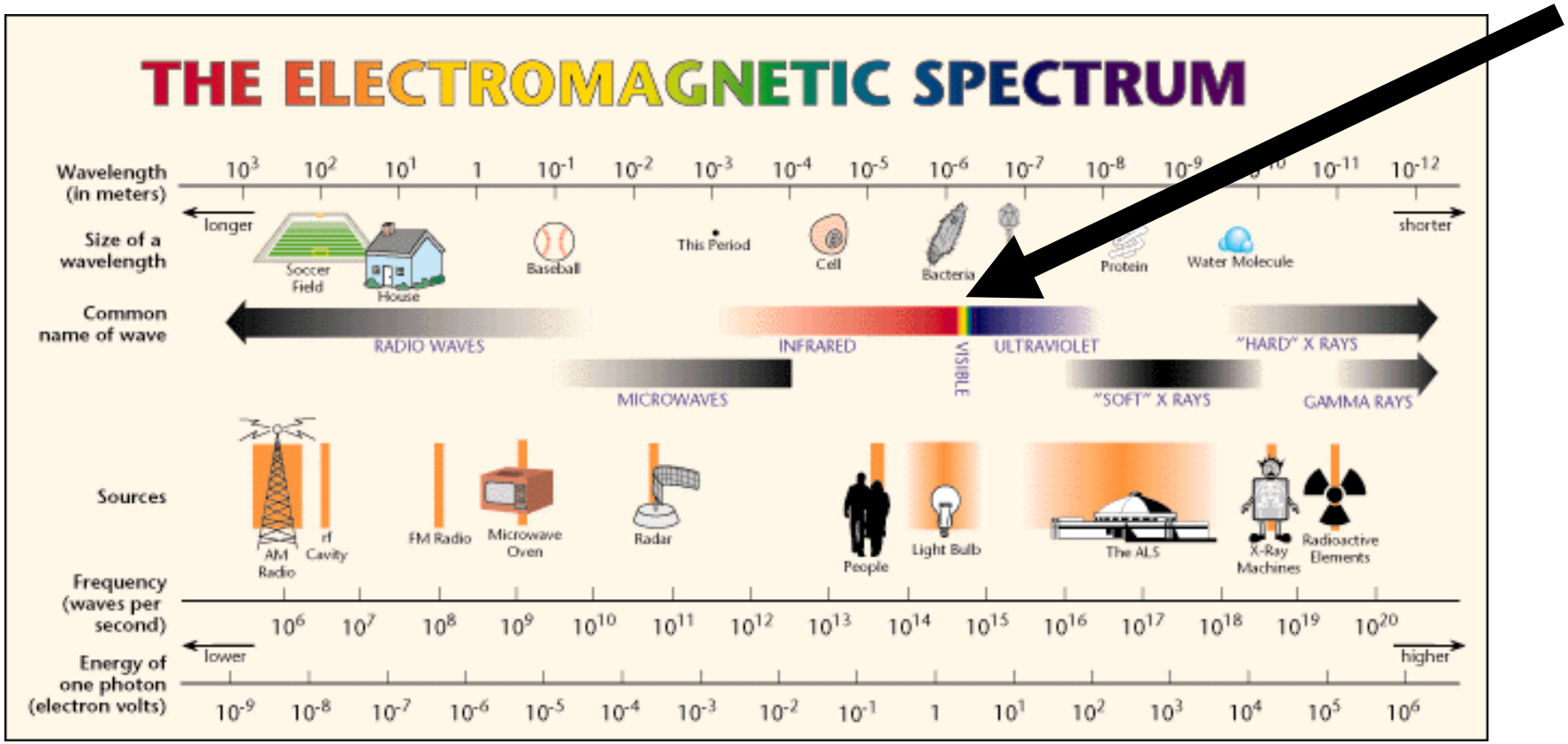
Electromagnetic Waves: Seeing Objects and Color

Electromagnetic Waves: Seeing Objects and Colors

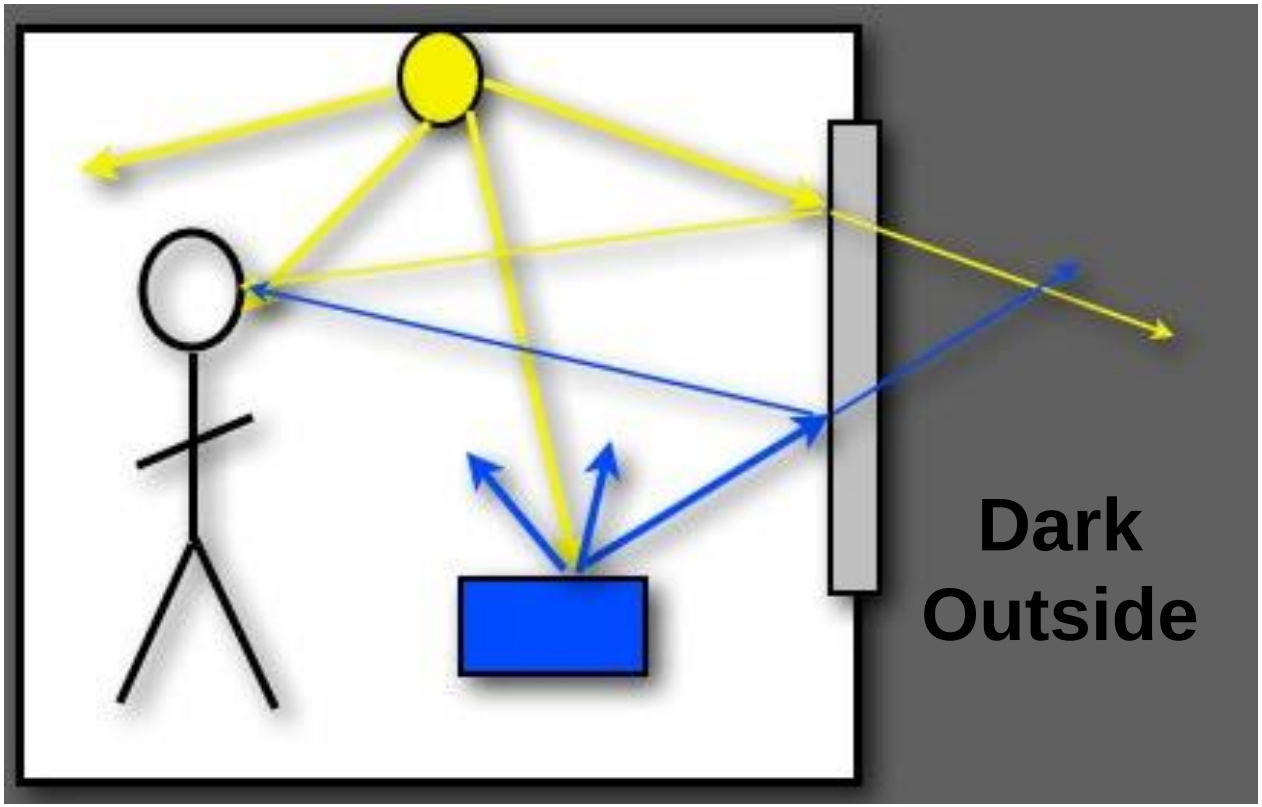
Visible light is a small part of the electromagnetic spectrum that the human eye is capable of seeing



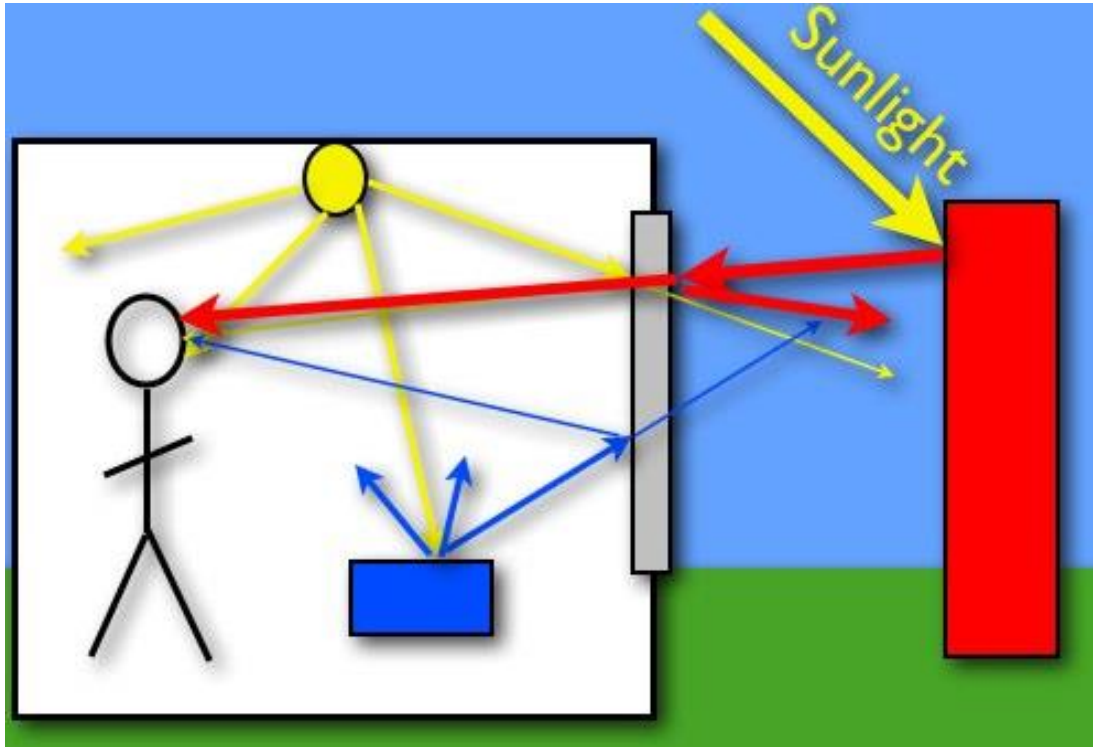
The Electromagnetic Spectrum Activity Sheet

