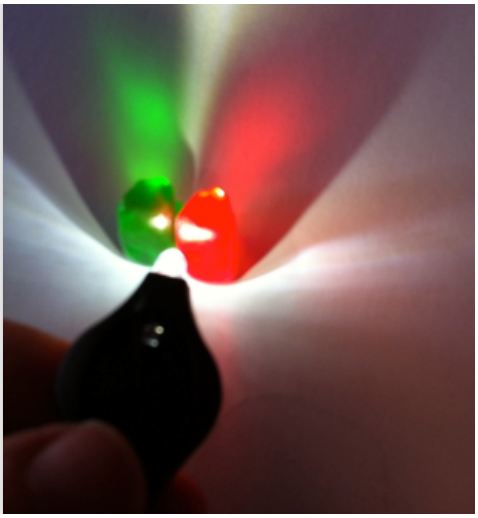
LASER CLASSROOM

Bringing STEM to light®



MATERIALS

(EACH GROUP OF 3-5)

- 1 Green Laser Blox
- 1 Red Laser Blox
- 1 White LED
- 1 Each: clear, red, green Gummy Bears
- 1 sheet of plain white paper
- 1 sheet of waxed paper
- 1 transparency or clear plastic baggie

TIME: 30-45 MIN.
GRADES: 7-12

GUMMY BEARS & LASERS

OVERVIEW

Gummy Bears, it turns out, are great for demonstrating the otherwise abstract concepts that describe the most basic of light-matter interactions: Absorption, Transmittance and Reflection.

BACKGROUND

A common misconception among students, is that color is a property of matter. This underlying misconception leads to all manner of confusion – like the idea that when white light passes through a green object to cast a green glow on the paper, the object is adding color to the otherwise clear, "natural" light. No matter how many times you say it…is difficult for students to grasp the idea that when they see an object as red, what's really happening is that most of the wavelengths that make up white light are being absorbed by the object and only the wavelength we know as red is being reflected. What they "see" is the red light transmitted to their eyes.

When LASER light, which is monochromatic (composed of a single color or wavelength) hits something, it is absorbed, converting light energy into heat, it is reflected, or it is transmitted. But most of the light students are familiar with is white light, composed of many colors, or wavelengths. When white light hits an object, the object selectively absorbs, reflects or transmits certain wavelengths. The way that light interacts with an object depends on the wavelength(s) of light and the nature of the atoms in the object.

A material will absorb frequencies of light that match the frequency at which electrons in the atoms that make up a material vibrate. Because different materials are made up of atoms whose electrons vibrate at different frequencies, different materials absorb different frequencies of light. This breaks up the notion that the reason light passes through a material or not because of its "thickness".

Light that a material does not absorb is either reflected, or transmitted.

The way in which we see color is due in large part to the way light interacts with matter. So the color was never in the object…only in the light that shines upon it and ultimately is reflected to our eyes.

The following hands on demo will give students an intuitive feel for this phenomenon and break through their misconceptions about light and color.

DEMONSTRATION

1. Shine the white LED towards the students and remind them that white light is composed of many ("all") wavelengths or frequencies of light. Explain that the LED is a light source – and that they can see directly the light that is emitted by the LED.
2. Ask… what happens when white light interacts with "something"?
3. Facing students, shine the LED at the white paper and ask – what's happening to the light?
4. Repeat with the waxed paper and the plastic baggie.

DISCUSSION TERMS

Transmittance is the fraction of incident light at a specified wavelength that passes through something (like a gummy bear). Mathematically, transmittance is the ratio of the intensity of the light that passe through a sample to the intensity of the light when it entered the sample or T = I out / I in

Reflection is the change in direction of a wavefront at an interface between two different media so that the wavefront returns into the medium from which it originated.

Absorbance is the measure of the quantity of light that a sample neither transmits nor reflects.

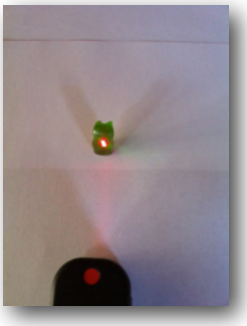
ACTIVITY SETUP

Divide Students in to groups and give each:

- a data sheet
- a red and a green Laser Blox
- a red, green and clear gummy bear

ACTIVITY

1. Remind students of LASER Safety rules
2. Tell students they will record their observations of how various light sources interact with different materials – 3 different colors of gummy bears.
3. Instruct students to shine the light from each light source at each color gummy bear and record their observation. They should specifically look for how and whether light is transmitted, reflected and absorbed by the different gummies.
4. When all groups have collected data from all three stations, instruct them to review their observations and their data and come up with one or more conclusions about how light behaves. Have them write their conclusion(s) on their data sheet.




DISCUSSION

1. Ask students to share their observations
   -Did all light sources behave the same?
   -When did you observe absorption, transmission and reflection?
   -Why did the green light not pass through the red gummy bear? And why did the red laser light not pass through the green gummy bear?
   -Why did the white light become red when it passed through the red gummy bear and become green when it passed through the green gummy bear?
2. Students may suggest that the gummy bear "colors" the white light, like you might color on a piece of white paper. Remind students that white light is made up of all the visible wavelengths of light. Help them make the connection that the red gummy bear actually allows only the red wavelengths of light to be transmitted or reflected—all the other wavelengths (colors) are absorbed (and we can not see light that is absorbed). As a result, the only light that passes through the bear is red. (Students may realize that is also why the red gummy bear looks red: when white light bounces off it, only red wavelengths are allowed to reach our eye; the others are absorbed.) The same is true for the green gummy bear – but with green instead of red.
3. Students discover that the beam from the red LASER Blox passes throught hte red gummy bear, but not the green one! remind them that the green gummy bear lets only green light through - it absorbs other wavelengths, so no red light is transmitted through the green gummy bear.
4. Optional - show the video that inspired this activity. http://www.youtube.com/watch?v=DThUKDM_Wtk

GUMMY BEARS & LASERS ACTIVITY SHEET

GUMMY COLOR	LIGHT COLOR	OBSERVATION