

Light Waves and Matter

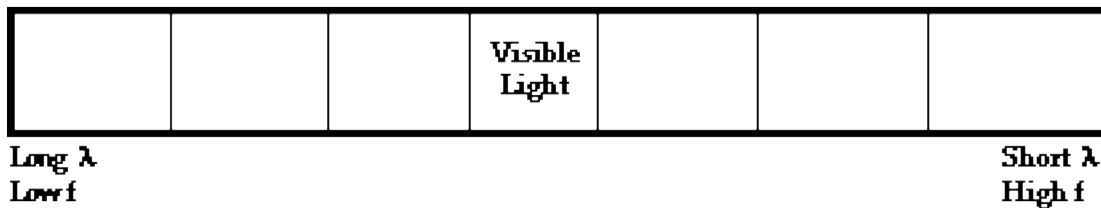
Read from **Lesson 2** of the **Light Waves and Color** chapter at **The Physics Classroom**:

<http://www.physicsclassroom.com/Class/light/u12l2a.html>

MOP Connection: Light and Color: sublevel 1

1. A light wave is an electromagnetic wave which has both an electric and magnetic component associated with it. Electromagnetic waves are often distinguished from mechanical waves. The distinction is based on the fact that electromagnetic waves _____.
 - a. can travel through materials and mechanical waves cannot
 - b. come in a range of frequencies and mechanical waves exist with only certain frequencies
 - c. can travel through a region void of matter and mechanical waves cannot
 - d. electromagnetic waves cannot transport energy and mechanical waves can transport energy
 - e. electromagnetic waves have an infinite speed and mechanical waves have a finite speed

2. Consider the diagram below. It represents the beginnings of an electromagnetic spectrum below. Complete the diagram by labeling the following regions: ultraviolet, infrared, x-ray, radio wave, gamma radiation, and microwave radiation.



3. Which region of the electromagnetic spectrum has the highest frequency?

4. Which region of the electromagnetic spectrum has the longest wavelength?

5. Which region of the electromagnetic spectrum will travel with the fastest speed?

6. It is known that electromagnetic waves with longer wavelengths have a greater ability to bend around obstacles that get in their path. This ability to bend around obstacles is referred to as diffraction. Electromagnetic waves with strong diffraction properties are used in communication. Which two regions of the spectrum have the greatest ability to diffract?

7. It is known that electromagnetic waves with high frequency are more capable of causing damage to the organs of living things. Which two regions of the spectrum have the tendency to cause the greatest damage to humans?

Sound and Music

Light that the human eye is capable of detecting is known as visible light. There is a range of frequencies that the eye can detect. Various frequencies are observed as different colors. The diagram below represents the range or spectrum of visible light frequencies labeled with their respective colors.

Infrared	Red	Orange	Yellow	Green	Blue	Indigo	Violet	Ultraviolet
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8. Which color of the visible light spectrum has the highest frequency?
9. Which color of the visible light spectrum has the longest wavelength?
10. Light and material objects always interact in one way or another. When light is incident on some materials, it is transmitted through the material. For instance, visible light is transmitted through glass. Glass is said to be _____ to visible light.
 - a. transparent
 - b. opaque
11. Other materials absorb and/or reflect light only. They do not allow light to pass through it. Such materials are said to be _____.
 - a. transparent
 - b. opaque
12. Some material objects are transparent to certain forms of electromagnetic waves but opaque to other forms. Earth's atmosphere is an example. The atmosphere allows visible light to pass through it. Much of the more damaging portion of the ultraviolet spectrum is blocked by a thin layer of ozone in the stratosphere. The atmosphere is said to be _____ (transparent, opaque) to visible light but _____ (transparent, opaque) to ultraviolet light.
13. As light passes through transparent objects, the speed at which it travels is _____.
 - a. the same speed as it travels through air
 - b. less than the speed at which it travels through air
 - c. greater than the speed at which it travels through air

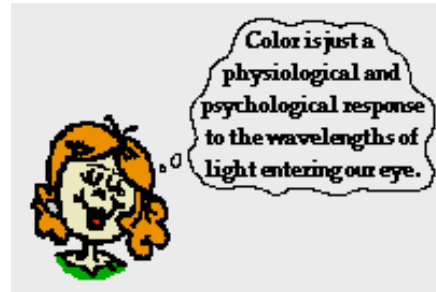
Reflection, Transmission and Color

Read from Lesson 2 of the Light Waves and Color chapter at The Physics Classroom:

