614-0650 (50-100) LED Array

Introduction: Light is a portion of the electromagnetic spectrum. The wavelengths we can see are called *visible light*. However, the electromagnetic spectrum is much larger than what we can see. It ranges from radio waves, which everybody is familiar with, to high energy gamma rays. The wavelength for radio waves can theoretically be as long as the universe itself. Some very high intensity gamma rays have wavelengths that are a fraction of the size of an atom, limited by Planck's constant.

While purely speculative, it is possible that creatures on distant worlds would develop eyes that could see wavelengths different from our own. On a world orbiting a red dwarf, visible light would not be nearly as abundant as infrared. The life forms there might use infrared to see instead of light. Even earthly creatures are known to use other wavelengths; bees can see by ultraviolet, giving them access to colors beyond our imaginations.

White light, while seemingly simple, is actually a very complex phenomenon. It is relatively uncommon in nature; our own sun is yellow, for example. Sunlight appears white to our eyes due to a fascinating twist: although the sun itself is yellow, it is able to produce a full spectrum. This means that instead of radiating just yellow light, as one might expect, it instead is able to produce all the colors of visible light, plus infrared and ultraviolet wavelengths. What we call visible light is only a narrow portion of the electromagnetic spectrum. In general, humans are able to see wavelengths between 400 and 700 nanometers. Some people have a slightly larger range, but this should be treated as the exception, rather than the rule.

Breaking white light into a spectrum is relatively easy using a prism or diffraction grating. However, unless these instruments are very large, it will be difficult for all your students to see the effects. With both of these, you must often make a choice between having a detailed spectrum spanning only a few degrees, or a larger projection that is not as detailed. Some prisms, notably those made out of fused quartz, produce a very detailed, very easy to see spectrum. Unfortunately, these prisms are often prohibitively expensive.

Instead, you can use our economical LED Array to show all of your students a full spectrum simultaneously. Our 11 LED setup shows a range of 400 to 640 nanometers, with one brilliant white LED included as a reference. The colors range from deep red to violet.

Operation: The LED Array is immensely simple to operate. First, plug in the included AC adaptor and connect it to the unit. The adaptor outputs 5V DC, so there is no risk of electric shock.

Flip the red button on top of the unit to activate it. All the LEDs will illuminate simultaneously. You should now see the spectrum, ranging from dark red to violet.

Experiments:

Next to each LED is printed the color and the wavelength. Using the wavelengths, you can extrapolate any conceivable color. For example, 630nm light lies between deep red and red, allowing you to estimate what it would look like. 350nm light is beyond violet, and thus ultraviolet and invisible.

1. The first experiment requires color filters. You should use as many as possible. They can be blue, green, red, yellow, or whatever you may happen to have. As an example, consider a red color filter. When you look at the LED array, the red LEDs will appear brighter than the rest. Why is this? Red color filters allow reed light to pass through, but block other wavelengths. This means that other colors have greater difficulty shining through. However, no color filter is perfect. A red filter will still allow some greens and yellows and even a small amount of blue to pass through.

If you double up on the same color filter, you will notice it becomes more effective at blocking other colors.

2. For the next demonstration, you should use a piece of diffraction grating. More lines per inch will give you a better experiment. For this demonstration, hold the diffraction grating up to the LED array and observe it. You will notice that an image of the LED array will appear to the right and left of the unit. However, instead of LEDs, you will see lines of light. Some of these are longer than others. Why is this?
    a. The diffraction grating breaks up the light from each LED into a full spectrum. With the white LED, this produces a long line of light, and if you look closely, you can see a spectrum in it. The red and blue LEDs produce very short lines. Yellows and greens are in the midrange.

Many LEDs tend to be *monochromatic*, or having only one color. This is especially true of red and blue LEDs. In fact, some of the first red LEDs developed could only produce one wavelength of light! White LEDs were believed to be impossible until recent breakthroughs. Scientists coated blue LED chips in a phosphor rich material. When the blue light strikes the coating, it causes it to fluoresce and emit yellow light. Blue and yellow light combined appears white to our eyes.

Warranty and Parts:
We replace all defective or missing parts free of charge. Additional replacement parts may be ordered toll-free. We accept MasterCard, Visa, checks and School P.O.s. All products warranted to be free from defect for 90 days. Does not apply to accident, misuse or normal wear and tear. Intended for children 13 years of age and up. This item is not a toy. It may contain small parts that can be choking hazards. Adult supervision is required.