Electromagnetic Waves: Seeing Objects

- Objects can be seen if they are a source of light
- However, most objects around you do not give off light on their own. They can be seen only if light waves from another source reflect off them and into your eyes
- Light waves move in all directions from a light source



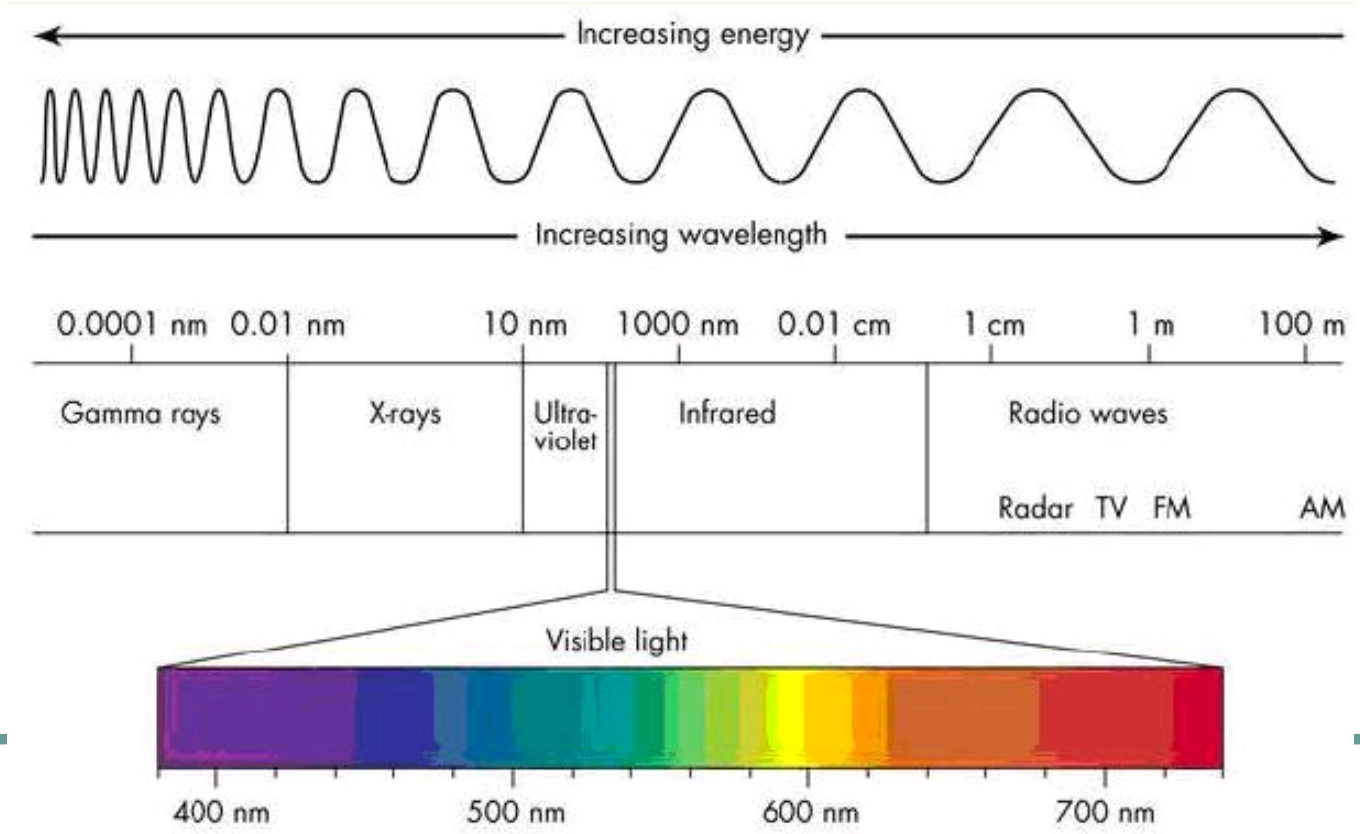
- The person can see the blue box because the light from the lamp (light source) reflects off of it (light as blue arrows).
- When light hits the window, some of it goes through the window and some reflects off the window.
- Some of the light reflected from the window goes to the person so that the person can see a reflection of the blue box and the light.
- Some of the light goes through the window. So, if you were outside in the dark, you could see the light and the blue box.



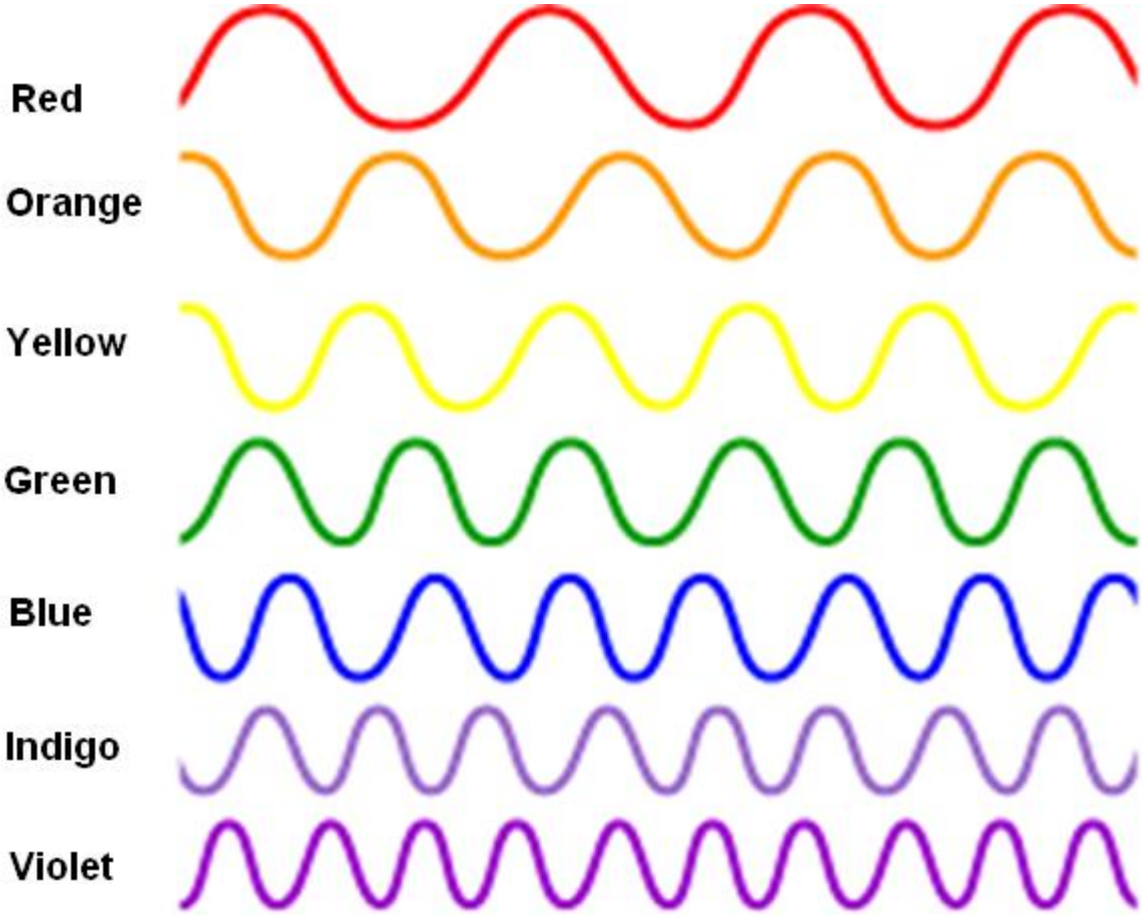
- Notice how the two light sources reflect off objects, which allows these objects to be seen.
- Additionally, light waves reflect in many directions, and only some of these enter your eyes.
- Remember, when waves strike an object, some are absorbed, some are reflected, and some pass through it. It depends on the material of the object.

Electromagnetic Waves: Seeing Color

Remember that visible light is a small part of the electromagnetic spectrum that the human eye is capable of seeing

