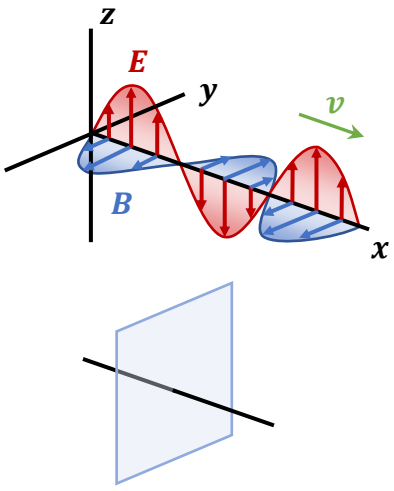
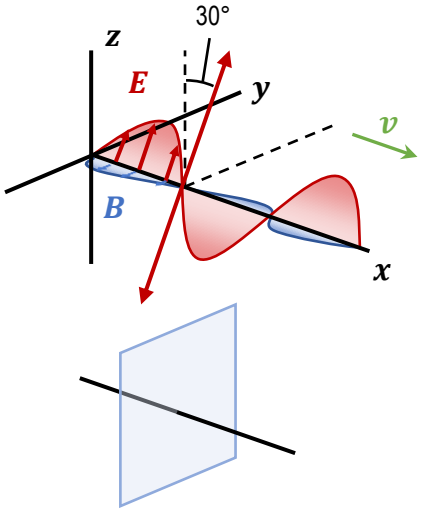
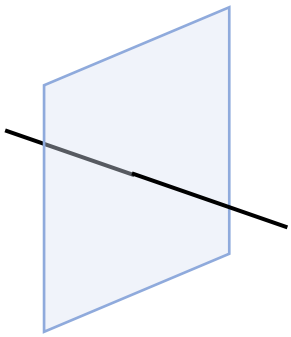
CONCEPT: INTRO TO POLARIZATION

● The **polarization** of an EM wave is ALWAYS the _____ that the _____ oscillates along.

- UNpolarized light = Electric Fields point in many random directions

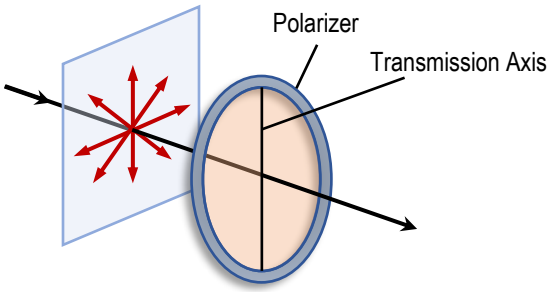
POLARIZED LIGHT		UNPOLARIZED LIGHT
		*(e.g. sunlight, lightbulbs)* 
Polarization: _____	Polarization: _____	
● Indicated with double-arrows along appropriate direction		● Double-arrows in _____ directions

● Polarizers are filters that only allow light components _____ to its transmission axis to pass through.

- When **unpolarized light** (I_0) passes through a polarizer, intensity I decreases by ____ and becomes **polarized**.

I = _____

(One-Half Rule)



EXAMPLE: For the above diagram, if the intensity of the unpolarized light was 100 W/m^2, what is the intensity of the transmitted light?

PROBLEM: Unpolarized light with intensity of 6 W/m^2 is incident on a polarizer**.** If the polarizer's transmission axis is at an angle of 45° above the horizontal, draw a diagram of this system and find the intensity of transmitted light**.**

E.M. WAVES EQUATIONS
$\boldsymbol{I = \frac{1}{2} I_0}$ (if $\boldsymbol{I_0}$ is unpolarized)

CONCEPT: MULTIPLE POLARIZERS AND MALUS'S LAW

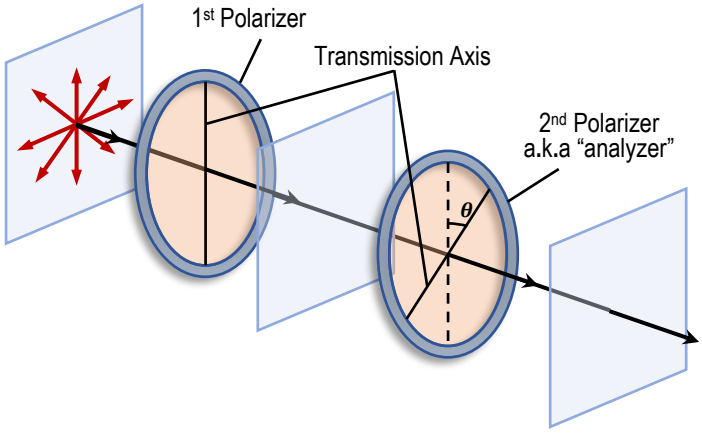
- Remember: **Unpolarized light** becomes **polarized** when it passes through a polarizer & decreases in intensity.
  - If **polarized** light passes through *another* polarizer ("analyzer") oriented at a different _____:
    1) The light is polarized in the direction of the _____.
    2) intensity decreases *again*, based on the _____ angle *between* the 2 polarizers.

$$I = \frac{1}{2} I_0$$

(One-Half Rule, use only when light is **UN**polarized)

$$I = \_\_\_\_\_$$

(Cosine-Squared Rule, use only when light is **polarized**)
"**Malus's Law**"



EXAMPLE: Unpolarized light with an intensity of 100 W/m^2 passes through 2 polarizers. The 1st makes an angle of 30° with the vertical, and the 2nd is oriented along the horizontal axis. What is the intensity of light after passing both polarizers?

POLARIZATION
1) Draw diagram, label initial light as I_0
2) For each "nth" polarizer:
Use $I_n = \frac{1}{2} I_{n-1}$ OR $I_n = I_{n-1} \cos^2 \theta$
3) Solve for Target

PROBLEM: Horizontally polarized light is incident on a polarization filter. Initially, the intensity of the light is 0.55 W/m^2, and 0.40W/m^2 after passing through the filter. Calculate the angle of the transmission axis of the polarization filter, with respect to the horizontal.

POLARIZATION

1) Draw diagram, label initial light as $\boldsymbol{I_0}$

2) For each "**nth**" polarizer**:**

a) Use $\boldsymbol{I_n = \frac{1}{2} I_{n-1}}$ **OR** $\boldsymbol{I_n = I_{n-1} \cos^2 \theta}$

b) If using cos^2 EQ, find θ ***between*** polarizers

3) Solve for Target

PROBLEM: Sunlight is unpolarized light that has an average intensity of 1350 W/m^2 near the Earth's surface.

a) If sunlight passes through two polarizers angled 90° with respect to each other, find the intensity of the light after passing through the second polarizer.

b) A third filter with a transmission axis at an angle of 30° to the horizontal is inserted between the first two. Find the intensity of the sunlight after passing through all three polarizers.

POLARIZATION

1) Draw diagram, label initial light as I_0

2) For each "**nth**" polarizer:

a) Use $I_n = \frac{1}{2} I_{n-1}$ OR $I_n = I_{n-1} \cos^2 \theta$

b) If using cos^2 EQ, find θ ***between*** polarizers

3) Solve for Target