Circular Polarization

Amount of time Demo takes: 3 minutes

Try this in the classroom!

Lesson's Big Ideas

- Through different methods of polarization, you can achieve different effects.
- With circular polarized 3D glasses, you can tilt your head sideways without affecting what you see. Because of how this works, a mirror will reverse the handedness of the light polarized by one of these lenses, allowing it to pass through the opposite lens.
- With linearly polarized lenses, the light that is allowed to pass through is dependant on the tilt of the lens. If you tilt your head, the polarized light that was previously blocked is able to pass through, and the polarized light that was able to pass through before, isn't able to now.

Materials

- Circularly polarized 3D glasses
- Linearly polarized 3D glasses
- LCD watch
- Mirror at face height
- Rubbing alcohol wipes

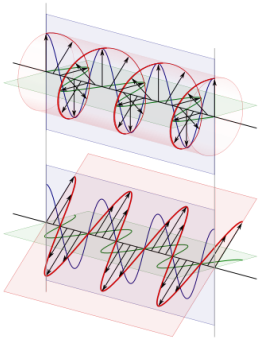
SAFETY!

- Even though polarized glasses are tinted, they are not sunglasses because they do not block UV rays from entering your eye! Do not stare at the sun with these glasses!

Background Information

- Light waves are **electromagnetic waves**. Electromagnetic waves are made up of oscillations of electric and magnetic fields that travel at the speed of light. These waves include radio waves, microwaves, infrared, visible light, ultraviolet, X-rays, and gamma rays.
- Polarization: Orientation of electromagnetic wave. A polarized wave

travels (or propagates) in a restricted direction. The two most common polarizations are **Circular Polarization** and **Linear Polarization**



← Circular Polarization

← Linear Polarization

- **Circular polarization** means that light waves propagate in a corkscrew. The two types of circular polarizations are **right hand polarization** and **left hand polarization**. These waves can be demonstrated via the right hand rule and the left hand rule. With your right thumb pointed to an object, the direction to where your fingers curl is how right hand circular polarization spirals. Using your left thumb pointed at the same object, the direction to where your fingers curl is how left hand circular polarization spirals.
- Circular Polarization can be reversed in its' handedness (like a right hand screw looks like a left hand screw in a mirror, if it was right handed circularly polarized before, it's left handed circular polarization after and vice versa) when it reflects from a mirror. Because of this you can see clear through the opposite lens (you'll see your closed eye), while the same side lens is completely blocking.
- **Linear polarization** means that light waves **propagate on an axis in a sinusoidal wave**. There are two types of linear polarizations: Vertical Polarization and Horizontal Polarization.
- If a horizontal polarized filter is placed in from of a vertical polarized light source, the light will not pass through. This is the same when a vertical polarized filter is placed in front of a horizontal polarized light source.

Set-up Instructions

1. Prop up the mirror so it is at face level.

Instructional Procedure

1. Put on linearly polarized glasses and observe the LCD watch as it is rotated. The numbers/symbols will fade away as certain angles are

reached. Now look in mirror and take turns closing each eye.

2. Put on the circularly polarized glasses. Now look at the LCD watch. Now look in the mirror and take turns closing each eye.

Assessment Questions

1. How will the polarized glasses affect your sight?
   If you are watching a 3D movie that is linearly polarized, turning your head 90 degrees causes the light to not pass through in one eye.
2. How is circular polarization different than linear polarization?
   Circular polarization propagates in a corkscrew while Linear polarized light propagates sinusoidally in one axis.

Careers & Real-World Applications

- RF Engineers are specialized Electrical Engineers that study and work on **R**adio **F**requencies.
- Michigan Tech's Aerospace Enterprise uses antennas to receive circularly polarized signal data for their satellite.

Clean Up

- Wipe off glasses using rubbing alcohol wipes (nose bridge and ear pieces, cleaning lenses as necessary) and place all in bin.

References

- Linear polarization: http://www.youtube.com/watch?v=KM2TkM0hzW8
- Circular polarization: http://www.youtube.com/watch?v=quoySiCVFfw

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