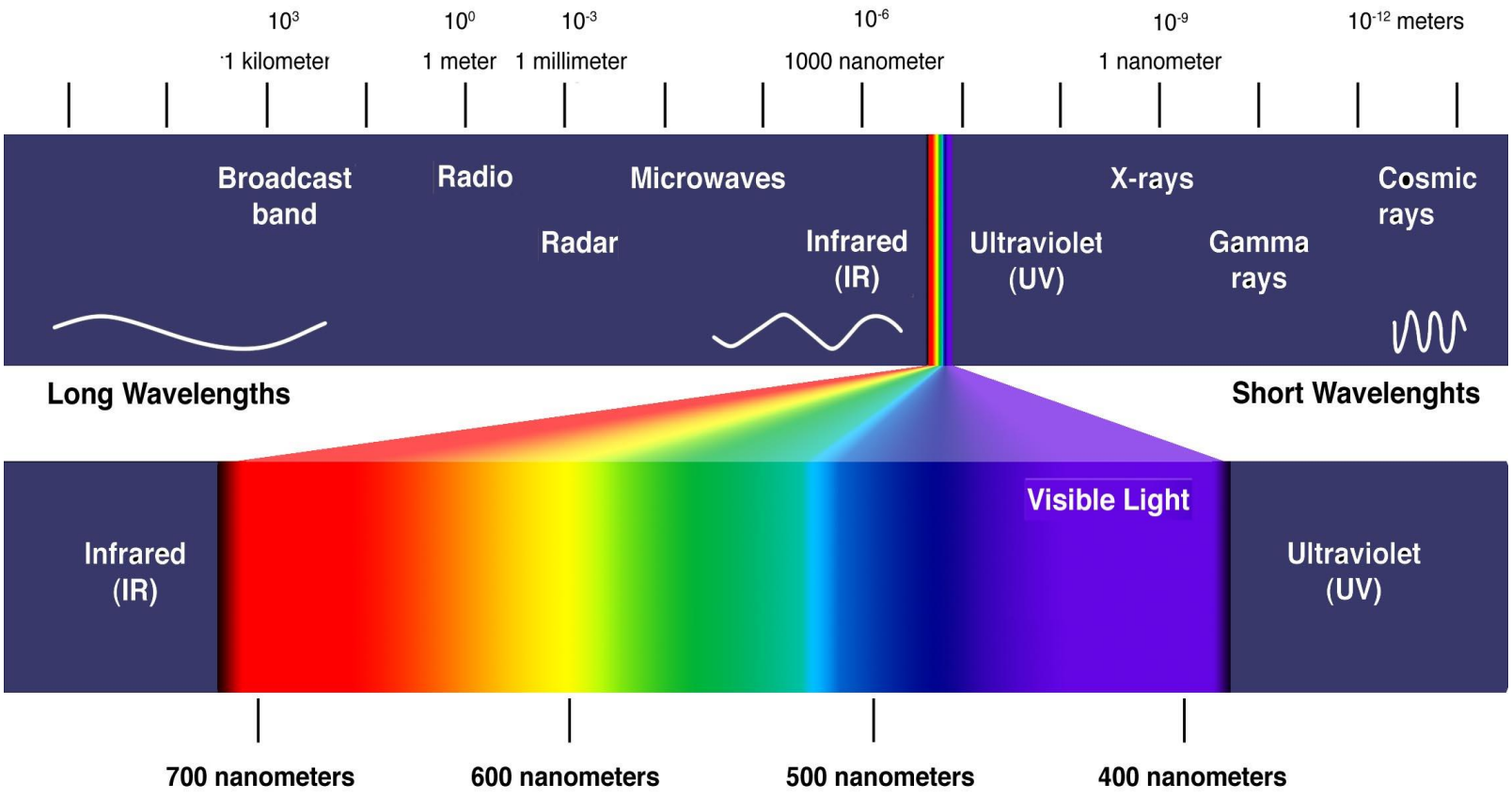


The colors of visible light are created by electromagnetic energy of various wavelengths (frequencies). See below



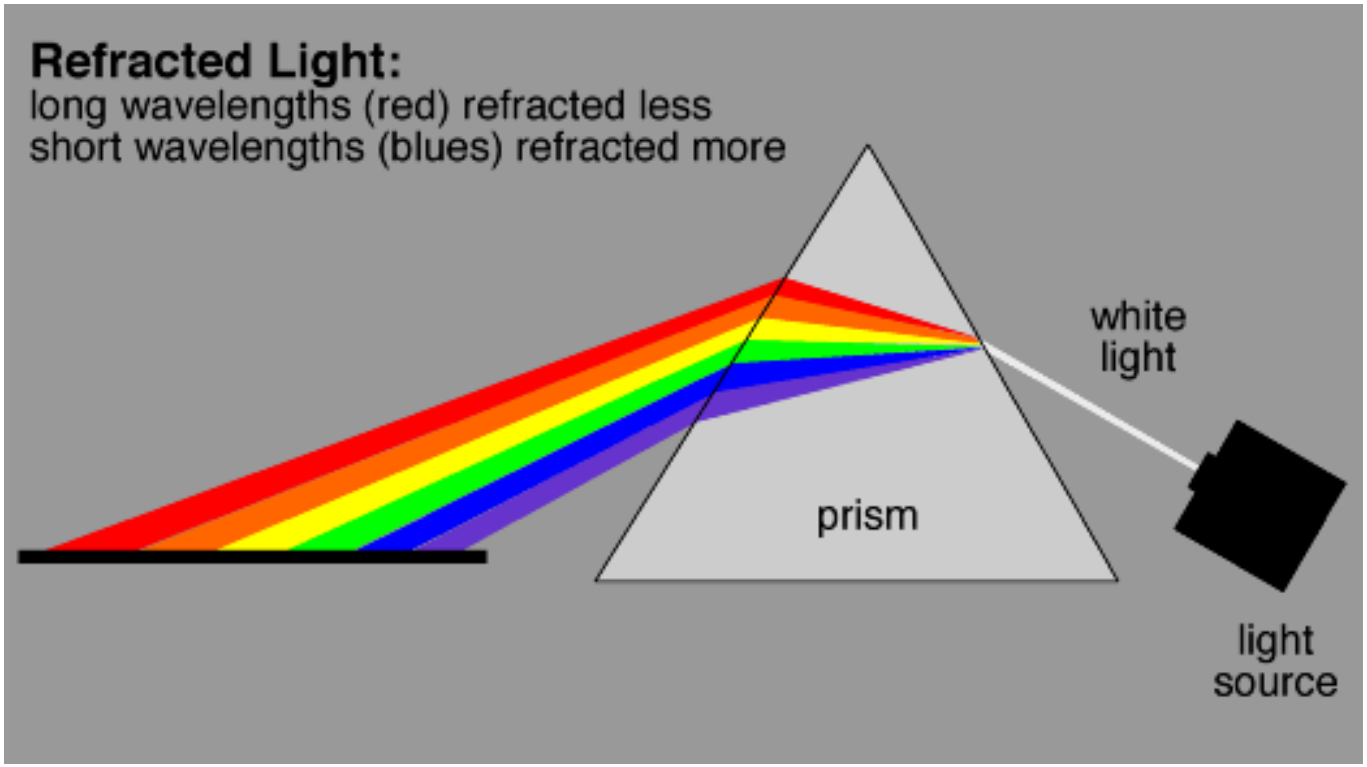
White light is made up of all the wavelengths of visible light.

Waves after Waves Activity

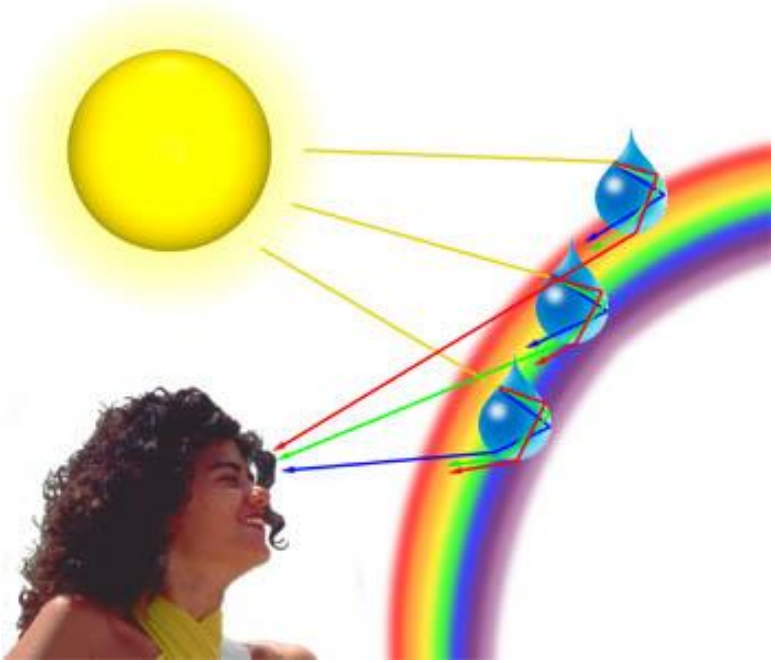


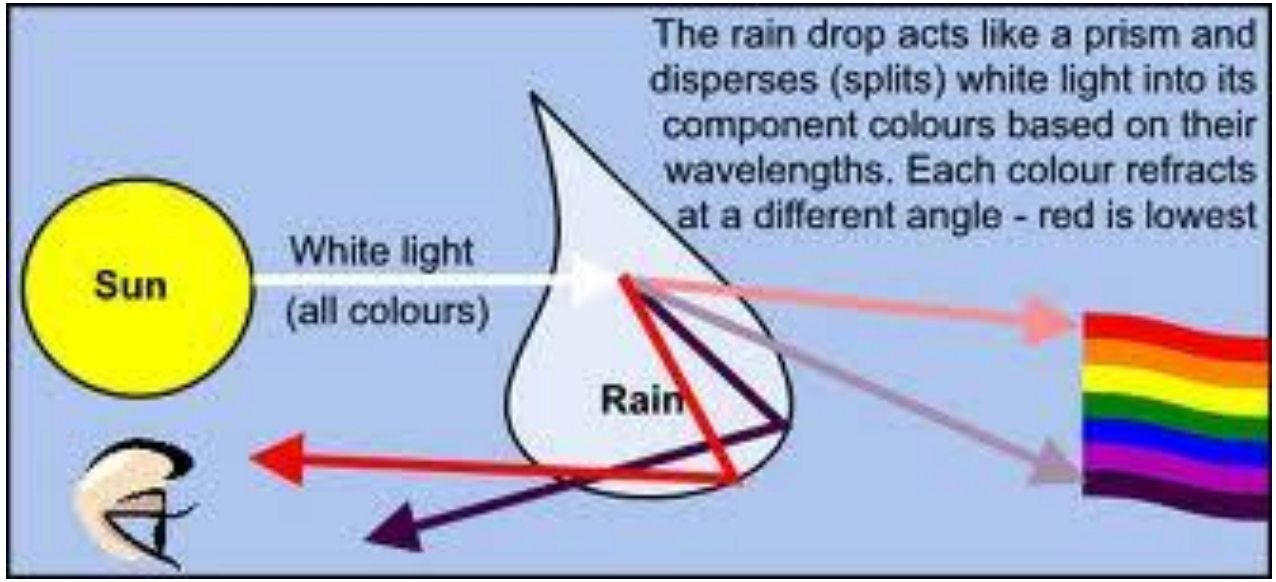
When white light is refracted, it can be separated into its component colors.

