

**Traditional: 12-06**

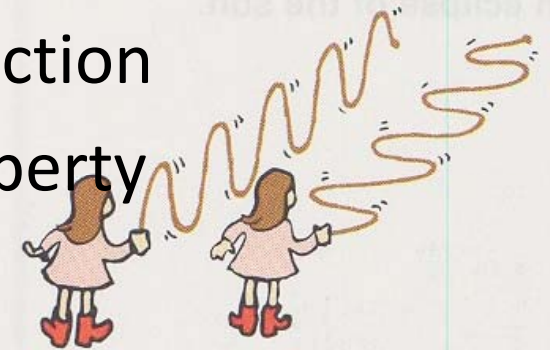
**Themed: 02-06**

Light Polarization

Themed only: Fluorescence, etc.

# How do we know light waves are transverse?

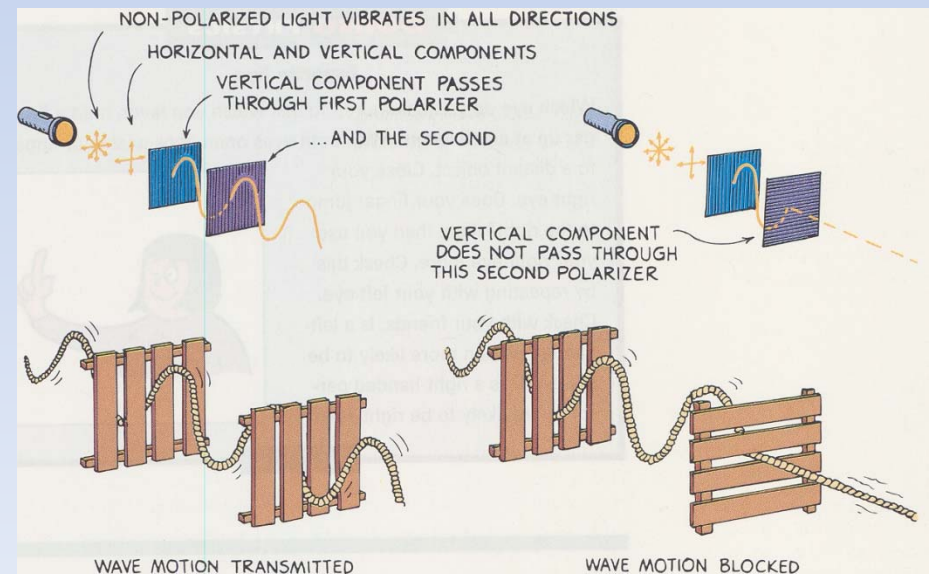
- Some light behaviors are consistently only if light is transverse
- Polarized light is one we need to know
  - Polarized light makes glare, but it also makes LCD TV's!
  - Certain materials will only let transverse waves through that vibrate in a particular direction
  - Longitudinal waves can't have that property



**Figure 27.15** ▲  
A vertically polarized wave (left)  
and a horizontally polarized  
wave (right).

# Polarized vs. non-polarized light

- Light is generally created non-polarized
  - Non-polarized: On average, 50% vibrates horizontally & 50% vertically (components of light)
  - A polarizing filter has molecules lined up like a picket fence
  - 50% of randomly polarized light will be blocked
  - The vertical portion of light makes it through a vertically polarized filter



# Making polarized light

- Light strikes a horizontal surface (your desk, floor), the horizontal component tends to reflect horizontally polarized light
  - This is GLARE
  - Fishermen & trucker drivers wear polarized lenses
  - If you want to block this, how would you orient your polarized lens?
- Light striking a vertical surface makes vertically polarized light (the whiteboard, windows)

