

1139901 - Science First Instructions for Color Mixer

Parts List:

057186	Color Mixer, including three screens
24-50105	Instructions



Introduction: 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.

Colour science is notoriously difficult to teach. Many students are skeptical when told that white light is actually made up of all the colors. How can something as pure as the color white be a blend of so many disparate colors, such as red, green, and blue?

As an educator, you can use prisms to break up white light into a spectrum. You can use ray boxes to mix different colors and show your students the results. However, these steps may not convince some of your students. For that, you need a color mixer.

Your color mixer will enable you to produce red, green, and blue light in precise ratios to one another. This in turn will allow you to produce a vast range of colors, all with the twist of a knob.

Operation: To use your color mixer, you will first need to plug it in. The AC adaptor included with your unit outputs 5V DC, which means there is no risk of electric shock. The cord plugs into a socket on the left side of the control box.

Your color uses six LEDs, although only three can be illuminated at any time. LEDs can burn continuously for years, draw almost no power, and are very bright. Each of the LEDs is equipped with an acrylic lens to better focus the light. You will never need to replace these LEDs.

To illuminate one of the LED sets, first select which one you would like to use. The inner LEDs are best for close up, more precise mixing, while the outer ones are better for general effects or longer range. On the control box in back of the unit is a three way switch. The center position shuts both sets of LEDs off. Moving it to the right will illuminate the outer set, while the left-hand position will activate the inner set.

Above the switch you will notice three knobs, and a small LCD screen. When you turn on the unit, this screen will display; "BLUE RED GREEN" and the current percentage of saturation for each color. These percentages can be adjusted using the knobs. For example, if you wanted to show only green light, you would turn the green up to 100% and the red and blue down to 0%. For a teal effect, you might put blue at 80% and green at 60%.

Experiments:

Once you have mastered the color mixer itself, it's time to use the screens.

1. One of the screens is made of frosted acrylic, which is translucent and helps spread the light. If you place this screen in front of the class and the color mixer behind it, your students will clearly be able to see the effects while you can manipulate the unit. This means that you will never block your student's sight lines.

To use this screen, place it in front of the color mixer with all the LEDs off. Ask your students what color it is. They will probably say whitish. Turn the blue LED up to 100% and ask the same question. They will now say the screen is blue. Turn off the blue LED and do the same thing for the red and green. Try to lead your students towards the conclusion that the color of a white object depends on what color light is falling on it.

Try adjusting the intensity of all three colors until your students agree that the screen looks white. Remind them that the screen appears white with all the LEDs off. This will reinforce the lesson that all the colors combine to produce white.

2. The second screen is black acrylic with a circular hole cut in the center. Place this screen between the translucent screen and the color mixer. Since the black material blocks all the light except for the circular hole, each color appears as a circle. Adjusting the distance between the black screen and the color mixer will determine how much the circles overlap. In effect, you are generating a red, blue, and green circle of light. When they overlap, they produce other colors, such as yellow between the green and red. The center where all the colors meet will appear white.
3. The third screen is clear with a blacked out center. It functions exactly the same as the second screen, with one notable difference. When the three colors are mixed, they produce black. This is important to note for one reason: when pigments are mixed, they always produce black, never white. Why is this? Pigments work by absorbing most colors and reflecting a specific color. For example, cyan ink combined with yellow ink cancels out blues, making the ink appear green. If all the primary colors of ink are mixed, they will absorb all the colors, making the final result black.

There is another interesting effect with this screen. The black circle can be thought of as casting a 'shadow' on the translucent screen. However, this shadow depends on the light being blocked. In the center, all the colors are blocked, leaving a black area. You will see red, green, and blue shadows, and they will combine to form yellow, magenta, and cyan shadows as well. For example, the magenta shadow is produced because all the green light is blocked by the circle in that area. This leaves only the blue and red light to interact, producing magenta.

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. **Designed and prototyped in the U.S.A.** Made in China.