As light passes through a prism, refraction causes light to bend and separate into many colors.



A rainbow is produced when a raindrop acts like a prism causing white light to refract (bend) and separate into many colors





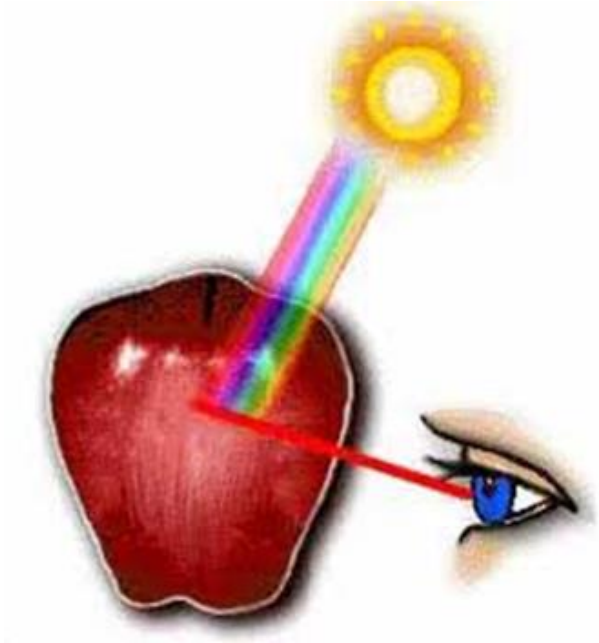
Electromagnetic Waves: Seeing Color

- Humans see different wavelengths of light as different colors.
  - Humans see long wavelengths as red 
  - Humans see short wavelengths as violet 
- Some colors, like pink and brown, are seen when certain combinations of wavelengths are present.

Electromagnetic Waves: Seeing Color

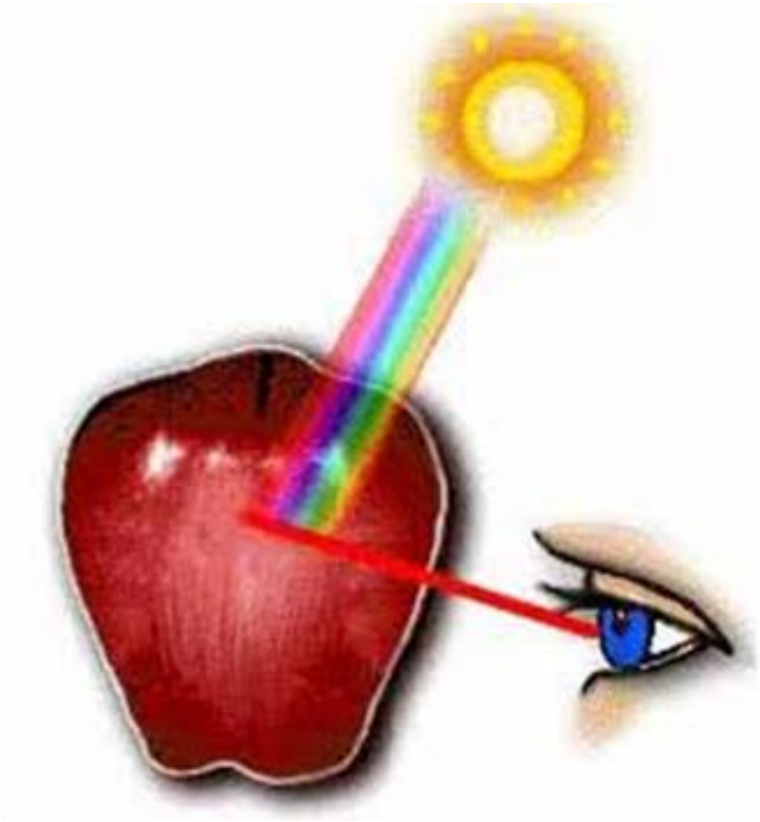
If we see an object because light is reflected off the object by a light source and white light is made up of all the wavelengths of visible light, why do objects have different colors?

The color of an object is determined by the wavelength's (color) light it reflects. So, if an object reflects one wavelength (color), it absorbs all the other wavelength's (colors) of visible light.

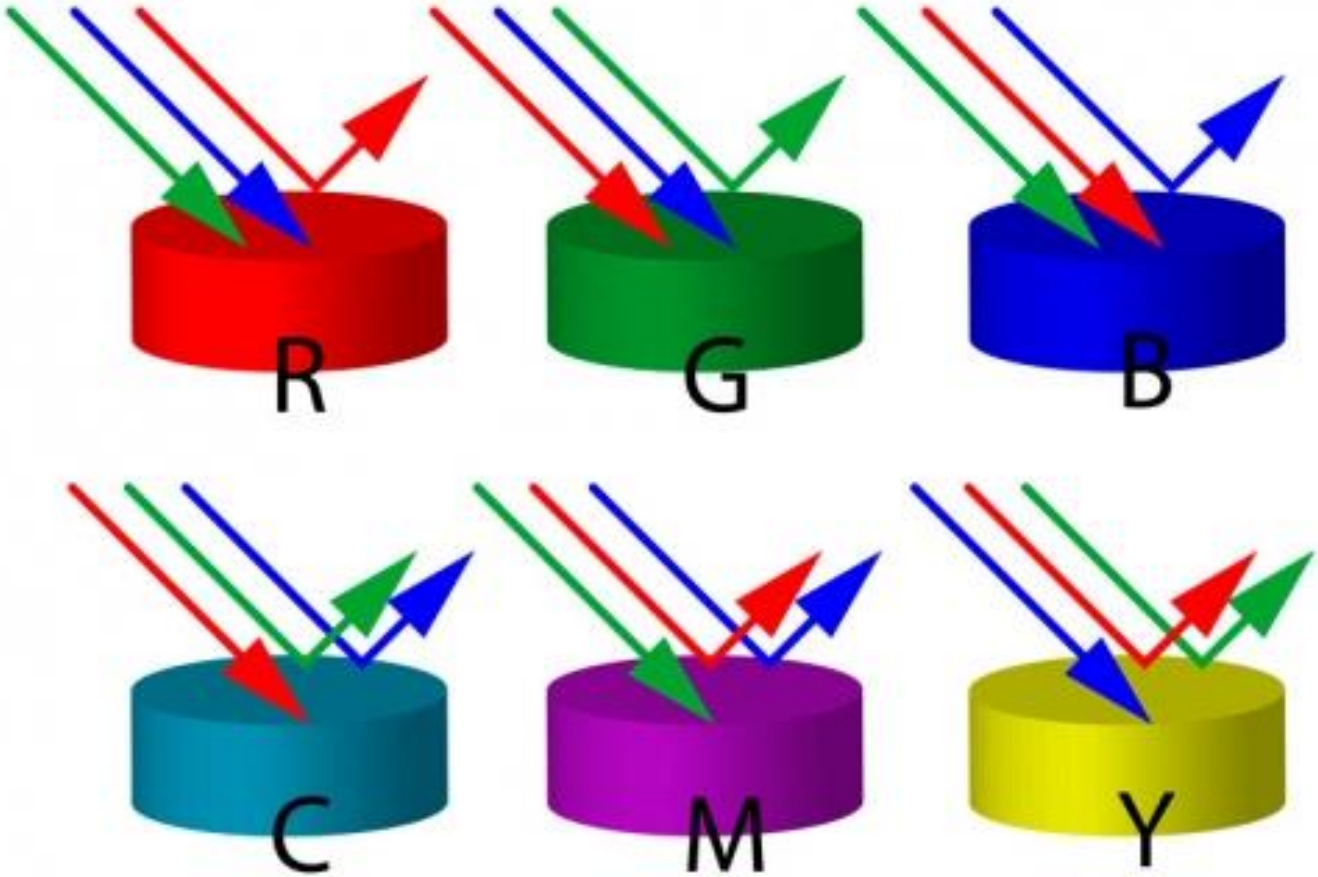


In this example, the sun is the light source. The sun's light appears white because it is made up of all the wavelengths of visible light.

However, humans see the apple as red because all of the other wavelengths (or colors) are absorbed by the apple. The wavelength that we see as red is reflected off the apple.



Absorption and Reflection



Seeing Color

- An object that reflects all the light waves that strike it looks white

- An object that reflects none of the light waves that strike it (which means it absorbs all light waves) looks black

Why Do You See Certain Colors Reflected?

