



Experiment P-42 Light and Dark Colors



Objectives

- To learn about light reflected from light and dark objects, and the amount of light they absorb.
- To understand the way we perceive different colors and shades.

Modules and Sensors

- PC + NeuLog application
- USB-200 module 
- NUL-204 Light logger sensor 

Equipment and Accessories

▪ Table lamp
▪ Florescent bulb
▪ Utility stand
▪ Right angle clamp
▪ Extension clamp
▪ White paper
▪ Grey paper
▪ Black paper

- The items above are included in the NeuLog Light kit, LGT-KIT (except for the table lamp and bulb).

Introduction

In order to understand color concepts, it is first necessary to understand light concepts. Visible light waves are seen by the human eye as different colors and they are characterized by their wavelength, which is the distance between any two corresponding points on successive waves. The length of the wave determines the amount of energy it has; the shorter the wavelength, the higher the energy.

Color may also be defined in more subjective terms, as something perceived by an individual. When light is reflected from an object, cones and rods in the retina of the eye respond to the light and the brain interprets the information received as color.

Light can be directly absorbed by an object, reflected at the surface or transmitted through it. The electromagnetic spectrum which is visible to us is in the range of 400-700 nm. When visible light with an energy distribution similar to sunlight (light of all colors) completely reflects from an object, this light appears white to the human eye. When the object completely absorbs all the light, it is recognized as black.

A light colored object reflects one color especially well, but also reflects other colors. Dark objects reflect mostly one color, but the reflected amount of light is relatively small.

In this experiment we will project light on white, grey and black papers. We will measure the reflected light intensity by using a light sensor.

Procedure

Experiment setup

1. Set up the experiment as shown in the picture below.





2. Place a white paper on the table.
3. Attach the extension clamp to the utility stand with the right angle clamp.
4. Attach the light sensor (connected to the USB-200 module) to the extension clamp, 7-10 cm from the white paper. The light sensor's opening should be facing the paper.

The sensor faces the paper because we want to measure diffuse reflection in which the light is scattered in all directions (unlike specular reflection).

5. Put the lamp near the light sensor.
6. Aim the lamp towards the paper. The bulb should be higher than the sensor's opening.

7. Dim the light in the room.

Sensor setup

8. Connect the USB-200 module  to the PC.
9. Check that the light sensor  is connected to the USB-200 module.

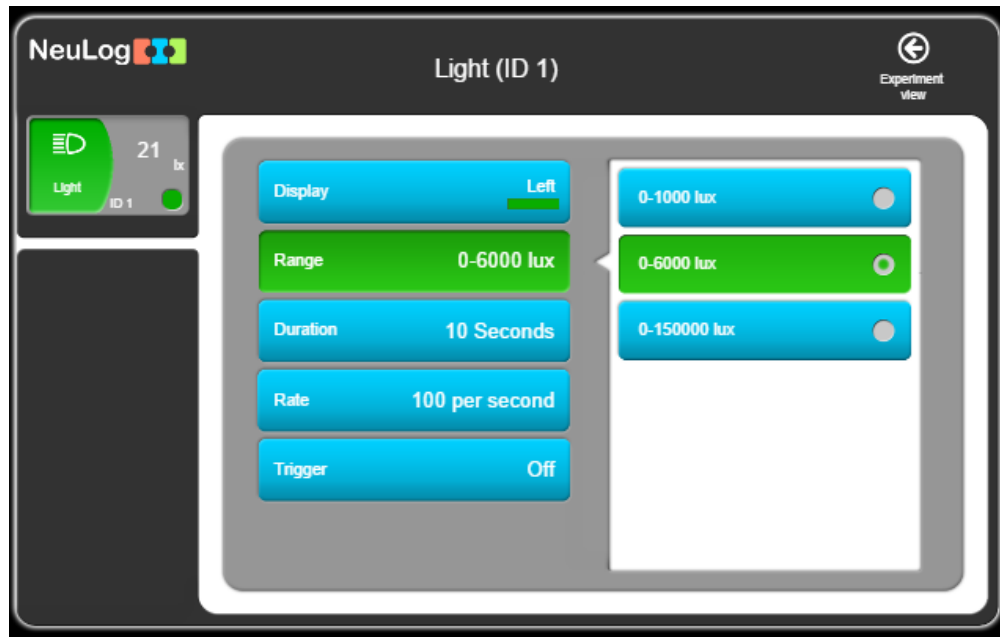
Note:

The following application functions are explained in short. It is recommended to practice the NeuLog application functions (as described in the user manual) beforehand.

