Shades – Investigating Polarized Light

Note: My thanks to Paul Robinson, author of the original *Shades* activity in the Conceptual Physics Lab Manual!

**Purpose:** To investigate sources and effects of polarized light.

**Materials:** 2 polarized filters

 Iceland spar calcite crystal

 Clear plastic object

 Plane Mirror

 Plexiglass

 Watch, calculator, or other object with an LCD screen

**Favorite Color:** Blue – no, yel--- AAAAAAAAAGGGGGGGGGGHHHHHHHHHH!

**Lab Report Format:**

The format for this activity’s lab report will be a li ttle different. Instead of reporting your procedure in paragraph form, you will report your procedure in the lefthand column of several tables. In the corresponding righthand column, you will report the corresponding observations.

Read through the procedure below. We will do step 0 together, then answer Analysis Question 0 together.

# Procedure (sample)

1. Find a spot on the floor where you observe the reflection of a ceiling light. View the reflection through a polaroid filter. Rotate the filter 360°. Observe the intensity of the reflected light through the filter. Record your observations in Table 0.

Here’s what I will look for in a lab report:

Table 0

|  |  |
| --- | --- |
| **Procedure** | **Observations** |
| 0. Look at reflected ceiling light on floor thru polaroid filter. Rotate filter 360° | Reflection got lighter & darker as the filter was rotated |

**Analysis Questions (sample)**

1. Is light reflected from our floor polarized? Justify your conclusion.

Yes, it is polarized. The reflected light could be blocked by a polaroid filter rotated to just the right angle. Polaroid filters can only completely block out polarized light. If the light were unpolarized, it would appear equally dim at if the filter were rotated to any angle.

# Procedure

1. Hold one polarizing filter between a light source (ceiling) and your eyes. Rotate the filter 360°. Observe the intensity of the light as seen through the filter. Record your observations in Table 1.
2. Repeat Step 1, adding a second filter. Rotate only the second filter, holding the first stationary. Observe what happens to light intensity. Record your observations in Table 1.
3. Repeat Step 2, except switch which filter you’re rotating and which you’re holding still. Record your observations in Table 1.
4. Place an Iceland spar calcite crystal over a written word. Record what you see in Table 2.
5. Hold one polarizing filter over the crystal. Observe the word as in Step 4 while you rotate the crystal through 360°. Record your observation in Table 2.
6. While rotating one polarizing filter, observe light reflected from a plane mirror. Do this while looking almost straight down at the mirror. Record your observations in Table 3. Now repeat, but observe the mirror at a much more oblique (shallow) angle.
7. While rotating one polarizing filter, observe light reflected from piece of plexiglass. Do this while looking almost straight down at the plexiglass. Record your observations in Table 3. Now repeat, but observe the plexiglass at a much more oblique (shallow) angle.
8. Place a piece of plastic (part of a water bottle) between two polarizing filters. Observe the patterns and colors in the plastic. Apply stress to the plastice by pushing on the side or bending the plastic. Observe what happens to the patterns and colors as stress is applied and released. Record your observations in Table 4.
9. View different regions of the sky on a sunny day through a filter. Rotate the filter 360° while viewing each region. Observe the intensity of the light as you rotate the filter. If it is partly cloudy, be sure to look at both clouds and blue sky. Record your observations in Table 5.
10. View a liquid crystal display (LCD) on a wristwatch or calculator using a filter. Rotate the filter 360°. Record your observations in Table 5.

# Analysis Questions

1. Is light from the ceiling polarized? Justify your conclusion.
2. What happens to the intensity of light viewed through two polarizing filters as one filter rotates? Does it matter which filter rotates? How far must you rotate one filter to go from maximum brightness to minimum?
3. Describe the images viewed through the Iceland spar crystal. Are the images polarized? How do you know? If they are polarized, are they polarized the same as each other? How do you know?
4. Is light reflected from a plane mirror polarized? Does the angle of reflection matter? Explain your answer.
5. Is light reflected from plexiglass polarized? Does the angle of reflection matter? Explain your answer.
6. Describe the appearance of unstressed plastic placed between two polarizing filters. What happened as you applied stress to the plastic?
7. Is light from the sky polarized? If so, where is the region of maximum polarization in the sky, relative to the location of the Sun? Is light from clouds polarized?
8. Is light from an LCD polarized? How can you tell?
9. Why do polarized lenses make better sunglasses compared with cheaper sunglasses that just have dark lenses?