- Dyes in clothes or dye in paint

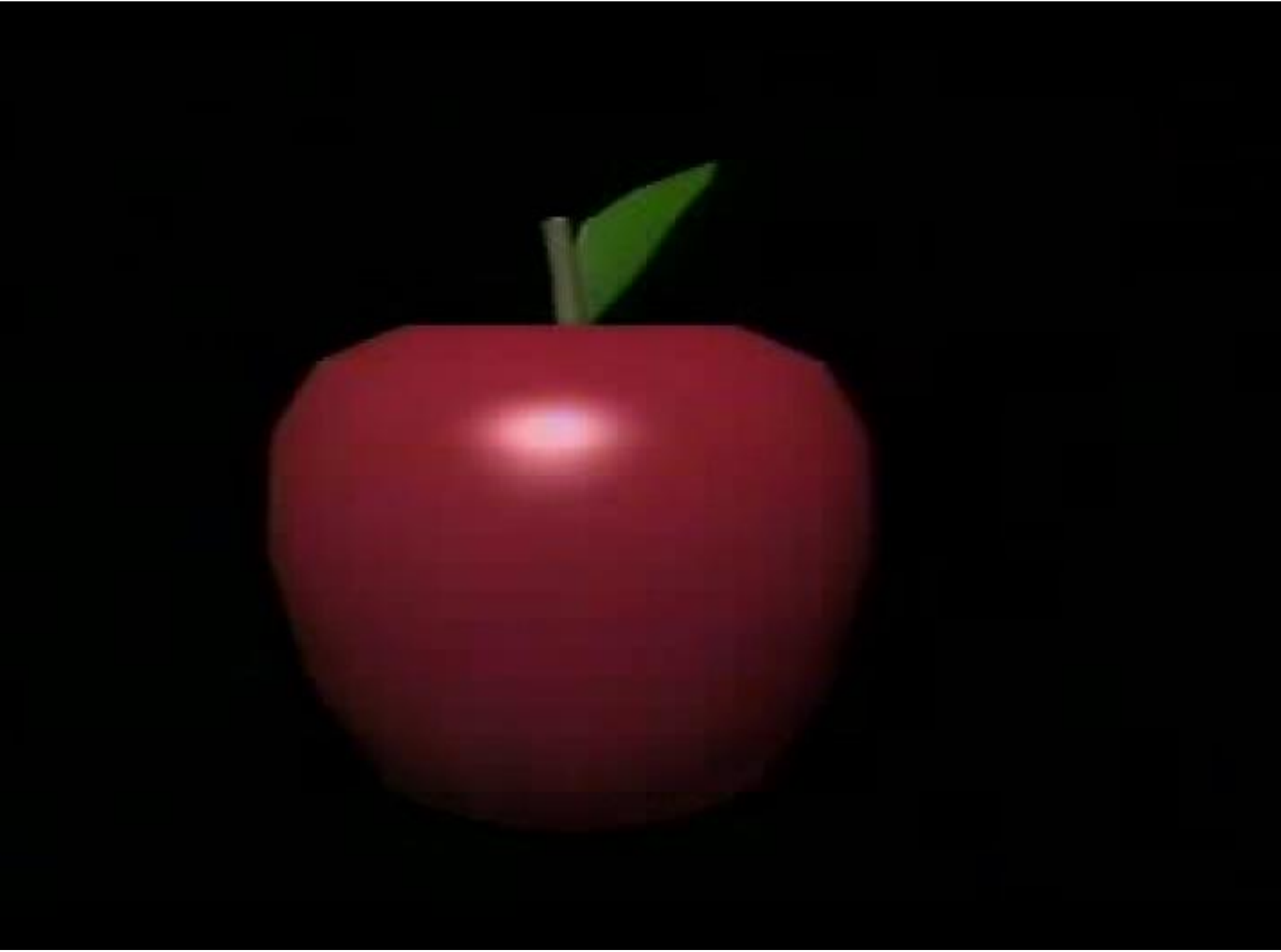
causes us to see certain colors reflected back

- The texture of surfaces influences

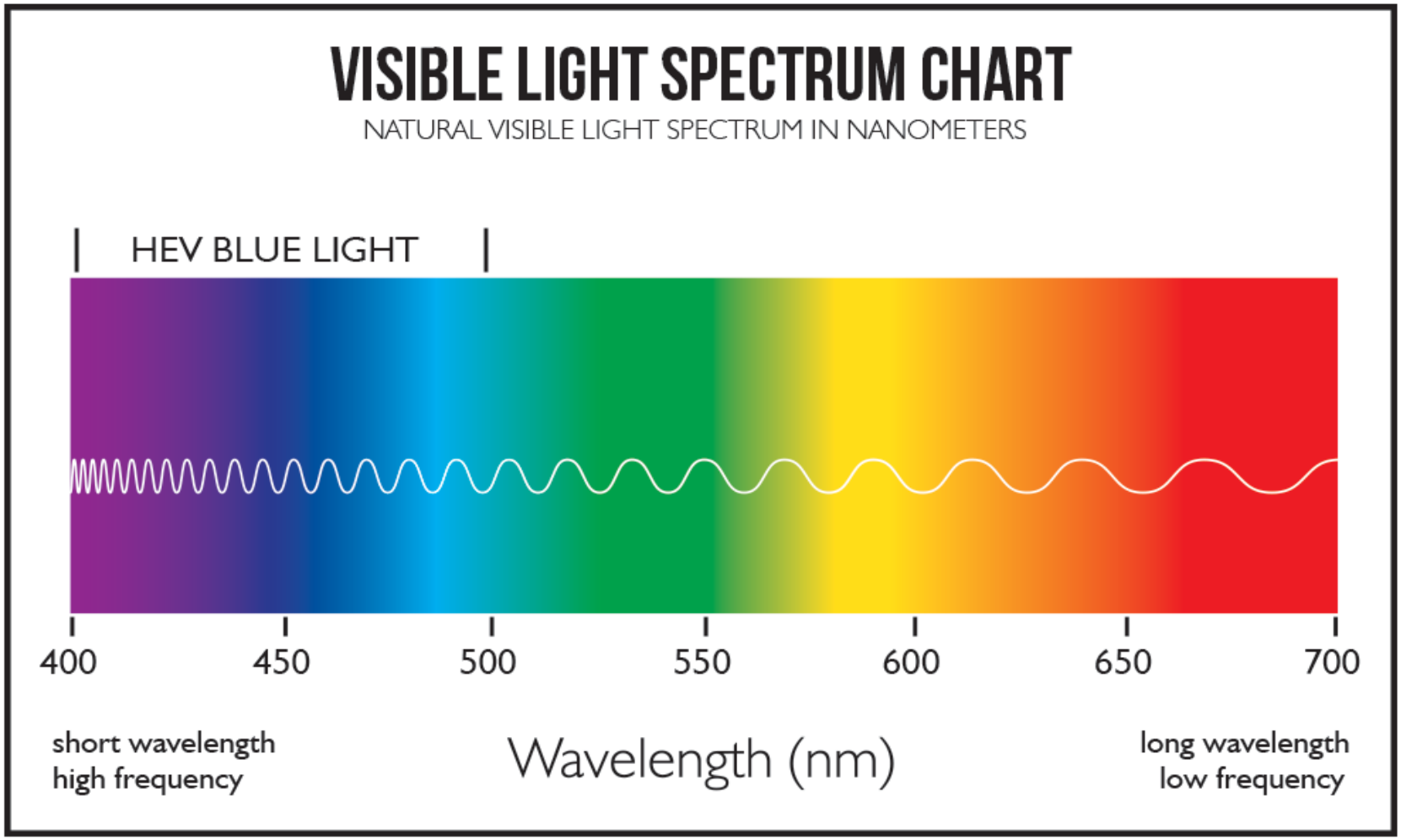
the color reflected as well (metal, wood, porous, etc…)

Where Does Dye Come From?

- Natural dyes are dyes or colorants derived from plants, invertebrates, or minerals. This is where most dyes comes from.
- Synthetic dyes produce bright and vibrant colors but they are man-made and come from various chemicals and elements such as mercury.

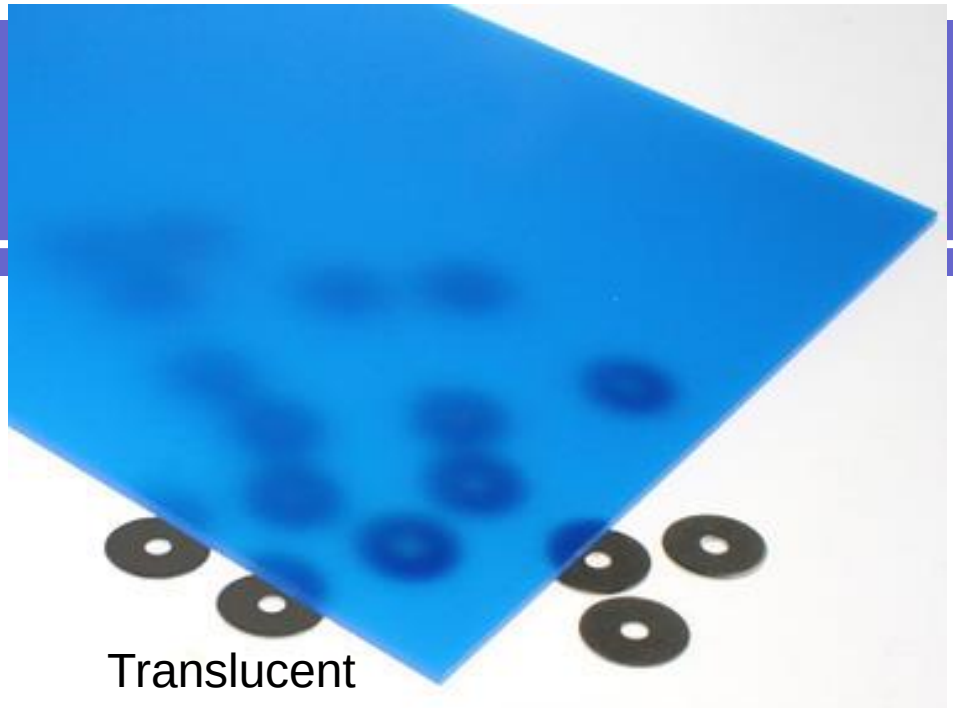


EM Spectrum Reading and Activity



Let’s Take Some Notes…

An object that is clear and light can pass through it is described as _____.	 _____
An object that is cloudy and only allows part of the light to pass through is described as _____.	 _____
An object that light cannot pass through is described as _____.	 _____

