

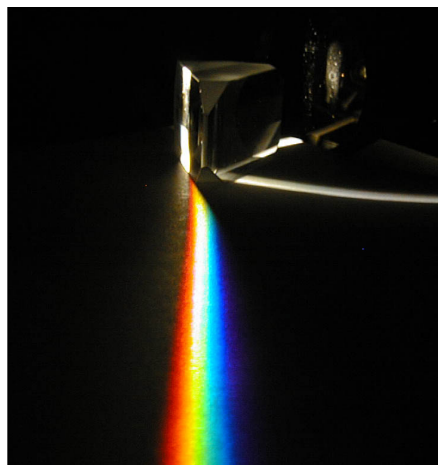
Lab 09: Light and Color

INTRODUCTION

Isaac Newton was the first man to really come close to understanding the nature of color, but he could not convince himself of the wave nature of light. He believed that light was “corpuscular,” or composed of particles. Christiaan Huygens, a contemporary of Newton’s, correctly thought that light was a wave, but could not bring himself to endorse Newton’s ideas on color. Who was right? Turns out they both were. Light has both particle and wave properties. Ironically, Huygen’s waves are better than Newton’s corpuscles for explaining color. We now associate the color of light with its particular wavelength: red light has a long wavelength (about 700nm) and violet light has a much shorter wavelength (about 450 nm).

OBJECTIVES

- Separate white light into its constituent colors
- Observe the results of combining colored light
- Compare the mixing of pigments to the mixing of light
- Demonstrate why an object appears to have a particular color, and how your perception of that color can be changed
- Use photographic negatives to illustrate complementary colors



I'll see you on the dark
side of the moon

ACTIVITY 1: PRISM

Rotate the platform of the prism until you find the separated light beam. Please rotate the platform only—carefully and gently. Leave the prism as positioned.

QUESTIONS

1. Sketch the prism, and show the direction of the incoming light beam, and the direction of the emergent separated beam. Note on your sketch the order in which the separated colors appear.
2. Which color of light is bent most by the prism? Which color is bent least? Why?
3. If you change the angle at which the white light hits the prism, will you change the color that gets bent the most? Explain.

ACTIVITY 2: MIXING PAINT

- Combine the provided red, green, and blue paints two at a time, then mix all three colors together. Use the paint sparingly; you only need to mix a few drops of each. Please don't squeeze out half the bottle. Use a separate dish for each trial, and please rinse them clean when you have finished.

- Dab a bit of each color mixture into your notebook. Label each color swatch with the paints mixed to make it.
- Combine the cyan, magenta, and yellow paints two at a time. Again, please use the paint sparingly. Use a separate dish for each trial, and please rinse them clean when you have finished.
- Dab a bit of each color mixture into your notebook. Label each color swatch with the paints mixed to make it.
- Examine the colored figures in your text with a magnifying glass.

QUESTIONS

4. Make a chart listing the pairs of color combinations and the resulting color when mixing paint. See the example on the following page
5. If you mix all three paint colors together, do you get white? Why not? What colors are used to produce the graphic images in the text? Why doesn't the color cartridge for your inkjet printer contain red, green, and blue ink?
6. If you examine the picture on a regular color TV closely, you will notice that the image is pixellated (you can see the dots without a magnifying glass), and that the image is made of red, green, and blue dots. Why not cyan, magenta, and yellow?



Christiaan Huygens: Not Quite Newton



Why CMY paint? Why not RGB?



Why RGB lights? Why not CMY?

ACTIVITY 3: MIXING LIGHT

- Use the color mixer to combine the three primary colors of light in various combinations. Note the colors of the mixed light and the colors of the shadows also.
- Sketch and label the appearance of the screen when all three lamps are switched on, including the shadows.

QUESTIONS

7. Make a chart listing the pairs of color combinations and the resulting color when mixing light.
8. If red + green + blue light combine to make white, how can you make black? Can you make black by turning lights on?
9. What is the result of mixing red + green light? Does this surprise you? Why?
10. Why do you get different results when mixing RGB paint or RGB light?

COLOR MIX	RED	GREEN	BLUE
R PAINT	Red		
R LIGHT			
G PAINT		Green	
G LIGHT			
B PAINT			Blue
B LIGHT			

Compare mixing pigment (paint) with mixing photons (light)

ACTIVITY 4: DISAPPEARING DOTS

Reverse the screen on the color mixer to show the pattern of colored dots. Pay careful attention to the appearance of both the dots and the background as you adjust the light source. Using one color at a time, observe and record what happens to your perception of color. Note especially if a particular color dot disappears completely, and under which lights. Also note what color the background appears to be under each lighting situation.

LIGHT SOURCE	DOTS				BACKGROUND	
	YELLOW	BLUE	RED	GREEN	WHITE	BLACK
RED						
GREEN						
BLUE						
R+G						
R+B						
B+G						

QUESTIONS

11. Does the blue dot appear blue under all lighting conditions? Why or why not?
12. Explain why a colored dot disappears under one colored light, but not another. Consult your table for at least two specific examples of this.
13. Do any of the dots disappear completely under **more than one lighting condition**? Cite at least two examples from your table, and explain why, in terms of reflection and/or absorption.
14. How do the backgrounds appear to change? Compare the white and black backgrounds as you viewed them under red light, then again under yellow light.

ACTIVITY 5: PHOTOGRAPHIC NEGATIVES

Examine the photographic film negatives provided under white light.

QUESTIONS

15. What color do green leaves appear on a negative? Why?
16. What color would a yellow daffodil appear on a photographic negative? What about a blue recycling bin?



Roses are red, negatives are cyan...