74 Shades

Purpose

To investigate the effects of polarized light

Required Equipment/Supplies

3 small polarizing filters
light source
small plane mirror

Discussion

The vibrations of light waves reaching your eyes are mostly randomly oriented; they vibrate in many planes at once. In polarized light, the light waves vibrate in one plane only. Polarized light can be made by blocking all the waves except those in one plane with polarizing filters. The filters can also be used to detect polarized light.

Procedure

Step 1: Position one polarizing filter between your eyes and a light source. Slowly rotate the filter 360°. Observe the intensity of the light as seen through the filter. Note any intensity changes as you rotate the filter.

1. What happens to the intensity of the light as you rotate the filter?

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_____

_____

Step 2: Arrange one filter in a fixed position in front of the light source. Slowly rotate a second filter held between your eyes and the fixed filter. Note any intensity changes of the light as you rotate the filter 360°.

Rotate second filter.

2. What happens to the intensity of the light as you rotate the filter?

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_____

Activity

Rotate other filter.

Step 3: Hold the filter at your eye in a fixed position while your partner slowly rotates the other filter next to the light source 360°. Note any intensity changes of the light as the filter as rotated.

3. What happens to the intensity of the light as the filter as rotated?

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Rotate both filters.

Step 4: Rotate both of the filters through one complete rotation in the same direction at the same time. Note any intensity changes.

4. What happens to the intensity of the light as you rotate both filters together?

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Rotate both filters in opposite directions.

Step 5: Rotate both of the filters through one complete rotation at the same time, but in opposite directions. Note any intensity changes.

5. What happens to the intensity of the light as you rotate both filters in opposite directions?

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Rotate single filter for light reflected off a mirror.

Step 6: Repeat Step 1, except arrange the light source and a mirror so that you observe only the light coming from the mirror surface. Note any intensity changes of the light as you rotate the filter.

6. What happens to the intensity of the light as you rotate the filter?

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7. Is the light reflected off a mirror polarized?

_____

_____

View sky through filter.

Step 7: View different regions of the sky on a sunny day through a filter. Rotate the filter 360° while viewing each region.

CAUTION: *Do not look at the sun!*

8. What happens to the intensity of the light as you rotate the filter?

9. Is the light of the sky polarized? If so, where is the region of maximum polarization in relation to the position of the sun?

Step 8: View a liquid crystal display (LCD) on a wristwatch or calculator using a filter. Rotate the filter 360°, and note any intensity changes.

View LCD with filter.

10. What happens to intensity of the light as you rotate the filter?

11. Is the light coming from a liquid crystal display polarized?

Analysis

12. Why do polarized lenses make good sunglasses?

13. Explain why the effects seen in Steps 1 to 3 occur.

Going Further

Step 9: Position a pair of filters so that a minimum of light from a light source gets through. Place a third filter between the light source and the pair.

14. Does any light get through?

Step 10: Place the third filter beyond the pair.

15. Does any light get through?

Step 11: This time, sandwich the third filter between the other two filters at a 45° angle.

16. Does any light get through?