

Color Management Concepts



A Chart of all the Visible Colors Emitted by the Sun (broken down across the entire spectrum)

Color Management Concepts

Properties of Light:

• What is light and how does it work...

Light is a term that we created based on our perception. Light exists as a very narrow band of the electromagnetic spectrum. Our eyes allow us to see a part of this spectrum of energy and we evolved to sense light in a very specific way. We sense light, with our eyes, and they have evolved over billions of years to discern the narrow band of energy into various colors that our mind separates and perceives as different colors based on our language and experience.

- Visible Light is just a small part of the electromagnetic spectrum and is part of the physical laws that are fundamental to the universe.
- Generally speaking, human beings can see light from 400 nm to 700 nm wavelength range in the electromagnetic spectrum.
- We perceive colors based on our eye anatomy and our mind's ability to process the information.
- We break up the light spectrum using special receptor cells in our retinas in order to see the colors of the rainbow.
- We sense Infra-red (IR) spectral radiation with our skin and think of it as heat. Some animals can see heat.
- All electromagnetic vibrations are defined on the spectrum of energy, and depending on the frequency or Hertz, a particular range is assigned a name like: visible light, x-rays, radio waves, Infra-red, ultraviolet or microwave energy.
- The higher the frequency, the more harmful it is to living creatures on earth and we think of it as radiation. In reality, it's just vibrational energy that our bodies have evolved to react to in different ways.