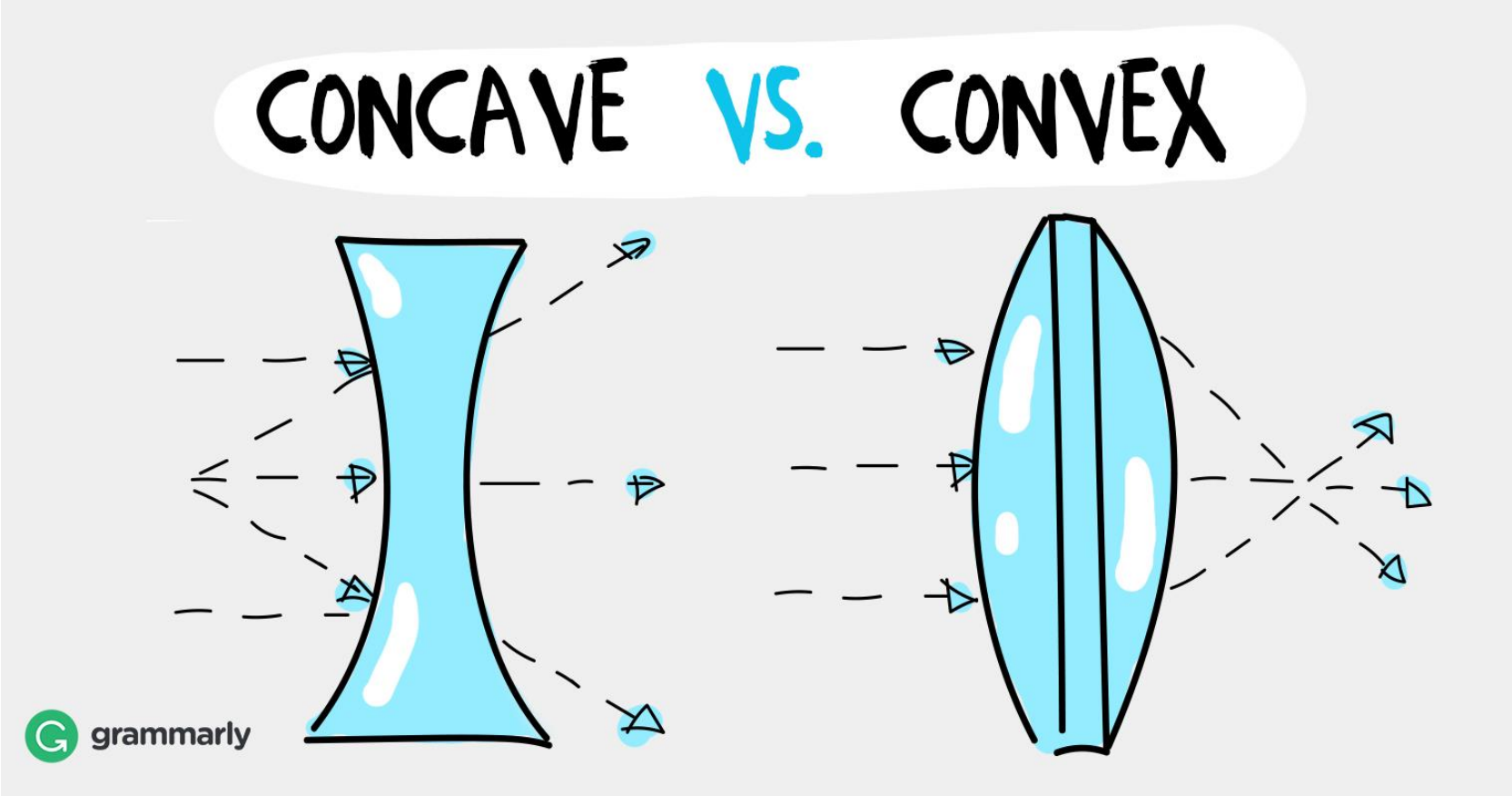


Translucent

Opaque

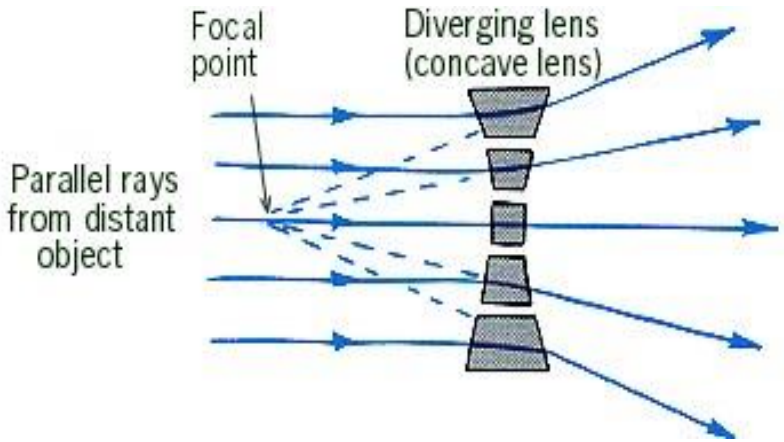
Transparent

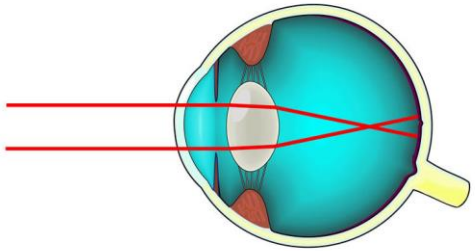
Mirrors and Lenses



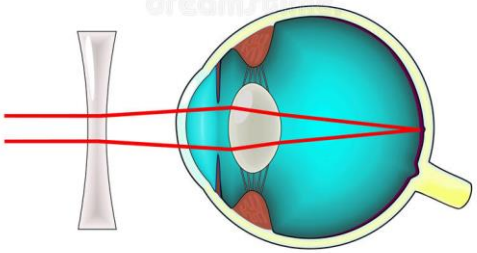
Concave Lenses

- Lenses that are thicker at the edges and thinner in the center.
  - Diverges light rays
  - Images virtual (upright) if you are close enough are real if far enough away.
  - Reduces the image by making the area around the object look smaller
  - Examples: microscopes and eyeglasses (for nearsightedness)





Natural eye
Convex lens



Corrected eye
Concave lens

Concave Mirrors

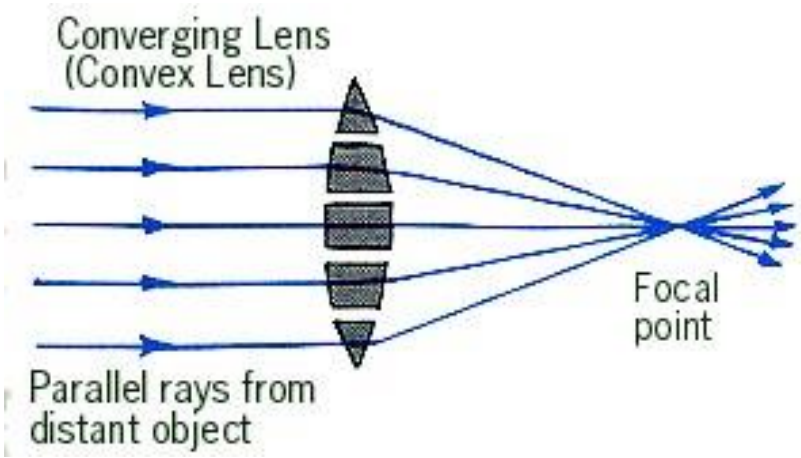
- Curves inward
- Can be used to make objects larger.

Uses: telescopes, makeup mirror, car headlights

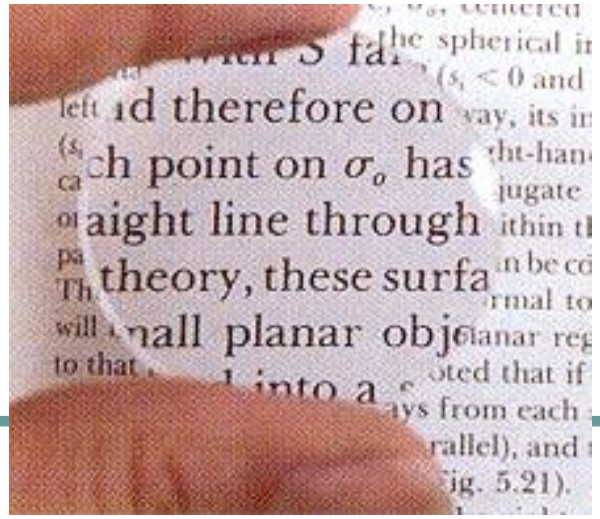
Convex Lenses

Thicker in the center than edges.

