

Rainbow Shadows

Overview: Imagine you're a painter. What three colors do you need to make up any color in the universe? (You should be thinking: red, yellow, and blue... and yes, you are right if you're thinking that the real primary colors are cyan, magenta, and yellow, but some folks still prefer to think of the primary colors as red-yellow-blue... either way, it's really not important to this experiment which primary set you choose.)

Here's a trick question – can you make the color “yellow” with only red, green, and blue as your color palette? If you're a scientist, it's not a problem. But if you're an artist, you're in trouble already. The key is mixing light, not paint.

What to Learn: The three primary colors of light are red, blue, and green. Red and green light mixed together make yellow light. Sunlight can be blocked to make shadows.

Materials

- flashlights (3)
- fingernail polish (red, green, and blue)
- clear tape (NOT translucent)
- a white wall (or another large white surface)

Experiment

1. Make your room as *dark* as possible for this experiment to work.
2. Cover each flashlight lens completely with the clear tape. Be sure to get the edges and around the rim.
3. Paint one flashlight's tape layer red, one blue, and one green. Make sure there are no unpainted spots.
4. Allow the nail polish to dry.
5. Turn off all the lights.
6. Shine the flashlights together onto a white wall. What color is the wall? Record it on your chart
7. Now turn off the red flashlight. What color do you see now? Record your observation.
8. Place your hand, a pencil, or another object in front of the flashlight. Wave it around a bit. What color shadows do you see on the wall?
9. Experiment with the different color combinations while filling out the chart with your observations.

Rainbow Shadows Data Table

Lens #1 Color	Lens #2 Color	Shadow Color

Reading

Mixing the three primary colors of light gives white light. If you took three light bulbs (red, green, and blue) and shined them on the ceiling, you'd see white. And if you could magically un-mix the white colors, you'd get the rainbow (which is exactly what prisms do).

If you're thinking yellow should be a primary color – it *is* a primary color, but only in the artist's world. Yellow paint is a primary color for painters, but yellow light is actually made from red and green light. (Easy way to remember this: think of Christmas colors – red and green merge to make the yellow star on top of the tree.)

Troubleshooting: This experiment has a few things to be aware of. If you're not getting the colored shadows, check to be sure that the flashlight is bright enough to illuminate a wall in the dark. Be sure to shut the doors, shades, windows, and drapes. In the dark, when you shine your red flashlight on the wall, the wall should glow red. Beware of using off-color nail polish – make sure it's really red, not hot pink. Alternately, you could use brightly-colored cellophane.

If you still need help making this experiment work, you can visit your local hardware store and find three flood lamp holders (the cheap clamp-style ones made from aluminum work well – you'll need three) and screw in colored "party lights" (make one red, one green, and one blue), which are colored incandescent bulbs. These will provide a lot more light! You can also add a fourth yellow light to further illustrate how yellow light isn't a primary color. Try using only red, yellow, and blue... you'll quickly find that you can't obtain all the colors as you could with the original red-green-blue lights.

Exercises

1. What are the three primary colors of light?
2. What color do you get when mixing the primary colors of light?
3. How do you mix the primary colors of light to get yellow?
4. Use crayons or colored pencils to draw what you saw when all three lights were shining on the wall and you waved your hand in front of the light.

Answers to Exercises: Rainbow Shadows

1. What are the three primary colors of light? (red, blue, and green)
2. What color do you get when mixing the primary colors of light? (white)
3. How do you mix the primary colors of light to get yellow? (green and red light make yellow light)
4. Use crayons or colored pencils to draw what you saw when all three lights were shining on the wall and you waved your hand in front of the light.