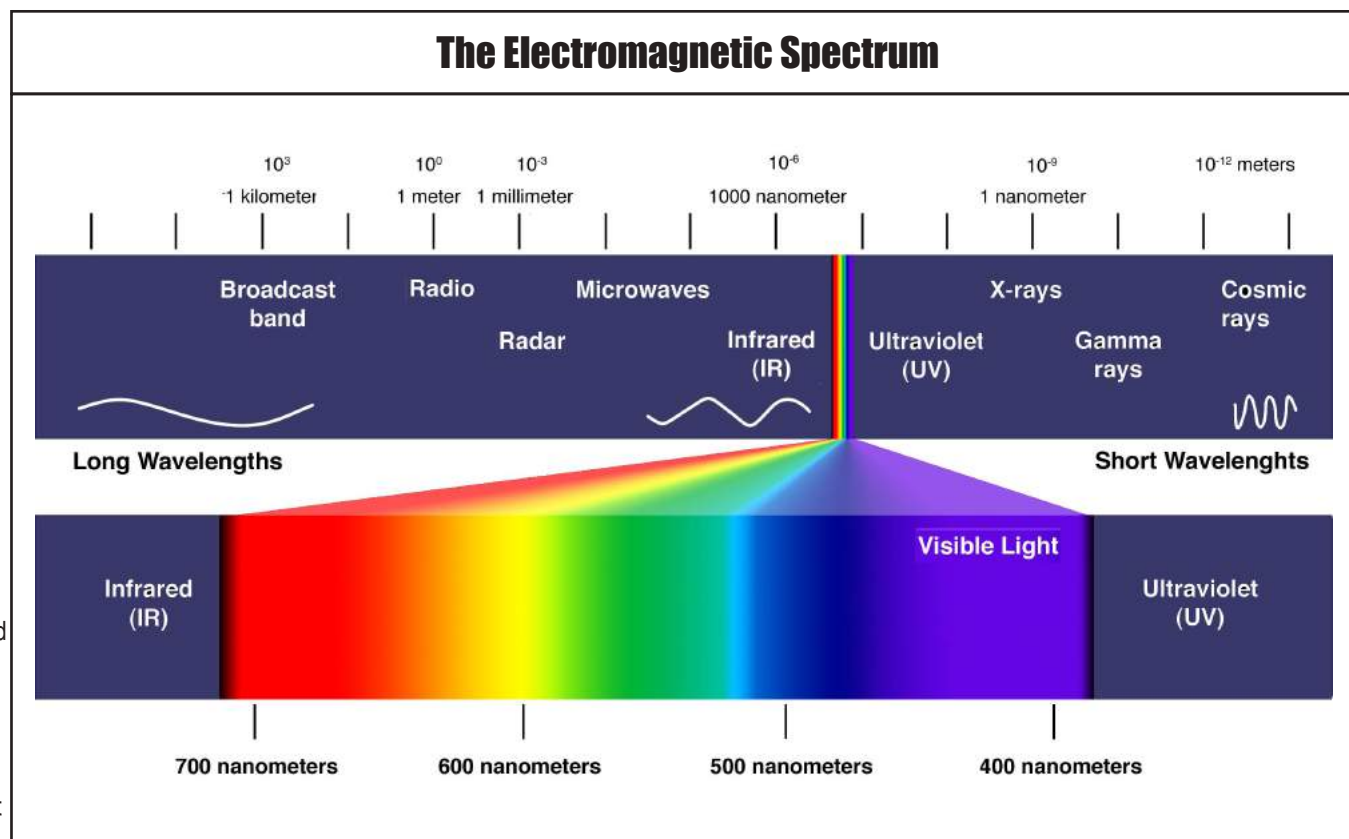


Image Credit: <http://g7power.com/blog/light-color/>

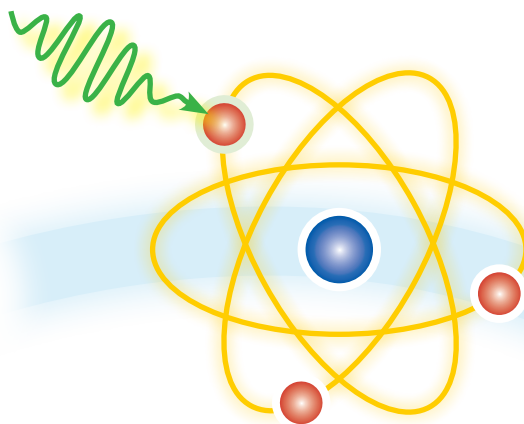
Color Management Concepts

Properties of Light:

• How is Light Created...

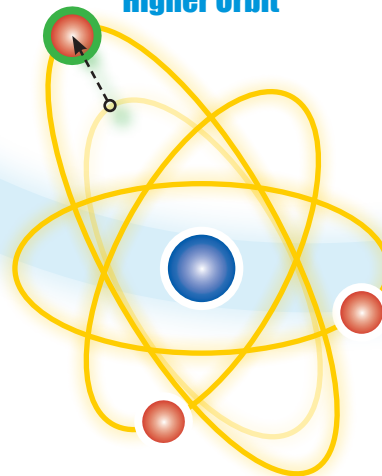
Electrons circle the nucleus in fixed orbits -- a simplified way to think about it is to imagine how satellites orbit the Earth. There's a huge amount of theory around electron orbitals, but to understand light there is just one key fact to understand. An electron has a natural orbit that it occupies, but if you energize an electron, it can move to a higher than normal orbit. A photon is produced whenever an electron in this higher orbit falls back to its normal orbit. During the fall from high energy to normal energy, the electron emits a photon -- a packet of energy -- with very specific characteristics. The photon has a frequency, or color, that exactly matches the distance the electron falls.

Step 1: EM Packet Hits Electron



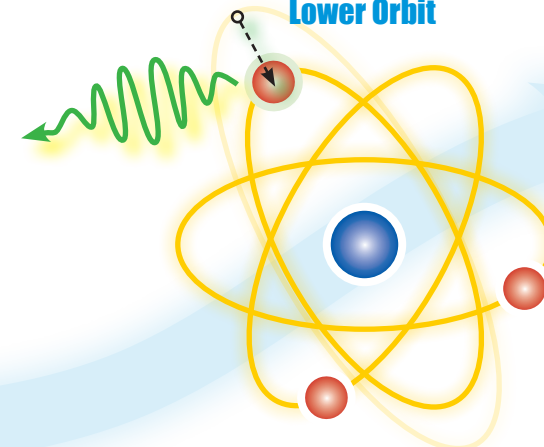
Atom Normal State

Step 2: Electron Jumps to Higher Orbit



Electron Energized
State

Step 3: Electron Returns to Lower Orbit



Atom Returns to its
Normal State



- The Distance up and down is always equal.
- Energy is always conserved.
- The frequency of the photon equals the distance between the orbits.
- If its the right distance, it generates visible light we can see. (a Color)

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Properties of Light:

• How is Light Created...

We are all very familiar with light from the sun, light from incandescent bulbs and light from a fire. These are three great examples of how light is generated for us to see. All of these examples excite the atoms to generate photons (energy packets of light). Here are the major ways light is created.

Heating Things Up

Probably the most common way to energize atoms is with heat, and this is the basis of incandescence. If you heat up a horseshoe with a blowtorch, it will eventually get red-hot, and if you indulge your inner pyromaniac and heat it even more, it gets white hot. Red is the lowest-energy visible light, so in a red-hot object the atoms are just getting enough energy to begin emitting light that we can see. Once you apply enough heat to cause white light, you are energizing so many different electrons in so many different ways that all of the colors are being generated -- they all mix together to look white.