- Lens that converge (brings together) light rays.
- Forms real images or virtual images (upright) that are larger.
- Your eyes are convex as are reading glasses



The Magnifier

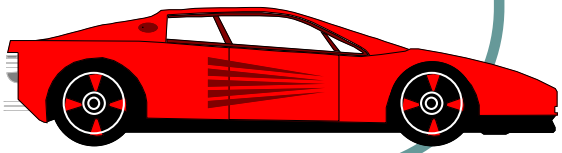


Convex Mirrors

- Curves outward
- Reduces the image
- Virtual images or real depending on the distance
- The area around you is larger

Uses: car mirrors, cameras, magnifying glasses

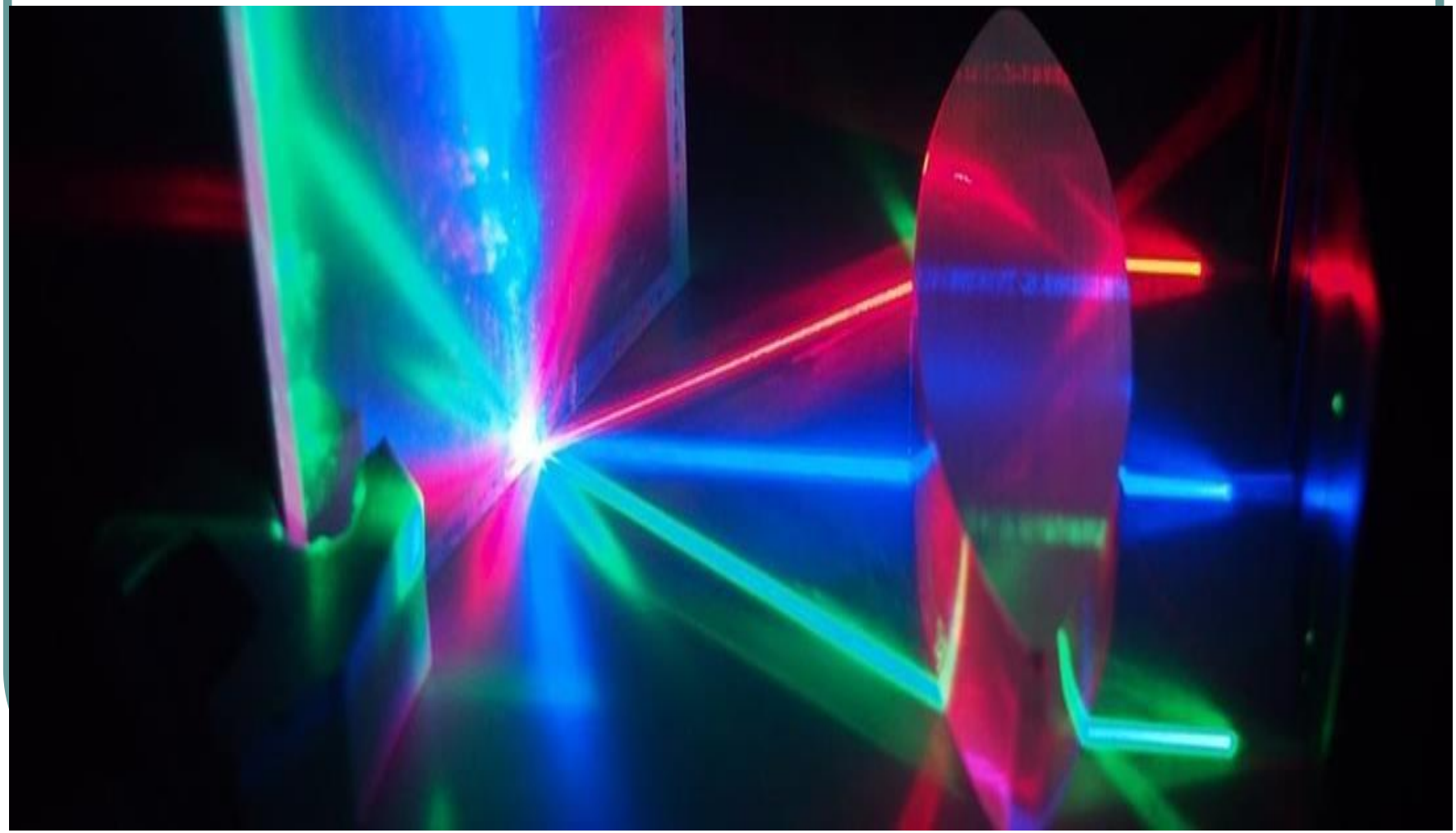
CAUTION! Objects are closer than they appear!



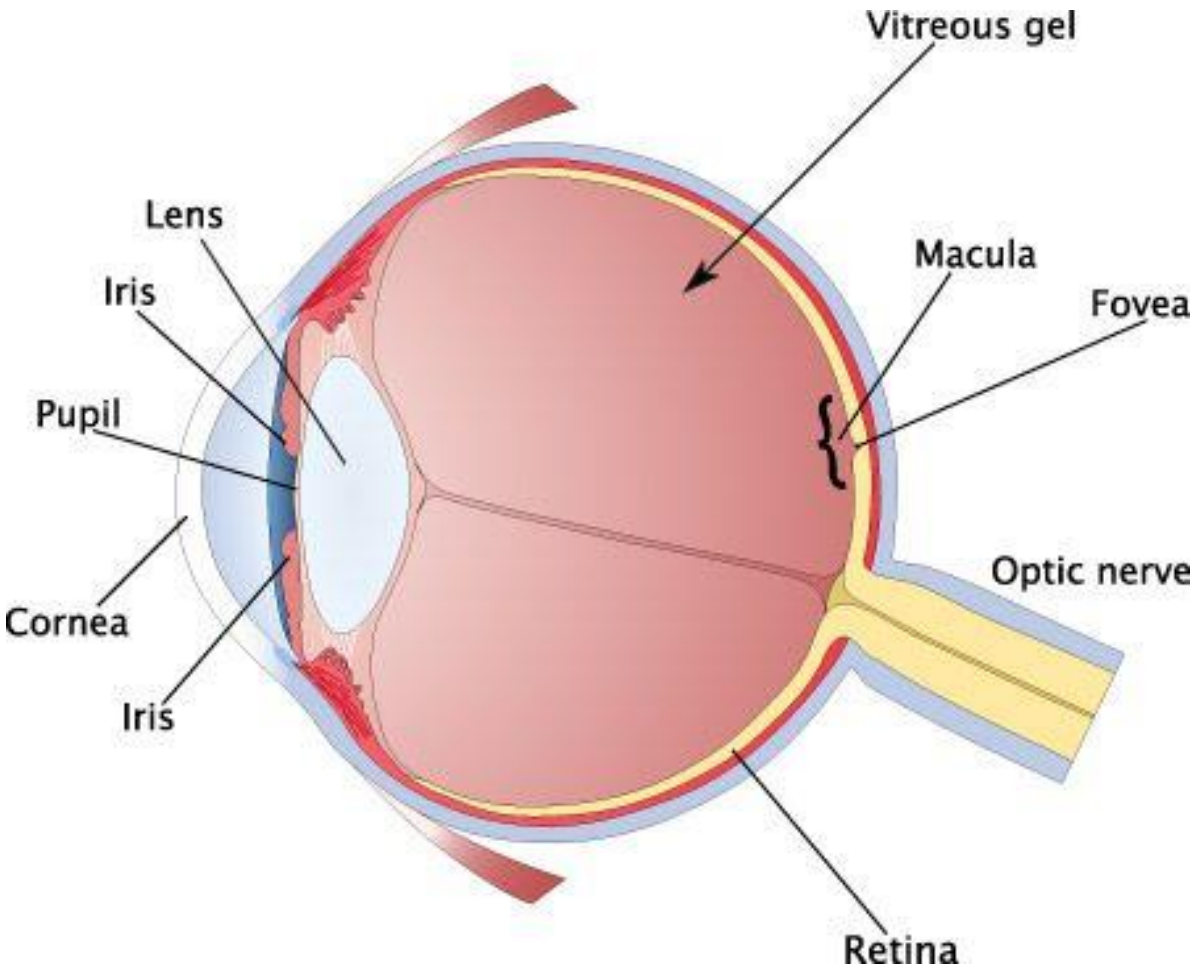
Convex and Concave

- Some devices use both convex and concave mirrors and/or lenses to allow the user to see both enlarged and smaller images as needed.

Optics Activity Sheet and Lab

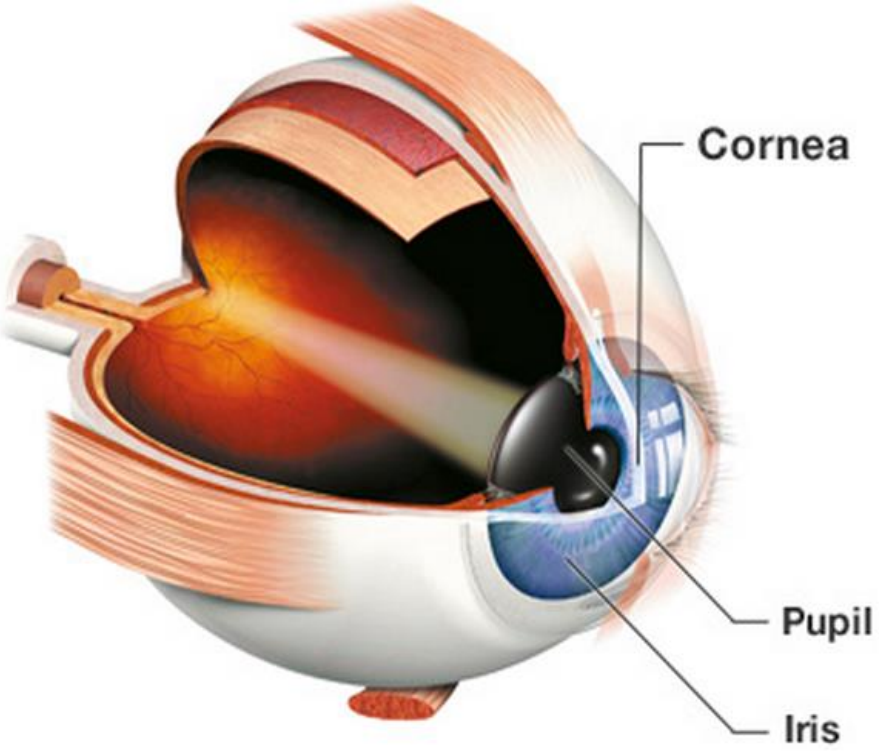


In a number of ways, the human eye works much like a digital camera



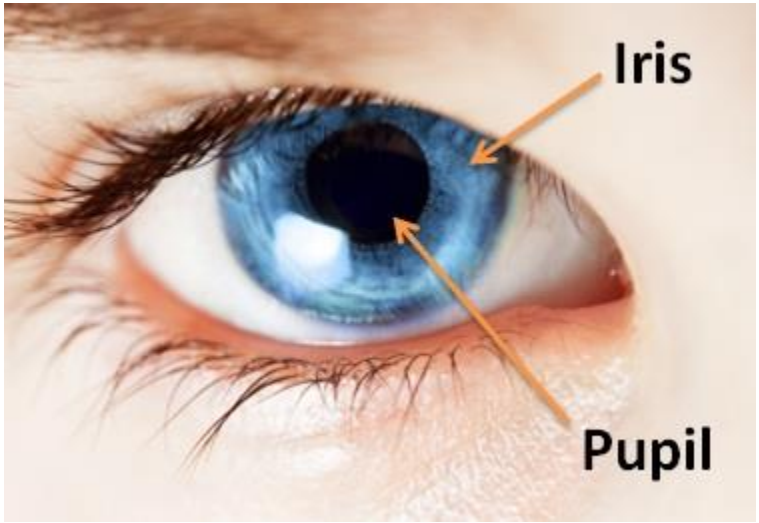
The Cornea

Light is focused primarily by the cornea — the clear front surface of the eye, which acts like a camera lens