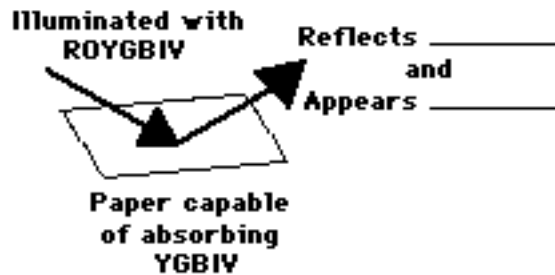
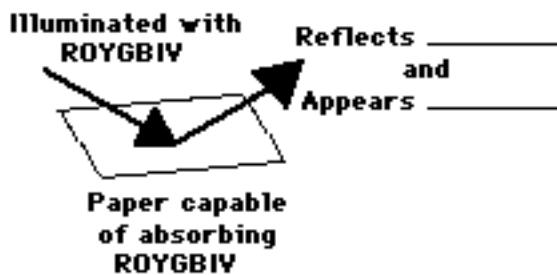
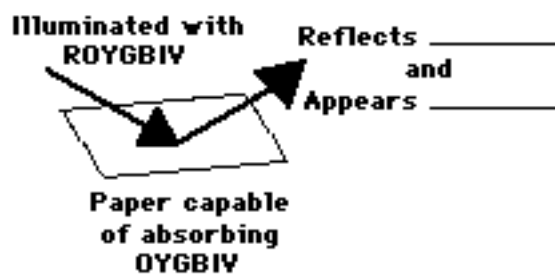
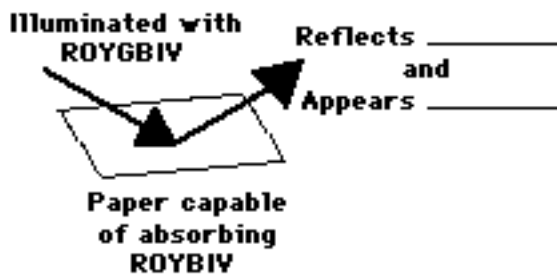
- <http://www.physicsclassroom.com/Class/light/u12l2a.html>
- <http://www.physicsclassroom.com/Class/light/u12l2b.html>
- <http://www.physicsclassroom.com/Class/light/u12l2c.html>

1. Visible light is composed of a range of wavelengths; different wavelengths correspond to different colors. Identify the seven component colors of visible light.

2. Natural philosophers have long pondered the underlying reasons for color in nature. One common historical belief was that colored objects in nature produce small particles (perhaps light particles) that subsequently reach our eyes. Different objects produce different colored particles, thus contributing to their different appearance. Is this belief accurate or not? _____ Justify your answer.



3. The color that an opaque object appears is dependent upon what color(s) of light incident upon the object and the color(s) of light reflected by the object. Express your understanding of this principle by filling in the blanks in the following diagrams.

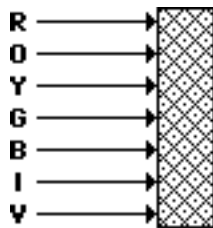


Sound and Music

4. Two students in the cafeteria are discussing the physics of color. The students are claiming that white and black are not really colors of light. If white and black are not really colors of light, then what are they? Explain fully.

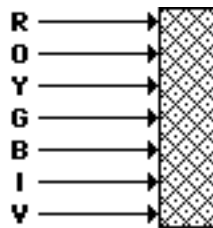
5. Explain why a red shirt looks red when visible light ("ROYGBIV") shines upon it.

6. Transparent materials are materials that allow one or more of the colors of visible light to be transmitted through them; whatever color(s) is/are not transmitted by such objects, are typically absorbed by them. The appearance of a transparent object is dependent upon what color(s) of light is/are incident upon the object and what color(s) of light is/are transmitted through the object. Express your understanding of this principle by continuing the arrow(s) for any transmitted color(s) and filling in the blanks in the following diagrams.



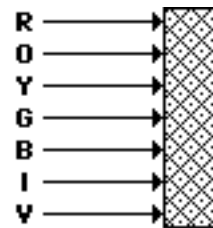
**Pigment capable
of absorbing
ROYBIV**

Appears _____



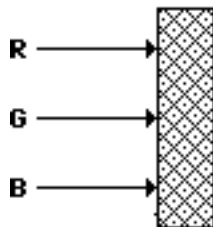
**Pigment capable
of absorbing
ROYIV**

Appears _____



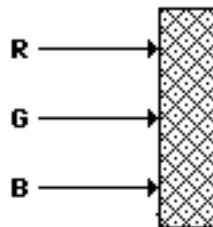
**Pigment capable
of absorbing
YGBIV**

Appears _____



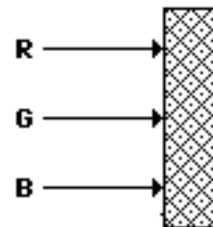
**Pigment capable
of absorbing
R**

Appears _____



**Pigment capable
of absorbing
G**

Appears _____



**Pigment capable
of absorbing
OYGBIV**

Appears _____

7. What color(s) of visible light will a cyan (bluish-green) pair of sunglasses ...
 - a. ... transmit?

 - b. ... absorb or block?