Electric Current

You can see this phenomenon quite clearly in neon lights. Fluorescent lamps, neon signs and sodium-vapor lamps are common examples of this kind of electric lighting, which passes an electric current through a gas to make the gas emit light. The colors of gas-discharge lamps vary widely depending on the identity of the gas and the construction of the lamp.



Combustion

Combustion offers another way to produce photons. Combustion occurs when a substance (the fuel) combines rapidly with oxygen, producing heat and light. If you study a campfire or a candle flame carefully, you will notice a small colorless gap between the wood or the wick and the flames. In this gap, gases are rising and getting heated. When they finally get hot enough, the gases combine with oxygen and are able to emit light. The flame, then, is nothing more than a mixture of reacting gases emitting visible, infrared and some ultraviolet light.



Chemical Luminescence

Another way to make photons, known as chemiluminescence, involves chemical reactions. When these reactions occur in living organisms such as bacteria, fireflies, squid and deep-sea fishes, the process is known as bioluminescence. At least two chemicals are required to make light.

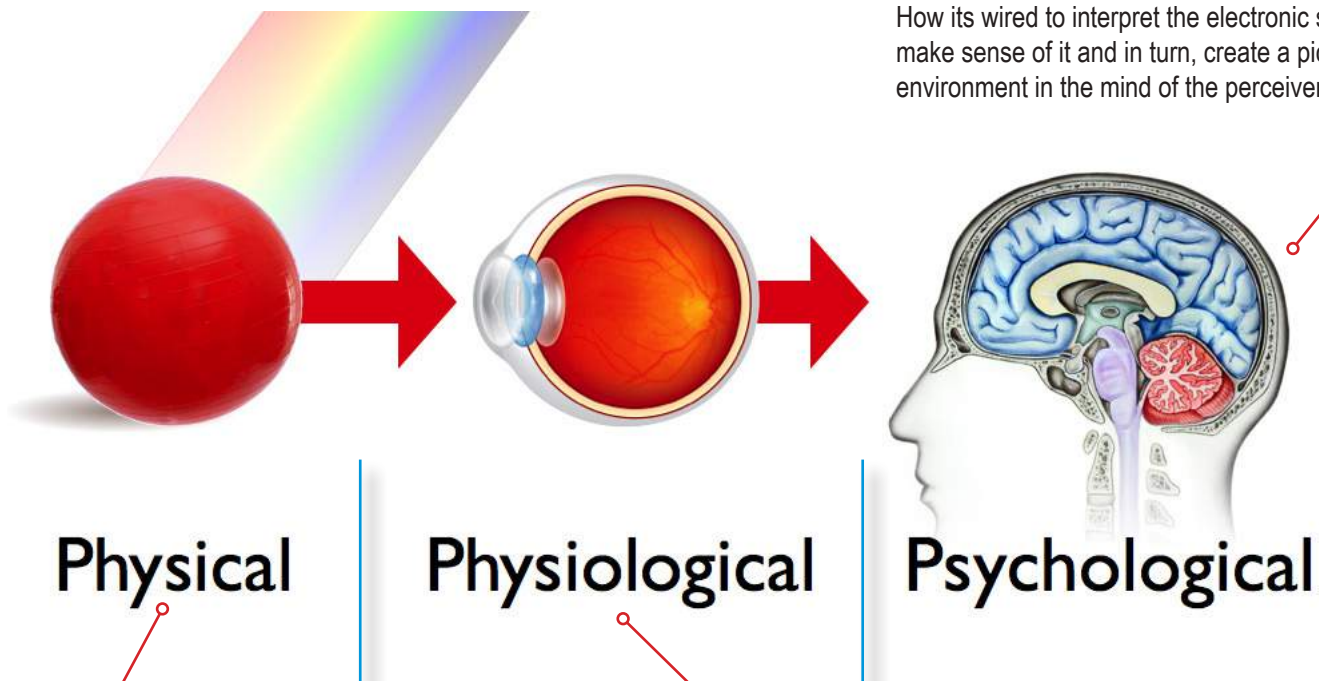


Color Management Concepts

Properties of Light:

• Light Perception

Scientists break the process of sensing light into three main categories.



This category is the ability of the body's nervous system. How it's wired to interpret the electronic signals from the eyes, make sense of it and in turn, create a picture of the external environment in the mind of the perceiver.

Physical

Physiological

Psychological

If there is no light reflected or emitted from an object (a light source), then there is no light to see. Interestingly, you don't see what color something is, you see the color(s) it reflects or emits. The red ball is red because it doesn't absorb light in the red spectrum and instead, reflects red frequency light away.

This is the mechanism for physically sensing light. Across species, eyes vary widely in form and function. The cells that interpret light into electronic signals also vary widely in the colors they can register in resolution and sensitivity.