Name:_____ Date:_____ Period:_____

Visible Light and Color

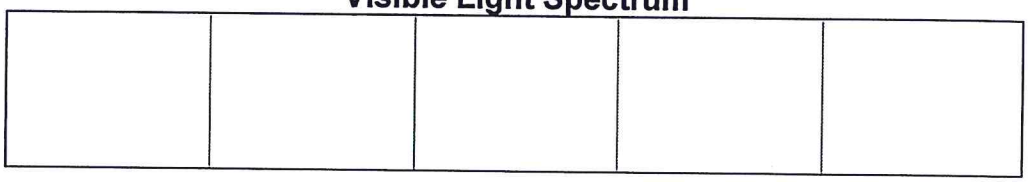
Visible Light

Visible light is the smallest portion of the electromagnetic spectrum, but it is the part we are most familiar with because it is the only part we can see! Visible light ranges in wavelength from 780 nanometers (nm) to 400 nm, or you can think about the largest wavelengths as about the size of a bacterium. The wavelength of visible light determines the color of the light, with red light having the longest wavelength and violet light having the smallest wavelength.

Fill in the visible light spectrum below with the appropriate colors (use colored pencils, make the spectrum gradational - blend from one color into the other) according to the chart on the left:

Visible Light	
Color	**Wavelength**
Red	780-620 nm
Orange	620-597 nm
Yellow	597-577 nm
Green	577-492 nm
Blue	492-455 nm
Indigo	455-435 nm
Violet	435-390 nm

Visible Light Spectrum

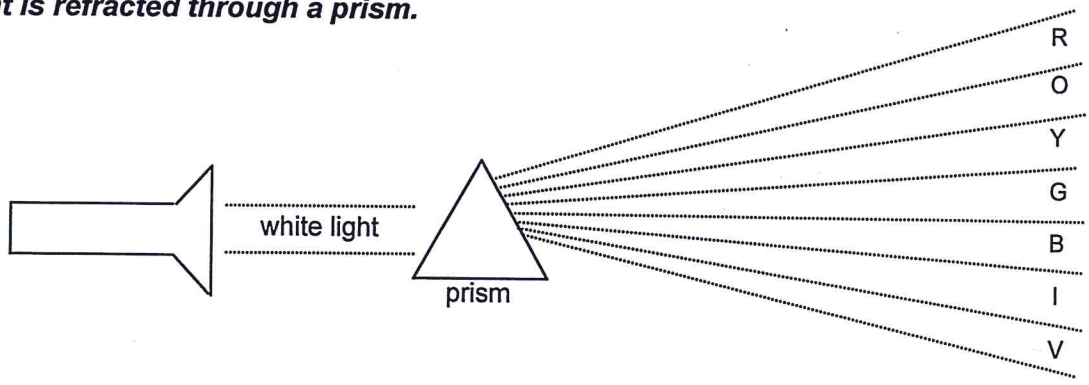


Units are in nanometers (nm). One nanometer is equivalent to 0.000000001 m.

300 400 500 600 700 800

White light is made up of all the ROY G. BIV colors. If you take white light and refract it through a prism, you see all of the colors of the visible light spectrum, just like what happens when water droplets refract visible light in the atmosphere to produce rainbows!

Fill in the drawing below (using colored pencils) to show the colors produced when white light from the flashlight is refracted through a prism.



Color

What determines color? Color is determined by both the type of atoms that something is made of and the type of visible light that is shining on something.

The frequency of the light hitting matter and the natural vibrations of the atoms in that matter help determine color. All matter is made of atoms, and these atoms have a natural vibration or frequency to them. When white light (all the ROY G. BIV colors) hits matter, it is hitting these vibrating atoms. If the frequency of any of the visible light colors hitting the matter is the same as the frequency of the atoms in the matter, then that particular color gets absorbed (or sucked in...just like a sponge soaks up water). When this happens, that particular color of light will never leave the matter, and it transfers its energy to the atoms with the same frequency. However, if the color of visible light has a different frequency than the atoms in the matter then that color gets reflected or bounces back off the surface of the matter. The visible light that bounces off the matter creates the colors that our eyes see. Here is an example using white light shining on a red rose. If the atoms in the petals of a *red* rose are naturally vibrating at a range of frequencies that correspond to wavelengths of 620-390 nm (OYGBIV), the petals will absorb all of the colors that fall into that range. Colors with different frequencies (only red is left in this case) of the atoms in the rose petals are not

absorbed and get reflected. So, the *red* rose petals absorb orange, yellow, green, blue, indigo, and violet. The *red* rose petals reflect red, so we see the color as RED!

Show the colors that will be absorbed and reflected by the squares. Represent the absorbed light by drawing colored arrows pointed toward the boxes and represent the reflected light by drawing colored arrows pointed away from each box. Each square has white light (ROYGBIV) shining on it. (Use colored pencils.)

ROYGBIV	ROYGBIV	ROYGBIV	ROYGBIV	ROYGBIV
White		Blue	Red	Green

With color, matter that is transparent (or see through) to visible light acts in a similar way to matter that is opaque (not see through) to visible light. Glass is transparent to visible light. If you have a piece of colored glass, it has pigments/dyes (molecules of atoms) in it that absorb certain wavelengths/frequencies of color. Whichever colors are allowed to pass through are the ones that color the glass.

Questions: (use complete sentences!)
What colors are transmitted (allowed to go through) through clear glass? Which colors are absorbed?

What colors are transmitted through red glass? Which colors are absorbed?

But not all light is the same! Natural light has all the different colors of the visible spectrum, but artificial light does not always contain all colors of the visible light (ROYGBIV) spectrum and they tend to emit light from one end of the visible light spectrum. Fluorescent lights (like the lights in our classroom) tend to emit light toward the blue/violet end of the spectrum whereas most light bulbs found in our homes (incandescent light) tend to emit light toward the red/orange end of the spectrum. Some lights are simply missing portions of the visible light spectrum. All of these factors have an effect on the colors our eyes see! Most of us have seen how different colors, such as on clothes, makeup, or fabric, can look in different types of light.

Color is a complex thing! There is a lot more information about color. If you would like to know more about it, such as how the cone cells in our eyes actually see color, or about color subtraction, see me or visit http://physicsclassroom.com/Class/light/lighttoc.html.

Questions: Use the entire text to answer these questions on YOUR OWN SHEET OF PAPER. Use COMPLETE SENTENCES answering ALL PARTS OF THE QUESTIONS.

1. Based on the range of wavelengths for the visible light colors, are all colors the same? (hint: is the blue at 492 nm the same as the blue at 455 nm?)
2. White light is made of what colors? How do we know this?
3. What determines the colors that will be reflected and the colors that will be absorbed when visible light hits matter?
4. What color would be seen if only the blue portion of the visible light was shining on matter that absorbed blue wavelengths?
5. The words opaque and transparent apply to all light waves. What does it mean to say that glass is opaque to ultraviolet light and that glass is transparent to visible light?
6. Why does color look differently in natural sunlight versus an artificial fluorescent light?