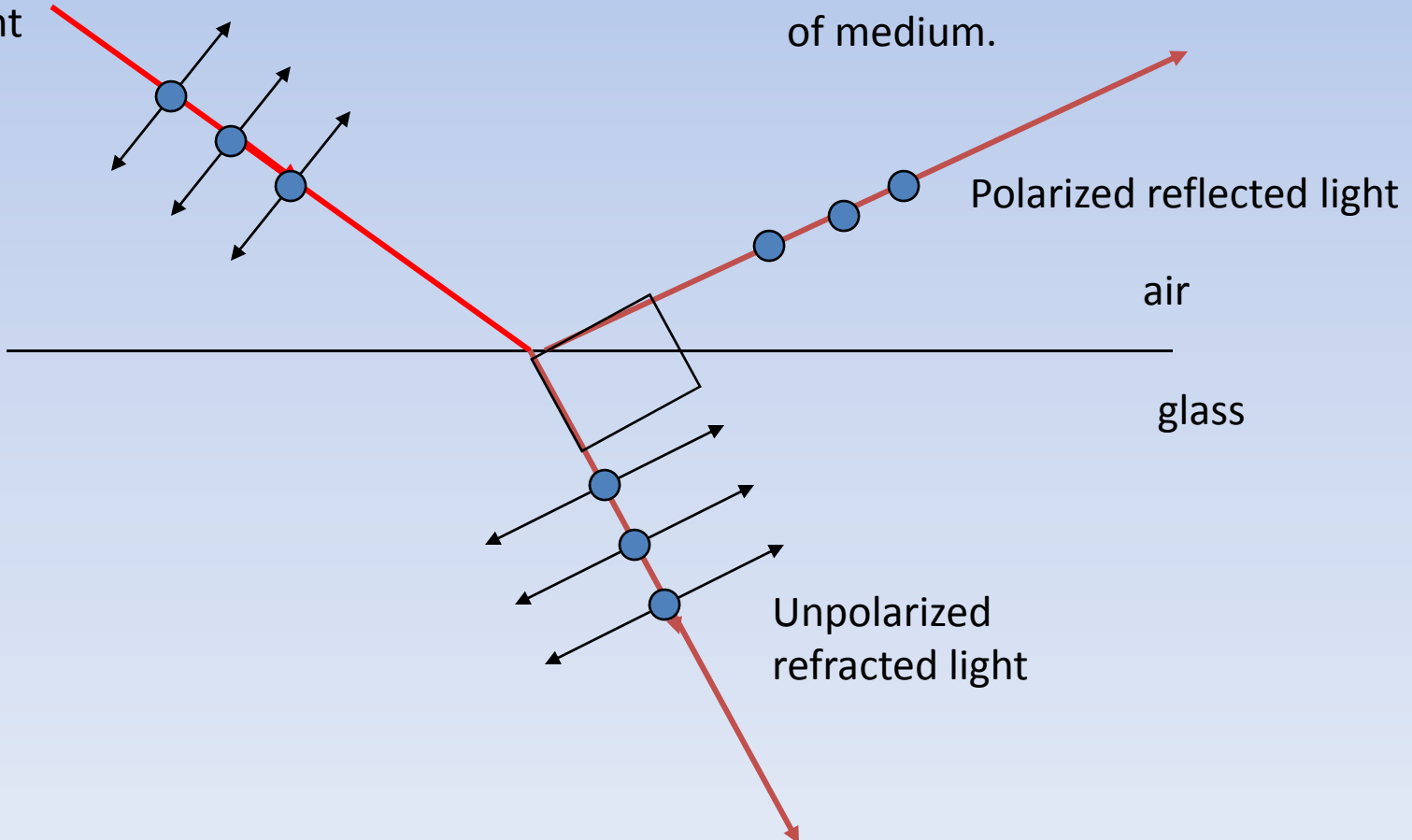
Which pair of glasses is best suited for automobile drivers? (The polarization axes are shown by the straight lines.)



# Polarization by Reflection

Assume that the direction of the reflected light and that of the refracted light are perpendicular.

Unpolarized incident light



The plane of polarization is parallel to the surface of medium.

