Solar Cells 2: Effects of Light Color on the Solar Cell Output

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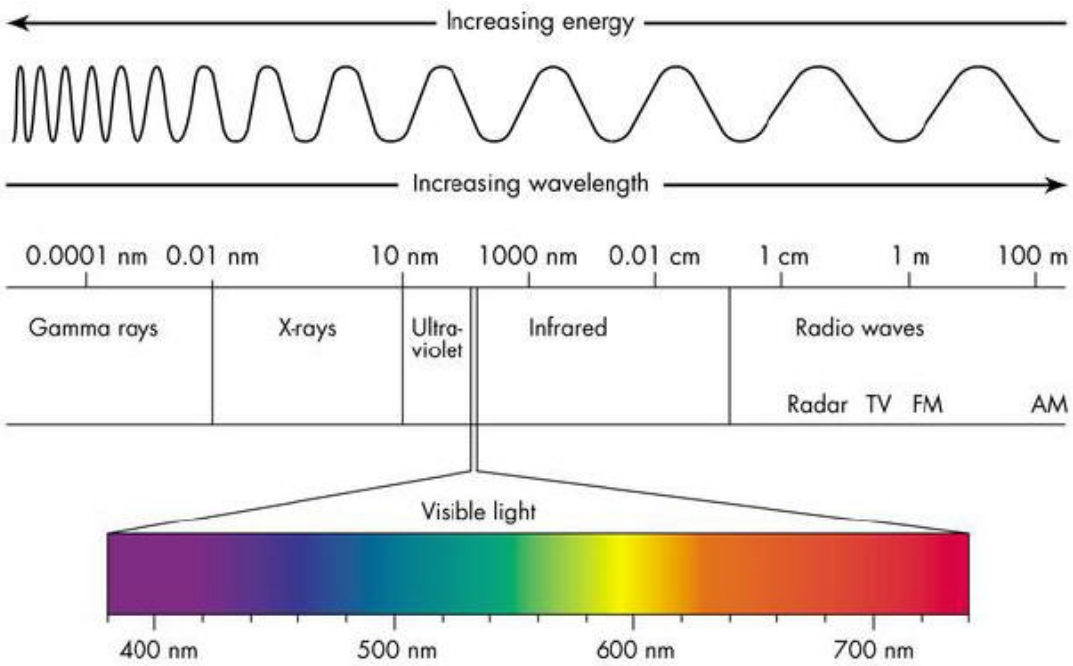
- To investigate the solar cell output current dependence on the wavelength (color) of light.
- To learn about different colors of light in the solar spectrum.

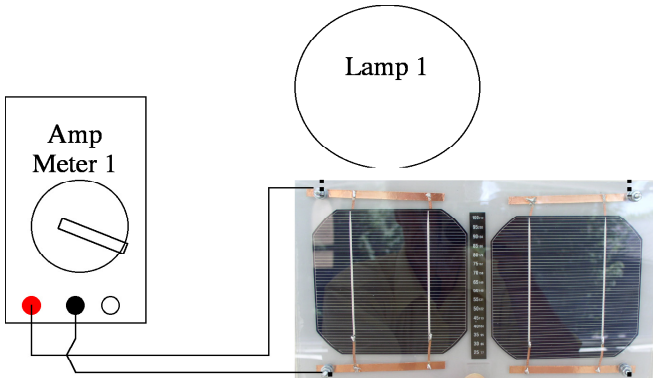
MATERIALS

- PV / solar Cell Module
- Electrical Leads
- DC ammeter
- DC voltmeter
- 2 Lamps
- Light Filters
- 60W Incandescent Bulb
- Compact Fluorescent Bulb (13W Comparable light to 60W Incandescent Bulb)

Background: Light is made up of different colors. The light you can see is called visible light and has colors from purple to red (see below). These different colors of light have different **wavelengths** and also different energies. There is also a lot of light that our eyes can't see! Light that is lower in energy than visible light we call **Infrared** or **IR** light. Your task is to determine what colors of light from a lamp and from sunlight work in a solar cell.



Part I Current and wavelengths ("color") of light



Use only one cell on the solar module in the following exercise. Solar cell response is dependent upon the wavelength of sunlight. You will investigate this property of the solar cell, including light we cannot see (Infrared).

1. Connect one cell and current meter to measure the short circuit current of the cell (as in the previous expercise)

2. Perform these measurements with the desk lamp first having an incandescent bulb and then a compact fluorescent bulb. **Be sure to keep the light source at a constant distance throughout the measurements.** Cover the solar cell with the various color filters provided and record the current. (Note: The black piece of plastic actually blocks visible light and passes Infrared (IR). The clear IR block sheet passes visible light but blocks **some** of the IR. There is a graph on the last page that shows the transmittance curves for the light filters.

Color of Filter	Wavelength being Transmitted
Yellow (Blocks Blue Light)	> 500nm
Fire Red (Blocks Blue and some green)	>550nm (color Filter # 15)
Red (Blocks blue and green)	> 630nm (color Filter # 27)
Black Plastic (Passes Infrared Blocks all visible)	> 780nm
Clear Filter (Blocks Infrared Passes Visible	< 800nm

3. Calculate the % of current coming from the various wavelengths of light:
% Current Output = (Filter Current/No Filter Current) x 100

Table 1. Effect of Color (Wavelength) on Cell Current using a Desk Lamp

Color of Filter	Current (A) Incandescent	Incandescent % Current Output	Current (A) Fluorescent	Fluorescent % Current Output
No filter		100%		100%
Yellow				
Fire Red				
Red				
Black Plastic (IR Pass)				
Clear (Block IR)				
Black Plastic + Clear.				

(With the Black Plastic and Clear plastic we would hope the current would go to zero. It does not go to zero because the clear plastic is not blocking all of the Infrared part of the spectrum.) Discuss your results and include answers to the following questions.

Things to think about: What part of the light spectrum has produced the most current from the solar Cell, Visible or Infrared (IR)? (You can observe the table data or a suggested analysis would be to graph % Current Output vs. Wavelengths for the Yellow, Fire Red, Red, and Visible Blocking filters.)

Why is the current output less for the Compact Fluorescent bulb?

Why are Compact Fluorescent bulbs replacing Incandescent bulbs in businesses and households?

4. Repeat the experiment with sunlight and see what you find.

Table 2. Effect of Color (Wavelength) on Cell Current using sunlight

Color of Filter	Current (A) Sunlight	Sunlight % Current Output
No filter		100%
Yellow		
Fire Red		
Red		
Black Plastic (IR Pass)		
Clear (Block IR)		
Black Plastic + Clear.		

Discuss your results below. What part of the solar spectrum seems to have the ***greatest*** effect on the solar cell, Visible or IR? How does the sun output ***compare*** with the light bulbs?

Light being absorbed by "filters" used in your study: