COLOR WITH M&M’S

Color is everywhere. Just this morning, you had to choose what color shirt or shoes you were going to wear. So what gives an object its color? Why are some things red and others blue?

COLOR STARTS WITH LIGHT

To understand why objects have color, we need to understand where light gets its color.

Light is a special kind of wave, called an electro-magnetic wave, and so it has a wavelength. Take a look at *Figure 1*. The blue light has a shorter wavelength than the red light. Wavelength is what gives light its color.

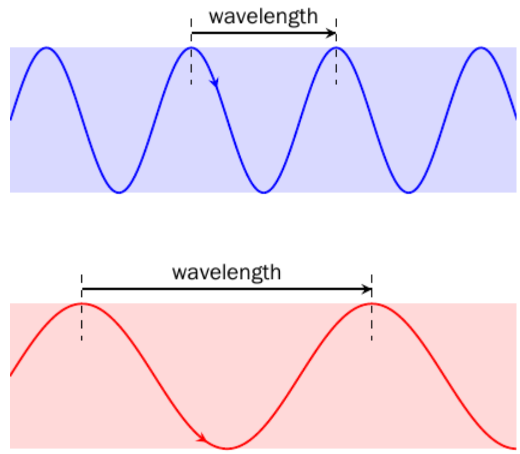

Figure 1: Blue and red light have different wavelengths, and wavelength gives light color

REFLECTION

So what gives an object its color? The simple answer: light!

Without light, an object has no color. This is because without light, we can’t see the object! When you look at a red object, what you’re actually seeing is red light bouncing off the object and into your eye. The bouncing of light off an object is called reflection.

WHITE LIGHT

When you see a red ball, however, there’s no red light shining on it, is there? Instead, there’s only the “clear” light coming from the sun or the light in your room. This “colorless” light is called white light.

But white light isn’t colorless at all! Itis a mixture of colors! White

BIG IDEAS

- Demonstrate how color is due to reflection and absorption of light by sorting M&M’s under colored lights.

WHAT YOU’LL NEED

- Light BLOX: Red, Green, Blue
- 1 White LED
- A packet of M&M’s

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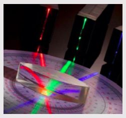
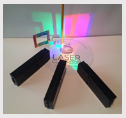


Light Blox



Elementary Light, Color & Shadow Kit

Tech Light Lab

light from the sun is actually all the colors of the rainbow! Many white lights that are made by people, like the lights in your tv, are made ofthe three primary colors of light: red, blue and green. This is why you can see all the colors of the rainbow under sunlight - all the colors are in the white light, ready to be reflected! So the red ball is red because it strongly reflects red light, but there's another effect that's happening called absorption.

ABSORPTION

Let's think more about the red ball. Say we take a look at it under sunlight, like in *Figure 2*. We now know that it looks red because the red wavelength in the white light is reflecting off the ball and into our eye.

But wait - we said white light is made up of all the colors of the rainbow. So what happened to the rest of the light? Where did the blue light go, for example?

The other colors that weren't reflected off the ball were trapped inside the ball by a process called. absorption. This is why it couldn't be reflected back for us to see. A black object, for example, absorbs all the light you shine on it, and reflects nothing back - this is why black is not scientifically considered to be a color! White objects reflect all the colors, and absorb none.

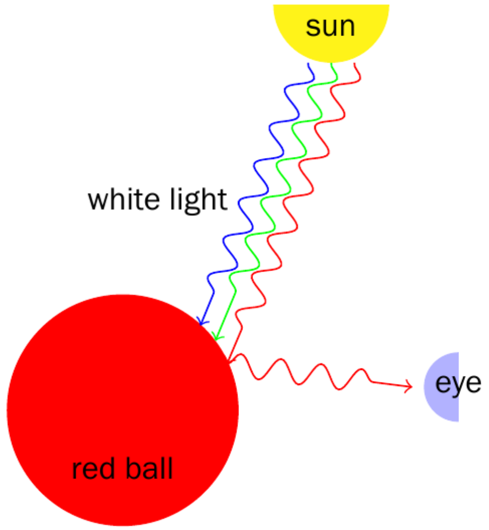


Figure 2: How objects have color

COLORS IN REAL LIFE: COLORIMETRY

Scientists can use a device called a colorimeter to find out what a liquid mixture is made of. Different substances absorb certain wavelengths, or colors, of light. If scientists know what ingredients are mixed together, they can figure out how much of each ingredient there is in the mixture by shining light at it.

The colorimeter measures how much of a specific wavelength of light is absorbed by the mixture. Each substance has its own distinct pattern of absorption. And so by measuring the absorption of many different wavelengths, it is possible to work out how much of a specific substance is in the mixture. (comment: I am having trouble using commenting in this box, but I wanted to say this just seems very abstract. Making it more concrete, with a specific example, would probably help younger students out a lot).

ACTIVITY SHEET: COLOR WITH M&M'S

We're now going to see just how much light affects our ability to see color by sorting M&Ms under colored light!

1. Mix up the M&Ms, and place them in the centre box of the worksheet.
2. Switch off the overhead light and darken the room as much as you can.
3. Switch on the white LED and hold it over the unsorted M&M's. Sort them into each of their labelled color boxes.
4. Switch off the LED and turn on the overhead light again.

Were the M&M's in the correct boxes? Why/Why not?

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Under the white light, all the M&M's should be sorted easily and correctly. This is because the white light contains all the colors of light needed to see each of the M&M's.

Place the M&M's in the unsorted box again and repeat the experiment using the red LED Were the M&M's in the correct boxes when sorted under the red light? Why/Why not?

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You probably found that some of the colors were in completely the wrong boxes! Others looked exactly like each other, but when you saw them under the white light again, they were completely different.

Repeat the experiment again using the green and then the blue LED, respectively. (This order is recommended, since the results just get crazier!)

Were the M&Ms in the correct boxes when sorted under the green or blue lights? What does this tell us about how color works?

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Under the colored lights, the M&M's were probably more difficult to sort. Like with the red light, a group of colors could all look exactly the same. Sometimes an M&M could look definitively like one color under a certain color light, but when the white light is switched on, it's another color entirely! This is because the wavelength of light making up the main part of the M&M's color wasn't present, so it could not be reflected, and you could not see it.

ACTIVITY SHEET: COLOR WITH M&M'S

RED

YELLOW

BROWN

UNSORTED

BLUE

ORANGE

GREEN