



Let There Be Light!

Then God said, "Let there be light"; and there was light. God saw that the light was good; and God separated the light from the darkness. God called the light day, and the darkness He called night. And there was evening and there was morning, one day.

Genesis 1: 3-5

Then God said, "Let there be light be in the expanse of the heavens to separate the day from the night, and let them be for signs and for seasons and for days and years; and let them be for lights in the expanse of the heavens to give light on the earth" and it was so. God made the two great lights, the greater light to govern the day, and the lesser light to govern the night; He made the stars also. God placed them in the expanse of the heaven to give light on the the earth, and to govern the day and the night, and to separate the light from the darkness; and God saw that it was good. There was evening and there was morning, a fourth day.

Genesis 1: 14-19

We know from the Bible that God separated light from darkness on the first day of Creation and He created the sun, moon, and stars on the fourth day and when He saw what He had made, He thought it good. If He created the sun on the fourth day, what is the "light" that He called out to shine on the first day? Was it God's own light? The Bible speaks of His light so it is likely, but we did not witness Creation and cannot even begin to fathom the details of God's power and planning of all that He made. What we do know from the Bible, is that light was a huge part of God's Creation, so it must be something pretty special. Not only is it mentioned many times in the first chapter of Genesis with the creation of the universe, the word "light" is mentioned over 200 times throughout the Bible. Jesus said He is the light of the world and we are called to let our lights shine before others, amongst many other comparisons to light. Certainly our spiritual light is special, but what is there to know about the physical light of our universe? It is so much more than the ability to see, which, in itself, is an awesome thing! But light also gives us warmth, the energy needed for plants to grow and thrive, time and seasons, and it gives our universe great beauty with the ability to see colors. Understanding all there is to know about light is complicated, even for physicists. However, it is my hope that in covering some very basics, it will give you a deeper understanding of just how amazing light is for God to have made it a major part of how the universe functions and works in perfect harmony. There is very good reason why He would call it "good." Let's look at the basics of understanding light.

What is light?

Light IS electromagnetic energy. It is the "L" in our MELTS acronym of five basic forms of energy. A scientific definition of light is that it is electromagnetic energy with wavelengths that fall in a range on the electromagnetic spectrum. Say what? In our last lesson I mentioned that electromagnetic energy (or radiation) exists in the form of waves and makes possible everything from television broadcasting to x-ray technology, depending on whether the shape of the wave is longer or shorter. The amount of energy that the waves carry determines its length. An electromagnetic spectrum is the range of light waves in order of their length and what they produce within that wavelength. When we talk about light, we are referring to visible light which is only a small part of the electromagnetic spectrum.

Refer to the chart below. Visible light is the only electromagnetic wave that we can see, all other waves are invisible to the naked eye.

Light (electromagnetic energy) is also made up of particles called photons. A photon is a bundle of electromagnetic energy and is the smallest unit of visible light. The concept of the photon was first introduced by Albert Einstein, but a scientist named Gilbert N. Lewis is the one to give it its name. Photons are very complicated to understand and physicists are still studying them to find out more. I have a good friend from my church who is undergoing cancer treatments, and who also happens to be a physics professor. He chose to have a newer cancer treatment called photon therapy and it is so far proving successful. Light as a cure for cancer! That is not what you usually think of when you think of light! There is so much to know and discover about photons, but all I want you to know for now is that light is made up of photons.

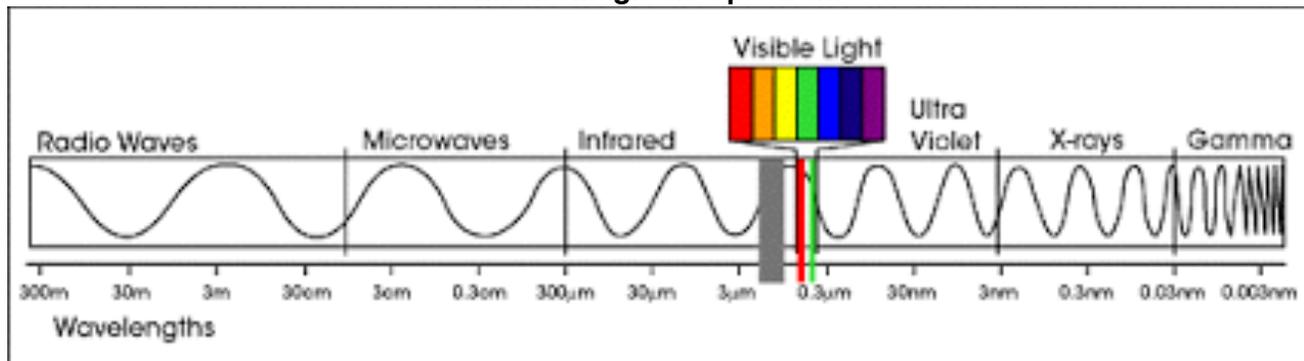
So to sum up, light is electromagnetic energy, a wave, and particles called photons. We will focus the rest of the lesson on visible light, a small part of the electromagnetic spectrum, but a small part with big benefits!

Sources of Light: <https://www.youtube.com/watch?v=d65mdTJaJTI>

***Light (Dr. Binocs):** <https://www.youtube.com/watch?v=d7yTlp4gBTI>

***Study Jams Light:** <http://studyjams.scholastic.com/studyjams/jams/science/energy-light-sound/light.htm>

Electromagnetic Spectrum



How does light travel?