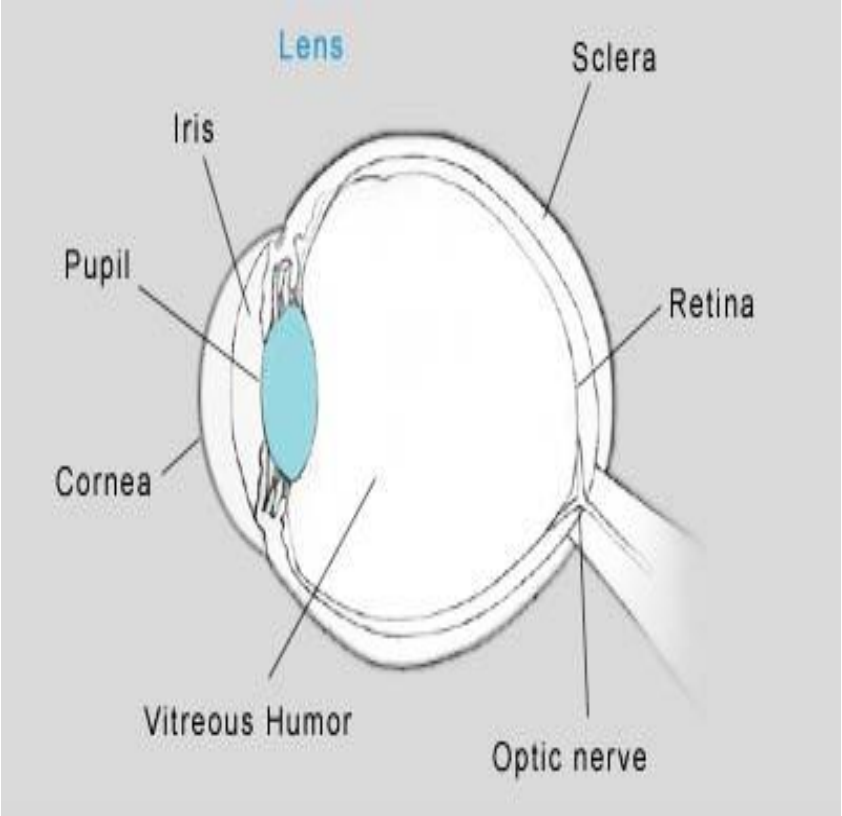
The Iris

The iris of the eye functions like the diaphragm of a camera, controlling the amount of light reaching the back of the eye by automatically adjusting the size of the pupil.



The Lens

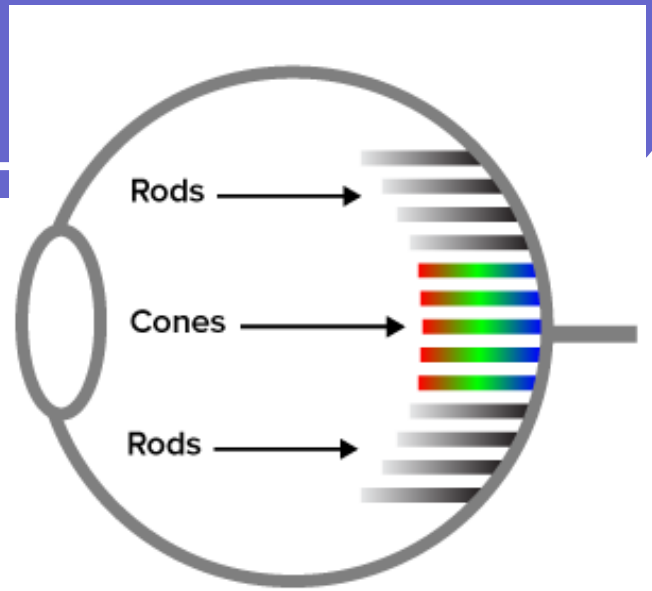
The eye's crystalline lens is located directly behind the pupil and further focuses light. Through a process called accommodation, this lens helps the eye automatically focus on near and approaching objects, like an autofocus camera lens.



The Retina

Light focused by the cornea and crystalline lens (and limited by the iris and pupil) then reaches the retina — the light-sensitive inner lining of the back of the eye. The retina acts like an electronic image sensor/screen of a digital camera, converting optical images into electronic signals. The optic nerve then transmits these signals to the visual cortex — the part of the brain that controls our sense of sight

Rods

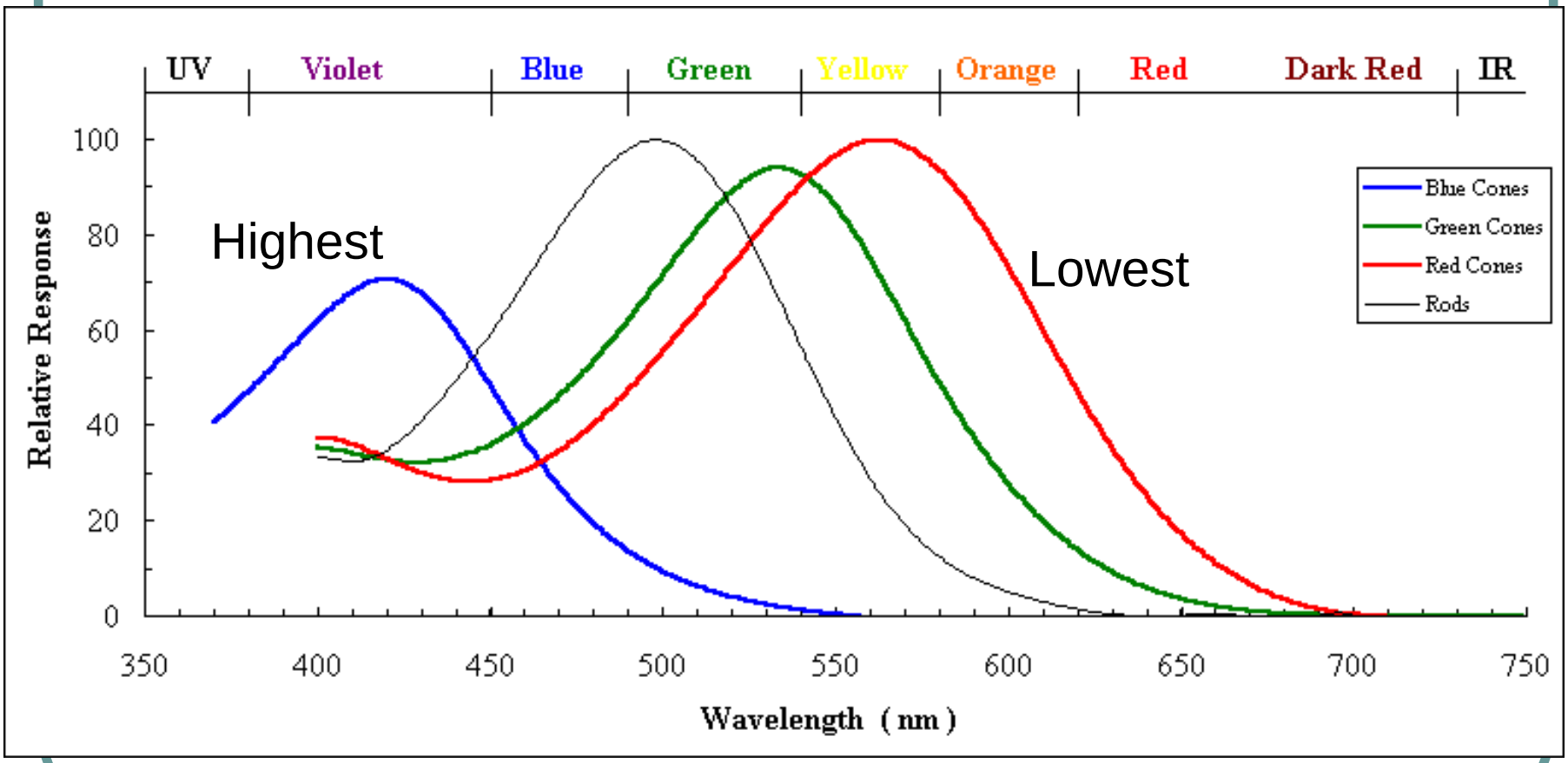


- **Rods:** See in black, white, and shades of gray and tell us the form or shape that something has. They are super-sensitive, allowing us to see when it's very dark.

Cones

Cones: Sense color and need more light than Rods to work well. Cones are most helpful in normal or bright light. There are 3 types of cones - red, green, and blue - to help you see different ranges of color. Together, these Cones sense combinations of light waves that enable our eyes to see millions of colors

Cones and Frequency



Your blue cones are capable of seeing the highest of frequency waves.