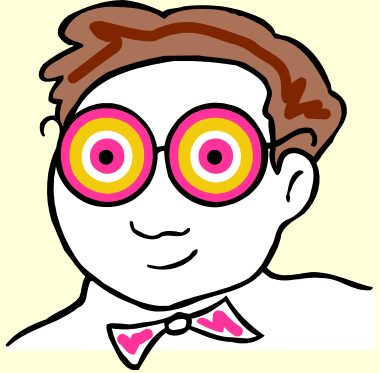


Concave Lenses

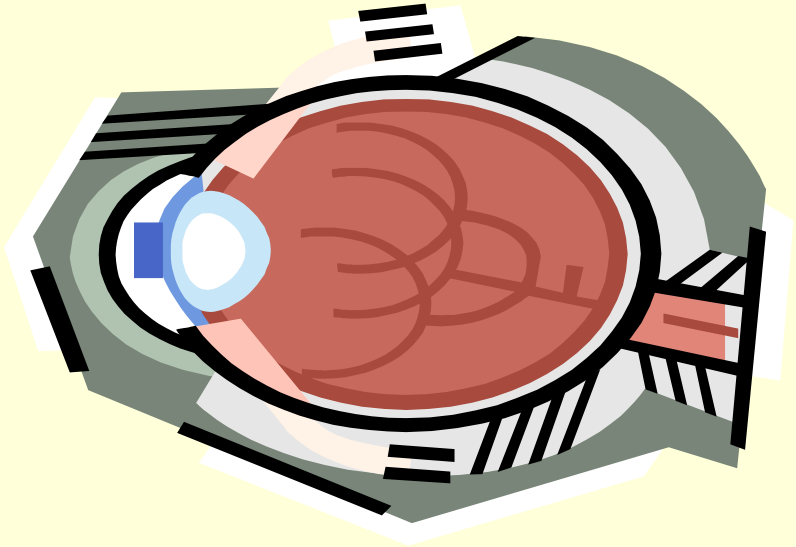
- Lenses that are thicker at the edges and thinner in the center.
  - Diverges light rays
  - All images are upright and reduced.



The De-Magnifier



How You See



- Near Sighted – Eyeball is too long and image focuses in front of the retina
- Near Sightedness – Concave lenses expand focal length
- Far Sighted – Eyeball is too short so image is focused behind the retina.
- Far Sightedness – Convex lens shortens the focal length.