Build a Light Experiment

Guided Project Instructor (Student) Set

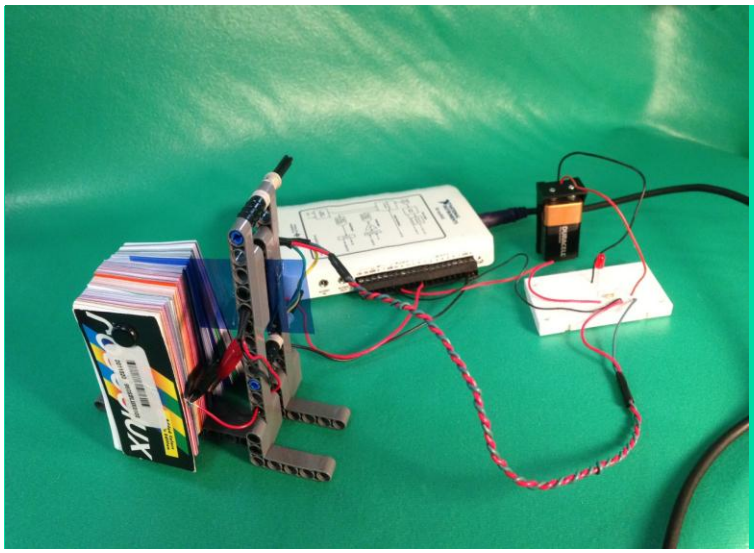

Figure 1 Example completed light transmission experiment

Related Core Concepts:

Lumens

Lights Out!

Learn It!

What's happening when you see color? Materials either absorb or reflect light energy and it is the reflected light that our eyes interpret as different colors. An object that reflects all of the light energy that hits it will be seen as white while an object that absorbs all of that light energy will be black. This concept not only applies to the visible spectrum but infrared and ultraviolet light as well. Light transmission concepts are used in a myriad of applications from gel filters in spotlights to Ultra Violet (UV) protective sunglasses. In this activity, you will build your own optical measurement system to examine how much light energy is transmitted through a material. You will explore the optical properties of different materials and, using different sources of light and an understanding of the material's transmission spectrum, draw conclusions on the materials being observed.

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Build It!

Task 1: Build a bright LED light source controlled via a LabVIEW front panel. Pay attention to Ohm's law and the current limits for the LED you choose. Design and build a physical apparatus to hold the LED and direct its light through a material to a measurement circuit.

Guiding Questions:

- When designing your LED circuit, what is an appropriate current limiting resistor to use? Use Ohm's law and the circuit specifications for the LED you chose.
- For light level control and optical transmission measurements, what LabVIEW front panel elements do you need?

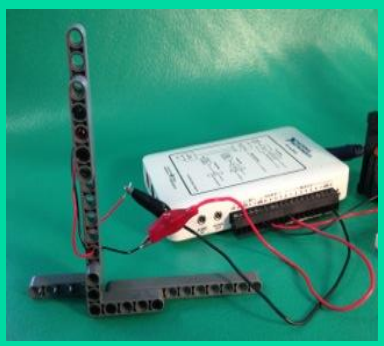

Figure 2 Example built light source with a physical apparatus to hold it

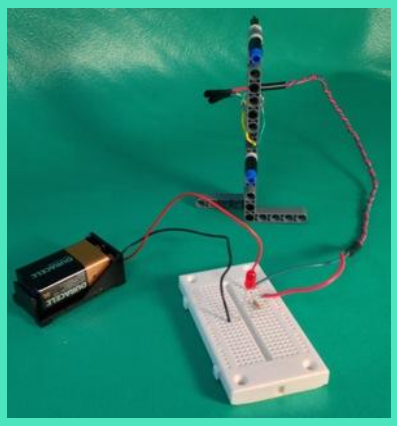

Figure 3 Example built light sensor with a physical apparatus to hold it

Task 2: Create a light level measurement circuit using a photoresistor in a voltage divider circuit. Display the photoresistor measurements on a graph in a LabVIEW front panel. Design and build a physical apparatus to hold the photoresistor and the materials you are testing such that the light from your LED source will be directed at and through a material and strike the surface of your light sensor.

Guiding Questions:

- What are the experimental variables and how will the design of your physical apparatus as well as your LabVIEW code allow you to control these variables for a scientific experiment? For example, how can you control for varying levels of light in the room?
- To meet the needs of your experiment, how will you design your LabVIEW code to collect and display your measurements?

Task 3: Design a controlled experiment to test the optical transmission and/or reflection characteristics of different materials. For simplicity you can use gel filters for your experiment, these have a well defined transmission curve for the visible light spectrum as seen in Figure 4. The curve here shows the percentage of energy transmitted through a Rose Pink colored gel filter across the visible light frequency spectrum

Guiding Questions:

- What optical properties are you testing?
- What is your experimental procedure to obtain data that supports a comparison of these optical properties across several materials?
- How did you control for room light level and/or other confounding variables?

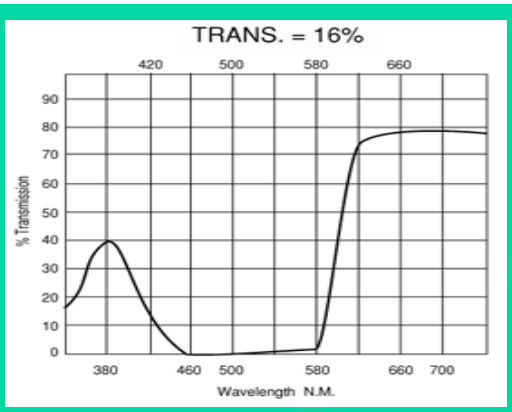

Figure 4 Rose Pink light transmission chart

Expand it!

- Redesign your experiment to allow for swapping out the LED in the light source to a different color or using a tricolor LED and Pulse width modulation to control the color of the light source.
- Explore the light transmission and/or reflection characteristics of Infrared and UV LED light sources. Explore the effects of opaque UV glass on the UV source.
- Redesign the physical apparatus to explore the reflection and/or transmission of polarized light.
- Are there materials for which optical properties depend on temperature?

Guiding Questions:

- When switching your light source, what variables do you need to control? How can you test your measurement circuit to ensure that results are comparable across multiple materials?
- What are the engineering applications for the findings of your experiments?

Research It!

How we see color

http://www.pantone.com/pages/pantone/Pantone.aspx?pg=19357&ca=29

Visible Light

http://missionscience.nasa.gov/ems/09_visiblelight.html