The short answer to how light travels is that it travels very fast and in a straight line. It travels as a particle (photons) and as a wave. You've probably heard the phrase "at the speed of light." There is nothing faster than the speed at which light travels. Light travels 186,000 miles per second!! Light travels in a straight line, but if it could travel AROUND the circumference of the earth, it could go around the earth SEVEN times in ONE SECOND! Now that is very, very fast!

***How Does Light Travel?:** https://www.youtube.com/watch?v=fm__GAlrBuQ

Reflection, Refraction, and Absorption

Physics is all about how matter and energy interact, so how does light energy interact with matter? Three ways that matter interacts with light is by either reflecting its rays, refracting its rays, or absorbing its rays. Read the definitions and refer back to them as you read the rest of the lesson and watch the videos.

Reflection is when light bounces off of an object. This allows us to see.

Refraction is the bending of light when it passes from one substance into another.

Absorption is when matter captures electromagnetic energy and converts it into internal energy. It takes in the energy and "keeps" it.

***Study Jams Light Absorption, Reflection, Refraction:** <http://studyjams.scholastic.com/studyjams/jams/science/energy-light-sound/light-absorb-reflect-refract.htm>

What is a Shadow?

Have you ever tried to catch your own shadow? Did it work? I think not. A shadow occurs when a solid object blocks light. When you see your shadow, you are a solid object blocking the light from the sun or other light source. The size of the shadow changes depending on how close the object is to the light. You can experiment with this by shining a flashlight onto a wall and then placing a solid object in front of the flashlight. Move the object closer and farther away from the flashlight and see how the shadow gets bigger and smaller.

Why Do We Have Shadows?: <https://www.youtube.com/watch?v=dsrCLE68660>

What is the difference between Transparent, Translucent, and Opaque?

The answer to this question is all about light being able to pass through matter. You may remember from the first semester that these are all properties of matter. So, what is the difference? Transparent objects allow all light to pass through. Translucent objects allow some light to pass through. Opaque objects do not allow any light to pass through. Opaque objects create the best shadows. The following video demonstrates these properties.

***Light and Shadow:** <https://www.youtube.com/watch?v=YuUJCNzf0Bw>

Light gives us color.

Sunlight contains all wavelengths of light, which means it contains all the colors of the rainbow within its rays. We call this **white light**. What are all the colors that make up white light? You can remember them with the "name" **Roy G. Biv** spelled using the first letter of each of the color names (red, orange, yellow, green, blue, indigo, violet). Each of these colors are determined by the size of their wavelength, with red's wavelength being longest and violet's being the shortest of the spectrum colors. The molecules that make up different kinds of matter reflects light differently. All matter absorbs and/or reflects these colors in some way, but which ones are reflected and absorbed depends on the atoms and molecules that make up the matter. The colors that matter reflects back are the ones that gives the matter a visible color. So, leaves, grass, and plants absorb all colors and reflect only the green wavelengths of light. Flowers are different colors depending on the molecules that make them up and how those molecules absorb and reflect light. But what about objects that are black or white? Those colors are not in a rainbow. You see the color black when matter absorbs ALL of the colors and you see white when matter reflects ALL colors.

***The Science of Light and Color:** <https://www.youtube.com/watch?v=9Vsl0Iom3SO>

Tyndall Effect-Why the Sky Appears Blue: <https://www.youtube.com/watch?v=qxlR7ZdgV7w>

Newton's Light Spectrum Experiment: <https://www.youtube.com/watch?v=-b1F6jUx44>

What is a Rainbow?

When it rains, the air is filled with water droplets. When the sun appears through the cloud cover after a rain, its light radiates through the water droplet-filled air which act like prisms, bending the white light of the sun. Remember, white light contains all colors. When white light is bent, the colors are separated and display themselves in a beautiful arch of color across the sky. Since each color has a different wavelength and they are always in order on the spectrum, a rainbow will always display the colors in the same order with red on the outside of the arch and violet on the inside of the arch.

Reverse a Rainbow Activity: https://www.youtube.com/watch?v=_z7BDab3N7w

***How is a Rainbow Formed:** <https://www.youtube.com/watch?v=nCPPLhPTAIk>

Natural vs. Artificial Light

So far we have discussed natural light. But, what about artificial light? We certainly use a lot of that in our homes! Artificial light is light created with the use of electricity. Examples are light bulbs, flashlights, televisions, and computer screens. Hopefully you are not spending too much time during the stay-at-home order, staring at artificial light! Watch these videos about the invention of artificial light to learn more. Learning about Thomas Edison's journey in perfecting the incandescent lightbulb is a good lesson in tenacity (being very determined). Edison experimented with 4,700 materials for a filament in his lightbulb before getting it right for our home use!

Invention of Lightbulbs: <https://www.youtube.com/watch?v=XWWgDnOC6DA>

Thomas Edison Biography: https://www.youtube.com/watch?v=KgSi_R1Wcyk

Wizard of Menlo Park: <https://www.pbs.org/video/scitech-now-menlo-parks-legendary-inventor-thomas-edison/>

As you can see, there is so much to learn about light. You are not expected to memorize everything from this lesson so not be overwhelmed. Explore the different sections of this lesson and see what you can learn about light. Spend more time on the sections that are most interesting to you. Be curious and have fun learning about light. The most important thing that I want you to take away from this lesson is that when God created light, it was so much more than something that allows us to see. It is indeed, very good!