Polarized reflected light

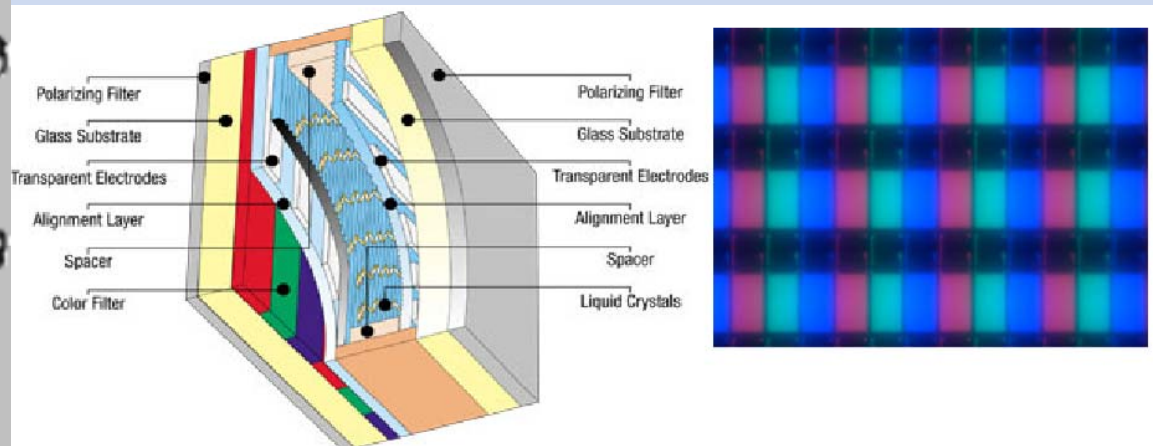
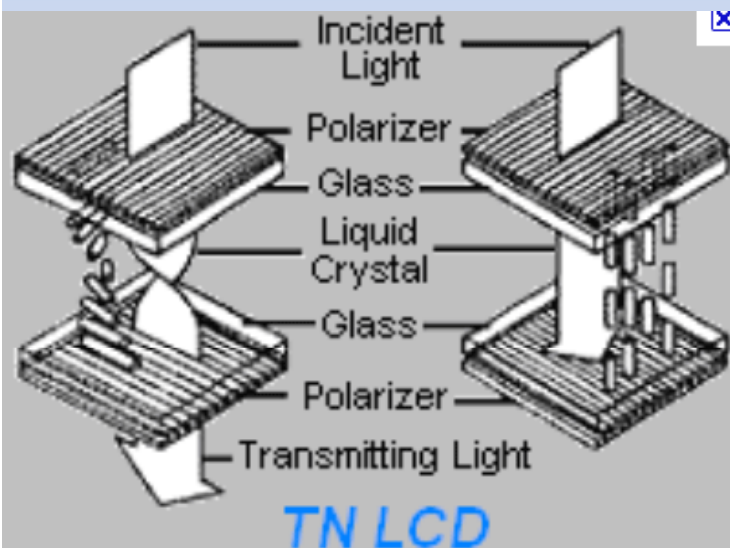
air

glass

Unpolarized refracted light

# How an LCD TV works

- LCD TV's have a back light (RGB)
- The light goes through a polarized filter
- Liquid crystals twist the light depending on voltage
- RGB filters color each pixel...each “square” is polarized a different angle...depends on how much twisting done
- Second polarizing filter: % of light (how bright each R, G, or B) depends on twist angle (voltage)!



# Color mixing practice

- Magenta light shines through a yellow filter onto a yellow t-shirt. What color does the t-shirt appear to be?
  - Red
- Cyan light passes through a yellow filter and reflects off a t-shirt. What t-shirt color(s) will make the shirt appear green? Blue?
  - Green, white; no color will do this

# Themed Only: Fluorescent lighting & more - definitions to know

- Incandescence: Light produced by an object simply being very **hot** – ordinary light bulbs
- Luminescence: Light produced by a means other than being hot – fluorescent light; lightning bug (**cool** light)
- **F**luorescence: Visible light from a non-visible source...usually UV is converted to visible light (**f**requency changes)
- **P**hosphorescence: **P**ersistent emission of light after the original energy source is removed – glow in the dark stick



## Themed Only

Specular and Diffuse reflection

Questions to ponder....

- Does green reflect in a mirror?
- Does green reflect on white paper?
- Does every color reflect on white paper? a mirror?
- Why can't I shave with a piece of paper?

# Themed Only

## Mirrors and paper

- Mirrors bounces light rays very predictably
  - “Glossy surface”: Polished, smooth surface
  - Specular reflection
- Paper bounces light rays randomly
  - “Matte surface”: rough edges
  - Diffuse reflection
- Glossy surfaces produce specular reflection
- Matte surfaces produce diffuse reflection
- Imagine a basketball bouncing off a flat wooden floor compared to a gravel road