10. Run the NeuLog application and check that the light sensor is identified.

Settings

11. Click on the **Sensor's Module** box.
12. Select the "0-6000 lx" button to change the sensor's mode to the 0-6000 lx range.




13. This experiment is done in single step mode so the experiment duration and sample rate will not be set.

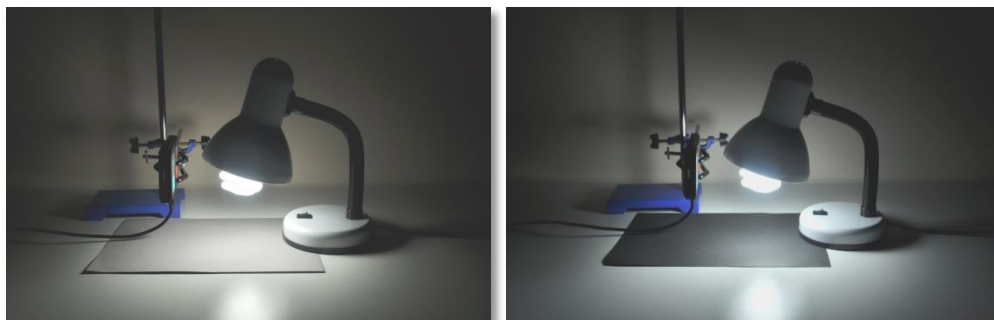
Testing and measurements

14. Make sure that the light intensity level displayed in the module window is lower than 60 lx.
15. Turn on the lamp and wait for the value to stabilize.



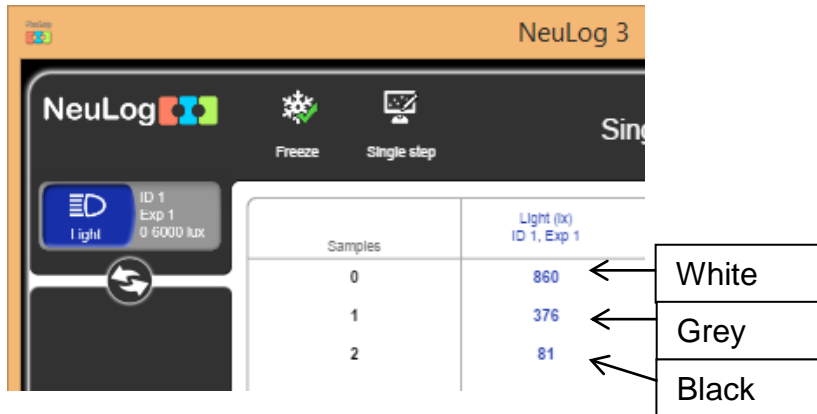
We are measuring light in the 0-6000 lx range because our maximal measured value is close to 1000 lx (you can change to the lower range if the intensity levels you get are lower than 700 lx).


16. Click on the **Single Step** icon .
17. Click on the **Table** icon .
18. Repeat this process with the grey paper and then with the black paper.



Sample	Paper	Light intensity [lx]
1	White	
2	Grey	
3	Black	

19. Your data should be similar to the following:



20. Click on the **Export** icon  and then on the **Save value table (.CSV)** button to save your graph.
21. We can see that the white paper reflects a high amount of light (860 lx), the grey paper reflects less light (376 lx) and the black paper reflects a very small amount of light (81 lx). The fact that the room is not fully dark may affect the results.

Summary questions

1. According to your results, which paper absorbed a greater amount of light? How could you check that?

Hint: absorbed light energy is converted to another form of energy.

2. If we would have used dark blue and light blue papers, what would be the results (compared to the black and white papers)?
3. Are black and white considered colors?

Hint: Think about color as light, as pigments (or dyes), or alternatively as a sensation.

4. Is it possible to perceive the same shade of grey as two different shades? The following illusion might help you (are the two squares marked A and B the same shade?).

